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Value archetypes in future scenarios: the role of scenario co-designers

Zuzana V. Harmáčková[1,2], *Klaus Eisenack*[3], *Yuki Yoshida*[4], *Nadia Sitas*[5,6], *Lelani M. Mannetti*[7] and *Patrick J. O'Farrell*[8,9]

ABSTRACT. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) relies on future scenarios in its assessments of global social-ecological systems. Scenarios explicitly or implicitly embed normative positions (e.g., values for nature, nature's contributions to people, good quality of life). Such scenario values shape how scenario narratives evolve, e.g. through driving forces, framings, or ways how decisions are legitimized within a given scenario. Initial research in futures studies has examined how scenario values depend on whose voices are included in scenario co-design. However, less attention has been paid so far to explicitly assessing the extent to which scenario values are associated with different types of scenario co-designers. Our paper expands this knowledge with a set of novel analyses building on the comprehensive review of scenarios in the IPBES values assessment. To this end, we conducted a formal archetype analysis of 257 scenarios assessed in the IPBES values assessment to identify re-appearing archetypal configurations of values and their link to the actors involved as scenario co-designers. The results show that scenarios valuing nature for itself and its benefits to societal well-being were co-designed by experts and academics less frequently than expected under the assumption of stochastic independence; on the contrary, such scenarios were co-designed more frequently than expected by governmental and community actors. The paper illustrates how archetype analysis can contribute to the validation and further development of scientific knowledge feeding into science-policy assessments. The findings are important to acknowledge how scenarios express and possibly re-enforce peoples' normative positions, and what role values might play when scenarios get translated into real-world decisions and actions.

Key Words: *archetype analysis; future scenarios; values; participatory scenario co-design; sustainability; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)*

INTRODUCTION

Scenarios describe plausible futures, with the aim to expand our collective imagination on what types of future development could occur (exploratory scenarios) and to collectively deliberate desirable futures and pathways to reach them (normative or target-seeking scenarios; IPBES 2016). As such, scenarios are widely used in research, policy-making, and practice to assess potential future development of social-ecological systems at various scales.

Scenarios can be developed in expert-based settings, participatory settings, or a combination of both (Harrison et al. 2019a, Pedde et al. 2021, Jahel et al. 2023, Lazurko et al. 2023). Whereas expert-based scenarios tend to be designed to allow for further modeling or to be further communicated to decision-makers and wider society (e.g., O'Neill et al. 2020), participatory scenarios tend to be co-designed to enable collective thinking, facilitating social learning and developing collective understanding of social-ecological complexities (Oteros-Rozas et al. 2015, Collste et al. 2023).

Science-policy interfaces have relied heavily on scenarios to assess implications of climate change and biodiversity loss for global ecosystems and human well-being in the context of future uncertainties (O'Neill et al. 2017, Rogelj et al. 2018). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), a global science-policy interface assessing the state of biodiversity and ecosystem services (in response to requests for evidence-based knowledge by decision-makers), is no exception and has invested substantial capacities in synthesizing available scenarios (Harrison et al. 2019b, IPBES 2019, Sitas et al. 2019, Díaz et al. 2020) and promoting advances in scenario co-design (Rosa et al. 2020).

Hitherto, scenarios typically focused on the role of indirect and direct driving forces (such as economy, demography, social-cultural change, governance, technologies, land use change, or natural resource use) in potential future development (IPBES 2018). Importantly, much less attention has been paid to the motivations and normative positions embedded in the scenarios (scenario values, for short), which (explicitly or implicitly) shape how the scenario storylines or narratives evolve. Scenario values underpin, for instance, indirect and direct driving forces, patterns, and motivators of people's future behavior, framings, and ways in which decisions, actions, or policies are legitimized in a scenario (e.g., people in the scenario preferring a mosaic landscape to an intensively farmed one, or people in the scenarios valuing individual benefits to collective ones; Martin et al. 2022, Pascual et al. 2023). An increasing number of scenarios have embedded normative positions, such as values for nature, nature's contributions to people (NCPs; including ecosystem services), and good quality of life in their storylines (Martin et al. 2022). Whereas the scenario literature had mostly treated scenario values implicitly, recent literature has seen an increase in their explicit inclusion in scenario storylines and logic (Rawluk et al. 2018, Harmáčková et al. 2022a, Kuiper et al. 2022, Durán et al. 2023).

[1]Global Change Research Institute of the Czech Academy of Sciences, Czech Republic, [2]National Institute for Research on Socioeconomic Impacts of Diseases and Systemic Risks – SYRI, Czech Republic, [3]Resource Economics Group, Humboldt Universität zu Berlin, Germany, [4]Center for Climate Change Adaptation, National Institute for Environmental Studies, Japan, [5]Centre for Sustainability Transitions, Stellenbosch University, South Africa, [6]Climate and Development Knowledge Network, SouthSouthNorth, South Africa, [7]Urban Studies Institute, Andrew Young School of Policy Studies, Georgia State University, United States, [8]Department of Biodiversity and Conservation Biology, University of the Western Cape, South Africa, [9]The Institute for Integrated Management of Material Fluxes and of Resources, UNU-FLORES, United Nations University, Dresden, Germany

IPBES has conducted multiple structured reviews of scenarios capturing potential future development of nature, nature's contributions to people, and people's quality of life across its assessment reports (e.g., Biggs et al. 2018, Gundimeda et al. 2018, Harrison et al. 2018, Klatt et al. 2018, Sitas et al. 2019). In particular, the IPBES Values Assessment (IPBES 2022) has synthesized scenarios with a specific emphasis on scenario values and their potential future impacts on nature, nature's contributions to people, and good quality of life (Martin et al. 2022, Harmáčková et al. 2023, Pascual et al. 2023).

There has been general agreement in the futures literature that scenario values, as well as their causal link to specific future trajectories, are shaped by the value considerations of scenario co-designers (Slaughter 1999, Bogert et al. 2022). However, the relationship between scenario co-designer values and the scenario values is by no means direct or straightforward. A common understanding has been that whose voices, worldviews, and interpretations are included in scenario co-design (e.g., the selection of considered narratives or variables) matters, as it influences what scenario content is created. However, the values held by scenario co-designers (e.g., whether a scenario co-designer likes particular types of landscapes, or whether they prefer technological fixes to behavioral change in the face of environmental challenges) may or may not align with the values embedded in the scenarios they create. Indeed, a single group of scenario co-designers (with their individual values) usually creates multiple scenarios during a scenario process. Those scenarios express a range of scenario values, while being created by an identical group of scenario co-designers (e.g., Lehtonen et al. 2021, Pedde et al. 2021, Harmáčková et al. 2022b). Thus, it is difficult to identify a direct relationship between scenario co-designers' values and the scenario values. This analytical distinction between scenario values and the values held by scenario co-designers is essential for this paper.

Yet, while this issue of the relationship between scenario values and values held by scenario co-designers was raised decades ago (Fowles 1977), empirical testing has been largely missing and the extent to which scenario values are a function of the kind of actors involved in scenario co-design remains unresolved (Schmid et al. 2017).[1] This represents a key caveat, as scenarios are socially performative, i.e., they express and reinforce peoples' framing of real-world situations that shape and influence decision- and policy-making (Oomen et al. 2022). It is thus important to understand how the scenario co-designers, with their own particular values, link to the values embedded in scenarios.

This paper aims to address this knowledge gap with a novel analysis building on the comprehensive review of scenarios in the IPBES values assessment. To this end, we advance the current knowledge on scenario values by identifying re-appearing archetypal configurations of values through a formal archetype analysis of 257 recent scenarios, and link these emerging value archetypes to the categories of actors involved in the scenario co-design, as well as to the conventional IPBES scenario families, commonly referred to as "scenario archetypes" (Hunt et al. 2012, IPBES 2016, Sitas et al. 2019).

METHODS

Scenario database, coding, and sampling

This study builds on a scenario database developed within the IPBES values assessment that catalogued values incorporated in scenarios relating to nature, nature's contributions to people, and good quality of life (Martin et al. 2022). Here, we briefly summarize the methodology, detailed in the Data Management Report to Chapter 5 of the IPBES values assessment (Harmáčková et al. 2022c).

Scenarios and other futures works were collected through a structured keyword-based search (see Box S1) of scientific databases, complemented by snowball sampling (Harmáčková et al. 2022c). While the database compiled 460 scenarios through iterative review processes that encompassed both academic and non-academic literature (Harmáčková et al. 2022c), the present study utilized a core sample of 257 scenarios from peer-reviewed literature. Selected descriptive characteristics of the scenarios in the core sample (e.g., regional coverage, scale, scenario type, and sector of origin) are included in Table S1.A and Figure S1. The majority of scenarios originated from local and national scales. Whereas the regions of the Americas, Asia-Pacific, Europe, and Central Asia were roughly equally represented, the structured keyword-based search identified comparatively fewer studies from Africa (Figure S1).

Scenario descriptions were thematically coded for over 60 scenario characteristics (e.g., geographic focus, scenario design methodology) and elements related to scenario content (e.g., driving forces, impacts on nature, nature's contributions to people, and good quality of life), including value attributes (different aspects of scenario values; Harmáčková et al. 2022c, 2023). Out of these, the codes relevant for this study were (1) the scenario values and (2) the categories of actors involved as scenario co-designers. Importantly, the coding process was (a) guided by a set of detailed questions related to each attribute, facilitating its thematic coding; and (b) started by iterative benchmarking among the coding team, which piloted the coding with a set of training scenarios independently coded by each member of the team. The pilot coding was subsequently compared, discussed, and iteratively repeated and re-discussed to ensure a coherent coding approach (Harmáčková et al. 2022c, 2023).

The value attributes whose presence or absence was coded (Table 1) followed the typology of values developed within the IPBES preliminary guide on values (IPBES 2015) and the IPBES values assessment (Anderson et al. 2022). Specifically, we coded the *focus* of the values in a given scenario, i.e., the dimensions toward which scenario values are expressed. In relation to human-nature relations, people's values can focus on (1) nature per se (e.g., biodiversity, ecosystems, non-human beings), (2) nature's contributions to people (i.e., the benefits provided to people by nature), and (3) good quality of life as supported by nature (see Box S2 for additional details). In addition, we coded the *justification* of the scenario values, i.e., the reasons why something is being valued with respect to human-nature relationships. Value justifications tend to be defined as (1) intrinsic (nature is valued for itself without reference to humans, e.g., as a motivation for nature conservation), (2) instrumental (nature is valued as a substitutable means to a human end, e.g., as a source of profit),

Table 1. Value attributes coded in the assessed scenarios.

Characteristics of values		Value codes used	Examples
Value focus The focus of people's value expression	Nature	Nature (NAT)	Biodiversity, ecosystems, non-human beings in general
	Nature's contributions to people (NCP) The benefits provided to people by nature (including ecosystem services and nature's gifts)	Material NCPs (MAT) Regulating NCPs (REG)	Food, clothing Clean water, clean air, inhabitable climate
		Non-material NCPs (NMT)	Scenic views, landscape aesthetics, nature-based recreation
	Good quality of life Relationships to nature that support a good quality of life, expressing broad values relating to ecological sensitivity and harmony with the natural world	Nature for good quality of life with individual focus (IND) Nature for good quality of life with societal focus (SOC) Nature for good quality of life with cultural focus (CUL)	Health, education Governance, sustainability Identity, spirituality, art
Value justification The reasons (justifications) why something is being valued with respect to human-nature relationships		Intrinsic Nature itself without reference to humans (INT) Instrumental Nature as a substitutable means to a human end (INS) Relational Non-substitutable relationship to nature (REL)	Nature itself as a motivation for nature conservation Nature as a source of profit Relationship between a person and a particular animal, tree or natural space

and (3) relational (non-substitutable relationship to nature is valued, e.g., in the form of relationship to a particular animal, tree, or natural space). Although these categories may be understood as partly overlapping, the distinction between value foci and justifications provides an additional level of nuance.[2] Multiple value attributes could apply to any given scenario.

The category of actors involved in each scenario's development (scenario co-designers) was coded, strictly on the basis of the information provided in each scenario study and/or its supplementary materials. The coding was based on the typology of actors used in the IPBES values assessment: the involvement of (1) governments and authorities, (2) communities and citizen groups, (3) businesses and private sector, (4) households, (5) individuals (e.g., people with land-based livelihoods such as farmers, other residents, recreationists), (6) others, and (7) experts and academics involved in co-designing the scenarios (e.g., various types of professionals or researchers with expertise in different aspects of the co-designed scenarios; Table S1.B). Multiple actor categories could apply to each scenario. The sets of scenarios emerging from a single scenario process commonly differed by their value attributes, while being co-designed by an identical set of actors. Although the categorization of scenario co-designers may seem rather coarse, as some categories may conceal a much more diverse set of actors (e.g., the category of experts and academics involved in the scenario co-design may involve a high diversity of people with their unique value systems), it is important to note that scenario studies rarely provide enough information on the actors involved in scenario processes to allow for a more fine-grained categorization. The rationale for selecting this categorization was inductive-deductive, motivated partly by the need to comply with a shared actor categorization across the IPBES values assessment, partly by the motivation to use a categorization as detailed as possible, given the descriptions available in the scenario studies.

Archetype analysis

The analysis aimed to identify "value archetypes" (i.e., configurations of value attributes that re-appear as scenario values), and how these systematically link to the scenario co-designers. To this end, we employed archetype analysis to investigate "recurrent patterns of the phenomenon of interest at an intermediate level of abstraction to identify multiple models that explain the phenomenon under particular conditions" (Oberlack et al. 2019). Archetype analysis inductively identifies archetypes (here, value archetypes) as a non-disjoined classification of cases (here, scenarios), where the resulting archetypes can be (re)combined in different ways, like building blocks, to scrutinize individual cases (Eisenack et al. 2021; see Technical Annex). Thus, archetype analysis is not meant to find a single pattern that fits every scenario but multiple patterns that endorse differences among scenarios. In other words, a single scenario can be covered by anything between zero, one, and all of the identified value archetypes, while the aim is to define a set of archetypes that covers as much of the overall scenario sample as possible.

In our case, we aimed to identify a suite of several value archetypes. Each of the value archetypes was characterized by three elements: (1) a configuration of several value attributes; (2) a set of scenarios covered by this archetype (i.e., all scenarios that are characterized by the respective configuration of value attributes); and (3) an explanation of why this configuration is reasonable, ideally supported by more details from the scenarios where it holds (cf. Eisenack et al. 2019). Since the coded data were binary (i.e., the presence or absence of value attributes and scenario co-designer categories), elements (1) and (2) can be described with set theory (see Technical Annex). For our data, each of the 257 scenarios was characterized by which value attributes were present (none, one, or multiple, from Table 1), and which actor categories were involved as scenario co-designers (none, one, or multiple). The archetype analysis itself was conducted by using only the value attributes, based on formal concept analysis (FCA; Ganter et al. 2005), which was previously applied in other archetype analyses (Oberlack et al. 2016, Oberlack and Eisenack 2018, Wang et al. 2019, Gotgelf et al. 2020). Importantly, FCA can cope well with the possibility that scenarios can be covered by multiple archetypes. Consequently, archetypes do not need to be completely different from each other in order to make them capable of representing different yet related nuances in the data.

An important step in the archetype analysis is to determine the optimal number of archetypes, i.e., the optimal size of the archetype suite. This task is not straightforward. For instance, if every scenario would count as an individual archetype, these archetypes would perfectly represent the diversity of the sample, but the analysis would not reduce any complexity ("idiographic trap"). On the contrary, admitting only a single archetype covering all the scenarios in the sample would not endorse differences among scenarios ("nomothetic trap"). Rigorous criteria for choosing the right suite size is thus acknowledged as a key desideratum in the archetype literature (Eisenack et al. 2019).

In this paper, we propose a novel way to deal with this challenge. In order to obtain an optimal suite of archetypes, we extend the proposal by Partelow et al. (2024) (see Technical Annex). The method consists of three steps, the first two are algorithmic and address elements (1) and (2) above, in order to maximize the number of scenarios covered by the suite of value archetypes. Technically speaking, the algorithm to compute optimal configurations solves a maximization problem with set operations in the maximand and the constraint. Each archetype in the optimal suite is described by a number of value attributes it includes. We call this number the richness ρ of an archetype. For instance, archetypes described by two attributes (ρ = 2) only allow for a simple description, whereas three or more attributes facilitate characterizing the archetype in a richer way. The first two steps of the method nevertheless compute several optimal suites (e.g., depending on the richness we require). This gives us a limited amount of possibilities to choose from in a qualitative way, in order to address element (3), the explanation of configurations. We only retained an optimal suite if it was backed up by robust qualitative rationale.

Comparing archetypes against scenario co-designers

Once the optimal suite of value archetypes was obtained, we tested whether they are systematically linked to the actor categories involved as scenario co-designers. We also tested whether the archetypes resemble or are different from established scenario families known as "scenario archetypes" in the IPBES community (IPBES 2016, Harrison et al. 2019b, Sitas et al. 2019). In order to do so, we used the *lift* metric, commonly applied in association rules mining (e.g., McNicholas et al. 2008). The observed frequency, e.g., of scenarios covered by a certain archetype and co-created with local citizens, is normalized to the frequency of local citizens being involved in the full data set, and normalized to the frequency that the certain archetype is present in the full data set (see Technical Annex for the formal definition). A lift of 1 means that features co-occur exactly as frequently as expected under the assumption of stochastic independence (McNicholas et al. 2008). A value above 1 means that they co-occur more frequently than expected; conversely, a lift value below 1 signifies that the co-occurrence is less frequent than expected under the assumption of stochastic independence.

We also calculated the lift for each pair of conventional IPBES scenario archetypes and the newly identified value archetypes.

