Visions for nature and nature's contributions to people for the 21st century

Report from an IPBES visioning workshop held on 4-8 September 2017 in Auckland, New Zealand

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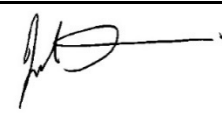
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Contents

Executive Summary

- Existing scenarios of biodiversity and ecosystem services (BES) have important limitations and gaps that constrain their usefulness for the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). Specifically, they fail to incorporate policy objectives related to nature conservation and social-ecological feedbacks, they do not address the linkages between biodiversity and ecosystem services, and they are typically relevant at only a particular spatial scale. In addition, nature and its benefits are treated as the consequence of human decisions, but are not at the centre of the analysis. To address these issues, **the IPBES Scenarios and Models Expert Group initiated the development of a set of Multiscale Scenarios for Nature Futures based on positive visions for human relationships with nature**.

- **The first step of this process was a visioning workshop with stakeholders and experts** on 4-8 September 2017 in Auckland, New Zealand**.** A total of 73 participants from inter-governmental organisations, national government organisations, non-governmental organisations, academia and the private sector, from 31 countries, and with a range of sectoral expertise on biodiversity topics, from urban development to agriculture to fisheries, worked together in a visioning exercise. This report documents the results from this visioning workshop to inform further stakeholder consultation and the development of the associated multiscale scenarios by modelers and experts.

- **This creative visioning exercise was carried out in four steps based on a suite of participatory methods that were used to develop visions of alternative futures (Figure 1)**. First the participants identified important themes to develop the visions. Next, thematic groups identified the main trends for BES in each theme and a set of "Seeds" of emerging initiatives leading to positive futures for our relationship with nature. Implications of what would happen across a range of sectors were identified for each seed. Then a pathway analysis of how the current regime in each theme may be transformed into the future desirable regime was carried out. Narratives were then built for the visions emerging from each group. Finally, commonalities of visions across the groups were identified, and the regional relevance of each vision for different parts of the world was assessed.
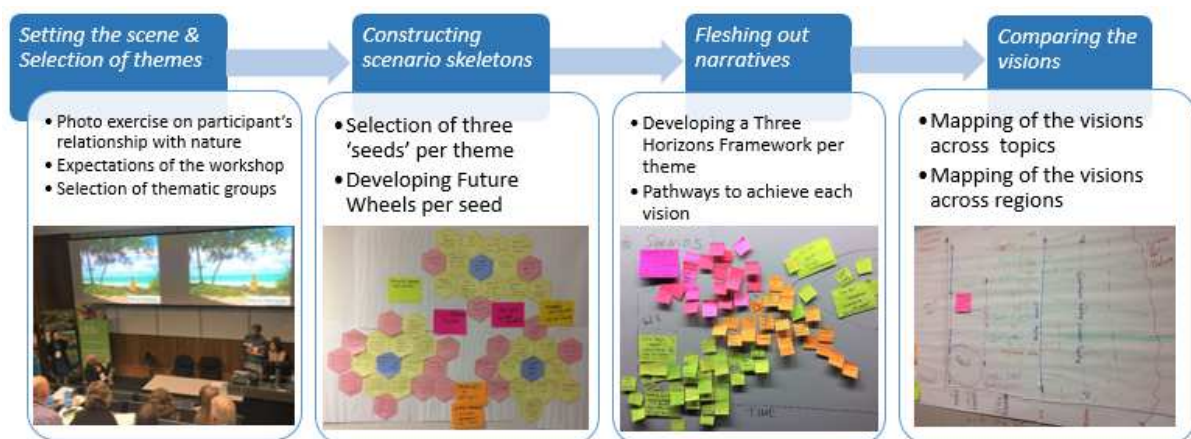
Figure 1. Steps in the development of the stakeholder visions

- Seven thematic groups emerged, with most groups developing a single vision. The visions were the following (Figure 2):

  - **Nature-based Inclusive Prosperity:** A healthy world, where wealth and wellbeing is accessed fairly and natural resources sustain richly diverse cultures, societies and nature into the future. This would be achieved through a recharacterisation of gross domestic product (GDP) "growth" to ensure it is connected to well-being and nature;

international resource use taxation schemes which incentivise sustainable resource use; in-country development plans with ecological objectives and institutional mechanisms which support community-based economies and natural resource management.

○ **Sustainable Food Systems:** a world without hunger based on a combination of sustainable supply chains between producers, traders, transporters and retailers, grounded on biodiversity-based food production at landscape and seascape levels, and supported by reciprocal agreements for sharing benefits, i.e., water and genetic materials.

○ **ReFooding and ReWilding the Urban Rural Flows:** a world where urban and rural dwellers reconnect with nature, reconcile their interests and assist each other in improving quality of life in the cities and valuing the countryside. Enhanced urban rural flows is achieved by improving governance systems and a locally-contingent mix of ReFooding, i.e., localized ecosystem service flows in cultural landscapes, and ReWilding, i.e., high-tech and global solutions to free up space for nature in the countryside and the cities.

○ **Healthy Social-Ecological Freshwater Systems:** a world where rivers are awarded legal rights as living systems, water use and extraction are done efficiently at the micro-scale in a circular economy paradigm with no waste-water, and a shift occurs from hydroelectric to other renewable energy systems, also at the micro-scale and decentralised.

○ **A Tasty World with Values:** a world where human-nature relations are based on reciprocity, harmony and relationality supported by educational systems infused by these values; food is predominantly produced in bio-culturally diverse and autonomous local food systems, strong cultural institutions ensure respectful sharing among diverse knowledge systems and governance systems share universal recognition of local small producers and indigenous peoples' sovereignty over territories, resources and knowledge.

○ **Dancing with Nature:** a world in which nature is given space to thrive. Nature is connected and changing at multiple scales. Dancing with Nature requires dynamic people, infrastructure, and civilizations. In this world, human societies build, live and work to accommodate and benefit from natural fluctuations, while using technology to enable people and nature to adapt to the challenges of the Anthropocene.

○ **Healthy Oceans, Happy Communities:** a world where the oceans and coasts are full of life, ecosystem services are sustained through the adoption of long-term sustainability strategies by governments and businesses (+500-year strategies) and the high-seas are closed to fishing. Local communities are involved in the sustainable management of coastal zones, and new technologies are developed to feed populations who also change their diets to decrease impacts on oceans.

In our groups, we identified 3 SEEDS

that can contribute to our thematic area

SEEDS exist now but are marginal – not widespread or well known

EXAMPLES:

- Successful rewilding initiatives
- farmers creating network with consumers
- structuring agriculture so it's attractive to farmers
- 3D acquaculture
- 4D printing
- fossil fuel free future
- Car sharing

FOOD PRODUCTION

- Biodiversity based food production at agro/ecosystem landscape & seascape level
- Accessible, equitable & reciprocal agreements for water
- Sustainable supply chain...

URBAN RURAL FLOWS

AGENDA ✓ Biodiversity

- Rethinking governance & societal systems
- connecting with nature through rethinking food systems
- COMMUNITY GARDEN
- LOCAL FOOD PRODUCTION
- Rewilding countrysides & bringing nature into cities

NATIONAL / LOCAL / GLOBAL / PROSPERITY

- Community based natural resource management
- country development plans – eco objective
- Displacing "GDP growth" as goal

NATURES DYNAMICS

- Engineered Nature
- Space & time for nature
- Dancing with nature on an evolutionary stage

WATER

- Rivers recognised as living systems
- LEGAL
- Cyclical micro water management systems are pervasive
- No Fossil Fuels or hydro

Figure 2. The three seeds for each thematic group (Source: Dave Leigh, Emphasise Ltd.; Mary Brake, Reflection Graphics; Pepper Lindgren-Streicher, Pepper Curry Design). Groups correspond to the following visions: Food Production = Sustainable Food Systems, Urban Rural Flows = ReWilding and ReFooding the Urban Rural Flows, Prosperity = Nature based Inclusive Prosperity, Nature Dynamics = Dancing with Nature, Water = Healthy Social-Ecological Freshwater Systems, Marine = Healthy Oceans, Happy Communities, Culture = A Tasty World with Values.

- Common themes on **preferences for the future of our relationship with nature** emerged across the visions. Some visions emphasize the **indirect and intangible benefits** of biodiversity, such as in *ReWilding the Urban Rural Flows*, *Dancing with Nature*, and *A Tasty World with Values*, while others emphasize the **direct uses of nature**, such as in the *ReFooding* and *Sustainable Food Systems*. **Localisation of ecosystem service flows** and the development of multifunctional landscapes is an important component of *ReFooding the Urban Rural Flows*, *Healthy Social-Ecological Freshwater Ecosystems*, *A Tasty World with Values*, and *Nature-based Inclusive Prosperit*y, while others emphasize the **management of global ecosystem service flows** or the segregation of spatial uses of ecosystems, such as *ReWilding the Urban Rural Flows*, *Dancing with Nature*, and *Healthy Oceans, Happy Communities*. Other themes emerging from a cross-cutting analysis include the **appreciation of specific elements of biodiversity** or a more **holistic appreciation of biodiversity**, varying degrees of the use of **technology to improve nature benefits**, and varying **intensities of nature management**. Shared themes across multiple visions include green infrastructure, a circular economy, context-dependent learning to inform environmental governance, and the equalisation and reduction of humanity's global footprint. Several visions, e.g., *A Tasty World with Values*, require a societal paradigm shift and significant changes in values.

- **These visions differ conceptually from traditional scenarios** that are used in environmental management, with the emphasis on nature and nature's benefits to people, and in visioning solely positive futures. These visions also allow for the inclusion of **dynamic processes and**

feedbacks between humans and nature that are missing in current scenarios, e.g., **changes in socio-cultural values and changes in practices** and concrete strategies for how such changes would come about, inclusion of qualitative values e.g., sense of place, **distribution of stakeholders' preferences**, teleconnections, and the **complexity of biodiversity change** (including aspects such as invasive and endemic species, and spatial scale).

● The visions identified in the workshop do not represent all possible positive future visions; rather, this workshop was just the first step in a 4-year process of developing Multiscale Scenarios for Nature Futures. This process involves iterative cycles of **visioning**, **stakeholder consultation**, and **modelling** (Figure 3). The current set of visions needs now to be consolidated, eventually into a smaller set of visions, through **global, regional and local consultations** during 2018. We envision using **fora such as meetings related to the Convention on Biological Diversity, the Future Earth Network, the Natural Capital Coalition**, **the High-level Political Forum on Sustainable Development** among others to refine the visions and develop the scenarios. Modelling groups and expert teams will then develop scenarios for each of the visions, that will lead to a new round of storyline development and visioning. It is likely that gaps in visions (i.e., alternative futures that were not identified at the Auckland workshop) will be identified and additional visions will be incorporated into further iterations of the Multiscale Scenarios for Nature Futures. The IPBES expert group on scenarios and models will guide this process up to the end of 2019, when its mandate ends. Scenario development will then continue under the leadership of a consortium of institutes, that will be duly initiated.
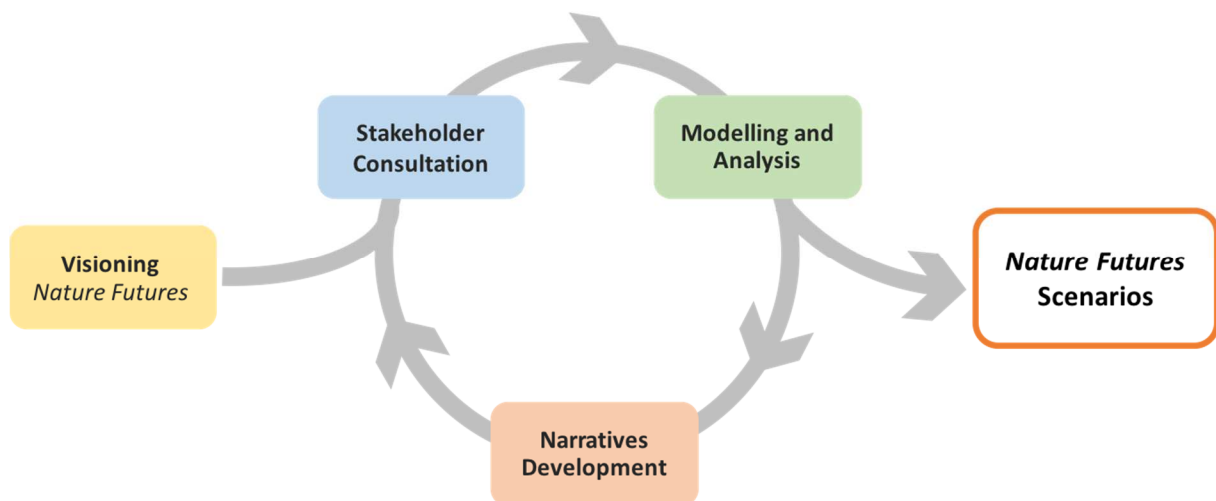
Figure 3. Iterative process for Nature Futures Scenarios development.

● **The process of iterating multiscale scenarios for nature futures requires substantial ongoing efforts and funding, and capacity building** both within and aligned with the IPBES Work Programme. The development of the multiscale scenarios for nature futures needs to **link both to ongoing work on both global scenarios** connected to IPCC and UNEP GEO processes and to **business and government scenarios**, as well as inform the increasing number of local, national and regional social-ecological scenarios. Further efforts will be made to engage and coordinate with diverse platforms already involved in local/regional participatory scenarios development. One funding call of direct relevance to this work, the BiodiveERsA/Belmont Forum call, has been put forward and will provide substantial support toward developing Nature Futures scenarios. However, the geographic limitations of this call suggest that other funding opportunities are required to fulfil the regional geographic representation called for by the Multiscale Scenarios for Nature Futures, and to better coordinate the rapid growth in national and regional scenario approaches.

1. Introduction

The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) was established in 2012 to serve a role linking the science and knowledge about nature and nature's benefits to people with policy and decision-making. IPBES is a science policy interface that provides governments and stakeholders with policy relevant information on the status and trends of biodiversity, ecosystems, and its contributions to people. IPBES produces global, regional and thematic assessments, provides methodological guides and tools to support policy decisions, and promotes coordinated research on nature and its benefits to societies around the globe.

The first IPBES methodological assessment, approved and released in 2016, reviewed "Policy support tools and methodologies for scenario analysis and modelling of biodiversity and ecosystem services" (IPBES 2016). This assessment addressed the development and interpretation of scenarios and models to perform assessments of biodiversity and ecosystem services, and for incorporating biodiversity and ecosystem services into policy and decision-making. Following the release of the IPBES methodological assessment on scenarios and models, Phase 2 of the IPBES Scenarios and Models Expert Group was initiated in October 2016 at a workshop held in Leipzig, Germany, to identify short-, medium- and long-term activities in regard to the use of scenarios in IPBES.

To date, most scenarios for global environmental assessments have explored impacts of society on nature, such as biodiversity loss, but have poorly explored the role of nature and related policies in socioeconomic development (Pereira et al. 2010). Most prior scenarios have failed to incorporate policy objectives related to nature conservation, social-ecological feedbacks, or the linkages between biodiversity and ecosystem services. Often, nature and its benefits were treated as the consequence of human decisions, but were not at the centre of the analysis. Scenarios to date are also typically relevant at only a specific spatial scale of analysis, and are unable to capture the cross-scale, dynamic and teleconnected characteristics of drivers of change to nature and nature's contributions to people. Furthermore, targets for human development derived from other sources are increasingly connected with targets for nature, such as in the 2030 Sustainable Development Goals. Scenarios thus need to be developed that better incorporate the role of nature in sustainable futures, and that explore interactions between nature and nature's benefits to people with societal drivers and connections to human wellbeing, enhancing linkages between nature and global governance targets. The next generation of scenarios should explore alternative pathways to reach these intertwined targets, including potential synergies and trade-offs between nature conservation and other development goals.

An important activity identified in the Leipzig workshop was for IPBES to develop global scenarios for biodiversity, noting the broad success of scenario approaches in international policy for the IPCC (Intergovernmental Panel on Climate Change) and following on from the Millennium Ecosystem Assessment. Scenarios are recognised as powerful tools to envision how nature might respond to different pathways of future human development and policy choices (Rosa et al. 2017). The new global biodiversity scenarios will enable a standard approach to assessing changes in nature's benefits to people over time for local, regional and global assessments, and facilitate coordination between nations and regions in reversing degradation of nature and declines in nature's benefits to people. Furthermore, the IPBES scenarios will inform global and regional IPBES assessments that synthesize information on the state of the planet's biodiversity, its ecosystems, and the essential services they provide to society and to support policy formulation to prevent further declines.

To address these issues, the IPBES Scenarios and Models Expert Group has initiated the development of a set of Multiscale Scenarios for Nature Futures based on positive visions for human relationships with nature. These new scenarios are part of a dual strategy which also includes, in the short-term, extension of existing global socio-economic scenarios developed by the IPCC community for BES (Rosa

et al. 2017), a task which is simultaneously being progressed by the IPBES Scenarios and Models Expert Group. The new IPBES scenarios represent a radical departure from previous scenarios examples. The new IPBES scenarios and modelling framework will shift traditional ways of forecasting impacts of society on nature to more integrative, nature-centred visions and pathways for the future of nature that are relevant for conservation policies and practice. They will explore alternative policies and management practices underpinned by diverse value systems, supported by improved use of scenarios and models, to better support decision-making in nature conservation and sustainable development. Importantly, they will integrate the social-ecological feedback loops across drivers, biodiversity, ecosystems, ecosystem services, and human wellbeing, and incorporate multiple systems of knowledge.

The objective of the developing a new set of Multiscale Scenarios for Nature Futures was not to replicate or adapt prior scenario initiatives to better suit BES. Rather a new approach was required, and an explicit decision was made by the expert group to restrict the develop of future visions to positive futures for BES, focussing on ways forward rather than emphasising existing negative trends in BES, and current barriers in science and policy that limit effective BES decision-making. Including only positive futures supports the visioning of different pathways toward these positive visions that may not be apparent when visions are limited to typically idealised scenarios across a spectrum of positive and negative futures, interspersed by scenarios replicating business as usual. Visioning of multiple future scenarios also allows reflection instead on a range of pathways toward better futures for BES that can be locally and regionally adapted based on socio-cultural values, governance systems, and local and regional aspects of biodiversity and resource utilisation. Multiple positive futures reflect that there is not solely one positive vision for nature; rather there are multiple pathways to incorporate the role of nature in sustainable futures.

Recognising the need for co-development of these multiscale biodiversity scenarios, the IPBES Scenarios and Models Expert Group organised the first global stakeholder workshop on visioning futures for biodiversity and ecosystem services, held on 4-8 September 2017 in Auckland, New Zealand. The workshop brought together a wide range of stakeholders, working across local, regional and global scales, including representatives of the scientific community, international institutions, governments, the private sector, indigenous and local communities and non-governmental organisations. The stakeholder visioning exercise conducted during the workshop aimed to lay the foundations for the development of new scenarios, specifically tailored to the objectives of IPBES (Kok et al. 2016). Stakeholders at the workshop contributed to discussions and identified alternative positive visions for the future of nature and nature's contributions to people, under different biodiversity management approaches.

This visioning workshop initiated the development of the next generation of scenarios by exploring alternative visions to reach intertwined global targets, including synergies and trade-offs between nature conservation and other development goals such as the United Nations Sustainable Development Goals, and interaction across nature, nature's contributions to people, and human well-being. Three key questions were addressed: 1) What visions (may be multiple) exist on nature (biodiversity) and nature's contributions to people (ecosystem services)?; 2) What future 'positive' scenarios can be built based on these multiple visions?; and 3) What is required to inform decision makers in order for them to address potential changes in biodiversity and ecosystem services (BES)? Using participatory approaches based on a suite of creative visioning techniques (i.e., an adapted Mānoa Mash-up method (Pereira et al. In Press)), an array of diverse visions emerged from the workshop that were initially clustered into seven visions. These visions will be further iterated into a suite of Nature Futures Scenarios by the Expert Working Group to allow them to be used in quantitative modelling to support future global and regional IPBES assessments. Ultimately, these scenarios will support the future assessments of IPBES by providing an integrative and scientifically plausible outlook on nature and society.

This report documents the methods and results of the visioning workshop. It discusses how these visions differ from existing scenarios and lessons learned from the process. Finally, it proposes a plan to develop the multiscale scenarios associated with the visions through further stakeholder consultation, use of models and expert knowledge, and refinement of narratives in an iterative process integrating multiple knowledge systems. To further catalyse the use of scenarios and models in the assessment of the status of biodiversity and ecosystem services, IPBES could mobilise scientific communities to align their activities in support of Nature Futures scenario development and to orchestrate a long-term research agenda.

2. Methodological approach

2.1 Participant selection

The participants in the workshop were selected to represent a diversity of views on nature and nature's contributions to people, and to obtain a broad set of visions, to ensure legitimacy of the process. See for more details on the selection process Appendix A.

A total of 73 participants from governmental organisations, non-governmental organisations, academia and the private sector, indigenous and local communities, from 31 countries, and with a range of sectoral expertise on biodiversity topics, from agriculture to fisheries, worked together in this visioning exercise.

2.2 Workshop process

The workshop used an approach developed by researchers in the Seeds of the Good Anthropocene Project (Bennett et al. 2016, Pereira et al. In Press) which was designed to develop bottom-up divergent visions of the future. This method included a suite of scenario building tools and techniques, adapted from the Mānoa Mash-up scenario building approach (Pereira et al. In Press). The Mānoa Mash-up scenario building approach is a combination of the original Mānoa method for building scenarios (Schultz 2015) and the Three Horizons Framework method which investigates transitions between current states and future visions (Sharpe et al. 2016). The approach was selected with the intention of creating a transformative space in which participants can think creatively and 'outside of the box' to create inspired and powerful set of visions, grounded in existing 'Seeds'. Seeds are innovative initiatives, practices and ideas that are present in the world today, but are not currently widespread or dominant (see Bennett et al. 2016). Figure 4 gives an overview of the steps taken in the development of the stakeholder visions, while Appendix A provides detailed description of the workshop methodology.
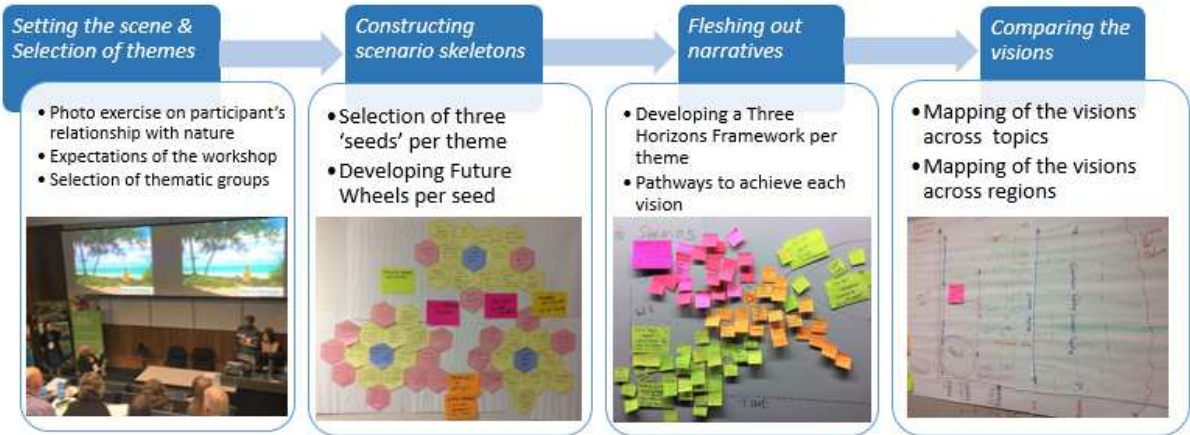
Figure 4. Steps in the development of the stakeholder visions.

The aim of the *first phase* of the workshop was to set the scene and organize participants into thematic groups. A few breakout group sessions were conducted during which several themes that should be captured in future biodiversity and ecosystem services scenarios emerged. Following discussions in Plenary, the participants agreed on thematic groups and self-organized into the groups for the remainder of the workshop.

During the *second phase* of the workshop, participants started with the construction of scenario skeletons. Each thematic group had a discussion on and selected three existing initiatives ('Seeds') that they believe are positive and would contribute to a better future that addresses the trends in their respective themes (Bennett et al. 2016; Pereira et al. 2017). Thematic groups shared these 'Seeds' in plenary sessions, presenting each as a newspaper headline that illustrated the key principles underpinning each Seed (Figure 5). Using each seed as a starting point, participants built 'Future Wheels' (Glenn 2009) which provided the basis for the scenarios (Figure 6).

Figure 5. Graphic illustration of newspaper headline for Seeds for each thematic group.

Figure 6. An example of the future wheels developed for the three seeds of Group 7 on Healthy Oceans, Happy Communities.

In the *third phase* of the workshop, participants worked on fleshing out the narratives and exploring possible pathways to achieving the visions, through developing a Three Horizons Framework (Figure 7). This graphical approach allowed participants to explore changes in issues over time and to identify what is required to transition from the current world to their vision for the future.

Figure 7. An example of the Three Horizons Framework developed by Group 7 on Healthy Oceans, Happy Communities.

During the *last phase* of the workshop, participants re-organized themselves into different groups in order to 1) map the visions across topics (Figure 8) and 2) test the visions across regions. The first exercise helped to identify the commonalities and differences between the visions. During the second exercise, the groups identified potential challenges and opportunities for the visions within their region, reflecting on how existing positive actions for biodiversity, infrastructure or other social, political or economic actors specific to a region might facilitate (or provide barriers to) the implementation of particular visions (Section 3.4.2).

Figure 8. Graphic illustration of final phase of the workshop where participants compared visions.

2.3 Visualisations of process and results through cartoons and other artwork

Developing a creative process was a central focus of the visioning process, as the imagination has an important role to play in developing more visions to which people feel connected and that allow for more radical transformations (Milkoriet 2017; Merrie et al. 2017). Three graphic illustrators were asked to attend the workshop to visualise the process and the outcomes of the workshop, and a dancer was brought in to help each of the groups animate the presentation of their visions at the end of the workshop (Figures 9-11). The artists followed the discussions of the groups throughout the entire week and produced visualisations during each step of the process, which helped the thematic groups to communicate with each other. The visualisations will also assist in translating and communicating the results of the workshop to other stakeholders during subsequent stakeholder consultations. The dancer could interact with each of the groups and help them to bring their visions to life, thereby sharpening the description of the future visions that they had articulated throughout the week. Visualisation tools will also be important as an interface to support future processes of stakeholder engagement in the further development of these visions within local to regional stakeholder workshops.

Figure 9. Graphic illustrators creating visualisations of the Nature Futures development process.
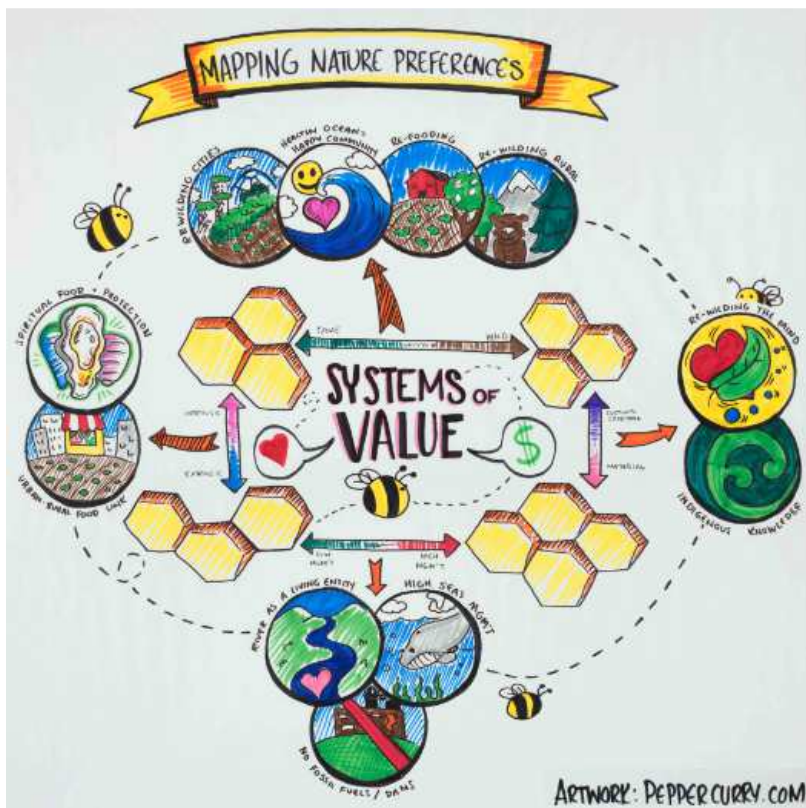
Figure 10. Visualisations of Systems of Values.
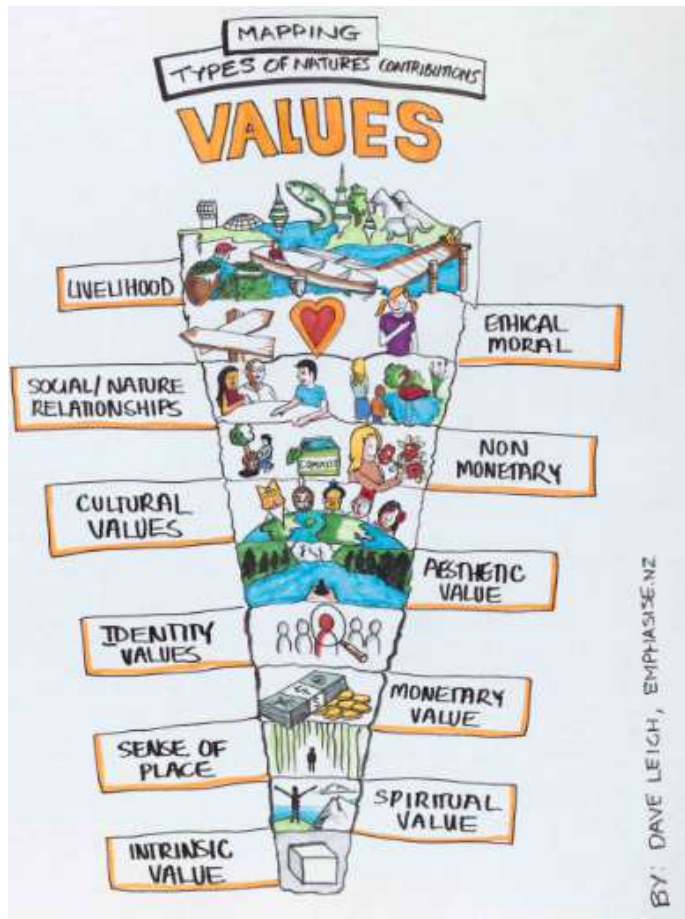
Figure 11. Graphic illustration of potential values associated with Nature's contributions to people, used to assist in developing positive future visions for nature.

3. Results
3.1 Overall: selection of participants and workshop approach

The methodological selection of participants resulted in a broad representation of regions (Africa, North America, Latin America and the Caribbean, Asia, Europe and Central Asia, Oceania); professional sectors (governmental and international institutions, interest groups and non-governmental organisations, private sector, scientific community); gender; and age (See Figure 12).
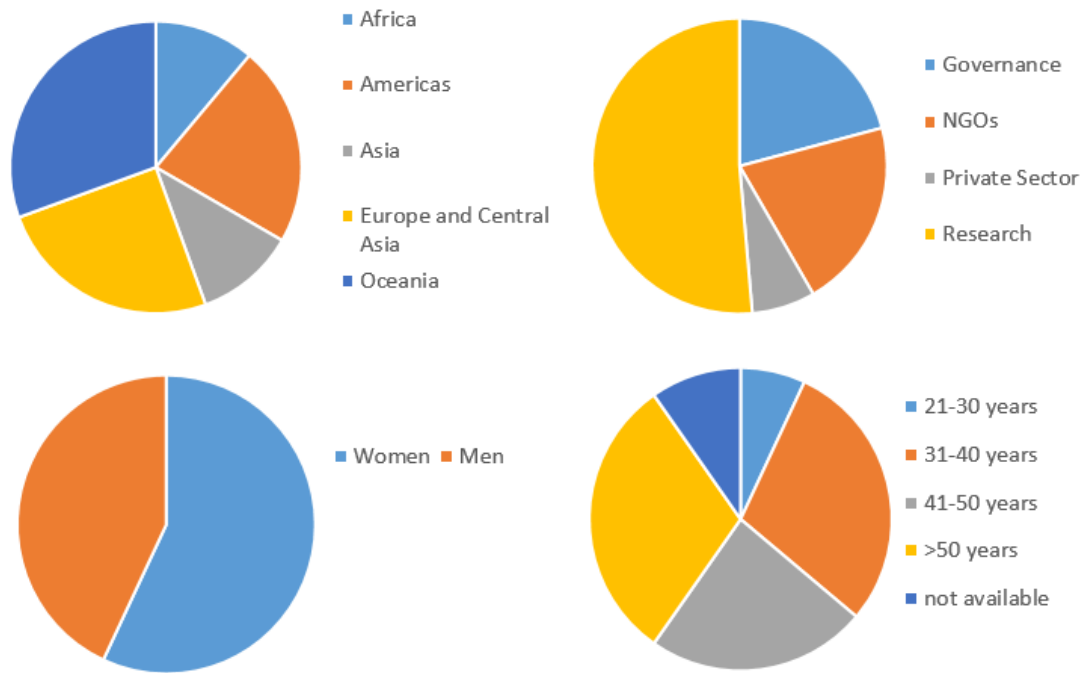
Figure 12. Distribution of participants that attended the IPBES participatory scenario development workshop by region, sector, gender and age.

3.2 Theme selection

To assist in the selection of thematic groups within which future visions were developed at the workshop, participants were randomly divided into breakout groups that discussed the following questions: 1) What are your expectations of the workshop? and 2) What experience have you had with working with scenarios and models?

Workshop expectations were diverse, with most participants expressing ambitious expectations for the development of a new generation of scenarios, or at least a first step in the development of these new scenarios. Participants also highlighted key elements that new scenarios should include, such as: scenarios that capture both nature and nature's benefit to people (and ecosystem services); scenario analysis frameworks that not only work at different scale but link the different scales; scenarios that capture all 'well-beings' – social, cultural, economic and environmental; scenarios that can be co-developed and integrated with traditional knowledge and community level activities; and scenarios that account for uncertainty. The need for common visions for nature's values was discussed in most breakout sessions, providing a scenario analysis framework that can support proactive management of nature–people relationships, and creating visions that catalyse and empower everyday people. Participation in both development of scenarios and capacity building to support their use and understanding by all groups, including governments, industry, indigenous groups and local communities, was highlighted as a required element for success of new IPBES scenarios. Coordination with other existing scenario initiatives (e.g., IPCC) and funding initiatives (e.g., the BiodivERsA/Belmont Forum Scenarios call), and alignment with Sustainable Development Goals (SDGs) were also within participant expectations. In general, participants were enthusiastic. They hoped to learn from the collective experience in the room, and facilitate development of ideas of pathways for the future work of the IPBES Scenarios and Models Expert Group and other regional, national and local scenario initiatives.

