Programme Scénario #2

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Vivre « bien » en 2050 dans son territoire

Quels socio-écosystèmes et quelles places pour la biodiversité ?

Contexte de l'appel

L'érosion de la biodiversité pose la question du devenir des espèces, de la pérennité des fonctions écosystémiques et des réseaux écologiques, des communautés biotiques. En conséquence, à travers la focale « fonctionnement des écosystèmes », la biodiversité est au centre des questions environnementales, de climat et d'énergie, d'agriculture et d'alimentation, d'eau et de gestion durable des ressources dites « naturelles », mais aussi de santé et de bien-être.
Les scénarios des devenirs de la biodiversité, et des sociétés, ont donc une importance cruciale, car pour concevoir et agir, les acteurs expriment le besoin d'une idée des futurs « possibles » voire « souhaitables », ou a contrario « à éviter » ainsi que des facteurs conditionnant ces scénarios. Cela permet notamment d'anticiper les difficultés et les risques, mais aussi les opportunités et les forces sur lesquelles s'appuyer – l'objectif étant de parvenir à changer les trajectoires vers un futur désirable. A cela correspond aussi, voire surtout, la nécessaire explicitation des valeurs et conceptions de mondes possibles.

Outils d'exploration des futurs plausibles et non de prédiction, les scénarios permettent de penser les transformations passées et à venir. Ce sont des vecteurs de prise de conscience, de connaissances, d'endossement des responsabilités sur des sujets controversés, potentiellement difficiles à appréhender étant données la complexité et les incertitudes qui les caractérisent. Ils sont précieux pour développer des capacités d'anticipation, de décisions et d'organisation collective. Toutefois, beaucoup de résultats de processus participatifs ou de modèles issus des communautés de recherche restent encore trop disciplinaires et abstraits pour répondre aux préoccupations des parties prenantes, acteurs et actrices, et permettre le dialogue nécessaire entre recherche et action.

Dans ce cadre, la FRB a initié le programme Scénario #2 et ouvre le présent appel à projets.

Ce programme Scénario #2 présente deux grandes caractéristiques :

1. Un enjeu **transdisciplinaire**[1]**,** fondamental pour contribuer à l'étude des relations science-société et à enraciner scientifiquement les scénarios.

[1] Voir les définitions de multi-, inter- et transdisciplinarité dans : Stock, P.; Burton, R.J.F. Defining Terms for Integrated (Multi-Inter-Trans-Disciplinary) Sustainability Research. *Sustainability* **2011**, *3*, 1090-1113. https://doi.org/10.3390/su3081090

- D'une part il doit appuyer les communautés scientifiques – quelles que soient leurs disciplines – dans leurs structurations et accompagner leur montée en compétence dans l'étude des relations science-société (intégration des savoirs, des valeurs, liens aux acteurs…).
- D'autre part, il doit permettre aux acteurs territoriaux - de toute nature, aux valeurs, visions et imaginaires pluriels - de renforcer leurs capacités en matière de définition d'orientations, de prise de décision pour transformer les pratiques et institutions afin de favoriser la résistance et la résilience des socio-écosystèmes et minimiser les risques dans le cadre des changements globaux et locaux à l'œuvre, ne pas être démuni face aux incertitudes.

2. Des synergies entre **trois piliers scientifiques et méthodologiques en interaction**. En effet, des politiques et mesures sociétales ambitieuses permettant d'enclencher des changements transformateurs exigent des scénarios convaincants, ce qui requiert des modélisations robustes de la biodiversité et de l'organisation socio-économique d'un territoire. Elles nécessitent aussi de tenir compte de la pluralité des imaginaires, des valeurs - positives ou négatives pour la biodiversité -, ainsi que des représentations des interactions au sein des communautés biotiques, entre les humains et le reste de la biodiversité. Ainsi, le programme Scénario #2 s'articule autour de :
   - Les récits, **mises en art** pour saisir les imaginaires associés aux transitions, coconstruire des recherches et traduire des résultats scientifiques.
   - Les **cartes cognitives** pour saisir et représenter les visions plurielles, et expliciter les dynamiques à l'œuvre dans des socio-écosystèmes complexes.
   - La **modélisation** pour matérialiser les trajectoires, des humains et des non-humains, autres vivants, en interaction, et selon différents récits, mises en art, imaginaires et cartes cognitives.

Objectif de l'appel

Le présent appel à projets vise à **soutenir des projets transdisciplinaires** (et interdisciplinaires), construits avec et pour des parties prenantes locales / acteurs locaux, et dont les objectifs seront de **nourrir l'action en définissant des scénarios territoriaux de transitions écologique et sociale**.
Cet objectif s'appuie sur les connaissances académiques et non-académiques.

Requis des projets attendus

Les projets proposés devront intégrer les requis suivants :

- Les projets viseront la construction de scénarios territoriaux de transitions écologique et sociale, de feuilles de route de changements transformateurs pour les territoires d'étude à l'horizon 2050, les activités qui y sont développées en y intégrant, de manière explicite, la place de la biodiversité et les types de socio-écosystèmes dans ce devenir. Les scénarios pourront être exploratoires ou ciblés[2].
- Outre la formalisation de scénarios, une importance sera accordée à la qualité du processus de construction avec les parties prenantes : caractère possiblement transformateur de ce

[2] Scénarios « exploratoires » (*exploratory*), scénario « ciblés » (*target-seeking*), selon la terminologie de l'Ipbes. IPBES. (2016a).
Voir : Summary for policymakers of the methodological assessment of scenarios and models of biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (S. Ferrier, K. N. Ninan, P. Leadley, R. Alkemade, L. A. Acosta, H. R. Akɜakaya, L. Brotons, W. W. L. Cheung, V. Christensen, K. A. Harhash, J. Kabubo-Mariara, C. Lundquist, H. M. Obersteiner, G.

processus ; utilisation de ce processus pour amener à la réflexion ; traitement, voire mobilisation, de l'inconnu et des incertitudes dans l'élaboration des scénarios etc.

- Les projets s'ancreront dans des territoires métropolitains et/ou ultra-marins. Les projets traiteront d'enjeux multiples d'un territoire (activités économiques, ressources, société, gouvernance...) en y articulant les enjeux de biodiversité. L'échelle et le périmètre territoriaux pertinents sont à l'appréciation des répondants.
- Les projets seront transdisciplinaires. Ils s'appuieront sur des visions et des valeurs plurielles, possiblement contrastées, des acteurs. La recherche d'un consensus ou d'une vision commune n'est pas requise (conflits, intérêts divergents peuvent être pris en compte).
- Les projets seront interdisciplinaires (notamment entre sciences de l'écologie et sciences humaines et sociales).
- Les scénarios intégreront les dynamiques et les interactions des socio-écosystèmes et tendront à amener, dans les actions individuelles et collectives, à une vision plus éco- et socio-systémique de la biodiversité, plus intégrée.
- Les projets contribueront explicitement à combler ou résoudre l'un des manques identifiés dans les travaux de l'Ipbes (Annexe 1)[3].
- Les projets articuleront à minima deux des trois piliers du programme, ou encore les trois. A noter :
    - Les modèles pourront être de toute nature et complexité, quantitatifs et/ou qualitatifs. Ils devront pouvoir être mis à jour (notamment pour intégrer les aspects évolutifs, amener de nouvelles réflexions pour les acteurs des territoires...) et à des échelles pertinentes pour la décision, possiblement emboîtées.
    - Renforcer les discussions avec les acteurs territoriaux pour mieux intégrer leurs savoirs et leurs représentations dans les modèles pour créer des déclinaisons "locales" est un élément important.
    - La diversité et la coexistence des cartes cognitives sur un territoire donné, au sein d'un projet, est un élément important.
    - Les récits, mises en art peuvent être de différentes natures (du récit littéral à l'architecture en passant par la vidéo, par exemple) et intégrer artistes, acteurs et chercheurs dès le début d'un projet.
    - Les projets peuvent contribuer à faire émerger ou documenter des visions non dominantes / alternatives.

Les préprojets et projets sectoriels, ou cloisonnant les enjeux territoriaux, ou ne prévoyant pas d'insérer des considérations écologiques, dynamiques et évolutives dans les échanges avec les acteurs ne seront pas considérés.

Budget alloué et durée des projets

L'appel soutiendra 4 à 6 projets pour une durée maximale de 2 ans.
Un budget de [90-150] k€ sera alloué par projet[4].

[3] Voir aussi : IPBES (2016). The methodological assessment report on scenarios and models of biodiversity and ecosystem services. S. Ferrier, K. N. Ninan, P. Leadley, R. Alkemade, L. A. Acosta, H. R. Akçakaya, L. Brotons, W. W. L. Cheung, V. Christensen, K. A. Harhash, J. Kabubo-Mariara, C. Lundquist, M. Obersteiner, H. M. Pereira, G. Peterson, R. Pichs-Madruga, N. Ravindranath, C. Rondinini and B. A. Wintle (eds.). Secretariat of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, Bonn, Germany. 348 pages.