RESULTS

The identified value archetypes represented configurations of value attributes from Table 1. Of the 257 coded scenarios, 254 were characterized by at least three value attributes (out of the ten possible value attributes). With respect to the value justification, instrumental values (INS) were covered in 97% of the scenarios, intrinsic values (INT) in 25%, and relational values (REL) in 26%. In terms of the value focus, 88% of the scenarios included a focus on material values of nature's contributions to people (MAT), 61% regulating values (REG), and 44% non-material values (NMT). A share of 39% of the scenarios included a focus on the value of nature *per se* (NAT). Scenarios also focused on the values of nature as related to individual aspects of good quality of life (IND) in 81% of the scenarios, 53% on societal aspects (SOC), and 25% on cultural aspects (CUL).

The frequencies of actor categories as scenario co-designers were: governments (39% of scenarios), communities (37%), businesses and private sector (26%), households (4.3%), individuals (47%), others (7.0%), and experts and academics involved in the scenario co-design (32%) (Figure S1). The actor frequencies add up to more than 100% as multiple actors can participate in a single scenario co-design process.

Some of the value attributes (in particular INS, MAT, IND) were highly frequent in the scenario sample. Should they be considered individually, they would not prove very helpful for telling apart the values embedded in the scenarios. This provided a strong rationale for identifying the re-appearing (recurrent) configurations of multiple value attributes characterizing the scenario values in the sample through an archetype analysis.

Identifying the optimal suite of value archetypes

Before identifying the final suite of value archetypes covering the reviewed scenarios, a vital intermediate step was to identify the optimal number of archetypes to cover our data sample.

The vast majority of scenarios (99%) were characterized by at least three value attributes (see above). Thus, we required value archetypes comprising exactly three value attributes (richness ρ = 3; see Table 2 and Technical Annex for further justification of this richness). For richness ρ = 3, a very good coverage was gained by a suite of five archetypes. This specific suite was optimal, as given the richness ρ = 3, no other selection of five configurations of value attributes was able to reach a higher coverage of scenarios. As usual for such an analysis, no single archetype covered all scenarios, and the archetypes were not mutually exclusive. The only scenarios not covered by any of the identified archetypes were the 3 scenarios for which only two value attributes were coded (and thus could not be covered by archetypes with richness ρ = 3), and 11 scenarios with extremely untypical value attribute configurations. As the following sections show, the resulting suite of archetypes could be well rationalized by closely inspecting the scenarios covered by the archetypes.

Additional levels of richness and numbers of archetypes in a suite were tested, but they did not provide better insights (see Technical Annex). Furthermore, we undertook validity checks in line with the quality criteria suggested by Eisenack et al. (2019), in particular with respect to external validity (see Piemontese et al. 2022). For this purpose, we used a larger pool of 437 coded scenarios, including the IPBES review of gray literature and science-policy reports (Harmáčková et al. 2022c, 2023, Martin et al. 2022, Yoshida et al. 2024). The checks (see Technical Annex) basically confirmed our results. The checks also confirmed the relations between scenario co-designing actor categories and values archetypes (see below) qualitatively. Finally, we exposed

Table 2. Optimal suite of five value archetypes. See Table 1 for the explanation of the value attributes (IND: individual focus; INT: intrinsic justification; INS: instrumental justification; MAT: material focus; NAT: nature focus; REG: regulating focus; SOC: societal focus).

Configuration of value attributes in the value archetype	Value archetype	Coverage (No. of scenarios in absolute and relative terms)
MAT - IND - INS	"Individualist": valuing nature for material benefits to individual well-being	184 (72%)
REG - IND - INS	"Conservationist": valuing nature for regulating benefits to individual well-being	110 (43%)
REG - MAT - INS	"Planned conservation": valuing nature for using its material and regulatory benefits	133 (52%)
REG - SOC - INS	"Fixing for society": valuing nature for regulating benefits to societal well-being	88 (34%)
NAT - SOC - INT	"Pristine ideals": valuing nature for itself and its benefits to societal well-being	58 (23%)
Total		243 (95%)

the optimal suite, as determined by the algorithm, to additional scrutiny in a qualitative way (step 3), i.e., whether the archetypes could be rationalized by the qualitative descriptions of the coded scenarios (see below). These measures ensure that the resulting selection of value configurations can indeed be considered a novel suite of value archetypes.

The resulting five values archetypes represented recurrent value configurations characterizing the analyzed future scenarios (Table 2). They showed that most of the variation in the data (with ten values attributes) could be represented by only five archetypes. As such, the identified value archetypes sorted nearly all coded IPBES scenarios into five overlapping classes, and represented frequent configurations of values attributes that play out in the scenarios' storylines. The full list of n = 275 scenarios included in the archetype analysis together with the archetype(s) covering each of them is available in Table S1.A.

Value archetype "Individualist": valuing nature for material benefits to individual well-being

Value archetype "Individualist" values nature for material benefits to individual well-being and covers scenarios typically assuming that as long as supply, demand, prices, trade, and competition are left free of government regulation, the pursuit of material self-interest will maximize the wealth of a society through profit-driven production of goods and services (de Bruin et al. 2017). These scenarios generally tend to prioritize profit generation from more or less sustainable economic activities. Furthermore, these scenarios frequently assume that policies on multiple scales (from local to global) will not undergo a substantial revision or paradigm shift compared to the current state (e.g., Ward et al. 2018). The scenario values in this value archetype tend to be characterized by self-centered attitudes or even greed (Boschetti et al. 2015, Kohler et al. 2017, Ward et al. 2018). However, in the case of some scenarios, the sustainability of economic activities, harvests, and their environmental and social impacts gradually gain more attention, although nature conservation tends to be weak (Farrell and Silva-Macher 2017). In terms of the impact on nature and people, scenarios covered by this archetype tend to assume negative impacts on ecosystems, biodiversity, and natural resources (Eide 2008, Koo et al. 2019), increased migration including rural abandonment, and negative impacts on equality (Kostakis et al. 2016), although in some of the scenarios covered by the "Individualist" value archetype, economic activities are regulated and profits redistributed in the societies (Farrell and Silva-Macher 2017, Martínez-Sastre et al. 2017). Finally, this archetype also holds in some breakdown scenarios, in which weakening regulation leads to disorder, dissolution of governments, over-exploitation of resources, and breakdown of the social order (Brown et al. 2016).

Value archetype "Conservationist": valuing nature for regulating benefits to individual well-being

Value archetype "Conservationist" values nature for regulating benefits to individual well-being. It is similar to "Individualist" in that people value nature for the benefits it provides them, and for enhancing their individual well-being. The difference is that in the scenarios covered by this value archetype, scenario values more strongly prioritize nature's contributions, such as climate regulation, air quality regulation, or water quality/quantity regulation. For instance, scenarios depict people who appreciate the cooling effects of green and blue areas in cities, providing local climate regulation and ensuring the flow of clean air, resulting in air quality regulation (Larondelle et al. 2016). In turn, these scenarios often value human health, recreational activities, and aesthetic appreciation (Larondelle et al. 2016), as well as revenues from ecotourism (May et al. 2019). In some scenarios, the emphasis on the regulating benefits of nature's contributions to people tended to be driven and regulated top-down, e.g., by governments (May et al. 2019).

Value archetype "Planned conservation": valuing nature for using its material and regulatory benefits

Value archetype "Planned conservation" was based on values for material and regulating benefits and their use by people. Unlike the previous two archetypes, this use is not necessarily linked to benefiting individual well-being, but can also contribute to other aspects of well-being, including societal and cultural. Scenarios covered by this archetype frequently include integrated land use planning and management, leading to sustaining and restoring material and regulating nature's contributions to people, such as food provision and water quality and quantity regulation (Arunyawat and Shrestha 2018). Scenarios covered by "Planned conservation" frequently resemble business-as-usual, differing in the extent to which market forces are regulated by policy and planning interventions, while trying to establish a balance between material and regulating nature's contributions (Chatterton et al. 2015, Albert et al. 2016). The scenarios covered solely by this archetype were primarily developed in collaboration between experts/academics and individuals such as farmers or local residents.

Value archetype "Fixing for society": valuing nature for regulating benefits to societal well-being

Most of these scenarios portrayed moderate conservation efforts, not very different from the status quo measures, led by local government agencies (Thorne et al. 2015, Santos et al. 2017). The means of conservation were primarily technological or engineering fixes (Thorne et al. 2015, Santos et al. 2017), followed by regulatory or pricing structures (Bartolai et al. 2015). Although

few scenarios are covered solely by this archetype, it illustrates a key contrast to the value archetype "Conservationist," which prioritized regulating benefits of nature's contributions to people from a purely individual perspective, as opposed to a societal one in this value archetype. The scenarios covered solely by this archetype were primarily developed in collaboration between experts/academics, representatives of governments and authorities, and individuals such as farmers or local residents.

Value archetype "Pristine ideals": valuing nature for itself and its benefits to societal well-being

These scenarios emphasize conservation and protection of nature with a focus on its intrinsic value. Many scenarios focus on the restoration of native species or ecosystems (Mitchell et al. 2016, Bremer et al. 2018, Burnett et al. 2019), such as the establishment of a protected area (Davies et al. 2015, Chu et al. 2018) or general approach of leaving nature alone (de Bruin et al. 2017). Some included human intervention to upkeep the ecosystem, which cannot persist on its own (Mitchell et al. 2016, Burnett et al. 2019). Scenarios covered solely by this value archetype were typically developed by a broad range of different types of societal actors, including governments, business, and private sector and communities.

Combinations of archetypes

Whereas some scenarios were covered by only a single value archetype, the archetype analysis also allows for a single scenario to be covered by multiple value archetypes (Table 3). In our sample, the combination of value archetypes "Individualist," "Conservationist," and "Planned conservation" was the most frequent.

The combination of value archetypes "Individualist," "Conservationist," and "Planned conservation" spanned a gradient ranging from business-as-usual scenarios, assuming that current policy and economic trends will continue without radical shifts (Gilbert et al. 2015, Harmáčková and Vačkář 2015, Zhang et al. 2017), to Economic Optimism or policy reform scenarios, assuming that society will continue focusing on economic growth and technological development, differing based on whether they assume more or less regulated markets (Carpenter et al. 2015, Hermanns et al. 2017, Qiu et al. 2018, Sandström et al. 2020). In addition, several scenarios combining these three archetypes fell into the category of breakdown scenarios (Tejada et al. 2016, Kubiszewski et al. 2017, Zhang et al. 2017).

Several scenarios were covered by all five value archetypes. Many of these focused on nature protection, conservation, and restoration (Bottalico et al. 2016, Farrell and Silva-Macher 2017, Wang et al. 2018, Sharma et al. 2019), sustainable agricultural intensification (Kindu et al. 2018, Sharma et al. 2019), and development beneficial to local communities (Carlsson et al. 2015, Mavrommati et al. 2016, May et al. 2019, Sandström et al. 2020). In addition, these scenarios were characterized as sustainable and often described as "win-win" or "desirable" by their authors (Beach and Clark 2015, Brown et al. 2016, Tejada et al. 2016, Wolff et al. 2018).

Although the frequency of value archetypes across scenarios from different geographic regions and scales did not substantially vary, there were several outstanding patterns (Table S2 and S3). For instance, the frequency of the archetypes "Fixing for society" and "Pristine ideals" was slightly higher in scenarios from the Americas and slightly lower in scenarios from Africa and the Asia-Pacific region; the value archetype "Planned conservation" was slightly more represented in scenarios from Europe and Central Asia (Table S2). In terms of spatial scale of the scenarios, scenarios focusing on the local scale had a stronger representation of the value archetype "Pristine ideals" and a weaker representation of the value archetypes "Individualist" and "Planned conservation" (Table S3).

Table 3. The combinations of archetypes and their frequency across the scenario sample. The combinations which do not appear in the table are not present in the data.

Combinations of archetypes					
Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals	No. of scenarios
Scenarios belonging to 1 archetype					
✓					78
	✓				5
		✓			16
			✓		5
				✓	12
Scenarios belonging to 2 archetypes					
✓				✓	5
	✓		✓		2
		✓	✓		8
			✓	✓	1
Scenarios belonging to 3 archetypes					
✓	✓	✓			39
	✓		✓	✓	2
		✓	✓	✓	8
Scenarios belonging to 4 archetypes					
✓	✓	✓	✓		32
Scenarios belonging to 5 archetypes					
✓	✓	✓	✓	✓	30

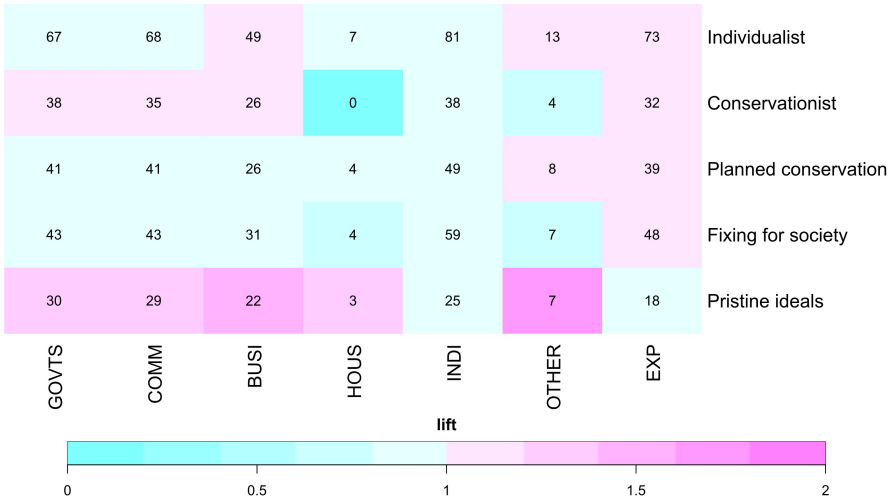
Value archetypes and the scenario co-designers

The next key step of the analysis was to assess how the participation of certain categories of scenario co-designers was associated with the occurrence of the value archetypes. For this purpose, Figure 1 depicts the frequency count and lift of each possible combination of actor category and value archetype in the data.

Some scenario co-designer categories and value archetypes co-occurred more (or less) frequently simply because some types of actors generally appear more (less, respectively) often in the scenario co-designing processes, thus were more (or less) represented across the whole scenario sample. This is indicated by the lift metric equal to 1. In many cells the lift is different from 1, i.e., from the expectation under stochastic independence (Fig. 1). This indicates that the value archetypes and the involved scenario co-designers are not completely independent of each other, underlining the need to understand this relation in a more nuanced manner.

In terms of lift, expert/academia-based scenario co-designers pervasively appeared in all studies that produced scenarios covered by value archetypes "Individualist," "Conservationist," "Planned conservation," and "Fixing for nature." In the vast majority of cases, the scenario studies do not provide sufficient

Fig. 1. Co-occurrence of value archetypes and actors. Numbers in cells report how frequently the categories of scenario co-designers and value archetypes co-occurred. The color indicates the lift, i.e. whether the co-occurrence is observed more frequently than expected under the assumption of stochastic independence (larger than 1, purple), or less frequently (below 1, blue; see Methods for further details on the metric). Legend: the involvement of (1) GOVTS - governments and authorities, (2) COMM - communities and citizen groups, (3) BUSI - businesses and private sector, (4) HOUS - households, (5) INDI - individuals (e.g., people with land-based livelihoods, such as farmers, other residents, recreationists), (6) OTHER - others, and (7) EXP - experts and academics involved in scenario co-design.



detail to disaggregate the description of the experts/academics involved. Scenario co-designers from business and private sector participated more pervasively in the "Individualist" scenarios, but also in the generation of scenarios covered by the value archetype "Pristine ideals." The latter, however, more frequently in collaboration with governments and citizen groups, covered a wide range of businesses from agricultural (Dupont et al. 2016) to industry (Sandhu et al. 2018) and tourism, forestry and mining-oriented companies (Harmáčková and Vačkář 2015, Brown et al. 2016, de Bruin et al. 2017, Sandström et al. 2020). This value archetype involved a more diverse sets of stakeholders as scenario co-designers. Individuals do not seem to be particularly associated with specific value archetypes. The "Fixing for society" value archetype was more pervasively associated with experts and academics involved in the scenario co-design.

Interestingly, scenarios covered by all value archetypes at the same time were quite frequently developed solely by scenario co-designing experts and academics (e.g., Law et al. 2015, Bottalico et al. 2016, Kindu et al. 2018, Wolff et al. 2018, Sharma et al. 2019). In the cases that other actor categories were involved as scenario co-designers, these were various mixes of actors, ranging from governments and authorities to businesses, communities, and individuals.

DISCUSSION

What can be learned through the archetype analysis of scenario values?

In contrast to past analyses that examined value-based clusters of scenarios or frequencies of individual value attributes (e.g., Harrison et al. 2018, Harmáčková et al. 2023), this study examined scenarios through the lens of different and partially overlapping configurations of value attributes. The use of archetype analysis is suited to cover the diversity of scenario values, as the approach does not require that each scenario is characterized by only a single archetype. The approach thus facilitates a more fine-grained perspective of the scenarios and their underlying values. In particular, the inductive nature of archetype analysis admits to cover configurations of value attributes (e.g., those related to breakdown scenarios) that are less frequently chosen by scenario co-designers, while also providing more detailed insights into more common configurations of value attributes (such as those related to instrumental value justification), through highlighting how they appear in a variety of nuances (e.g., in different configurations with a material, regulating or individual value foci). The identified set of value archetypes covers scenarios originating from the majority of global regions (with a slightly lower coverage for Africa), and reflects well the variability among scenarios from different local contexts (Figure S1). Thus, the resulting suite of value archetypes covers a rich sample of scenarios, while admitting to "zoom into" common value patterns.

