IPBES Global assessment Chapter 5 -Supplementary Material

Contents

Appendix 5.1: Global scale search strings

General

TITLE-ABS-KEY ((("Scenario*") AND ("Backcasting" OR "Normative" OR "Target" OR "Target seeking*") AND ("species" OR "biological" OR "ecological" OR "nature" OR "biodiversity" OR "natural resource*" OR "organism*" OR "ecosystem*" OR "ecological service*" OR "conservation") AND ("Global"))) AND PUBYEAR > 2006

Nexus

TITLE-ABS-KEY ((("Scenario*") AND ("Backcasting" OR "Normative" OR "Target" OR "Target seeking*") AND ("species" OR "biological" OR "ecological" OR "nature" OR "biodiversity" OR "natural resource*" OR "organism*" OR "ecosystem*" OR "ecological service*" OR "conservation") **AND ("Food" OR "Cities" OR "Consumption" OR "Fisheries" OR "Agriculture" OR "Restoration" OR "Conservation" OR "freshwater")))** AND ("Global") AND PUBYEAR > 2006

Nexus and land cover change

TITLE-ABS-KEY ((("Scenario*") AND ("Backcasting" OR "Normative" OR "Anticipatory" OR "Target seeking") AND ("species" OR "biological" OR "ecological" OR "nature" OR "biodiversity" OR "natural resource*" OR "organism*" OR "ecosystem*" OR "ecological service*" OR "fisheries" OR "agriculture" OR "freshwater" OR "food" OR "urban*" OR "consumption*") **OR "land use change*" OR "restoration" OR "deforestation" OR "conservation")**) AND PUBYEAR > 2006

Appendix 5.2: Scenario review tables: synthesis of pathway elements across scales

This Appendix contains the following Tables and Figures:

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Table SM 5.2.A - Key pathway elements derived from scenarios related to MARINE resources (all SCALES).

No	Spatial Scale	Region/ system	Goal/ Vision	Type of scenario	Sectors	Pathway elements (measures, policies, changes)	Scenario short name	Complete reference
1	Global	World	To minimize of climate impacts on marine biodiversity and fisheries	Target-seeking	Fisheries	Climate mitigation	Cheung, et al. (2016)	Cheung, W. W., Reygondeau, G., & Frölicher, T. L. (2016). Large benefits to marine fisheries of meeting the 1.5 C global warming target. Science, 354(6319), 1591-1594.
2	Global	World	To mitigate cumulative impacts of human activities on marine ecosystem through marine protected areas	Target-seeking	Multiple marine sectors	Protected area and ecosystem-based fisheries management (MPA is necessary, but not sufficient to achieve EBM goals).	Halpern et al. (2010).	Halpern, B.S., Lester, S.E. and McLeod, K.L., 2010. Placing marine protected areas onto the ecosystem-based management seascape. Proceedings of the National Academy of Sciences, 107(43), pp.18312-18317.
3	Global	World	To marine mammals through protected area	Target-seeking	Multiple marine sectors	Marine Protected Areas	Pompa et al. (2011).	Pompa, S., Ehrlich, P.R. and Ceballos, G., 2011. Global distribution and conservation of marine mammals. Proceedings of the National Academy of Sciences, 108(33), pp.13600-13605.
4	Global	World	To achieve multi-species maximum sustainable yield	Target-seeking	Fisheries	Ecosystem-based fisheries management	Worm et al. 2009.	Worm, B., Hilborn, R., Baum, J.K., Branch, T.A., Collie, J.S., Costello, C., Fogarty, M.J., Fulton, E.A., Hutchings, J.A., Jennings, S. and Jensen, O.P., 2009. Rebuilding global fisheries. science, 325(5940), pp.578-585.
5	Global	World	To adapt to climate change impacts on coastal fisheries	Policy-screening	Fisheries	Climate adaptation for fisheries	Cheung, et al. 2017.	Cheung, W.W., Jones, M.C., Lam, V.W., D Miller, D., Ota, Y., Teh, L. and Sumaila, U.R., 2017. Transform high seas management to build climate

