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Nature as Culture: Conceptualizing What It Implies and Potential Ways to Capture the Paradigm in Scenario Building Exercises

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Background and Context

The nature futures framework (NFF) has been developed under the initiative of the IPBES task force on modelling and scenarios for biodiversity and ecosystem services. It brings together three values perspectives on the relationship between humans and nature, and can be used as a heuristic tool to guide scenario development towards positive futures for nature (Pereira et al. 2020). In brief, the framework indicates that nature can be viewed from an intrinsic, an instrumental and a cultural perspective — broadly understood as nature for nature, nature for society and nature as culture/One with Nature, respectively. Scenarios which are built from one perspective could differ significantly from scenarios built from the others. As the perspectives are not mutually exclusive and are often combined, scenarios will always be some mixture of the three (see Figure 1 on page 2 from IPBES 2022b).

The three values perspectives put forth by the Nature Futures Framework include:

Nature for Nature
Nature is seen as the non-human areas, parts and aspects of the environment. Nature is thus perceived as the vast wild areas of the environment, where nature's processes and dynamics are not influenced by humans. Indicators are biophysical, emphasizing the diversity of species, habitats, ecosystems and processes that form the natural world, and nature's ability to function autonomously.

Nature for Society
Nature is seen as an intricate ecological system that sustains all life on Earth, including human society. Nature is thus understood as a functioning life-support system, operating through ecosystems, that contributes to every part of human life. Indicators focus on aspects of nature that provide utilitarian benefits such as food, medicine, etc.

Nature as Culture (aka One with Nature)
Nature is seen as a fundamental, inseparable part of human life and society. Nature is thus understood as an interconnected web of all species on Earth, of which humans are only one part. It speaks to reciprocal and interdependent links between people and their environments.

Amongst the three value perspectives the Nature as Culture framework pertains heavily to the biocultural diversity discourse and is tightly linked to different types of relational values that people hold with nature. This could be in terms of sacred, aesthetic or educational values; or values linked to identity, sense of place and other cultural motifs. Given the

diverse perspectives that could be held across various scales of governance (local to international), this paradigm is highly contextual. It also informs how the perspectives of Nature for Nature and Nature for Society are operationalized — since depending on how different stakeholders relate to nature they ascribe different values that determines the way in which resources and ecosystems are exploited and conserved. Understanding the Nature as Culture perspective also helps us to see more clearly that the three perspectives are not mutually exclusive and each could be expressed in a more pronounced manner depending on context.

A clear conceptualization and unpacking of the Nature as Culture perspective is therefore required to design and implement policies and actions. This is based on a clearer understanding of the diversity of values underpinning this perspective and further to ensure that they resonate with motivations of different stakeholders towards conservation goals. Furthermore, the synchronicity (or lack thereof) of diverse values across different levels of implementation from the local to national and global depends on the design and envisioned future scenarios relating to nature futures (and human well-being) and potential pathways to attain them. Not all of these values can be measured, as they may be linked to more evocative or intangible relations between people and nature (e.g., totemic species, culturally important areas, etc.) even while some might be measurable (e.g., trade in commodities with cultural significance viz., foods linked to cultural identity). How these values and related indicators (to measure them) may be identified is another aspect that merits reflection.

In order to address inadequacies in bringing these multiple values perspectives in developing scenarios on natures futures and its modelling, the IPBES-9 Plenary (IPBES 9/14) mandated that these concepts be clarified and further understood through consultations and engagement with diverse stakeholders. In this context, this paper is a summary of findings from a review of relevant literature that examines nature–culture interconnections and how they play out in outcomes related to conservation and human well-being. Specifically, it seeks to highlight the various ways in which Nature as Culture is conceptualized and further, generalized. In addition, it aims to identify a short set of promising indicators that could be used for scenario modelling for nature futures work. In the process, it also seeks to identify potential areas of research to explore further in this field to ensure that the concept is more robustly embedded in plans to operationalize policy goals on sustainability, including biodiversity conservation.

Methodology for Data Collection

A literature review was conducted across peer reviewed journals and grey literature, especially of agencies, interest groups and NGOs that work with local communities on conservation and development goals. It examined literature across multiple

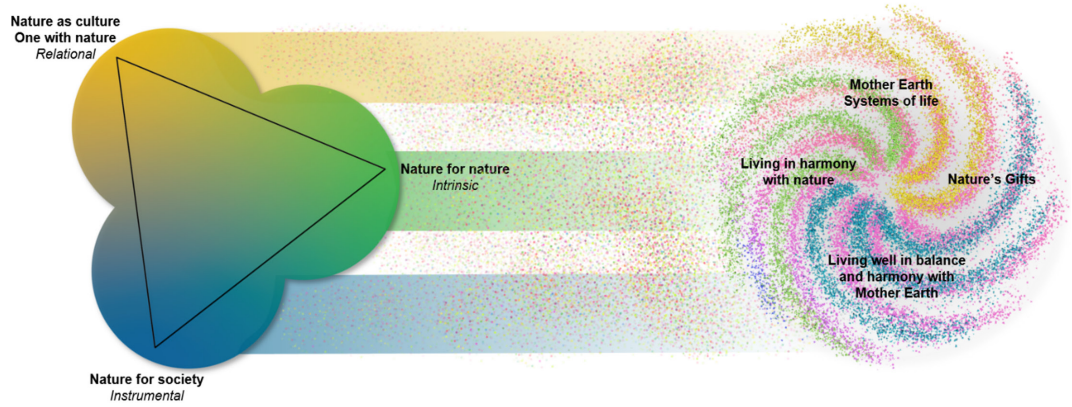

Figure 1. The nature futures framework presents three value perspectives of nature in a triangle. In the "nature for nature" perspective, people view nature as having intrinsic value, and value is placed on the diversity of species, habitats, ecosystems and processes that form the natural world, and on nature's ability to function autonomously. The "nature as culture/one with nature" perspective primarily highlights relational values of nature, where societies, cultures, traditions and faiths are intertwined with nature in shaping diverse biocultural landscapes. The "nature for society" perspective highlights the utilitarian benefits and instrumental values that nature provides to people and societies. The coloured circles associated with each value perspective blend together where they intersect, indicating that they are not mutually exclusive. According to other knowledge systems and world views, as portrayed in the right-hand part of the figure, human-nature relationships may be perceived in different ways. The examples in the right-hand part of the figure come from the IPBES conceptual framework but are not an exhaustive list of knowledge systems and world views. The bands and dots indicate that the right-hand part of the figure and the left-hand part of the figure are intimately related, but in complex ways that cannot be described in a one-to-one relationship. *Source: IPBES, 2022b https://ipbes.net/node/48281 accessed on 23 February 2023*

disciplines including resource economics, interdisciplinary studies, environmental policy, anthropological studies, ethnographic studies, indigenous studies among others. The following search terms were used to conduct a structured search of literature:

- Cultural ecosystem services
- Quantifying cultural ecosystem services
- Valuing cultural ecosystem services
- Cultural indicators in scenario building
- Cultural demand for natural resources
- Cultural markets, natural resource economics
- Cultural indicators in environmental management and planning
- Cultural bads and goods in resource conservation
- Totemic species and conservation
- National identity and natural resources
- Sustainability enablers and cultural resources
- Nature as Culture Scenarios
- Community wellbeing and resilience
- Biocultural diversity and indicators
- Relational values, identity, valuation

Values Relating to Human-Nature Interactions that Arise from Nature as Culture Paradigm

The Nature as Culture exposition arises in a social context — wherein a group of people linked through various identities relate to nature and different natural resources in specific ways. Informed by the worldviews they share and related beliefs, different communities, societies and peoples relate to nature in various ways giving rise to values that span the spectrum of intrinsic (respecting aspects of nature for what they are), instrumental (using nature and resources to meet various needs) and further, giving it personhood and spiritual attributes. Depending on the strength of the values held over a resource, how it is conserved and used is determined. Given the diversity of peoples and values that exist, mismatches between values attributed to resources and ecosystems occur and primacy is determined more through either a power hierarchy between stakeholders or through a process of deliberation (IPBES 2022; Duraiappah et al. 2014; Zafra-Calvo et al. 2020).

Such social values have been found to play a vital role in conservation (emotional, affective, spiritual and symbolic values) that go beyond cultural ecosystem services (Mattijssen et al. 2022; Bryce et al. 2016). These shared values can also be created through appropriate messaging that enables stakeholders to reflect on the consequences of their actions and how these may be modified (Mattijssen et al. 2022).

The following section highlights some of the dominant areas where we see a strong articulation of the linkages between nature and culture.

Anthropomorphism: Anthropomorphism denotes attributing human qualities to non-human aspects of nature. This is evident in narratives of animism, naturalism and totemism and is more commonly seen in non-western societies. This is considered highly relevant to nature and biodiversity conservation and is prevalent in several regions of the world (Root-Bernstein et al. 2013; Berkes 2017).

Cultural keystone (or important) species: These are culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine and/or spiritual practices, and could exist across all types of societies (indigenous peoples, local communities or any mainstream societies). These may overlap with ecological keystone species (Garibaldi and Turner 2004) or with other species (Reyes-Garcia et al. 2023). Identifying such species can help develop proxies that relate to social and ecological priorities.

Multifunctionality of ecosystems and resources: The concept of multifunctionality is relevant as it brings together the commodity and non-commodity outputs from a socio-ecological system and how they are produced (Mulazzani et al. 2019). Similar concepts of co-production and multiple benefits are also highlighted in the IPBES Global Assessment, Chapter 2 (2019) and the IPBES Values Assessment (2022), and in the broader literature on socio-ecological systems approaches (for instance, UNU-IAS and IGES 2015 2019; Saito et al. 2020). This can help to identify resources and ecosystems valued for various benefits, including cultural ones.

Articulation of territory, sense of place and identity: Landscapes that are nationally or regionally representative are intrinsically linked to mental and symbolic images of self and identity, and are expressed through what is referred to as "articulation of territory". This includes natural resources (rivers, mountains, etc.), human-made monuments and artefacts and social practices such as tourism (Sorlin S 2010; Winter 2007). In a similar vein, Nogue and Vincente (2004) highlight landscapes as a cultural translation of a society on a particular portion of nature, which includes material and intangible aspects. Landscapes and seascapes are thereby linked to a sense of territorial identity, and thereby hold promise to motivate people to engage in conservation or environmentally friendly activities. Ecosystems that are linked to such high sense of place and identity are also good proxies to be used in scenarios.

Capturing Various Dimensions of Nature as Culture

There are aspects of the nature–culture perspective that can be quantified (for instance, see Huynh LTM et al. 2022) and several that are qualitative in nature, and therefore require imaginative use of proxy variables. Highlighted below are some methodological approaches that show good promise for applicability in the work on indicators for nature–culture scenario development and modelling. These approaches are categorized into those related to the process of collecting data (in the task of research activities) and those related to indicators that help capture the status of, and changes to nature–culture linkages.

1. Methodological approaches (process): Several studies have resorted to the following processes to elicit information and data from across different social groups. These include:
    a. Participatory scenario building: This can be done to identify future scenarios for landscapes. For instance, landscapes could be viewed through the NFF lens (see Quintero-Uribe et al. 2022); backcasting participatory scenario building approaches can be used to examine transformations within socio-ecological systems (Aoki et al. 2020); identify research priorities through interviews of individual and focus groups discussions (Weeks and Adams 2018).
    b. Participatory mapping of use of resources for various purposes at multiple scales (Satterfield et al. 2013; Burkhard 2014; Beichler 2015; Wang et al. 2021).
    c. Surveys that include interviews of individuals (structured, semi-structured and open-ended), and focus group interviews/discussions.
    d. Meta analyses of relevant literature.
    e. Citizen science efforts, especially in undertaking socio-cultural valuation, although the purposes seem more oriented towards raising awareness among stakeholders about these nature-culture interlinkages (Mattijssen et al. ibid).