The identified value archetypes hence reflect and advance discussions in the current scenario literature, e.g., the commonly recognized types of values. For instance, the value archetype "Individualist," prioritizing instrumental values of nature while focusing on nature's material contributions, is a value configuration typically featured in business-as-usual scenarios (Bogert et al. 2022). However, the archetype analysis has newly revealed other value configurations characterizing business-as-usual scenarios, such as the value archetype "Conservationist," which places emphasis on regulating contributions of nature (REG), individual aspects of well-being, and instrumental valuing of nature. Thus, the identified value archetypes reduced

complexity of the data while simultaneously highlighting ranges of value attributes and configurations not previously perceived as relevant in future scenarios.

In light of these reflections, the identified value archetypes strive to supplement future scenario development processes by providing a motivation to explore more complex combinations and patterns of value attributes than in the status quo scenario practice (e.g., Durán et al. 2023), thus improving the credibility of the developed scenarios. Though not aiming to become a classification system for future scenarios (as in the case of the conventional scenario archetypes, e.g., Economic Optimism, Global Sustainable Development; IPBES 2016), the developed value archetypes aim to provide a potential entry point for including diverse value combinations in future scenarios.

Value archetypes and scenario co-designers: implications for future scenario processes

As expected, the analysis showed that there is no perfect one-to-one relationship between the categories of scenario co-designers and scenario values. This can be attributed to the common way of co-designing scenarios, and arguably to the values held by scenario co-designers. With this in mind, the analysis confirms several assumptions prevalent in the scenario literature, while qualifying others.

First, experts and academics tend to be more frequently (than expected under the assumption of stochastic independence) involved in the design of scenarios that value nature for material benefits to individual well-being (value archetype "Individualist"), while exactly such values are commonly reflected as less likely to lead to sustainable and just futures in the peer-reviewed literature (Yoshida et al. 2022, Pascual et al. 2023). On the other hand, governmental and community actors more frequently (than expected) contributed to the design of scenarios valuing nature for itself and its benefits to societal well-being (value archetypes "Conservationist" and "Pristine ideals"). This became even more apparent when expanding the analyzed dataset to also include non-academic future visions and pathways (see Technical Annex; cf. Vainio et al. 2019).

Scenarios covered by the value archetype "Pristine ideals" were the least represented, showing that considering nature in terms of its intrinsic value and its benefits to societal aspects of well-being is currently underrepresented in the scenario literature. This also contrasts with the current literature illustrating that these types of values are crucial for sustainable and just outcomes (Vervoort et al. 2015, Klain et al. 2017, Neuteleers et al. 2021). Scenarios covered by the "Pristine ideals" value archetype were primarily created in studies co-designed by a more diverse set of stakeholders (see also Technical Annex, section on validation). This may indicate that actor categories outside academia can be more open to exploring non-conventional value configurations and may bring in a stronger emphasis on appreciating nature's role in societal aspects of well-being. Because such values seem to be strongly associated with sustainable and just outcomes (Harmáčková et al. 2023), these results provide an additional strong justification for involving diverse portfolios of actors and stakeholders in scenario design processes (Aguiar et al. 2020).

In summary, the results provide valuable insights for diversity and inclusivity in scenario co-design, resonating with previous calls (Saito 2017, McElwee et al. 2020, Harmáčková et al. 2022a, Maraud and Roturier 2023, Muiderman et al. 2023). They further illustrate that stakeholder diversity in scenario co-design processes may not utilize its full potential, e.g., if the process operates within the value framings and configurations predefined by academic actors. Instead, more emphasis needs to be put on co-designing scenario values from the bottom up, in order not to fall into conventional value configurations in an unreflected way (Le Heron et al. 2016). The value archetypes can be used to purposefully create scenarios that leave the beaten path of conventionally considered value patterns.

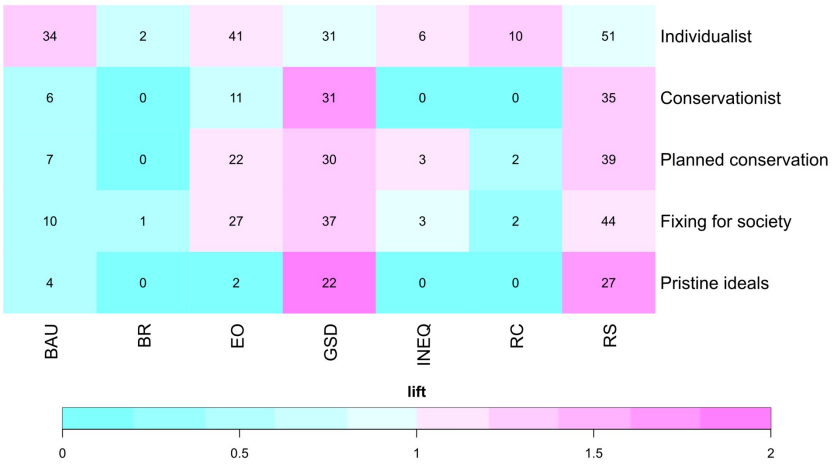
Value archetypes and the IPBES scenario archetypes: implications for future IPBES assessments

IPBES commonly relies on deductive heuristic to divide assessed scenarios into pre-existing categories, denoted as scenario archetypes (IPBES 2016). These "conventional" scenario archetypes have been used for scenario synthesis across multiple IPBES science-policy assessment reports (Sitas et al. 2019). In contrast, the value archetypes in this study were derived inductively from the source data, and thus can be used to generate a new perspective on the conventional scenario archetypes. In this respect, this study strives to highlight how these two approaches to archetype thinking match and what complementary strengths they have. For the purposes of this discussion, we compare the identified value archetypes with the conventional scenario archetypes of Economic Optimism, Business as Usual, Regional Competition, Inequality, Breakdown, Regional Sustainability, and Global Sustainable Development (Harrison et al. 2018, 2019b). To this end, Figure 2 determines the co-occurrence frequency count and lift of conventional and value archetypes in the coded data.

In particular, Figure 2 highlights that the Breakdown, Inequality, and Regional Competition scenarios are developed less often compared to other types of scenarios. The remaining conventional archetypes (Business as Usual, Economic Optimism, Global Sustainable Development, and Regional Sustainability) and the newly identified value archetypes do not show any clear one-to-one relation, which may hint that from the perspective of values, the conventionally used sets of scenario archetypes may not provide a sufficiently fine-grained heuristic to characterize currently available sets of future scenarios (Pedde et al. 2019, Sitas et al. 2019). In particular, the analysis illustrates that while sustainable outcomes are conventionally associated with only two sets of value-related assumptions (those of Regional Sustainability and Global Sustainable Development), the newly identified value archetypes show that the underlying values tend to be differentiated among four different value configurations (value archetypes "Conservationist," "Planned conservation," "Fixing for society," and "Pristine ideals"), which emphasize different value foci and value justifications. This analysis thus illustrates that aggregating scenarios into conventional scenario archetypes may result in homogenization, which threatens to lose important value texture (Hunt et al. 2012), or might question the legitimacy of the resulting aggregated scenario groups for decision-making.

The study illustrates that future assessment processes within IPBES and other science-policy processes should strive for a

Fig. 2. Co-occurrence of newly identified value archetypes and conventional IPBES scenario archetypes. Numbers represent the frequency count of co-occurrence. The color indicates the lift, i.e. whether the co-occurrence is observed more frequently than expected (larger than 1, purple), or less frequently (below 1, blue; see Methods for further details on the metric). Legend: BAU – Business as Usual; BR – Breakdown; EO – Economic Optimism; GSD – Global Sustainable Development; INEQ – Inequality; RC – Regional Competition; RS – Regional Sustainability.



more contextualized approach to synthesizing and sense-making around values in future scenarios. Although the conventional IPBES scenario archetypes have been well received by policy- and decision-makers as intuitive and operational tools for futures thinking (Sitas et al. 2019), this analysis shows that their interpretation may be misleading, and that they should ideally be combined with more bottom-up, inductive approaches to scenario synthesis.

CONCLUSIONS

This study contributes to the current sustainability literature by going beyond previous syntheses of values in future scenarios and providing fine-grained insights into the patterns of scenario values, building on a nuanced inductive approach. In addition, it contributes to bridging the knowledge gap related to the link between scenario values and the values held by scenario co-designers.

We find that the diversity of value foci and value justifications in most scenarios (which come in quite different configurations) can be well covered by five newly determined value archetypes. Based on a rigorous and inductive approach, they provide a novel view on how, for instance, instrumental value justifications are combined in different ways with a material, regulating, or individual value focus. The archetype analysis revealed that these nuances are quite common in currently published scenario studies, whereas scenarios with intrinsic value justification are not so frequent and not so diversified.

Furthermore, the analysis provides novel insights in the association between value archetypes, scenario co-designers, and commonly used scenario archetypes. In particular, we find a strong role of experts and academics in the scenarios with instrumental justification. Similarly, the analysis shows that conventional scenario archetypes may conceal more diverse configurations of value attributes. Specifically, it appears that the new value archetypes facilitate deeper examination of multiple facets within the conventional Global Sustainable Development and Regional Sustainability scenario archetypes.

From a methodological perspective, this study tested the use of a novel method for selecting the optimal suite of archetypes, successfully addressing a well-known gap in the general archetype literature (cf. Oberlack et al. 2019). This approach considerably simplified the justification of the suite of archetypes. Interestingly, the optimal configurations of value attributes, determined in this way, turned out to be systematically related to the actor categories, even without considering these in the primary analysis. This indicates that archetype selection methods might be further improved by directly considering their explanatory power. Obviously, the method would require considerable extension should it be applied to non-binary data; however, this is not necessary in studies where research questions can be examined through binary data, such as in this case.

Our study thus offers new perspectives to enrich future scenario co-design processes by embedding more diverse value configurations, whether within the IPBES context or beyond. It also offers new ways to research the relation between the values held by scenario co-designers, and the values embedded in scenarios. Though not aiming to become a standard classification system for future scenarios, the novel value archetypes offer insightful nuances to complement the conventional scenario archetypes. Most importantly, value archetypes contribute a further step to ultimately achieve one of the very promises of scenario co-design: the representation of multiple futures that are diverse both in the values embedded in scenarios and the people involved in their creation.

[1] Importantly, in typical participatory scenario-building processes, actors are involved in the co-design of an entire set of multiple different scenarios. Usually, the scenario co-designers do not state a preference for any of the scenarios and the values embedded in them. Thus, the association between scenario co-designers and the values embedded in scenarios should not be understood in terms of the co-designers imposing their preferences for particular values in scenarios, but rather in terms of the scenarios mirroring the way how scenario co-designers think about the link between values, specific decisions and actions, and future outcomes.

[2] For instance, the value focus on "nature" and the "intrinsic" justification for valuing nature may appear as equivalent. However, this is not entirely the case: "nature's" value can be justified by the existence of nature as such ("intrinsic" value), but also by unique relationships between specific natural elements (organisms, specific ecosystems, and natural places), such as pets, familiar animals, or sacred groves ("relational" values).

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Data Availability:

Data are made available in the appendices. Code is available on request because of privacy/ethical restrictions.

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Annex A: Methods

Annex to manuscript "Value archetypes in future scenarios: the role of scenario co-designers"

Zuzana Harmáčková, Klaus Eisenack, Yuki Yoshida, Nadia Sitas, Lelani Mannetti, Patrick O'Farrell

Box S1: The Web of Science keyword chain applied to identify the core sample of n = 257 scenarios*.

TS =

(

(

(

(nature OR ecosystem OR biodiversity OR ecological OR environment* OR cosmos OR creation OR "global commons")

AND

("nature's contribution$ to people" OR "ecosystem service$" OR "environmental service$" OR "landscape service$" OR "adaptation service$" OR "ES" OR "NCP$" OR "value of biodiversity" OR "option value$" OR "existential value")

AND

("quality of life" OR well$being OR social OR socio OR society OR societal OR economic OR socio$economic OR culture OR cultural OR just OR justice OR unjust OR inequity OR equity OR inequality OR inequal OR unequal OR sustainable OR sustainability OR "The Good Life" OR Eudemonia)

)

OR

(social-ecological OR socio-ecological OR socioecological OR social-environmental OR socio-environmental OR human-nature OR "people and nature" OR "people and ecosystem$")

)

AND

(future AND (scenario OR vision OR pathway OR model OR impact OR "scenario analysis" OR "scenario planning" OR "scenario building" OR "participatory scenario$" OR anticipatory OR "anticipatory planning" OR foresight OR narrative OR storyline OR strategy OR projection OR simulation OR backcasting))

AND

(value OR preference OR perception OR valuation OR Stewardship OR holistic OR Holism OR Respect OR Care OR Love OR harmony OR (value AND (instrumental OR non-instrumental OR anthropogenic OR anthropocentric OR non-anthropocentric OR relational OR intrinsic OR biophysical OR economic OR socio-cultural OR future$oriented OR

bequest OR insurance OR option OR "ecocentric" OR "biocentri*")) OR "power" OR "self-transcendence" OR pluralis*)

)

*For details, please see Harmáčková, Z. V., Y. Yoshida, and L. Mannetti. 2022. *IPBES VA Chapter 5. Systematic review of association between values of nature, nature's contributions to people and good quality of life and futures in scenarios, visions and pathways (Version 04)*. Zenodo. 10.5281/zenodo.4359655.

Box S2: IPBES framing of values applied in the manuscript

The role of people's values in the literature related to nature and sustainability has been addressed from a multitude of perspectives (Anderson et al. 2022, Balvanera et al. 2022, Pascual et al. 2023, Raymond et al. 2023). Literature stemming from environmental psychology has focused on the role of broad values (e.g. justice, freedom) in people's interactions with nature (Schwartz 2012, Anderson et al. 2018, Horcea-Milcu 2022). A wide array of literature in environmental science, environmental studies, environmental economy and other fields and knowledge systems has focused on specific values of nature for people (e.g. nature as a place providing habitats for biodiversity, nature as a source of ecosystem services, nature as a source of a sense of place) and multiple ways how people can assess them, including economic, biophysical, socio-cultural and indigenous approaches (Kenter et al. 2015, 2019). An influential lens on values of nature has been the distinction between intrinsic, instrumental and relational values (Chan et al. 2018). Finally, recent value frameworks have strived to highlight the complexity and fluidity of different value types and dimensions pertinent to human-nature relationships (O'Connor and Kenter 2019, Pereira et al. 2020).

Besides nature as such, people's values can be related to the benefits provided by nature, ecosystems and biodiversity to people as individuals, groups and societies. Such benefits tend to be denoted by different terms across different traditions. IPBES refers to these benefits as nature's contributions to people (Díaz et al. 2018), referring to both concepts established in science, practice and decision-making such as ecosystem services, and to concepts stemming from other knowledge systems such as nature's gifts. Nature's contributions to people are commonly categorised into three broad groups, including material, regulating and non-material contributions (Table 1). Material contributions are those related to the provision of food, clean water, fibres, etc., underpinned by nature's functioning. Regulating contributions are those facilitating a benign environment for human existence, including climate regulation, erosion control, flood regulation, etc. Non-material contributions relate to increasing people's psychological and physical wellbeing, e.g. by nature providing a place for recreation and identity-building.

Nature can act as a source of good quality of life for people. IPBES recognizes three broad categories of nature influencing human well-being, in terms of (i) individual, (ii) societal and (iii) cultural benefits (Table 1) (IPBES 2015). In individual terms, nature contributes

to people's physical and mental health and well-being, provides a source of education and inspiration, a source of livelihood, and can act as a space for building social relations. In societal terms, nature can provide a range of options to build societal resilience and sustainability, and is an object related to the issues of justice, inter- and intra-generational equity. In cultural terms, nature provides the basis for relationships and interactions between people and nature, provides a sense of place and the source of spirituality, religion, arts and cultural heritage.

References to Box S2:

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Annex B: Results

Annex to manuscript “Value archetypes in future scenarios: the role of scenario co-designers”

Zuzana Harmáčková, Klaus Eisenack, Yuki Yoshida, Nadia Sitas, Lelani Mannetti, Patrick O’Farrell

Table S1.A. The list of scenarios included in the analysis (n=257) with their descriptive characteristics. For full references, see below.