			through management of fishing in the high seas					resilience in marine seafood supply. Fish and Fisheries, 18(2), pp.254-263.
6	Global	World	To reduce plastic waste in the ocean	Target-seeking	Waste management	Improved waste management	Jambeck et al. 2016	Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R. and Law, K.L., 2015. Plastic waste inputs from land into the ocean. Science, 347(6223), pp.768-771.
6	Regional	North Sea	Population and community-level targets of the MSFD, as described by 4 fish community indicators	Size-spectrum model	Fisheries	Marine Strategy Framework Directive and effects of fishing	Blanchard et al. 2014	Blanchard, J. L., Andersen, K. H., Scott, F., Hintzen, N. T., Piet, G., & Jennings, S. (2014). Evaluating targets and trade-offs among fisheries and conservation objectives using a multispecies size spectrum model. Journal of Applied Ecology, 51(3), 612-622.
7	Regional	Caribbean	To maximize the net present discounted value of the multi-species fishery	Policy-screening	Fisheries	Ecosystem-based fisheries management (25 years)	Kellner et al 2011	Kellner, J. B., Sanchirico, J. N., Hastings, A., & Mumby, P. J. (2011). Optimizing for multiple species and multiple values: tradeoffs inherent in ecosystem-based fisheries management. Conservation Letters, 4(1), 21-30.
8	Regional	Baltic Sea	To conserve marine biodiveristy through marine protected areas	Target-seeking	Multiple marine sectors	Protected Area	Berglund et al 2012	Berglund, M., Jacobi, M. N., & Jonsson, P. R. (2012). Optimal selection of marine protected areas based on connectivity and habitat quality. Ecological Modelling, 240, 105-112.
9	Regional	North Sea	To conserve benthic marine ecosystems	Policy-screening	Fisheries	Ecosystem-based fisheries management	Hiddink et al 2006	Hiddink, J. G., Hutton, T., Jennings, S., & Kaiser, M. J. (2006). Predicting the effects of area closures and fishing effort restrictions on the production, biomass, and species richness of benthic invertebrate communities. ICES Journal of

								Marine Science: Journal du Conseil, 63(5), 822-830.
10	Regional	South China Sea	To achieve sustainable fisheries in terms of biodiversity, livelihood and economic benefits	Target-seeking	Fisheries	Ecosystem-based management	Sumail and Cheung 2016	Sumaila and Cheung 2016. Boom or Bust.
11	Regional	Northern South China Sea	To achieve sustainable fisheries in terms of biodiversity, livelihood and economic benefits	Ecopath with Ecosim	Fisheries	Ecosystem-based management	Cheung and Sumail 2008	Cheung, W.W. and Sumaila, U.R., 2008. Trade-offs between conservation and socio-economic objectives in managing a tropical marine ecosystem. Ecological Economics, 66(1), pp.193-210.
12	Regional	Gulf of California	To conserve marine biodiveristy through marine protected areas	Target-seeking	Multiple marine sectors	Marine protected areas	Sala et al. 2002	Sala, E., Aburto-Oropeza, O., Paredes, G., Parra, I., Barrera, J.C. and Dayton, P.K., 2002. A general model for designing networks of marine reserves. Science, 298(5600), pp.1991-1993.
13	National	Faroe Islands	To achieve sustainable fisheries management through marine protected areas	Policy-screening	Fisheries	Ecosystem-based fisheries management by MPAs and effort management	Zeller and Reinert 2004	Zeller, D. and Reinert, J., 2004. Modelling spatial closures and fishing effort restrictions in the Faroe Islands marine ecosystem. Ecological modelling, 172(2): 403-420.
14	National	Eritrea	To achieve multi-species	Target-seeking	Fisheries	Ecosystem-based fisheries management	Tsehaye and Nagelkerke 2008	Tsehaye, I., & Nagelkerke, L. A. (2008). Exploring optimal fishing scenarios for the multispecies