Participants came with a range of backgrounds and past experiences with scenarios and models in environmental management. Participants shared a suite of techniques that individual participants had utilized in environmental assessment (e.g., risk assessment, facilitating discussion of policy options, connecting monitoring data to assessment, allocation of funding for monitoring and research, future impact assessment). While some participants had minimal experience with scenarios and models, others identified processes or methods with which they had been involved, or were familiar with (e.g., "Futures Literacy Labs", State of future index (SOFI), 40+ futures research methods - millennium-project.org, CBA modelling, Climate change models (RCPs, SSPs)). Many participants also reflected on their experiences with scenarios and models, highlighting perceptions of limited stakeholder participation in global and regional processes, though participation was often perceived as successful for local processes.

A 'World Café' session was then conducted to assist in the identification of themes that were used to identify thematic groups for the remainder of the workshop. Potential themes were summarised from breakout sessions and presented in the plenary. Extensive discussion followed the initial presentation of potential themes, with some participants preferring thematic groups aligned with SDGs, or following themes of existing scenario processes, or based on sectors or resource uses. A further plenary session was allocated to facilitate consensus-building on the selection of thematic groups, as these were deemed to be critical to the process of developing nature visions. Discussions around the novelty of the new scenarios resulted in eventual agreement to not use thematic groups based on prior structures or processes to avoid reinforcing existing divisions between sectors or disciplines; rather themes were selected that were broadly applicable across sectors and disciplines. There was broad overlap of participants who wished to attend a thematic group focussing on qualitative, non-consumptive, 'more than human' values, and those interested in an indigenous/cultural thematic group. The participants initially combined these groups, with the option to split them later in the workshop. The final seven thematic groups emerged covering a diversity of topics relevant to BES, and were attended by 7-12 participants. The thematic groups and the topics that facilitated their selection were (See also Figure 13):

- *Group 1: Nature-based Inclusive Prosperity* (political natures, justice, poverty eradication and development, re-characterising economic systems and wellbeing).

- *Group 2: Sustainable Food Systems* (Food-Energy-Water nexus, resource flows, teleconnections, sustainable production and consumption, forests and agriculture, fisheries).

- *Group 3: Urban Rural Flows* (blurring urban-rural divide, making cities more liveable by adding value to rural areas).

- *Group 4: Healthy Social-Ecological Freshwater Systems* (wetlands, watersheds, transboundary).

- *Group 5: A Tasty World with Values* (cultural/spiritual natures (forests, mountains, deserts) and 'more than human' natures).

- *Group 6: Dancing with Nature* (change and surprise, uncertainty, biodiversity dynamics).

- *Group 7: Healthy Oceans, Happy Communities* (local-regional-global connections and continuities with respect to oceans).
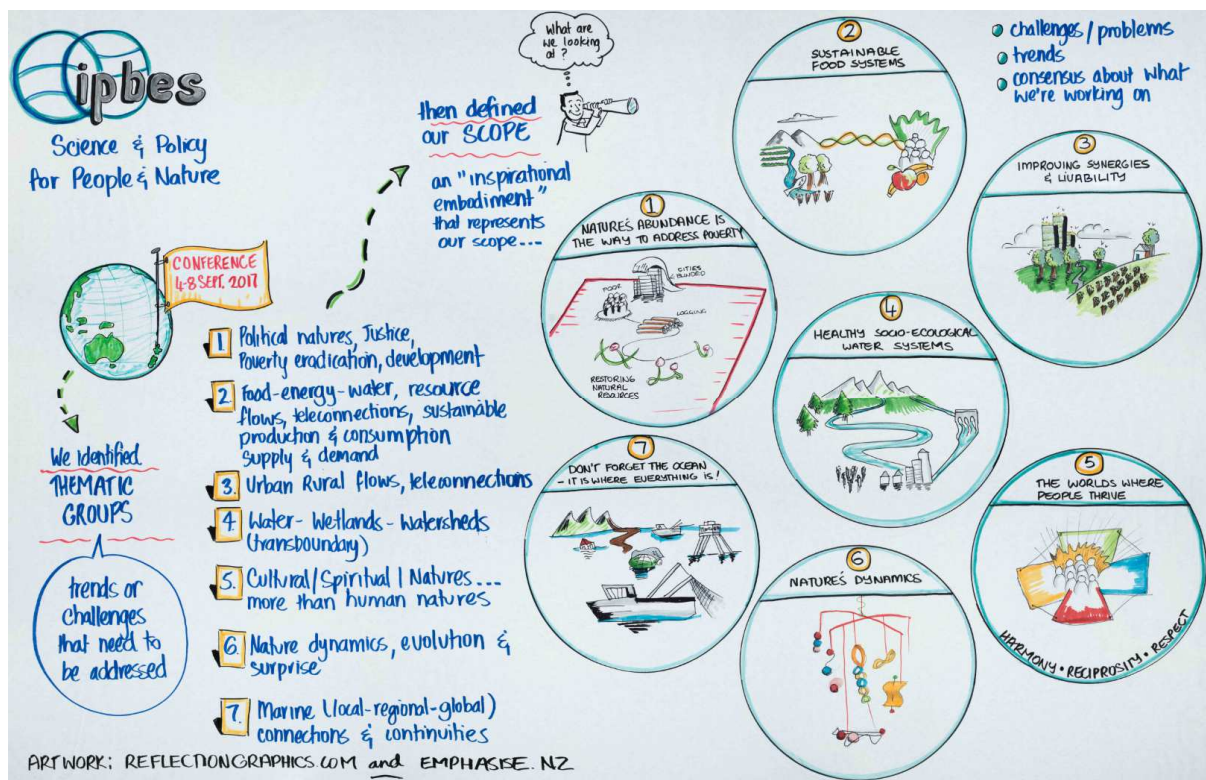
Figure 13. Example cartoon: Visualisation of themes (Source: Dave Leigh, Emphasis; Mary Brake, Reflection Graphics; Pepper Lindgren-Streicher, Pepper Curry Design).

3.3 Narratives per theme

This section synthesizes the visions emerging in each theme, by describing what the word looks like in each vision, how the vision can be reached, and what are the key tensions that exist during the transition to achieve the vision. Appendix B provides further detail on the narratives.

3.3.1 Group 1 - Nature-Based Inclusive Prosperity

What does the world look like?

Nature-based inclusive prosperity is based on three main components or seeds. The first component envisions a global network of self-governing and self-sustaining community-based economies with an equitable (in terms of nature, gender, religion, race, age or cultural group) approach to sustainable natural resource use and management. The second component comprises national and regional development plans with key ecological objectives that complement local economic activities, sustains and supports the wellbeing of all sectors of society and contributes to reducing inequalities. Development plans would be underpinned by national systems of natural resource use taxation, associated BES monitoring and assessment systems, environmental education, public awareness programs and participatory planning. The foundations for these developments are framed within a global agreement to replace the "GDP growth" goal with new paradigms for the wellbeing of people and nature, including placing the rights of nature at the centre of the international legal system (along with other universal and inalienable rights). Mechanisms to support this paradigm shift include biodiversity, quality of life and natural resource use metrics as measures of GDP, as well as an international natural resource consumption taxation system that redistributes funds to a common international funding pool to alleviate poverty, support environmental management, and provide venture capital for sustainable technological innovation. Education and awareness building are central to implementing the vision.

How did we get there, and Tensions (transition zone)?

One of the biggest system changes to realize this vision was the establishment of a global governance system in charge of a global taxation system based on a consumption metric, which now transfers monetary wealth from high consumer countries to others, and a considerable budget is also allocated to nature. Usage of fossil fuel and broad lobbyism are banned. Support for these changes are taxations based on used resources, pollution and owned land. Systems of Environmental-Economic Accounting have been extended to capture good quality of life, prosperity and sustainability. They are supported by monitoring systems. These schemes are multi-level to support national development plans and balanced national budgets reallocating budgets, e.g., from military to nature conservation. Some budget is also allocated for reward systems for good corporate business practices. Essential to facilitate and maintain the change is free education, including new curricula, awareness raising and a thorough understanding of nature's contributions to people, from global to local scale and in all languages. Education as well as decision making is based on strong scientific evidence, but also with evidence from other knowledge systems, which is for example synthesized by participatory scenario and modelling approaches to help identify impacts of different resource uses. Respective university curricula are building capacity to support the major changes, with major degrees in: community based natural resource management, national development plans with ecological objectives, and new global paradigms. These capacities are also needed to work towards a fine-scale and timely global environmental performance and monitoring system that produces data for strategic participatory planning on the local level.

3.3.2 Group 2 - Sustainable Food Systems
What does the world look like?

The world of the Sustainable Food Systems theme has several components. Sustainable supply chains provide long term agreements between producers, traders, transporters, and retailers, and support the implementation of sustainable practices (by training and transferring knowledge and technical innovations), balance prices, and help to stabilise the income of rural communities. Biodiversity-based food production occurs at agro-ecosystem, landscape and seascape levels. Accessible reciprocal agreements for water and other ecosystem services are also key elements of this vision.

Sustainable food production includes efficient use and management of resources and inputs. This is enabled through production of highly diverse food sources in landscapes and seascapes. Clean technologies and energy will allow for a low ecological footprint, and enhanced liveability of rural areas (alongside sustainable cities and communities). There will be zero hunger and reduced inequalities. Nature is the foundation ensuring an optimal delivery of ecosystem services and goods (including maintenance and use of genetic diversity and clean and sufficient water). Land used for production and resource extraction is planned and managed sustainably within a landscape matrix that equally supports nature and biodiversity.

Incentives for sustainable farming/food production and innovations support transition from the current state to these sustainable food systems. Inclusive and effective governance in all settings (local, national, international) will open debates over resource use to wider social, environmental (value of nature), and ethical interests. Education/training, public (consumer) awareness programs (environmental, ecological and nutrition consciousness) as well as technical support plans and protocols for the production of food, will lay the foundations for pathways of change associated with nature and nature's contribution to people at local, regional and global scales. Food production can only be sustainable if it provides decent employment conditions to those who practice it, in an economically and physically safe and healthy environment.

How did we get there?

The Sustainable Food Systems vision emerged from a combination of driving forces. A combination of consumers' awareness (healthy, diverse and sustainably produced food), producers' awareness, and regulations (including production protocols) is driving more informed choices. Environmental education at all levels (with teaching on local food diversity, school gardens, with biodiversity and ecosystem services in university textbooks) helps to connect people to nature again. In addition, there is a high awareness of the importance of both species and genetic diversity for health, nutrition and food security. Dietary guidelines aiming at healthy diets based on local biodiversity, traditional knowledge and cultural differences adds a stronger perspective on environmentally-friendly diets and fostered healthy eating habits and lifestyles.

Technological innovations, co-developed with producers, individually and within communities in cooperation with researchers and industry are available in order to find best ways to use ecosystem services from nature, and to use local biodiversity and to develop other technologies respectful of nature. Research output directly contributes to production. High-tech and traditional agro-technologies are applied to the agro-food system to maximize ecosystem services. Economies acknowledge the economic values of nature to deliver benefits to people. This includes nature's environmental functions but also social features (job creation) and cultural cohesion. Consumer awareness (through education) combined with track and tracing systems of environmental and social features of food helps consumers to make informed choices. Transparency between producers and consumers is introduced through a self-evaluation of food production management and practices, rather than third party accounting.

Governmental institutions and private sectors are ecologically literate and consider the positive or negative impacts of decisions on biodiversity and ecosystem services carefully. Changes along the food chain, from producers to consumers significantly contributes to reduction of food waste. Collaborative governance across scales (locally based, globally oriented) supports ecological efficiency of global trade and development of strong cross-boundary regulations that support nature and wellbeing.

Tensions (transition zone)

 "Agents of change" such as consumers could induce firms/producers to produce more sustainable and healthy, nutritious food. Information provided to consumers about sustainable and healthy food products is limited. New flows of information through social media (Twitter, cloud-based applications, QR-codes etc.) could provide a more detailed picture for consumers. However, knowledge is lacking about how such new flows of information could be used. In the envisioned future, governments, international institutions and the private sector are trying to fill this gap efficiently.

Traditional linear knowledge transfer dominates most knowledge systems. In particular, small producers are often under-serviced by formal advisory services. Innovative resource-efficient production and diversification knowledge can be exchanged through decentralized networks (farmer-field schools, Trainer-to-Trainer programmes) with a range of actors involved across varying geographical distances. Small producers play an important role in the rural area, providing employment, maintaining landscapes and nature, and preserving both traditions and traditional products. They also offer opportunities for new entrants to engage in farm/production business development opportunities. By utilising the state funding allocated to advisory services for small-scale producers primarily, important opportunities for innovation can be created. Improved access to finance (especially for women) plays an important role in longer term sustainable, resource-efficient food production and security.

A major shift in farm/production policy, practice and trade is needed if a growing world population is to be fed without overexploiting scarce natural resources and further damaging the environment. Prices that reflect the scarcity of natural resources as well as the environmental impact of farming can contribute to greater efficiency. Economically and environmentally harmful subsidies should be

phased out. The polluter pays principle needs to be enforced through charges and regulations. Incentives should be provided for maintaining biodiversity and environmental services. Internalizing environmental costs and getting the price right is necessary to reach and maintain sustainable food production systems and consumption.

3.3.3 Group 3 - ReWilding and ReFooding Urban Rural Flows

What does the world look like?

The ReWilding and ReFooding Urban Rural Flows (URF) vision is all about making cities more liveable by adding value to rural areas. This implies blurring of rural-urban boundaries by reinforcing rural-urban synergies (e.g., interdependence, stewardship) and reducing conflicts (e.g., waste, water). This nature future is sustained by BES and is achieved by three elements: 1) reconnecting to nature through enhanced food systems (*ReFooding*); 2) reconnecting to nature by bringing nature back to cities and ReWilding the countryside (*ReWilding*); and 3) reconnecting to nature through improved Governance (*ReGoverning*). ReFooding includes innovative market arrangements (e.g., online platforms) and social enterprises promoting greater community socialisation through food (food markets/swaps), and adding value to food by sharing food knowledge (eating according to the season, locally sourced food). This creates multiple use landscapes, including foodscapes, that safeguard biodiversity (e.g., creation of seed banks). Society appreciates this "tamed" nature which stimulates innovative entrepreneurship across urban-rural landscapes and localized ES flows (e.g., closing the nitrogen cycle at the landscape scale). ReWilding is based on high tech driven solutions to free up space for nature in cities (e.g., green architecture), while supporting rewilding the countryside initiatives (large areas for nature). In these landscapes, the flow of ES tends to be globalized and new values are entrenched in the society that adapts to live hand in hand with "wild" nature. ReGoverning makes the "orchestration" of this URF vision. ReGoverning involves innovative policy and planning mechanisms that can reinvent peri-urban landscapes also stimulating benchmarking of municipalities according to their performance on nature based solutions. The balance of ReWilding/ReFooding/ReGoverning will depend on the context and different mixes apply according to the specificity of regions/continents. In this future, there are strong connections between the local, national and global scales. Cross scale coordination is very critical as the local implementation of initiatives need support at higher level (e.g., taxation).

How did we get there?

At the local scale, there is the need for encouraging and supporting a diversity of rural livelihoods, that go well beyond agriculture alone to include arts, theatre, tourism, and other home-based employment activities. This will also create a network of diverse urban and rural institutions (private and social enterprises, NGOs, local governments) working together and strengthening each other. This reinforces and reinvents cultural identities and a new urban rural stewardship. At the national scale, there is the need to integrate urban-rural landscapes and lively peri-urban zones promoting food sharing and knowledge (economic platforms) across cities and rural areas. There is also the need for supporting initiatives to allocate land for rewilding (tax policies) and incorporating biodiversity into national planning (e.g., avoided costs of flood mitigation). There is the need to develop and implement city food networks and encourage innovative trade relations (e.g., countries will need to negotiate the potential decreases in trade in certain exotic types of food). This will imply trans-border cooperation and a high-level commitment to rewilding (e.g., by COPs Conference of the Parties). Multi scale dialogues and coordination across municipalities, districts and states/governments shelter the initiatives that give better access to nature, spread food knowledge and, at the same time, value the intrinsic value of nature in its utility form (ReFooding) and non-utility values (ReWilding). These innovative governance values are mainstreamed both by innovative ecological accountability and focus on social enterprises. This delivers forest and biodiversity recovery that are sponsored by Payment for Ecosystem Services and tourism related activities (e.g., ecotourism, cultural tourism).

3.3.4 Group 4 - Healthy Social-Ecological Freshwater Systems

What does the world look like?

This freshwater thematic group is framed by an overarching vision of Healthy Social-ecological Freshwater Systems across the globe. It recognizes the dependency of humanity on freshwater as arguably our most limiting natural resource and provisioning ecosystem service essential to all human endeavour. In this world rivers would be accorded legal rights as *living systems*; socio-cultural connections would be re-established and the decision-making regarding resource use and management carried out locally by all catchment stakeholders in dedicated catchment management fora. Water extraction and use would be micro-scale, optimally efficient and recycled i.e., all return flows would be in as, or better quality, than prior to abstraction, as part of an overarching circular economy paradigm, with pollution treated at source or prevented, by the polluter. As such there would be no such thing as polluted 'wastewater' and freshwater biodiversity and productivity of, for example, local fisheries, would be actively restored. Further, in recognising the interdependency of our energy and water systems and needs, this world also encompasses an interconnected rapid shift to micro-scale renewable energy systems and complete phase-out of all fossil fuel based energy, as well as hydropower due to its disruption of free-flowing river systems. With a rapidly urbanizing humanity, this world recognizes emerging and created (e.g., artificial wetlands) novel ecosystems in urbanizing environments, including urban agriculture, and the complete redesign via 'green infrastructure' of 'green cities', and active enhancement of the role of urbanised areas in biodiversity protection and ecosystem connectivity. The 'greening' of cities plays a major role in enhancing human health, wellbeing and livelihoods in this world.

How did we get there?

The shift came about largely through community-driven demand for decentralized, local control over resources, the demand for recognition and restoration of the socio-cultural role of rivers as living systems and the snowballing effect of the global fossil fuel divestment campaign to combat climate change. Overall a social demand promoted more equitable, local development options which combined economic prosperity (as opposed to wealth accumulation) with environmental stewardship and restoration and without environmental degradation. With the impacts of climate change on water resources in particular ever more apparent, and the failure of numerous large impoundments, with devastating consequences, and the inability or unwillingness of central governments to curtail massive, wasteful demand and rampant pollution of water sources, communities and local governments at municipal and city levels took increasing control of resources, especially in terms of catchment management and restoration, and complete redesign of cities to be both 'water catchments' in their own right, catching and storing all rainfall over the city, as well as far more efficient in use of water and allowing zero contamination without treatment and restoration. Combined with such city re-design was energy source and efficiencies, making cities self-sufficient in energy generation from renewables, primarily solar, with 'smart' micro-grids enabling shifting of energy supply in response to demands across the urban landscapes. All local-scale water and energy adaptations are within a circular economy framework, of local control, local use, efficiencies, system enhancement and zero waste. Alternative production systems incentivised in an increasingly urbanised world included urban agriculture, vertical food gardens, 'dry agriculture' (drought resistance, pest resistance, etc.) and desalinisation (using solar energy) as a complementary freshwater source to compensate for reducing unsustainable demand from land and groundwater sources.

Tensions (transition zone)

Major tensions in transition from today encompass collapse of top-down, centralised policy-making and governance to more decentralised, local empowerment for decision-making around alternative, local development options. In particular, recognising whole river ecosystem integrity through a legal persona of an 'entity', of the function of water flows (i.e., the ecological function of free-flowing water and changing water flows that is disrupted by impoundments and/or excessive abstraction, e.g.,

changing perennial rivers to seasonal), system connectivity, affected species, rights of both community (human users) and water bodies themselves in terms of water quality and quantity, and the impacts of human water demand. An additional requirement is for rehabilitation of already degraded freshwater systems, including their catchments, whilst considering the ongoing need for agricultural production and other human uses but with far greater emphasis on efficiencies of water use, and non-polluting return-flows. The decommissioning of large dams, whilst controversial, was made easier by their increasing failure, with devastating consequences, due to increasingly extreme climate events.

The need to plan for future water management, encompassing whole catchments, which prioritise protecting the 'ecological infrastructure', providing water quantity and quality over its exploitation, led to tensions over resource ownership and relevant policy. This meant phasing out completely today's mega-infrastructure, demand-driven 'solutions' with the move to decentralised supply-side management focusing on local-scale solutions. Massive, wasteful irrigation systems and hydropower and other dams, for example, needed to be dismantled. Solutions included focusing on restoration of whole catchment landscapes (ecological infrastructures) and rivers' natural flows which co-evolved with these landscapes, including engineering artificial enhancements such as creating artificial wetlands to improve water quality and attenuate flooding from extreme events linked to climate change. Micro-scale infrastructure is also less costly, quicker to build and maintain and less vulnerable to extreme events, thus undercutting the construction sector. Particularly challenging was control over groundwater resources and enforcement on not contaminating groundwater, nor abstracting beyond the recharge rates.

3.3.5 Group 5 - A Tasty World with Values
What does the world look like?
This vision is of a world which manifests at all levels of human organisation values of reciprocity, harmony and relationality in humans' relationship with nature, where humanity is continuously enriching the flourishing of nature and able to sustainably reap its abundant bounties, and where biological and cultural diversity are co-conserved and co-managed without being enclosed in protected areas. Every child appreciates the cultural and spiritual values of nature and every human has a relation to place, feels part of nature and a community, has a deep awareness of interrelations between their own place and actions with places far away in space and time and learns to act accordingly through a lifelong intergenerational educational process. It is a world where there is respectful sharing among diverse knowledge systems and their ways of looking at and valuing the world based on the recognition of the valuable contribution of all humans to the generation of knowledge and wise application of technology. This world is one where most food is produced by small scale farmers along the continuum of rural to urban (e.g., urban agroecological gardens creating biocultural corridors) under principles of respect and enhancement of cultural and biological diversity, creating a food production system highly resilient towards environmental changes. Landscapes will in this world be connected locally and over long distances. There would be considerable exchange of information, and products locally and internationally. Trade would operate under principles that consider social-ecological justice. In this world, relationships of domination and inequity (e.g., epistemological domination, gender and social inequity) have been transformed into relationships of mutual respect and justice. A rich diversity of governance systems related to place and context share central value foundations of obligation and responsibility towards nature and universal recognition of indigenous peoples' sovereignty over their lands and knowledge systems through which they serve as custodians for 60 percent of the world's biodiversity and much of the potential of conserving and enriching the food crops for humanity.

How did we get there?
To arrive to this world where values of reciprocity, harmony and relationality are characterising humans' relationship with nature, different strategies, instruments and policies were increasingly adopted for co-managed and collaborative planning of urban-rural food systems. Crucially the three seeds in gradual uptake work as mutually reinforcing. At regional and national level, low carbon and

clean sources of energy were diffused. Regional and local markets were created and novel business models based on biocultural values and increasing partnership with non-traditional business players were set up. They were supported by biocultural brands and international certification. Novel strategies of value-centred environmental communication through media and education, which increases access to traditional cultures and learning across generations for the future, were implemented in all landscapes including cities. This approach enabled a shift towards a nature-centric and diversity-centred narrative, and strengthened support for strong legal protection for indigenous peoples' lands and other areas of nature, all species and mother earth, ocean and land rights of access for small farmers and indigenous people, and no patentable seeds, genetic stocks, or species. Key transitions were toward biocultural regions free from genetically modified organisms and locally owned and operated seed-crop-food biocultural systems. This transition required deep-rooted cultural change with its embedded recognition of and respect for indigenous knowledge and epistemic diversity having parity with scientific knowledge.

Tensions (transition zone)
Tensions in the zone of transition from small scale seeds to universal adoption include the role of urban areas. With stronger immersion in nature in educational systems manifesting the values of relationality and harmony, many people may want to leave to live closer to nature, in rural areas or small urban centres. This can have repercussions for efficiency of resource use. An associated tension is between increased demands for environmental tourism, with its potential negative consequences on carbon emissions and biodiversity. The role of technology is another potential game changer where widespread use of information technology can be used for both enhancing nature experiences and creating diversions of entertainment that provides obstacles for children and youth to find their roots in their local nature. With increasing levels of food sovereignty and food production in the hands of small farmers, the role for multinational agrochemical and agro-producers and value chains will diminish, but not without resistance and counter-movements in the transition phase.

3.3.6 Group 6 - Dancing with Nature
What does the world look like?
This vision focuses on dynamic nature, meaning ecological processes that operate largely independent of human control. In this vision, humanity has reconfigured itself to accommodate and steward these shifting processes. People have given nature space, biomass and connections at multiple scales, to enable nature to continually change and evolve. People have restored many natural processes, such as migrations and flooding. Where appropriate, people have returned missing species to ecosystems to allow plants and animals to dynamically reshape ecological structures and processes. Human infrastructure and civilization is designed to accommodate rather than regulate the living and non-living fluctuations of nature, for example seasonal animal migrations and periodic floods. Finally, humans intervene in nature to enhance the adaptive capacity of ecosystems, using technology, including genetic engineering, to enable nature to thrive in a world transformed by humanity.

How did we get there?
This vision emerged from three related existing examples of changes in how people are moving into a more dynamic relationship with nature. First, development of dynamic infrastructure that allows space for dynamic natural processes, such as flooding to occur without costly damage occurring to human populations (e.g., Rotterdam's layout allowing "room for the river"). Second, projects that aim to restore or increase ecological connectivity across human landscapes, for example wildlife corridors and riparian buffers, which allow animals to move and natural dynamics to occur within and across human dominated ecosystems. Third, new genetic technologies that allow people to modify and create new types of genetic diversity, such as CRISPR. These technologies have allowed people to increase the adaptive capacity of populations.

Many social changes are required for these examples to grow and spread. In particular there would need to be changes in property rights, agriculture, and urban design. First, property rights would have to become 'unbundled,' meaning that there would be more diverse set of rights over land use. Such rights already exist, for example the 'freedom to roam' recognises the right of people to travel and harvest wild goods on most public and private land. This scenario assumes that property owners would be required to allow specific types of activities that enable society to steward and adapt to natural dynamics. Such changes in property rights would require the development of new types of institutions to manage conflicts among different people and demands on property and nature.

Second, shifts would occur away from large monocrop agriculture towards more diverse multifunctional agricultural landscapes. These landscapes would allow more space for nature, and allow space for wild animals and plants to move across landscapes. Such changes would likely require shifts in global diets away from meats and towards more healthy plant based diets, such shifts would allow more people to be feed from less agricultural land, providing more space for nature. Third, cities and infrastructure would need to be built to enhance the supply of urban ecosystem services to people. The risks of sea level rise, climate disruption, and extreme events are currently promoting interest in infrastructure that is resilient to extreme events. More radically, cities, housing, and infrastructure would need to be designed to cope with and adapt to wildlife, floods, and climate extremes. This would likely require new building technologies, regulations, and lifestyles.

Tensions (transition zone)
We identified a number of tensions that occur between these competing world systems, and sketched some of the factors that would enhance the chances to achieve a dynamic nature. There are many cracks in the existing world system, and these tensions are likely to increase. Climate change is a spectre haunting the world. An energy transformation is in transition. Similarly, the future of the global economic system is increasingly contested, with economically large nations holding inconsistent visions of the future of world trade. Major economic institutions such as the OECD and the World Bank have developed 'green' measures of GDP and new approaches to measure social well-being. The expansion of global trade has reached a plateau and new media have disrupted late 20th century models of development. Machine learning and robotics are challenging existing economic development models. Negotiating these tensions to achieve this vision would require the emergence of novel partnerships. Already today, new partnerships between climate, food, and health are occurring as communities are identifying how better eating can be good for health, the planet, and the plate.

Some of the ways these tensions could lead to new partnerships could be around the need to govern the novel social-ecological connections of the Anthropocene, declines in meat consumption, new economic models, new types of commons, and new social-ecological connected types of finance. The pervasive social and newly important biophysical connections of the Anthropocene could lead to the expansion of transnational agreements and organisations, such as the Arctic Council, to address social-ecological issues across national borders. Some of these will lead to the creation of transnational spaces for nature, in the deep ocean and mountain areas, that enable rewilding while providing economic and human opportunity. Declining demand for meat, driven by health, climate, and anti-meat values will provide space for new uses of some agricultural land allowing the expansion of rewilding. New economic models, some based on new types of ownership, and others based on new types of valuation of natural capital or insurance, will challenge investments into green infrastructure, rewilding, and new forms of monitoring and knowledge creation. Increasingly globally distributed knowledge, combined with advances in translation, will advance the provision of basic knowledge and income to everyone as a human right, driven by global desires for social resilience, equity, and economic opportunity. A diversification and increased monitoring and regulation of finance will reduce the returns to financial speculation, and tie money more to local natural and social capital, encouraging investments that build local wealth in diverse fashion rather than solely the distant accumulation of

financial capital. Focus on people is amplified by increasing restrictions on the accumulation of capital, and a shift towards the co-management and commons management of ecosystems.

3.3.7 Group 7 - *Healthy Oceans, Happy Communities*

What does the world look like?

In the vision *Healthy Oceans, Happy Communities*, the oceans and coasts are full of life – biodiversity and ecosystem services provision in oceans and coasts are sustained. A radical guardian role is adopted by governments and businesses, which commits to 500-year strategies (e.g., Weitzman et al. 2001; Sumaila and Walters 2005), and accounts for the full life cycle of their products. The high seas are closed to fishing (Rogers et al. 2014; White and Costello 2014; Sumaila et al. 2015) and the coastal zones are managed sustainably (ban of unsustainable fishing practices). Inputs from the land are well-managed (including cumulative effects and full bans of single-use plastics). Indigenous and local communities are actively involved in the management and restoration of the coasts (including, for example, participating in community coral gardening). There is an equitable sharing of benefits from oceans and coasts (across gender, race, religion, age, etc.). New, sustainable technologies are developed to produce energy, which has helped tackle climate change and its consequences for the ocean. New technologies (e.g., artificial fish growing) are also helping to feed vast populations, while at the same time the rise of vegetarian/vegan movements have further reduced the pressures on ocean resources. In this future, society has respect for ocean life, rights and welfare and treats it as 'if it feels pain'. Children are taught of the intrinsic value of the ocean and intergenerational environmental knowledge is widely shared.

How did we get there?

This vision emerged from several targeted streams of work that supported and reinforced each other, leading to the development of networked communities of practice. Environmental education at all levels acted as a main driver of social change and restored the connection between people and nature. Environmental education with a strong holistic and humanities foundation, starting in the early years and continuing through to university was put in place. Consumer education helped to make informed choices through, for example, transparent tracing of product life cycles, while environmental education of businesses enabled the transition towards sustainability on the production side.

A number of societal changes enabled the transition to sustainable global oceans. Social change campaigns pushed society to move to more sustainable food patterns: a high percentage of people became vegetarian and vegan, while for others, eating artificially produced fish protein, food produced from waste products or eating across the food chain (instead of only top-predators) became the new normal. Movements, such as the Slow Food and De-Growth movements drove the transition of society towards sustainable lifestyles. Social media helped to raise awareness of ocean issues among the youth. Aquariums become widespread and help to raise awareness on ocean issues, as well as enhance the connection between people and marine life.

Co-production of knowledge between industries, governments, indigenous and local communities and researchers was another essential aspect of the transition towards a sustainable future. Advances in technology subsidised by governments and businesses helped to: 1) address waste reuse and minimise waste; 2) monitor ocean health and changes; 3) determine what are sustainable harvest levels; and 4) enforce strict monitoring of fishing activities and regulations (e.g., satellites, drones). Technology and observers on all commercial fishing vessels further helped with the control of fishing activities. Research and communication programmes on understanding biodiversity and ecosystem services helped communities and decision makers to make informed decisions. Indigenous and local communities were involved in 'train the trainer' programs. Decision support tools development and implementation assisted community and local decision making. IPBES and other international connectors put more focus on oceans.

Strong leadership from key positions within industries, governments, research and indigenous and local communities, as well as community champions who already have some authority also helped to achieve the desired vision. Long-term strategic planning by industries, governments, indigenous and local communities and research in the form of 500+ year strategies, with a focus on implementation, became the new norm. Investment in blue economies at local and regional levels was scaled-up.

Another essential element in the transition towards a sustainable future of the oceans was the collaborative governance across scales and boundaries, which included: 1) strong regulations and regulatory bodies; 2) strong local and regional scale decision-making connected to larger scales; 3) governance that crosses the land-sea interface (e.g., Arctic Council, cumulative effects); 4) development of a collective land-ocean governance vision (e.g., IPBES and other intergovernmental process lead the way to the establishment of an Oceans Council); and 5) management of ecosystems as a whole (e.g., single species harvest focus replaced with ecosystem focus).

Tensions (transition zone)
Several tensions arise in the transition period between current ocean governance and management regimes and the future vision described above. To enable the co-production of knowledge between indigenous and local knowledge (ILK) communities and scientists, the engagement of scientists and ILK practitioners in the identification of issues and solutions, and the involvement of indigenous peoples in training programmes and decision making, new ways of integrating different knowledge systems was required. A major shift in human values, preferences and behaviours was required to transition from the consumer-oriented culture to a world in which societies have respect for the ocean and marine life, and understand and value the contributions of the ocean to human well-being. New ways of thinking were required to repair the disconnect of society with the ocean. Changing food choices, acceptability of new food options (artificial fish) and social practices was a major challenge. In regard to governance, local and regional control over coastal and ocean management needed to align with global scale needs and governance. A new model of cross-scale governance of the oceans and coasts was required in order to enable local authority and at the same time align with global scale vision and needs. Collective efforts (investment and commitment) of businesses, governments and individuals was also required to close the waste streams.

In the envisioned future, priority is given to local and indigenous coastal communities, which in turn presented the challenge of getting large industries on board. New ways of incentivising large companies to adopt long-term thinking and sustainability strategies (500 + year strategies) and at the same time subsidize small social projects, were needed. One of the biggest challenges faced was to ensure that tele-coupling (i.e., an integrative way to study coupled human and natural systems that are linked over long distances) was considered and that there was an alignment between costs and benefits. Finally, the need to shift away from a globalized system to create more sustainable food choices also created tensions with large scale industries.

3.4 Comparing visions across themes and regions

The cross-cutting analysis completed across the seven visions in this section presents the activities carried on the last day of the workshop. Comparative analysis is based on and builds on the results of the group activities as synthetic representation of cross-thematic and regional group analyses of the visions.