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
1	Albert et al. 2016	Unregulated	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	0	0
2	Albert et al. 2016	Regulated	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	0	0
3	Albert et al. 2016	Status quo	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	0	0
4	Arunyawat et al. 2018	Business as usual	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	0	0
5	Arunyawat et al. 2018	Integrated land use development	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	0	0
6	Arunyawat et al. 2018	Enhancing environmental services	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	0	0
7	Bartolai et al. 2015	A2 "The Fog"	Academia participatory/ policy-driven	Regional (continental)	Americas	0	0	0	0	0
8	Bartolai et al. 2015	A1FI "The Wreckage" - BAU	Academia participatory/ policy-driven	Regional (continental)	Americas	0	0	0	0	0
9	Bartolai et al. 2015	B1 "The Lighthouse"	Academia participatory/ policy-driven	Regional (continental)	Americas	0	0	0	1	0
10	Beach and Clark 2015	Scenario 1 (Doom and Gloom)	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
11	Beach and Clark 2015	Scenario 2 (Slow Boil)	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
12	Beach and Clark 2015	Scenario 3 (A Confused State)	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
13	Beach and Clark 2015	Scenario 4 (Win-win)	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
14	Bennich et al. 2018	Transition pathway to bio-based economy	Academia participatory/ policy-driven	National	Europe and Central Asia	1	0	0	0	0
15	Berg et al. 2016	Increased Conservation Scenario	Academia participatory/ policy-driven	Local	Americas	0	1	0	0	0
16	Berg et al. 2016	Increased Development Scenario	Academia participatory/ policy-driven	Local	Americas	0	1	0	0	0
17	Beringer et al. 2011	F1C1	Academia without stakeholder engagement	Global	Global	1	1	1	1	1
18	Beringer et al. 2011	F1C2	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
19	Beringer et al. 2011	F2C1	Academia without stakeholder engagement	Global	Global	1	1	1	1	1
20	Beringer et al. 2011	F2C2	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
21	Borsuk et al. 2019	Linear Trends + climate "low"	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
22	Borsuk et al. 2019	Backyard Amenities + climate "low"	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
23	Borsuk et al. 2019	Large Community & Wildlands + climate "low"	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1
24	Borsuk et al. 2019	Small Community & Food + climate "low"	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
25	Borsuk et al. 2019	Linear Trends + climate "high"	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
26	Borsuk et al. 2019	Backyard Amenities + climate "high"	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
27	Borsuk et al. 2019	Large Community & Wildlands + climate "high"	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1
28	Borsuk et al. 2019	Small Community & Food + climate "high"	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
29	Boschetti et al. 2015	"Now"	Academia participatory/ policy-driven	National	Asia-Pacific	1	0	0	0	0
30	Boschetti et al. 2015	Apocalypse	Academia participatory/ policy-driven	National	Asia-Pacific	1	0	0	0	0
31	Boschetti et al. 2015	Utopia	Academia participatory/ policy-driven	National	Asia-Pacific	1	0	0	0	1
32	Bosma et al. 2017	wetland conservation	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
33	Bosma et al. 2017	wetland cultivation	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
34	Bosma et al. 2017	enforcement of laws and rules	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
35	Bottalico et al. 2016	BaU	Academia without stakeholder engagement	Local	Europe and Central Asia	1	0	0	0	0
36	Bottalico et al. 2016	Nature protection	Academia without stakeholder engagement	Local	Europe and Central Asia	1	1	1	1	1
37	Bottalico et al. 2016	Wood production	Academia without stakeholder engagement	Local	Europe and Central Asia	1	0	0	0	0
38	Bremer et al. 2018a	Pasture	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
39	Bremer et al. 2018a	Native forest restoration	Academia participatory/ policy-driven	Local	Americas	0	0	0	0	1

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
40	Bremer et al. 2018a	Agroforestry	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
41	Bremer et al. 2018a	Coffee	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
42	Bremer et al. 2018b	Biocultural restoration	Academia participatory/ policy-driven	Local	Americas	0	0	0	0	0
43	Bremer et al. 2018b	Urbanisation	Academia participatory/ policy-driven	Local	Americas	0	0	0	0	0
44	Brown et al. 2016	Resources reallocation	Academia participatory/ policy-driven	National	Americas	1	1	1	0	0
45	Brown et al. 2016	Policy dominates	Academia participatory/ policy-driven	National	Americas	0	0	0	0	1
46	Brown et al. 2016	Social entrepreneurship	Academia participatory/ policy-driven	National	Americas	1	0	0	0	1
47	Brown et al. 2016	Sustainable socioecological system	Academia participatory/ policy-driven	National	Americas	1	0	0	0	1
48	Brown et al. 2016	Chaotic world	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0
49	Brown et al. 2016	Stable future	Academia participatory/ policy-driven	National	Americas	1	1	1	1	0
50	Brown et al. 2016	Desirable future	Academia participatory/ policy-driven	National	Americas	1	1	1	1	1
51	Brown et al. 2016	Undesirable future	Academia participatory/ policy-driven	National	Americas	0	0	0	0	0
52	Brown et al. 2016	Policy reform	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
53	Brown et al. 2016	A new paradigm of sustainability	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0
54	Brown et al. 2016	Chaos	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0
55	Bryan et al. 2015	L1	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	0
56	Bryan et al. 2015	M3	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	0
57	Bryan et al. 2015	M2	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	0
58	Bryan et al. 2015	H3	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	0	0	0	0
59	Budiharta et al. 2018	Restoration to offset the impacts of palm-oil developments	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	1	1
60	Burnett et al. 2019	Unrestored forest	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
61	Burnett et al. 2019	Pre-European	Academia participatory/ policy-driven	Local	Americas	0	0	0	0	1
62	Burnett et al. 2019	Pre-rat (hypothetical)	Academia participatory/ policy-driven	Local	Americas	0	0	0	0	1
63	Burnett et al. 2019	Hybrid (hypothetical)	Academia participatory/ policy-driven	Local	Americas	0	0	1	1	1
64	Carlsson et al. 2016	Fade Out	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	1
65	Carlsson et al. 2016	Rural diversity	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	1

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
66	Carlsson et al. 2016	Reindeer husbandry	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	1
67	Carpenter et al. 2015 & Qiu et al. 2018	Abandonment and Renewal	Academia participatory/ policy-driven	Local	Americas	0	0	1	0	0
68	Carpenter et al. 2015 & Qiu et al. 2018	Accelerated Innovation	Academia participatory/ policy-driven	Local	Americas	1	1	1	0	0
69	Carpenter et al. 2015 & Qiu et al. 2018	Connected Communities	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
70	Carpenter et al. 2015 & Qiu et al. 2018	Nested Watersheds	Academia participatory/ policy-driven	Local	Americas	1	1	1	0	0
71	Ciplak 2015	SC1: off-site incineration	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	0	0
72	Ciplak 2015	SC2: central incinerator	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	0	0
73	Ciplak 2015	SC3: in situ incineration	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	0	0
74	Comer et al. 2014	thriving and prosperous	Academia participatory/ policy-driven	Regional (continental)	Americas	0	0	1	1	0
75	Connor et al. 2016	No cap	Academia without stakeholder engagement	National	Asia-Pacific	1	1	1	0	0
76	Connor et al. 2016	Cap with trade	Academia without stakeholder engagement	National	Asia-Pacific	1	1	1	0	0
77	Connor et al. 2016	Cap without trade	Academia without stakeholder engagement	National	Asia-Pacific	1	1	1	0	0
78	Costello et al. 2016	BaU	Academia without stakeholder engagement	Global	Global	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
79	Costello et al. 2016	Fishing to maximize long-term catch (FMSY)	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
80	Costello et al. 2016	Rights-Based Fishery Management (RBFM)	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
81	Davies et al. 2015	Protected ocean	Academia participatory/ policy-driven	Regional (continental)	Asia-Pacific	0	0	0	0	1
82	Davies et al. 2015	Sustainable seafood	Academia participatory/ policy-driven	Regional (continental)	Asia-Pacific	1	0	0	0	0
83	Davies et al. 2015	Depleted ocean	Academia participatory/ policy-driven	Regional (continental)	Asia-Pacific	1	0	0	0	0
84	de Bruin et al. 2017	Liberal future	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0
85	de Bruin et al. 2017	Romantic nature future	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	1
86	de Bruin et al. 2017	Utilitarian future	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	0
87	Delzeit et al. 2017	baseline	Academia participatory/ policy-driven	Global	Global	1	0	0	0	0
88	Delzeit et al. 2017	land expansion	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
89	Devisscher et al. 2016	Hands-off	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
90	Devisscher et al. 2016	Fire management	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1
91	Devisscher et al. 2016	Fire suppression	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
92	Dueri et al. 2016	Maximum Sustainable Yield (MSY)	Academia without stakeholder engagement	Global	Global	1	1	1	1	0
93	Dueri et al. 2016	Maximum Economic Yield (MEY)	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
94	Dueri et al. 2016	Zero Rent (ZR)	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
95	Dupont et al. 2016	Current Trends	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	1
96	Dupont et al. 2016	Sustained Management	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	1
97	Dupont et al. 2016	Stopping Agricultural Activities	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	1
98	Dupont et al. 2016	Without Agriculture and Without Conservation Actions	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0
99	Eide 2008	High exploitation rates (scenarios OA, TAC2, LE)	Academia without stakeholder engagement	Regional (continental)	Europe and Central Asia	1	0	0	0	0
100	Eide 2008	Low exploitation rates (scenarios PA, 3PA and TAC1)	Academia without stakeholder engagement	Regional (continental)	Europe and Central Asia	1	1	1	1	1
101	Elwell et al. 2018	Potential interventions	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
102	Estoque & Murayama 2016	S1 (BaU)	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	0	0
103	Estoque & Murayama 2016	S2 (slowed urban expansion)	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	0	0
104	Estoque & Murayama 2016	S3 (increased urban expansion)	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
105	Fain et al. 2017	B1	Academia without stakeholder engagement	National	Americas	1	1	1	0	0
106	Fain et al. 2017	A1B	Academia without stakeholder engagement	National	Americas	1	1	1	0	0
107	Fain et al. 2017	A2	Academia without stakeholder engagement	National	Americas	1	1	1	0	0
108	Farrell and Silva-Macher 2017	Conservation is prioritized over cash income	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1
109	Farrell and Silva-Macher 2017	Cash income is prioritized over conservation	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
110	Gilbert et al. 2015	"then"	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	1	1	1
111	Gilbert et al. 2015	"now"	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	0	0
112	Harmackova and Vackar 2015	Business-as-Usual	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	0	0
113	Harmackova and Vackar 2015	Protection	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	1
114	Harmackova and Vackar 2015	Exploitation	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	0	0
115	Hengeveld et al. 2017	Green values	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	0
116	Hermanns et al. 2017	Services for services (PU1)	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	0	0
117	Hermanns et al. 2017	Market determines usage (PU2)	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
118	Hu et al. 2018	Inner Mongolian Plateau with sound landscape management	Academia participatory/ policy-driven	Regional (continental)	Asia-Pacific	0	0	1	1	0
119	Hu et al. 2018	Inner Mongolian Plateau without sound landscape management	Academia participatory/ policy-driven	Regional (continental)	Asia-Pacific	1	0	0	0	0
120	Chatterton et al. 2015	Business As Usual (BAU)	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	0	0
121	Chatterton et al. 2015	Optimised BAU	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	0	0
122	Chatterton et al. 2015	BAU + (up to 20%+)	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	0	0
123	Chatterton et al. 2015	GHG reduced by 25%	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	1	0
124	Chatterton et al. 2015	Red to white meat	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	1	0
125	Chatterton et al. 2015	Arable substitution	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	1	0
126	Chu et al. 2018	BaU	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0
127	Chu et al. 2018	Ecological Protection	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	0	0	1
128	Jia et al. 2018	No spatial restrictions	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	0	0	0
129	Jia et al. 2018	Traditional spatial restrictions	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	1	0
130	Jia et al. 2018	Ecological redline restrictions	Academia without stakeholder engagement	Local	Asia-Pacific	0	0	1	1	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
131	Kindu et al. 2018	Business As Usual (BAU)	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
132	Kindu et al. 2018	Forest Conservation and Water Protection (FCWP)	Academia without stakeholder engagement	Local	Africa	1	1	1	0	0
133	Kindu et al. 2018	Sustainable Intensification (SI)	Academia without stakeholder engagement	Local	Africa	1	1	1	1	1
134	Kohler et al. 2017	trend	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0
135	Kohler et al. 2017	positive	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	0
136	Kohler et al. 2017	negative	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	0	0
137	Koo et al. 2019	Urbanisation	Academia participatory/ policy-driven	Local	Africa	1	0	0	0	0
138	Koo et al. 2019	Deforestation	Academia participatory/ policy-driven	Local	Africa	1	0	0	0	0
139	Kostakis et al. 2016	Neo-feudal cognitive capitalism (NFCC)	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
140	Kostakis et al. 2016	Hypothetical case of mature peer production (HMPP)	Academia without stakeholder engagement	Global	Global	0	0	1	1	0
141	Kubiszewski et al. 2017	Market Forces	Academia participatory/ policy-driven	Global	Global	1	1	1	1	0
142	Kubiszewski et al. 2017	Fortress World	Academia participatory/ policy-driven	Global	Global	1	1	1	0	0
143	Kubiszewski et al. 2017	Policy Reform	Academia participatory/ policy-driven	Global	Global	1	1	1	1	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
144	Kubiszewski et al. 2017	Great Transition	Academia participatory/ policy-driven	Global	Global	1	1	1	1	0
145	Lane et al. 2015	the reference (REF) or “business-as-usual” case	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0
146	Lane et al. 2015	(POL4.5): radiative forcing levels are stabilized at 4.5 W/m2	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0
147	Lane et al. 2015	(POL3.7): radiative forcing levels are stabilized at 3.7 W/m2	Academia participatory/ policy-driven	National	Americas	1	0	0	0	0
148	Larondelle et al. 2016	Edible city	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	1
149	Larondelle et al. 2016	Thermally comfortable city	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	1	0	0	0
150	Larondelle et al. 2016	Celebrating water city	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	1	0	1	0
151	Larondelle et al. 2016	Clean circular city	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	0
152	Larondelle et al. 2016	Joyful city	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	1
153	Larondelle et al. 2016	Reindustrialization (BaU)	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	0
154	Larondelle et al. 2016	Reindustrialization (eco-smart)	Academia participatory/ policy-driven	Local	Europe and Central Asia	0	0	0	0	0
155	Law et al. 2015	current	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	0
156	Law et al. 2015	current with oil palm	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
157	Law et al. 2015	scenario 3: development as per the zoning plan outlined in Presidential Instruction No. 2/2007 on rehabilitation and revitalization of the Ex-Mega Rice Project Area in Central Kalimantan	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	1
158	Law et al. 2015	scenario 4: development as per the zoning plan outlined in the Ex-Mega Rice Project "master plan"	Academia without stakeholder engagement	Regional (continental)	Asia-Pacific	1	1	1	1	1
159	Lázár et al. 2015	Extended CROPWAT model	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	0	0
160	Le Heron et al. 2016	Open Exploitation	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
161	Le Heron et al. 2016	Regulation by response	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
162	Le Heron et al. 2016	Sustainable management	Academia participatory/ policy-driven	Local	Asia-Pacific	0	0	1	1	1
163	Le Heron et al. 2016	Socio-ecological visioning	Academia participatory/ policy-driven	Local	Asia-Pacific	0	0	1	1	1
164	Li and Wu 2015	Scenario 1 Yan'an area for all the grass	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
165	Li and Wu 2015	Scenario 2 Yan'an regional gradient in the 6° above all land to grassland, slope below 6° for farm land	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
166	Li and Wu 2015	Scenario 3 Yan'an regional gradient in the 15° above all land to woodland, 6°-15° for	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
		grassland, farm land still is below 6°								
167	Li and Wu 2015	Scenario 4 Yan'an regional gradient in the 25° above all land to woodland, 6°-25° for grassland, farm land still is below 6°	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
168	Li and Wu 2015	Scenario 5 Yan'an regional gradient in the 6° above all land for forest land, slope below 6° for farmland	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
169	Li and Wu 2015	Scenario 6 Yan'an an area for all the woodlands	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
170	Li and Wu 2015	Scenario 7 Yan'an an regional gradient in the 25° land to woodland, 25° following total farmland	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
171	Li and Wu 2015	Scenario 8 Yan'an regional gradient in the 15° land to woodland, 15° following total farmland	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
172	Li and Wu 2015	Scenario 9 Yan'an regional farmland	Academia participatory/ policy-driven	National	Asia-Pacific	1	1	1	0	0
173	Mahabadi et al. 2018	Non-optimized scenario	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0
174	Mahabadi et al. 2018	Optimized scenario	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	1	0
175	Martinez-Sastre et al. 2017 (Zuzana's version)	Intensified and green olive production	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
176	Martinez-Sastre et al. 2017 (Zuzana's version)	BaU	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0
177	Martinez-Sastre et al. 2017 (Zuzana's version)	Back to livestock	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	0
178	Martinez-Sastre et al. 2017 (Zuzana's version)	Mosaic landscape	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	1	1	1	0
179	Mavrommati et al. 2017	backyard amenities	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1
180	Mavrommati et al. 2017	community amenities	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	1
181	May et al. 2019	Business As Usual (BAU)	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
182	May et al. 2019	Green Haven	Academia without stakeholder engagement	Local	Africa	0	1	0	0	0
183	May et al. 2019	Downward Spiral	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
184	May et al. 2019	Local Communities	Academia without stakeholder engagement	Local	Africa	1	1	1	1	1
185	May et al. 2019	Globalization	Academia without stakeholder engagement	Local	Africa	1	1	1	1	0
186	Meyer et al. 2016	Regional aspirations for landscape futures analysis tool	Academia participatory/ policy-driven	Local	Asia-Pacific	0	0	1	1	1
187	Mitchell et al. 2016	Death by a Thousand Cuts	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
188	Mitchell et al. 2016	Cha Ching	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
189	Mitchell et al. 2016	People's Republic of Northern Midlands	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	1	0
190	Mitchell et al. 2016	Marvellous Midlands	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	1	0
191	Mitchell et al. 2016	RIP - Take the Package Now	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
192	Mitchell et al. 2016	Mulit Use Park	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
193	Mitchell et al. 2016	We Care, But is it Too Late?	Academia participatory/ policy-driven	Local	Asia-Pacific	0	0	0	0	1
194	Mitchell et al. 2016	Alpine Dreaming	Academia participatory/ policy-driven	Local	Asia-Pacific	0	0	0	0	1
195	NAWMP 2018	North American Waterfowl Management Plan	Policy-making and support: governments, intergovernmental organizations, NGOs	Regional (continental)	Americas	1	1	1	0	0
196	Outeiro et al 2016	Enviro conservation and indigenous development	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	1
197	Outeiro et al 2016	Industrial development	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
198	Outeiro et al 2016	BAU- current zoning	Academia participatory/ policy-driven	Local	Americas	1	0	0	0	0
199	Pröbstl-Haider et al. 2016	Short-Rotation Forestry	Academia participatory/ policy-driven	National	Europe and Central Asia	1	1	1	0	0
200	Pröbstl-Haider et al. 2016	Improved Growing Conditions for Cash Crop	Academia participatory/ policy-driven	National	Europe and Central Asia	1	1	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
201	Pröbstl-Haider et al. 2016	Impact of Incentives and Possible Structural Policies (AES	Academia participatory/ policy-driven	National	Europe and Central Asia	1	1	1	0	0
202	Ramm et al. 2017	RCP4.5	Academia participatory/ policy-driven	Local	Asia-Pacific	0	1	0	1	1
203	Rawluk et al. 2018	Developing self-reliant people and communities	Academia participatory/ policy-driven	National	Asia-Pacific	0	0	0	0	0
204	Rawluk et al. 2018	A safe society: separating people and fuel	Academia participatory/ policy-driven	National	Asia-Pacific	0	0	0	0	0
205	Rawluk et al. 2018	Living with nature and fire	Academia participatory/ policy-driven	National	Asia-Pacific	0	0	0	0	0
206	Sandhu et al. 2018 - very detailed narratives available	Lacuna	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
207	Sandhu et al. 2018 - very detailed narratives available	Gold Coast SA	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
208	Sandhu et al. 2018 - very detailed narratives available	Down to Earth	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	1	1
209	Sandhu et al. 2018 - very detailed narratives available	Green & Gold	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	1	1
210	Sandström et al. 2020	Biomass and Bioenergy	Academia participatory/ policy-driven	National	Europe and Central Asia	1	1	1	0	0
211	Sandström et al. 2020	Conservation	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	1	1