			maximum sustainable yield					artisanal fisheries of Eritrea using a trophic model. ecological modelling, 212(3), 319-333.
15	National	Wales, U.K.	To conserve marine biodiversity that minimize the loss of fisheries revenues	Target-seeking	Multiple marine sectors	Protected Areas	Richardson et al. 2006	Richardson, E. A., Kaiser, M. J., EDWARDS-JONES, G. A. R. E. T. H., & Possingham, H. P. (2006). Sensitivity of marine-reserve design to the spatial resolution of socioeconomic data. Conservation Biology, 20(4), 1191-1202.
16	Sub-national	West Coast of Vancouver Island, Canada	To meet multiple objectives of coastal and marine sectors	Exploratory	Multiple marine sectors	Ecosystem-based management/Marine spatial planning of multiple human activities	Guerry et al. 2012	Guerry, A.D., Ruckelshaus, M.H., Arkema, K.K., Bernhardt, J.R., Guannel, G., Kim, C.K., Marsik, M., Papenfus, M., Toft, J.E., Verutes, G. and Wood, S.A., 2012. Modeling benefits from nature: using ecosystem services to inform coastal and marine spatial planning. International Journal of Biodiversity Science, Ecosystem Services & Management, 8(1-2), pp.107-121.
17	Sub-national	Massachusetts Bay, USA	To mitigate carbon emission through the development of marine-based wind farm while minimizing ecosystem impacts and maximum benefits to other economic sectors	Policy-screening	Multiple marine sectors	Marine spatial planning – trade-offs between marine renewables and benefits of other sectors, and ways to resolve that trade-offs through MSP.	White et al. 2012	White, C., Halpern, B.S. and Kappel, C.V., 2012. Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses. Proceedings of the National Academy of Sciences, 109(12), pp.4696-4701.
18	Sub-national	France (Bay of Biscay)	To rebuild the Bay of Biscay Nephrops fishery	Policy-screening	Fisheries	Fisheries recovery plan	Martinet et al. 2007	Martinet, V., Thébaud, O., & Doyen, L. (2007). Defining viable recovery paths toward sustainable fisheries. Ecological Economics, 64(2), 411-422.

19	Sub-national	Hong Kong	To restore marine ecosystems and fisheries	Policy-screening	Fisheries	Ecosystem restoration and management	Buchary et al. 2003	Buchary, E.A., Cheung, W.L., Sumaila, U.R. and Pitcher, T.J., 2003. Back to the future: A paradigm shift for restoring Hong Kong's marine ecosystem. In American Fisheries Society Symposium (pp. 727-746). AMERICAN FISHERIES SOCIETY.
20	Sub-national	Mombasa, Kenya	To achieve sustainable use of coastal fisheries resources	Exploratory	Fisheries	Ecosystem-based management	Daw et al. 2015	Daw, T.M., Coulthard, S., Cheung, W.W., Brown, K., Abunge, C., Galafassi, D., Peterson, G.D., McClanahan, T.R., Omukoto, J.O. and Munyi, L., 2015. Evaluating taboo trade-offs in ecosystems services and human well-being. Proceedings of the National Academy of Sciences, 112(22), pp.6949-6954.
21	Sub-national	Great Barrier Reef	To achieve sustaianble use of coastal fisheries resources	Exploratory	Multiple marine sectors	Ecosystem-based management, including catchment-to-reef linkages	Butler et al. 2013	Butler, J.R., Wong, G.Y., Metcalfe, D.J., Honzák, M., Pert, P.L., Rao, N., van Grieken, M.E., Lawson, T., Bruce, C., Kroon, F.J. and Brodie, J.E., 2013. An analysis of trade-offs between multiple ecosystem services and stakeholders linked to land use and water quality management in the Great Barrier Reef, Australia. Agriculture, Ecosystems & Environment, 180, pp.176-191.
22	Local	South Africa (Namaqualand, De Hoop and Tsitsikamma Marine Protected Areas)	Effects of implementing Marine Protected Areas in three localities in SA in terms of fish biomass (predatory or pelagic fish)	Explor Quantitative, Policy screening	Fisheries	The introduction of marine protected area introduction was assessed using spatial and multi-species models. The introduction of marine protected areas generally resulted in a decrease in the biomass of small pelagic fish species, but an increase in predator species biomass. Trophic interactions need to be considered when introducing management interventions of this nature, and the there may be detrimental effects for small species.	Yemane et al. 2008	Yemane, D., Shin, Y.J. and Field, J.G., 2008. Exploring the effect of Marine Protected Areas on the dynamics of fish communities in the southern Benguela: an individual-based modelling approach. ICES Journal of Marine Science, 66(2), pp.378-387.