[4] Par exemple : 120 k€ permettent de couvrir environ 18 mois de salaire d'un(e) jeune post-doctorant(e), des frais d'ateliers/réunions, de mission, de petit matériel

Résultats attendus et livrables

Les projets contribueront à :

- **Explorer scientifiquement la complexité de la biodiversité** en intégrant un ensemble d'hypothèses cohérentes quant à la nature des forces et entités présentes, à leurs dynamiques, à leurs interactions et à leurs résultats au sein des socio-écosystèmes à plus ou moins proche échéance.
- **Aller vers une appropriation partagée des enjeux de biodiversité** entre acteurs en éclairant les tensions, les antagonismes ou les convergences entre des intérêts, des conceptions du monde et les effets sur la biodiversité et les socio-écosystèmes.
- **Identifier et hiérarchiser des mesures leviers sur les territoires** aptes à engager un changement transformateur des dynamiques sociétales actuelles, à même de faire évoluer les logiques (de type *business as usual* ou sectorielle avec des effets pervers) affectant la biodiversité.

Au cours des projets : les porteurs seront appelés à collaborer lors de rencontres conjointes (un à deux ateliers scientifiques et méthodologiques d'une journée).
En fin de projet : les équipes diffuseront leurs résultats *via* des publications scientifiques, des résumés pour décideurs et des livrables dont la forme et le fond auront été définis avec les acteurs engagés dans les projets. Les porteurs participeront à un colloque de restitution (une journée). Outre la présentation des méthodes, résultats, etc., il pourra leur être demandé de faire ressortir, en fonction de leur(s) question(s) et de leur maturité, certains éléments thématiques[5].

Gouvernance et déroulé de l'appel

Gouvernance

La gouvernance du programme Scénario #2 et de l'appel est réalisée par :

- Le Comité scientifique du programme appuie le Conseil scientifique de la FRB dans ses missions. Il est constitué d'une dizaine d'experts académiques, dont les référents scientifiques / pilotes des piliers issus de membres du CS de la FRB, et d'experts externes, disposant d'une expertise dans au moins un des piliers et/ou le développement et/ou l'utilisation de scénarios.
- Le Comité d'orientation du programme est constitué d'une dizaine de membres, issus du Conseil d'orientation stratégique de la FRB, et complétés par des acteurs externes, disposant

[5] Outre en quoi les projets répondent à un ou des résultats attendus mentionnés (complexité de la biodiversité, appropriation partagée, mesures leviers) et à un manque identifié dans les travaux de l'Ipbes – ils pourront faire ressortir, en fonction de leurs sujets et de leur maturité :

- Les avancées sur un ou des thèmes particuliers.
  Par exemple : les représentations et valeurs associées à la biodiversité, aux écosystèmes, aux dynamiques associées, aux relations humaines - non-humains ; les dissensus, controverses ou points de levier communs vers les changements transformateurs ; des innovations (conceptuelles, méthodologiques, de gouvernance, techniques…) pour les transitions ou les révolutions ; les solutions fondées sur la nature ou solution basées sur les écosystèmes, les liens entre ces solutions et les solutions climatiques fondées sur la nature ; les services écosystémiques ou contributions de la nature aux personnes, les dyservices ; la planification écologique territoriale ; l'exploration, la prise en compte, l'explicitation des incertitudes (au sens large) ; des recommandations en termes d'atténuation, d'adaptation, de nouvelles politiques publiques et des mesures sociétales plus écologiques ; éclaircir les postures ou les comportements de décideurs ou d'acteurs face à l'action environnementale ; etc.
- Les échelles spatiales et temporelles mobilisées, les réflexions et questions soulevées par les changements d'échelles.
- Les méthodologies mobilisées, les réussites, les bonnes pratiques, les conditions défavorables et les stratégies pour y remédier.
- Etc.

d'une expertise dans au moins un des piliers et/ou le développement et/ou l'utilisation de scénarios et de représentants de bénéficiaires du programme.
- Le Bureau est constitué des pilotes scientifiques des piliers (membres du Comité scientifique du programme), du(de) la pilote société du Comité d'orientation du programme, de représentants de la FRB chargé(e)s de la mise en œuvre du programme.

Déroulé de l'appel

Cet appel se déroule en **deux temps** :
- Temps 1 - Dépôt, évaluation et sélection des préprojets. Les préprojets retenus seront accompagnés de recommandations aux porteurs invités à déposer un projet (temps 2).
- Temps 2 - Dépôt, évaluation et sélection des projets.

Les préprojets et les projets sont évalués par le Comité scientifique du programme, responsable de la qualité scientifique du programme Scénario#2, et par le Comité d'orientation du programme, responsable de la pertinence sociétale du programme Scénario #2.
Les évaluations des préprojets et des projets sont synthétisées par le Bureau, responsable du pilotage et de la mise en œuvre du programme Scénario #2. Le Bureau informe alors de l'invitation ou non à déposer un projet complet puis de la sélection ou non. Le Bureau est aussi en mesure de sélectionner les projets finaux *ex-aequo* si l'enveloppe financière totale demandée excède l'enveloppe financière disponible.

Éligibilité, évaluation et sélection des préprojets et des projets

Éligibilité

L'éligibilité des préprojets et des projets sera vérifiée par l'équipe FRB en charge de la gestion de l'appel selon les critères suivants :
- Le(la) coordinateur(trice) du projet devra être un(e) chercheur(euse) en poste permanent ou sous contrat ayant cours jusqu'à la fin du projet, affilié(e) à un établissement de recherche français (recherche, recherche et enseignement).
  Un(e) seconde coordinateur(trice), en poste permanent ou sous contrat ayant cours jusqu'à la fin du projet, au sein d'une structure française ou étrangère, académique ou non, pourra co-porter le projet. S'il(elle) est chercheur(euse), il(elle) doit être issu(e) d'un laboratoire différent du(de la) premier(e) coordinateur(trice).
- Les propositions de préprojets et de projets devront être complètes.
- Les préprojets et les projets sont en rapport avec le sujet de l'appel.
- Les propositions déposées ou complétées après la clôture de l'appel ne seront pas éligibles.

Évaluation des préprojets

Les préprojets seront évalués par le Comité scientifique et le Comité d'orientation pour leur qualité scientifique et leur pertinence sociétale selon les critères suivants :

- Pertinence vis-à-vis de l'objectif de l'appel ;
- Caractère original, possiblement innovant, des objectifs visés (nouvelle façon d'aborder un sujet, d'engager des parties prenantes, développement scientifique, méthodologique ou technique…) ;

- Valeur ajoutée attendue pour un territoire (objectifs du projet, territoires(s) envisagés, enjeux territoriaux traités) ;
- Pertinence et qualité de la mobilisation envisagée des acteurs (qui, quand, comment).

Les préprojets sont évalués soit A (excellent / très bon / très bon avec quelques points d'attention), B (bon avec plusieurs points manquants), ou C (trop juste / faible).
La synthèse des évaluations des projets est effectuée par le Bureau : les préprojets évalués A et B sont invités à déposer un projet complet. Cette invitation est accompagnée, lorsque nécessaire, de recommandations.

Évaluation des projets

Les projets seront évalués par le Comité scientifique pour leur qualité scientifique selon les critères suivants :

- Pertinence vis-à-vis de l'objectif et des résultats attendus de l'appel
    - Objectifs en termes de scénarios territoriaux et trajectoires de transition.
    - Intérêt vis-à-vis des résultats attendus de l'appel (exploration de la complexité de la biodiversité, appropriation partagée des enjeux de biodiversité, identification de mesures levier).
- Propriétés scientifiques du projet vis-à-vis des requis
    - Clarté et pertinence des hypothèses de travail et/ou concepts mobilisés, et/ou questions posées.
    - Qualité et originalité des approches et/ou méthodes employées pour mener à bien le projet (collecte/analyse de données ou de connaissances, engagement des acteurs…).
    - Impacts scientifiques, méthodologiques, ou techniques attendues du projet.
    - Valeur ajoutée attendue du projet en termes d'articulation de piliers (récits, mises en arts et imaginaires ; cartes cognitives ; modélisation).
    - Contribution à combler un des manques identifiés par l'Ipbes.
- Qualité et faisabilité du programme de travail
    - Qualité du groupe de travail / de l'équipe projet constitué(e) (transdisciplinarité, interdisciplinarité, expertises).
    - Clarté et qualité du déroulé du projet, sa coordination, sa gouvernance.
    - Clarté et adéquation du calendrier et du budget.
    - Qualité de la gestion prévue des données au regard des principes FAIR[6].