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
212	Sandström et al. 2020	Sami Livelihoods	Academia participatory/ policy-driven	National	Europe and Central Asia	0	0	1	1	1
213	Sandström et al. 2020	Recreation and Rural Development A	Academia participatory/ policy-driven	National	Europe and Central Asia	1	1	1	1	1
214	Sandström et al. 2020	Recreation and Rural Development B	Academia participatory/ policy-driven	National	Europe and Central Asia	1	1	1	1	0
215	Santos et al. 2017	A1 - private landfills	Academia participatory/ policy-driven	Local	Americas	0	1	0	1	0
216	Santos et al. 2017	A2 - municipal waste treatment plants	Academia participatory/ policy-driven	Local	Americas	0	0	0	1	0
217	Santos et al. 2017	A3 - private landfills + an incinerator	Academia participatory/ policy-driven	Local	Americas	0	0	0	0	0
218	Schulp et al. 2019 + Stürck et al. 2018	Libertarian Europe (V-A1)	Academia without stakeholder engagement	Regional (continental)	Europe and Central Asia	1	0	0	0	0
219	Schulp et al. 2019 + Stürck et al. 2018	Eurosceptic Europe (V-A2)	Academia without stakeholder engagement	Regional (continental)	Europe and Central Asia	1	1	1	1	1
220	Schulp et al. 2019 + Stürck et al. 2018	Social Democracy Europe (V-B1)	Academia without stakeholder engagement	Regional (continental)	Europe and Central Asia	1	1	1	1	1
221	Schulp et al. 2019 + Stürck et al. 2018	European Localism (V-B2)	Academia without stakeholder engagement	Regional (continental)	Europe and Central Asia	0	0	0	0	0
222	Sharma et al. 2019	BaU	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0
223	Sharma et al. 2019	Conservation	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0
224	Sharma et al. 2019	Sustainable intensification	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	1	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
225	Sherrouse et al. 2018	road network expansion	Academia participatory/ policy-driven	Local	Americas	1	1	1	1	0
226	Teixeria et al. 2018	Aquaculture carrying capacity given the current situation	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0
227	Teixeria et al. 2018	Aquaculture carrying capacity given activation of all farms	Academia participatory/ policy-driven	Local	Europe and Central Asia	1	0	0	0	0
228	Tejada et al. 2016	Sustainability	Academia without stakeholder engagement	National	Americas	1	1	1	1	1
229	Tejada et al. 2016	Middle of the road	Academia without stakeholder engagement	National	Americas	1	0	0	0	0
230	Tejada et al. 2016	Fragmentation	Academia without stakeholder engagement	National	Americas	1	1	1	0	0
231	Thorne et al. 2015	No Action	Academia participatory/ policy-driven	Local	Americas	0	1	0	0	0
232	Thorne et al. 2015	Static Restoration	Academia participatory/ policy-driven	Local	Americas	0	0	0	1	0
233	Thorne et al. 2015	Resilient Restoration	Academia participatory/ policy-driven	Local	Americas	0	0	0	1	0
234	Thorne et al. 2015	Migration Restoration	Academia participatory/ policy-driven	Local	Americas	0	0	0	1	0
235	Thorne et al. 2015	Wildlife Adaptation	Academia participatory/ policy-driven	Local	Americas	0	0	0	1	1
236	Wang et al. 2018	BaU	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0
237	Wang et al. 2018	Rapid Economic Development	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
238	Wang et al. 2018	Ecological Land Protection	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	1	1
239	Ward et al. 2018	Business as usual	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
240	Ward et al. 2018	Redirect the poachers	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
241	Ward et al. 2018	Large scale cutbacks	Academia without stakeholder engagement	Local	Africa	1	0	0	0	0
242	Wolff et al. 2018	Restoration and Protection (SSP1 + global targets)	Academia without stakeholder engagement	Global	Global	1	1	1	1	1
243	Wolff et al. 2018	Sustainability (SSP1)	Academia without stakeholder engagement	Global	Global	1	1	1	1	1
244	Wolff et al. 2018	Middle of the Road (SSP2)	Academia without stakeholder engagement	Global	Global	1	0	0	0	0
245	Wu et al. 2015	GDP	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	0	0
246	Wu et al. 2015	urban development	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	0	0
247	Wu et al. 2015	urban population	Academia participatory/ policy-driven	Local	Asia-Pacific	1	1	1	0	0
248	Xu et al. 2019	Continued expansion of cropland	Academia without stakeholder engagement	Local	Asia-Pacific	1	0	0	0	0
249	Xu et al. 2019	Return from cropland to grassland	Academia without stakeholder engagement	Local	Asia-Pacific	0	1	0	1	1
250	You et al. 2017	historical trend	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Origin	Geographic scale	IPBES Region	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
251	You et al. 2017	non-selective management of tea plantations	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
252	You et al. 2017	selective management of tea plantations	Academia participatory/ policy-driven	Local	Asia-Pacific	1	0	0	0	0
253	Zhang et al. 2017	SSP1 (sustainable scenario)	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	1	0
254	Zhang et al. 2017	SSP2 (middle of the road)	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	0	0
255	Zhang et al. 2017	SSP3 (regional rivalry)	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	0	0
256	Zhang et al. 2017	SSP4 (inequality)	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	0	0
257	Zhang et al. 2017	SSP5 (fossil-fuelled development)	Academia without stakeholder engagement	Local	Asia-Pacific	1	1	1	1	0

Table S1.B. The list of scenarios included in the analysis (n=257) with their respective scenario co-designer groups. For full references, see below.

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
1	Albert et al. 2016	Unregulated	0	0	0	0	1	0	0
2	Albert et al. 2016	Regulated	0	0	0	0	1	0	0
3	Albert et al. 2016	Status quo	0	0	0	0	1	0	0
4	Arunyawat et al. 2018	Business as usual	0	0	0	0	0	0	1
5	Arunyawat et al. 2018	Integrated land use development	0	0	0	0	0	0	1
6	Arunyawat et al. 2018	Enhancing environmental services	0	0	0	0	0	0	1
7	Bartolai et al. 2015	A2 "The Fog"	0	0	0	0	1	0	0
8	Bartolai et al. 2015	A1FI "The Wreckage" - BAU	0	0	0	0	1	0	0
9	Bartolai et al. 2015	B1 "The Lighthouse"	0	0	0	0	1	0	0
10	Beach and Clark 2015	Scenario 1 (Doom and Gloom)	0	1	0	0	1	1	0
11	Beach and Clark 2015	Scenario 2 (Slow Boil)	0	1	0	0	1	1	0
12	Beach and Clark 2015	Scenario 3 (A Confused State)	0	1	0	0	1	1	0
13	Beach and Clark 2015	Scenario 4 (Win-win)	0	1	0	0	1	1	0
14	Bennich et al. 2018	Transition pathway to bio-based economy	1	1	1	0	1	0	0
15	Berg et al. 2016	Increased Conservation Scenario	1	1	0	0	0	1	0
16	Berg et al. 2016	Increased Development Scenario	1	1	0	0	0	1	0
17	Beringer et al. 2011	F1C1	0	0	0	0	0	0	1
18	Beringer et al. 2011	F1C2	0	0	0	0	0	0	1
19	Beringer et al. 2011	F2C1	0	0	0	0	0	0	1
20	Beringer et al. 2011	F2C2	0	0	0	0	0	0	1
21	Borsuk et al. 2019	Linear Trends + climate "low"	0	0	0	0	1	0	0
22	Borsuk et al. 2019	Backyard Amenities + climate "low"	0	0	0	0	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
23	Borsuk et al. 2019	Large Community & Wildlands + climate "low"	0	0	0	0	1	0	0
24	Borsuk et al. 2019	Small Community & Food + climate "low"	0	0	0	0	1	0	0
25	Borsuk et al. 2019	Linear Trends + climate "high"	0	0	0	0	1	0	0
26	Borsuk et al. 2019	Backyard Amenities + climate "high"	0	0	0	0	1	0	0
27	Borsuk et al. 2019	Large Community & Wildlands + climate "high"	0	0	0	0	1	0	0
28	Borsuk et al. 2019	Small Community & Food + climate "high"	0	0	0	0	1	0	0
29	Boschetti et al. 2015	"Now"	0	0	0	0	0	0	0
30	Boschetti et al. 2015	Apocalypse	0	0	0	0	0	0	0
31	Boschetti et al. 2015	Utopia	0	0	0	0	0	0	0
32	Bosma et al. 2017	wetland conservation	0	0	0	0	0	0	1
33	Bosma et al. 2017	wetland cultivation	0	0	0	0	0	0	1
34	Bosma et al. 2017	enforcement of laws and rules	0	0	0	0	0	0	1
35	Bottalico et al. 2016	BaU	0	0	0	0	0	0	1
36	Bottalico et al. 2016	Nature protection	0	0	0	0	0	0	1
37	Bottalico et al. 2016	Wood production	0	0	0	0	0	0	1
38	Bremer et al. 2018a	Pasture	0	1	0	0	1	0	0
39	Bremer et al. 2018a	Native forest restoration	0	1	0	0	1	0	0
40	Bremer et al. 2018a	Agroforestry	0	1	0	0	1	0	0
41	Bremer et al. 2018a	Coffee	0	1	0	0	1	0	0
42	Bremer et al. 2018b	Biocultural restoration	0	1	0	1	0	0	0
43	Bremer et al. 2018b	Urbanisation	0	1	0	1	0	0	0
44	Brown et al. 2016	Resources reallocation	1	1	1	1	1	1	0
45	Brown et al. 2016	Policy dominates	1	1	1	1	1	1	0
46	Brown et al. 2016	Social entrepreneurship	1	1	1	1	1	1	0
47	Brown et al. 2016	Sustainable socioecological system	1	1	1	1	1	1	0
48	Brown et al. 2016	Chaotic world	1	1	1	1	1	1	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
49	Brown et al. 2016	Stable future	1	1	1	0	1	1	0
50	Brown et al. 2016	Desirable future	1	1	1	0	1	1	0
51	Brown et al. 2016	Undesirable future	1	1	1	0	1	1	0
52	Brown et al. 2016	Policy reform	1	1	1	0	1	0	0
53	Brown et al. 2016	A new paradigm of sustainability	1	1	1	0	1	0	0
54	Brown et al. 2016	Chaos	1	1	1	0	1	0	0
55	Bryan et al. 2015	L1	0	0	0	0	0	0	1
56	Bryan et al. 2015	M3	0	0	0	0	0	0	1
57	Bryan et al. 2015	M2	0	0	0	0	0	0	1
58	Bryan et al. 2015	H3	0	0	0	0	0	0	1
59	Budiharta et al. 2018	Restoration to offset the impacts of palm-oil developments	0	0	0	0	0	0	1
60	Burnett et al. 2019	Unrestored forest	1	0	0	0	0	0	0
61	Burnett et al. 2019	Pre-European	1	0	0	0	0	0	0
62	Burnett et al. 2019	Pre-rat (hypothetical)	1	0	0	0	0	0	0
63	Burnett et al. 2019	Hybrid (hypothetical)	1	0	0	0	0	0	0
64	Carlsson et al. 2016	Fade Out	1	1	1	0	1	0	0
65	Carlsson et al. 2016	Rural diversity	1	1	1	0	1	0	0
66	Carlsson et al. 2016	Reindeer husbandary	1	1	1	0	1	0	0
67	Carpenter et al. 2015 & Qiu et al. 2018	Abandonment and Renewal	1	1	1	0	1	0	0
68	Carpenter et al. 2015 & Qiu et al. 2018	Accelerated Innovation	1	1	1	0	1	0	0
69	Carpenter et al. 2015 & Qiu et al. 2018	Connected Communities	1	1	1	0	1	0	0
70	Carpenter et al. 2015 & Qiu et al. 2018	Nested Watersheds	1	1	1	0	1	0	0
71	Ciplak 2015	SC1: off-site incineration	0	0	0	0	1	0	0
72	Ciplak 2015	SC2: central incinerator	0	0	0	0	1	0	0
73	Ciplak 2015	SC3: in situ incineration	0	0	0	0	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
74	Comer et al. 2014	thriving and prosperous	1	1	1	0	0	0	0
75	Connor et al. 2016	No cap	0	0	0	0	0	0	1
76	Connor et al. 2016	Cap with trade	0	0	0	0	0	0	1
77	Connor et al. 2016	Cap without trade	0	0	0	0	0	0	1
78	Costello et al. 2016	BaU	0	0	0	0	0	0	1
79	Costello et al. 2016	Fishing to maximize long-term catch (FMSY)	0	0	0	0	0	0	1
80	Costello et al. 2016	Rights-Based Fishery Management (RBFM)	0	0	0	0	0	0	1
81	Davies et al. 2015	Protected ocean	0	1	0	0	1	0	0
82	Davies et al. 2015	Sustainable seafood	0	1	0	0	1	0	0
83	Davies et al. 2015	Depleted ocean	0	1	0	0	1	0	0
84	de Bruin et al. 2017	Liberal future	1	1	1	0	1	0	0
85	de Bruin et al. 2017	Romantic nature future	1	1	1	0	1	0	0
86	de Bruin et al. 2017	Utilitarian future	1	1	1	0	1	0	0
87	Delzeit et al. 2017	baseline	1	0	0	0	0	0	0
88	Delzeit et al. 2017	land expansion	0	0	0	0	0	0	1
89	Devisscher et al. 2016	Hands-off	1	1	1	0	1	0	0
90	Devisscher et al. 2016	Fire management	1	1	1	0	1	0	0
91	Devisscher et al. 2016	Fire suppression	1	1	1	0	1	0	0
92	Dueri et al. 2016	Maximum Sustainable Yield (MSY)	0	0	0	0	0	0	1
93	Dueri et al. 2016	Maximum Economic Yield (MEY)	0	0	0	0	0	0	1
94	Dueri et al. 2016	Zero Rent (ZR)	0	0	0	0	0	0	1
95	Dupont et al. 2016	Current Trends	1	1	1	0	0	0	0
96	Dupont et al. 2016	Sustained Management	1	1	1	0	0	0	0
97	Dupont et al. 2016	Stopping Agricultural Activities	1	1	1	0	0	0	0
98	Dupont et al. 2016	Without Agriculture and Without Conservation Actions	1	1	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
99	Eide 2008	High exploitation rates (scenarios OA, TAC2, LE)	0	0	0	0	0	0	1
100	Eide 2008	Low exploitation rates (scenarios PA, 3PA and TAC1)	0	0	0	0	0	0	1
101	Elwell et al. 2018	Potential interventions	0	0	0	0	1	0	0
102	Estoque & Murayama 2016	S1 (BaU)	0	0	0	0	0	0	1
103	Estoque & Murayama 2016	S2 (slowed urban expansion)	0	0	0	0	0	0	1
104	Estoque & Murayama 2016	S3 (increased urban expansion)	0	0	0	0	0	0	1
105	Fain et al. 2017	B1	0	0	0	0	0	0	1
106	Fain et al. 2017	A1B	0	0	0	0	0	0	1
107	Fain et al. 2017	A2	0	0	0	0	0	0	1
108	Farrell and Silva-Macher 2017	Conservation is prioritized over cash income	0	1	0	0	1	0	0
109	Farrell and Silva-Macher 2017	Cash income is prioritized over conservation	0	1	0	0	1	0	0
110	Gilbert et al. 2015	"then"	0	1	0	0	1	1	0
111	Gilbert et al. 2015	"now"	0	0	0	0	1	0	0
112	Harmackova and Vackar 2015	Business-as-Usual	1	0	1	0	0	0	0
113	Harmackova and Vackar 2015	Protection	1	0	1	0	0	0	0
114	Harmackova and Vackar 2015	Exploitation	1	0	1	0	0	0	0
115	Hengeveld et al. 2017	Green values	1	1	1	0	1	0	0
116	Hermanns et al. 2017	Services for services (PU1)	1	1	0	0	0	1	0
117	Hermanns et al. 2017	Market determines usage (PU2)	1	1	0	0	0	1	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
118	Hu et al. 2018	Inner Mongolian Plateau with sound landscape management	0	0	0	0	0	0	0
119	Hu et al. 2018	Inner Mongolian Plateau without sound landscape management	0	0	0	0	0	0	0
120	Chatterton et al. 2015	Business As Usual (BAU)	0	0	0	0	1	0	0
121	Chatterton et al. 2015	Optimised BAU	0	0	0	0	1	0	0
122	Chatterton et al. 2015	BAU + (up to 20%+)	0	0	0	0	1	0	0
123	Chatterton et al. 2015	GHG reduced by 25%	0	0	0	0	1	0	0
124	Chatterton et al. 2015	Red to white meat	0	0	0	0	1	0	0
125	Chatterton et al. 2015	Arable substitution	0	0	0	0	1	0	0
126	Chu et al. 2018	BaU	0	0	0	0	0	0	1
127	Chu et al. 2018	Ecological Protection	0	0	0	0	0	0	1
128	Jia et al. 2018	No spatial restrictions	0	0	0	0	0	0	1
129	Jia et al. 2018	Traditional spatial restrictions	0	0	0	0	0	0	1
130	Jia et al. 2018	Ecological redline restrictions	0	0	0	0	0	0	1
131	Kindu et al. 2018	Business As Usual (BAU)	0	0	0	0	0	0	1
132	Kindu et al. 2018	Forest Conservation and Water Protection (FCWP)	0	0	0	0	0	0	1
133	Kindu et al. 2018	Sustainable Intensification (SI)	0	0	0	0	0	0	1
134	Kohler et al. 2017	trend	1	1	0	0	1	0	0
135	Kohler et al. 2017	positive	1	1	0	0	1	0	0
136	Kohler et al. 2017	negative	1	1	0	0	1	0	0
137	Koo et al. 2019	Urbanisation	1	1	1	0	1	0	0
138	Koo et al. 2019	Deforestation	1	1	1	0	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
139	Kostakis et al. 2016	Neo-feudal cognitive capitalism (NFCC)	0	0	0	0	0	0	1
140	Kostakis et al. 2016	Hypothetical case of mature peer production (HMPP)	0	0	0	0	0	0	1
141	Kubiszewski et al. 2017	Market Forces	1	0	0	0	0	0	0
142	Kubiszewski et al. 2017	Fortress World	1	0	0	0	0	0	0
143	Kubiszewski et al. 2017	Policy Reform	1	0	0	0	0	0	0
144	Kubiszewski et al. 2017	Great Transition	1	0	0	0	0	0	0
145	Lane et al. 2015	the reference (REF) or “business-as-usual” case	0	0	0	0	1	0	0
146	Lane et al. 2015	(POL4.5): radiative forcing levels are stabilized at 4.5 W/m2	0	0	0	0	1	0	0
147	Lane et al. 2015	(POL3.7): radiative forcing levels are stabilized at 3.7 W/m2	0	0	0	0	1	0	0
148	Larondelle et al. 2016	Edible city	1	1	0	0	1	0	0
149	Larondelle et al. 2016	Thermally comfortable city	1	1	0	0	1	0	0
150	Larondelle et al. 2016	Celebrating water city	1	1	0	0	1	0	0
151	Larondelle et al. 2016	Clean circular city	1	1	0	0	1	0	0
152	Larondelle et al. 2016	Joyful city	1	1	0	0	1	0	0
153	Larondelle et al. 2016	Reindustrialization (BaU)	1	1	0	0	1	0	0
154	Larondelle et al. 2016	Reindustrialization (eco-smart)	1	1	0	0	1	0	0
155	Law et al. 2015	current	0	0	0	0	0	0	1
156	Law et al. 2015	current with oil palm	0	0	0	0	0	0	1