2. Methodological approaches (indicators): Several innovative attempts have been made to define appropriate indicators to capture the interconnections between nature and culture. Some of the ones that could be examined further for adaptation to suit the purposes of the project are highlighted below.
    a. Cultural Ecosystem services (CES) index: Here, an index of autochthonous livestock in Europe and their potential for value addition were examined to project value addition prospects and conservation status (Marsoner et al. 2018).
    b. Identification of cultural keystone species (Garibaldi and Turner 2004) and culturally important species (Reyes-Garcia 2023).
    c. Tardio and Pardo de Santayana (2008) construct an index of value of plants based on frequency of use and number of citations by survey respondents in Spain. They advocate the use of cultural importance index (CI) — a summation of the proportion of informants who mention each of the uses of the species.
    d. Social Values for Ecosystem Services (SolVES): a fully open-source, GIS-based tool designed to aid in the creation of quantitative, spatially explicit models of the nonmonetary values attributed to cultural ecosystem services (Sherrouse et al. 2022). Similar approaches have been taken by Villamagna et al (2014).
    e. Capturing subjective wellbeing (Bryce et al. 2016; Verschuuren et al. 2014) and socio-ecological resilience (Dunbar et al. 2012) using participatory, deliberative approaches to capture and facilitate community planning on socio-ecological resilience based on broad social and ecological indicators scored across community criteria across a scale.
    f. Quantifying local food self-sufficiency examining food flows from rural to urban and implications for sustainability (Schreiber et al. 2021). Kassman et al. (2003) examine the demand for cereal as a function of cultural fads and its implications for sustainability. Quantifying the cultural value of food appears to be a more common practice as flows and traceability and diversity of resources can be obtained from various documents including FAO statistics.
    g. Saghal et al. (2021), through a meta-analysis of the inclusion of food sovereignty into global food futures examine the cultural relations with food and how this needs to be factored in agricultural production planning.
    h. Gonçalves et al. (2021) demonstrate an indicator-based tool to operationalize the biocultural diversity framework in urban contexts deriving from the three conceptual layers (i.e., materialized, lived and stewardship).
    i. DeRoy et al. (2019) highlight through examples the nested nature of cultural values associated with environment and species at different levels of governance. Acknowledging the contextual nature of these values, they provide criteria to identify biocultural indicators for environmental management and monitoring.
    j. Identifying community cultural resources as enablers of sustainability: Chung and Lee (2019) highlight how buildings, landscapes and resources of cultural value can be actively fostered by communities and incorporated into urban planning.

The following tables highlight the salient details of various approaches that have attempted to quantify nature–culture linkages.

Table 1: Key Concepts, Approaches, and Indices Identified in Key Literature

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
1	Marsoner et al. (2018)	Cultural ecosystem services (CES) (i.e., "cultural heritage and identity"): key features include: non-substitutability, sociocultural significance (e.g., connections to rituals and traditions, human cultural identity), non-material values.	Ecosystem services (ES) framework (with a focus on CES, referring to Common International Classification of Ecosystem Services (CICES) — this framework enables the recognition of a variety of relevant services)	A **spatially explicit index** representing the breeds' contribution to cultural heritage and identity (i.e., an area-wide CES index) — to assess "potential sociocultural benefits" conferred by farm animal breeds in the European Alps.	Literature & existing database (e.g., data from national and int'l breeding associations, national Red Lists, DAD-IS hosted by FAO).
2	Schreiber et al. (2021)	"Foodshed" – two common definitions: 1) the actual geographic areas from which a population sources its food; and 2) the region surrounding a city with a certain potential to satisfy the population's food demands.	"Urban foodshed analysis" renders a quantitative approach for examining links between urban consumers and rural agricultural production by mapping food flow networks or estimating the potential for local food self-sufficiency (LFS). Three main foodshed types: 1) agricultural capacity; 2) food flow; and 3) hybrid (combining both approaches and studying dynamics between imports, exports, and LES).	Various indicators for foodshed analysis – e.g., capacity studies used different calculation approaches grouped into 3 categories: 1) self-sufficiency threshold (ST); 2) inverse self-sufficiency threshold (IST); and 3) foodshed size.	Capacity studies often used secondary data to calculate production and consumption. Due to a lack of spatially explicit household consumption data, capacity studies used 'actual diet' or 'theoretical diet' models, which follow dietary guidelines or scenarios, respectively. Tracing of food flows and mapping networks often used primary data or a mixture of primary and secondary data. The calculation approaches and data sources for hybrid studies are similar to capacity and flow studies.

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
3	Saghal et al (2021)	**Food sovereignty**: the right to direct and participatory democratic control over small- scale, largely autonomous, and relocalized agri-food systems based on: (1) sustainability; (2) social justice; (3) gender equity; and (4) respect for cultural diversity, nature, the value of food, and the peasant way of life. It is also the process that leads to fully realizing that right and vision of the future. A rallying cry for an alternative to economic globalization and the "food security" discourse.	A "**scenario** is a story with plausible cause and effect links that connects a future condition with the present, while illustrating key decisions, events, and consequences throughout the narrative." The **scenario-building process** can be expert led or participatory and inclusive. The **quantification step** allows participants to adjust and refine their story lines based on numerical feedback obtained using a computer model designed and validated to simulate how a system and its components behave based on some	In food futures studies, three main types of models are used: 1) **economic equilibrium models** (e.g., International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) — a partial equilibrium model (a detailed simulation of the agri-food sector, in which global food demand and supply are determined by trade and price.); 2) **biophysical models**; and 3) integrated models that combine models of different types, including climate models.	Expert knowledge, agricultural science, etc. Case studies and success stories of alternative agricultural practices as well as local and indigenous knowledge grounded in experience and cultural practices.