23	Local	Tunisia (Northern coast)	Determining trade-offs in regulatory measures (economic and viability considerations) associated with ecosystem restoration	Quantitative, Policy screening	Conservation, fisheries	1) A bioeconomic model was used to test management measures through scenarios to determine the viability a fishery according to biological and economic factors. 2) Management measures identified as being key to sustainability included the periodic closure of the fishery, changing net mesh shape, the removal of a biological tax, the removal of a fuel subsidy, and a reduction in fishing capacity.	Vendeville et al. 2016	Vendeville, P., Fadhel, H., Magraoui, A. and Sacchi, J., 2016. Restoring the ecosystem creates wealth. The case of the Northern coast of Tunisia's deep-water rose shrimp trawl fishery. Fisheries Research, 183, pp.55-73.
53	Local	Guinea (Guinea shelf ecosystem), South Africa (Southern Benguela ecosystem)	Understanding key ecosystem dynamics and realistic management options through the use of two fishing scenarios	Quantitative, Policy screening	Fisheries	1) The exploitation of low trophic level (forage) species may provide high catches but impacts the whole food chain, reducing the biomass of predators even if they are not directly targeted. 2) Fisheries should be managed to leave enough food in the ecosystem to avoid reaching thresholds where lack of energy might hamper reproduction and growth of key species, possibly by means of explicit protection of forage fish species.	Gasche & Gascuel 2013	Gasche, L. and Gascuel, D., 2013. EcoTroph: a simple model to assess fishery interactions and their impacts on ecosystems. ICES Journal of Marine Science, 70(3), pp.498-510.
70	Local	Eritrea (Masawa and Assab, Eritrean coast)	Scenarios for optimising artisinal fisheries	Quantitative, Policy screening	Fisheries	1) Optimal strategy involves reduced reef catch and increased pelagic (near-reef and large) catch. 2) Ecosystem-based analysis is not a substitute for rigorous single species stock assessment	Tsehaye et al. 2008	Tsehaye, I. and Nagelkerke, L.A., 2008. Exploring optimal fishing scenarios for the multispecies artisanal fisheries of Eritrea using a trophic model. Ecological Modelling, 212(3-4), pp.319-333.

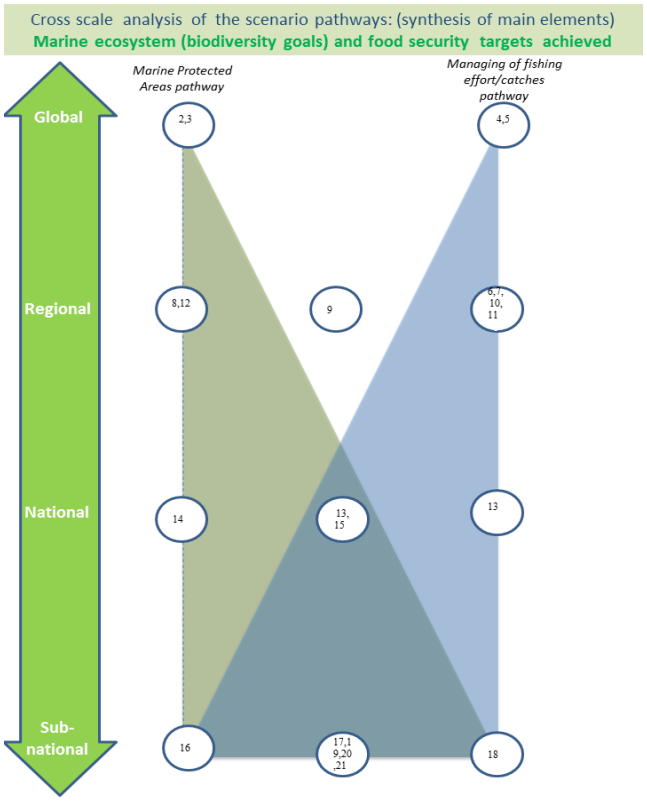

Figure SM 5.2.A - Graphical representation of how scenarios at different scales combine alternative pathways related to MARINE resources.

As the figure illustrates, ocean-related scenarios consider the interactions between marine protected area and fisheries management across scales and regions regarding pathways to SDG 15 for marine biodiversity conservation versus food security (SDG 2). Numbers in the diagram refers to the scenarios in Table SM 5.2.A.