Les projets seront évalués par le Comité d'orientation pour leur pertinence sociétale selon les critères suivants :

- Pertinence vis-à-vis de l'objectif et des résultats attendus de l'appel
    - Objectifs en termes de scénarios territoriaux et trajectoires de transition.
    - Intérêt vis-à-vis des résultats attendus de l'appel (exploration de la complexité de la biodiversité, appropriation partagée des enjeux de biodiversité, identification de mesures levier).
- Engagement des acteurs et caractère transdisciplinaire du projet
    - Pertinence des acteurs engagés dans le projet (qui, pourquoi, volonté de ces derniers).
    - Degré d'implication des acteurs dans le projet (information, consultation, collaboration…)[7].

[6] Descriptions des principes FAIR : https://www.go-fair.org/fair-principles/
Il s'agit d'appliquer progressivement ces principes.
[7] Les répondants pourront se reporter à Durham E., Baker H., Smith M., Moore E. & Morgan V. (2014). The BiodivERsA Stakeholder Engagement Handbook. BiodivERsA, Paris (108 pp) - Table 1.1 notamment.

    - Valeur ajoutée attendue du projet en termes d'appropriation et/ou de transfert de connaissances/méthodes et/ou d'encapacitation des acteurs.
- Impact sociétal du projet
    - Clarté de l'identification des bénéficiaires finaux du projet.
    - Pertinence de la recherche pour contribuer à répondre à une question sociétale territoriale.
    - Modalités de prise en compte de plusieurs enjeux territoriaux (approche dite « nexus »).
    - Modalités de diffusion et de mise à disposition des connaissances et des données au-delà du cercle du projet.

Sélection des projets financés

La synthèse des évaluations scientifique et sociétale des projets est effectuée par le Bureau : les projets seront ainsi financés selon leurs qualités scientifiques et sociétales, dans la limite de l'enveloppe financière disponible. Le Bureau est aussi en mesure de sélectionner entre deux projets *ex-aequo* si l'enveloppe financière totale demandée excède l'enveloppe financière disponible.

Politique de gestion des données

La FRB adhère à la démarche des données ouvertes. Les jeux de données produits/rassemblés par les projets financés dans le cadre de cet appel à propositions devront être rendus publics et accessibles à la communauté scientifique la plus large possible.
Pour atteindre cet objectif, il est demandé aux porteurs et porteuses de projets retenus que :

- Les jeux de données brutes et dérivées produits pendant le projet de recherche soient mis à disposition dans des entrepôts nationaux et puissent être rendus publics dans un délai raisonnable ;
- Les jeux de données brutes et dérivées produits pendant le projet de recherche soient décrits de manière pertinente en utilisant des standards de métadonnées internationaux tel l'*Ecological metadata langage* et les métadonnées publiées *via* le Pôle national de données de biodiversité (PNDB) et/ou le Système d'information sur la biodiversité (SIB) ;
- Des standards de Creative Commons BY 4.0 ou licence ouverte Etalab soient appliqués autant que possible pour toutes les données produites ;
- Les droits de propriété intellectuelle soient respectés tant lors de réutilisations de données que lors du choix de licence à appliquer.

Calendrier de l'appel et procédure de soumission

Calendrier

4 juillet – 22 septembre 2023 (12 sem.) **Ouverture de l'appel : 3 juillet 2023** **Date limite de dépôt des préprojets : 22 septembre 2023, 18h CEST**	Soumission des préprojets

25 septembre – 28 octobre 2023 (5 sem.)	Évaluation des préprojets
30 octobre – 22 décembre 2023 (8 sem.) Annonce des résultats et ouverture de la plateforme : 30 octobre 2023 Date limite de dépôt des projets : 22 décembre 2023	Soumission des projets
26 décembre – 2 février 2024 (6 sem.)	Évaluation des projets
Annonce des résultats : 5 février 2024 Février 2024 – Janvier 2025 (2 ans)	Contractualisation et déroulement des projets La durée prévue des projets est de 24 mois.

Procédure de soumission

Dépôt des pré-propositions : https://appelscenario.sciencescall.org/

Contact

Contact : programmescenario2@fondationbiodiversite.fr

Annexe 1 – Manques identifiés dans les travaux de l'Ipbes

Extrait de "Dialogues on knowledge gaps: screening of the gaps identified in the IPBES Global and Regional Assessments" produit par la Technical support unit (TSU) on knowledge and data (2022).

I. Synthetized information on knowledge gaps

A. Introduction

Context for the document

One of the main functions of IPBES consists in strengthening the knowledge foundations, to promote the generation of new knowledge and management of data on biodiversity and ecosystem services. To do so, the task force on knowledge and data is mandated to catalyse the generation of new knowledge by making the knowledge gaps identified through IPBES assessments known, and promote their uptake by relevant organizations that programme and fund biodiversity research.

In this context, the task force facilitates the organization of dialogues between experts of IPBES assessments and relevant external organizations and institutions, primarily programmers and funders involved in new knowledge generation. To have a basis of content for the dialogues and to facilitate the presentation of knowledge gaps, the task force developed the present document.

Objectives for the document

The dialogues will primarily focus on the IPBES Global Assessment of Biodiversity and Ecosystem Services and as relevant, Regional Assessments or recent IPBES workshop reports. This document thus presents the knowledge gaps identified within these assessments, with references to the corresponding chapters, sections and pages. **The main objective is to give an easily accessible overview of the knowledge gaps from the previously cited assessments**, providing the rationale behind the knowledge gaps and referring to some more detailed content of the assessments, as appropriate.

Section I introduces the present document and provides a synthetic version of the gaps. Section II corresponds to the background information and gives more details on the gaps identified within each chapter of an assessment.

Methodology for the document

Only the gaps explicitly identified as such in the assessments are presented in this document, which is thus based on a strict interpretation of knowledge gaps: a semantic research has been done throughout the assessments, using terms such as "gap" or "gaps", "lack of information", "lack of knowledge" but also "remains unclear" or "unknown". The content presented has not been modified but copy-pasted as such. Please note that some knowledge gaps may have escaped this semantic research.

This document is based on previous assessments and workshops reports and it is not intended to be reiterated. For ongoing assessments, the task force on knowledge and data supports assessments authors in the identification of knowledge gaps by providing guidelines which would be followed by experts to identify and report on knowledge gaps in their respective assessments.These guidelines provide the definition of a knowledge gap, the key steps throughout the assessments for the identification of knowledge gaps, a template for the collection of knowledge gaps to help structure them. These guidelines are available here: https://ipbes.net/modules-assessment-guide.

B. EXTRAIT - Draft table of knowledge gaps from the Global Assessment (summary for policymakers, SPM)

Disclaimer: This table of knowledge gaps was prepared by the experts of the Global Assessment and presented to and considered by a working group established by the Plenary at its seventh session. The Plenary did not approve this table as part of the summary for policymakers. It is therefore included in draft form, which does not imply working group or Plenary approval.

NB: This table is reproduced from appendix 4 of the Summary for Policymakers of the Global Assessment, with the addition of references to specific sections in the chapters or to the SPM.

Categories	**Sector**	**Knowledge gaps (in data, indicators, inventories, scenarios)[8]**
Modelling & scenarios	Integrated scenarios and modelling studies	● Regional and global socioeconomic scenarios explicitly considering the knowledge, views and perspectives of indigenous peoples and local communities *(Erreur ! Source du renvoi* **introuvable.***)* ● Regional and global socioeconomic scenarios developed for, by and in collaboration with indigenous peoples and local communities and their associated institutions *(4.1.2)* ● Quantitative data showing how nature, its contributions to people, and good quality of life interact and change in time along different pathways *(Erreur ! Source* **du renvoi introuvable.***, pages 609-610)* ● Scenarios of the future of biodiversity which quantify the possible co-benefits related to nature's contributions to people *(4.1.2)* ● Scenarios about nonmaterial benefits to people compared to material benefits and regulating benefits *(Erreur ! Source* **du renvoi introuvable.***, pages 609-610)* ● Integrated scenarios for areas projected to experience significant impacts and possible regime shifts (e.g., Arctic, semi-arid regions, and small islands) *(4.1.2)* ● Knowledge about the interaction, feedback and spill-overs among regions within future global scenarios *(Erreur ! Source du renvoi* **introuvable.***)* • Assessment of nature's contributions to people across scenario archetypes with robust knowledge and quantitative estimates *(Erreur ! Source du renvoi* **introuvable.***)*

C. EXTRAIT - Table of knowledge gaps from the Europe and Central and Asia Assessment sorted by categories

Disclaimer: The Plenary did not approve this table as part of the Assessment. It was prepared by the technical support unit to serve this dialogue.