3.4.1 Mapping the visions across topics and dimensions of nature preferences
This section presents the analysis carried out by the members of different thematic visioning groups on how the seven visions (Figure 14) capture our preferences for and relationships with nature across a range of dimensions in biodiversity, ecosystem services, socio-economics and human well-being (see Appendix C for the complete set of thematic gradient mapping results of each group).
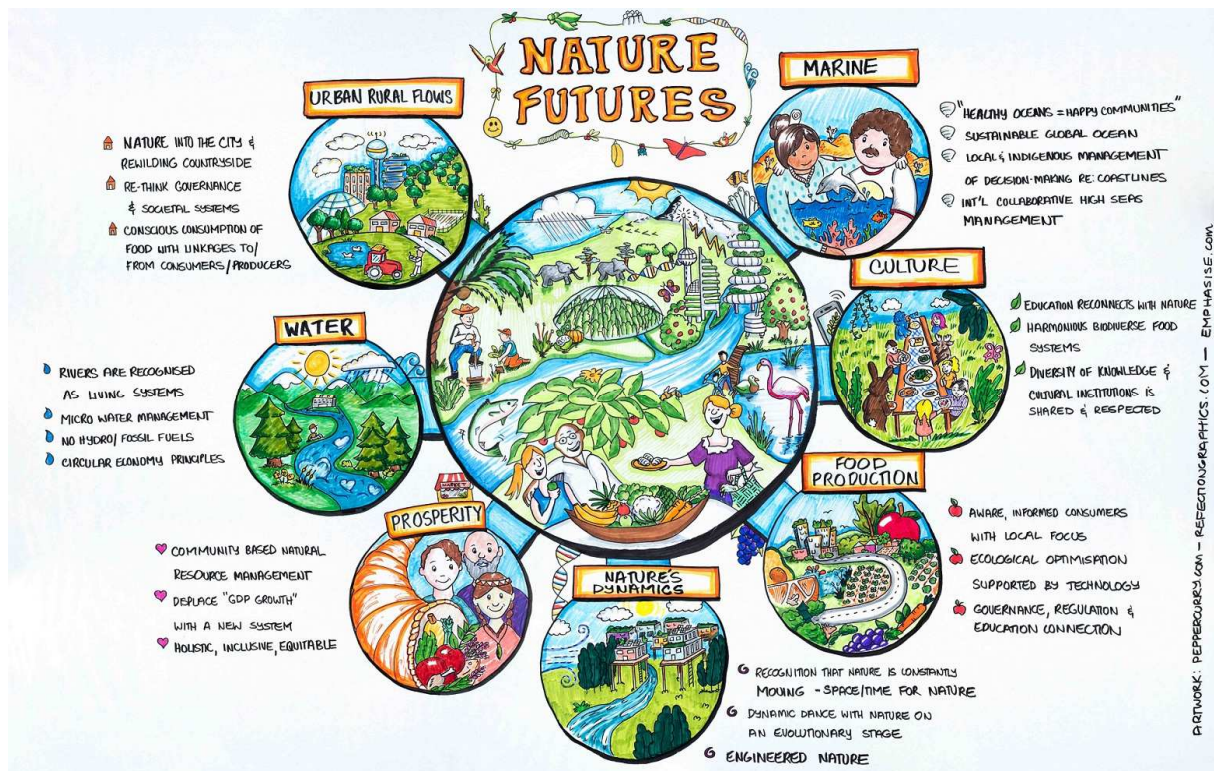
Figure 14. Overview of visions from all themes. (Source: Dave Leigh, Emphasis; Mary Brake, Reflection Graphics; Pepper Lindgren-Streicher, Pepper Curry Design).

The seven visions, and their sub-visions, were mapped to different thematic axes to assess their coverage of different dimensions of nature preferences (see Figure 15 for some examples and Appendix C for all the diagrams of the different cross-cutting groups). Common themes on preferences for the future of our relationship with nature emerged across the visions. Some visions emphasise the indirect and intangible benefits of biodiversity, such as in *ReWilding the Urban Rural Flows*, *Dancing with Nature*, and *A Tasty World with Values*, while others emphasise the direct uses of nature, such as in the *ReFooding* and *Sustainable Food Systems*, although in most cases visions and sub-visions or seeds capture both direct and indirect values (Figure 15a and 15b). Localisation of ecosystem service flows and the development of multifunctional landscapes is an important component of *ReFooding the Urban Rural Flows*, *Healthy Social-Ecological Freshwater Ecosystems*, *A Tasty World with Values*, and *Nature-based Inclusive Prosperit*y, while others emphasise the management of global ecosystem service flows or the segregation of spatial uses of ecosystems, such as *ReWilding the Urban Rural Flows*, *Dancing with Nature*, and *Healthy Oceans, Happy Communities* (Figure 15 c). Other themes emerging from a cross-cutting analysis include the appreciation of specific elements of biodiversity or a more holistic appreciation of biodiversity (Figure 15b), varying degrees of the use of technology to improve nature benefits, and varying intensities of nature management.

(a)

Space for nature

Living water

A Tasty World with Values

ReWilding

Local community based natural resource management

National plans with key ecological objectives

Global GDP replaced with nature-based matrix

Spiritual cultural symbolic

Material

ReFooding

No dams

Healthy oceans

Healthy Oceans, Happy Communities

Engineered nature

Sustainable Food Systems

Small scale water management

Agro   Land   Forests   River.   Freshwater   Sea   Ocean   Air

(b)

Healthy Oceans, Happy Communities

Use

ReFooding

Nature-based Inclusive Prosperity

Healthy Socio-Ecological Freshwater Systems

Value

Sustainable Food Systems

ReWilding

A Tasty World with Values

Dancing with Nature

Non-use

Individualistic (species)

Importance of biodiversity on ecosystem services

Holistic (ecosystems)

(c)

Figure 15. Visions mapping on thematic scales (a) Nature Preference: values vs. ecosystems, (b) Importance of Biodiversity for Ecosystem Services: species vs. composition diversity, (c) Drivers: consumption vs. globalisation.

In order to further identify common and unique elements across the visions, we tabled elements of each vision for each dimension of nature preference and related topic (Table 1) including associated values, management, governance, production and consumption of ecosystem services, socio-economic development, technology use and lifestyle. Shared themes across multiple visions include a holistic view of nature which may receive legal rights on its own, the importance of ecological restoration and nature-based solutions, the need for more sustainable supply chains closer to a circular economy, the need to improve environmental governance and increase social cohesion, and the importance of increased equity and of the reduction of humanity's global footprint. Several visions, e.g., *A Tasty World with Values*, require a societal paradigm shift and significant changes in values, lifestyles and diets.

Table 1. Visions on dimensions of nature preferences.

Visions Preference dimensions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Biodiversity	Global monitoring system on biodiversity change to feed scientific evidence into government planning and management	High level of biodiversity at genetic, species, ecosystems level (wild and domesticated), biodiversity based food production	*ReFooding* - particular species or functional groups with direct or indirect-use valued. *ReWilding* - particular species or ecosystems Both reductionist (e.g., megafauna) and holistic (e.g.,	River as whole living system, with rights	Nature as a living system with rights	Nature connected at multiple scales	Oceans as life with rights and welfare

Visions / Preference dimensions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
			ecosystem function)				
Value of nature	National accounting systems incorporating values of nature and symbolic (e.g., rights of nature in international legal system)	Nature is the foundation for optimal delivery of ecosystem services and goods	*ReFooding* - material value as well as shareable culture *ReWilding* - intrinsic value	Water as material with use value and recognised as a living system with persona	Every human has a relation to place and feels part of nature	Land and sea as common property with multiple values	Oceans as life with rights and welfare
Management of nature	Community based natural resource management	Multifunctional land use, efficient use and management of resources	*ReFooding* - multiple use landscapes *ReWilding* - some areas dedicated to rewilding in rural areas, nature-based solutions and intensive sustainable farming in urban areas	No fossil fuels, no dams, biodiversity protection, ecosystem connectivity, water extraction optimally efficient and recycled at micro-scale, active system/ catchment restoration	Multifunctional biocultural, sovereign polycentric agrifood system; conservation of culture and nature	Multifunctional agricultural landscape, human intervention for increased autonomy of ecosystems using technology	Sustainable management and restoration of the coasts through indigenous and local communities
Governance of nature	Self-governing, self-sustainable community based natural resource management; national plans with ecological objectives; national system with BES monitoring, assessment, participatory planning; global governance systems with taxation based on resource use	Inclusive and effective governance (multi-scale)	Strong connection and coordination across scales, governance orchestration, innovative policy and planning, local implementation with high level support	Decisions on resource use and management by local stakeholders, scaling up to national and regional shared river basin authorities/ management agencies	Rich diversity of governance systems sharing value foundations of obligation and responsibility towards nature with indigenous people's' having sovereignty over their land and knowledge systems multiscale laws/policies for environmental management (e.g., national, global laws, protocols etc.)		Radical guardian role adopted by governments and businesses with 500 year strategies and account for full life cycle of products

Visions / Preference dimensions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Production and consumption of ecosystem services		Sustainable supply chain, biodiverse food at landscape and seascape level	*ReFooding* - localized ES flows. *ReWilding* - globalized ES flows	Micro-scale water extraction and decentralised renewable energy systems	Most food produced by small scale familiar farmers along the on rural urban continuum, harmonious, and biodiverse food systems resilient to environmental change	Multiple types of ecosystem services flow across landscapes	Artificial fish growing, vegan/ vegetarian movement
Socio-economics development	GDP replacement with nature-based indices; national and international taxation system on natural resource use, common international resource pool redistribution alleviates poverty	Enhanced liveability of rural areas, zero hunger, accessible equitable reciprocal agreement for water, fair and equitable sharing of benefits arising out of the utilisation of genetic resources for food and agriculture	Making cities more liveable by adding value to rural, inter-regional equity, development	Circular economy at local to regional scales	Social-ecological justice of trade, gender equity	World population fed without intensification or extensification of global agriculture	Equitable sharing of benefits from oceans and coasts (across gender, race, religion, age, etc.)
Technology use	Provide venture capital for sustainable technological innovation	Clean technology to decrease energy use	*ReFooding* - high tech solutions to give value to social capital and traditional ecological knowledge *ReWilding*- high tech driven solutions to free up space for nature in cities	Micro-scale water and energy systems in circular economy, and decom-missioning of dams, low for rewilding/ restoration of river systems and catchments	Wise application of technology	Enhanced autonomy of ecosystems with use of technology and genetic engineering, new technologies and infrastructure allow people to live good lives and cope with impact of climate change	Sustainable technology produces energy, new technologies help to feed vast population (e.g., artificial fish growing)
Influence on lifestyles	Education - nature centred education in school curriculums and public awareness programs	Cohesion - increased community cohesion through landscape ownership Security - decent employment, safety, health	Cohesion – rural–urban boundaries broken, synergy with reduced conflict, greater community socialisation through food, valuing of emerging urban-rural identities	Cohesion - socio-cultural connections re-established with 'living' river systems Health - greening cities (circular economy water and renewable	Cohesion - cultural inclusiveness Education - reconnecting to nature through education Gender and social	Cohesion - ecological connectivity to human landscapes Diet - healthy diet with less meat consumption	Diet - rise of vegetarian/ vegan movements reduces pressures on ocean resources Education - children are taught

Visions / Preference dimensions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
		Education - education programmes and public awareness on environmental, ecological and nutrition conscious-ness		energy systems) enhances human health, wellbeing and livelihoods	equity/justice at the core of renewed nature-society relationship (queer ecology) Recognition of local and indigenous knowledge systems	Well-being - cities and infrastructure provide multiple benefits to people and economies	intrinsic value of the oceans and inter-generational environmental knowledge

3.4.2 Regionalising visions with potential challenges and opportunities

This section presents an analysis of the challenges (or lock-ins in existing regimes)) and opportunities (or cracks in existing regimes) for each vision to be realised in different regions of the word. The outputs of the groups, including a series of tables for each region, are documented in Appendix D.

3.4.2.1 Africa

In Africa, potential challenges and opportunities in achieving the seven visions were categorised into nine topics: urbanisation, inequity and inclusivity, technology, cultural heritage and diversity, pan-African/sub-regional governance, biodiversity, demographics, education, and trade. The challenges include extraction leading to biodiversity loss, growing pressure on natural resource and over-exploitation, climate change impacts, food and market connectivity and trade relations, land grabbing, patriarchy, plastic pollution, and access to information. Opportunities include longstanding traditions of organic and eco-agriculture and agroforestry building on local knowledge, long history of community based natural resource management with proven record of success, urban-rural connections and flow, ability to 'leap-frog' over the negative impacts of industrialisation, such as clean energy solutions, improved agricultural innovation and food systems, transboundary natural resource management, education and cooperative programmes, and use of digital technology.

3.4.2.2 Asia

In Asia, the most commonly identified challenges across visions include economic development, urbanisation, demand for land and infrastructure, increasing inequity, countries with high population, consumer preferences (e.g., meat, fish) and over-exploitation, and locked-in education. The opportunities include implementation of global initiatives and regulations (e.g., Convention on Biological Diversity (CBD), System of Environmental and Economic Accounting (SEEA), protected area), community-based, small scale innovations (e.g., organic farming, co-adaptive management), local production and resource management (e.g., fair trade certification, mini hydro systems), consumer awareness and mindset shifts (e.g., consumption habit, food waste, links between biological and cultural diversity), support for urban to rural migration, failure of state, and social enterprises that promote global ownership and stewardship.

3.4.2.3 Europe and North America

In Europe and North America, key actors include policy frameworks such as Common Agriculture Policy and Farm Bill, as well as supermarkets and retailers and consumers that influence the food supply chain. The lock-ins include general lack of protection (e.g., U.S.), infrastructure planning, poor natural resource management and regulations suppressing local innovations among the identified challenges.

Reformed environmental policy schemes, regulations on resource management (e.g., integrative pest management, river rewilding), rural urban flow models (e.g., southern countries in Europe), biodiversity based landscapes, green certification, innovations in optimizing energy use, shifts in diet and grass root movement are potential opportunities. Some of the medium to large scale leverages include innovations in catastrophe insurance, large scale policies, environmental consumerism, indigenous rights, and resilient management of climate change opening opportunities for biodiversity planning.

3.4.2.4 Latin America

In Latin America, challenges and opportunities across visions were analysed by sectors/actors. At the governance level, challenges include legal and institutional incongruity and heterogeneity, commons enclosure, lack of legal and political protection and an inequitable access to food and assets. Conflictive issues, such as bio-piracy, infrastructure expansion, costly environmental engineering, and large-scale agriculture expansion were also highlighted. Factors such as rural-urban migration, societal problems (e.g., violence, drugs, corruption) and dominant scientific-technocratic knowledge systems and patriarchal culture are also constraints for change. The opportunities mostly refer to environmental governance systems, such as regional multilateral initiatives, systems of participatory governance and management of cultural heritages, co-management planning, multi boundary politics, and biodiversity and ecosystem services based policies. Additionally, at social-economic level, common cracks include bio-cultural innovations (economy, technology), sustainable food production movements, access to technology, shared economy models, novel financial systems and recent emphasis on gender and social equity. On environmental management dimensions, common efforts in environmental connectivity, multifunctional landscapes valorisation and ecological restoration can be potential opportunities.

3.4.2.5 Oceania

In Oceania, challenges and opportunities were examined across the seven future visions. Key opportunities in Oceania that facilitate adoption of positive nature futures include the prevalence of collaborative governance models and community management, including most small island nations, as well as in New Zealand. The vibrant indigenous cultures in the region result in leadership in indigenous knowledge practices in environmental management. Similarly, as much of Oceania was only recently colonised by humans, the region has a pioneering spirit, is resourceful, lacks historic baggage and is willing to adapt to new challenges. New Zealand, for example, is often a test-bed for new technologies (e.g., predator-free islands and mainland-islands). The typical island nature of most of Oceania results in strong connections to nature due to the proximity to nature. However, key challenges also result from this proximity, for example, much of Oceania is highly vulnerable to climate change, particularly the effects of sea level rise and ocean acidification. Population growth is an ongoing challenge in islands with limited available space, with high rates of migration to larger neighbouring countries. In developed countries in the region, urban sprawl is rampant, and there are preferences to spread outward rather than upward to accommodate population growth. For nations with small population sizes and limited funds to support governance, foreign investment has been a common option, trading access to natural resources in return for funding to support human infrastructure.

4. Discussion

4.1 Approach and limitations

Adapting approaches to positive scenario building developed at regional scales, we initiated the first iteration of global nature futures scenario building. Stakeholder participation, encompassing sectors and all regions provided a diverse suite of viewpoints from which to develop novel future visions, while

enhancing trust and credibility of the scenarios co-developed from this broad participatory approach. A structured stakeholder selection process was used to provide diversity of participants, ensuring a broad set of different and divergent views, and ensuring the visions were legitimate, realistic, and applied across sectors and ecosystems. While backgrounds of participants were biased toward the research community, most researchers had experience across other backgrounds (i.e., governance, industry), through contributions to research informing policy and decision making, or through prior employment in other professional fields. Similarly, governance, private sector and indigenous participants often had research backgrounds, further diversifying the collective knowledge of the workshop, and enhancing the applicability of the visions across scales.

Graphic illustration support throughout the workshop, and the suite of creative visioning techniques used during the workshop, allowed for participants to view nature and nature's benefits to people in a new light, away from the prior structures and themes which often guide global environmental assessments. Visualisations of workshop content also allowed participants to see how their ideas were being formed, and graphics allowed for informal iteration of visions and their key components.

The use of a suite of tools allowed for evaluation of which methods and techniques were best suited to the process, as well as supporting capacity building of the team of researchers and participants in the sharing of participatory methods for scenario development. Future iterations of scenario development at regional and local scales will allow for further adaptation of suite of scenario building tools, and the workshop facilitators will continue to share perceptions of which methods were most successful during the design and development of future workshops.

Still, there were also lessons learned from the process. The division of the participants into thematic groups that overlapped with particular systems or sectors (e.g., Oceans, Freshwater, Food Production), and the convergence into a vision per group that the adopted methodology favours, lead to lack of diverse visions for each sector or system. Instead the process resulted in some common ideas and preferences emerging across the different thematic groups that, to some extent, can be integrated into a common overall vision. Perhaps this can also be attributed to the fact that the nature preferences represented by the participants at the workshop were not fully representative of society as a whole. We had a limited number of participants in the workshop and most had a connection to biodiversity issues, so further stakeholder consultation may be needed to broaden the range of societal preferences for our relationship with nature. On the other hand, there is a more diverse range of solutions and approaches in the sub-visions and seeds of each vision, that perhaps could be further explored in follow-up work with stakeholders and experts, to further refine a set of visions that can be uptaken by the modelling and expert community.

4.2 Implications for IPBES scenario development

The large number of global scenarios that are developed during the last decades can be grouped into archetypes or scenario families that share similar storylines and similar societal assumptions. The IPBES methodological assessment on scenarios and models (IPBES 2016) uses 'scenario families', based on van Vuuren et al. (2012), which also cover the scenario archetypes distinguished by Hunt et al. (2012), based on the scenarios developed by the Global Scenario Group (Raskin 2005). The archetypes can be characterised by their guiding principle. Six archetypes are distinguished including scenarios focussing on 'economic optimism', 'reformed markets', 'global sustainable development', 'regional competition', 'regional sustainable development', and 'business as usual'. A summary table is provided in Appendix E.

For scenario development in the IPBES context, it is essential to analyse whether the new visions are in line with existing archetypes, so that elements of these archetype can be combined with the new visions to create new scenarios, or whether the new visions will lead to completely new scenario archetypes. Appendix E shows statements derived from the vision descriptions mapped upon the

dimensions that are used to distinguish the archetypes. This mapping enables a first comparison between the archetypes and the visions.

The seven visions all tend to focus on sustainable development, by enhancing the role of nature to contribute to human well-being. The majority of the visions have a holistic approach to natures. *Nature-based Inclusive Prosperity* and *Sustainable Food Systems* are grounded in material values of nature, whereas *A Tasty World with Values* and *Happy Oceans, Happy Communities* visions have a strong foundation on cultural and symbolic values of nature. *Healthy Social-ecological Freshwater Systems* and *Dancing with Nature* have both material and non-use values. All visions except for the *ReWilding* countryside sub-vision and *A Tasty World with Values* visions assume increased management of the multifunctionality of nature.

Most of the visions aim at an economy where GDP growth is not dominant, but instead led by a sustainable lifestyle. Reduced inequalities and healthy diets are key. The economy will be structured differently using innovative market agreements and connections through global networks of local economies. The concept of the circular economy may be the leading process. *Sustainable Food Systems* and *Urban Rural Flows* include multi-scale production and consumption of ecosystem services while in *Healthy Social-ecological Freshwater System*, *A Tasty World with Values*, and *Dancing with Nature* the production and consumption are organized locally. *Happy Oceans, Happy Communities* has a global focus.

In the visions, except *A Tasty World with Values*, technological development is towards a combination of high-tech applications, combined with optimal use of natural processes to enhance production of food and energy, and for protection to hazards. Education and public awareness of principles derived from nature are regarded as essential in most visions. Assumptions on global population growth are generally lacking.

These general tendencies are similar to the 'Global Sustainable Development' and the 'Regional Sustainable Development' archetypes. The '*Healthy Oceans, Happy Communities*' vision is closest to the 'Global Sustainable Development' archetype with its strong emphasis on global co-operation between governments and industries to manage the world's oceans. The focus on local communities and local production in the remainder of the visions make them more inclining towards the 'Regional Sustainable Development' archetype. A *'Tasty World With Values'* combines a strong local focus with appropriate and value based governance at all levels, from local to global and thus combines these two archetypes.

From the various visions, a strong cross-scale governance system emerges, where local communities are managing their natural resources, with a strong underpinning from national governments, and strong global connections between local communities and circular economies. In addition, the notion that ecosystems, including freshwater systems and oceans, are 'persona' with autonomous legal rights to be respected, came out as a key aspect of these visions. These aspects do not appear in scenario archetypes so far. In contrast to the visions none of the scenario archetypes put nature and nature's contributions to people as a central element of their narratives.

The visions developed in this report come closest to the archetype of "Regional Sustainable Development", but some of narratives may lead to distinguishing an additional archetype based on a 'nature first' argument. Elements of that additional archetype may include multi-scale policies and practices with integration of traditional knowledge and considering the distribution of stakeholder preferences; multi-sectoral reform on consideration of tele-coupled social-ecological impacts on nature; giving nature space through green growth and rewilding; recognizing nature as living and dynamic systems; co-evolving with adoptable nature that benefits from ecological engineering; reconnecting with nature through raised awareness and enhanced appreciation for biodiversity and cultural inclusiveness.

Until now, the 'Regional Sustainable Development' scenarios family, which includes the SRES B2 scenario (SRES 2002) and the 'Adaptive Mosaic' scenario from the Millennium Ecosystem Assessment (MA 2015), are not thoroughly and systematically quantified (van Vuuren et al. 2012). A main challenge is to describe the economy, where conventional economic viewpoints, such as the optimisation of economic growth as described by GDP growth, are no longer valid. Furthermore, the technology pathways emphasized here are not commonly considered in the majority of the scenario models at global level.

Two topics highlighted in the visions have a particularly poor treatment in existing scenarios and require consideration in the development of the Nature Futures Scenarios. One is the complexity of biodiversity change, including aspects such as the spatial scale of analysis, the way in which different species groups respond to anthropogenic pressure, and the role of invasive species. Another issue is the importance of social-ecological feedbacks and how they may change the trajectories of socio-economic drivers. In addition, despite these visions emphasising positive futures, the modelling work can test some underlying assumptions (e.g., what would happen if the high seas are closed to fishing; how effective are nature-based solutions) in each of these visions and identify possible negative surprises.

4.3 Next steps

The objective of this workshop was to lay the foundations for the development of scenarios for IPBES in the next few years. Building upon the outcome of this workshop, the IPBES Scenarios and Models Expert Group will continue with an extended analysis and synthesis of the information generated from visioning exercises to prepare additional regional and sectoral consultations with a wider range of stakeholders. The IPBES expert group will guide this process up to the end of 2019, when its mandate ends, as consistent with the first work programme of IPBES. Scenario development will then continue under the leadership of a consortium of institutes, that will be duly initiated.

The work will be organised in iterative annual cycles of stakeholder consultation, modelling and analysis, and narrative development of the Nature Futures (Figure 16), which will result in a rich set of Nature Future Scenarios by 2021 (Figure 17) and associated shared social-ecological pathways. This work will also link and build on existing work in the scenarios and futures community, including global climate scenarios (RCPs) and associated Shared Socio-economic Pathways (SSPs), the GEO 5 assessment, the work from the High-level Political Forum on Sustainable Development, the seeds of a good Anthropocene, among others.

In the stakeholder consultation step, the Expert Group will consult governments during the CBD COP/SBSTTA and IPBES Plenary, engage with the business sector through networks such as Natural Capital Coalition and World Business Council for Sustainable Development, connect to the diverse groups of scientists in Future Earth transdisciplinary research projects (www.futureearth.org/), and engage people through global biodiversity or environment related civil society networks. For *regional* consultations in refining region specific visions, stakeholder days of IPBES plenaries are one suitable platform. An on-line survey tool could also be used to promote a broader consultation on the visions. The objectives of these stakeholder consultations will be in assessing the realisability of preliminary visions, filling critical gaps, identifying pathways, ensuring sectoral and regional relevance of the visions, and creating networks and communities of practice for continued collaboration in achieving the visions. Through multiple iterative consultation process with governments, institutions, businesses, scientific communities, indigenous and local communities and citizens, the Expert Group will refine the initial visions developed from this workshop into storylines and quantifiable scenarios.
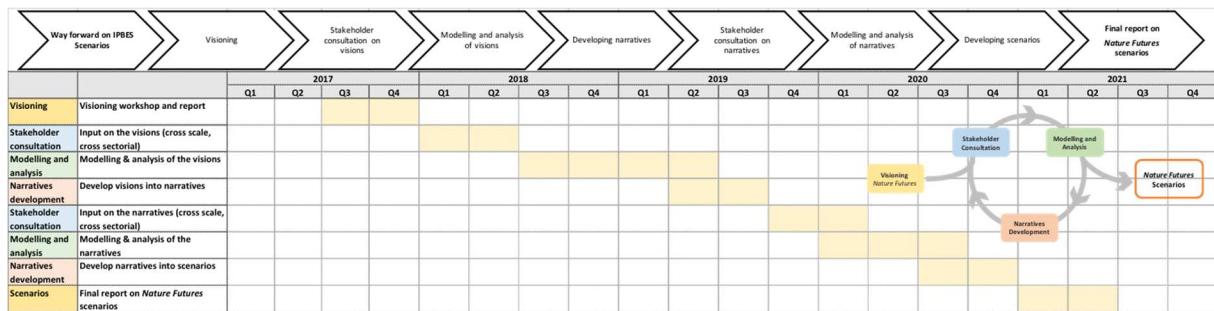
Figure 16. Draft roadmap of IPBES scenarios development; note that most activities require research funding to support their implementation.

The modelling and analysis step can be developed by different working groups addressing specific aspects of the IPBES conceptual framework. For instance, different groups may look at the dynamics of drivers, multiple dimensions of biodiversity, the linkages between biodiversity and ecosystem services, and social-ecological feedbacks to the drivers (Figure 17). Each modelling and analysis round should be followed by a narrative development round that integrates the work from the different modelling and analysis groups and translates their results into relevant knowledge for the stakeholder consultation step (Figure 16). Likewise, the modelling and analysis groups need to uptake the results from each stakeholder consultation round to guide and inform their work.

A key component of the strategy outlined here is the strong stakeholder engagement in all stages of the process, but it will be necessary to develop a broader communication strategy for the Nature Futures Scenarios. With increased awareness of nature's role in sustainable future, such as in the United Nations, Agenda 2030 and its Sustainable Development Goals, we are at an opportune era in history where the value of biodiversity can be better acknowledged through the global governance of human and societal development. This next generation of scenarios will explore alternative visions to reach intertwined global targets, including potential synergies and trade-offs between nature conservation and other development goals. Ultimately, these scenarios will support the future assessments of IPBES with modelled results on trends, status and projections of interactive impacts of nature and society. This will help researchers, policymakers and practitioners to identify areas of concern based on scientific evidence to further explore alternatives pathways that could impact biodiversity conservation.
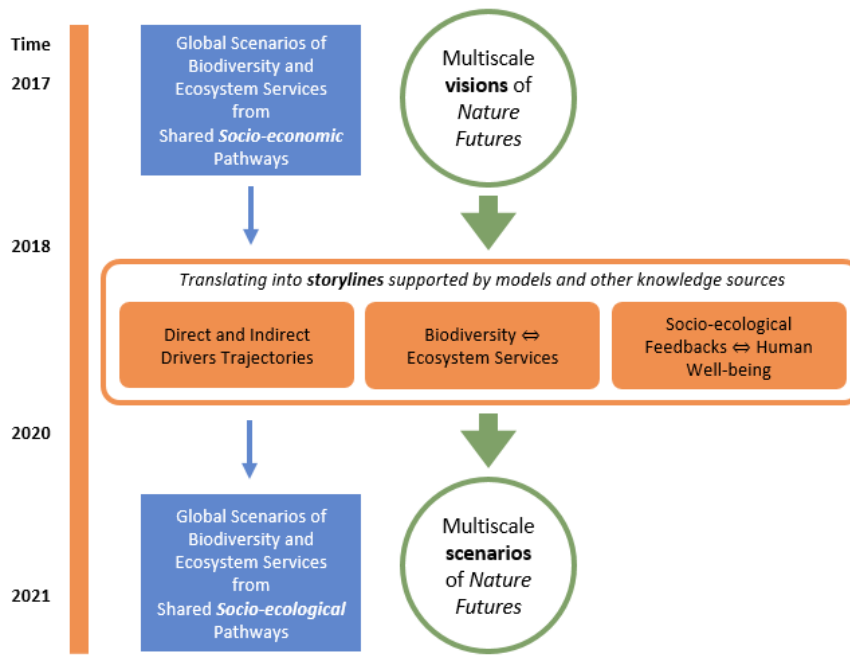
Figure 17. Calendar for the development of the multiscale scenarios of nature futures, based on the visions developed in the workshop.

Appendices:

Appendix A: Detailed description of the methodological approach:

A.1 Participant selection and preparation

The first step of this process of developing the IPBES global biodiversity scenarios, a stakeholder workshop was held on 4-8 September 2017 in Auckland, New Zealand. A total of 73 participants from governmental organisations, non-governmental organisations, academia and the private sector, from 31 countries, and with a range of sectoral expertise on biodiversity topics, from agriculture to fisheries, worked together in this visioning exercise. Three key questions were addressed: 1) What visions (may be multiple) exist on nature (biodiversity) and nature's contributions to people (ecosystem services)?; 2) What future 'positive' scenarios can be built based on these multiple visions?; and 3) What is required to inform decision makers in order for them to address potential changes in biodiversity and ecosystem services (BES)?

The participants in the workshop were selected to represent a diversity of views on nature and nature's contributions to people, and to obtain a broad set of visions, to ensure legitimacy for the process and to avoid biases. Following the method of Gramberger et al. (2015), selection criteria were agreed upon. Criteria included representation from different sectors (governmental and international organisations, private sector, interest groups and NGOs, indigenous and local communities, and the wider scientific community); representation of spatial scales (local, regional and global), geographical regions (Africa, North America, Latin America and the Caribbean, Asia, Europe and Central Asia, Oceania), disciplinary background (social, technological, ecological, economic, etc.), age and gender. All these features may greatly influence the vision on nature and nature's contributions to people. Participants were invited to participate as individuals, with the explicit objective to think about broader visions of nature and nature's contributions to people, rather than advocate for particular sector objectives.

A tailor-made database was set up which contained the criteria. Nominations of individuals to be invited to the workshop were solicited from the IPBES Scenarios and Models Expert Group, the Technical Support Unit (TSU) on Scenarios and Modelling, the IPBES Multidisciplinary Expert Panel and Bureau, and other IPBES TSUs. Nominations included stakeholders that participated in the IPBES-4 Stakeholder Day event, as well as those (n=174) that completed a survey of policy and management options to promote biodiversity and nature's contributions to people and human well-being. This survey was one of the tasks initiated by the Expert Group in early 2017 as an early step in the development of new IPBES scenarios. A total of 590 initial nominations were compiled. Minimum quotas per sector and geographical region were determined in advance to obtain a proportional representation in the initial selection of invitees to the workshop. The invitation list was further iterated as invitees responded with ability to participate (or not); in some cases, new individuals were nominated to replace the expertise of invitees that could not attend. Funding was available for approximately two-thirds of participants, and support was obtained from both the IPBES Trust Fund for eligible nations and from a New Zealand government contestable research grant to support other attendees who requested assistance with travel funding. A limited number of self-nominations provided by the IPBES Secretariat were further selected for attendance if they fulfilled gaps in the balance across sectors, disciplines and geographies, and if funding was available to support their attendance. Late cancellations were received which impacted the balance across sectors; some sector gaps were filled with invitations to locally based (i.e., New Zealand) participants.

In preparation for the workshop, participants were asked to read a selection of articles including: Summary for policymakers of the IPBES Scenarios and Modelling Assessment (IPBES 2016) and Multiscale Scenarios for Nature Futures (Rosa et al. 2017) and to think of existing initiatives (or 'Seeds')

that they believe are positive and would contribute to a better future for nature (See Bennett et al. 2016). Following guidelines for human ethics within participating institutions on the workshop organising committee, participants were provided with a 'Participant Information Sheet' which explained the confidentiality and information recording procedures, as well as likely research outputs from the workshop. Chatham House Rules were used to encourage openness and the sharing of information, allowing for use of the material discussed at the workshop, but protecting identification of the individual source of comments and discussions.

A.2 Workshop process

Below is a detailed description of the steps taken in the development of the stakeholder visions during the workshop:

- *Phase 1: Setting the scene and organisation in thematic groups*

The workshop started with an inspiring exercise during which all participants introduced themselves and presented a photo which represented their personal relationship with nature. The participants then split into smaller groups and discussed their experiences with scenarios and their expectations of the workshop.

A 'World Café' session was then conducted to discuss the following questions: 1) How does nature contribute to current and future human wellbeing?; 2) To what extent are nature's contributions to people captured in existing biodiversity and ecosystem services scenarios?; 3) What is missing in current global scenarios that we need to capture in future biodiversity and ecosystem services scenarios? and 4) What are the most important and easiest/tractable issues that should be captured in future biodiversity and ecosystem services global scenarios? What are the uncertainties and social-ecological connections that should be captured? The themes that emerged from the World Cafe session were discussed and further revised during a plenary session involving all participants in the selection of thematic groups. An initial suite of groups was proposed at the conclusion of the first workshop day, and further iterated the following morning. Following agreement of thematic groups, and confirmation that sufficient numbers of participants were interested in each of the proposed groups, participants self-selected which thematic group to join for the remainder of the workshop. Participants were provided with the opportunity to switch groups during the week, if necessary.

Each thematic group began their session with a discussion on the main trends within their theme. Afterwards, the groups prepared an artwork as a team building exercise, to visualise the critical drivers and key trends in BES within their thematic group. Figure A1 shows two examples of the artworks.

Figure A1. Artistic representations of two thematic groups including key trends within the themes (left Group 7, Healthy Oceans, Happy Communities and right Group 6, Dancing with Nature).

- *Phase 2: Identification of seeds that address thematic trends and constructing scenario skeletons*

Each thematic group had a discussion on existing initiatives ('Seeds') that they believe are positive and would contribute to a better future that addresses the trends in their respective themes (Bennett et al. 2017; Pereira et al. 2017). Afterwards, each group selected three 'Seeds', which were then used as a starting point of developing scenario skeletons (Pereira et al. In Press). Three seeds that differed from each other were intentionally selected to encourage a diversity of ideas.

The process of building scenario skeletons started with the groups imagining what the three seeds would look like in a mature condition, i.e., once the initiatives have scaled-up and become mainstream. The 'Future Wheels' method (Glenn 2009) was then used to assess the direct and indirect implications of the seeds in mature conditions (Figure A2). For each of the seeds, the teams used hexagonal post-it notes that fitted together like the cells in a beehive to create a 'Future Wheel', with the core being the key theme to emerge from the seed, and the surrounding post-it notes representing the related effects and impacts this seed would have, from first order to secondary and tertiary implications. The discussion on implications was structured by using the STEEPV analysis (Schultz 2015) and VERGE framework (Lum 2015). Using the STEEPV analysis participants considered Social, Technological, Economic, Environmental, Political and Value implications of each future wheel. The VERGE framework encouraged participants to consider different domains of human experience: How would the mature seed influence the way we define things, relate to one another, connect to each other (and the environment), create, consume or destroy?