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
4	Garibaldi and Turner (2004)	"**Cultural keystone species**": the culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine, and/or spiritual practices. The main criterion for a cultural keystone species is its key role in defining cultural identity.	Cultural keystone species **vary over temporal, geographic, and social scales.** A **quantitative aid** is to assess the overall influence a particular species exerts within a culture, **an index based on its identified cultural influence**.	The different elements that must be considered when identifying a cultural keystone include the following: 1) intensity, type, and multiplicity of use; 2) naming and terminology in a language, including the use as seasonal or phenological indicators; 3) role in narratives, ceremonies, or symbolism; 4) persistence and memory of use in relationship to cultural change; 5) level of unique position in culture, e.g., it is difficult to replace with other available native species; and 6) extent to which it provides opportunities for resource acquisition from beyond the territory.	Using **a series of questions** associated with each of the six identified elements to extract a quantitative indicator of species "keystone-ness" The best test of all is to ask the people themselves which species they feel are key to their identity and survival.

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
5	DeRoy et al. (2019)	**Biocultural indicators** are rooted in local values and place-based relationships between nature and people. **Biocultural approaches** to Environmental management (EM) projects, and their indicator development, typically start with values important to local governments, communities, and stakeholders. **Biocultural approaches** to EM foster human well-being and ecosystem integrity at the subregional scale, both major components of modern EM and global sustainability goals. - Biocultural approaches to EM have promoted social-ecological resilience for thousands of years.	**A framework composed of criteria** helps distill **biocultural approaches** to indicator development that foster socio-cultural resilience and well-being, while also promoting ecosystem integrity and biodiversity protection. The criteria offer a means to communicate priorities between in situ and ex situ actors and outline how the process of indicator development can and should be locally led. The conceptual framework that these criteria create is offered to provide conceptual guidance while recognizing that processes will develop differently in different territories.	**Six generalizable criteria** that can guide resource stewards and agencies in selecting locally relevant indicators to implement biocultural EM and monitor the performance of outcomes: 1) Cultural saliency; 2) Supportive of place-based relationship; 3) Linked to human well-being, 4) Inclusive; 5) Sensitive to impacts; and 6) Perceptible.	Community input (e.g., surveys, interviews, and focus groups) – to identify the perceptions of local peoples. Other methods of monitoring change or impacts to sense of place (e.g., analytical tools and observational data to help identify, define, reinforce, and communicate the boundaries of finer scale culturally significant areas). Perceptions, with a focus on how they can monitor change over time as a function of proposed or tangible changes to the environment, can identify precautionary thresholds for sense of place, as well as other biocultural indicators, or inform management action in relation to longer term processes for which other data sources are lacking (e.g., climate change).

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
6	Tardio and Pardo de Santayana (2008)	"**Cultural importance**": "culturally important plants are those that are used by a large number of people for the same category of use," assuming the idea of cultural consensus for evaluating the importance of plants for people. **Culture**: a shared system of knowledge and competence among a group of people. A **culturally important plant**: a species desired, preferred, or with an affective evaluation by most members of this culture	The **cultural importance of a plant** depends on the number of informants who mention **its usefulness (FC)** and on the **number of uses (NU)**. The **cultural importance index (CI)** is strongly correlated with FC and, although it also considers the diversity of uses, each use-category is conveniently weighted. "**Quantitative ethnobotany**": the effort in improving the traditional compilation-style of ethnobotanical studies by incorporating quantitative research methods in data collection, processing, and interpretation of results. "**Total value**" to estimate the significance of plant species for humans: the sum of three values obtained along three different dimensions – 1) "**cultural value**" (obtained with free-listing interviews); 2) "**practical value**" (with observational data); and 3) "**economic value**" (taking into account the price of the ethnospecies).	**Cultural importance index (CI)**: the summation of the informants' proportions that mention each of the uses of the species. This additive index takes into account not only the **spread of the use** (number of informants) for each species, but also its versatility (i.e., the diversity of its uses). Another important property of the CI index is that each addend is a measure of the **relative importance** of each plant use.	The most popular indices are based on "**informant consensus**" (i.e., the degree of agreement among the various interviewees - founded on reasonable assumption that the greater the salience of a given plant or use in the community, the more likely it is to be mentioned) - more objective because they reduce researcher bias in the attribution of the relative importance of plants. CI = "cultural value" multiplicative index takes into consideration frequency of citation and versatility of the species. Indices based on **in-depth, semi-structured interviews** can be useful in analyzing passive knowledge (i.e., knowledge about the use certain species). - data obtained using in-depth, semi-structured interviews gather a greater proportion of informant knowledge than those involving free-list methods, which work better for present uses (active uses).

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
7	Chung and Lee (2019)	**Community-based cultural resources** as sustainable enablers: community members and organizations need to develop their capacities and properties (Skills, Knowledge, Resources, Power and influence) -- culture can be a powerful driver for development, with community-wide social, economic, and environmental impacts. **Cultural heritage**: previously confined to architectural and artistic masterpieces, but has expanded to include landscapes, vernacular constructions, intangible cultural resources, etc.	**Three models of culture's contribution to urban regeneration**: 1) Culture-Led Regeneration (Cultural activity is seen as the catalyst and engine of regeneration); 2) Cultural Regeneration (Cultural activity is fully integrated into an area strategy alongside other activities in the environmental, social, and economic sphere); and 3) Culture and Regeneration (Cultural activity is not fully integrated at the strategic development or master planning stage).	**Cultural properties** have evolved to include landscapes, industrial relics, local heritage, vernacular constructions, urban and rural settlements, and intangible elements such as temporary art performances and even ways of life.	**Field studies** of culture and regional regeneration (context, cultural properties, and community engagements.