Sector	**Knowledge gaps**
Modelling & scenarios	● **Erreur ! Source du renvoi introuvable.**, page 577 *«Knowledge gaps and resulting uncertainties in exploring future interactions between nature and society are substantial because integrated assessments of future impacts on nature, nature's contributions to people and a good quality of life that take account of the complex interdependencies in human and environmental systems are rare (well established) (5.6.2).* ○ *"Very few studies were available for Central Asia and to a lesser extent for Eastern Europe (well established)" (5.6.2).* ○ *Less information was also available for marine systems than for terrestrial and freshwater systems (well established) (5.6.2).* ○ *Few integrated scenario and modelling studies include indicators of nature's nonmaterial contributions to people and good quality of life (5.3.2, 5.5.1, 5.6.2)* ○ *and therefore existing assessments of synergies and trade-offs are limited in the interactions and feedbacks they represent (well established) (5.3.2).* ○ *No studies were found that assessed future flows of nature's contributions to people across countries, which would have been important to assess the impacts of the scenarios and pathways for Europe and Central Asia on other parts of the world (well established) (5.6.2).* ○ *There is also a significant gap in the current literature in recognizing the diversity of values, with the focus being mainly on instrumental values (well established) (5.6.2).* ○ *Finally, scenario and modelling studies include many uncertainties in their projections of the future resulting from input data, scenario assumptions, model structure and propagation of uncertainties across the integrated components of the systems, which should be borne in mind when interpreting their results (well established). »*

[8] "This list of knowledge gaps in the IPBES Global Assessment on Biodiversity and Ecosystem Services is not exhaustive".

	• *" Inequality scenarios, which assume increasing economic, political and social inequalities, where power becomes concentrated in a relatively small political and business elite who invest in green technology, result in negative impacts on nature's regulating contributions to people (established but incomplete), but mixed or unclear impacts on other indicators (inconclusive)"- (***Erreur ! Source du renvoi introuvable.***, page 575)* • *Details: "There were very few studies investigating the impact of land-use change and even fewer investigating future projected impacts of pollution, invasive species, fishing and other drivers of change" -****Erreur ! Source du renvoi introuvable.*** • *"It was often impossible to quantify the relative role of drivers of change in determining trends in species and ecosystems. This was due to lack of synthetic studies on this subject and the limited ability to meta-analyze the literature to provide this evidence" -****Erreur ! Source du renvoi introuvable.*** • *" Confidence is generally high in all statements, yet often somewhat decreasing towards Eastern Europe and Central Asia, usually due to a lack of accessible literature and insufficient number of studies analysing trends and impacts."-* **Erreur ! Source du renvoi introuvable.** page 510 • *"there were very few scenario studies which modelled feedbacks from direct drivers, such as climate change or land use change, to socio-economic trends (an integral component of the IPBES conceptual framework; D.az et al., 2015), highlighting a key gap in the scientific literature" -* 5.2.1, page 586 • *"Studies which explicitly covered indigenous and local knowledge were largely unrepresented in all the reviews." - 5.6.2* • *"The coverage of nature's non-material contributions to people, and quality of life indicators was poor in most scenario and modelling studies and they were absent from, or limited to, recreational benefits in most visions and pathways studies"-* ***Erreur ! Source du renvoi introuvable.*** • *"Studies covering the marine realm were poorly represented, and almost absent from visions and pathways."-* ***Erreur ! Source du renvoi introuvable.*** • *"The analysis of how values were included in the exploratory scenario and normative scenario (or pathways) literature showed that some dimensions of value (i.e. intrinsic values) were not considered by the majority of futures studies [...]recognizing the diversity of values [...]socio-cultural approaches to valuation" -* ***Erreur ! Source du renvoi introuvable.*** • *"The direct drivers of pollution and invasive alien species also had limited coverage in exploratory scenarios compared to other direct drivers, such as climate change and land use change"-* ***Erreur ! Source du renvoi introuvable.*** • "*The review of integrated models revealed that integrated studies which attempt to capture some of the complex interdependencies between human and environmental systems under multiple drivers of change are rare, particularly for Eastern Europe and Central Asia" - 5.6.2* • *" The visions literature search yielded only a limited number of regional visions, with a small number of visions from the scientific literature"-* ***Erreur ! Source du renvoi introuvable.*** • *" The pathways review found that there are very few fully developed pathways studies that go beyond narrative presentations of pathways and are supported by quantitative modelling"-* ***Erreur ! Source du renvoi introuvable.***

D. EXTRAIT - Table of knowledge gaps from the Africa Assessment sorted by categories

Disclaimer: The Plenary did not approve this table as part of the Assessment. It was prepared by the technical support unit to serve this dialogue.

Sector	**Knowledge gaps**
Modelling & scenarios	• **Erreur ! Source du renvoi introuvable.** page 300 - *«There are currently clear gaps in the type and distribution of scenario studies in Africa, with some subregions – such as central, northern and western Africa – being particularly poorly covered."* • **Erreur ! Source du renvoi introuvable.** page 328 - "*Mostly, the scenarios paint general pictures of social-ecological trajectories for Africa, where changes in human well-being are not necessarily directly linked to changes in biodiversity or ecosystem services."* - *" The links between biodiversity, ecosystem services and human well-being are only partly explored in the scenarios assessed in this chapter." - "There is also very little regional specificity when it comes to human well-being in the different scenario studies"* • **Erreur ! Source du renvoi introuvable.**- "*There are many drivers that have not been considered in scenarios of future development pathways across Africa"* • **Erreur ! Source du renvoi introuvable.**-*" there is relatively little published literature that considers the full suite of scenario archetypes for Africa, and few comparable studies on the same species groups, precluding the assessment of collective responses per taxon at this time"* • **Erreur ! Source du renvoi introuvable.**- "*There is a strong spatial bias towards biodiversity studies in Southern Africa (South Africa specifically), and to a lesser extent, East Africa. Central Africa is most poorly represented."* - *" Specifically, there is a need for further scenarios and modelling work on tropical ecosystems that takes into account the different levels of biotic interactions and that incorporates*

	sufficient geographical (scale issues), ecological and taxonomic resolution (Kissling et al., 2010; Jaramillo et al., 2011). [...]" ● **Erreur ! Source du renvoi introuvable.** page 338 - *"There is a major need for building the capacity of African researchers, policymakers and institutions to understand, carry out and use scenario analyses."* ● **Erreur ! Source du renvoi introuvable.** page 338 - *" In particular, there is a need to broaden the focus of African scenario studies beyond modelling climate change impacts, and especially to better incorporate broad stakeholder participation and ILK into scenario processes."*

E. EXTRAIT - Table of knowledge gaps from the Americas Assessment sorted by categories

Disclaimer: The Plenary did not approve this table as part of the Assessment. It was prepared by the technical support unit to serve this dialogue.

Sector	**Knowledge gaps**
Modelling & scenarios	● (Executive summary, page 441 - message 12) "*There is a significant research gap in the development of models and scenarios that integrate drivers, nature, nature's contributions to people and good quality of life"* ○ **Erreur ! Source du renvoi introuvable.** page 241 - "*Studies linking biodiversity and other less tangible kinds of NCP are incipient"* ○ (**Erreur ! Source du renvoi introuvable.**) **Erreur ! Source du renvoi introuvable.**, page 19 - "*Knowledge gaps for assessing the linkages between indirect and direct drivers and between the drivers and specific changes in biodiversity and nature's contributions to people."* ○ **Erreur ! Source du renvoi introuvable.**- "*social and cultural values of nature and NCP have been rarely incorporated in models and scenarios."* ● **Erreur ! Source du renvoi introuvable.**, page 560 - message 9 - *"It could also benefit from improved analytical tools that integrate biodiversity and ecosystem services variables and human and socioeconomic development variables."* ● **Erreur ! Source du renvoi introuvable.**, page 560 - message 9 - *« There is an overall gap of policy evaluation in the Americas, which is more pronounced in Latin America and the Caribbean than it is in North America."*

F. EXTRAIT - Table of knowledge gaps from the Asia and Pacific sorted by categories

Disclaimer: The Plenary did not approve this table as part of the Assessment. It was prepared by the technical support unit to serve this dialogue.

Sector	**Knowledge gaps**
Modelling & scenarios	● ***Erreur ! Source du renvoi introuvable.*** *- "most studies significantly focus on social and economic drivers, but lack incorporation of ecological drivers, such as possible introduction of invasive species or new crop or animal breeds, which underpin existing research gaps"* ● ***Erreur ! Source du renvoi introuvable.*** *- "In general, however, regional scenario exercises generally lacked assessments of cultural or nonmaterial ecosystem services, probably due to lack of well established models and methods, highlighting a significant research gap. "* ● 5.3.3, pages 403-404 *and* ***Erreur ! Source du renvoi introuvable.***- *"No studies could be retrieved which either provide 'target-seeking' or 'back-casting' scenarios - marking an outstanding research gap in development of normative scenarios in the region that would assist governments with policy development."* ● 5.5, pages 414-415 - *"The comparison across the models in the region has been difficult due to different set of temporal, spatial and units of analysis as well as socio-economic and cultural differences."*

G. EXTRAIT - Table of knowledge gaps in the IPBES Workshop Report on Biodiversity and Pandemics sorted by categories

Disclaimer: The Plenary did not approve this table as part of the Assessment. It was prepared by the technical support unit to serve this dialogue.