After the completion of the future wheels, participants mapped the linkages between the implications of the three seeds and identified potential synergies and conflicts. In addition, the participants developed a cross-impact matrix which was used to get a further insight into potential interactions between the seeds.

Figure A2. An example of the future wheels developed for the three seeds of Group 7 on Healthy Oceans, Happy Communities.

- *Phase 3: Fleshing out narratives*

In the next phase of the process, participants were asked to build on the discussions of the Future Wheels and further enrich the narratives. Participants discussed what their visions mean for: 1) biodiversity; 2) ecosystem services; 3) people's decisions and behaviour; and 4) achieving those visions.

To help further enrich the scenario narratives and to explore possible pathways to achieving the visions, each group developed a Three Horizons Framework (Figure A3). The first horizon (pink notes in Figure 6) represents the dominant elements of society today, some of which would need to decrease with time in order to achieve the vision. The third horizon (yellow notes in Figure A3) represents the seeds, which are currently marginal, but over time would mature and eventually reach a state in which they are mainstream in order to achieve the vision. The second horizon (orange notes in Figure A3) represents the transitional phase in which transformative changes needed to happen in order to eliminate the dominant negative elements of society today and enable the seeds to reach a mature state. In the second horizon, the participants identified what is required to transition from the current world to their vision for the future; many of these are leverage points allowing a systemic shift towards a more positive future.

Figure A3. An example of the Three Horizons Framework developed by Group 7 on Healthy Oceans, Happy Communities.

- *Phase 4: Comparison of the visions*

During the last phase of the workshop, participants re-organized themselves into different groups to map the visions across topics and to test the visions across regions (Figure A4). In the first exercise, participants split into six groups to map the visions across gradients of the following topics: 1) cross-scale linkages: global versus local scales; 2) nature preferences: tamed versus wild nature; 3) types of nature contributions: use versus non-use; 4) importance of biodiversity for ecosystem services: species diversity versus composition; 5) social-ecological feedbacks: influence on social cohesion versus influence on consumption; and 6) drivers: slow versus fast population growth; equitable versus inequitable economy; urban expansion versus urban contraction. This exercise helped to identify the commonalities and differences between the visions, as well as gaps in the identification of alternative future visions.

In the second exercise, participants re-grouped according to their region (Africa, Asia, Europe and North America, Latin America and the Caribbean, Oceania and the Pacific) and discussed what each of the visions meant for their respective region. The groups identified potential challenges and opportunities for the visions within their region, reflecting on how existing positive actions for biodiversity, infrastructure or other social, political or economic actors specific to a region might facilitate (or provide barriers to) the implementation of particular visions.
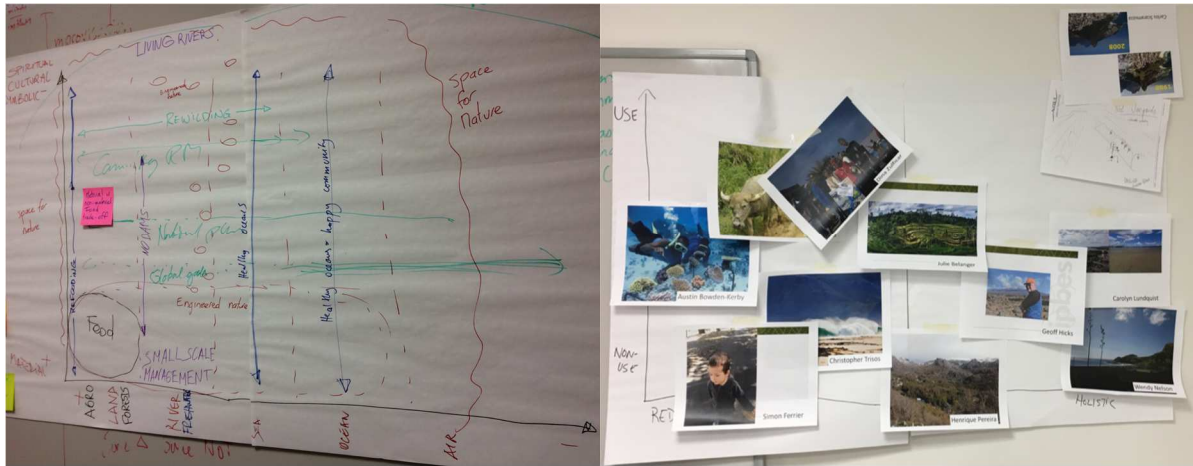
Figure A4. An example of the visions mapping on thematic gradients in relation to nature preferences. On the left, participants mapped the seven alternative visions on axes represented by nature preferences, from wild to tamed. On the right, participants used the photograph of their personal relationship with nature to envision where their own relationship with nature mapped out on the nature preferences diagram.

Appendix B: Detailed descriptions of the narratives:

Appendix B.1

Group 1 - Nature-Based Inclusive Prosperity

B1.1   Three seeds session:
a) All seeds proposed, clustered according to scale
- ○ Local: community based natural resource management (conservation models with or without incentives)
  - Namibia, Fiji (happy chicken), Madagascar, Germany (agriculture).
  - Enables more equitable resource distribution.
  - Community based governance.

- ○ Regional/National: country development plan with key ecological objectives
  - Sustainable development zones and national programs.
  - China: special designated sustainable zones.

- ○ Global: replace GDP with nature based growth matrices
  - Non-economic and more ecological governing model - philosophy and value.
  - Bhutan gross national happiness model.
  - Taxation.

- ○ Cross-cutting: education
  - Formalising nature-centred education curriculum.

b) Selection process
After participants presented their seeds, the above-mentioned clusters became apparent quickly. Particularly at the local level, the three examples refer to a broadly similar topic and participants chose this topic (community based resource management) rather than a particular case. For the regional level participants selected the national programmes as most information was available. On the global level a mixture was developed, starting with elaboration of a paradigm shift that led to a different taxation scheme.

B1.2   Future wheels session
Future wheel of seed 1: Community based natural resource management
Community based natural resource management ensures access to markets and fair trade. This economical new possibility contributes to community wellbeing and helps to eradicate poverty. Together with general individual and community-based empowerment, increasing local land user rights and an equitable (nature, gender, religion, race, age or cultural group) approach, this establishes resilience and security of the whole community as a whole. Because of the local focus it is very likely that overall awareness of nature is rising which contributes to an enriched species and livelihood diversity, finally leading to an abundance of nature. Potential risks are inter- and intra- community conflicts, when topics are negotiated and power inequality is sustained, followed by the displacement of current users. Nature's benefits can be pointed out easily. Human-wildlife conflicts could also increase. Due to increased access, increased material consumption is also a possibility, if sustainable consumption patterns are not established.

Future wheel of seed 2: Country development plans with key ecological objectives

Implementing country development plans with key ecological objectives helps to prioritise planning options, and systematic spatial planning changes the value system to a "green-attitude". This attitude supports resource efficiency and helps to reduce pollution, which in turn results in better health. Because of the key objectives, business confidence can be established, resulting in increased prosperity and enhanced human well-being. Risks in this context such as "greenwashing" are also possible. This future wheel, however, could go another way and lead to an increased consumption and thus to reinforced production and need of resources.

Future wheel of seed 3: Displacing GDP "growth" as goal (e.g., Bhutan happiness index, taxation)

With displacing GDP-growth as goal, this is a start to define limits to growth and a redistribution of wealth and a new centring of different measures of success. This seed goes hand in hand with a new paradigm of global governance, where many priorities are valued, especially equity (nature, gender, religion, race, age or cultural group), and security. With this shift away from GDP there is a chance that well-being of nature gets into focus and ecological loss and damage are properly addressed. A main idea is to prioritise disincentives for ecological harms, but this will result in some people losing and a risk is the possible repression of people who dissent from this paradigm. With this global approach comes a large system change, implicating a disruption of the current value system and benefits. Another risk with large changes is that resource distribution is insufficient and the vulnerable often become even more vulnerable.

Interactions between seeds

	Community based natural resource management	Country development plans with key ecological objectives	Displacing GDP and growth as goal
Community based natural resource management	---	- provides grassroots information to guide plan - could be integral part of national plan restoration of resource based impact - provides model of inclusive development - supports implementation of new plans - feeds into scaling up possibility from local to national - creates more stable society - allows plans to be evaluated	- supports bottom up implementation of a new growth model - provides value based priorities - provides evidence/data/proof - measure and ground truth provides alternative examples of growth - uses a lot of theory of commons and inspire discussion to GDP displacement

	Community based natural resource management	Country development plans with key ecological objectives	Displacing GDP and growth as goal
Country development plans with key ecological objectives	- government must allow for local regulations and control - supports implementation and resource provision for CBNRM - The existence of CBNRM in national plans done in the capital	---	- provides social and ecological examples for new growth model - creates in country harmonisation with new international growth model
Displacing GDP and growth as goal	- enables locally defined success matrix - giving examples of alternative benefits to economic provides mandate for localised sustainable and ethical production system - global standards help define local protections and actions - decentralised economic growth	- provides framework for ecological and social objectives - provides mandate for changed value system in country - global standards help define national level standards - resource restricted from global markets	---

B1.3   Developing scenario narratives

Summary of the discussions based on the STEEP and VERGE methods, which contributed to 'fleshing out' the scenario skeletons

- **Seed 1: Community based natural resource management (CBNRM)**

While a local approach, this seed ensures rights for self-determination and custodial rights, while at the same time communities are linked via a global network of organised communities. This global movement for decentralised governance and economic systems is working with corporate production. It results in a wide range of social-ecological impacts, e.g., for population and migration, in a socially equitable manner, but also to a partially changed landscape, e.g., by new agroforestry systems. The local sustainable production and consumption supports a global rescaling of resource use and sustains the increase of resource abundance. Thus, the tangible benefit of management is greater than the cost. But the question is whether this approach is possible in an economic system, which is just (as in justice) on a global level. It is an ambitious vision, but with dramatised scaling and impact.

- **Seed 2: Country development plans with key ecological objectives**

Having key ecological objectives in planning means focusing on nature based options for prosperity and using an ecosystem and natural capital assessment and monitoring approach. The performance is based on genuine progress, including a development process for plans, which might however look different for different nations to account for diversity and ensure buy in from all actors. A better understanding of biodiversity and ecosystem services, including establishing comprehensive indicators and a data management system, are needed to establish a new taxation system. Complementary instruments considered are environmental fiscal reform, payments for ecosystem services, biodiversity offsets, markets for green products and biodiversity in climate change funding.

- **Seed 3: Displacing GDP "growth" as goal (e.g., Bhutan happiness index, taxation)**

Thinking beyond a growing GDP as a goal requires a new mind set and implies long-term thinking and working. The foundation, and at the same time basic requirement, is world peace and a deep understanding of intergenerational equity. Regulatory steps could be reconsidering the military budget, a captured rewarding system and a governance and accountability system which need a new

valuation system, including intrinsic values of nature. The global system must be linked to national accounting systems capturing economic, cultural, social, intergenerational growth and other dimensions of assets. Potential new metrics include biodiversity abundance or well-being metrics including intrinsic value metrics. It might be valuable to also develop a metric contrasting natural capital and consumption. Either way a global constructive cooperation is required to establish goals of sustainability and ensure an equitable distribution of wealth.

B1.4   Three Horizons Frameworks

Present:
The current situation is complex, with a multitude of aspects which need to be altered. On the one side, there is a growth based understanding of development, which comes along with a cash-focused economy. This sustains the over-consumption of the rich and the lack of access and deprivation of the poor. Hand in hand with that goes the pervasive inequality – nature, gender, religion, race, age or cultural group. Over-consumption and commitment to growth lead to questionable aspects of current globalisation and a degraded nature.

Transition zone:
One of the biggest system changes would be the establishment of a global governance system in charge of a global taxation system based on a consumption metric, which then transfers monetary wealth from high consumer countries to others, and a considerable budget is also allocated to nature. Usage of fossil fuel and broad lobbyism would be banned. Support for these changes would be taxations based on used resources, pollution and owned land. Systems of Environmental-Economic Accounting would be extended to capture good quality of life, prosperity and sustainability and would be supported by monitoring systems. These schemes would be multi-level to support national development plans and balanced national budgets reallocating budgets, e.g., from military to nature conservation. Some budget is also allocated for reward systems for good corporate business practices. Essential for such a change is free education, including new curricula, awareness raising and a thorough understanding of nature's contributions to people, from global to local scale and in all languages. Education as well as decision making would be based on strong scientific evidence, but also with evidence from other knowledge systems, which is for example synthesized by participatory scenario and modelling approaches to help identify impacts of different resource uses. Respective university curricula can build capacity to support the major changes, with major degrees in: community based natural resource management, national development plans with ecological objectives, and new global paradigms. These capacities are also needed to work towards a fine-scale and timely global environmental performance and monitoring system that produces data for strategic participatory planning on the local level.

Future:
The basis of the vision is a vastly improved governance structure for society and nature, a globally regulated "law for mother nature" which is a mandatory part of the educational system. This moral approach gets supported by socially and environmentally responsible public media. On the global organisational level, it means that the current World Trade Organization (WTO), World Bank (WB) and International Monetary Fund (IMF) need to be reconfigured with a development approach based on nature based inclusive growth. With the help of the structural change a universal currency will be established. Governmental corruption will unfortunately probably be a persisting negative feature where work is needed constantly. Another aspect with long-term character is the ideal to eliminate extreme wealth via tax and extreme poverty via aid. In the long run, military budgets are ended as there is world peace.

At the end of the horizons exercise we developed the steps suggested for horizon 2 and 3 according to the following different themes. The essentials are however, captured in the above text:

- Just governance
  - Institutional development for CBNRM.
  - Leadership (gender based) identification for CBNRM.
  - End corruption in governments.
  - Re-configure current WTO/WB/IMP "development" approach based on nature-based inclusive growth.
  - Corporations banned from buying politicians.
  - Institutional governance system that supports national development plans (network and trade associations).
  - Vastly improved governance structure for society/nature.

- Education and awareness
  - Reinstate or develop socially environmentally responsible public media.
  - Education and subsidies.
  - New nature based curriculum for schools.
  - Moral education teaching respect for all living beings.
  - University curriculum, major, and degree on CBNRM, ecological national development plan, nature based growth matrix.
  - Free education including sustainable development.
  - Awareness raising regarding nature – local, national, global.
  - K-12 school curriculum including nature centred education as a mandatory subject.

- Taxation
  - Global taxation system based on ecological footprint/consumption metric, which transfers monetary wealth from high consumer countries to others.
  - Taxation on resource, pollution, land.

- Participatory planning
  - Stakeholder engaged participatory and process based scenarios and modelling community of practice (network and technical assistance).
  - Participatory scenarios and modelling to help identify impacts of different resource uses.

- Incentives
  - Incentives for small families.
  - Reward system for good corporate business practices.

- Social and economic justice
  - Dismantle the patriarchy.
  - Eliminate extreme wealth (tax) and extreme poverty (aid).
  - Alternative non-growth inclusive, equitable monetary system.

- Rights of nature
  - Recognize rights of nature.
  - Eliminate fossil fuel use.
  - Regulate globally "law for mother nature".
  - Pressure on politicians.

- Assessment system

- Global monitoring system that feeds data into analysis system to produce results for use.
- Scientific evidence.
- Fine scale global biodiversity and ecosystem monitoring system (timely).
- Implementation of harmonised/agreed biodiversity and ecosystem metrics across the world

- Annual, quarterly and monthly monitoring
  - Global environmental performance monitoring system.
  - SEEA accounting/data system need to be revamped – what indicates capture wellbeing? Prosperity? Sustainability?

- Budget shift
  - Prioritise budget allocation to nature.
  - Get more balanced national budget decreasing allocation for some issues like defence, monitoring nature contribution for people issues.
  - Military budgets ended.

Appendix B.2

Group 2 - Sustainable Food Systems

B2.1   Three seeds session

Each participant explained his/her seed in short statements after individual reflection about a seed which could be used as a starting point for the visioning process.

- Aquaponics production system is an indoor closed-loop food production system, a very efficient process compared to soil-based food production.
- Agroforestry in Madagascar/Bolivia/Peru. Agroforestry systems can be advantageous over conventional agricultural, and forest production methods. They can offer increased productivity, economic benefits, and more diversity in the ecological goods and services provided.
- Climate smart agriculture, is an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate.
- Coffee production in agroforestry systems linking consumer's awareness (certification) and a sustainable chain (producer, transport, retailer, etc.) (Colombia) SEED 1.
- Co-benefits and landscape/seascape management (example from China Grain for Green), co-benefits, mitigating and prevent flooding and soil erosion SEED 2.
- Community supported agriculture.
- Payment for ecosystem services.
- Cosmetic industry with natural ingredients (Natura is a Brazilian cosmetics). Managing eco-toxicity of products and ingredients.
- Eco-certification watershed protection in highland Bolivia/Colombia, in-kind type of compensation for ecosystem management.
- Healthy soil in Mexico, cooperation CIMMYT/Syngenta partnership, improving small producers' productivity.
- Holistic systemic education in coffee-agroforestry, Farmer Field School approach, public/private cooperation (Peru).
- In situ conservation of genetic material: The conservation, on farm and in natural (protected) areas, sustainable use of varieties of crops and trees, their wild relatives, and breeds of livestock.
- Landscape, marginal lands, restoration, connectivity, better production/resilience.
- Natura: Thailand Karen people, nature conservation.

- Reciprocal agreement water governance (Bolivia, Colombia, Peru, Ecuador), reciprocity-based incentives for private and community conservation, generate additional income for the rural families that conserve their ecosystems SEED 3.
- Landscapes and seascapes management (Thailand), developing policy and regulatory frameworks that provide incentives for biodiversity-friendly land and resource use that remains productive but that does not degrade biodiversity.
- Synthetic meat, also called in vitro meat, is meat grown in cell culture instead of inside animals. It is a form of cellular agriculture.

After a very lively discussion, the team identified three seeds to work with: 1) Sustainable Coffee production in agroforestry systems including consumer's awareness (through certification) in a sustainable chain (producers, transport, retailers, consumers), 2) Grain for Green-project on landscape/seascape management (to mitigate and prevent flooding and soil erosion, 3) Reciprocal agreements on water governance, reciprocity based incentives for community and private conservation, generating additional income for the rural families that conserve their ecosystem. Participants agreed that the selected seeds might offer them the opportunity to reflect about desired and positive futures because they cover the various scales from local to regional, cover the various sectors (indigenous and local communities, civil society, private sector, governments and research) and cover a mosaic of approaches. This combination of seeds also includes social issues on human rights, gender inclusiveness, access to food, co-benefits and governance issues as shifts in power relations. The selected seeds share the participants' wishes to look into the future, achieving food production systems that are sustainable, incorporate resource use efficiency, and enhance liveability of rural areas and a pervasive nature.

B2.2 Future wheels session

Future wheel of seed 1 "sustainable food chain"
a) Description of 1st order implications

- Community cohesion-landscape ownership.
- Cooperatives-associations.
- Resources used sustainably.
- Resources used efficiently.
- Clean technologies as decrease in energy use.
- Increased pest control.
- Controlled soil erosion.
- Adaptation to climate change.
- Decrease in food loss and increase in food quality.
- Income alternatives, increased revenues, jobs.
- Increasing income generated through Ecotourism and carbon sequestration.
- Income stabilisation of farming community (livelihoods).
- Financial incentives or subsidiaries as insurance for externalities.
- Increased connectivity of natural habitats.

b) Description of 2nd order implications

- Increased community cohesion-landscape ownership.
- More sustainable platforms and initiatives.
- Land management by local communities.
- More jobs in the sustainable area.
- Increase in human health.
- Increase in nutritional value of food.

- New economic alternatives.
- Demand driven change.
- Better climate regulation.

c) Description of 3rd order implications

- Equitability.
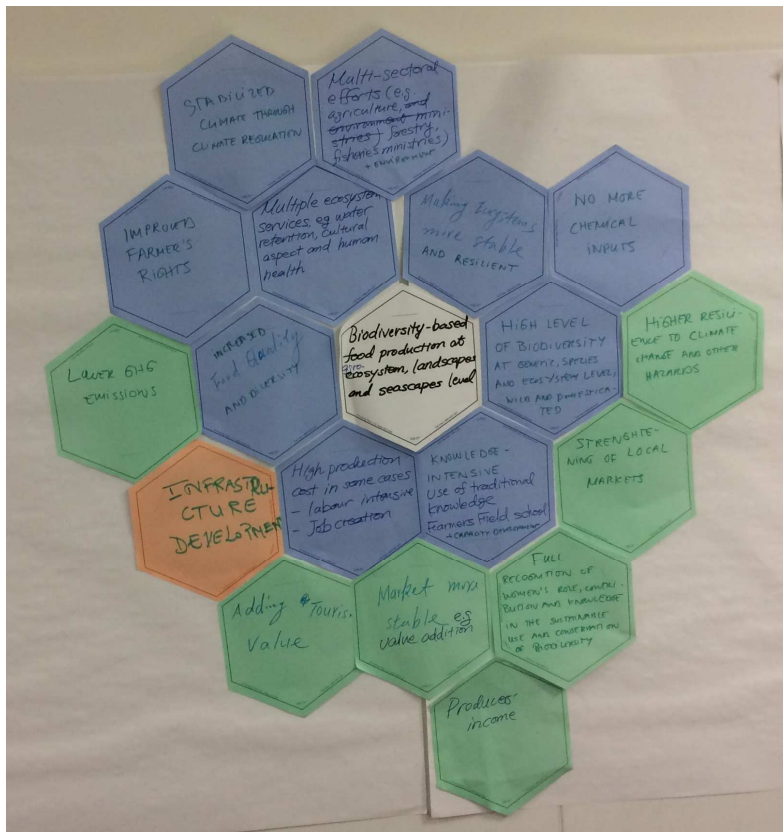
Future wheel of seed 2: Biodiversity-based food production at agro-ecosystem, land-and seascapes level

a) Description of 1st order implications

- Multi-sectoral efforts e.g., agriculture, forestry fisheries and environment.
- Multiple ecosystem services e.g., water retention, cultural aspects and human health.
- Making ecosystems more stable and resilient.
- High level of biodiversity at genetic, species and ecosystem level (wild and domesticated)
- Increased food quality and diversity.
- Stabilized climate through climate regulation.
- Knowledge intensive use of traditional knowledge, farmer field schools and capacity development.
- High production in some cases, labour intensive, job creation.
- Improved farmer's rights.
- Less chemical inputs.
-

b) Description of 2rd order implications

- Full recognition of women's role contribution and knowledge in the sustainable use and conservation on biodiversity.
- Market more stable (e.g., value addition).
- Strengthening of local markets.
- Adding tourism value.
- Higher resilience to climate change and other hazards.
- Lower greenhouse gas emissions.

c) Detailed description of 3rd order implications

- Improved infrastructure development.
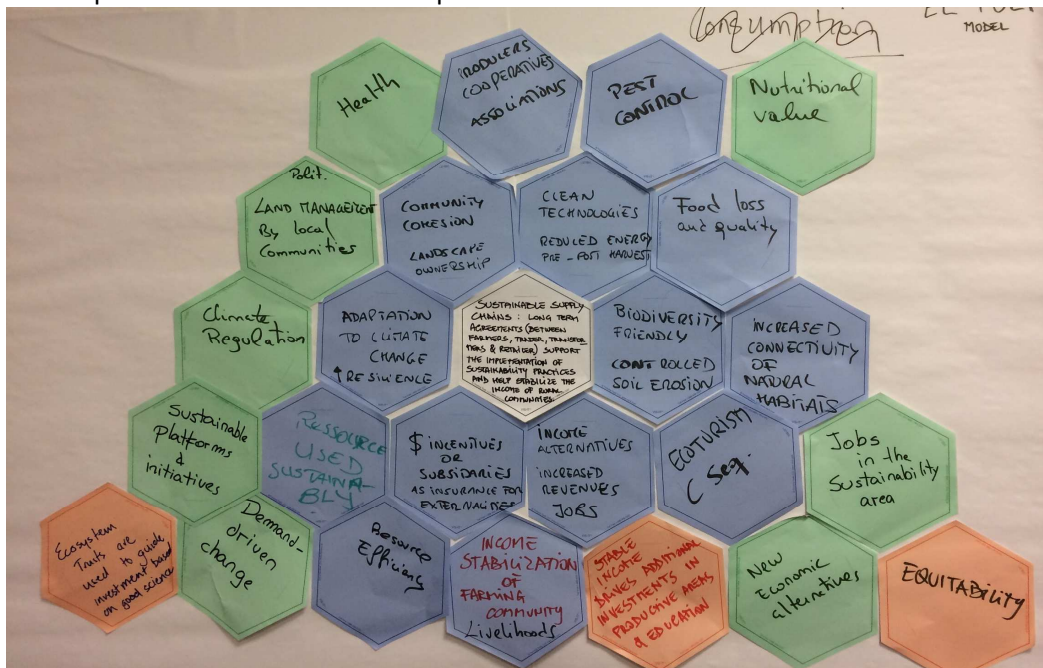
Future wheel of seed 3: Accessible equitable reciprocal agreements for water.

a) Description of 1st order implications

- Sense of ownership and empowerment.
- Subsidiarity-local communities are directly working to manage ecosystems.
- Job creation in the upstream communities.
- Water services and compensation of impacts.
- Recharge of subterranean water.
- Healthy stream/river.
- Protected areas-sustainability.
- Improved ecosystem protection and restoration.
- Impact mitigation-carbon sequestration

b) Description of 3²ⁿᵈ order implications

- Improved water security.
- Increase in livelihood security and avoidance of migration.
- Human health and resilient settlements.
- Decrease in conflicts over resource reduced-upstream-downstream.
- Shared value and environmental consciousness-responsibility.
- Water bill and consumption effects.
- Enabling legal frameworks.

- Wise use of water by farmers.
- Increased possibility for certification.
- Reduction of natural hazards.
- Increase in sustainable energy production.

c) Description of 3rd order implications

- Increased commodity price for consumer.
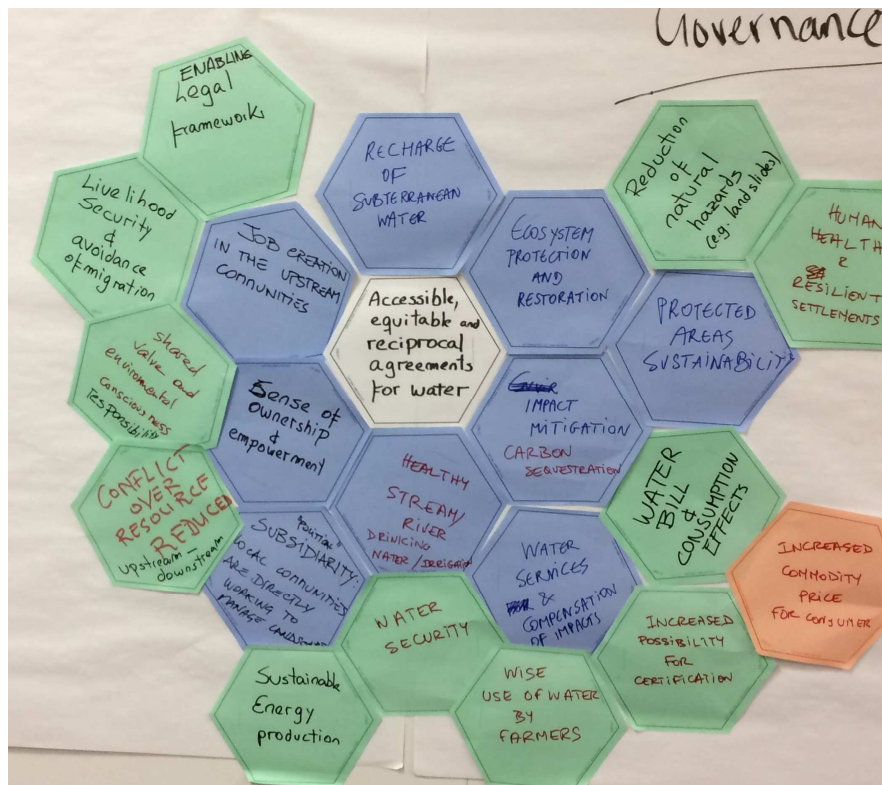
Linkages between the three wheels of future (connecting the three future wheels)
After mapping out the Future Wheels, the team demonstrated how themes linked together by using lines to connect implications in each wheel that relate to those in other wheels. From the Future wheels of sustainable food supply chains (Seed 1) and biodiversity-based food production (Seed 2), the following issues had been connected: increased connectivity of natural habitats and stability climate through climate regulation, biodiversity friendly/controlled soil erosion which makes ecosystems more stable and resilient, pest control with reduction of chemical inputs, nutritional value with increased food quality and diversity, income alternatives and increased revenues with job creation. The Future Wheels of sustainable food supply chains (Seed 1) and accessible and equitable reciprocal agreements for water (Seed 3) linked together through: human health, income stabilisation of farming communities with sense of ownership and empowerment, and income stabilisation of farming communities with livelihood security and avoidance of emigration. From the Future Wheels of biodiversity-based food production (Seed 2) and accessible and equitable reciprocal agreements for water (Seed 3), the following issues had been connected: higher resilience to climate change and other hazards (e.g., landslides), job creation, improved farmers' rights with sense of ownerships and empowerment.

Short description of the results from the cross-impact matrix
The team chose to create a cross-impact matrix to help determine how relationships between the three future wheels would impact each other. Sustainable food supply chains (Seed 1) would impact

Biodiversity-based food production at ecosystem, landscapes and seascapes (Seed 2) via enhanced market access, enhanced access to food and improved nutrition through nutritional value and diversified diets, and more stable incomes for rural communities/producers. Biodiversity-based food production at ecosystem, land and seascapes (Seed 2) would impact sustainable food supply chains (Seed 1) via increased awareness of sustainability and negative incentives for "non-compliance". Sustainable food supply chains (Seed 1) would impact accessible equitable reciprocal agreements for water (Seed 3) resulting in opportunities for water agreements versus conflicts and clarified use rights (negotiated), and water bodies as legal (spiritual) entities. Accessible equitable reciprocal agreements for water (Seed 3) would affect sustainable food supply chains (Seed 1) resulting in continuous production and improved availability of food. Biodiversity-based food production at ecosystem, landscape and seascape level (Seed 2) would affect accessible water equitable reciprocal agreement for water (Seed 3) through increased production, habitat connectivity and reduced risks of extreme events. Accessible equitable reciprocal agreement for water (Seed 3) would affect biodiversity-based food production at ecosystem, landscape and seascape level (Seed 2) through fostering water security (quantity and quality), improved water efficiency and cost reduction.

Headline and 3 statistics:
Headline
Human population is now living within the limits of one planet.
Statistics
- IPBES announced today the world now has fully sustainable food systems: we saved biodiversity, we improved health for all.
- No more poverty, no hunger, no conflicts, climate change is no longer a threat. This signals the closure of IPBES as all goals achieved.

B2.3   Developing scenario narratives

Starting from the individual participant imaginations of how a future would look, and starting with questions such as "What will we see, smell, taste, hear? Who will we become? What about wellbeing? How will we interact with nature? How differently will we behave? What does biodiversity create society?", the participants shared their imaginations on how a future would look, and participants discussed 'how these could shape production systems and roles, the importance of investments in technology for production and consumer information, regulations, the role of research, innovation, and how to support producers. Remarks made by the individual participants were:

- Knowledge is directly connected to farmers for food security. Managers know how watersheds function. You can see happiness and satisfaction in society.
- Laws support how land/seascapes need to be managed. Education will be nature inclusive. You will find models and nature related scenarios in textbooks.
- Nutrition. You can find much more production and conservation of domesticated species (vegetable and animal). There will be regulation in place. Traditional and non-conventional technologies will be used. In the newspaper you can find an Agrobiodiversity Index on how we are performing nowadays.
- Economists will value internalised ecological and social features. Knowledge to consumers and producers is largely accessible and available. Picture forests that clean up water to support, for example, beer production. Mobile devices, e.g., videos/apps for farmers and consumers.
- Governments and scientists will be focusing on food production systems and new varieties and biodiversity. Varieties consider both biodiversity and nutrition of people. There is no hunger and the world is food secure, both in rural and urban areas.
- A society is driven by sustainable energy. Transport and energy to bring your products is very well organised. First horizon petroleum, second phase hydropower energy on large scale and in the

third phase hydropower on the large scale, resulting in the other factors falling into place. Governance replaces governments. Economical drivers have to be replaced by ecological drivers. Recycling is very important. Think locally, act globally.

- Networks of production systems of healthy and nutritious food will be in place. Happy farmer. Economical optimisation to be replaced by ecological optimisation. Picture a landscape with healthy food caring for biodiversity, healthy landscape.
- Market regulation for food production is in place integrating global to local scales. Share the benefits, share equitable food. Farmers/producers will be knowledgeable. No speculations with the economic power/free of speculations. Access to new knowledge. Power symmetry and benefit sharing.
- Worldwide there is zero waste. All important information is availability and can be used easily. Schools do have food quality in their curriculum. Human understanding and being respectful for each other are common features of society. You see Planet Earth with a large variety of landscapes and wide range of peoples.

B2.4 Three Horizons Framework

The Theme 2 Sustainable Food Systems team used the Three Horizons framework to think about the future (first horizon -H1- is the dominant system at present, the third horizon -H3- is the ideal system they desire and the second horizon -H2- is a pattern of transition activities and innovations, where people are trying out things in response to the ways in which the landscape is changing and moving away from the first horizon towards the third horizon.

Present:
The team identified the following dominant features of current human society (the first horizon). At present, these features are mostly negative which have to decline or disappear (So=social, T=technological, Ec=economic, En=environmental, P=political and Val=values).

- Rising corruption (e.g., in irresponsible governance of tenure of land, fisheries and forestry, So).
- Unequal access to resources (So).
- The poor going to the cheapest food (So).
- Lack of knowledge/capacity transfer (Te).
- Low access to information on good sustainable practice (Te).
- Protectionism and protectionist measures adopted by "developed countries" (Ec).
- Trade negotiations (Ec).
- Private enterprise's power on government's decision-making (Ec).
- No balance between private capital and public good dimension (Ec).
- Overexploitation of resources (En).
- Lack of financial resources for conservation of genetic resources and biodiversity (Po)
- Limited recognition of property rights (Val).

Transition zone:

In the transition phase (how) theme 2 team identified the following issues that would facilitate the process of change:

- Elimination of food waste around the globe (So/Po).
- Produce of food with high nutrient value (So/Te).
- Promoting nutrient rich varieties, breeds and species (Te/En/Po).
- Coordinated efforts to enhance and sustainable use of genetic resources (Te/En).
- Using clean technology that reduces negative environmental impact, sound use of inputs (Te).
- Energy conservation and renewable energy (So/Te/En).
- This requires industry innovations (Te).

- This requires recycling plus optimisation of food supply chain (So/Te/En/Ec/Po).
- Systematic knowledge transfer applying newest information technologies (Te).
- Connecting healthy responsible consumption and production (So).
- Decent work (protection of workers, decent employment conditions to those who practice it, in an economically and physically safe and healthy environment) (So).
- Integrated landscape and seascape management (Te/En).
- Incentives stimulating innovations (Ec).
- Valuation (economic) of co-benefits (Ec).
- Shift from economic to ecological optimisation (Ec).