ID	Authors & Year	Concepts/notions	Frameworks/approaches	Indicators	Data
8	Sherrouse et al. (2022)	Social values: nonmarket values perceived by stakeholders often corresponding to cultural ecosystem services (e.g., aesthetics, recreation).	A social-ecological approach to valuation: provides a more explicit accounting for the social value of various aspects of nature – a diversity of conflicting values that are grounded in a wide array of cultural experiences and research disciplines from religion and social psychology to indigenous knowledge and philosophy. Social Values for Ecosystem Services (SolVES): a custom toolbar to assess, map, and quantify the social values of ecosystem services – the relative intensity and spatial distribution of a social value are rendered by SolVES as a 10-point, value-index map derived from modeling the relationship between value and preference data collected from survey respondents and potentially explanatory environmental variables.	Information regarding perceived social values representing "magnitude of preferences" (one of the four concepts in a values typology – 1) a magnitude of preference, 2) a contribution to a goal, 3) individual priorities, and 4) relations), when elicited from the public in a spatially explicit format, can help provide a basis for robust modeling of the relationships between human valuation and the environmental factors with which values are associated, and would assist with addressing the growing demand that stakeholders be more engaged in environmental modeling.	PPGIS value and preference survey data (collected in formats including hardcopy surveys sent by mail, online desktop and mobile surveys, and visitor-intercept surveys). The environmental data: determined by the user and selected according to their judgement regarding specific environmental characteristics that potentially explain how the survey point data, and associated social values, are distributed across a study area. Social-value transfers: evaluated by consulting user-provided metadata for each model describing the environmental variables and the socio-economic and demographic composition of survey respondents (which facilitates the assessment of site similarities).
9	Reyes- Garcia et al. (2023)	Culturally important species. Assessing biocultural vulnerability.	Explores biocultural status of plant species across continents and socio cultural groups but does not establish causal links between biological and cultural threats.	Index developed using Culturally important plants. Biological conservation status of plants. Cultural status based on language vitality.	Culturally important plants from previous documentation and a survey. Biological conservation status of plants using IUCN List. Cultural status based on language vitality using Ethnologue.

Table 2: Applicability/Utility and Limitations of Each Methodology Identified or Proposed in Key Literature

ID	Authors & Year	Applicability and usefulness	Limitations
1	Marsoner et al. (2018)	Identification of critical areas of CES supply (e.g., potential regional hot/cold spots), potentials for economic initiatives (e.g., marketing and labelling unique agricultural products). Highlighting CES patterns across a region. Complemented by region-specific breeding and extinction history. Further research on the cultural value of each breed could help to determine the actual use (flow) and needs (demand) of CES of the breeds, and thereby assess the entire ES supply chain. The regions with low index values do not necessarily have a low potential for CES.	The index can only provide a good indication of the potential supply of the CES (rather than quantifying real supply). The actual benefits generated by the CES (resulting from a complex interplay of various drivers and causes) are not quantifiable without additional qualitative ES assessment. The cultural values associated with local breeds can vary from region to region and are strongly influenced by time and by changes in society and the living conditions of livestock holders, but this cannot be directly reflected. The focus on the breeds originated from the region does not necessarily indicate today's distribution of breeds. Differed perception of ESs by stakeholders cannot be expressed.
2	Schreiber et al. (2021)	The foodshed concept provides an interdisciplinary approach to investigate food systems by linking culture (food) with nature (shed) and therefore aspects of both people and place. Food shed analyses can highlight links between multiple production and consumption factors and the feasibility of LFS, while investigating city-specific scenarios linking multiple social and ecological sustainability issues (e.g., contribution of dietary changes). Foodshed analysis can also help in weighing the benefits and limitations of local versus global sourcing, while identifying and mapping existing interdependencies with regard to resource and food security. Hybrid approaches are particularly useful for assessing a region's embeddedness in physical, economic, and cultural systems on multiple scales.	Research priorities include: 1) how physical and social barriers interact in local food systems (most capacity studies neglected social preferences) – consideration of adequate processing, storage, and transportation infrastructure as well as the regionally prevailed economic incentive to source locally; and 2) how food flows are linked with other urban material flows and embodied resources (e.g., combining foodshed analysis with urban metabolism and circular economy). Data challenges in quantitative assessment of urban foodsheds include: 1) accounting for local socio-economic and cultural differences in food consumption; 2) need for temporal data on inter- and intra-annual food supply dynamics; 3) the need for primary data collection to compensate gaps in data-poor regions.

ID	Authors & Year	Applicability and usefulness	Limitations
3	Saghal et al (2021)	The "**reality check**": from models to narratives and from narratives to models The **heuristic function of scenario analysis** (a path for learning - the interaction between particular processes, the impact of certain decisions, the need for certain indicators), revealing and questioning our anticipatory assumptions. **Biophysical mode**l: 1) quantifies the import, export, and other uses of agri-food products; 2) calculates the maximum cultivable area in each region; and 3) estimates the difference between the actual per-hectare yield of each product in each region, and its potential maximum yield according to local agroclimatic conditions—avoid the focus on market prices and do not obscure the nonmarket side of agri-food systems; their model's **simplicity and transparency** make it highly usable by nonexperts in participatory exercises.	**Not all aspects of the qualitative narrative can be modeled.** Given that models are always simplified idealizations of interdependent complex systems, they each have strong limitations and represent only part of reality in a useful manner. **Economic equilibrium models**: 1) model opacity obstacle (readability by those with no technical expertise); 2) epistemic pluralism obstacle (different perspectives on the knowledge base for evidence used as input); 3) internalized bias obstacle (potential bias towards internal features – e.g., ever-increasing production powered by technological innovation); and 4) free-trade bias obstacle (trade within nations and at smaller scales is made invisible). These obstacles are normative and ultimately rely on divergent moral, political, and epistemic assumptions. **Biophysical model**: 1) invisible small holder obstacle (smallholders who cultivate areas less than two hectares are still invisible); 2) ecological and political scale obstacle (The political and spatial dimenions of food sovereignty are missing); and 3) incomplete transformation obstacle (many of the basic structures of the market capitalist economy remain unchallenged).
4	Garibaldi and Turner (2004)	**Four major contributions** of the cultural keystone model to conservation and restoration: 1) the concept of the cultural keystone species provides an opportunity to begin to reinforce and study the relationship of local communities to place (starting small and directing attention to a limited number of species will favor success); 2) the identification and analysis of cultural keystone species, both those that have experienced decline and those that have not, may provide a starting point for further analysis of environmental change and community resilience in the face of such change; 3) a better understanding of the interactions between keystone species and other species may be gained (cultural keystone species play more than one role, and often this role is supported and enabled by other nonkeystone species—this relationship is paramount to understanding the role of cultural keystone species in restoration); and 4) If we begin our conservation and restoration efforts by focusing on cultural keystone species, both social and ecological integrity may be enhanced.	**Three potential limiting factors** of the concept of cultural keystone species: 1) the ecological status of the keystone species may restrict suggestions for its future use (the substitution of a cultural keystone species may not always be possible because of the unique cultural niche the species fills); 2) even if a species is not officially listed as "threatened," it may be at risk from environmental change or habitat loss; and 3) an absolute quantification of the significance of a particular cultural keystone species (i.e., the identified cultural influence) is not possible.