Sector	Knowledge gaps
Modelling & scenarios	● ***Erreur ! Source du renvoi introuvable.***- *Analyzing trade-offs between biodiversity conservation and disease transmission within landscape conservation and restoration programs - "There is a paucity of empirical data on how large-scale conservation programs that restore habitat, create corridors, or otherwise alter landscapes affect disease transmission, despite evidence from limited studies and modelling that they can promote or reduce disease risk."*

H. EXTRAIT - Table of knowledge gaps in the Workshop Report on Biodiversity and Climate Change sorted by categories

Disclaimer: The Plenary did not approve this table as part of the Assessment. It was prepared by the technical support unit to serve this dialogue.

Sector	Knowledge gaps
Modelling & scenarios	● (Synopsis, page 19 - message 19*) "Current scenarios used by the IPCC do not differentiate between natural forest regrowth, reforestation with plantations, and afforestation of land not previously tree-covered, which makes assessment of biodiversity impacts difficult and is a knowledge gap that needs to be addressed."* ● ***Erreur ! Source du renvoi introuvable.***- *" The vast majority of these models do not, however, account for important mechanisms of adaptation (Razgour et al., 2019; Settele et al., 2014)."*

II. Background information on knowledge gaps

A. EXTRAIT - List of knowledge gaps in the IPBES Global Assessment

Chapter 4. Plausible futures of nature, its contributions to people and their good quality of life

Some knowledge gaps disseminated within the chapter.

> (**Erreur ! Source du renvoi introuvable.**7, pages 609-610) « ***There is a lack of global-scale impact analyses that integrate across natures, nature's contributions to people and good quality of life***. *Most scenarios developed for global environmental assessments have explored impacts of humans on ecosystems, such as biodiversity or productivity loss {4.1, 4.2}. The effects of alternative trajectories of socioeconomic development on ecosystems and ecosystem services have been assessed as one way outcomes, ignoring the possible interactions between natural and socioeconomic systems. A better understanding of feedback mechanisms is needed on many fronts, for instance: in what ways pollution arising from agricultural intensification does impact pollinators and/or water quality, which in turn impact land use and intensification?; or how do changes in food prices arising from different land uses feed back to land use decision making?; or how is overfishing leading to depletion of large predatory fish and development of global markets for alternative species, often their own prey, leading to further collapse of marine resources?; or, to what extent climate change induced sea level rise is decreasing wetlands area and is affecting carbon sequestration? (established but incomplete) {4.1, 4.3.2.1, 4.5.1-4.5.3, 4.6.1, 4.7.3}. In addition, storylines of socio-economic development that underlie global scenarios consider mostly material aspects of GQL and do not consider other indicators of GQL {4.4.1-4.4.3}.* ***There is a knowledge gap in scenario studies*** *about non-material benefits to people compared to material benefits and regulating benefits, which limits our capacity to understand quantitatively how nature, its contributions to people and good quality of life interact and change in time.*

In particular, human decision making at multiple levels is not well integrated in global scenario modelling tools such as Integrated Assessment Models that focus on economic objectives (well established) {4.1, 4.2, 4.5.1, 4.5.2, 4.4.1-4.4.3}. A paradigm shift in scenario design could be achieved by considering, alongside of economic principles, provisioning of multiple ecosystem services and GQL as part of the storyline and human decisions (and subsequent scenario realisation), rather than as an outcome of socio-economic drivers {4.6.1}. For a more robust scientific underpinning of biodiversity and multiple sustainability targets, these non-material aspects need to be explicitly addressed in the scenarios (unresolved) {4.6.1}. Such scenarios would facilitate policy-relevant scientific evidence through exploration of trade-offs and cobenefits between targets related to biodiversity and ecosystem services, including the interconnected nature of drivers across

regions {4.3.4, 4.5.1}. Participatory Scenario Planning, with stakeholders aligned to the scale of the scenario (e.g., the CBD for global scenarios) would allow for a differentiated assessment of good quality of life across stakeholder groups, and highlighting winners and losers across environmental or policy scenarios (established but incomplete) {4.4.2}. »

> (**Erreur ! Source du renvoi introuvable.**, page 613 - Exploratory scenarios) «*Issues related to conservation or biodiversity, or feedbacks from changes in ecosystem services to socio-economic decision-making, have typically not been well considered in the wide range of global scenarios that are well established in the climate change scientific communities. Likewise, scenarios of the future of biodiversity typically do not seek to quantify the possible co-benefits related to ecosystem services (Kok et al., 2017; Powell & Lenton, 2013)(Pereira, Leadley, Proenca, et al., 2010). Important gaps remain in scenario development, such as the development of integrated scenarios for areas projected to experience significant impacts and possible regime shifts (e.g. Arctic, semi-arid regions and small islands), and socioeconomic scenarios developed for and in collaboration with Indigenous Peoples and Local Communities (IPLCs) and their associated institutions, values and worldviews (Furgal & Seguin, 2006). »*

> (**Erreur ! Source du renvoi introuvable.**, page 623 - Considering IPLCs and ILK in scenarios) «*The integration of Indigenous and Local Knowledge (ILK) into scenarios developed at the regional and global scales, as well as the assessment of the impacts of scenarios on Indigenous Peoples and Local Communities (IPLCs), have been limited and remain a key challenge in scenario development (Wohling, 2009; Hill et al., 2012). Varying combinations of indirect drivers, and especially government policy, can disproportionately impact IPLCs and their livelihoods. This is particularly significant when considering scenarios as alternative policy or management options intended to alter the future state of these (system) components (IPBES, 2016a). The following examples provide evidence for the potential benefits that could be gained from a better recognition of and respect for ILK and IPLCs in conservation of Nature, as well as adaptation to and mitigation of climate change.* »

> (**Erreur ! Source du renvoi introuvable.**, page 665 - Nature's contribution to people across scenario archetypes) « *Scenarios and models are important tools for understanding how the multiple contributions of nature to people (NCP) might unfold in the future. Scenarios that are adverse for biodiversity and ecosystem function are likely to be adverse for NCP because of known links between biodiversity, ecosystem function and the material, regulating and non-material benefits to humans (Mace et al., 2012). Nonetheless, there is still a lack of robust knowledge and quantitave estimates of these relationships, and thus how they might impact future changes in NCP.* »

> (**Erreur ! Source du renvoi introuvable.**- How changes in NCP will manifest in different regions, including teleconnections across regions) «*Knowledge about the interaction, feedback and spill-overs among regions, and implementation in future global scenarios is needed for better projections and management of NCP including flow-based aspects of governance beyond the classical territorial approaches (Sikor et al., 2013; Liu et al., 2013a). Without such knowledge, decisions on the management of NCP in one region will lead to incomplete and skewed conclusions that affect sustainability at the global level (Schröter et al., 2018). For example, telecoupling is linked to remote, large-scale investment in land purchase or lease and freshwater demand, which is happening in all continents except Antarctica (Rulli et al., 2013). Also in context of urban-rural relations this consideration can help to better understand interactions with systems beyond their boundaries (Seto et al., 2012).* »

> (**Erreur ! Source du renvoi introuvable.**- Non-Material dimensions of good quality of life) « *Knowledge and education related to biodiversity and ecosystem services are essential for ensuring good quality of life. The taxonomic records of world fauna and flora indicate 8.7 million known species (Mora et al., 2011), which represent only a fraction of the species that may exist (WRI-IUCN_UNEP 1992), indicating a large knowledge gap on fundamental aspects of biodiversity. It has been estimated that 86% of existing species on Earth and 91% of species in the ocean still await description (Mora et al., 2011). Much of the knowledge used in scenarios of biodiversity and ecosystem services is derived from biology, ecology and related disciplines.* »

Chapter 5. Pathways towards a Sustainable Future

Some knowledge gaps disseminated within the chapter.