Future:

The positive seeds at the lower left corner grow and become the predominant features of positive futures (third horizon, H3). The seed grows from fringe activity in the present that introduces completely new ways of doing things, and which turn out to be much better fitted to the world that is emerging than the dominant H1 systems. The horizon three voice is the voice of the visionary.

- Technical services in place and support for farmers plus learning across sites improving efficiency in the use of resources and inputs (Te).
- Cross pollination of knowledge at local-regional and global level (Te).
- Exchange of experiences in sustainable food production processes (Te).
- Skills/technological development in sustainable food chains (Te).
- Identified and shared information on success factors in sustainable food production (Te).
- Formalisation and use of models, scenarios, models, protocols, examples (Te).
- Global protection convention (global environmental agreements) are in place to conserve, protect and enhance natural resources (Po).
- Multifunctional landscape (En.)
- Self-assessment by farmers using a simple jointly used tool allowing for sharing benchmark efforts (Te).
- Transition pathways for good market access, equity in terms of access to inputs and markets (Ec)
- Investment in incentives for biodiversity-based farming (Po).
- Increased values/ income for farmers (Ec).
- Growth of ethical niches (Ec).
- Price interventions (Po).
- Responsible and effective governance mechanisms for sustainable food and agriculture (Po)
- Support from governments, international and local (Po).

Group 2 numbered the post-it notes in the following sequence: no poverty (1), zero hunger (2), responsible consumption and production (3), good health and wellbeing (4), clean water and sanitation (5), affordable clean energy (6), decent work and economic growth (7), industry innovations (8), reduced inequalities (9), sustainable cities and communities (10), climate action (11), life below water (12) and life on land (13).

The team determined the following overarching issues as important: information on nutrition/consumption patterns and consumer awareness, production protocols. The team suggested the following key indicators to track current progress and future ambition spanning different level of detail and time periods: cultural/ethical knowledge, consumer awareness, access to knowledge, genetic diversity, value of nature/economic drivers and regulations and governance.

Theme 2 did consider their visions related to almost all SDGs: 01,02, 03, 04, 05, 06, 07, 09, 10, 12, 13, 14, 15, 17.

Appendix B.3

Group 3 - Urban Rural Flows

B3.1 Three seeds session
a) All seeds proposed
- Short circuit food provision: e.g., 'la rouche qui dit oui' in France which cuts out the middleman in food production and supply.
- Community gardens- boom of examples in major cities all over the world.
- Green architecture (Vertical farming, green roofs).
- Rewilding- giving areas back to nature.
- Innovative nature based solutions (high tech solutions to environmental problems e.g., capturing CO_2).
- Increasing green spaces in cities (allotments, community gardens).
- Benchmarking/ranking of nature friendly municipalities. Improved measures for urban indicators/urban metabolism/urban biodiversity measures (e.g., national Biosecurity Index – could this be improved so that there is more regular reporting on urban metabolism, or some sort of competition between cities?)
- Mainstreaming biodiversity into urban planning. Innovative planning and governance mechanisms
- Preservation of peri-urban zones (e.g., recognising and planning for the peri-urban zone in policy and urban planning, and acknowledging the complexity of this space).

b) Brief description of the three seeds that were selected
New visions for nature futures are based on the reconnection between rural and urban areas in an innovative and synergic way. In this future, positive flows (e.g., alignment of supply and demand) across rural and urban areas are enhanced and negative flows (e.g., waste) are marginal.

There are three effective "Seeds" able to enhance Urban/Rural Flows (URF), as follows:

Seed 1: ReFooding: "Reconnecting with nature through rethinking food systems"
This seed was selected because urban-rural areas can be synergically linked through food. The portfolio of initiatives includes innovative platforms (online) for stimulating the spreading of food knowledge and the stimuli of eating habits (seasonal food choices, organic food), creation of seed banks. This is done by implementing multiple use landscapes, including foodscapes, encouraging sustainable socio-economic development in rural areas by stimulating innovative entrepreneurship.

Seed 2: ReWilding: "Bringing Nature to the cities and rewilding the countryside"
This seed was selected due to the importance of searching for nature based solutions in order to create synergies across rural urban areas. This seed implements by bringing to cities "close to nature" e.g., green roof tops, opening space for nature in the cities (e.g., allotments), use of innovative green solutions (technology driven) for example for producing food. The rural areas are instead a place for nature to return. There is in rural areas a lively community of people that appreciates living in close proximity to nature and adapting to it (living within fenced areas that protect humans from wild animals).

Seed 3: ReGoverning: "Reconnecting to nature through rethinking Governance and Societal System Properties"
This seed was selected due to the important role of governance to instil transitions to nature futures. This seed sets the path for the implementation of the other two seeds and thus is the basis for implementation of nature futures). The portfolios of initiatives in this seed are: innovative policy and planning mechanisms to reinvent peri-urban landscapes. This policy shift will stimulate benchmarking

of municipalities/city councils for self-assessment on sustainability and nature based solutions initiatives.

B3.2 Future wheels session

Future wheel of seed 1: ReFooding

a) Description of 1ˢᵗ order implications

Through ReFooding, urban and rural citizens will reconnect and assist each other in creating greater community cohesion. This synergy makes demand and supply of food become "tailor made", thus food waste is marginal and BES flows are enhanced (water cycle, nitrogen cycle). Urban and rural dwellers acknowledge the role of biodiversity as capital for food production and value it. In this way agrobiodiversity is improved and immaterial dimensions associated to it create cultural landscapes that are valued by both urban and rural populations. This synergy improves profits of producers and drives entrepreneurship in rural areas that form a lively socio-economy. This lively economy is able to support high technology solutions to produce affordable food for all. This all happens with increased economic protectionism driven by policy that stimulates these localized flows of ES across rural and urban areas.

b) Description of 2ⁿᵈ order implications

There are a set of environmental benefits from ReFooding such as sustainable land and water management, improved soils, and restored ES such as pollination. All this leads to improved health in urban and rural societies. As food is accessible to all and there is less migration and an increased state of happiness and well-being in the communities. Rural communities secure revenues, however, food prices can increase to the final consumer. All this calls for an increased coordination across political domains.

***Future wheel of seed 2:* ReWilding:**
a) Description of 1ˢᵗ order implications
When ReWilding is implemented, society appreciates and connects to the non-utility spiritual values of nature. Urban and rural dwellers all show mental health benefits. Economically, pristine nature and

wilder biodiversity is the basis of nature-based economies. Environmentally, there are improved climate conditions in cities (e.g., improved air quality, reduced temperatures) all this driven by green architecture, and leads to increased property values.

b) Description of 3rd order implications
- Reduced expenditures on land management and enhanced strategies of risk reduction (e.g., flooding) due to climate change.

Future wheel of seed 3: ReGoverning
a) Description of 1st order implications
When ReGoverning is implemented, BES become mainstream in political agendas (local, regional, global). Research and development tools for measuring performance on BES are mainstream governance approaches. There is greater political accountability, thus decreasing socio-economic inequality. Land use planning in rural-urban areas is reconciled. Peri-urban areas are flourishing and there is greater political accountability.

b) Description of 2nd order implications
There is increased effectiveness of nature conservation policies and this is gauged through effective measurements and reporting on biodiversity status across urban-rural areas. This delivers an increase in education for nature, greater social cohesion, reduction of poverty and corruption. Nature is synergistically linked to both tourism in cultural landscapes (tamed nature of ReFooding) and rewilding areas (wild nature of ReWilding). BES are synergistically linked to touristic activities. In this vision, there is room for clearer political prioritisation based on environmental and societal goals and corruption is decreasing.
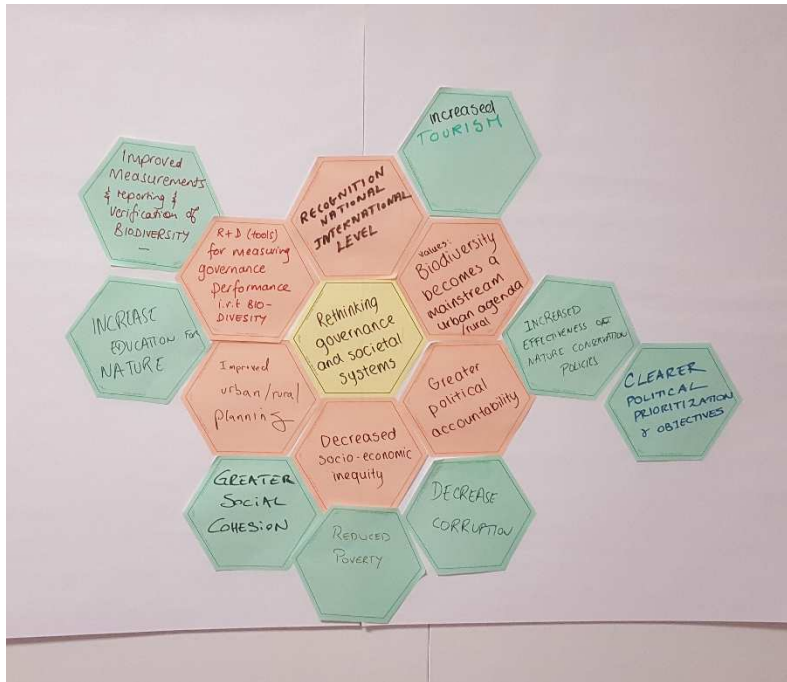
Interactions between seeds

At the local scale, major collisions can unfold over "tamed" vs "wild" biodiversity and cultural vs wild landscapes. For example, in areas where ReFooding prevails, farmland species may be favoured over "wilder" biodiversity. However, at the landscape scale, ReFooding and ReWilding complement each other and this is due to innovative governance (ReGoverning).

There will be strong connections between urban and rural areas and this solves important environmental problems caused by dysfunctional flows of BES. URF scenarios require strong connections across governance scales from the local to national to global. Both ReWilding and ReFooding may start with small local initiatives (e.g., community gardens or farmers allowing forest growth on their properties), which will grow into more defined, collaborative movements. These will then help to initiate global change.

Headline:

"Improved governance and mixes of rewilding and novel food systems, improve wellbeing in urban and rural areas"

B3.3 Developing scenario narratives:

URF is a win-win scenario. It connects urban and rural dwellers through enhanced governance (ReGoverning), it reconciles ReFooding (food provision, agrobiodiversity, "tamed nature" and local flow of ES) with ReWilding (global flows of BES (biogeochemical cycles e.g., CO_2 sequestration, "wild nature"). For achieving this there is the need to rethinking governance approaches at multiple spatial scales. At the local scale there is the need for encouraging and supporting a diversity of rural livelihoods, that go well beyond agriculture alone for also including arts, theatre, tourism, and other home-based employment activities. This will also create a network of diverse urban and rural institutions (private and social enterprises, NGO, local governments) working together and strengthening each other. All this reinforces and reinvents cultural identities and a new urban rural stewardship. At the national scale, there is the need to integrate urban-rural landscapes and lively peri-urban zones, promoting food sharing and knowledge (economy platforms) across cities and rural areas. There is also the need for supporting initiatives allocating land for rewilding (tax policies) and incorporating biodiversity into national planning (e.g., avoided costs of flood mitigation). At the global

scale there is the need to develop and implement city food networks and encourage innovative trade relations (e.g., countries will need to negotiate the potential drop off of trade in certain exotic types of food). This will imply trans-border cooperation and the high-level commitment to rewilding (e.g., by Conference of the Parties (COPs)). Based on these settings, URF scenario will unfold. For example, community gardens will start as small, fragmented programmes across cities. Rewilding the countryside initiatives that were locally based start to upscale. As they grow in popularity, more urban residents will become connected to nature and more aware of where their food (and ES they use/appreciate) are coming from. These movements will be exacerbated by support at a regional or national/global level, through funding for urban gardens, education around urban gardening, provision of space to nature arrangements (Rewilding initiatives), etc. This will then change societal values pushing toward more conscious consumption which will change consumer demand for certain food products, leading to a restructuring of the global food market – i.e., local food economies will become stronger and sustainable food production will be the norm. BES are cared for in all dimensions for utility and non-utility values. Citizens adapt to life with wild animals and recognize the importance of having "wilder" ecosystems. Smart development bounds urban and rural dwellers and a common urban-rural stewardship blend it all together.

B3.4 Three Horizons Frameworks

Present:

Sustainability is emerging from three different seeds: ReFood, ReWilding, and ReGoverning, but these initiatives are not coordinated across scales so they are fragmented and not building in "momentum". Although these initiatives are seen as promising they do not upscale or are able to hold down out migration from rural areas and stop uncontrolled urban sprawl. There is increasing contrast between rich and poor, biodiversity and natural capital is declining in both rural and urban areas, natural hazards (e.g., flooding) are even more frequent and associated with poverty. All this raises social conflicts.

Transition zone:

Reconciling governance across scales from local and regional to national, and global is the only way to make sustainable initiatives such as ReFooding, ReWilding and ReGoverning build momentum and truly be a solution to improve societal well-being across rural and urban areas. These multi scale dialogues and coordination across municipalities, districts and states/governments shelter the initiatives that give better access to nature, spread food knowledge, and, at the same time, value the intrinsic value of nature in its utility form (ReFooding) and non-utility values (ReWilding). All this is done by rethinking Governance values (ReGoverning) and innovative ecological accountability. This paves the way for green entrepreneurship, nature-based solutions and the creation of rewilding incentive taxes. This delivers forest and biodiversity recovery that are sponsored by Payment for Ecosystem Services (PES) and tourism related activities (e.g., eco-tourism, cultural tourism).

Future:

The Urban Rural Flows (URF) vision is all about making cities more liveable by adding value to rural areas. In this vision there are changed biodiversity values that are based on tailored dynamics across urban and rural areas through integrated governance across space (horizontal governance) and scales (vertical governance). This delivers climate smart development, including smart agriculture. Rethinking governance has an outcome of food security, green cities, cultural identity and stewardship based on nature values. This vision is able to promote social cohesion, and urban and rural areas live hand in hand with each other. Citizens (both rural and urban) eat sustainably and there is a lively local food economy bonding them. This is promoted by sustainable land and water management. This URF vision is able to fulfil 12 SDGs goals.
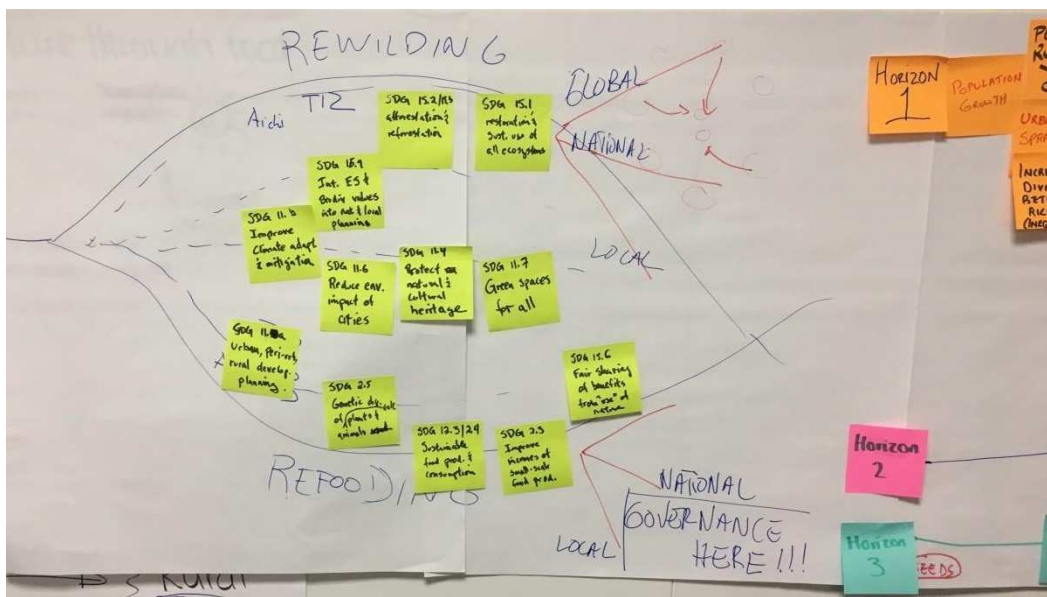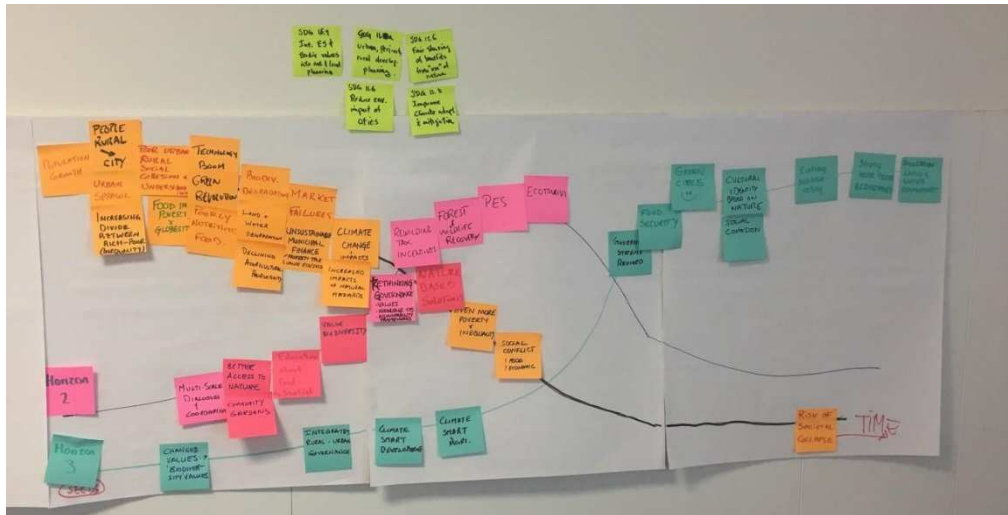
Appendix B.4

Group 4 - Healthy Social-Ecological Freshwater Systems

B4.1 Three seeds session

Seed 1: Rivers recognised as living systems with legal persona

Enabling people to 'see' intact rivers as whole systems with persona i.e., variability in features, modes, functions over time and space which need to be respected for optimal functionality. For many indigenous cultures, this is already true and will help restore these traditional socio-cultural value systems and respect for freshwater systems (including their associated biodiversity) on which humanity depends. In decentralising governance, those who live within watersheds essentially become the "owners" of the system and are more empowered to manage and take care of the whole system. The 'legal persona' is required so that rivers have legal rights to their survival which can be invoked against excessive use, pollution, degradation etc. The primary inspiration for this Seed is the indigenous (Māori) culture in New Zealand, which recognises rivers as living systems and sacred givers of life.

Seed 2: Cyclical Micro-scale Water Management Systems are pervasive

In an increasingly urbanised world, complete engineering re-design of urban areas to 'green' infrastructure means water use is managed at the local level in a circulating/closed system of water collection and use with on-site water collection, treatment and management; all households and businesses are self-sufficient in water provision and enabled to be as efficient as possible through various 'dry technologies'. All households, businesses etc., have integrated waste-management and supply systems, and most importantly, industry and other large users with significant discharge must discharge upstream of their intake to ensure strict water quality standards are adhered to (they must now re-use their own recycled water). Urban areas are designed to be 'catchments' from rainwater-harvesting rooftop designs to porous hard surfaces on the ground which allow water to soak through and not run-off, replacing the current 'hard' engineering designed to facilitate run-off of rainwater as fast as possible (via stormwater drains etc.) in urban areas. The primary inspiration for this Seed is the 'Ormax Safe Water for all in Moldova' micro-scale water systems, winner of the UN "Water for Life Best Practice Award" 2013.

Seed 3: Energy via Renewables only, excluding hydropower

In recognising the interdependency of our energy and water systems and needs (the 'water-energy nexus'), this Seed encompasses a rapid shift to micro-scale renewable energy systems managed by smart-grids in real-time, avoiding the need for massive base-loading and thus ushering in complete phase-out of all fossil fuel based energy, as well as hydropower due to its disruption of free-flowing river systems, and nuclear as an unnecessary high-risk option. In this new energy system, energy generation and transmission are separated out, as generation will occur everywhere via renewables and the transmission grids are available to facilitate 'smart-grid' transmission on demand. The primary inspiration for this Seed is the global fossil fuel divestment campaign (e.g., 350.org; Fossil Free South Africa; etc.) which has sprung up worldwide via concerned citizens in universities, religious groups, cities etc. focusing on phasing out fossil fuels as rapidly as climate science demands but with re-investment in renewables to effect the necessary energy transition.

B4.2 Future wheels session

Future wheel of seed 1: Rivers recognised as living systems with legal persona
a) Description of 1st order implications
-   Enhanced natural functioning of rivers.
-   Socio-cultural connections and respect for water/river systems restored.

- More collaborative/cooperative governance and approaches to management.
- Legislative/policy changes to enable water systems to have rights (legal persona).

b) Description of 2nd order implications
- Improved consumptive water-use and management, prioritising efficiencies and not polluting water.
- Initiatives to return used water back in better condition than when initially found (a way of "healing" water).
- Intergenerational value shifts from utilitarian to integrative/systemic/regenerational benefits.
- Species habitats improved, biodiversity values enhanced.
- Integrated monitoring systems (local to national to transboundary scales).
- Improved land management practices in catchments (stewardship paradigm), lower sedimentation, reduced run-off of pollutants, enhanced availability of better quality water, etc.

c) Description of 3rd order implications
- Knowledge-sharing/Teleconnections of benefits local to global.
- Significant changes to in-stream non-consumptive water use, and consequences for navigation/transport, fisheries access, etc.
- Significant changes in transboundary river basin policy and governance regimes.
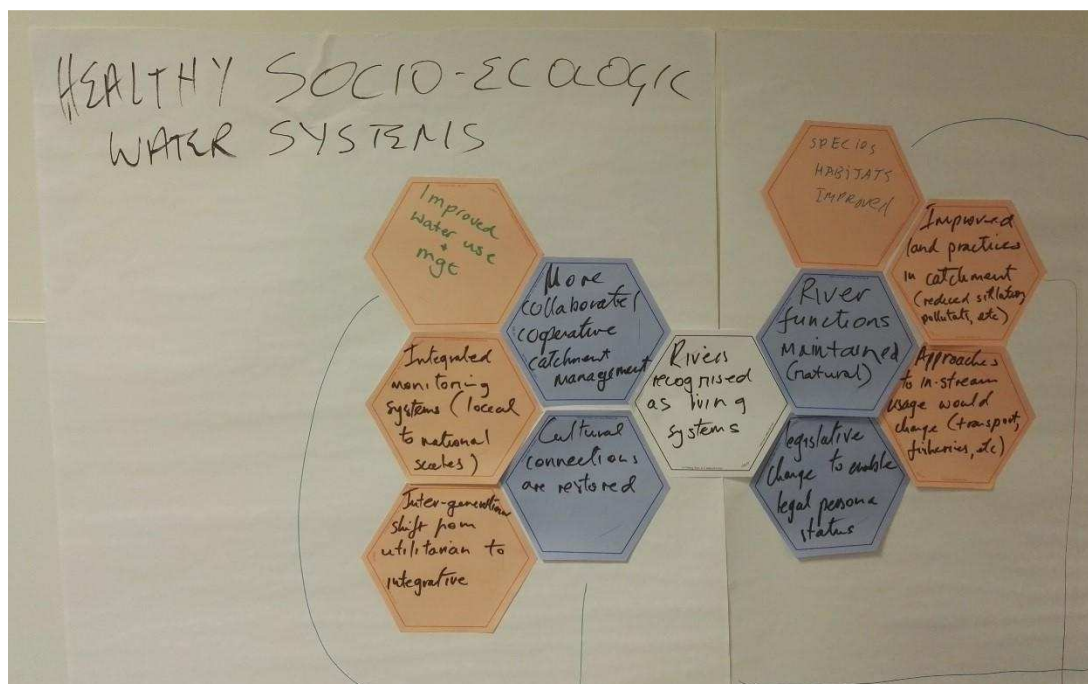
Future wheel of seed 2: Cyclical Micro-scale Water Management Systems are pervasive
a) Description of 1st order implications
- Improved social awareness and responsibility in use and consumption.
- Improved water security for all.
- Cleaner, enhanced ecological functioning for river systems.
- Reduced water usage and wastage.

b) Description of 2nd order implications
- Significant human behavioural changes, greater social cohesion.
- No more mega-dams, reduced water translocation, cost savings.
- Avoidance of groundwater extraction/exploitation/pollution.

- Agricultural systems shift to local, cultural, away from massive monocultures.
- Improved cultural and recreational services.
- Less contaminants in water systems.
- Increased overall human health.
- Sustainable/secure water supplies, increased climate resilience.
- Re-design ('green') of cities/urban environments.

c) Description of 3rd order implications
- Significant changes in centralised economy and costing structures for services provision; breakdown of centralised systems.
- Greater urban efficiency (reduced space needed for utilities and infrastructure).
- Lowered pressure on resources, improved river flows, increase/return of aquatic habitats and species, including floodplain and estuarine systems, improved marine biodiversity stocks.
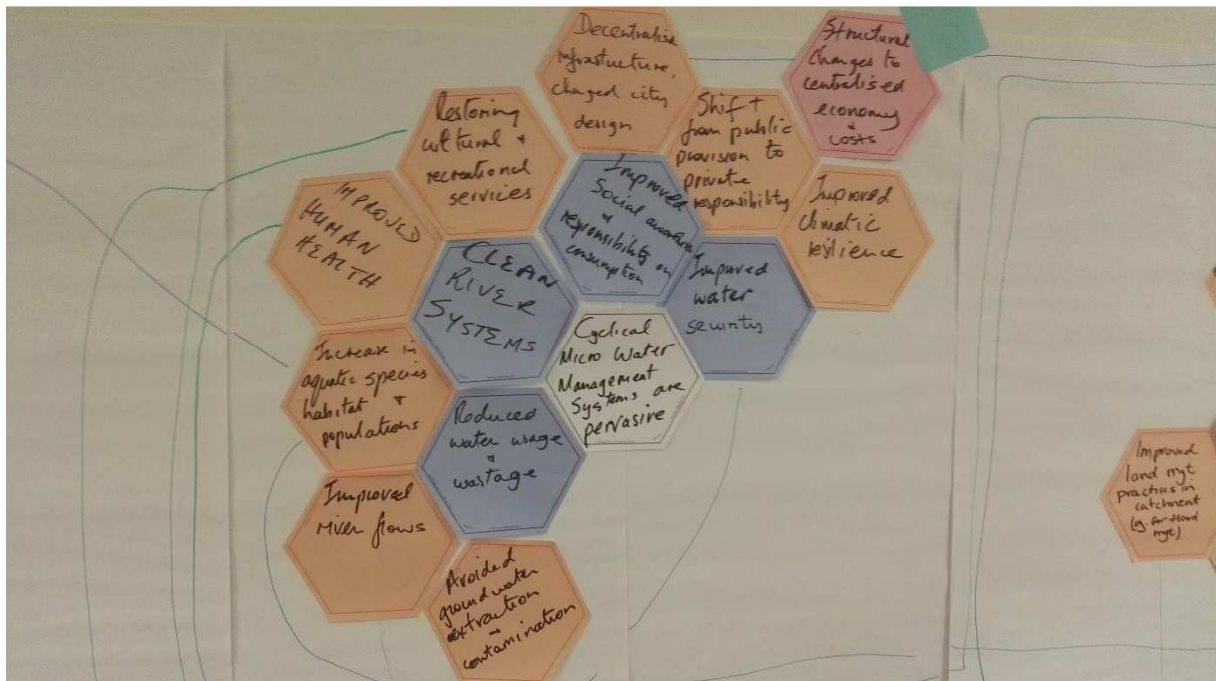
Future wheel of seed 3: Renewable Energy only, excluding hydropower
a) Description of 1st order implications
- Free-flowing rivers, no more impoundments.
- No fossil fuel mining nor water use and contamination from it.
- Recovering river systems and habitats.
- A spurt in alternative energy technologies, innovation and solutions.
- Significant reduction in greenhouse gas emissions, achieving climate targets.

b) Description of 2nd order implications
- Vastly reduce losses in in-pipe transfers and from reservoirs.
- Significant changes in sediment delivery downstream, restoring floodplain and estuarine function, without impoundments trapping sediment.
- Community-scale energy generation.
- Improved human health (no air pollution from fossil fuels).
- Increase learning to use natural cycles (e.g., flooding).
- Improved land management practices in catchment, improved agricultural productivity.
- Water savings, improved system function, natural flooding systems restored.

c) Description of 3rd order implications
- Increase in socio- cultural services.
- Increased tourism and recreational opportunities.
- Less fossil fuel by-products polluting freshwater systems, including groundwater.
- Local job creation from new services sectors (installing, maintaining etc.)
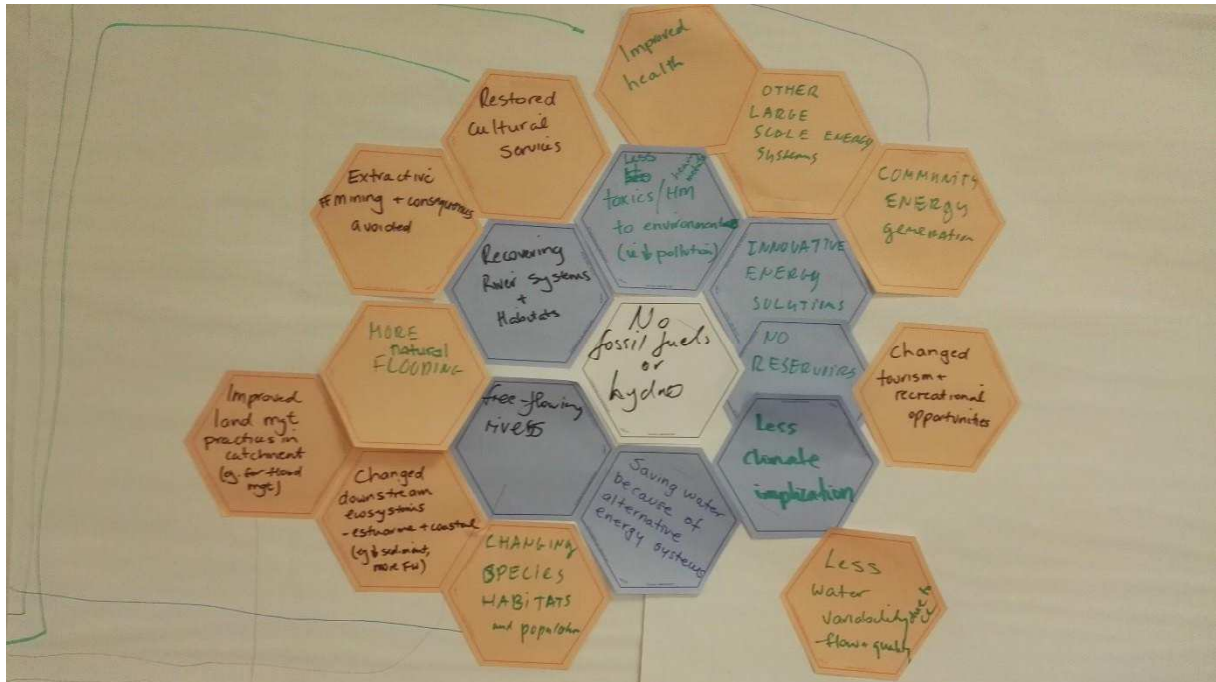
Interactions between seeds:
The three seeds in the water theme reinforced each other. All three rely on the use of ecological principles in the form of biomimicry and ecosystem-based adaptation to change to restore optimal natural functioning and urban redesign. Within this context it is imperative to work with indigenous species in restoration within a framework of rewilding the landscapes.

Recognising rivers as living systems and restoring their optimal functioning enables greater surety of supply as well as numerous other ecosystem and human health benefits. Micro-scale water management enables better understanding of, and local ownership over, resources and local monitoring and enforcement of transgressions, all brought about by greater social cohesion and cooperation through Catchment Management Agencies (CMAs), building cooperative trust regarding working towards common and more equitable sustainability goals. With the water-energy nexus being inseparable, micro-scale renewable energy systems offer enhanced ownership and control of energy resources, the exploitation of which (fossil fuels) have had vast negative impacts on water resources in the past. Together this focus on inseparable micro- scale water-energy systems vastly improves the ability to rapidly enable re-design of urban environments and better use of green infrastructure for energy and water efficiencies, and generation. All three Seeds also demand improved overall land and catchment management practices (stewardship). This will only be achieved by changes in policy to enable formation of CMAs incorporating all stakeholders within each catchment, as for example in South Africa with revised water laws intended to enable the formation of stakeholder-based CMAs of all water users within a catchment.

Headline and three statistics:

Headline

"Nature shows the way"

Statistics

- Houston withstands Category 10 Hurricane Harvible!!!!
- 100% redesigned urban planning based on biomimicry of natural river systems.
- 90% of households recover power due to micro energy systems.
- 75% of households back on drinking water supply because of micro-water systems.

B4.3 Developing scenario narratives

Summary of the discussions based on the STEEP and VERGE methods, which contributed to 'fleshing out' the scenario skeletons.

Greater resilience of communities, urban environments and infrastructure and natural systems emerged as common denominators from the proposed seeds. Because of these changes, all human and natural systems would be less vulnerable to extreme weather events, as well as a generally warmer world and its implications for 'drying out'. The overall trajectory is for the creation of more sustainable social-ecological systems where solutions need to be developed in a local and culture-specific context, as well as being customised to the type of local natural systems (terrain, climate, soils etc.). This shift toward the decentralisation of politics, societies and services would also enhance resilience, breaking dependency on top-down governance, massive infrastructure and policy inertia in the face of change, most especially localised change.

Enhanced information flows and more collaborative and cooperative societies are envisaged, along with dramatic shifts in socio-economic models, away from elite capture and flows to the top, to more equitable societies and circular economy flows. Radical shifts in urban design, green infrastructure and sustainable cities would bring about improvements in human wellbeing and life satisfaction, with services more customised to local and individual needs.

A key component of the shift to a 'good Anthropocene' in the Water theme is of a change in social norms and values regarding freshwater, where water is no longer treated as a "free good" nor rivers, etc. as a 'waste repository', but in addition to being a valued provisioning ecosystem service, water has fully recognised cultural and ecological values. Valuing and treating water as an eco-cultural heritage by using and enhancing cultural knowledge around water mythology, traditional water management and learning to classify the different uses for water, both consumptive and non-consumptive, including cultural uses, will greatly assist in the required mindset shift. In this it is key to share and integrate communal-based information and methodologies, such as cultural indicators of water health, with more usual scientific indicators of water and river system health.

B4.4 Three Horizons Framework

Present:

The current era of massive water and energy infrastructure build must be phased out. This includes large scale dams, irrigation and water treatment systems and large energy infrastructure based around fossil fuels, such as coal-fired power stations. These have led to massive disruption and pollution of river systems, habitat destruction, disconnection from and mass migration of people and lack of any local ownership and control, resulting in lack of care for water resources and the greenhouse gas emissions which have given rise to global warming. Subsidies for fossil fuels must be phased out rapidly, and massive engineered water works, controlled by central governments yet paid for by taxpayers, must no longer be built. The new focus must be on investment into interconnected

microscale water and energy systems, community-ownership and demand side management of all water and energy provision.