ID	Authors & Year	Applicability and usefulness	Limitations
5	DeRoy et al. (2019)	A biocultural indicator that can satisfy all six of the criteria is **sense of place**. The evaluation of local peoples' perceptions can accurately assess the impacts that a given activity has on peoples' sense of place. Evaluating and respecting the perceptions of local people can be a method to prevent desecration of culturally salient spaces and place-based relationships and can provide an opportunity to strengthen relationships among communities, governments, and industry operators. The set of criteria may offer a tool to distill and communicate local priorities and promote stewardship outcomes that support biocultural resilience.	**Common barriers** for implementation include: 1) **urgency matters** (urgency increases as systems become more degraded, added urgency is to develop and implement biocultural indicators, which are underrepresented in sustainability indicators globally); 2) **different scales of time, space, and institutions matter**; 3) **resources available for monitoring**; and 4) **how many indicators** (fewer indicators that are highly inclusive and can capture the fundamental interactions may be more effective than many indicators with narrow scope—indicators with strong links to cascading effects should be given priority).
6	Tardio and Pardo de Santayana (2008)	The CI index is an efficient tool for highlighting those species with a high agreement for the culture of the whole survey area and so to recognize the shared knowledge of these people. The CI index also can be used to compare the plant knowledge among different cultures. The decomposition of the CI index in the components of each use-category also allows the analysis of the relative importance of plants in the different categories. The CI index can be employed to test statistically different hypotheses (e.g., the greater salience and usefulness of trees over shrubs and herbs).	
7	Chung and Lee (2019)	(No particular methodological discussion)	(No particular methodological discussion)

ID	Authors & Year	Applicability and usefulness	Limitations
8	Sherrouse et al. (2022)	Individual social-value maps can be generated for survey respondents as a whole or for specific survey subgroups (stakeholder groups) defined by any number of distinguishing characteristics. Social-value transfers: Social-value models developed for a primary study area can be transferred by SolVES to areas of similar biophysical and social context that lack their own survey data. The open-source environment of SolVES 4.0 expands the availability of SolVES to a broader user audience.	The collection of value and preference survey data through PPGIS is essential to the application of SolVES, but the ability to collect these data can be limited by costs and other resource constraints as well as institutional and cultural barriers. The methods used to collect these data vary and different survey implementation approaches have implications for results. It is important to consider early in the SolVES study design which environmental variables would potentially be the most useful for explaining the spatial distribution of social values given the specific biophysical context and if these data are available at an appropriate scale for the study area. If a social value transfer is anticipated, it is important to consider if the same or similar environmental data are available for any potential receiving sites. The primary consideration for social-value transfer is to assess whether a transfer is appropriate based on biophysical and social similarities between the study and receiving sites.
9	Reyes- Garcia et al. (2023)	Applicable at macro and socio-cultural scales Builds on existing datasets plus key stakeholder surveys	Does not capture causality of biological and cultural threats

Summary & Conclusions

Culture determines how we relate to both social and ecological aspects of the world around us. While ethnographic and anthropological studies have documented this causality, its relevance to conservation and sustainability-aligned behaviour has gained attention with less frequency. With various global assessments — the Global Biodiversity Outlook 5 (2019) and the IPBES Global Assessment (2019) — underlining the declining state of biodiversity and focusing on the underlying drivers to be addressed, a stronger emphasis on the human dimensions of conserving nature has emerged in policy thinking.

The recent Values Assessment (IPBES 2022) shows how the ways different stakeholders interact and perceive their relationships with nature are informed by the different worldviews that they hold; and intrinsic, instrumental or relational values of nature arise from the different socio-cultural, environmental and political contexts in which people live. That said, researchers have been, over the years, attempting to measure and capture this "bio-cultural" linkage (including the concept of Nature as Culture or One with Nature) in order to more representatively envision likely outcomes of production and consumption pathways that we might follow. Evidence from literature shows that conservation actions are more visible for species and ecosystems considered part of biocultural heritage, as it is linked directly to sense of identity and wellbeing. Furthermore, it is possible to leverage such perspectives to motivate and nudge people within a country or region to engage in economic activities that build on indigenous species and further, ensure that they are sustainably used. However, obtaining relevant information and data in this regard requires robust engagement with a diverse array of stakeholders (IPBES 2022).

Given the highly contextual nature of this connection, as seen above, indicators and data used tend to be localized, non-longitudinal and to a large extent qualitative and non-standardized. As a consequence of this review, however, some promising initiatives could be identified that could be adapted to develop plausible Nature as Culture Futures scenarios. The most adaptable ones are highlighted below.

1. Cultural Keystone Species (CKS) Index: Building on the keystone species concept, this index is developed based on a species' impact on a culture based on intensity, type and frequency of use; references to it in languages and its role in cultural activities and symbols; among other related variables (Garibaldi and Turner 2004; requires primary data).
2. Culturally Important Species Index: An adaptation of the CKS Index (Reyes-Garcia et al. 2023; requires secondary and primary data).
3. Cultural Ecosystem Services Index framework: This maps the contribution of indigenous livestock animal breeds across a wide area using data from multiple sources (Marsoner et al. 2018). It could be extended to other elements of nature (secondary data from databases can be adapted).
4. Foodsheds: This captures the capacity of a region to provide food self-sufficiency for a population and maps food flows dependent on consumer demand (Schreiber et al. 2021; requires primary survey data).
5. Food futures: Scenario building to determine possible food futures using biophysical models, partial equilibrium agri food demand and supply model or a combination of both, including participatory information such as case studies, expert knowledge and ILK (Saghal et al. 2021; this can build on secondary data and ground truth with primary surveys or participatory scenario building).
6. Cultural importance index: An index developed on the basis of number of uses of a plant and how many times its usefulness (frequency of use) is mentioned by informants. Total value is derived from a combination of primary information (cultural values and practical values) and secondary information (economic values) (Tardio and Pardo de Santayana 2008).
7. SoLVES (Social Values for Ecosystem Services): A value index map developed to capture the relative intensity and spatial distribution of a social value derived by modelling the relationship between value and preference data collected from survey respondents and potentially explanatory environmental variables (Sherrouse et al. 2022; requires primary data and user-provided metadata).