> (5.3.2.2, page 798) - Meeting climate goals while maintaining nature and NCP) «*Large-scale deployment of intensively managed first-generation monoculture bioenergy crops would have profound negative impacts on biodiversity and many ecosystem services but a comprehensive quantification of such effects at the global scale is missing. A recent study concluded that a low-emission scenario with BECCS might affect global vertebrate diversity as negatively as a high-emission scenario with stronger climate change but without BECCS (Hof et al., 2018). Nevertheless, substantial additional potential for bioenergy exists without compromising biodiversity and ecosystem services, but the implications of different bioenergy systems for a variety of ecosystem services and sustainable development are often poorly captured in scenario studies.* »

B. EXTRAIT - List of knowledge gaps in the IPBES Europe and Central Asia Assessment

Summary for policymakers:

- ***Lack of integrated scenario and modelling studies****: Scenarios rarely account for effects of multiple drivers and their interactions on impacts on the different components of biodiversity, nature's contributions to people and a good quality of life {5.6.2}. There is also a significant gap in terms of exploring the full range of synergies and trade-offs between the multiple aspects of biodiversity, ecosystem services and a good quality of life under different scenario archetypes and across different scales. It is also important to develop and couple process-based models of ecosystem functioning with the human dimensions of socioecological systems and to thoroughly evaluate these models, including the assessment of uncertainties* {*Erreur ! Source* **du renvoi introuvable.***}.*
- ***Gaps in the quantification and timing of pathways towards desired futures****: Pathways and envisioning studies are often not supported by modelling and, so, lack detailed quantification of goals and actions. Detailed description and sequencing of actions within pathways is rare, as is information on combinations of policy instruments to implement specific actions* {*Erreur ! Source* **du renvoi introuvable.***}. The incorporation of combinations of exemplary transition movements pathways into large-scale scenario exercises and into participatory scenario development is suggested as a way forward for better resolving trade-offs and for scaling-up local or sectoral solutions {Erreur ! Source* **du renvoi introuvable.***}.*

Chapter 5. Current and future interactions between nature and society

Knowledge gaps within the chapter.

> (executive summary, page 577) «***Knowledge gaps and resulting uncertainties in exploring future interactions between nature and society are substantial because integrated assessments of future impacts on nature, nature's contributions to people and a good quality of life that take account of the complex interdependencies in human and environmental systems are rare (well established) (5.6.2****). Very few studies were available for Central Asia and to a lesser extent for Eastern Europe (well established) (5.6.2). Less information was also available for marine systems than for terrestrial and freshwater systems (well established) (5.6.2). Few integrated scenario and modelling studies include indicators of nature's nonmaterial contributions to people and good quality of life (5.3.2, 5.5.1, 5.6.2) and therefore existing assessments of synergies and trade-offs are limited in the interactions and feedbacks they represent (well established) (5.3.2). No studies were found that assessed future flows of nature's contributions to people across countries, which would have been important to assess the impacts of the scenarios and pathways for Europe and Central Asia on other parts of the world (well established) (5.6.2). There is also a significant gap in the current literature in recognizing the diversity of values, with the focus being mainly on instrumental values (well established) (5.6.2). Finally, scenario and modelling studies include many uncertainties in their projections of the future resulting from input data, scenario assumptions, model structure and propagation of uncertainties across the integrated components of the systems, which should be borne in mind when interpreting their results (well established). »*

> (5.2.1, page 586 - Review of exploratory scenarios for Europe and Central Asia) *« Finally, there were very few scenario studies which modelled feedbacks from direct drivers, such as climate change or land use change, to socio-economic trends (an integral component of the IPBES conceptual framework; D.az et al., 2015), highlighting a key gap in the scientific literature» covering nature's contributions to people.*

{...}

These findings show that only a minority of scenario studies take account of the value of nature, its contributions to people, and good quality of life (Murray-Rust et al., 2013). They also indicate that most studies addressed the different dimensions of value only independently (e.g. MEA, 2005) or linked nature with a limited set of mainly instrumental values, excluding other dimensions such as intrinsic or relational values. This highlights a significant gap in the current scenario literature in recognizing the diversity of values (e.g. IPBES, 2016b). Closing this gap could be of particular importance as the transformative practices that may be needed for achieving sustainable futures can benefit from embracing such value diversity (Pascual et al., 2017) (see Section 5.5). »

>Dedicated section on knowledge gaps and uncertainties (**Erreur ! Source du renvoi introuvable.**)

« In this section, the knowledge gaps and uncertainties that appeared across all the sections of Chapter 5 are first listed followed by knowledge gaps specific to the assessments undertaken within each section. ***Knowledge gaps and uncertainties across all sections of the chapter****:*

→ The assessment of how findings from the different reviews related to policy goals or targets similar to the Sustainable Development Goals and Aichi Biodiversity Targets was mostly based on the expert judgement of the author team, as most documents reviewed did not explicitly include links to these goals or targets. The absence of direct links to these international goals in reviewed documents is related, on the one hand, to the fact that scenarios usually deal with time horizons going beyond 2020 and even 2030. Furthermore, most studies were published before the Sustainable Development Goals were adopted and naturally did not include the goals. Moreover, the partial coverage of the full set of these international goals is related to their regional prioritization and reflects the dominant regional values. Lastly, our primary focus on studies targeting at least nature and its contributions to people meant that other strategic documents focusing on good quality of life with only loose links to nature were not considered.

→ All reviews reveal knowledge and information gaps for Central Asia and, to a lesser extent, for Eastern Europe. In general, higher uncertainties in outcomes are expected from regions where evidence is based on very few studies. There is a high diversity in the complexity and degree of integration reflected in the four reviews, which is explored further below.

→ Studies which explicitly covered indigenous and local knowledge were largely unrepresented in all the reviews. This is related to the focus of some of the reviews on the national scale or higher. Yet, while indigenous and local knowledge was often not included explicitly, a range of studies, particularly in the visions and pathways review, were developed together with stakeholders and revealed valuable insights into nature's non-material contributions to people and relational values. This confirms the suggestion made by the IPBES "Guide on the production and integration of assessments from and across all scales" (IPBES/4/INF/9) as well as in the IPBES Methodological Assessment of Scenarios and Models of Biodiversity and Ecosystem Services (IPBES, 2016b), where participatory scenario development and modelling are recommended as powerful approaches for knowledge co-production and the inclusion of indigenous and local knowledge. The development of new scenarios for IPBES (Rosa et al., 2017) will open up opportunities for such approaches and work towards the appropriate inclusion of indigenous and local knowledge in future assessments.

→ The coverage of nature's non-material contributions to people, and quality of life indicators was poor in most scenario and modelling studies and they were absent from, or limited to, recreational benefits in most visions and pathways studies.

→ Studies covering the marine realm were poorly represented, and almost absent from visions and pathways. Consequently, very few results and conclusions on associated ecosystems can be provided.

→ The analysis of how values were included in the exploratory scenario and normative scenario (or pathways) literature showed that some dimensions of value (i.e. intrinsic values) were not considered by the majority of futures studies. This highlights a significant gap in the current literature in recognizing the diversity of values where most studies predominantly focus on anthropocentric values (i.e. instrumental). Furthermore, socio-cultural approaches to valuation were used to a much lesser extent than biophysical or economic methods.

In the following, ***knowledge gaps and uncertainties for each of the individual reviews*** *are highlighted:*

The review on exploratory scenarios revealed that the indirect drivers of institutional change, cultural change and technology were rarely explicitly included within scenario analyses, but frequently subsumed within common socioeconomic storylines (i.e. IPCC SRES, SSPs). Only limited aspects of these driver categories were addressed by the studies, for example efficiency of governance, level of international collaboration and proactivity of environmental management among institutional drivers; diet, material and meat consumption and environmental awareness among cultural drivers; and agricultural efficiency among technological drivers. Given the frequent presence of technology, cultural and governance drivers within qualitative storylines, we hypothesize that the relative absence of explicitly quantified technology and governance drivers is due to the complexities involved in parameterizing such uncertain drivers for inclusion in models. Economic drivers were frequently parametrized through increasingly questioned indicators, such as GDP.

The direct drivers of pollution and invasive alien species also had limited coverage in exploratory scenarios compared to other direct drivers, such as climate change and land use change. Among pollution drivers, only nutrient emissions from agriculture were covered more frequently. Biological invasions were addressed only generally in most cases, assuming high or low levels of invasive alien species, without specific assumptions regarding individual species.

The review of integrated models revealed that integrated studies which attempt to capture some of the complex interdependencies between human and environmental systems under multiple drivers of change are rare, particularly for Eastern Europe and Central Asia. Furthermore, they are often limited in the different social and ecological components that are coupled and the feedbacks between them that are represented. Few studies specifically focus on nature and its contributions to people, although such aspects can be

included as part of a model chain or by linking the output of integrated models to biodiversity or ecosystem service models. ***This is a key priority for future work to quantify impacts on nature, its contributions to people, and good quality of life indicators*** *under both exploratory and normative scenarios (or pathways), including the uncertainties associated with such model projections. Moreover, integrated models that accounted for nature's non-material contributions and aspects of a good quality of life were rare, and the few that were found used simplified expert-based approaches for representing the interrelationships. Few integrated modelling approaches have been benchmarked or inter-compared to fully capture and quantify uncertainties from different approaches. There is a significant gap in integrated assessments in terms of exploring the full range of synergies and trade-offs between the multiple aspects of nature, its contributions to people, and a good quality of life under different scenario archetypes and across different scales.*

Furthermore, nature is not a simple unit. Rather, any change in drivers will likely favour some dimension of biodiversity (i.e. some species, variants, combinations of species that produce a given ecological function) at the expense of others. As a result, nature is rarely included as a dependent variable in scenarios. However, according to the IPBES conceptual framework, knowledge on the responses of various facets of nature to various direct and indirect drivers, and on the effects of changes in nature on changes in its contributions to people, would be crucial. Moreover, the multifaceted character of biodiversity may also explain why integrated models struggle to capture detailed impacts on biodiversity (many use simple indicators, such as mean species abundance or biodiversity vulnerability indices). Coupling more sophisticated (process-based rather than statistical) models of biodiversity and ecosystem functioning with models of human processes within integrated assessment models would provide a more realistic assessment of the trade-offs between nature and other indicators of socio-ecological systems. Despite these drawbacks, integrated modelling approaches offer great promise in capturing some of the important interrelationships in complex systems which are key to understanding the impacts of drivers on nature, its contributions to people, and a good quality of life.