Transition zone:
In order to effect this transition, the following need to occur: demonstration of effectiveness of small-scale systems; improved citizen knowledge about the real cost of resource use; real-cost accounting of the current system with removal of externalities and making environmental crimes such as water pollution capital crimes; tax breaks and incentives for micro-enterprises and immediate adoption of feed-in tariffs for renewable energy generation; rapid changes in political governance systems and incentivizing local 'sustainable development councils' whereby local citizenry are empowered to take ownership and decide and plan on their resource use, types of utilities, energy generation, etc., engagement and building of community trust with retraining and empowerment programmes, retrain and reskill people from the fossil fuel sector into new renewable energies and jobs generated by maintenance of small scale infrastructure, with subsidised entrepreneurial opportunities in micro-enterprises for those workers and communities where jobs will disappear with the shift; and re-integrating urban environments with natural environments so that the former are not just a driver of exploitation and degradation of the latter, undermining urban sustainability in the long- term.

Future:
The 'brave new world' of sustainable, micro-scale, clean, cost-effective renewable energy and water systems will enhance social cohesion through citizen cooperative councils, and reduce inequities and greatly improve citizen wellbeing and access to opportunities. Rapid phase out of the old will occur by aggressively retraining people to participate in the new micro-scale, circular economy. River systems will be restored, habitats and biodiversity enhanced and cultural relations with nature restored. However, massive pushback will occur from vested business interests such as the fossil fuel sector in maintaining the status quo, as well as the entrenched corruption endemic with massive construction projects and tender processes worldwide. Society will need to mobilise in great numbers to demand the shifts in the current socio-economic order based on the knowledge of enhanced ownership of livelihoods, improved health, addressing the dangers of GHG emissions and restoring cultural heritage and nature's benefits to people. Defining these priority strategic pathways and the key enabling environment should include measures such as ramping up carbon taxes and eradication of fossil fuel subsidies to incentivise the shift to a zero carbon economies, incentivising water efficiencies and 'dry technologies' and making water pollution and wastage capital crimes. The opportunities for more liveable cities, local ownership, reduced consumerism and building a more equitable circular economy will enable momentum to build to effect the necessary changes.

Appendix B.5

Group 5 - A Tasty World with Values

B5.1 Three seeds session

Seed 1: Biodiverse food systems based on reciprocity, harmony, relationality and sovereignty
Example: Potato park in Peru (see http://www.parquedelapapa.org/eng/03parke_01.html)
- Indigenous communities caring for diversity of natural varieties of important food crops, particularly in their areas of origin.
- Management systems based on inherent values in community.
- Future oriented – preparing for environmental (including climate) change.

This seed was selected for the way it manifests the central role of food systems in the relationship and wellbeing of humans and nature. It highlights the role of spiritual values and indigenous communities in conserving biodiversity and enabling humans to reap its bountiful harvests as well as the contribution of humans to nature when agricultural systems are centred on values of reciprocity, harmony and relationality. Finally, it brings to the fore the importance that food sovereignty constitutes for small-scale farmers and communities around the world.

Seed 2. Cultural institutions for managing epistemic diversity between indigenous peoples and communities and other knowledge systems
Example: Centres of Distinction on Indigenous and Local Knowledge (see http://swed.bio/news/indigenous-and-local-knowledge-in-ipbes-traditional-knowledge-in-the-cbd/)
- Empowering local communities to contribute in exchange, transmission, mutual learning and community participation.
- Governing the sharing of knowledge process and practices of local and indigenous communities based on principles adopted in various international agreements (CBD) and declarations (Universal Declaration on the Rights of Indigenous Peoples) including within IPBES
- Recognising and respecting epistemic diversity in the processes, values and approaches for generating and applying knowledge.

This seed was selected because of the central role that knowledge systems, encompassing values and worldviews, have for the human relationships with nature and the challenges currently posed for gaining respect for epistemic diversity in the dominating scientifically based knowledge system. Furthermore, it illustrates the need for capacity building among all participants in biodiversity related knowledge systems for enabling the fruits of epistemic diversity to mature and benefit decision-making and governance in human-nature systems.

Seed 3. Reconnecting with nature - nature values centred learning and education processes
Example: Enviroschools (see http://www.enviroschools.org.nz/)
- Connecting young children from early years with nature, including growing food.
- Enabling the understanding and recovering of ancestral views of human-nature relation and learn from other cultures' perceptions of the world, capacities and behaviour.
- Improving cognitively oriented relations with nature (passion for sciences and knowledge)
- Pedagogical approaches that combine heart, mind and practice.

This seed seemed inevitable when contemplating our desired vision of what human-nature relationships should look like in the future. It reflected insights gained from the introductory session of the workshop where each participant shared a picture and narrative of how they related to nature. So many of them referred to childhood memories of being *in* nature and observations of how different

and less intense that is for their own children. Educational processes – broadly speaking – that engage not only cognitive facilities but also emotions and values connected to place and culture emerged as a central means of achieving our vision.

B5.2 Future wheels session
Future wheel of seed 1 – biodiverse food systems
a) First order implications were identified in the following clusters
- Positive impacts on food (production) systems through: recovery of diverse seeds and plant races, recovery of water sources, increased adaptive capacity of crops towards climate change, a broader transition in agro-ecology, maintaining landscapes that ensure continuous evolutionary processes, more resilient, stable and predictable ecological dynamics, the expansion of networks of production and distribution of products, business models based on reciprocity, harmony and relationality, opportunities for biocultural branding, the coexistence of diverse food production systems with food evolution and innovations in quality.
- Positive impacts on human wellbeing through: reduction in poverty and hunger, better mental and physical health and people reconnecting with nature through a fundamental human requirement (food) and through this increasing their appreciation for biological diversity.
- Positive impacts on local communities through: more ownership, protection, access and control of food crops, localised solidarity and sharing economies, increased community resilience, rejuvenated practical skills, the empowerment and involvement of women and youth in the economy.

As second order impact was raised the reduced power and resources of large scale agribusiness.
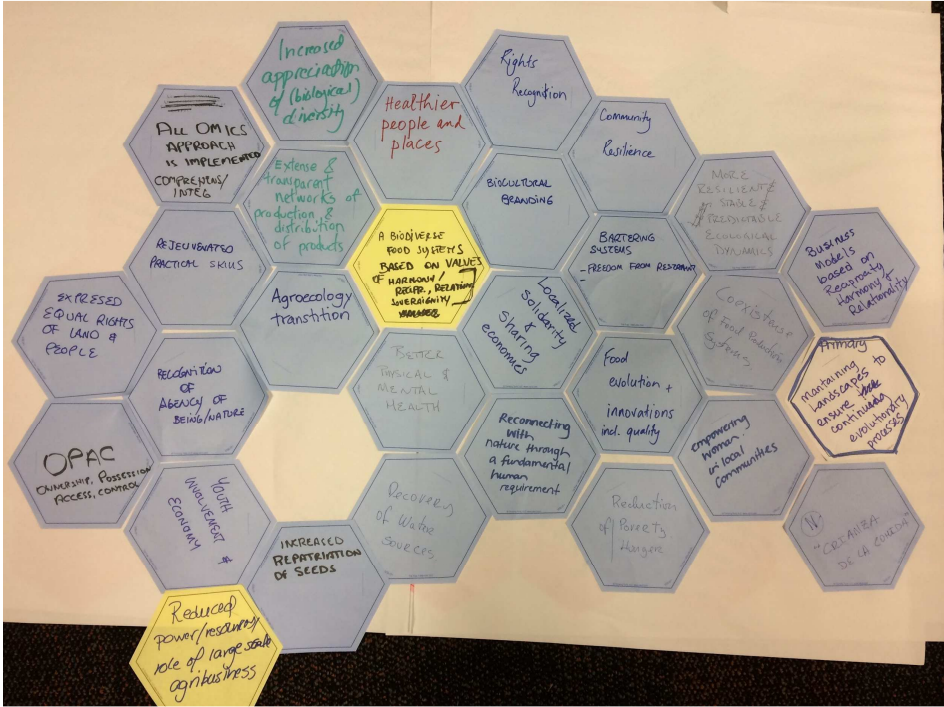
Future wheel of seed 2 – cultural institutions for managing epistemic diversity
a) First order implications were identified in the following clusters
- Strengthening of traditional knowledge systems through: increased knowledge transfer across generations and communities, increased innovations based on traditional knowledge protection of indigenous and local knowledges, support for community initiatives, cooperative approaches in generation and management of knowledge, linguistic diversity and proficiency, databases controlled by communities, enabling of the expression of sovereignty for indigenous

peoples and local communities with regard to their knowledge system and related access to benefit sharing from the use of that knowledge.
- Changes in the relationship and valuing of different knowledge systems through: the widespread recognition of the right of all to contribute to the generation of knowledge, ILK systems considered having equal standing with scientific knowledge systems, the recognition of epistemic diversity in all curricula, democratisations of knowledge and technologies, new tools for sharing and mobilising knowledge, more humble scientists and other experts, investment and recognition of traditional knowledge at national and global levels.

Second order implications include new social hierarchies and multiple sources of identity and changes in the ideology of knowledge.
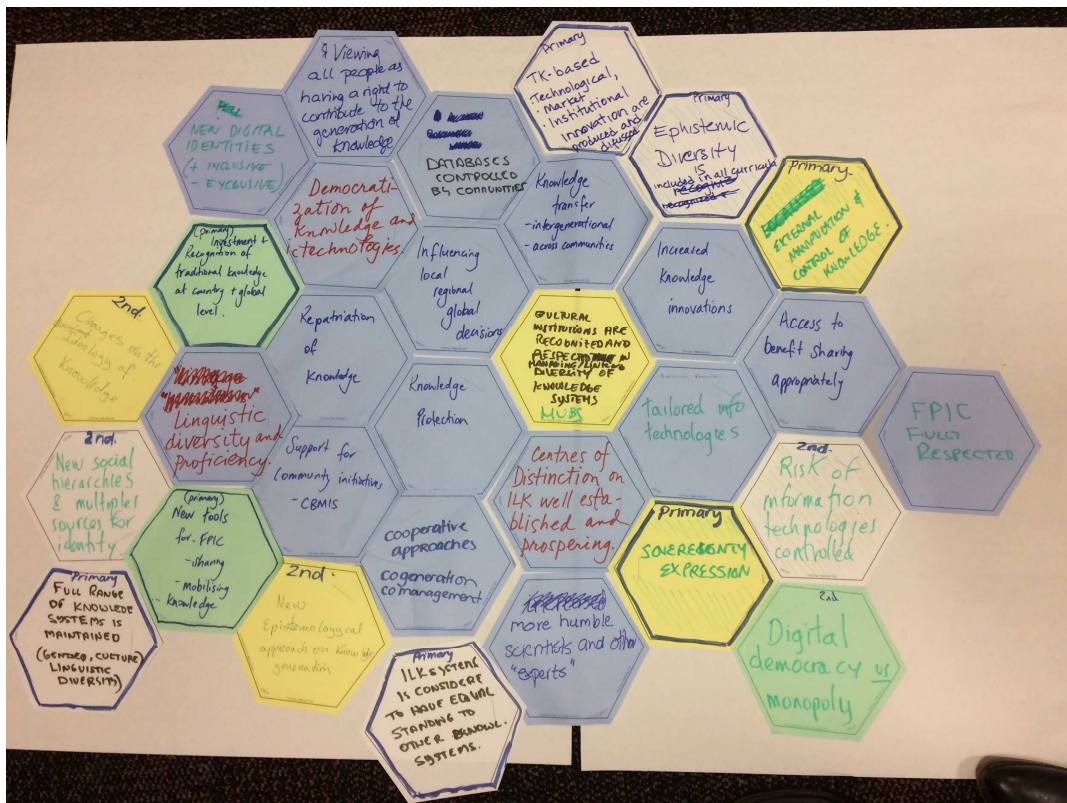
Future wheel of seed 3: re-connecting with nature

a) Most discussion was centred on 1st order implications. These came in the following clusters:
- Positive impacts on human wellbeing, through gaining emotional and spiritual intelligence, reconnection with nature, widening senses, celebrated gender diversity, the embedding of indigenous food technologies and traditional medicine, more outdoor pre-schools, more place based and intergenerational education, including 'other' ways of knowing and interaction-centred education.
- Positive impacts on communities and society at large through more caring and empathetic people, elders recognized and respected, families connected and involved, the ripple effects into homes and communities, generation of new knowledge responsive to future needs, more but critical development and embodiment of technology, together providing real links between education and social change.
- Positive impacts on biodiversity through higher levels of customary law directing action, customary practice manifested in daily actions, much stronger support for environmental regulation in the electorate, and regenerating (repairing) nature in experimental programs,

As second order implication was mentioned the risk of more environmental tourism (and thus higher CO_2 emissions).

Headline and three statistics:
Headline
Learning tasty knowledges of nature in a bioculturally diverse world
Four target indicators by 2050
- All children appreciate cultural and spiritual values of nature.
- Food system diversity is increased 20 times.
- A convention on epistemic diversity in place.
- Universal and full implementation of internationally agreed upon principles that ensure the rights of indigenous peoples.

B5.3 Developing scenario narratives
Summary of the discussions based on the STEEP and VERGE methods, which contributed to 'fleshing out' the scenario skeletons.

Our vision is of a world which manifests at all levels values of reciprocity, harmony and relationality in humans' relationship with nature; where humanity is continuously enriching the flourishing of nature and able to sustainably reap its abundant bounties and where biological and cultural diversity are co-conserved and co-managed without being enclosed in protected areas. Every child appreciates cultural and spiritual values of nature and every human has a relation to place, feels part of nature and a community, has a deep awareness of interrelations between their own place and actions with places far away in space and time and learns to act accordingly through a lifelong intergenerational educational process. It is a world where there is respectful sharing among diverse knowledge systems and their ways of looking at and valuing the world based on the recognition of the valuable contribution of all humans to the generation of knowledge and wise application of technology. Our world is one where most food is produced by small scale familiar farmers along the continuum from rural to urban (e.g., food demand/supply short chains, urban agroecological gardens creating

biocultural corridors) under principles of respect and enhancement of cultural and biological diversity, creating a sovereign polycentric agrifood system highly resilient towards environmental changes. Such landscapes will be (tele)connected exchanging information, learning and products locally and internationally, under principles of social-ecological justice of trade. In our world relationships of domination and power inequity (e.g., epistemological domination, gender and social inequity) has been transformed into relationships of mutual respect and justice. A rich diversity of governance systems related to place and context share central value foundations of obligation and responsibility towards nature and universal recognition of indigenous peoples' sovereignty over their lands and knowledge systems through which they serve as custodians for 60 percent of the world's biodiversity and much of the potential of conserving and enriching the food crops for humanity.

B5.4 Three horizons

Today the three seeds above mentioned are niches constrained by several barriers and facing multidimensional challenges. Major environmental change drivers (e.g., climate change and its cascade consequences, loss of natural resources, invasive species) are concomitant with other political (e.g., free trade agreements, lack of support to small farmers and indigenous people), socio-economic (e.g., urbanisation trend, land grabbing, social problems) and cultural drivers (e.g., economic centric values, scientific-technocratic dominance) in hampering a scaling up and scaling out of such initiatives.

Some of the interventions proposed could create a favourable environment for future transitions, decreasing some of the negative effects of such changes. However, uncertainty and surprises, especially for environmental changes and possible ecological tipping points, are expected to highly influence future transitions from the seeds to their mature state (i.e., vision).

Many measures and interventions can be promoted to create a favourable environment for a transition. Different instruments and policies are implemented, such as co-managed and collaborative planning of food systems, from local to national and transboundary, and specifically adopting novel urban-rural planning initiatives at the local level and enhancing international networks for exchanges of tools and information. Such initiatives should be achieved in a not so far future, as intermediate steps to the vision, including the restitution of diversity through participatory plant breeding among experiences and Biocultural regions without genetically modified organisms (GMOs), consisting of only wild heritage species (global scale). In the meanwhile, an energetic transition is implemented, driven by a continuum change in the energy system through the implementation of policies and measures for introducing local clean energy sources and implementing low carbon food systems as well as changing demand of energy. Tensions over technological change achievements as support to energetic transition emerged during the debate.

In order to have in the future novel business models implemented and new partnerships, local and regional markets and biocultural innovations should be promoted with biocultural brands created and certification regulated.

The legal and institutional system will be modified at national and international level to achieve the abovementioned vision, for instance recognizing Mother Earth and living systems' rights, valorising biocultural heritages, implementing protocols for supporting indigenous and small farmer access to land, protection against biopiracy, and elimination of patents on seeds, genetic stocks and species.

The cultural changes mainly drive the transformative pathways from the seeds to the future vision. Short and medium-term steps should include a wider mobilisation and support of collective actions around the world and the diffusion of a more radical or direct democracy mechanisms. Working with elder people and nature-centred communities to guide the establishment of learning for future and valorise traditional knowledge and culture in urban spaces as well as engaging younger people and their parents on such new learning spaces, e.g., including in University degree studies of traditional /indigenous and environmental culture, may reinforce in the future a renewed nature-centric culture

and finally influencing changes in dominant narratives and behaviours (e.g., changes in consumption, waste culture, environmental behaviours). Such objectives may contribute to changing the language of media to support nature-centred worldview. In order to achieve the above-mentioned vision, a recognition of rights of diverse knowledge systems is also needed (i.e., indigenous and local as well as gender) as opposed to the current domination of scientific–technocratic epistemology. The vision also requires further strengthening of multicultural pluralistic institutional engagement and acknowledgement and promotion of pro-gender and pro-diversity policies and education.

The following tables show the complete list of current challenges, the pathways from present niches to the future vision and the transition phase as discussed within the group.

	Biophysical	Political	Socio-economic and demographic	Cultural-technological
Current challenges/ barriers/ conditions	Nutrient and soil erosion /loss /desertification	Lack of State support to small/family farming	Free trade agreements on local production	Scientific arrogance and hegemony
	Genetic erosion	State nationalism/State interests	Urbanisation and worldwide migration	Widespread access to technology
	Lack of diverse and multifunctional systems	Loss of traditional institutions, norms, knowledge, values	Land ownership/land grabbing	Understanding knowledge rules privacy /new rules in the age of rapid technological changes
	Climate change/water availability /climate thresholds /disasters	Authoritarianism	Loss of land/loss of culture	City way of living- reduced opportunities to experience nature/culture
	Species range shifts	Reversal of progressive norms in governance	Intellectual property rights exclosure/ enclosure	Economic centric principles of values: consumerism, materialism
	Ecological threshold changes		Social issues: Poverty/undernutrition and malnutrition conditions	Loss of languages from traditional people
	Uncertainty/surprises		Domestic violence	Validity of knowledge/who validates? Science does not validate traditional ecological knowledge (TEK)
	GMO impacts		Tourism as place - culture consumption	Barrier: number of existing TEK holders low
	Invasive species		Backlash from business (big conglomerations)	Communication concentrated in consumerisms
	Loss/erosion crop diversity			

	Near future	Transitions
Food system	Different instruments and policies to implement co-managed and collaborative planning of food systems (local/national)	Key transition in seed-crop-food systems: Repatriation and restitution of diversity through participatory plan breeding among experiences
	Different instruments and policies to implement urban/rural planning (small towns, Supply/demand short chain, agroecological gardens, more integrated food systems…) (local /national)	Biocultural regions without GMO, only wild heritage species (global scale)
	Creation of international network (exchange of information, best practices, tools for biocultural food system management etc.)	
Energy system	Policies and measures for local clean energy sources, low C food systems implementation (local/national level)	Key transition in energy system: technological change achieved
Economic system	Create local and regional markets	Increasing partnership with non-traditional players business
	Biocultural certification (international)	Novel business models implemented
	Biocultural brand created (international)	
Legal/ institutional system	National recognition of biocultural heritages	Recognition by UN and national legal systems of all species' rights, and the right of Mother earth
	Implementation of relevant internationally agreed upon treaties and declarations e.g., the Nagoya protocol and the United Nations Declaration on the Rights of Indigenous Peoples	Revised National Biodiversity Strategy and Action Plans
	Environmental/social safeguards are implemented with compliance + redress mechanisms	International legal recognition on biocultural heritage
	National protocols for supporting indigenous land rights	United Nations treaty on ocean and land rights for recognition and access
		Elimination of patents on seeds, genetic stocks, species through treaties

	Near future	Transitions
Cultural system	Mobilisation and collective action	Changing narratives - nature centric
	Diffusion of co-production of knowledge based on multiple evidence	Radical or direct democracy implemented
	Elder guiding the establishment of learning for future and create new traditions in cities	Recognition of rights of indigenous knowledge vs science dominated
	Youth waiting to engage parents support uptake of new learning	Strengthening multicultural pluralistic institutional engagement
	Traditional schools and universities /cultural traditions implemented	Becoming part of other communities - adopting nature centred communities as reference
	Reduce consumerism due to media changing language to support nature	Gender rights acknowledgement; pro-gender policies and education, pro-different abilities policies
	Recognition of cultural dimension of sustainable development	Technology widespread (Information and communication technology (ICT)): tensions and opportunities
	Promotion and awareness of cultural issues	Behavioural changes in consume, waste culture, environmental behaviours
	Uptake of pro-environmental innovations	New youth culture nature-centric from traditional /indigenous and environmental culture

Appendix B.6

Group 6 - Dancing with Nature

This vision focuses on dynamic nature, where there are processes that function autonomously of humanity, and that humanity has reconfigured itself to accommodate these shifting processes. This vision was developed by articulating a future that produces dynamic nature in the Anthropocene, an era of pervasive human influence. This vision includes a world in which nature is given space, biomass and resources to thrive, and this nature is connected at multiple scales. Human infrastructure and civilization is designed to accommodate rather than regulate the living and non-living fluctuations of nature, for example seasonal animal migrations and periodic floods. When and where needed, humans intervene in nature to enhance the autonomy of ecosystems and to cope with human-caused changes in the environment, using technology, including genetic engineering to enhance ecosystems, and helping ecosystems and species to thrive in a world transformed by humanity.

B6.1 Three seeds session

This group focussed on the idea of maintaining and enhancing the capacity for nature to be dynamic, surprising, and producing novelty, while supporting and being stewarded by human civilizations whose dynamism matches dynamic natures. We discussed seeds, example of existing projects and initiatives that could grow into part of a future dynamic nature, prior to selecting three seeds to focus on for developing a future vision. In the discussion of seeds we aimed to identify a set of different complementary seeds to start with, and we did this by identifying a set of themes, that included size and connectivity of non-human dominated ecosystems, the ability of both plants and animals and wilderness to move, which raised the theme of corridors and barriers and the concept of dynamic 'reserves' and dynamic zoning (i.e., land use planning that is not fixed but rather plans for dynamism of societies and ecosystems). We also discussed what would maintain adaptive capacity and diversity necessary for dynamism in both societies and ecosystems, which raised the themes of modularity, loose coupling, diversity, and scale, and noted that a world of change will have novel ecosystems. Such novel ecosystems are more likely to be desirable if they maintain nature's diversity and dynamics while providing benefits to people, however novel ecosystem can also create negative surprises which negatively impact both people and nature. Novel ecosystems can act as evolutionary traps, decreasing the adaptive capacity of species, and novel ecosystems can be socially undesirable providing few ecosystem services and multiple ecosystem dis-services, such as pests, diseases, and infrastructure damage.

The group clustered the discussion of seeds to focus on three complementary areas, connected landscapes, dynamic settlement and infrastructure, and technological stewardship to enhance the dynamism and autonomy of nature. The three seeds we selected in these categories were:

- Conserving the stage – maintaining more wild regions and wild connections among them across large trans-national, continental scale areas.
- 'Room for the River' – defined broadly, the assortment of initiatives around allowing rivers to vary in the Netherlands, including urban redesign.
- Gene Editing Technologies – gene editing was incredibly time consuming and cumbersome, recently CRISPR has allowed the more wider use of gene editing in conservation and management of nature.

B6.2 Future wheels session

The initial seeds: conserving the stage, room for the river, and genetic engineering were projected to grow into the mature Seeds: Space and Time for Nature, Dancing with Nature on the Evolutionary

Stage, Engineered Dynamic Nature. As shown below each of these mature seeds was then developed by articulating social and ecological implications of the seeds. These are outlined below:


Future Wheel of Mature Seed: Space and Time for Nature

Implications of this seed included new approaches to infrastructure that made human dominated areas such as croplands and urbanised areas permeable and habitable to nature, enabling seasonal migrations, dispersal, and longer-term movement of plants and animals, but also increasing the ability of ecosystems to cope with and recover from shocks and extreme events. Populations of plants and animals would suffer less from inbreeding, increasing ecological resilience and maintain evolutionary processes. These changes in infrastructure also mean there would be more integration of wild nature in most people's daily life, including how people make their livings based on these changes. There could also be new types of conflicts between human activities and wildlife, building designs would have to shift to accommodate dynamic nature, and alternative approaches to building that combine cheaper temporary, seasonal buildings with more expensive long-lasting, adaptive buildings.

Second order consequences of this vision would be increased space for wilderness in dynamic protected area networks, along with a rewilding of human dominated lands. These changes would lead to an increase in the diversity, and the population and biomass of wild animals. We also anticipated the increased ability of nature to move would be combined with the increased ability of people to move; these approaches could be inspired by historical practices of seasonal migration and common property rights that enable seasonal migration. These changes would be produced by and require a related set of social, political, and policy changes. There are many existing, or sleeping institutions, that unbundle land rights. Such systems granted diverse people different rights to land. For example, the right for people to seasonally harvest fruit or temporarily graze animals in a landscape. Such

institutions, which recognise the dynamic quality of interactions between people and nature, could provide a basis for the reinvention of new types of flexible unbundled property rights to a dynamic nature. Some of these changes would be relatively simple, such as mechanisms for investments and implementation of climate adaptation, while others would be more complex, such as ecological engineering for rewilding, and building new social institutions to enable more flexible societies for people and wildlife. These changes would likely require new experimental approaches to regional governance, which could grow out of existing institutions for peace parks, and regional river management.
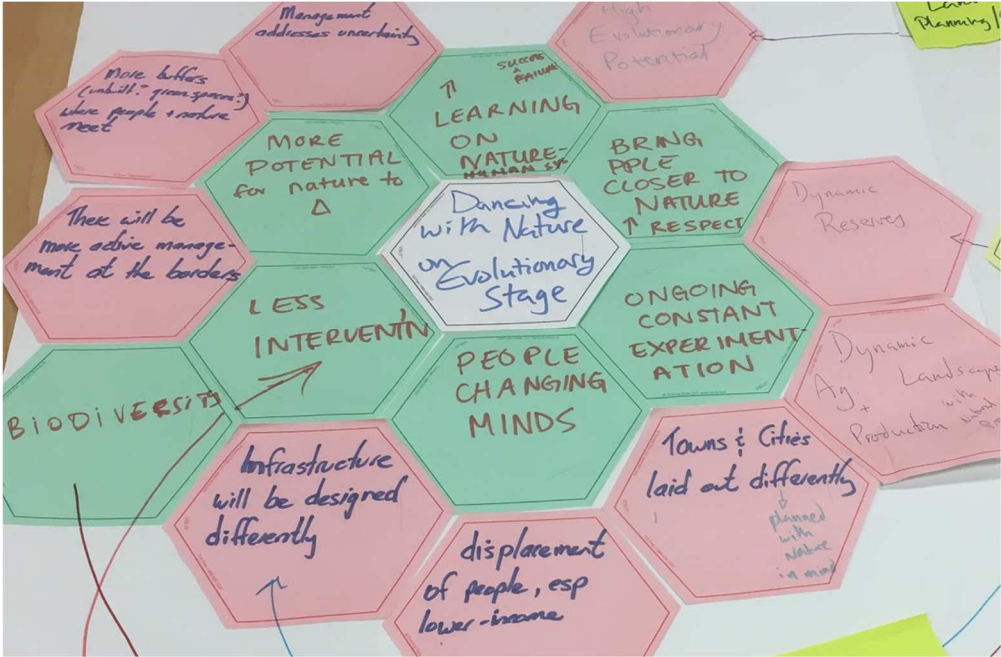
Future Wheel of Mature Seed: Dancing with Nature on Evolutionary Stage
The mature seed, Dancing with Nature on the Evolutionary Stage, represents a society in which human civilization responds to and stewards the dynamics of nature. This represents an approach to the Anthropocene that acknowledges that the world is on a path into novel environmental and ecological conditions that require an ever-shifting set of new solutions and strategies. The implications of this world are a shift in world values towards a focus on dynamism, adaptation, and accommodation, and away from one focused on stability and control. This implies a focus on constant experimentation and learning about an ever-shifting dynamic between people and nature. This means that nature has more possibility to change, both in terms of the structure of communities, but also in terms of fluctuations in water, vegetation, and animal populations. These changes provide both resilience and adaptive capacity to ecosystem. In this world, along with stewardship of wild nature, there active and dynamic management of the shifting ecotones between human dominated and more wild ecosystems. This would likely develop into different types of dynamic zoning and mobile buffer zones in which various types of human activities would be matched with different types of natural dynamics, for example flood tolerant buildings and infrastructure in flood zones. Towns and cities will be continually changing, requiring innovative ecological approaches to the design of infrastructure and housing. Second, shifts from agriculture toward more multifunctional agricultural landscapes are needed to provide space for multiple types of ecosystem service flows across landscapes. These changes would be enabled by shifts towards healthier, lower meat diets, that allow the world's population to be fed while using less land. These changes will also produce and require shifts in property rights and other institutions that are time dependent and adapt to changes over time. Such changes could grow out of adaptive regulations that lock in rights for a fixed time period, during which rights can be adapted and extended or

maintained for the fixed period. There is more social planning for surprise and an increased ability of organisations and individuals to accept, cope with, and benefit from ambiguity, surprise and novelty.

Mature Seed: Engineered Dynamic Nature

The mature seed, Engineered Nature, represents a society in which humanity takes a broadly active role in the stewardship of non-human, autonomous nature. Genetic engineering, ecological engineering, and the construction of green infrastructure are used to produce novel ecosystems that enhance nature's adaptive capacity while also meeting human needs. Such engineering could increase the human benefits of agriculture, diversify agricultural ecosystems, reduce the need for animal protein, and in many ways, increase the availability of healthy food for people and reduce the negative impact of humans on nature. For wild ecosystems, this vision includes management or removal of species that disrupt ecological functioning or negatively impact biodiversity (e.g., by producing evolutionary traps), and ecosystem services. This could include the removal of diseases, disruptive invasive species, such as predators that kill native birds, or the introduction of novel species, such as large browsers or predators that restore or introduce desired ecological functions. This could produce novel designer animals, plants and ecosystems that are designed to replace formerly extinct large animals (i.e., extinct megafauna) to restore important ecological functions. This could also decrease interest in conserving existing ecosystems and lead to the accidental spread of disruptive novel plants and animals with negative surprising properties. Engineered nature has the potential to empower elite visions of nature, due to their access to resources to engineer, and has the possibility to privatise nature. These tendencies could increase divides in the access to ecological engineering knowledge. These negative consequences would lead to social conflict over ecological and genetic modification, and lead to the creation of new local, national, and international organisations and institutions to regulate, negotiate and manage these conflicts.

Interactions among seeds

Among these seeds we anticipated many mutually reinforcing process and several tensions. We foresee a declining spatial extent for agriculture and an increase in urbanisation that would enable rewilding, which would include the human re-creation of populations of megafauna and predators over wide areas. Populations of wild large animals would be supported by large wild ecosystems.

Dynamic networks of wild ecosystems would exist at multiple scales and would be accompanied by efforts to assist migration of plants and animals to cope with climate change. These would co-exist with shifting mosaics of domestic and wild ecosystems, accommodating change and ensuring the resilience of ecological processes. People would act of stewards of these mosaics, using adaptive land use planning and management. Management activities would aim to enhance and maintain adaptive capacity of both people and nature, while attempting to resolve emerging conflicts. Management would build and utilise ecological and genetic engineering, in combination with green infrastructure.

While space, variety, diversity and autonomy increase nature's ability to thrive in the Anthropocene, there are a number of tensions that emerge in this vision. The first tension is deciding which people's values are selected and which types of dynamism are accepted, and where does that dynamism occur. There would have to be some legitimacy of decision making for this vision to even exist, but there are many ways dynamic nature could be created. For example, more space for nature could mean more separation of people from some aspects of nature. Alternatively, more intermixing of people and nature could impair the ability of big slow species and processes to function and change. Similarly, attempts to genetically or ecological enable wild nature may be able to maintain nature, but this runs the risks of eroding the long term adaptive capacity of evolution and ecosystems.

Headlines and Statistics

- Moas recolonise North Island.
- Predator fences removed from Zealandia.
- 10 ways we avoid an extinction crisis while creating our fabulous, sexy world.
- Last species removed from 'threatened' status on IUCN red list.

B6.3 Developing scenario narratives

We identified a number of principles that lie at the core of the "Dynamic Nature" vision:

- People provide space for a diverse, connected and therefore adaptive nature in a dynamic world (Anthropocene).
- Dynamic nature requires dynamic people. Nature changes and civilization changes with it.
- Civilization is built to accommodate and enhance nature's shifting rhythms and flows.
- Genetic, industrial, and ecological technologies are used to create engineered wilderness across landscapes and seascapes to enhance people's lives and nature's dynamic capacity.
- Governance of ecosystems and processes prioritises the diverse patterns and rhythms across political, economic, and institutional boundaries.
- Society enhances its capacity to accommodate nature's dynamics by using learning-based management that prepares for surprises, plans for the unexpected, and provides precautionary safety and insurance measures.

Enabling a dynamic nature requires changes in property rights, agriculture, and urban design. First, growth must occur to support common property or management of multiple values on land and sea. This means that private property rights decrease, which requires the growth of new forms of institutions to manage conflicts among different values and demands on ecosystems. Second, shifts from agriculture toward more multifunctional agricultural landscapes, which provide space for multiple types of ecosystem services flow across landscapes, and a shift towards healthier diets that consume less meat, and allow the world's population to be fed, without requiring further intensification and extensification of agriculture globally. Third, there would need to be a focus on developing cities and infrastructure to provide multiple benefits to people and economies. Incentives and investments that spur the development of new technologies and structures would allow people

to live quality lives while coping with dynamic processes, such as sea level rise and shifts in climate and ecosystems.

B6.4 Three Horizons Framework:

The vision articulated above represents the third horizon, or how some projects that exist in the world today could grow into a new world. Looking backwards from this vision we articulated what would have to decline in the first horizon to enable this world to be.

Today's world is one of great prosperity, but also inequality, and its prosperity is full of diseases of affluence. Obesity and diet related disease are major causes of death and ill-health. While this prosperity is based on food and energy systems that have driven the world into the Anthropocene, unless rapidly changed, they are committing the world to huge declines in biodiversity and dangerous climate change.

Today the world is unequally owned, with most of the world owned by the richest 1%, while a few individuals own as much as the poorest half of the world's population. Control of land and sea is fragmented and movement and change are blocked by private and national borders. Growth of material consumption continues to grow exponentially. Wilderness, energy, urban development, agriculture, and business are largely separate fields and governments and finance focuses on returns on investments rather than enhancing human well-being. Stewardship of nature is focused on local problems and individual species, and often not part of long term strategies. These are all things that have to decline for our vision of a robust dynamic nature to be achieved.

The second horizon represents the zone of conflict between a new world emerging and an old world declining. We identified a number of tensions that occur between these competing world systems, and sketched some of the factors that would enhance the chances to achieve a dynamic nature.