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
157	Law et al. 2015	scenario 3: development as per the zoning plan outlined in Presidential Instruction No. 2/2007 on rehabilitation and revitalization of the Ex-Mega Rice Project Area in Central Kalimantan	0	0	0	0	0	0	1
158	Law et al. 2015	scenario 4: development as per the zoning plan outlined in the Ex-Mega Rice Project "master plan"	0	0	0	0	0	0	1
159	Lázár et al. 2015	Extended CROPWAT model	0	0	0	0	1	0	0
160	Le Heron et al. 2016	Open Exploitation	1	1	1	0	0	0	0
161	Le Heron et al. 2016	Regulation by response	1	1	1	0	0	0	0
162	Le Heron et al. 2016	Sustainable management	1	1	1	0	0	0	0
163	Le Heron et al. 2016	Socio-ecological visioning	1	1	1	0	0	0	0
164	Li and Wu 2015	Scenario 1 Yan'an area for all the grass	0	0	0	0	1	0	0
165	Li and Wu 2015	Scenario 2 Yan'an regional gradient in the 6° above all land to grassland, slope below 6° for farm land	0	0	0	0	1	0	0
166	Li and Wu 2015	Scenario 3 Yan'an regional gradient in the 15° above all land to woodland, 6°-15° for grassland, farm land still is below 6°	0	0	0	0	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
167	Li and Wu 2015	Scenario 4 Yan'an regional gradient in the 25° above all land to woodland, 6°-25° for grassland, farm land still is below 6°	0	0	0	0	1	0	0
168	Li and Wu 2015	Scenario 5 Yan'an regional gradient in the 6° above all land for forest land, slope below 6° for farmland	0	0	0	0	1	0	0
169	Li and Wu 2015	Scenario 6 Yan'an an area for all the woodlands	0	0	0	0	1	0	0
170	Li and Wu 2015	Scenario 7 Yan'an an regional gradient in the 25° land to woodland, 25° following total farmland	0	0	0	0	1	0	0
171	Li and Wu 2015	Scenario 8 Yan'an regional gradient in the 15° land to woodland, 15° following total farmland	0	0	0	0	1	0	0
172	Li and Wu 2015	Scenario 9 Yan'an regional farmland	0	0	0	0	1	0	0
173	Mahabadi et al. 2018	Non-optimized scenario	0	0	0	0	0	0	1
174	Mahabadi et al. 2018	Optimized scenario	0	0	0	0	0	0	1
175	Martinez-Sastre et al. 2017 (Zuzana's version)	Intensified and green olive production	1	1	1	0	1	0	0
176	Martinez-Sastre et al. 2017 (Zuzana's version)	BaU	1	1	1	0	1	0	0
177	Martinez-Sastre et al. 2017 (Zuzana's version)	Back to livestock	1	1	1	0	1	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
178	Martinez-Sastre et al. 2017 (Zuzana's version)	Mosaic landscape	1	1	1	0	1	0	0
179	Mavrommati et al. 2017	backyard amenities	0	0	0	0	1	0	0
180	Mavrommati et al. 2017	community amenities	0	0	0	0	1	0	0
181	May et al. 2019	Business As Usual (BAU)	0	0	0	0	0	0	1
182	May et al. 2019	Green Haven	0	0	0	0	0	0	1
183	May et al. 2019	Downward Spiral	0	0	0	0	0	0	1
184	May et al. 2019	Local Communities	0	0	0	0	0	0	1
185	May et al. 2019	Globalization	0	0	0	0	0	0	1
186	Meyer et al. 2016	Regional aspirations for landscape futures analysis tool	1	0	0	0	0	0	0
187	Mitchell et al. 2016	Death by a Thousand Cuts	1	1	1	0	1	0	0
188	Mitchell et al. 2016	Cha Ching	1	1	1	0	1	0	0
189	Mitchell et al. 2016	People's Republic of Northern Midlands	1	1	1	0	1	0	0
190	Mitchell et al. 2016	Marvellous Midlands	1	1	1	0	1	0	0
191	Mitchell et al. 2016	RIP - Take the Package Now	1	1	1	0	1	0	0
192	Mitchell et al. 2016	Mulit Use Park	1	1	1	0	1	0	0
193	Mitchell et al. 2016	We Care, But is it Too Late?	1	1	1	0	1	0	0
194	Mitchell et al. 2016	Alpine Dreaming	1	1	1	0	1	0	0
195	NAWMP 2018	North American Waterfowl Management Plan	1	0	0	0	0	0	0
196	Outeiro et al 2016	Enviro conservation and indigenous development	1	1	0	0	1	1	0
197	Outeiro et al 2016	Industrial development	1	0	1	0	1	0	0
198	Outeiro et al 2016	BAU- current zoning	1	1	1	0	0	0	0
199	Pröbstl-Haider et al. 2016	Short-Rotation Forestry	0	1	0	1	0	0	0

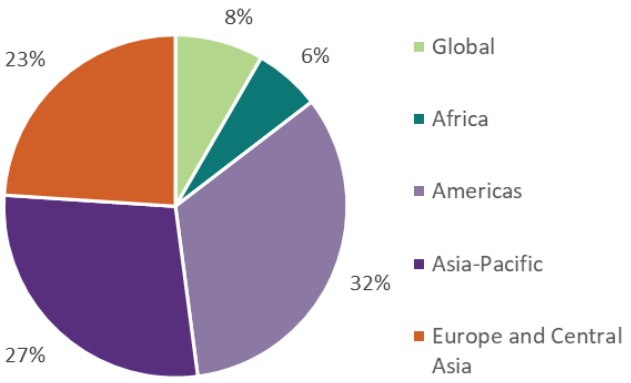
Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
200	Pröbstl-Haider et al. 2016	Improved Growing Conditions for Cash Crop	0	1	0	1	0	0	0
201	Pröbstl-Haider et al. 2016	Impact of Incentives and Possible Structural Policies (AES	0	1	0	1	0	0	0
202	Ramm et al. 2017	RCP4.5	0	0	0	0	1	0	0
203	Rawluk et al. 2018	Developing self-reliant people and communities	0	0	0	0	1	0	0
204	Rawluk et al. 2018	A safe society: separating people and fuel	0	0	0	0	1	0	0
205	Rawluk et al. 2018	Living with nature and fire	0	0	0	0	1	0	0
206	Sandhu et al. 2018 - very detailed narratives available	Lacuna	1	1	1	0	0	0	0
207	Sandhu et al. 2018 - very detailed narratives available	Gold Coast SA	1	1	1	0	0	0	0
208	Sandhu et al. 2018 - very detailed narratives available	Down to Earth	1	1	1	0	0	0	0
209	Sandhu et al. 2018 - very detailed narratives available	Green & Gold	1	1	1	0	0	0	0
210	Sandström et al. 2020	Biomass and Bioenergy	1	1	1	0	0	0	0
211	Sandström et al. 2020	Conservation	1	1	1	0	0	0	0
212	Sandström et al. 2020	Sami Livelihoods	1	1	1	0	0	0	0
213	Sandström et al. 2020	Recreation and Rural Development A	1	1	1	0	0	0	0
214	Sandström et al. 2020	Recreation and Rural Development B	1	1	1	0	0	0	0
215	Santos et al. 2017	A1 - private landfills	1	1	1	0	0	0	0

Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
216	Santos et al. 2017	A2 - municipal waste treatment plants	1	1	1	0	0	0	0
217	Santos et al. 2017	A3 - private landfills + an incinerator	1	1	1	0	0	0	0
218	Schulp et al. 2019 + Stürck et al. 2018	Libertarian Europe (V-A1)	0	0	0	0	0	0	1
219	Schulp et al. 2019 + Stürck et al. 2018	Eurosceptic Europe (V-A2)	0	0	0	0	0	0	1
220	Schulp et al. 2019 + Stürck et al. 2018	Social Democracy Europe (V-B1)	0	0	0	0	0	0	1
221	Schulp et al. 2019 + Stürck et al. 2018	European Localism (V-B2)	0	0	0	0	0	0	1
222	Sharma et al. 2019	BaU	0	0	0	0	0	0	1
223	Sharma et al. 2019	Conservation	0	0	0	0	0	0	1
224	Sharma et al. 2019	Sustainable intensification	0	0	0	0	0	0	1
225	Sherrouse et al. 2018	road network expansion	0	0	0	1	0	0	0
226	Teixeria et al. 2018	Aquaculture carrying capacity given the current situation	0	0	0	0	1	0	0
227	Teixeria et al. 2018	Aquaculture carrying capacity given activation of all farms	0	0	0	0	1	0	0
228	Tejada et al. 2016	Sustainability	0	0	0	0	0	0	1
229	Tejada et al. 2016	Middle of the road	0	0	0	0	0	0	1
230	Tejada et al. 2016	Fragmentation	0	0	0	0	0	0	1
231	Thorne et al. 2015	No Action	1	0	0	0	1	0	0
232	Thorne et al. 2015	Static Restoration	1	0	0	0	1	0	0
233	Thorne et al. 2015	Resilient Restoration	1	0	0	0	1	0	0
234	Thorne et al. 2015	Migration Restoration	1	0	0	0	1	0	0
235	Thorne et al. 2015	Wildlife Adaptation	1	0	0	0	1	0	0
236	Wang et al. 2018	BaU	0	0	0	0	0	0	1
237	Wang et al. 2018	Rapid Economic Development	0	0	0	0	0	0	1
238	Wang et al. 2018	Ecological Land Protection	0	0	0	0	0	0	1

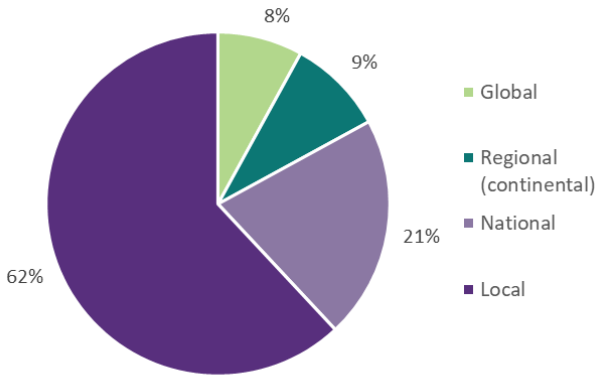
Nr	Source document	Scenario/ vision/ pathway name	Governments, authorities	Communities and organised groups	Businesses and private sector	Households	Individuals	Others	Experts and academics involved in scenario co-design
239	Ward et al. 2018	Business as usual	0	0	0	0	0	0	1
240	Ward et al. 2018	Redirect the poachers	0	0	0	0	0	0	1
241	Ward et al. 2018	Large scale cutbacks	0	0	0	0	0	0	1
242	Wolff et al. 2018	Restoration and Protection (SSP1 + global targets)	0	0	0	0	0	0	1
243	Wolff et al. 2018	Sustainability (SSP1)	0	0	0	0	0	0	1
244	Wolff et al. 2018	Middle of the Road (SSP2)	0	0	0	0	0	0	1
245	Wu et al. 2015	GDP	0	0	0	0	1	0	0
246	Wu et al. 2015	urban development	0	0	0	0	1	0	0
247	Wu et al. 2015	urban population	0	0	0	0	1	0	0
248	Xu et al. 2019	Continued expansion of cropland	0	0	0	0	0	0	1
249	Xu et al. 2019	Return from cropland to grassland	0	0	0	0	0	0	1
250	You et al. 2017	historical trend	1	0	0	0	0	0	0
251	You et al. 2017	non-selective management of tea plantations	1	0	0	0	0	0	0
252	You et al. 2017	selective management of tea plantations	1	0	0	0	0	0	0
253	Zhang et al. 2017	SSP1 (sustainable scenario)	0	0	0	0	0	0	1
254	Zhang et al. 2017	SSP2 (middle of the road)	0	0	0	0	0	0	1
255	Zhang et al. 2017	SSP3 (regional rivalry)	0	0	0	0	0	0	1
256	Zhang et al. 2017	SSP4 (inequality)	0	0	0	0	0	0	1
257	Zhang et al. 2017	SSP5 (fossil-fuelled development)	0	0	0	0	0	0	1

Figure S1. Selected descriptive characteristics of the 257 analysed scenarios.

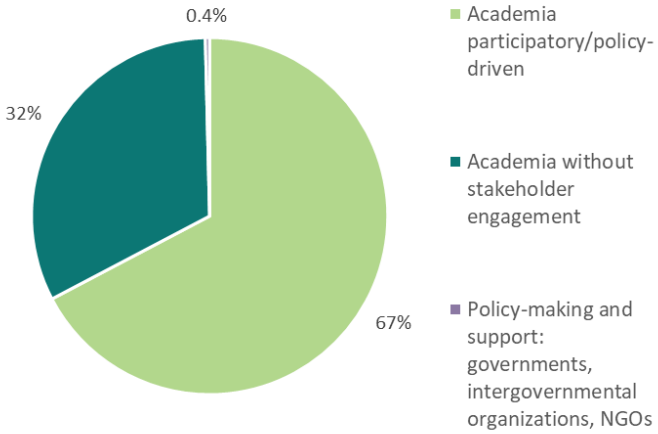
I) Regional coverage



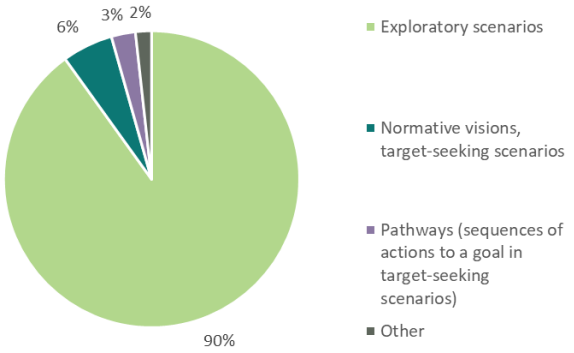
II) Scale



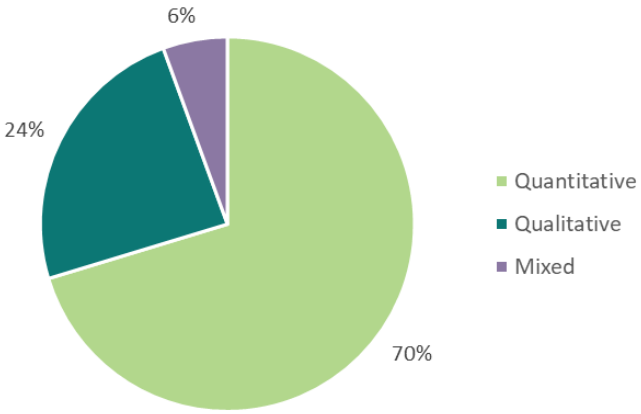
III) Study initiated by...



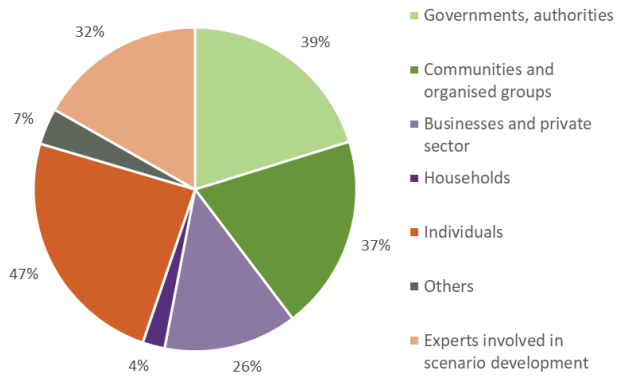
IV) Type of futures-oriented work



V) Quantitative or qualitative study



VI) Types of scenario co-designers involved in the analysed studies*



* The co-designer frequencies add up to more than 100% as multiple actors can participate in a single scenario co-design process.