The visions literature search yielded only a limited number of regional visions, with a small number of visions from the scientific literature. For Western, Central and Eastern Europe, visions have already been developed by different stakeholder groups and for several activity sectors. In Central Asia, however, future planning is only covered by the strategic plans developed by governmental agencies. Thematic gaps, for which societal visions have not been found, include marine ecosystems and urban systems at the broad regional scale. The level of development of visions was very heterogeneous (from a single paragraph to detailed descriptions of vision components), and most lacked quantitative goals providing only qualitative orientating goals. Moreover, reviewed visions did not explicitly include a diverse range of values in their narratives. Visions can also be "stakeholder-specific" with different societal groups having different (and potentially conflicting) visions of the future. Visioning processes which rationalize or accommodate these different viewpoints in their analysis are rare, although cross-sectoral visions involving multiple stakeholders were found.

Environmental goals within visions were mostly related to the need to reduce or avoid environmental impacts derived from human activity or in the context of nature's contributions to people. The underpinning role of nature and ecosystems in the delivery of these contributions and the maintenance of good quality of life was often missed. Finally, the analysis of visions content suggests that interregional flows are being overlooked, which could result in an aggravation of global inequalities.

The pathways review found that there are very few fully developed pathways studies that go beyond narrative presentations of pathways and are supported by quantitative modelling. Nevertheless, well-developed narrative approaches may be just as valuable (if sometimes not more so) for empowering decision-makers and stakeholders, but this makes results more difficult to link with exploratory scenarios and formal analyses of specific drivers (i.e. analytical approaches) using quantitative modelling approaches. In addition, this lack of quantitative analysis means that pathway narratives express intent rather than feasibility, and that some trade-offs may be underestimated. Many pathways studies addressed tradeoffs between nature's material contributions to people (food, timber, fisheries) and water provisioning and quality, global climate regulation and biodiversity conservation. However, consideration of biotic regulation services (e.g. pollination, pest control), natural hazard protection and non-material contributions were largely absent from trade-off analyses. Detailed descriptions and sequencing of actions within pathways was rare, as was information on combinations of policy instruments for implementing specific actions. With the notable exception of transition movements narratives, pathways to sustainability focused on very few dimensions of a good quality of life. The incorporation of combinations of exemplary transition movements pathways into largescale scenario exercises and into participatory scenario development is suggested as a way forward for better resolving trade-offs and for scaling-up local or sectoral solutions. Furthermore, while investments were mentioned in a number of studies across the chapter, none of them provided systematic research to appropriately respond to the role of investments in the protection of ecosystems. »

Also, there is an **« inconclusive statement »** within the chapter, which can be highlighted here:

> (executive summary, page 575) *« Inequality scenarios, which assume increasing economic, political and social inequalities, where power becomes concentrated in a relatively small political and business elite who invest in green technology, result in negative impacts on nature's regulating contributions to people (established but incomplete), but mixed or unclear impacts on other indicators* ***(inconclusive)*** *(5.3.3, 5.6.1). »*

C. EXTRAIT - List of knowledge gaps in the IPBES Americas Assessment

Chapter 5. Current and future interactions between nature and society

There is no dedicated section on knowledge gaps in chapter 5.

> (Executive summary, page 441 - message 12) *«* ***There is a significant research gap in the development of models and scenarios that integrate drivers, nature, nature's contributions to people and good quality of life (well established) {5.3}.*** *Models and scenarios can be powerful tools to integrate and synthesize the complex dynamics of coupled human and nature systems, and to project their plausible behaviors into the future. Most existing models and scenarios focus on the link between drivers and its impacts on nature. Few cases exist in which models or scenarios integrate the relationships between changes in nature and changes in nature's contributions to people and good quality of life {5.3}. Inter-and trans-disciplinary modeling efforts will be required to address this research gap {5.3}.»*

> (5.6.4, page 497 - Recognition and inclusion of multiple values) *«Economic or monetary values have often been incorporated into models and scenarios, for example, to make global estimates of the value of ecosystems and their services (Kubiszewski et al., 2017a) (Box 5.3). In contrast, social and cultural values of nature and NCP have been rarely incorporated in models and scenarios. This represents a significant research gap as the knowledge and values of local stakeholders have been demonstrated to confer legitimacy, flexibility and adaptive capacity to policy and management actions (Pascual et al., 2017). »*

III. EXTRAIT - List of knowledge gaps in the IPBES Asia and the Pacific Assessment

Chapter 5. Current and future interactions between nature and society

There is no dedicated section but some knowledge gaps disseminated within the chapter.

> (Executive Summary, pages 373-374) *« There is variation in the coverage, distribution and relative influence of different drivers on the human nature interactions across the Asia-Pacific region (established but incomplete) {5.3.2.1} (Figure 5.17). Most studies on influence of drivers focus on social and economic drivers, but lack integration of ecological drivers, such as the invasive alien species or new breeds of species, which underpin* ***existing research gaps*** *{5.1.3, 5.2.1}. In Oceania and North-East Asia, economic and policy drivers are somewhat less integrated, in South and South-East Asia, economic drivers, particularly changing lifestyles and consumption patterns, expansion of biofuels, and governance reforms were found to have strong influence {5.3.2.2, 5.3.3.3}. Similarly, climate change-related drivers such as sea level rise and rise in sea surface temperature have been relatively well captured in Oceania including Pacific islands compared to other subregions, in part because of the well-known climate vulnerability of small islands and low lying coastal areas in the Pacific {5.2.3}. However, most studies significantly focus on social and economic drivers, but lack incorporation of ecological drivers, such as possible introduction of invasive species or new crop or animal breeds, which underpin* ***existing research gaps*** *{5.2.1, 5.2.2, 5.2.3}. Scenario archetypes depicting plausible futures under Business As Usual conditions, which are predominantly influenced by Market Forces, or scenarios with increased focus on national-level securities, all present narratives that show declines in both BES and human well-being across the Asia-Pacific region {5.2.1, 5.2.2, 5.2.3}.*

> (5.3.3, pages 403-404 - Assessment of scenarios from regional and subregional literature) «*Spatially-explicit, quantitative and exploratory scenarios dominated the regional/subregional scenario studies. Nearly 93 per cent of the selected studies explored plausible alternative futures, in comparison to five studies delivering 'policy-screening' scenarios (e.g. Cotter et al. (2014); Suwarno et al. (2016). No studies could be retrieved which either provide 'target-seeking' or 'back-casting' scenarios - marking an* ***outstanding research gap in development of normative scenarios*** *in the region that would assist governments with policy development. Within spatially explicit scenarios, nearly half of the studies utilized land-use transition pathways as proxies to determine competing claims over ecosystem goods and services. These delivered understanding of critical sustainability issues, such as food productivity, water availability, changing life-styles and energy consumption, and carbon sequestration. (e.g. Schaldach et al. (2011); Zhao & Wu (2014); Connor et al. (2015); Bryan et al. (2016).»*

> (5.3.3, pages 406-407 - Assessment of scenarios from regional and subregional literature) «*Water availability was also addressed by studies examining potential impacts of indirect drivers, such as changes*

in life styles and consumption, and the intensification of direct drivers such as climate change, land use alteration, crop intensification, and urbanization (e.g. Herzig et al. (2016); Yang et al. (2016). In general, however, regional scenario exercises generally lacked assessments of cultural or nonmaterial ecosystem services, probably due to lack of well established models and methods, ***highlighting a significant research gap****. »*

> (5.5, pages 414-415 - Synthesis of the plausible futures in the Asia-Pacific region - where to next?) «*The synthesis of these studies on a common platform were marred by the fact that a very few studies looked at the whole range of nature's contribution to people using common sets of scenarios and models. Most of the scenarios considered were Business-as-Usual scenario and there is a dearth of 'target-seeking' and 'back-casting scenarios' that would assist governments with policy developments, constituting a* ***significant research gap****. The comparison across the models in the region has been difficult due to different set of temporal, spatial and units of analysis as well as socio-economic and cultural differences. Although the region is divided by boundaries, most often biodiversity does not know any administrative bounds, adding an extra layer of complexity (especially for transboundary resources).»*