There are many cracks in the existing world system. Climate change is a spectre haunting the world. An energy transformation is in transition. Similarly, the future of the global economic system is increasingly contested, with economically large nations holding inconsistent visions of the future of

world trade. Major economic institutions such as the Organisation for Economic Co-operation and Development (OECD) and the World Bank have developed 'green' measures of GDP and develop new approaches to measure social well-being. The expansion of global trade has reached a plateau and new media have disrupted late 20th century models of development. Machine learning and robotics are challenging existing economic development models. Negotiating these tensions to achieve this vision would require the emergence of novel partnerships. Already today, new partnerships between climate, food, and health are occurring as communities are identifying how better eating can be good for health, the planet, and the plate.

In the second horizon, novel partnerships emerge to take advantage of problems and tensions in the current world. Some of the ways these tensions could lead to new partnerships could be around the need to govern the novel social-ecological connections of the Anthropocene, declines in meat consumption, new economic models, new types of commons, and new social-ecological connected types of finance. The pervasive social and newly important biophysical connections of the Anthropocene could lead to the expansion of transnational agreements and organisations, such as the Arctic Council, to address social-ecological issues across national borders. Some of these will lead to the creation of transnational spaces for nature, in the deep ocean and mountain areas, that enable rewilding while providing economic and human opportunity. Declining demand for meat, driven by health, climate, and anti-meat values will provide space for new uses of some agricultural land allowing the expansion of rewilding. New economic models, some based on new types of ownership, and others based on new types of valuation of natural capital or insurance will challenge investments into green infrastructure, rewilding, and new forms of monitoring and knowledge creation. Increasingly globally distributed knowledge, combined with advances in translation will create a global information commons. The advancement of providing basic knowledge and income to everyone as a human right, is driven by global desires for social resilience, equity, and economic opportunity. A diversification and increased monitoring and regulation of finance will reduce the returns to financial speculation, and tie money more to local natural and social capital, encouraging investments that build local wealth in diverse fashion rather than solely the distant accumulation of financial capital. Focus on people is amplified by increasing restrictions on the accumulation of capital, and a shift towards the co-management and commons management of ecosystems.

There are many movements that could encourage such a negotiation of the second horizon, but we did not complete a more systematic assessment of the risks and opportunities that could enable a transition to the world of nature's dynamics.

Appendix B.7

Group 7 - Healthy Oceans, Happy Communities

B7.1 Three seeds session
a) The group discussed a number of initiatives, or 'Seeds'
- 3D aquaculture: providing habitat for the fish; tourist opportunities and ocean restoration.
- Aquatic polyculture: growing different species in one system (e.g., kelp and shellfish); building on indigenous and local knowledge.
- Community coral gardening: planting thermal-resistant corals where coral reefs have bleached; genetic sourcing; empowering local communities and building on local knowledge; climate change mitigation/adaptation.
- The Arctic Council: covers land-sea connection issues; intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States, indigenous communities and other inhabitants on common Arctic issues.
- Protection and management of the high seas: an example is the SeaBOS initiative (The Seafood Business for Ocean Stewardship initiative) which connects the global seafood business to science, wild capture fisheries to aquaculture, and European and North American companies to Asian companies.
- Ban of single-use plastics: pioneer countries Rwanda and Hawaii; dealing with pollution in the ocean (including microplastics); supermarkets with no packaging.
- Social change movements and campaigns: lifestyle changes; slow food; sustainable use; veganism; consumers triggering changes on the supply side.
- Artificial fish growing: fish protein cultured in laboratories.
- Awareness raising: Global Oceans Commission which highlights the value of the sea; ocean art.

b) The three seeds were selected by the participants by voting. The group aimed at selecting seeds which were contrasting from each other and deal with different issues in oceans. The selected seeds were:
1. Community coral gardening (climate change mitigation/adaptation).
2. High seas protection and management (ending unsustainable fishing practices).
3. Artificial fish growing and social change (consumption change).

B7.2 Future wheels session:
Future wheel of Seed 1: Community coral gardening:
The group imagined what the seed would look like in a mature state: Local communities engaged in and having control over the management of coastal areas. Communities connected with their environment in a holistic way, and the environment is restored and actively managed.

a) *1ˢᵗ order implications of the vision:*
- Empowered communities: respect to values, articulation of rights - regulatory documentation; Respect for local authority and guardianship; indigenous knowledge, practice and authority is exercised.
- Co-benefits: education, sustainable lifestyles, being connected to others, politically active, demonstration value (you are an example to other societies), health and wellbeing.
- Stable and Sustainable economic livelihoods.
- More resilient to climate changes (as you have restored the ecosystem). Resilience of both society and the environment.
- Restored relationship with nature (spirituality).
- Some practices and uses excluded.

- Potential for reduced biodiversity and other ecological impacts of manipulation: restoration can lead to reduced genetic diversity if not done right.

b) *2nd order of implications of the vision:*
- Long-term visionary leadership: sympathetic leadership, championship leadership.
- Networked communities of practice (learning from each other's successes and failures). Interconnected 'ridge-to-reef' management groups; networked restoration areas.
- Equitable markets: benefits remain within the local community.
- Comprehensive valuation, capturing multiple values.
- Translation of methodology and technology (you can use the same restoration methods in other ecosystems).
- Cross-scale regulatory agencies/regimes.
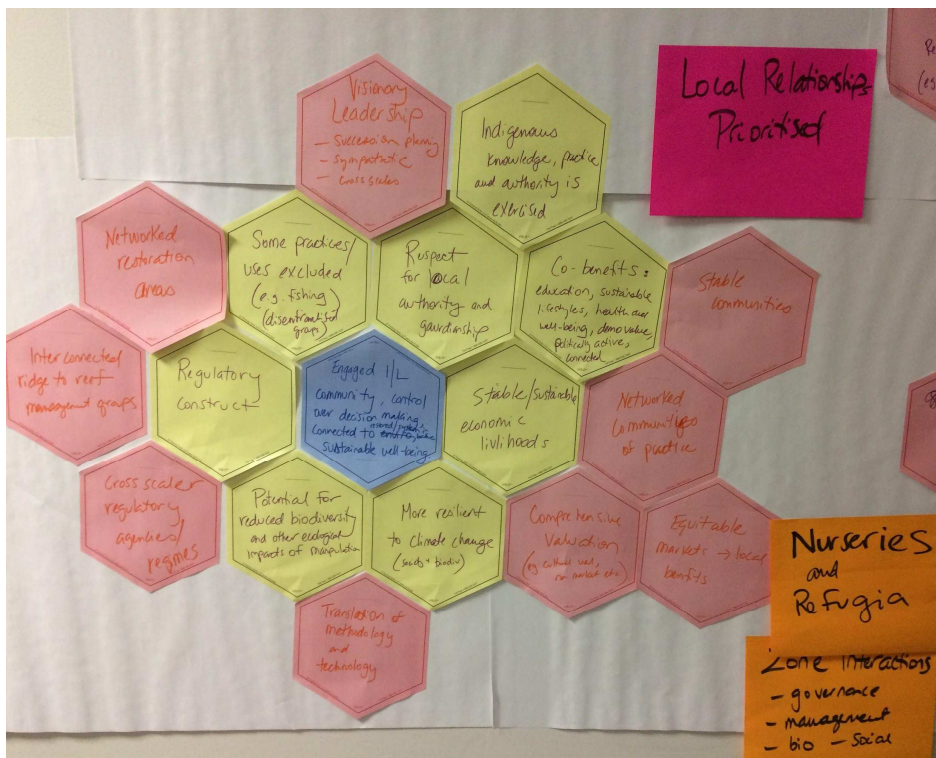
Future wheel of Seed 2: High seas protection and management:
The group imagined that the seed in a mature state would lead to a sustainable global ocean.

a) *1st order implications of the vision:*
- Full protection of the high seas (no fishing, no extractive activities e.g., Rogers et al. 2014; White and Costello 2014; Sumaila et al. 2015).
- Well managed Exclusive Economic Zones (EEZs).
- Enforcement technologies implemented (GPS, satellite, drones used for monitoring).
- More fish in the ocean.
- Marine recreational activities are sustainable (whale watching, recreational fishing).
- Benefits for the local market (e.g., reduction in costs gas, etc.)
- Food security.
- Ocean Council established as a regulatory body. Equitable membership for all countries.

b) *2nd order of implications of the vision:*
- Fish bank flow on effects.
- Reduced effects of climate change (e.g., less gas use, etc.)

- Stable communities and livelihoods.
- No forced economic migration (e.g., due to fisheries collapsing, etc.)
- Highly connected collaborative governments (lobbying to keep up the status quo).

Future wheel of Seed 3: Artificial fish growing and Social change:
The group imagined that the seed in a mature state would lead to sustainable marine food practices on both the consumption and production sides.

a) *1st order implications of the vision:*
- Educated consumers.
- Innovative protein alternatives (e.g., fish grown in labs, artificial fish made from plants).
- Eating across the trophic scales (e.g., eating invasive species, algae, jellyfish).
- Diverse food cultures (e.g., slow fish, etc.).
- Food champions (healthy/sustainable practices).
- Indigenous food and harvest practices are exercised.
- Respect for animal rights and welfare; Respectful and balanced relationship with oceans (living in harmony with nature, etc.).
- Trade-offs are transparent (costs, values, benefits, etc.).
- Waste streams are managed (bycatch, food waste, life-cycle analysis, et.).
- Equitable job markets (local control over and benefits of the fisheries).

b) *2nd order of implications of the vision:*
- Networked experiences and practices.
- Regulatory recommendations (on health, use, etc.). Regulatory component on what we should be eating (e.g., information on plastics in fish, toxicity).
- Intergenerational strategy (500-year food strategy).
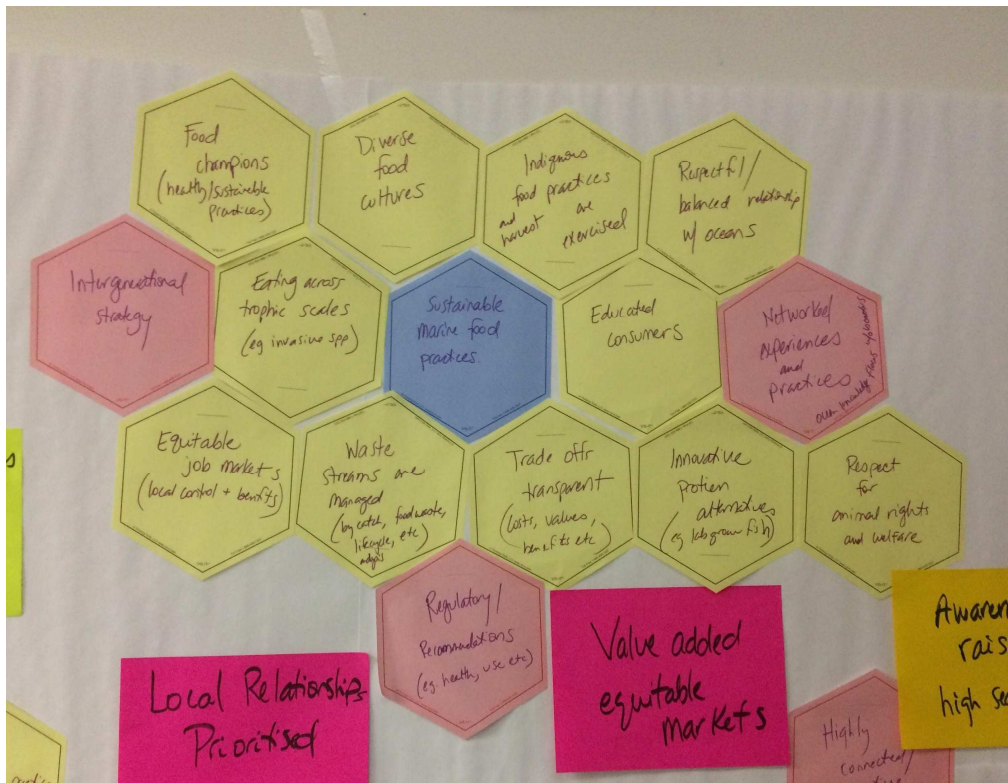
Interactions between seeds:

The cross-impact matrix exercise helped to identify potential synergies between the seeds:
-   Zone interactions (governance, management, bio-social).
-   Networked experiences and practices.
-   Local relationships prioritized.
-   Value added (equitable markets).
-   Nurseries and Refugia (coral restoration in coastal areas provides nurseries to high seas).
-   Awareness raising (social change movements have a positive impact on the high seas).

Headlines and statistics from the visions:
Headlines:
-   Nemo finds new home!
-   Coral reefs and coastal communities restored.
-   Coast restored! Indigenous and local communities in the driving seat.

Statistics:
-   100% high seas closed to fishing.
-   Indigenous and local communities driving coastal restoration and management.
-   Zero-waste from marine food practices.

B7.3   Developing scenario narratives

Social developments
-   Large businesses include social components in their strategies, where a percentage of their profit can go towards subsidising small social projects.
-   Consumers are educated on environmental issues. The change has started with education initiatives in schools, which has then passed on across generations.
-   Coastal communities have sustainable livelihoods connected with a thriving environment. The benefits from the coast remain among local communities. They are actively involved in the management of the coast through participatory processes and are sitting at the negotiating table.

Decision making tools that enable people to voice their opinion are used. Community champions have authority. Furthermore, communities are engaged with each other through networked communities of practice.
- Networks of land care management groups are widespread.

Economic developments
- There is an equitable sharing of benefits from the coast with a focus on local and indigenous populations.
- Large businesses (e.g., fishing, aquaculture) are obliged to account for the true costs of the products and develop respectful, responsible and long-term strategic planning (500-year strategies sensu Weitzman 2001; Sumaila and Walters 2005). Tele-coupling on a global scale is accounted for by businesses.
- Businesses are educated on environmental issues, which helps to repair the disconnect between the wealth of businesses and nature's contribution to that wealth.
- Subsidies help people in impoverished areas to be able to offer their locally sourced products, while perverse incentives are eradicated.

Environmental developments
- Ocean and coastal biodiversity is sustained and thriving. Protected high-seas actively managed EEZs have helped to achieve this.
- Coastal ecosystems are actively managed and account for the whole watershed and all land-sea connections. People from all parts of the watershed work together to protect the watershed and reduce impacts downstream and on the ocean.

Political developments
- In the vision, regulatory bodies oblige businesses to adopt long-term strategies (e.g., 500 year strategies). There are strict regulations to control waste streams and on accounting for the true costs of products (environmental, social, economic).
- Regulatory bodies help to ensure the transparency in the management of the ocean and coasts (e.g., destructive practices become visible).

Values
- In the vision, people have respect for all life in the ocean and animals are treated in a humane way. People treat the ocean as if it feels pain.
- There is a rise in vegan/vegetarian movements in Western societies and societies which live inland. Coastal communities which rely on the ocean for their subsistence continue to extract ocean resources but in sustainable way and treating all living things with respect.
- Locally sourced, seasonal food becomes the norm.
- Sustainable and cheaply produced artificially grown fish protein, as well as manufactured food from waste products (e.g., fish skeletons) become a popular option for people who still continue to eat seafood.

B7.4   Three Horizons Framework

Present
At present, there are a number of dominant negative features in our society, which need to be eradicated or at least have their influence reduced, in order to achieve the desired vision. These features include:
- Industrial fishing (overfishing), damaging fishing practices (e.g., bottom trawling, bycatch discards, etc.) and perverse subsidies.
- Disconnected communities, lack of respect for indigenous and local knowledge and lack of respect for other living beings.

- Ocean pollution (including microplastics) and habitat destruction; fossil fuel use driving climate change and ocean acidification.
- Capitalism, consumerism culture and focus on material wealth in today's societies; increasing gap between the rich and the poor and forced economic migration.
- Corruption and lack of respect for treaties; flags of convenience (ships registered in a country other than that of the ship's owners to reduce operating costs or avoid the regulations).

Transition zone:
Transformative changes across multiple sectors were required to move from the current negative features of society to the desired vision.

A number of societal changes enabled the transition to sustainable global oceans. Social change campaigns pushed society to move to more sustainable food patterns: a high percentage of people became vegetarian and vegan, while for others, eating artificially produced fish protein, food produced from waste products or eating across the food chain (instead of only top-predators) became the new normal. Movements, such as the Slow Food and De-Growth movements drive the transition of society towards sustainable lifestyles. Social media helps to raise awareness on ocean issues among the youth. Aquariums become widespread and help to raise awareness on ocean issues, as well as enhance the connection between people and marine life. Environmental education at all levels (businesses, governments, society) acts as a main driver of social change and restoring the connection between people and nature.

At the government level, transparency and technology help to battle corruption, through open access databases. Judicial systems are sensitized about environmental crimes. Governments develop policies which make unsustainable fishing uneconomic via heavy monitoring, penalties and taxes. A full ban on unsustainable fishing practices, such as trawling, is enforced. Governments redirect harmful subsidies, set strict quota levels and reduce over-capacity. Strict regulations come into place for the purpose of managing pollution and waste, such as a full ban on single use plastics, as well as improving recycling of materials, for the purpose of reducing extractive activities in the oceans.

Governments take a radical role in ensuring long-term strategic planning is in place on national level. Businesses are also obliged to adopt 500-year strategies, and to fully account for impacts on biodiversity and ecosystems services and for the true costs of products (environmental and social cost included in the cost of the product).

Environmental education at all levels (governments, businesses, individuals) acts as a main driver of social change and restoring the connection between people and nature. Environmental education with a strong holistic and humanities foundation, starting in the early years and continuing through to university becomes the new normal. Consumer education helps to make informed choices as, for instance, transparent tracing of product life cycles, while environmental education of businesses enables the transition towards sustainability on the production side.

The co-production of knowledge between industries, governments, indigenous and local communities and researchers was another essential aspect of the transition towards a sustainable future. This involves the engagement of scientists and ILK practitioners in the identification of issues and solutions, and the involvement of indigenous peoples in training programmes and decision making through participatory processes. Subsequently, this helps with the development of networked communities of practice which learn from each other and share their experiences. Networks of community coast care programs, supported by NGOs and governments are established.

Advances in technology subsidised by governments and businesses help to: 1) address waste reuse and minimise waste; 2) monitor ocean health and changes; 4) determine what are sustainable harvest levels; and 3) strictly monitor fishing activities and enforcement of laws (satellites, drones). Technology and observers on all commercial fishing vessels further help with the control of fishing activities. Research and communication programmes on understanding biodiversity and ecosystem services help communities and decision makers to make informed decisions. Indigenous and local communities are involved in 'Train the trainer' programs. Decision support tools development and implementation assist community and local decision making. IPBES and other international connectors put more focus on oceans.

Another essential element in the transition towards a sustainable future of the oceans is the collaborative governance across scales and boundaries, which includes: 1) Strong regulations and regulatory bodies; 2) Strong local and regional scale decision-making connected to larger scales; 3) Governance that crosses land-sea interface (e.g., Arctic Council, cumulative effects); 4) Development of a collective land-ocean governance vision (e.g., IPBES and other intergovernmental process lead the way to the establishment of an Oceans Council); and 5) Management of ecosystems as a whole (e.g., Single species harvest focus replaced with ecosystem focus).
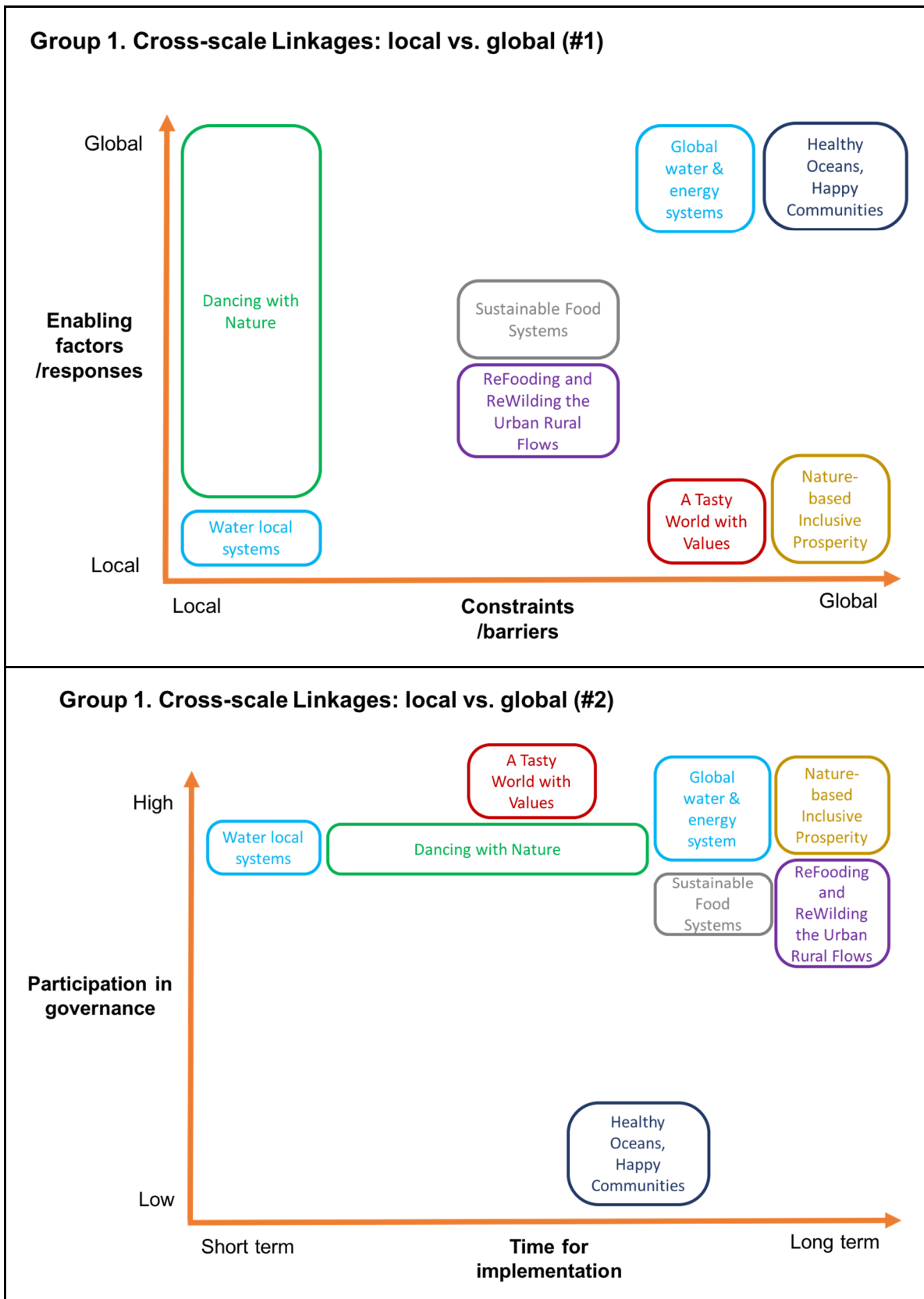
Internationally, a multi-national governance model for the high-seas is established, while EEZs are effectively managed. Protected areas are representative and effectively managed (including community managed areas). Coastal habitats are restored for climate and biodiversity resilience through partnerships between science, businesses, governments and indigenous and local communities.
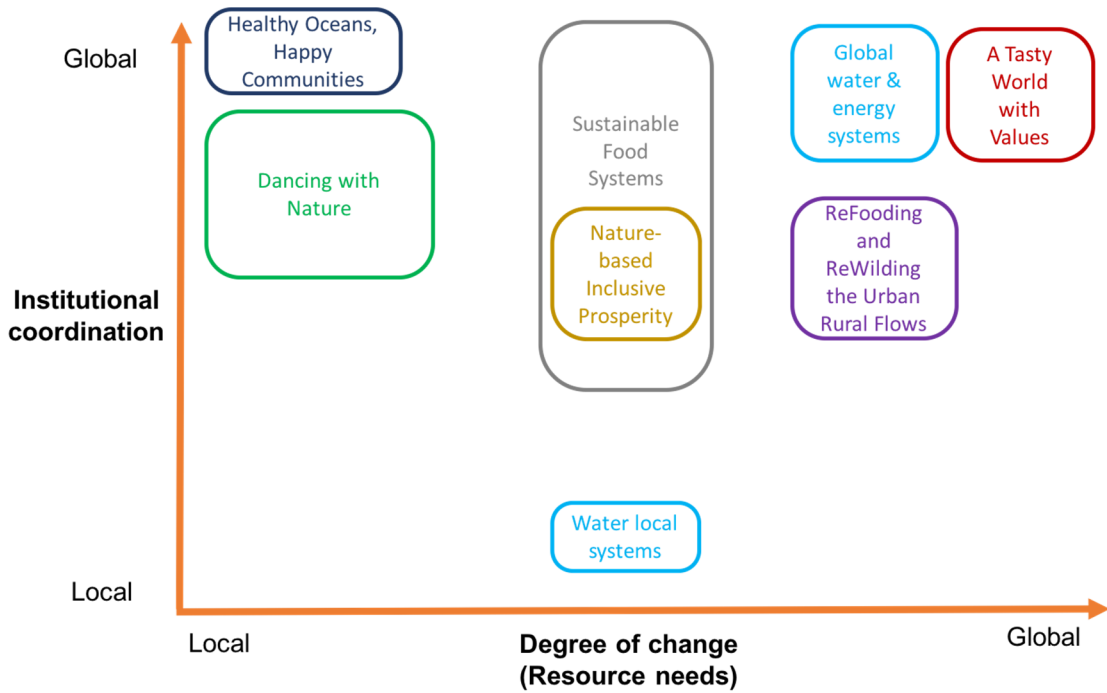
Future:

In the vision *Healthy Oceans, Happy Communities*, the oceans and coasts are full of life – biodiversity and ecosystem services provision in oceans and coasts are sustained. A radical guardian role is adopted by governments and businesses, which commits to 500-year strategies (e.g., Weitzman et al. 2001; Sumaila and Walters 2005), and accounts for the full life cycle of their products. The high seas are closed to fishing (Rogers et al. 2014; White and Costello 2014; Sumaila et al. 2015) and the coastal zones are managed sustainably (ban of unsustainable fishing practices). Inputs from the land are well-managed (including cumulative effects and full bans of single-use plastics). Indigenous and local communities are actively involved in the management and restoration of the coasts (including, for example, participating in community coral gardening). There is an equitable sharing of benefits from oceans and coasts (across gender, race, religion, age, etc.). New, sustainable technologies are developed to produce energy, which has helped tackle climate change and its consequences for the ocean. New technologies (e.g., artificial fish growing) are also helping to feed vast populations, while at the same time the rise of vegetarian/vegan movements have further reduced the pressures on ocean resources. In this future, society has respect for ocean life, rights and welfare and treats it as 'if it feels pain'. Children are taught of the intrinsic value of the ocean and intergenerational environmental knowledge is widely shared.

Appendix C. Mapping the visions on topical gradients.

Group 1. Cross-scale Linkages: local vs. global (#1)

Group 1. Cross-scale Linkages: local vs. global (#2)

Group 1. Cross-scale Linkages: local vs. global (#3)

Global

Healthy Oceans, Happy Communities

Dancing with Nature

Sustainable Food Systems

Nature-based Inclusive Prosperity

Global water & energy systems

A Tasty World with Values

ReFooding and ReWilding the Urban Rural Flows

Institutional coordination

Water local systems

Local

Local

Degree of change (Resource needs)

Global

Group 2. Nature Preference: tamed vs. wild (#1)

Visions

Community based natural resource management @ national

Prosperity

CBNRM @ local

Displacing GDP growth as a goal @ global

Food system

Multifunctional ecological infrastructure w/ productive agriculture

Urban rural flow

ReFooding

ReWilding (cities)

ReWilding (rural)

Culture

Expression of culture and knowledge

Global scale ecosystem services driven lands

Promoting sense of wilderness

Ocean

Coastal areas

Healthy oceans

High seas

Water

Small scale management

No dams, no fossil fuels

Nature dynamics

Engineered nature

Space for nature - Half earth protection

High - tamed

Management intensity

Low - wild

99

Group 2. Nature Preference: tamed vs. wild (#2)

Space for nature

Living water

A Tasty World with Values

ReWilding

Local community based natural resource management

National plans with key ecological objectives

Global GDP replaced with nature-based matrix

Spiritual cultural symbolic

ReFooding

No dams

Healthy oceans

Healthy Oceans, Happy Communities

Engineered nature

Sustainable Food Systems

Small scale water management

Material

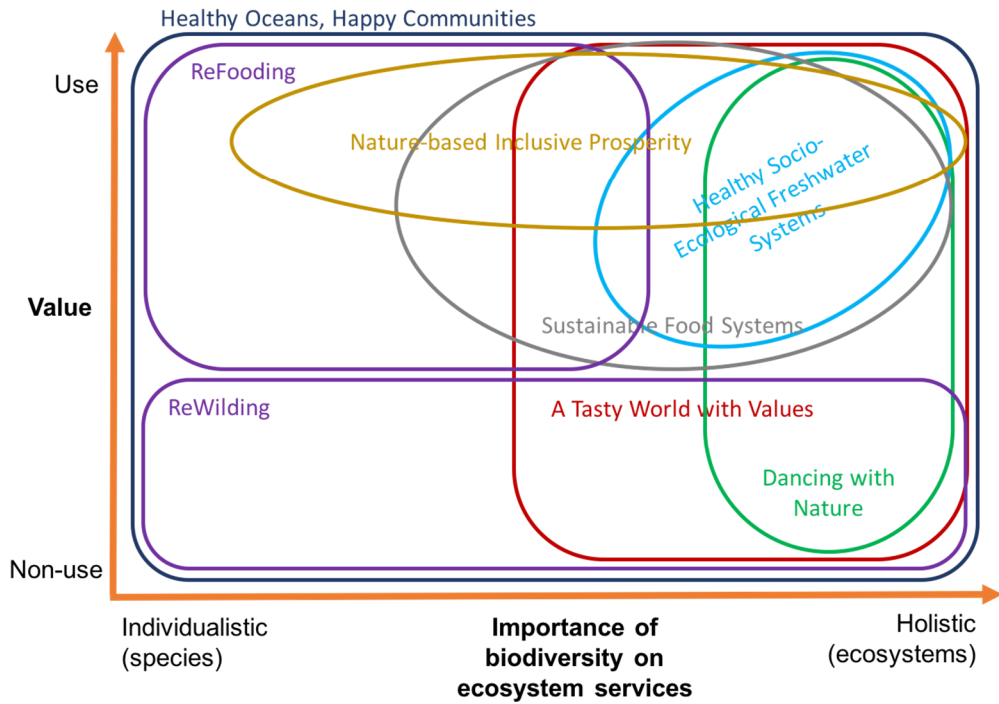Agro   Land   Forests   River.   Freshwater   Sea   Ocean   Air

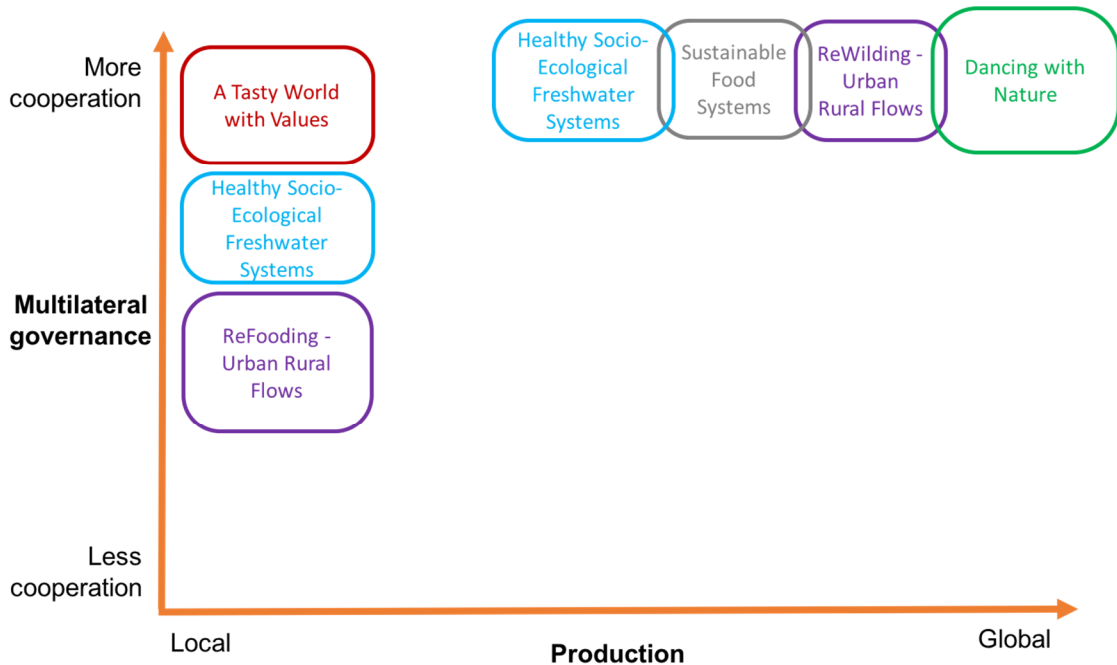# Group 3 Types of Nature Contributions: use versus non-use

Importance of different types of values (monetary, cultural, spiritual, social)

Vision / Values	1 Nature-based Inclusive Prosperity	2 Sustainable Food Systems	3 ReFooding and ReWilding the Urban Rural Flows	4 Healthy Socio-Ecological Freshwater Systems	5 A Tasty World with Values	6 Dancing with Nature	7 Healthy Oceans, Happy Communities
livelihood	++	++	++/+	++	++	?	++
Identity	+	++	+/+	+	++	?	++
Norms	+	++	+/+	++	++	++	++
Cultural	+	++	+/+	++	++	+	++
Intrinsic	+	+	?	+	+	+	++
Non-monetary utility	+	++	+/++	++	++	++	++
Aesthetic	+	++	+/+	++	+	+	++
Sense of place	+	+	+/+	+	++	+	++
Spiritual	+	?	++	+	++	?	+
Monetary	++	++	++/?	+	0	?	+
Social /natural Relational	++	+	++	+	++	++	++

Group 4. Importance of Biodiversity for Ecosystem Services: species vs. composition diversity

Healthy Oceans, Happy Communities

ReFooding

Nature-based Inclusive Prosperity

Healthy Socio-Ecological Freshwater Systems

Sustainable Food Systems

ReWilding

A Tasty World with Values

Dancing with Nature

Use

Value

Non-use

Individualistic (species)

Importance of biodiversity on ecosystem services

Holistic (ecosystems)