Table S2. Frequency of value archetypes across different IPBES geographical regions (total n = 257 scenarios). Rows can add up to more than total because scenarios can belong to multiple archetypes.

	Total	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
Nr of scenarios						
Global	**21**	**20**	**9**	**10**	**9**	**4**
Africa (subtotal)	**16**	**15**	**5**	**4**	**3**	**2**
Ethiopia	3	3	2	2	1	1
Ghana	2	2	NA	NA	NA	NA
South Africa	3	3	NA	NA	NA	NA
Tanzania	5	4	3	2	2	1
Uganda	3	3	NA	NA	NA	NA
Americas (subtotal)	**83**	**58**	**37**	**37**	**32**	**23**
Americas	3	3	NA	NA	NA	NA
North America	7	1	2	2	2	1
Canada	4	4	1	1	1	1
USA	30	17	14	14	12	8
Mexico	11	9	3	3	2	4
Puerto Rico	3	3	3	3	NA	NA
South America	2	2	1	1	1	1
Bolivia	6	6	4	4	3	2
Brazil	3	NA	1	NA	2	NA
Chile	4	4	1	1	1	1
Indonesia	8	7	6	7	7	5
Iran	2	2	1	1	1	NA
Asia-Pacific (subtotal)	**70**	**49**	**31**	**41**	**18**	**12**
Asia-Pacific	3	NA	NA	3	NA	NA
Australia	27	20	11	11	9	7
Bangladesh	1	1	1	1	NA	NA
China	30	25	19	20	6	3
Mongolia	2	1	NA	1	1	NA
New Zealand	4	2	NA	2	2	2
Thailand	3	NA	NA	3	NA	NA
Europe & Central Asia (subtotal)	**60**	**37**	**26**	**38**	**21**	**14**
EU	4	4	2	2	2	NA
Austria	6	6	5	5	1	NA
Czechia	3	2	2	2	NA	1
France	4	3	2	2	2	3
Germany	5	2	2	5	NA	NA
Italy	3	3	1	1	1	1
Netherlands	10	3	3	1	2	3
Portugal	2	2	NA	NA	NA	NA
Spain	4	4	2	2	2	NA
Sweden	10	8	7	9	8	6
UK	6	NA	NA	6	3	NA
Turkey	3	NA	NA	3	NA	NA
Marine areas (subtotal)	**7**	**5**	**2**	**3**	**2**	**3**
Barents Sea	2	2	1	1	1	1
Indian Ocean	3	2	NA	NA	NA	1
North Sea	2	1	1	2	1	1
Total	**257**					
% of each column						
Global	**8%**	**11%**	**8%**	**8%**	**11%**	**7%**
Africa (subtotal)	**6%**	**8%**	**5%**	**3%**	**4%**	**3%**
Ethiopia	1%	2%	2%	2%	1%	2%
Ghana	1%	1%	0%	0%	0%	0%
South Africa	1%	2%	0%	0%	0%	0%
Tanzania	2%	2%	3%	2%	2%	2%
Uganda	1%	2%	0%	0%	0%	0%
Americas (subtotal)	**32%**	**32%**	**34%**	**28%**	**38%**	**40%**
Americas	1%	2%	0%	0%	0%	0%
North America	3%	1%	2%	2%	2%	2%

	Total	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
Canada	2%	2%	1%	1%	1%	2%
USA	12%	9%	13%	11%	14%	14%
Mexico	4%	5%	3%	2%	2%	7%
Puerto Rico	1%	2%	3%	2%	0%	0%
South America	1%	1%	1%	1%	1%	2%
Bolivia	2%	3%	4%	3%	4%	3%
Brazil	1%	0%	1%	0%	2%	0%
Chile	2%	2%	1%	1%	1%	2%
Indonesia	3%	4%	5%	5%	8%	9%
Iran	1%	1%	1%	1%	1%	0%
Asia-Pacific (subtotal)	**27%**	**27%**	**28%**	**31%**	**21%**	**21%**
Asia-Pacific	1%	0%	0%	2%	0%	0%
Australia	11%	11%	10%	8%	11%	12%
Bangladesh	0%	1%	1%	1%	0%	0%
China	12%	14%	17%	15%	7%	5%
Mongolia	1%	1%	0%	1%	1%	0%
New Zealand	2%	1%	0%	2%	2%	3%
Thailand	1%	0%	0%	2%	0%	0%
Europe & Central Asia (subtotal)	**23%**	**20%**	**24%**	**29%**	**25%**	**24%**
EU	2%	2%	2%	2%	2%	0%
Austria	2%	3%	5%	4%	1%	0%
Czechia	1%	1%	2%	2%	0%	2%
France	2%	2%	2%	2%	2%	5%
Germany	2%	1%	2%	4%	0%	0%
Italy	1%	2%	1%	1%	1%	2%
Netherlands	4%	2%	3%	1%	2%	5%
Portugal	1%	1%	0%	0%	0%	0%
Spain	2%	2%	2%	2%	2%	0%
Sweden	4%	4%	6%	7%	9%	10%
UK	2%	0%	0%	5%	4%	0%
Turkey	1%	0%	0%	2%	0%	0%
Marine areas (subtotal)	**3%**	**3%**	**2%**	**2%**	**2%**	**5%**
Barents Sea	1%	1%	1%	1%	1%	2%
Indian Ocean	1%	1%	0%	0%	0%	2%
North Sea	1%	1%	1%	2%	1%	2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
% of each row						
Global	**100%**	**95%**	**43%**	**48%**	**43%**	**19%**
Africa (subtotal)	**100%**	**94%**	**31%**	**25%**	**19%**	**13%**
Ethiopia	100%	100%	67%	67%	33%	33%
Ghana	100%	100%	0%	0%	0%	0%
South Africa	100%	100%	0%	0%	0%	0%
Tanzania	100%	80%	60%	40%	40%	20%
Uganda	100%	100%	0%	0%	0%	0%
Americas (subtotal)	**100%**	**70%**	**45%**	**45%**	**39%**	**28%**
Americas	100%	100%	0%	0%	0%	0%
North America	100%	14%	29%	29%	29%	14%
Canada	100%	100%	25%	25%	25%	25%
USA	100%	57%	47%	47%	40%	27%
Mexico	100%	82%	27%	27%	18%	36%
Puerto Rico	100%	100%	100%	100%	0%	0%
South America	100%	100%	50%	50%	50%	50%
Bolivia	100%	100%	67%	67%	50%	33%
Brazil	100%	0%	33%	0%	67%	0%
Chile	100%	100%	25%	25%	25%	25%
Indonesia	100%	88%	75%	88%	88%	63%
Iran	100%	100%	50%	50%	50%	0%
Asia-Pacific (subtotal)	**100%**	**70%**	**44%**	**59%**	**26%**	**17%**
Asia-Pacific	100%	0%	0%	100%	0%	0%
Australia	100%	74%	41%	41%	33%	26%
Bangladesh	100%	100%	100%	100%	0%	0%

	Total	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
China	100%	83%	63%	67%	20%	10%
Mongolia	100%	50%	0%	50%	50%	0%
New Zealand	100%	50%	0%	50%	50%	50%
Thailand	100%	0%	0%	100%	0%	0%
Europe & Central Asia (subtotal)	**100%**	**62%**	**43%**	**63%**	**35%**	**23%**
EU	100%	100%	50%	50%	50%	0%
Austria	100%	100%	83%	83%	17%	0%
Czechia	100%	67%	67%	67%	0%	33%
France	100%	75%	50%	50%	50%	75%
Germany	100%	40%	40%	100%	0%	0%
Italy	100%	100%	33%	33%	33%	33%
Netherlands	100%	30%	30%	10%	20%	30%
Portugal	100%	100%	0%	0%	0%	0%
Spain	100%	100%	50%	50%	50%	0%
Sweden	100%	80%	70%	90%	80%	60%
UK	100%	0%	0%	100%	50%	0%
Turkey	100%	0%	0%	100%	0%	0%
Marine areas (subtotal)	**100%**	**71%**	**29%**	**43%**	**29%**	**43%**
Barents Sea	100%	100%	50%	50%	50%	50%
Indian Ocean	100%	67%	0%	0%	0%	33%
North Sea	100%	50%	50%	100%	50%	50%

Table S3. Frequency of value archetypes across different geographic scales (total n = 257 scenarios). Rows can add up to more than total because scenarios can belong to multiple archetypes.

	Total	Individualist	Conservationist	Planned conservation	Fixing for society	Pristine ideals
Nr of scenarios						
Global	21	20	9	10	9	4
Regional (continental)	24	18	11	13	13	4
National	53	40	26	34	10	9
Local	159	106	64	76	56	41
Total	**257**					
% of each column						
Global	8%	11%	8%	8%	10%	7%
Regional (continental)	9%	10%	10%	10%	15%	7%
National	21%	22%	24%	26%	11%	16%
Local	62%	58%	58%	57%	64%	71%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
% of each row						
Global	**100%**	95%	43%	48%	43%	19%
Regional (continental)	**100%**	75%	46%	54%	54%	17%
National	**100%**	75%	49%	64%	19%	17%
Local	**100%**	67%	40%	48%	35%	26%

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Technical Annex for Value archetypes in future scenarios: the role of scenario co-designers

Zuzana Harmáčková, Klaus Eisenack*, Yuki Yoshida,
Nadia Sitas, Lelani Mannetti, Patrick O'Farrell

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1 Optimal suite of archetypes

Currently, criteria for a good choice of the archetypes' configurations are claimed to be one desideratum in the archetype literature (Oberlack et al., 2019). In this paper, we propose a novel way on how to deal with this challenge. It proceeds in three steps. First, we require a criterion for a single configuration to be an archetype, and then (second) a more advanced criterion for the a whole suite of archetypes. Those two steps can be done computationally. Third, among those suites that pass both tests, we qualitatively select the suite which is most insightful. We first provide some overview. Step 1 and Step 2 are then described in more detail in Sec. 2-Sec. 4

Step 1 requires that each archetype is maximal in the following sense (see Sec. 2): It should cover *all* scenarios which have at least the archetype's configuration of value attributes, and it should contain *all* value attributes which are shared by these scenarios. In other words, if all scenarios which share two value attributes also share a third value attribute, the third should also be part of this archetype. This step is based on formal concept analysis (FCA, Ganter et al., 2005),

*Corresponding author for Technical Annex, klaus.eisenack@hu-berlin.de, Resource Economics Group, Humboldt-Universität zu Berlin, Germany

as has been done in other archetype analyses (e.g. Oberlack et al., 2016; Oberlack and Eisenack, 2018; Gotgelf et al., 2020; Partelow et al., 2024). Usually, there are quite a lot of such maximal configurations.

Step 2 requires that a suite of archetypes should only contain maximal configurations determined in the previous step, which taken together are optimal in a specific sense (see Sec. 3). The intuition is as follows, based on the consideration of three trade-offs. First, it is quite evident that a larger number of configurations admits to cover more scenarios: to be covered, it is sufficient if a scenario is only contained in one of them. Then, more diversity of values which are considered in the scenarios is represented. Configurations then tend to be more "rich", i.e. they consist of more attributes, admitting a more detailed interpretation of configurations and scenarios. Yet, a larger number of configurations also has its drawbacks. When the scenarios are classified into a larger number of configurations (in the extreme case with each scenario being covered by an individual configuration), we likely lose power to compare different scenarios (called the ideographic trap). Second, if we want to have a smaller number of configurations, we would likely need to select configurations which are not so rich, because larger sets of scenarios have less in common. Less richness however, tends to come at the expense of weaker interpretations (called the nomothetic trap). Third, if we want to keep rich configurations, but only a smaller number, they would cover a smaller share of scenarios: A larger part of the data would be disregarded in the analysis.

The novel procedure proposes a way on how to transparently deal with these trade-offs. The basic idea is to first fix a certain number of configurations (a possible size of the suite of archetypes), and to require that each configuration contains a fixed number of attributes (the richness). The algorithm then selects those maximal configurations which cover the largest possible number of scenarios. This algorithm requires to solve a maximisation problem with set operations in the maximand and the constraint. We solve this problem by converting it into an equivalent integer program with binary variables. This integer program is quite large, but can be numerically computed with the R package lpSolve (see Sec. 4). This calculation is repeated for different numbers for size and richness. In this way, we obtain a kind of Pareto frontier that we should not fall behind. It gives the optimal coverage for given size and richness. This Pareto frontier is generally increasing with size, and decreasing with richness. The final suite of archetypes is required to be on this Pareto frontier.

Step 3 admits some degree of freedom to chose a suite of archetypes from the Pareto frontier. This choice is yet considerably simplified (and not arbitrary) compared to the situation without the proposed algorithm. It can be justified qualitatively to find a suite which admits good explanations and is salient for the research question. The intermediate steps in Sec. 6 and the results in the main text illustrate how the criteria of Step 3 can be addressed.

2 Archetypes based on formal concept analysis

Archetype analysis aims to develop a non-disjoined classification of cases, where classes can be (re)combined in different ways like building blocks to scrutinize individual cases. Those classes should represent the diversity of cases, and should jointly cover many of them. Here, the main components of an archetype analysis (as proposed by Eisenack et al., 2019) can be described with set theory.

Our cases are the 257 scenarios, denoted by the set O. The vocabulary of attributes are the presence/absence of the value attributes, denoted by the set

$$A = \{NAT, REG, MAT, NMT, IND, SOC, CUL, INT, INS, REL\}.$$

Targeted size of suite of archetypes	N
Configuration or archetype	χ_k
Suite of archetypes	$\mathcal{X} = \{\chi_1, \ldots, \chi_k, \ldots, \chi_N\}$
Set of n cases:	$O = \{o_1, o_2, \ldots, o_j, \ldots o_n\}$
Targeted richness of suite	ρ
Set of m formal concepts to select from:	$\mathcal{C} = \{c_1, c_2, \ldots, c_i, \ldots, c_m\}$
Intent of a formal concept or archetype (set):	$a(c_i), a(\chi_k)$
Extent of a formal concept or archetype (set):	$o(c_i), o(\chi_k)$
Transpose of a matrix or vector M:	M^t
The ith column vector of M:	$M_{\cdot,i}$
A set of cases $s \subseteq O$ written as a column vector	$\bar{s} = (s_1, \ldots, s_n)^t$ (set membership)
Diagonal $n \times n$ unit matrix	I_n

Table 1: Overview of mathematical notation.

When we need to refer to a single attribute, we write $a_i \in A$. It is helpful to employ further terminology from FCA (Ganter et al., 2005). For a given case $o \in O$, all attributes which were coded for this case are denoted by its "intent" $o' \subseteq A$. Conversely, all cases where a specific attribute $a \in A$ holds, are denoted by its "extent" $a' \subseteq O$. We aim to identify a suite of N archetypes $\mathcal{X} = \{\chi_1, \chi_2, \ldots, \chi_N\}$ from this data (more on the set $\mathcal{X}$'s cardinality below). In line with Eisenack et al. (2019), each archetype χ is characterised by three elements: (1) a configuration of attributes (the archetype's intent, i.e. a set $a(\chi) \subseteq A$), (2) the cases which are covered by this archetype (the archetype's extent, i.e. a set $o(\chi) \subseteq O$), and (3) an explanation why this configuration is reasonable, ideally supported by more details from the cases where it holds (see Tab. 1 for a summary of notation).

Now turn to Step 1. For individual configurations χ to be maximal, we demand the following feature (again, taken from FCA): It should cover all cases which have at least the configuration's intent, and it contains all attributes which are shared by all cases from its extent (formally, each such combination of cases and attributes satisfies $o'(\chi) = a(\chi)$, and $a'(\chi) = o(\chi)$, called a "formal concept"). We compute all concepts in R using the fcaR package (Lopez Rodriguez et al., 2020). This maximality feature is helpful, but typically leaves a very large number of formal concepts being candidates for being included in the suite $\mathcal{X}$. The set of all concepts with this feature is denoted by $\mathcal{C} = \{c_1, c_2, \ldots, c_m\}$. Which and how many such concepts should make it into $\mathcal{X}$?

3 Optimal selection of configurations

This brings us to Step 2. As outlined above, choosing an optimal selection of concepts requires the consideration of three trade-offs among: (1) The number of concepts N being selected into the suite (size); (2) the joint size of cases covered by the suite in total, i.e. the cardinality of the union $\cup_{k=1,\ldots,N} o(\chi_k)$; (3) the richness of the suite $\rho = \min\{|a(\chi_k)|, k = 1, \ldots, N\}$. We operationalize these trade-offs by solving the following constrained maximization problem (with set-valued arguments) for given size N and richness ρ:

$$\nu(N, \rho) := \max_{\mathcal{X}=\{\chi_1,\ldots,\chi_N\}\subseteq\mathcal{C}} |\cup_{k=1,\ldots,N} o(\chi_k)|, \tag{1}$$

$$\text{s.t.} \quad \rho = \min\{|a(\chi_k)|, k = 1, \ldots, N\}. \tag{2}$$

Thus $\nu(N, \rho)$ denotes the joint size (number of cases) of the "best" suite among those selections of formal concepts with given (N, ρ): If we want to have an optimal suite for given (N, ρ), we

should not select another one. This still leaves open which values to chose for (N, ρ). If we plot $\nu(N, \rho)$, we obtain the Pareto frontier, from which choices should be made in Step 3 (see Sec. 6 for an example).