D. EXTRAIT - List of knowledge gaps in the IPBES Africa Assessment

Summary for policymakers

> (D4, page XXXIX - Africa has options) *«There are clear gaps in the geographical distribution of African scenario studies. Central, North and West Africa are poorly represented, have limited stakeholder participation and limited incorporation of indigenous and local knowledge. The prevalence of studies in Southern and East Africa and adjacent islands is due to a relatively long history of investment in biodiversity research. The same pattern was observed for valuation studies of biodiversity and nature's contributions to people. In addition to human capacity-building, there is a need to generate information, in particular quantitative data, needed for the development of scenarios and to take into account the specific contexts and diversity of the subregions, groups of people and related differences in culture, and in ecological, social and economic conditions. There is also generally limited accessible peer-reviewed and grey literature to support a comprehensive assessment of policy and governance options for Africa. This creates challenges when identifying policy options but presents an opportunity for more frequent and comprehensive ecosystem assessments. It also presents an opportunity for the development of case studies and pilot projects that explore the different policy options and instruments that are specifically relevant in the African context. Data collected from such efforts will help strengthen scenarios and models about plausible futures for Africa {5.1.1, 5.2.1, 5.2.2}.»*

Chapter 5. Current and future interactions between nature and society

There are some sections focused on uncertainties, gaps and research needs.

> (executive summary, page 300) *«****There are currently clear gaps in the type and distribution of scenario studies in Africa, with some subregions – such as central, northern and western Africa – being particularly poorly covered (established but incomplete).*** *Most of the studies assessed in this chapter have addressed future changes in southern Africa (37%) and eastern Africa (18%). Almost 50% of the studies focused on local scales, while 26% covered multiple countries, and 18% are part of global scenario exercises. Only 11% of the assessed studies were conducted at the national scale, which is arguably the most useful scale for decision-making. The majority of the studies (80%) have had a broad exploratory focus, with only 24% focused on assessing specific policies or interventions. Furthermore, most studies (46%) used existing scenario storylines from other (often global) studies to explore future impacts on biodiversity and NCP in Africa; only 14% developed new integrated scenario storylines (5.2.2, established but incomplete). Furthermore, the links between NCP and human well-being are not often explored in much detail beyond climate change impacts on disease vectors and livelihoods {5.5}.»*

> (5.4.6, page 315 - Uncertainties, gaps and key research needs) *«Most of the assessments focus on a similar set of key drivers. In a comparison with Chapter 4, there are many drivers that have not been considered in scenarios of future development pathways across Africa. For example, there are a limited number of scenarios and models which consider drivers related to invasive species introductions, rapid migration due to conflicts and natural hazards, and land tenure issues linked to land and water grabbing, or scenarios that address the impacts of urbanisation on energy demand, rates of charcoal consumption, sanitation needs, or pollution in Africa. The intensity and frequency of many of these underexplored drivers are likely to increase in the future and warrant further research and better incorporation into scenario studies. In addition, there are few scenarios that look at the compounding impacts of multiple drivers on the ability of social-ecological systems to provide ecosystem services (Adano et al., 2011). »*

> (5.5.3, page 320 - Provisioning services) *«In general, significant uncertainty and* ***knowledge gaps remain around biofuel production in Africa*** *(Niang et al., 2014), particularly with respect to socio-ecological*

sustainability considerations and land-use trade-offs (i.e., food versus fuel), and how trade-offs are manifest both spatially and within communities (Niang et al., 2014), with implications for livelihood security. »

> (5.5.4, page 322 - Regulating services) *«For Africa specifically, the existence of large data gaps around wild pollinators and their services (species identity, distribution and abundance) precludes any conclusive statements about pollinator impacts for the continent (IPBES, 2016). »*

> (5.5.5, page 322 - Uncertainties, gaps and research needs) *«However, there is relatively little published literature that considers the full suite of scenario archetypes for Africa, and few comparable studies on the same species groups, precluding the assessment of collective responses per taxon at this time. For the most part, this results in low resolution and levels of certainty about the future of biodiversity and NCP in Africa. Specifically, there is a need for further scenarios and modelling work on tropical ecosystems that takes into account the different levels of biotic interactions and that incorporates sufficient geographical (scale issues), ecological and taxonomic resolution (Kissling et al., 2010; Jaramillo et al., 2011). [...]*

There is a strong spatial bias towards biodiversity studies in Southern Africa (South Africa specifically), and to a lesser extent, East Africa. Central Africa is most poorly represented. The direct links between biodiversity features, ecosystem services and human livelihoods are not well explored. Instead, most of the literature focuses on forecasting species' range shifts, extinction risk and habitat loss. This points to an urgent need for making the biodiversity and ecosystem services benefit linkage more explicit in future scenarios work. »

> (5.6.6, page 328 - Uncertainties, gaps and research needs) *« The links between biodiversity, ecosystem services and human well-being are only partly explored in the scenarios assessed in this chapter. Mostly, the scenarios paint general pictures of social-ecological trajectories for Africa, where changes in human well-being are not necessarily directly linked to changes in biodiversity or ecosystem services. With the exception of the MA, human well-being components such as equity, security, or freedom and choice are rarely considered explicitly in the context of environmental change. This lack of detail in the main scenario reports and the papers included in the systematic review points to a lack of research that considers a broad range of human well-being aspects (beyond just material well-being) in future scenarios of Africa's biodiversity and ecosystem services.*

The links between biodiversity, ecosystem services and human well-being are only partly explored in the scenarios assessed in this chapter. Mostly, the scenarios paint general pictures of social-ecological trajectories for Africa, where changes in human well-being are not necessarily directly linked to changes in biodiversity or ecosystem services. With the exception of the MA, human well-being components such as equity, security, or freedom and choice are rarely considered explicitly in the context of environmental change. This lack of detail in the main scenario reports and the papers included in the systematic review points to a lack of research that considers a broad range of human well-being aspects (beyond just material well-being) in future scenarios of Africa's biodiversity and ecosystem services.

There is also very little regional specificity when it comes to human well-being in the different scenario studies. This is especially concerning when one considers the large differences in culture, socio-economic conditions and projected climate change impacts between different subregions of Africa – impacts such as water stress and concomitant water quality issues that can lead to a wide range of potential diseases, including childhood diarrhoea, a leading cause of death among African children (UNEP, 2008). The majority of scenarios also outline a tension between urban and rural areas, or the centres of development and the communities 'left behind', yet these divergent trajectories are not explored in detail. Future African scenarios research should address these gaps to understand differences bewteen areas, along with carefully disaggregating well-being impacts across different groups of people. Because of the high levels of inequality on the African continent, especially in sub-Saharan Africa (Beegle et al., 2016), scenarios of well-being impacts due to environmental change need to take into account the often fine-scale heterogeneity among Africa's population.»

> (5.9, page 338 - Conclusion) *«This chapter highlights clear gaps in the type and distribution of African scenario studies, with some subregions (central, north and west Africa), issues (non-climate-related) and perspectives (ILK), being particularly poorly covered. There is a major need for building the capacity of African researchers, policymakers and institutions to understand, carry out and use scenario analyses. In particular, there is a need to broaden the focus of African scenario studies beyond modelling climate change impacts, and especially to better incorporate broad stakeholder participation and ILK into scenario processes. The potential for using scenarios to support decision-making in Africa, particularly around potential risks, opportunities and trade-offs of the different future pathways of change, will only be realised if concerted efforts are taken to mobilise financial and other resources to build capacity for carrying out and using scenario analyses. »*

E. EXTRAIT - List of knowledge gaps in the IPBES Workshop Report on Biodiversity and Pandemics

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F. List of knowledge gaps in the IPBES-IPCC Co-sponsored Workshop Report on Biodiversity and Climate Change

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IPCC co-sponsorship does not imply IPCC endorsement or approval of these proceedings or any recommendations or conclusions contained herein. Neither the papers presented at the Workshop/Expert Meeting nor the report of its proceedings have been subjected to IPCC review.

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The IPBES-IPCC report and workshop did not aim to comprehensively address knowledge gaps in a dedicated section due to the format of this exercise. Nevertheless, some relevant knowledge gaps are identified but by no means systematic or exhaustive. The aim of this section is to highlight the need for such an exercise in the future.

Biodiversity and climate change - Synopsis

> (Synopsis, page 19 - message 19) *« Recent claims of massive areas available for forest area expansion and associated large carbon uptake potentials are likely incorrect, and greatly exaggerate what is ecologically and socially achievable. Current scenarios used by the IPCC do not differentiate between natural forest regrowth, reforestation with plantations, and afforestation of land not previously tree-covered, which makes assessment of biodiversity impacts difficult and is a knowledge gap that needs to be addressed. »*