Table SM 5.2.B - Key pathway elements derived from scenarios related to TERRESTRIAL AND FRESHWATER resources (GLOBAL)

No	Spatial Scale	Region/ System	Goal/ Vision	Type of scenario	Sectors	Pathway elements (measures, policies, changes)	Scenario short name	Complete reference
1	Global	World	Objectives related to the key areas of sustainable development and the land-energy nexus: provision of energy and food, mitigating climate change, providing clean air and reducing the loss of biodiversity (defined prior to the SDGs, but aligned to them). Three alternative narratives underlying three scenarios/pahways.	Target-Seeking	Agriculture, Energy	Thee alternative pathways: 1) Global Technology pathway: Emphasizing the use of technology and a high level of international coordination. Increased agricultural productivity needed to achieve food and BD goals. 2) Consumption Change pathway: Changing human consumption patterns, including reduced meat intake and food waste. 3) Decentralized solutions: Emphasizing decentralized solutions, such as extensive agriculture, natural corridors and national policies for equitable access to food. Agriculture is interwoven with natural corridors (ecological farming, avoided fragmentation). All pathways: (a) In mono-functional landscapes - strong emphasis on resource efficiency using cutting edge technological refinements, agronomic optimization of the farm environment and new animal breeds and crop varieties that perform best under these optimized conditions. (b) In multifunctional landscapes - combining technological advances with the services provided by natural	Rio+20/GBO4 pathways (PBL, 2012; Van Vuuren et al. 2015)	PBL. (2012). Roads from Rio +20: Pathways to achieving global sustainability goals by 2050. The Hague: Netherlands Environmental Assessment Agency.

						processes. (c) Scaling up of sustainable intensification technologies is key (by enabling farmers to make long-term investments by improving market transparency, price stability and secure land tenure) (d) Removing distorting subsidies, implementing regulation to discourage land conversion and/or creating income opportunities from preserving nature and ecosystem goods and services. (e) Reversing the trend in public investment in agricultural research and development, particularly in developing countries, is also a priority. (f) Create a more robust food system by creating more transparent and well-functioning market mechanisms and investing in more climate-resilient agricultural systems (g) Integrate biodiversity and ecosystem services into land-use planning and management (financial, technical and administrative capacities are needed for this) (h) Initiate a shift towards alternative consumption patterns (Potential instruments include regulation, economic incentives, and information campaigns) (g) International cooperation on protected areas (protect on average 17% of the terrestrial areas). Especially in developing regions, establishing effective		

						protection in current and future protected areas is challenging. Internationally, however, costs would seem to be modest, especially considering the benefits that protected areas may bring; for instance, via ecosystem service management and tourism. Mechanisms to facilitate and scale up international financing of protected areas are essential.		
2	Global	World	Assessment of priority areas for expanding the current global PA network, and quantified their potential contribution to global conservation.	Target seeking	Nature conservation	Prioritise threatened species in protected area expansion Reduce land use change in prioirity areas Intensity land use, and increase protection target to 21% Increase international cooperation for higher conservation outcomes Transboundary cooperations for connectivity and compactness of PAs	Pouzols et al. (2014)	Pouzols, F. M. et al. (2014) 'Global protected area expansion is compromised by projected land-use and parochialism', Nature, 516(7531), pp. 383–386. doi: 10.1038/nature14032.
3	Global	World	The objectives of the targets are to: improve energy access (universal by 2030), reduce airpollution and improve human health (Compliance with WHO standards by 2030), avoid climate change (2 degree limit) and enhance energy security (diversify energy supply by 2050)	Target seeking	Energy, Climate	Reduce enery use in buildings, transport and industry single most important strategy by: Improving technological efficiency (e.g. vehicle fuel efficiency) Change structure of energy services deamnd (e.g. physical to virtual mobolity) Reduce the level of energy services demand (e.g.reduce travel by living close to work)	McCollum et al. 2012	Mccollum, D. L., Krey, V. and Riahi, K. (2012) 'Beyond rio: Sustainable energy scenarios for the 21st century', Natural Resources Forum, 36(4), pp. 215–230. doi: 10.1111/j.1477-8947.2012.01459.x.
4	Global	World	They evaluate seven policy clusters ranging from energy, food, agriculture,	Policy screening	Energy, Food,	Increase bioenergy, Waste reduction, Input neutral yields, Shift production	Obersteiner et al. 2016	Obersteiner, M. et al. (2016) 'Assessing the land resource-