It is important to note that these approaches have more or less the same objectives of understanding and defining human–nature interconnections. They differ in the methods used to capture values and thereby, the potential cultural and conservation status of species in the future. The process of data collection clearly hinges on the need for ground-truthing, even if a significant amount of information can be collected from secondary sources (such as from consumer demand for indigenous species, seasonal demand for certain resources during festivals, ceremonies and the like, in addition to the population status of species). There remains insufficient uptake, and more methods are needed to incorporate a diverse range of resources (across connected ecosystems and species types and national borders — e.g., cultural values of migratory species or species that occur in multiple cultures). This research area requires greater attention, bringing together approaches that capture intrinsic, instrumental and relational values and enable a better understanding of the use of resources, their flows and potential measures to encourage sustainable practices.

REFERENCES

Aoki, K., Kishita, Y., Nakamura, H. & Masuda, T. 2020. "The Use of Backcasting to Promote Urban Transformation to Sustainability: The Case of Toyama City, Japan." In *Managing Socio-ecological Production Landscapes and Seascapes for Sustainable Communities in Asia*, ed. Saito, O., Subramanian, S. M., Hashimoto, S. & Takeuchi, K., 45–66. Springer: Singapore. https://link.springer.com/chapter/10.1007/978-981-15-1133-2_4.

Beichler, S.A. 2015. "Exploring the Link Between Supply and Demand of Cultural Ecosystem Services— Towards an Integrated Vulnerability Assessment." *International Journal of Biodiversity Science: Ecosystem Services and Management*, (11) 3: 250–263. https://www.tandfonline.com/doi/full/10.1080/21513732.2015.1059891.

Berkes, F. 2017. *Sacred Ecology*. New York: Routledge. https://doi.org/10.4324/9781315114644.

Burkhard, B., Kandziora, M., Hou, Y. & Muller, F. 2014. "Ecosystem Service Potentials, Flows and Demands-Concepts for Spatial Localisation, Indication and Quantification." *Landscape Online*, 34: 1–32. https://doi.org/10.3097/LO.201434.

Cassman, K.G., Dobermann, A., Walters, D.T. & Yang, H. 2003. "Meeting Cereal Demand While Protecting Natural Resources and Improving Environmental Quality." *Annual Review of Environment and Resources*, 28: 315–58. https://doi.org/10.1146/annurev.energy.28.040202.122858.

Chung, H. & Lee, J. 2019. "Community Cultural Resources as Sustainable Development Enablers: A Case Stud on Bukjeong Village in Korea Compared with Naoshima Island in Japan." *Sustainability*, (11) 5: 1401. https://doi.org/10.3390/su11051401.

DeRoy, B.C., Darimont, C.T., & Service, C.N. 2019. "Biocultural Indicators to Support Locally Led Environmental Management and Monitoring." *Ecology and Society*, (24) 4: 21. https://doi.org/10.5751/ES-11120-240421.

Dunbar, W., Subramanian, S.M., Matsumoto, I., Natori, Y. et al. 2020. "Lessons Learned from Application of the 'Indicators of Resilience in Socio-ecological Production Landscapes and Seascapes (SEPLS)' Under the Satoyama Initiative." In *Managing Socio-ecological Production Landscapes and Seascapes for Sustainable Communities in Asia*, ed. Saito, O., Subramanian, S. M., Hashimoto, S. & Takeuchi, K., 93–116. Springer: Singapore. https://doi.org/10.1007/978-981-15-1133-2_6.

Duraiappah, A. K., Asah, S.T., Brondizio, E. S. & Kosoy, N. et al. 2014. "Managing the Mismatches to Provide Ecosystem Services for Human Well-being: A Conceptual Framework for Understanding the New Commons." *Current Opinion in Environmental Sustainability*, 7: 94–100. https://doi.org/10.1016/j.cosust.2013.11.031.

Garibaldi, A. & Turner, N. 2004. "Cultural Keystone Species: Implications for Ecological Conservation and Restoration." *Ecology and Society*, (9) 3: 1. https://www.ecologyandsociety.org/vol9/iss3/art1/.

Harmackova, Z. V., Blattler, L., Aguiar, A. P. D., Danek, J. et al. 2022. "Linking Multiple Values of Nature with Future Impacts: Value-based Participatory Scenario Development for Landscape Management." *Sustainability Science*, 17: 849–864. https://doi.org/10.1007/s11625-021-00953-8.

Huynh, L. T. M., Gasparatos, A., Su, J., Lam, R. D. et al. 2022. "Linking the Non-Material Dimensions of Human-Nature Relations and Human Well-being through Cultural Ecosystem Services." *Science Advances*, (8) 31: 1–21. https://doi.org/10.1126/sciadv.abn8042.

IPBES. 2019. "Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." Díaz, S., Settele, J., Brondízio, E. S., Ngo, H. T. et al., ed. Bonn: IPBES Secretariat. https://doi.org/10.5281/zenodo.3553579.

IPBES. 2022. "Decision IPBES-9/1: Implementation of the Rolling Work Programme of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services up to 2030." https://ipbes.net/documents-by-category/Decisions.

IPBES. 2022.17 "Summary for Policymakers of the Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services." Pascual, U., Balvanera, P., Christie, M., Baptiste, B., et al., ed. Bonn: IPBES Secretariat. https://doi.org/10.5281/zenodo.6522392.