4 Optimal selection of configurations as integer program with binary variables

We solve the optimization problem for given size N and richness ρ by converting it into an equivalent linear integer program (LP), which can be solved with standard numerical methods (we use lpsolve in R, Berkelaar, 2023).

First, remove all formal concepts c with $a(c) < \rho$. The remaining formal concepts are considered to be contained in $\mathcal{C}$. This guarantees that only suites with a richness of at least ρ can be found.

Then, code the extent of each formal concept by constructing a matrix which contains one row per case, one column per concept, and a value of unity iff a case is in the extent of the concept. This is expressed by the $n \times m$ extension matrix E with entries $E_{j,i} = 1$ if $o_j \in o(c_i)$ (and zero otherwise):

$$E = \left(\begin{array}{cccccc} \bar{o}(c_1) & \bar{o}(c_2) & \dots & \bar{o}(c_i) & \dots \bar{o}(c_m) \end{array} \right). \tag{3}$$

We introduce a vector x of binary variables (length m) to select concepts. It's components x_i are unity if concept i is considered for inclusion in the suite, and zero otherwise. Optimization thus requires to find the optimal vector x under the constraint that its components add to N. The maximand is more complicated to represent. We introduce another vector v of binary variables (length n), where each component v_j expresses whether the case j is included in the suite selected by x. Thus, the integer program is actually solved over all vectors x, v which respect the constraints that guarantee v being consistent with x to represent the set union in the maximand. Formally, the argument of the maximand is a ($m + n$ rows) column vector $(x, v)^t$ with:

1. A column vector x of length m, with $x_i = 1$ iff $c_i \in \mathcal{X}$ (and zero otherwise).
2. A column vector v of length n, with $v_j = 1$ iff $o_j \in \cup_{k=1,\dots,N} o(\chi_k)$ (and zero otherwise). Further constraints (see below) achieve that this is the case.

The maximand then becomes $\nu = \sum_{j=1,\dots,n} v_j$.

The constraints are formulated to force that the coefficients of v fit to x, and are expressed in the form (matrix notation, component-wise inequalities):

$$M \left(\begin{array}{c} x \\ v \end{array} \right) \leq R, \tag{4}$$

with

$$R = \left(\begin{array}{c} 0 \\ \vdots \\ 0 \\ \hline 0 \\ \vdots \\ 0 \\ \hline N \\ -N \end{array} \right), \qquad \begin{array}{c} \vdots \\ n \quad \text{rows} \\ \vdots \\ \hline \vdots \\ m \cdot n \quad \text{rows} \\ \vdots \\ \hline 2 \end{array} \tag{5}$$

being a column vector with $n+m\cdot n+2$ rows. The large matrix M has $m+n$ columns, $n+m\cdot n+2$ rows, and the following form:

$$M = \left(\begin{array}{ccccc|ccc} & & -E & & & & I_n & & \\ \hline E_{\cdot,1} & 0 & 0 & \dots & 0 & & -I_n & & \\ \hline 0 & E_{\cdot,2} & 0 & \dots & 0 & & -I_n & & \\ \hline & \vdots & & & & & \vdots & & \\ \hline 0 & & \dots & 0 & E_{\cdot,m} & & -I_n & & \\ \hline 1 & 1 & & \dots & 1 & 0 & \dots & 0 \\ -1 & -1 & & \dots & -1 & 0 & \dots & 0 \end{array}\right) \begin{array}{c} n \text{ rows} \\ \hline \text{for } c_1 : n \text{ rows} \\ \hline \text{for } c_2 : n \text{ rows} \\ \hline \vdots \\ \hline \text{for } c_m : n \text{ rows} \\ \hline 2 \text{ rows} \end{array} \tag{6}$$

The first m columns of M correspond to the formal concepts, the remaining n columns to the cases. The first n rows also correspond to the cases. Then, for every of the m formal concepts there is another row block for all n cases.

The last two rows add-up the presence of the formal concepts in a suite, and forces their number $\sum_{i=1,\dots,m} x_i$ – via Eq. (4) – to be equal to N, which is the required size of the suite.

The first n rows count for each of the n cases how frequently it is covered by concepts (as selected via x). It thus states that, for each case j, the constraint $v_j \leq \sum_{i=1,\dots,m} \bar{o}(c_i)_j \, x_i$ needs to hold. The purpose of this constraint is to force $v_j = 0$ if case j is not covered by any concepts selected through x.

Yet, if a case j is covered by at least one formal concept selected through x, we need to force $v_j = 1$, which is obtained by the remaining rows. Each of the blocks takes care for one concept. The block for c_1, for instance, requires that $\forall j = 1, \dots, n : v_j \geq \bar{o}(c_1)_j \, x_1$. Thus, if case j is covered by the concept c_1, we have $v_j \geq 1$. The further blocks do this for the other concepts. Together with the constraints from the first block, this forces $v_j = 1$ iff case j is in the intent of at least one concept – exactly what v has been introduced for.

We can thus complete the second step by numerically solving

$$\max_{x_1,\dots,x_m,v_1,\dots,v_n} \nu = \sum_{j=1,\dots,n} v_j \tag{7}$$

$$\text{s.t.} \quad M \begin{pmatrix} x \\ v \end{pmatrix} \leq R. \tag{8}$$

We are sure that there are more elegant or more computationally efficient methods to solve the maximization problem with set-valued arguments, but the proposed one works well in R within reasonable time for the data set of the paper, and other experimental data sets. The code is available from the corresponding author upon request.

5 Lift

To test whether formal concepts from an optimal suite are associated with actors in an unexpected way, we used the lift metric (e.g. McNicholas et al., 2008). Suppose we have a concept c with its extent $o(c)$. Then, $p_c := |o(c)|/n$ denotes the relative frequency of c in the data. Now consider one attribute a, e.g. whether a certain kind of actor was involved in constructing a scenario. In the analogue way, we thus denote by $p_a := |a'|/n$ the relative frequency of scenarios being created with a (irrespective of whether these scenarios are in the extent of c or not). Finally, let

$p_{a,c} := |a' \cap o(c)|/n$ be the relative frequency of scenarios where actor a participated and that belong to the extent of c at the same time. Then, lift is defined by

$$\text{lift}(c, a) := \frac{p_{a,c}}{p_c \cdot p_a} \geq 0. \tag{9}$$

6 Optimal suite: Some intermediate results

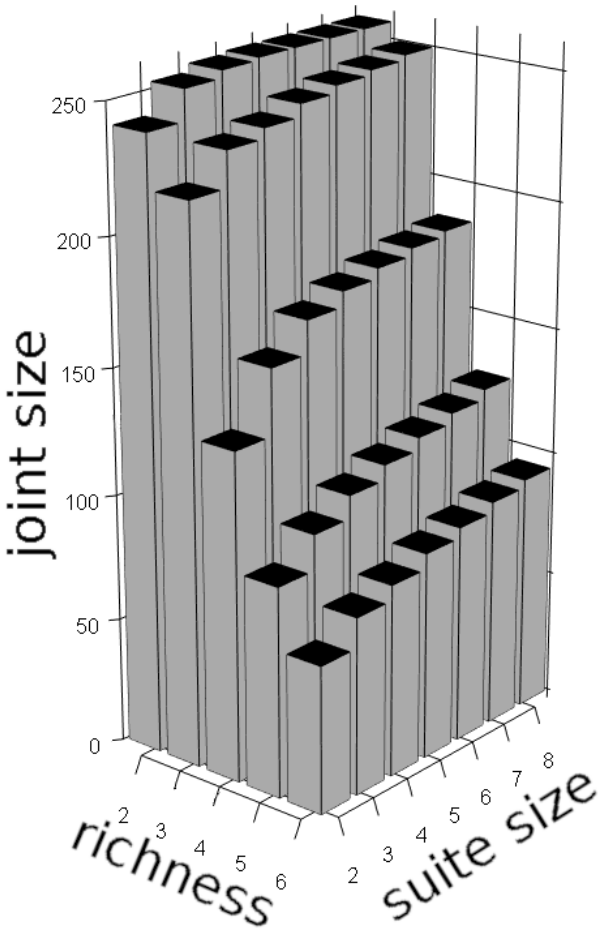

Figure 1: Optimal joint size for given richness ρ and given suite size N, as determined by the algorithm.

We first ran the algorithm for a range of different parameters for suite size and richness. Fig. 6 visualizes the Pareto frontier. We see that a larger suite always covers more scenarios, yet the optimal joint size converges to a maximum. With suites of two attributes ($\rho = 2$), all scenarios are covered with five concepts. Then, a larger suite cannot increase coverage further. With a richness of three attributes, when admitting more and more concepts in the suite, coverage converges to 254 out of 257 scenarios. The remaining three scenarios can never be covered, since they are characterized by only two attributes. If a higher richness is required, the joint size becomes lower because less scenarios are coded with four or more attributes. The optimal joint size also decreases

with richness because there are more possibilities to combine attributes, so more formal concepts are needed to capture this variation.

Every bar in the graph corresponds to the concepts which achieve this optimal joint size. For instance, if $N = 2, \rho = 2$ (with optimal joint size of 241 out of 257 scenarios), the following two pairs of attributes (intents of two concepts) are optimal: (i) IND-INS; (ii) REG-INS. So, any of these 241 scenarios either have the attribute pair IND-INS, or the pair REG-INS, or both pairs (and possibly further attributes). There are 16 remaining scenarios which are neither characterized by the first, nor the second pair of attributes. Yet, with any other suite of two pairs, the coverage would be less than 241 scenarios.

We used Fig. 6 to guide our selection of the appropriate values for (N, ρ), in combination with the following arguments. If we accept $\rho = 2$, four simple concepts cover all scenarios except one (IND-INS, MAT-INS, REG-INS, NAT-SOC). We would obtain complete coverage if we admit a fifth concept. But adding one more concept just to cover a single additional case would not reduce the complexity in our a data. If we admit only $N = 3$ concepts, three more scenarios are lost from coverage. This might be considered as bearable. However, a suite of value attribute pairs seemed to be too simple in order to provide a useful classification of scenarios. Moreover, some attributes are quite frequent anyway (in particular INS). So, we opted for $\rho > 2$. This would be problematic if coverage would be heavily reduced if a higher richness is required, but Fig. 6 shows that this is not the case for $\rho = 3$.

With $\rho = 3$, configurations become more interesting, and we think our qualitative discussion in the main paper supports this claim. Since we have ten values attributes, only a suite with $N < 10$ is reasonable, since we wanted to simplify the structure in our data. A complete coverage of all scenarios which have been coded with three attributes (254) yet requires more than nine concepts. We thus thought that some scenarios are too idiosyncratic to require coverage by our archetypes. We presumed that the non-covered scenarios represent extraordinary settings, which may warrant a separate analysis. With $N = 8$, the optimal joint size becomes 250 scenarios. If we go down to $N = 7$, we lose another two scenarios. This loss is arguably acceptable since one archetype for just two extra scenarios is still costly. If we apply the criterion that each additional archetype should raise the joint size by more than 2 scenarios, the best choice is $\rho = 3, N = 5$ with a joint size of 243 scenarios. With only $N = 4$, however, the joint size would be reduced by 5 more scenarios (only 94% of all scenarios with 3 coded attributes being covered).

We could have also requested a higher richness $\rho > 3$, which would admit even more detailed characterizations of the scenarios. Yet, Fig. 6 shows that coverage would decrease considerably. Already with $\rho = 4$, we cannot achieve a higher coverage than 74%, because only 190 scenarios where coded with four or more attributes. Even if we select the best eight concepts (which is a lot in light of the ten attributes), the coverage would only be 72% of all scenarios – more than 70 scenarios from the data would "escape" the analysis. With $\rho = 4, N = 5$, joint size is down to 176 scenarios (less than $3/4$ of the coverage with $\rho = 3, N = 5$). If we raise the bar for richness above four, more than half of the scenarios escape the analysis.

Thus, we choose $\rho = 3, N = 5$ as our main parameters. The unique optimal suite contains the concepts for which the intent is given in Table 2 of the main paper's results section. If the qualitative discussion in the paper would not have been able to support this (by agreement between the authors), we would have re-iterated the analysis with other parameters.

7 Validity checks

To scrutinise the validity of the identified value archetypes, we tested whether they also hold in a larger scenario dataset (cf. Piemontese et al., 2022). For this purpose, we used a pool of additional 203 scenarios derived from the IPBES review of grey literature and science-policy reports (Martin

configuration	coverage in peer-reviewed	coverage in full data
MAT - IND - INS	72%	52%
REG - SOC - INS	34%	27%
REG - IND - INS	43%	35%
REG - MAT - INS	52%	40%
NAT - SOC - INT	23%	21%
Total coverage	95%	70%
REG - INT - REL	8.7%	43%
Total coverage	95%	95%
	$(n = 254)$	$(n = 437)$

Table 2: Changes of archetype coverage in full data.

et al., 2022; Harmáčková et al., 2023; Yoshida et al., 2024). Since those scenarios stem from other kinds of sources than the 257 peer-reviewed papers studied above, they cannot be expected to be perfectly covered by the above archetypes. On the other hand, the strength of the five archetypes would be underpinned if they also represent a set of other studies, and if the relation between actors and values archetypes is similar. The validation procedure was identical to the above described archetype analysis, however, performed on a larger and more diverse sample of scenarios.

The full data with both peer-reviewed and grey literature contains 460 scenarios. Out of those, 437 are characterized by at least 3 value attributes. This is the maximum possible coverage (100%) of the archetypes. The frequency of individual attributes (peer-reviewed scenarios only / full data set) changes as follows: INS (97% / 67%), MAT (88% / 65%), IND (81% / 74%), REG (61% / 72%), SOC (53% / 41%), NMT (44% / 55%), NAT (39% / 47%), REL (26% / 58%), CUL (25% / 24%), INT (25% / 55%). The data on the grey literature scenarios might not be as high quality as on the peer-reviewed scenarios. Strictly speaking, we can't be sure in how far the changes in frequencies are due to another content, due to the lower quality of the data derived from the additional 203 scenarios, or due to the lower information value of some of the source documents (Yoshida et al., 2024).

Next, we determined the coverage of the five archetypes in the full data set (see Tab. 2). While the coverage of 70% is still sufficiently high and proves the quality of the identified suite of value archetypes, these results indicate that there seems to be more structure in the full scenario dataset (having in mind the previous considerations on data quality). The strongest change in coverage occurs for the first value archetype (MAT - IND - INS). Given that, in the original sample, the scenarios covered by this value archetype are primarily scenarios designed by academics, with much less contribution of other actors, it seems reasonable that this value archetype is less present in grey literature (which is primarily of non-academic origin). The only value archetype maintaining a roughly similar coverage in the original and the full dataset is the fifth archetype (NAT - SOC - INT).

In a further step, we inspected those scenarios in the full data set which are not covered by any of the five archetypes. Among those, we determined the most frequent configuration of three attributes (which is REG - INT - REL). This configuration focuses on relational and intrinsic values of nature, while particularly valuing regulating nature's contributions to people. This validation step thus revealed a candidate for another value archetype, emerging from the grey-literature scenarios, which is yet not much frequent in the peer-reviewed scenarios. If one adjoins the configuration as a sixth archetype, this gives an optimal suite for $(N, \rho) = (6, 3)$. The aggregate coverage of the suite of archetypes would then increase to 95% of the scenarios in the full dataset (see Tab. 1).

Finally, we computed the lift for the five archetypes and the actors for the full data, including

the possible sixth archetype (note that the lift of each archetypes/actor combination is independent from the other archetypes). We wanted to test whether our findings on surprisingly frequent scenario co-designers are robust for the larger data set. Experts again designed scenarios of the first to fourth archetype more frequently, with even more emphasis in the first value archetype (MAT - IND - INS). The diversity of involved actors tends to become broader (except for the first and fourth, but also for the fifth archetype). The sixth archetype is characterised by frequent "other" actors, which further indicates that several grey literature scenarios differ more deeply from the peer-reviewed ones.

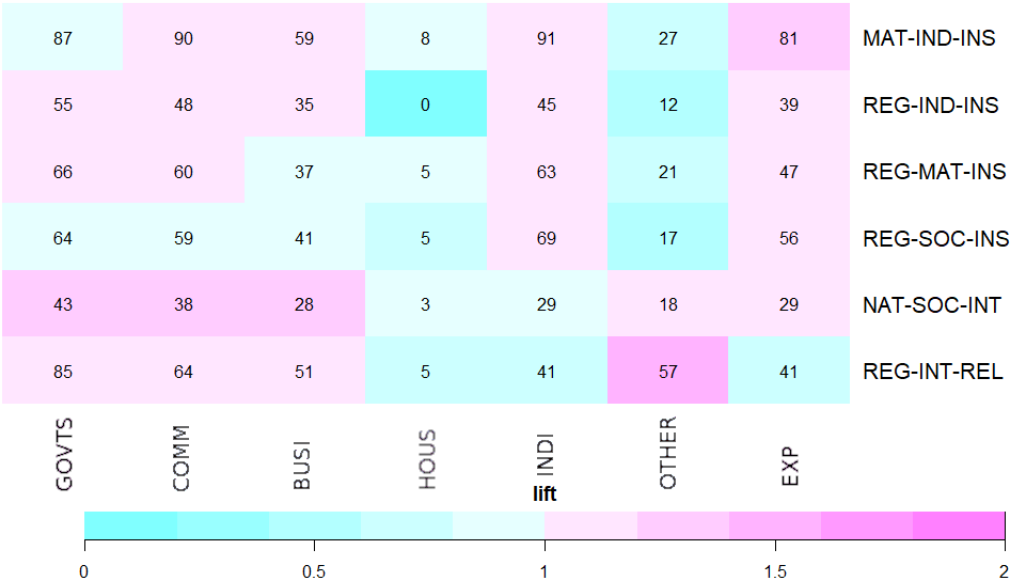

Figure 2: Co-occurrence of actors and archetypes. Numbers denote frequencies, and colour represents the lift (same colour code as in main paper).

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