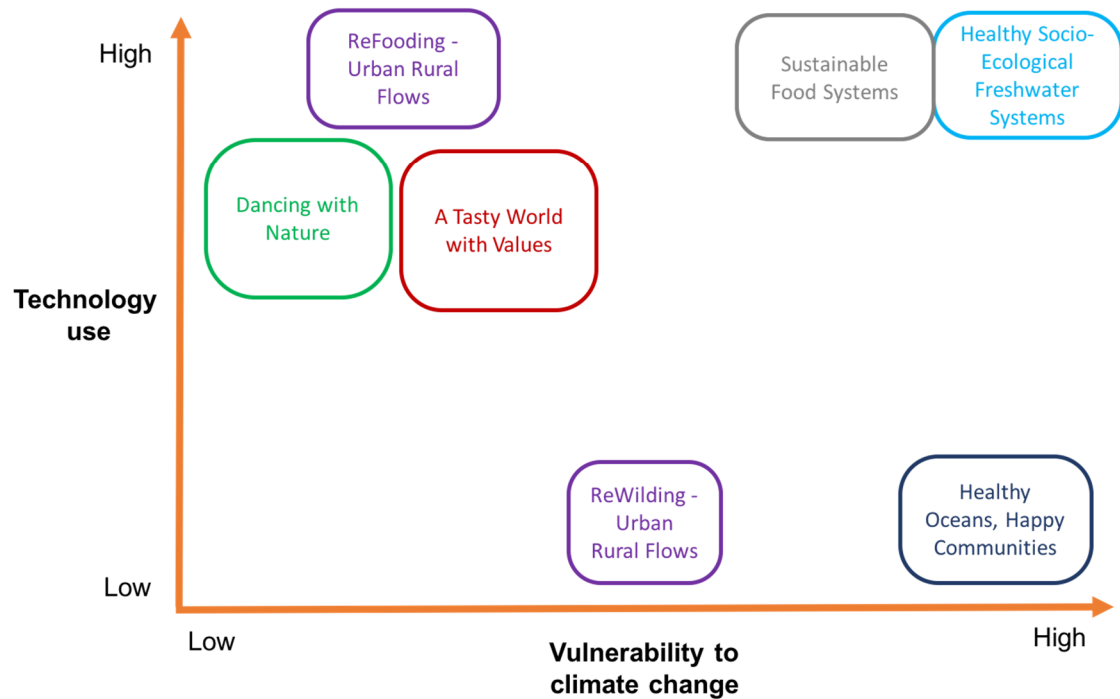**Group 6 Drivers: slow vs fast population growth, equitable versus inequitable economy, urban expansion versus urban contraction (#1)**

More cooperation

A Tasty World with Values

Healthy Socio-Ecological Freshwater Systems

Sustainable Food Systems

ReWilding - Urban Rural Flows

Dancing with Nature

Healthy Socio-Ecological Freshwater Systems

Multilateral governance

ReFooding - Urban Rural Flows

Less cooperation

Local

Production

Global

Group 6 Drivers: slow vs fast population growth, equitable versus inequitable economy, urban expansion versus urban contraction (#2)
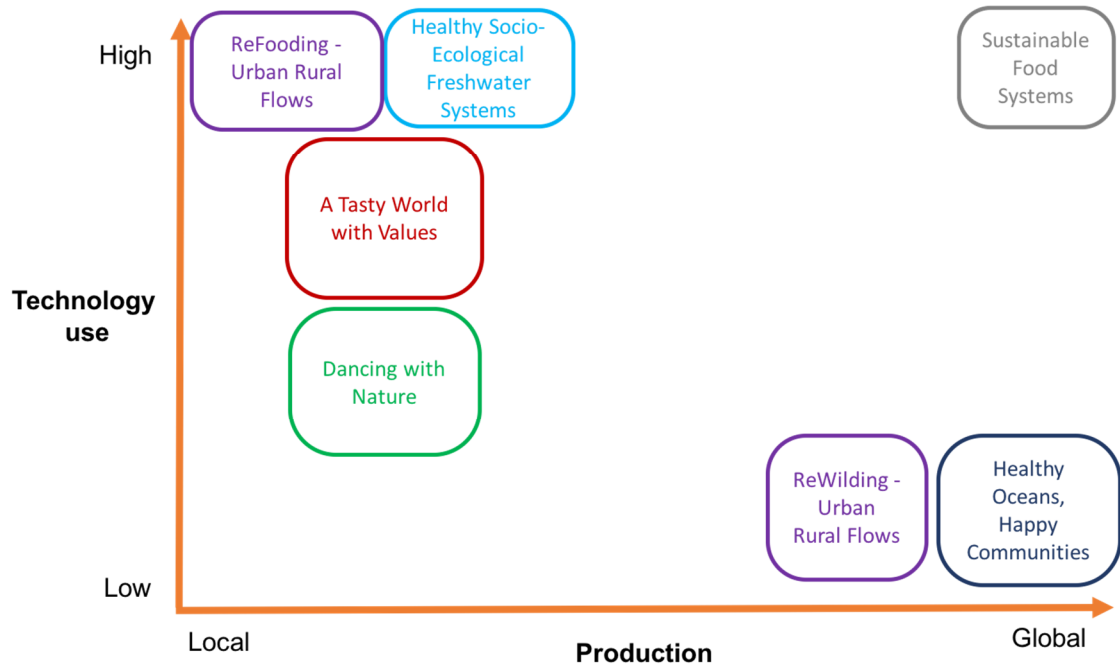
Group 6 Drivers: slow vs fast population growth, equitable versus inequitable economy, urban expansion versus urban contraction (#3)

Group 6 Drivers: slow vs fast population growth, equitable versus inequitable economy, urban expansion versus urban contraction (#4)
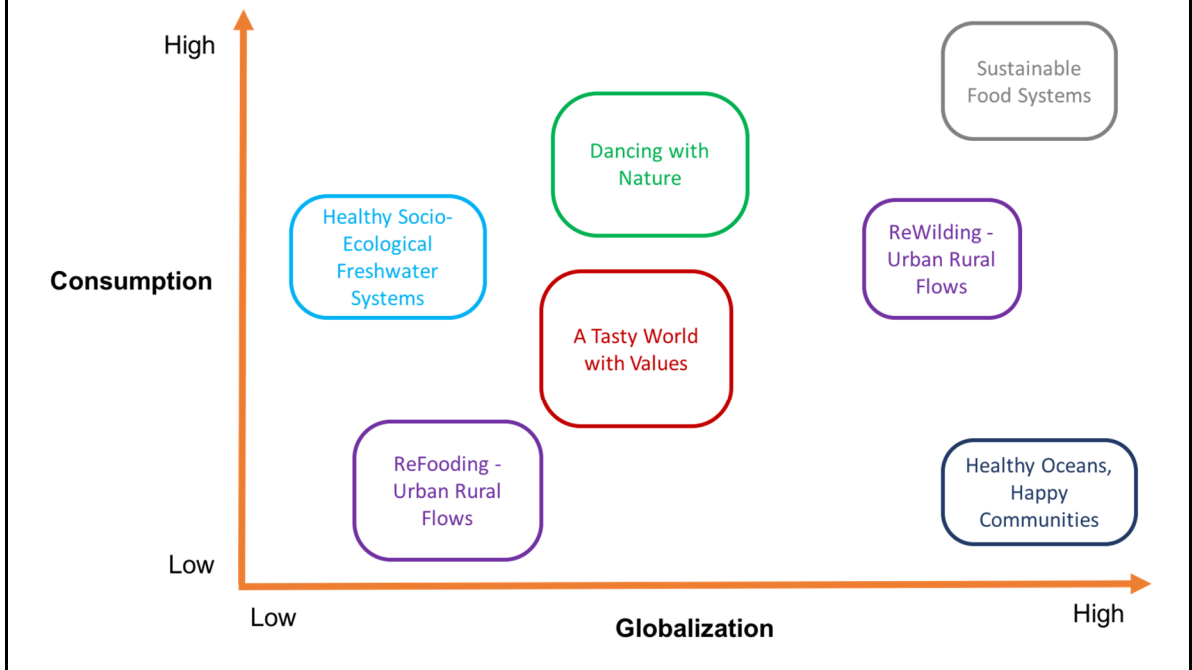
Appendix D. Regionalising the visions with potential lock-in's (challenges) and cracks (opportunities)

Regionalising visions with lock-ins and cracks

Visions Regions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Africa							
Lock-ins	· Extractive sector challenges leading to biodiversity loss	· Extractive sector challenges leading to biodiversity loss · Climate change impacts · Resource pressures	· Growing pressures on natural resource management	· Food/market connectivity · Gender inequality, access to land, trade relations · Land-grabbing – biofuel, infrastructure, disenfranchising local people	· Patriarchy	· Regional trade deals	· Plastics pollution · Access to resources and decision-making over resource management · Marine fisheries over-exploited with biodiversity implications and production issues
Cracks	· Re-connecting cultural heritage, governance · Decentralisation · Facilitated access to certification schemes and markets · Longstanding traditions of eco-agriculture and agro-forestry building on local knowledge · Promoting open access data, culture of transparency and information sharing · CBNRM with proven record of success · Greater investment in primary and secondary education, use of	· Commission Catchment and ecological infrastructure integrity · Local-scale services provision, local governance structures · Micro-water management systems with tech for water quality improvements · Transboundary catchment agreements and collaboration · Cultural and technological ways to conserve water, water efficiencies	· Outmigration from rural to cities is a problem that cities and regions need to tackle together. Enhancing Urban Rural Flows is a possible way forward · Cities have organisations fighting for sustainability and there is social capital ready for action (e.g., South Africa)	· Improved agricultural innovation and food systems · ICT for information-sharing, access to market information · Agro-ecology, indigenous food practices, indigenous fisheries, · Traditional culture of eco-agriculture and organic farming · Economies of scale, digital technologies for information sharing and collaboration · Organic agriculture, promotion of healthy food choices, access to information	· Digital technologies for empowering women · Urban-Rural flows, Social innovation in avoiding conflict · Smartphones, markets, etc. · Promotion of CBNRM and local governance structures in resource access, protection and management · Family planning and gender equity · Connecting urban-rural · Cultural sharing education sharing	· Urban-Rural Re-design of cities, decentralisation of services, greening infrastructure · Promotion of CBNRM and local governance structures in resource, access, protection and management · Citizen science engagement of local populations, from water quality to biodiversity monitoring · TFCAs - Peace-Parks: transboundary natural resource management to sustainably manage resources, and improve livelihoods;	· CBNRM – participatory management and use of NRs for improved livelihoods · Pan-African EEZ, well policed and enforced through redeployment of defence forces to environmental/marine policing · Stronger focus on protection and integrity of marine ecosystems and sustainable fisheries · Marine Stewardship Council certification

Visions / Regions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
	online, open access sources			· Certification schemes		· Strong institutions, intact ecosystems, implementation of MEAs · Eco-tourism as growth sector based on biodiversity and cultural diversity · Home grown institutions · Dodd-Frank Act on financial reform	
Asia							
Lock-ins	· Globalisation · Economic development · Corruption · Lack of capacity · Increasing gap between the rich and the poor	· Trade negotiations · Economical optimisation of trade and production · Food waste caused by poor storage and distribution facilities · Climate change · Increased meat consumption	· Strong trend of urbanisation (urban sprawl) · Migration from rural to urban · Huge demand for infrastructure · Lack of job opportunities in rural areas · Education · Lack of medical facilities in rural areas	· Mindset of people on having large dams · Mindset of people on fossil fuels displacement · Urbanisation – high demands for water · Water as a resource for use	· Economic and political systems in the region · Insufficient recognition of indigenous people's rights · Current educational system · Tradition recognised as 'old' – looking for new and future things · Educational system does not recognise traditional knowledge · Notion of modernisation	· Countries with high-population · half earth (protected areas) with many trade-offs (e.g., indigenous people's territories, requiring re-organisation of the local populations) · Increased demand for land, urbanisation and rapid economic development · Relocation of people from nature areas	· Plastic pollution · Mechanisation of fishing · Overfishing · Habitat destruction · Strong power of fishing industry, lobbying · Consumer preferences (e.g., tuna) · Industrialised food production systems
Cracks	· Community based natural resource management · Natural capital accounting systems (e.g., SEEA) · Failure of the states strengthens the	· Local food · Certification (e.g., fair trade) · Consumer awareness · Cultural perception of food waste	· Nature-based solutions (e.g., community gardening) · Circular economy · Healthy food choices · Locally grown organic food	· Mini-hydro systems: Decentralised water and energy systems · Reuse/water treatment on a household level · Cultural aspect of water	· Raised awareness & inclusion of cultural values in international conventions · Greater autonomy/ opportunities · Cultural diversity and biodiversity	· Increasing protected areas · (Co-)Adaptive management that gives indigenous peoples more ownership of the land · 'Engineering nature' - Genetic engineering for	· Awareness raising campaigns · Global stewardship · Global ownership - protection of the high seas · Marine Protected Areas (MPAs)

Visions / Regions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
	relationship of the community · Social enterprises		· Green tourism · Urban-rural migration · State policy to rehabilitate rural areas · Welfare services in rural areas	· Ecosystem-based adaptation for water		increased resilience in biodiversity	· Change of consumption habits · Maintaining marine habitats e.g., mangroves

Latin America

Visions / Regions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Lock-ins	· Lack of political representativeness · Systems of conservation units/protected areas · infrastructure expansion in Amazon (e.g., roads, dams) - Social problems (violence; corruption); - Institutional and legal incoherence · Alliance between government and powerful economic groups	· Asymmetries between countries · Powerful economic groups · Access to microcredit, access to technology · Zero values for non-use area vs. intrinsic value	· Inequitable, affordable food · External barriers to national and global interests (e.g., mining) · Lack of integration of environmental and development policies	· Scale misfit in environmental management · Religious education, patriarchy - Current educational model, - Attachment to official knowledge, academic-scientific ideology dominant	· Rural-urban migration · Erosion of cultural system and agro-biodiversity (biopiracy) - Erosion of communal systems · Excessive laws and regulations on the use of resources, -No recognition of rights of local and indigenous small farmers in free trade agreements -Large scale agriculture -Gender- blindness in policy design and education systems; -Dominant scientific-technocratic knowledge systems	· Genetic manipulation - Costly ecological restoration	
Cracks	· Systems of conservation units · Participatory digital democracy · Regional development banks at the national level	· Agro-biodiversity related to culture in technology and household - Transboundary linkages recognised at governance level	· Urban ReFooding movements, - Balance between reciprocity and economic growth, - Multi-boundary politics,	· Energy and water management globally interconnected without relying on fossil energy · National movement for local water management,	· Consultation and participation spaces and mechanisms, - Governance and management of biocultural heritage	· Ecological restoration/reforestation with biocultural innovations · Urban connectivity shorter access to nature	

Visions / Regions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
	- Implementation and strengthening of protected areas - Cultural diversity of identities, languages, problems recognition - Multilateral initiatives with common goals - BES based design of policies	· Access to microcredit, access to technology, - Corporate social responsibility - Multi-sectoriality and opportunity in the financial systems (SMEs, microcredit) adapted to indigenous minorities · Zero values for non-use area vs. intrinsic value · Gender inclusion	-Evaluation of systems efficiency /environmental impact of policy intervention, - - Integrated networks natural resource managements (e.g., watershed management committees) - Innovative PES scheme arrangements	movements affected by mining and other interventions · Construction of self-sustaining local water and energy systems, river as free systems · Removal of infrastructure forcing rivers · Biodiversity values and services, water dependence in interior systems, rights to be rivers	- Biocultural innovations, - Adoption of the rights of Mother Earth in the UN system · Adaptation based on communities and families · Opportunity in infrastructure, technology with connection · New business models based on shared economy as traditional household level - Sacred values of nature - Traditional, local and indigenous knowledge systems - Knowledge and science democratisation - Queer ecology and social diversity agenda - Recognition in legal system of environmental justice - Value chains and local actors' participation	· Connectivity that increases with multifunctional landscape	
Oceania							
Lock-ins		· Not prepared to eat seasonally – consumption expectations. · Price setting and	· Lack of recognition of diverse knowledges. · Resource pressures preventing rewilding e.g., agriculture.			· Reduction in central resource availability. · Population growth/immigration. · Urban sprawl.	· Benefit sharing. · Multinational, profit driven governance systems.

Visions / Regions	Nature-based Inclusive Prosperity	Sustainable Food Systems	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
		taking processes. · Spread of invasive species in the Pacific. · Misalignment between state biosecurity regulations.	· Urban sprawl vs agriculture vs conservation.⍰ · Lack of interaction between Pacific nations. · Lack of national parks in the Pacific. · Distribution of aid in the Pacific.			· Inadequate housing solutions.⍰ · Lack of big picture knowledge of ecosystems/environmental issues. · Reductions/fragmented view of ecosystem services.⍰ · Lack of intergenerational perspective.⍰ · Complexity of the system.⍰ · Siloed laws and regulations. · Difficulties in accessing New Zealand funding for Pacific nations.	· Desecration of cultural values.⍰ · Creation of rights/recognition of rights. · Economy vs environmental trade-offs. · Chinese investment into the Pacific. · Exclusion of cultural rights from MPAs. ⍰
Cracks		· Growing consumer connection to producers e.g., through farmers markets.⍰ · Eating lower down the food chain.⍰ · Expression of cultural knowledges and hubs of cultural knowledges – values approach to sustainability.⍰ · Slow food movements.⍰ - NZ biosecurity.	· Recognition of rights of nature and planet e.g., Whanganui. Aotearoa can share examples of co-management.⍰ · Transition to well-designed high-quality production e.g., niche markets which are ethical and sustainable.⍰ · QEII land covenants⍰ · New for New Zealand to appear clean and green. · Increasing capacity of Pacific nations.⍰			· Increasing involvement and awareness for managing areas around use in biodiverse way – urban and semi urban.⍰ · Greenways and corridors e.g., in Auckland.⍰ · Cycling support – from local government.⍰ · Potential to change long term plans in NZ.⍰ · Rewilding/ecosanctuaries e.g., Zealandia, Tiritiri Matangi.	· Expand EEZ – reduce area for multinationals to expand from.⍰ · Voluntary protected areas for whales.⍰ · State-owned value add mechanisms e.g., canning fish.⍰ · No take areas – recovery through 30%.⍰ · Local knowledge systems.⍰ · Taiapure/mataitai/rahui.⍰ Moana management (NZ example).⍰ · Community based management.

Actors based lock-ins and cracks

Visions / Actors	Nature-based Inclusive Prosperity	Sustainable Food	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Households							
Lock-ins		· Increased meat consumption	· Urban and rural citizens have been traditionally apart. · Space and time for bridging urban - rural lifestyles is a challenge. · Difficult to connect (e.g., how to join) to sustainable initiatives (local market, food swaps) as the mainstream "development" actors are strong and institutionalised while new actors do not have institutions sheltering them. · Difficult to overcome traditional food habits (used to have all goods all year round) · Unequitable, cheap affordable food	· Mindset of people on having large dams. · Mindset of people on fossil fuels displacement.			· Consumer preferences (e.g., tuna)

Visions / Actors	Nature-based Inclusive Prosperity	Sustainable Food	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Cracks		· Local food. · Shift in consumer consciousness. · Consumer awareness.	· Healthy food choices and change to healthier life styles (jogging, cycling). · Locally grown organic food. · Valuing food knowledge. · Families need to cope and adapt to global environmental change and look for implementing nature-based solutions in their backyard. · Households in cities aware of the value of nature and the wellbeing this brings to their livelihoods.	· Reuse/water treatment on a household level.	· Adaptation based on communities and families. · New business models based on shared economy as traditional (barter, sharing) household level. · Family planning and gender equity.		· Change of consumption habits

Natural Resource Management (agriculture, forestry, fishery, water)

Visions / Actors	Nature-based Inclusive Prosperity	Sustainable Food	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Lock-ins	· Extractive sector - removal of minerals and wealth from the continent, inequitable use and distribution of resulting benefits, and associated pollution and biodiversity loss. · Systems of conservation units.	· Extractive sector - removal of minerals and wealth from the continent, inequitable use and distribution of resulting benefits, and associated pollution and biodiversity loss. · Resource pressures.	· Intensive modes of production (agriculture, forestry) are mainstream and powerful · Not respecting diversity of cultures and traditional ecological knowledge (TEK) practices with low intensity, multifunctional, land use mosaics · Difficult to make explicit the intangible values of nature and how this may reinforce urban-rural synergies	· Improved agricultural innovation and food systems: conservation agriculture – soil conservation + habitat conservation + carbon storage; · Land-grabbing – biofuel land-grabbing, infrastructure land grabbing – disenfranchising local people · High demands for water with urbanisation · Water as a resource for use	-Large scale agriculture · Erosion of cultural system and agrobiodiversity (biopiracy)	Command and control approaches that require increased regulation to decrease variation in nature, but produce increased vulnerability to breakdown in regulation	· Aquaculture - Marine fisheries overexploited · Habitat destruction (e.g., changes in mangrove areas)

Visions / Actors	Nature-based Inclusive Prosperity	Sustainable Food	ReFooding and ReWilding the Urban-Rural Flows	Healthy Social-ecological Freshwater System	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Healthy Communities
Cracks	· Agro-forestry and Eco-agriculture – longstanding traditions of eco-agriculture and agro-forestry which should be supported and expanded not undermined, building on local knowledge · CBNRM with track records with success in certain countries (e.g., Namibia, South Africa, Nepal, India) · Systems of conservation units · Implementation and strengthening of protected areas (e.g., Amazonia)	· Micro water management systems; pervasive tech for water quality improvements · Transboundary catchment agreements and collaboration (e.g., Okavango River basin) · Cultural and technological ways to conserve water, water efficiencies	· Nature-based solutions (e.g., community gardening) · Innovative social enterprises and novel ways of reconnecting with food (artistic movements, plays, theatre of sustainable consumption initiatives) · Awareness of problems due to unsustainable land use practices (heat waves in cities with lack of vegetation cover) · Willingness of some small-scale farmers to get out of traditional market mechanisms that are associated to unbalanced power relationships (e. cooperatives where bigger producers set the rules to small scale farmers)	· Agro-ecology, indigenous food practices, indigenous fisheries · Traditional culture of eco-agriculture and organic farming · Organic agriculture, promotion of healthy food choices, access to information · Certification schemes · Mini-hydro systems: Decentralised water and energy systems (Philippines and Kazakhstan) · Ecosystem-based adaptation for water (Japan) · Integration networks of natural resource managements (e.g., watershed management committees)	· Governance and management of biocultural heritage,	· Land abandonment giving space for rewilding · Promotion of CBNRM and local governance structures in resource, access, protection and management · Citizen science engagement of local populations, from water quality to biodiversity monitoring · TFCAs - Peace-Parks: transboundary natural resource management to sustainably manage resources, and improve livelihoods · Increasing protected areas, especially in countries with declining population (Japan) · Co-/Adaptive management that gives indigenous peoples more ownership of the land · Ecological restoration/reforestation with biocultural innovations in three areas: technology, markets and institutions	· CBNRM – participatory management and use of NRs for improved livelihoods e.g., Madagascar, Kenya, and Tanzania marine environments · Pan-African EEZ, well policed and enforced through redeployment of defence forces to environmental/marine policing · Stronger focus on protection and integrity of marine ecosystems and sustainable fisheries; · Marine Stewardship Council certification · Global ownership - protection of the high seas · MPAs· Maintaining marine habitats/ mangroves

Government and City Planning

Lock-ins	· Populism voting cycle (short term perspective), lack of political representativeness · Traditional infrastructure expansion in amazon (e.g., roads, dams)		· Strong trend of urbanisation (urban sprawl) · Huge demand for infrastructure (conventional ways) · Lack of job opportunities in rural areas · Lack of medical facilities in rural areas · Lack of integration of environmental and development policies	· National government vs local management	· Economic and political systems in the region · Rural-urban migration · erosion of communal systems · Excessive laws and regulations on the use of resources	· Increased demand for land, urbanisation and rapid economic development (e.g., India) · Long life of existing infrastructure, development structures created by existing transportation networks	· Access to resources and decision-making over resource management
Cracks	· Decentralisation of government – e.g., Kenya · Natural capital accounting systems (e.g., SEEA)	· Open borders, asymmetries between countries · Commission Catchment and ecological infrastructure integrity, climate change impacts · Local-scale services provision, local governance structures	· Urban to rural migration (Korea) · State policy to rehabilitate rural areas (Kazakhstan) · Improved welfare services in rural areas · Urban ReFooding movements · Planning bodies encourage a diversity of actors (well beyond traditional market mechanisms that are associated to unbalanced power relationships) and incentivise other fresh and innovative institutions (e.g., innovation prizes) · Benchmarking of cities according to their performance on nature based solutions (e.g., Biodiversity ranking)	· Construction of self-sustaining local water and energy systems, river as free systems, removal of infrastructure forcing rivers (free flowing rivers), movement by dams or environmental problems · Energy and water management globally interconnected without relying on fossil energy, national movement for local water management, movements affected by mining and other interventions	· Connecting urban-rural · Urban-Rural flows, Social innovation in avoiding conflict · Greater autonomy/ opportunities · Consultation and participation, systems - biocultural innovations (institutional) - adoption of the rights of Mother Earth in the UN system; - Governance and management of biocultural heritage, - Recognition in legal system of environmental justice	· Urban-Rural re-design of cities, decentralisation of services, greening infrastructure · Relocation of people from nature areas (China) · Strong institutions, intact ecosystems · Connectivity at the ecological level and initiatives as brokers; urban connectivity shorter access to nature; connectivity that increases with multifunctional landscape	

Business and Trade

Lock-ins	· Economic development	· Trade negotiations · Economical optimisation of trade and production (not only about consumption but also about production) · Access to microcredit · Powerful economic groups	· Non-recognition of rights on seeds and knowledge (conocimientos) in free trade agreements, external barriers to national and global interests (e.g., mining) communal systems, excessive laws and regulations on the use of resources, non-recognition of farmer's rights	· Food/market connectivity		· Subsidies and not having to pay for environmental costs encourage destructive investments · Trade sometimes hides connections between distant ecosystems	· Plastic pollution · Mechanisation of fishing (e.g., trawlers) · Industrialized food production systems · Strong power of fishing industry
Cracks	· Facilitated access to certification schemes and markets · Social enterprises · Regional development banks at the national level	· Certification (e.g., fair trade)	· Circular economy · Green tourism · Social enterprises	· Economies of scale, digital technologies for information sharing and collaboration	-Biocultural innovations (market,) -Value chains and local actors' participation -New business models	· Opportunities for developing green infrastructure and nature based solutions, increasing growth area. · Supply chain transparency Increased financial transparency, possibilities that computers and data will enable rather than mask accountability	

Technology and innovations

Lock-ins		· Access to technology	· Very expensive to promote high tech solutions in developing countries (some initiatives were frustrated) · The traditional way is still entrenched in habits			Subsidised research into industrial agriculture and fossil fuel economy	

			· Institutions fight against innovation and change			
Cracks	· Promoting open access data, culture of transparency and information sharing	· Access to technology	· Universities and enterprises establish partnerships to create innovation. · Online platforms change food habits as they share food knowledge.	· ICT for information-sharing, access to market information · Digital technologies for empowering women	· Biocultural innovations (technology), · Smartphones, markets e.g. MPESA; smart phones spur innovation and boost incomes: farmers use them to check market prices before selling to middlemen, and market traders can accept payments in mobile money · Opportunity in infrastructure, technology with connection	· Genetic manipulation - ecological restoration · 'Engineering nature' - Genetic engineering for increased resilience in biodiversity · Water funds payment for ecosystem services Implementation of MEAs High potential for large rewards in under researched areas such as ecological restoration, green infrastructure, and ecological payment systems	
Culture, and Indigenous and local knowledge						
Lock-ins		· Zero values for non-use area vs. intrinsic value	· View that traditional food systems and traditional farming practices are not able to feed the world · Rewilding the countryside erodes cultural footprint in cultural landscapes	· Gender inequality	· Patriarchy · Insufficient recognition of indigenous and small farmers/producers' rights · Tradition recognised as 'old' – looking for new and future things · Notion of modernisation - Gender- blindness in policy design and education systems; - Dominant scientific-technocratic knowledge systems	· Globalisation and technology alienating people from their local places leading to a loss of local knowledge · Homogenisation of language leading to loss of smaller local knowledge and some of the knowledge held within those languages	

| Cracks | · Re-connecting cultural heritage, governance
· Participatory digital democracy | · Cultural perception of food waste
· Agro-biodiversity related to culture in technology and household | · Awareness that the blueprint solutions based on homogenised mainstream practices do not solve problems we face.
· There is an increasing awareness of the need to include culture and local knowledges as social capital for overcoming environmental challenges that society faces at the present | · Cultural aspect of water (intrinsic value) (India) | · Cultural sharing education sharing best practices across countries
· Raised awareness and inclusion of cultural values in international conventions (e.g., CBD, UNESCOs approach to rights to indigenous people)
· Cultural diversity and biodiversity (understanding greater support for cultural diversity, recognition of intrinsic value of nature) | · Eco-tourism as growth sector based on biodiversity and cultural diversity
Biocultural revitalisation movements that link assertion of indigenous sovereignty with stewardship of a place | |

Education and Science

| Lock-ins | | | · Lack of food education-. food knowledge is limited in traditional markets
· Science interaction with traditional ecological knowledge TEK is fragmented and limited | · Religious education, gender rigidity, current educational model, attachment to official knowledge, ideology dominant to academic-scientific | · Current educational system not nature-centred
· Educational system does not recognise traditional knowledge
- Dominant scientific-technocratic knowledge systems | · Current educational system fragmented and focuses on private individualistic solutions and control rather than commons based systems | |
| Cracks | · Greater investment in primary and secondary education, use of online, open access sources | | · Academia is increasingly engaging with other types of knowledge
· Nature values in addition be accounted for in economics are also being accounted for other societal benefits growing | | · Cultural sharing education sharing best practices across countries | · Growth of sustainability science, ecological restoration, ecological economics, etc., and movements to bridge multiple knowledge systems
· Diversification of higher education
· Home grown institutions e.g., African Leadership University (ALU) | · Awareness raising campaigns |

Others

Lock-ins	· Globalisation · Corruption · Increasing gap between the rich and the poor	· Food waste caused by poor storage and distribution facilities · Climate change	· There is not a powerful set of actors pushing for overcoming the polarisation urban-rural · No one care about flows		Current food system makes it difficult to implement this system, large amount of agriculture land in USA, Europe, India and China make it difficult to realise this vision	
Cracks			· Increasing awareness of the important of governing across multiple spatial scales and overcoming and blurring traditional urban-rural boundaries.	· Biodiversity values and services, water dependence in interior systems, rights to be rivers	Potential for decline in meat consumption could allow a lot of farmland to be restored or rewilded	· Global stewardship

Appendix E. Archetype scenarios and the visions.

The IPBES methodological assessment on scenarios and models (IPBES 2016) adopted the 'scenario families', as described in van Vuuren et al. (2012), which also cover the scenario archetypes distinguished by Hunt et al. (2012), that were based on the scenarios developed by the Global Scenario Group (Raskin 2005). Six archetypes are distinguished including scenarios focusing on sustainability. Table E1 shows characteristics of the six archetypes as derived from van Vuuren et al. (2012). The archetype assumptions are summarised across seven different dimensions, including Economic development, Human population growth, Technological development, the main objectives of the scenarios, environmental protection, trade and policies and institutions. Table E2 shows statements on these 7 dimensions from the visions that each group developed. Note that not all dimensions of the archetypes are covered by the visions descriptions and that the statements are much more qualitative. The 'lifestyle' dimension is added as part of economic development. Comparing these two tables enables the potential relationships between the archetypes and the visions.

Table E1. Main characteristics of the six scenario archetypes.

	Economic Optimism	Reformed Markets	Global Sustainable Development	Regional Competition	Regional Sustainable Development	Business as usual
Economy development	Very rapid	Rapid	Ranging from slow to rapid	Slow	Ranging from mid to rapid	Medium (globalisation)
Population growth	Low	Low	Low	High	Medium	Medium
Technology development	Rapid	rapid	Ranging from mid to rapid	Slow	Ranging from low to rapid	Medium
Main objectives	Economic growth	Various goals	Global Sustainability	Security	Local sustainability	Not defined
Environmental protection	Reactive	Both reactive and proactive	Proactive	Reactive	Proactive	Both reactive and proactive
Trade	Globalisation	Globalisation	Globalisation	Trade barriers	Trade barriers	Weak globalisation
Policies and Institutions	Policies create open markets	Policies reduce market failure	Strong global governance	Strong national governments	Local steering: local actors	Mixed

Table E2. Summary scenario statements as derived from the seven visions.

	Nature based Inclusive Prosperity	Sustainable Food Systems	Urban Rural Flows	Healthy Social-ecological Freshwater Systems	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Happy Communities
Economic development and lifestyle	Reduce inequalities; Gross Domestic Product (GDP) is not leading	Shift from economic to ecological optimisation Stabilize rural incomes; Reduce inequalities; Zero hunger	Social enterprises; Innovative market arrangements	Circular economy paradigm, Reduce inequalities; optimise resource use, minimise wastage and waste production as in linear economy	Circular economic model; Novel business models based on local, sovereign (food) systems; Nature-centred behavioural changes	Reduce demand; Healthy diets	De-growth Sustainable lifestyle: vegetarian or sustainable fish and meat, slow food.
Population growth	Moderate	Not considered	Not considered	Appropriate for all growth scenarios	Not considered	Not considered	Not considered
Technology development	Sustainable techno-logical innovations; Education	IT to strengthen reciprocal communi-cation between producers and consumers; High tech, combined with traditional agro-technologies maximise ecosystem services	Nature-based solutions, High-tech innovations to free space for rewilding and for producing food without threatening the environment	Alternative small scale, high-tech production at local scales, complete shift from use of fossil fuels and large dams to sustainable energy and optimisation of ecosystem services	Alternative small scale, locally controlled technologies (e.g., alternative energetic transition)	Dynamic infra-structure; Building with nature	Sustainable technologies to produce energy; Advanced technologies for sustainable practices; Education
Main objectives	Wellbeing of people and nature	Sustainable food system	Reconnecting nature and people across rural urban areas	Healthy freshwater systems; Restoration of cultural connections and benefits	Highly diverse and sovereign food systems and knowledge systems	Nature is given space and humanity is accom-modated	Healthy oceans

	Nature based Inclusive Prosperity	Sustainable Food Systems	Urban Rural Flows	Healthy Social-ecological Freshwater Systems	A Tasty World with Values	Dancing with Nature	Healthy Oceans, Happy Communities
Environmental protection	Natural resource management	Efficient sustainable use of natural resources	Blurring urban-rural gradient and ReWilding. ReFooding-safeguarding the genetic pool of edible species and traditional varieties; Closing the nitrogen cycle at the landscape scale and national	Ecosystem function restoration; Green urban infrastructure; Recycling; 100% waste treatment	Protection of biological diversity under agroecological principles; Energy localized transition (e.g., low carbon; small scale)	Ecological connectivity; Create new types of diversity	No fishing in high seas; Protection of species, habitats and ecosystems to ensure continued genetic diversity and species survival
Trade	Self-sustaining; Reduced trade	Sustainable supply chains; Long term agreements	Local/regional markets for food; Global market for ES flows such as water	Knowledge transfer around circular economy; Local solutions	Local urban-rural marketing initiatives		Sustainable use of resources and development of new products
Policies and Institutions	Global network of self-governing community-based economies; National system underpins local development	Collaborative governance across scales; Strong cross boundary regulations; Implementation of production protocols and certification	Cross-scale coordination, with strong connection from local to global; National taxation underpins local initiatives	Community driven demand for local resource governance structures; Legal regime change for living rivers as legal persona	Locally driven autonomous systems within a multiscale governance system; New institutions and policies to protect rights of nature and rights of small farmers and indigenous people; New institutions to protect and integrate policies of cultural and social diversity; new educational/ learning institutions nature values centred programs/policies	Autonomy of ecosystems; Private property right decrease; New forms of institutions to manage conflicts	Guardian role by governments and businesses for the oceans; Strong leadership from industries, governments, science and ILC; 500-year strategies; Respect oceans life and rights;

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