Irvine, K. N., O'Brien, L., Ravenscroft, N., Cooper, N. et al. 2016. "Ecosystem Services and the Idea of Shared Values." *Ecosystem Services*, 21: 184–193. https://doi.org/10.1016/j.ecoser.2016.07.001.

Marcenor, T., Vigl, L. E., Manck, F., Jaritz, G. et al. 2018. "Indigenous Livestock Breeds as Indicators for Cultural Ecosystem Services: A Spatial Analysis within the Alpine Space." *Ecological Indicators*, 94: 5–63. https://doi.org/10.1016/j.ecolind.2017.06.046.

Mattijssen, T. I. M., Ganzevoort, W., van den Born, R. J. G., Arts, B. J. M., et al. 2020. "Relational Values of Nature: Leverage Points for Nature Policy in Europe." *Ecosystems and People*, (16) 1: 402–410. https://doi.org/10.1080/26395916.2020.1848926.

Mulazzani, L., Camanzi, L., & Malorgio, G. 2019. "Multifunctionality in Fisheries and the Provision of Public Goods." *Ocean and Coastal Management*, 168: 31–62. https://doi.org/10.1016/j.ocecoaman.2018.10.037.

Nogué, J. & Vicente, J. 2004. "Landscape and National Identity in Catalonia." *Political Geography*, 23: 113–132. https://doi.org/10.1016/j.polgeo.2003.09.005.

Quintero-Uribe, L. C., Navarro, L. M., Pereira, H. M., & Fernandez, N. 2022. "Participatory Scenarios for Restoring European Landscapes Show a Plurality of Nature Values." *Ecography*, 4: eo6292. https://doi.org/10.1111/ecog.06292.

Root-Bernstein, M., Douglas, L., Smith, A. & Verissimo, D. 2013. "Anthropomorphized Species as Tools for Conservation: Utility Beyond Prosocial, Intelligent and Suffering Species." *Biodiversity Conservation*, 22: 1577–1589. https://doi.org/10.1007/s10531-013-0494-4.

Saghai, Y. 2021. "Subversive Future Seeks Like-Minded Model: On the Mismatch between Visions of Food Sovereignty Futures and Quantified Scenarios of Global Food Futures." *Ethics & International Affairs*, (35) 1: 51–67. https://doi.org/10.1017/S0892679421000071.

Saito, O., Subramanian, S. M., Hashimoto, S., Takeuchi, K., ed. 2020. *Managing Socio-ecological Production Landscapes and Seascapes for Sustainable Communities in Asia*. Singapore: Springer. https://doi.org/10.1007/978-981-15-1133-2.

Satterfield, T., Gregory, R., Klain, S., Roberts, M., et al. 2013. "Culture, Intangibles and Metrics in Environmental Management." *Journal of Environmental Management*, 117: 103–114. https://doi.org/10.1016/j.jenvman.2012.11.033.

Schreiber, K., Hickety, G. M., Metson, G. S., Robinson, B. E., et al. 2021. "Quantifying the Foodshed: A Systematic Review of Urban Food Flow and Local Food Self-Sufficiency Research." *Environmental Research Letters*, (16) 2. https://doi.org/10.1088/1748-9326/abad59.

Stahlhammer, S. & Thoren, H. 2019. "Three Perspectives on Relational Values." *Sustainability Science*, 14: 1201-1212. https://doi.org/10.1007/s11625-019-00718-4.

Tardío, J. & Pardo-de-Santayana, M. 2008. "A Comparative Analysis Based on the Useful Wild Plants of Southern Cantabria (Northern Spain)." *Economic Botany*, (62) 1: 24–39. https://doi.org/10.1007/s12231-007-9004-5.

UNU-IAS and IGES. 2015. *Satoyama Initiative Thematic Review Vol. 1. Enhancing Knowledge for Better Management of Socio-ecological Production Landscapes and Seascapes (SEPLS)*. Tokyo: United Nations University Institute for the Advanced Study of Sustainability. https://collections.unu.edu/eserv/UNU:3365/sitr1_sepls.pdf.

UNU-IAS and IGES. 2019. *Satoyama Initiative Thematic Review Vol. 5. Understanding the Multiple Values Associated with Sustainable Use in Socio-ecological Production Landscapes and Seascapes*. Tokyo: United Nations University Institute for the Advanced Study of Sustainability. https://collections.unu.edu/eserv/UNU:7506/SITR_vol5_fullset_web.pdf.

Verschuuren, B., Subramanian, S. M. & Hiemstra, W., ed. 2014. *Community Well-Being in Biocultural Landscapes: Are We Living Well?* Rugby, UK: Practical Action Publishing. https://www.researchgate.net/publication/261548180.

Villamagna, A. M., Mogollón, B., & Angermeier, P. L. 2014. "A Multi-indicator Framework for Mapping Cultural Ecosystem Services: The Case of Freshwater Recreational Fishing." *Ecological Indicators*, 45: 255–265. https://doi.org/10.1016/j.ecolind.2014.04.001.

Wang, Y., Hong, S., Wang, J., Lin, J. et al. 2021. "Complex Regional Telecoupling between People and Nature Revealed via Quantification of Trans-boundary Ecosystem Service Flows." *People and Nature*, (4) 1: 274–292. https://doi.org/10.1002/pan3.10298.

Weeks, R. & Adams, V.M. 2018. "Research Priorities for Conservation and Natural Resource Management in Oceania's Small-Island Developing States." *Conservation Biology*, (32) 1: 72–83. https://doi.org/10.1111/cobi.12964.

Winter, C. 2007. "The Intrinsic, Instrumental and Spiritual Values of Natural Area Visitors and the General Public: A Comparative Study." *Journal of Sustainable Tourism*, (15) 6: 599–614. https://doi.org/10.2167/jost686.0.

Zafra-Calvo, N., Balvanera, P. Pascual, U., Merçon, J., et al. 2020. "Plural Valuation of Nature for Equity and Sustainability: Insights from the Global South." *Global Environmental Change*, 63: 102115. https://doi.org/10.1016/j.gloenvcha.2020.102115.

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