			biodiversity conservation to sustainable consumption using two sustainability scenarios		Agriculture, Climate, Nature conservation	systems, No gross forest loss, Halt conversation of biodiversity hotspots, Emission taxes, Reduced meat consumption		food price nexus of the Sustainable Development Goals', Science Advances, 2(9), pp. e1501499–e1501499. doi: 10.1126/sciadv.1501499.
5	Global	World	Alternative pathways to the 1.5 °C target using SSP2	Target seeking	Agriculture, Emergy, Climate	Introduction of of a uniform global carbon price, efficient technologies in transport, industrial production, buildings and material use, rapid electrification with renewables, intensification of agriculture with increased yields and land efficientlivestock farming, mitigation driven by stringent enforcement measures to reduce end of pie emissions and by introduction of in vitro (cultured) meat, produced on the basis of stem-cell technology, and input of energy and proteins (mostly based on soya).	Van Vuuren et al. 2018	Van Vuuren, D. P. et al. Alternative pathways to the 1.5 °c target reduce the need for negative emission technologies. Nat. Clim. Chang. 8, 391–397 (2018).
6	Global	World	Explore the impacts of land-based mitigation measures such as bioenergy production and afforestation to limit global warming to 2 °C or even 1.5 °C on the land system	Policy screening	Agriculture, Energy, Biodiversity, Water, Forestry, Urban	Reduction in animal product consumption by 30% in SSP1, 33% reduction in food losses at the household level due to environmental awareness, Trade tarrifs removed relfecting increased globalisation (SSP2 assumes trade tariffs to remain in place), Expansion of protected areas and areas excluded from agriculture expansion increase, Improved efficiencies in agriculture, Imrpove efficiency in irrigation, reducing irrigation growth	Doelman et al. 2018	Doelman, J. C. et al. Exploring SSP land-use dynamics using the IMAGE model: Regional and gridded scenarios of land-use change and land-based climate change mitigation. Glob. Environ. Chang. 48, 119–135 (2018).

7	Global	World	Limit global mean temperature increase below 1.5 degree celcius	Target seeking	Agriculture, Energy, Biodiversity	Shift away from fossil fuels to bioenergy (dedicated crops and residues) and renewable energy technologies, reduced energy use, carbon dioixde removal, change consumption patterns, sustainable intensification of agriculture	Rojelj et al. 2018	Rogelj, J. et al. Scenarios towards limiting global mean temperature increase below 1.5 °c. Nat. Clim. Chang. 8, 325–332 (2018).
8	Global	World	Scenarios for ambitious policy targets aiming to reverse within the 21st century the current declining trends in biodiversity as affected by land use	Policy screening	Biodiversity, Food, Agriculture, Climate	Increased conservation (through regulation of land use change that is detrimental to biodiversity) and restoration (thorugh financial incentives) , healthy diets (50% less meat in 2050, except n regions with low meat consumption), reducing waste in food supply chain by 50% in 2050, sustainably increased productivity particularly in developing countries, increase trade in agriculture by reducing trade barriers, reduce impacts of climate change through taxation on GHG emissions and no additional demand for biofuels and afforestation for carbon sequestration	Leclere et al. 2018	Leclère, D. et al. (2018) 'Towards pathways bending the curve of terrestrial biodiversity trends within the 21 st century', Preprint. doi: 10.22022/ESM/04-2018.15241.
9	Global	World	SSP2: Provide background on the quantification of the reference for implementation, a middle-of-the-road development in the mitigation and adaptation challenges space. Discuss the implications on land use and cliamte change.	Policy screening	Energy, Agriculture	Population and economic development: Global population grows to 9.4 billion in 2070, and slowly declines thereafter. GDP follows regional historical trends and global average GDP/capita reaches 60 000 USD, PPP, by the end of the century. Baseline energy intensity improvements: driven by advances in energy efficiency and evolving behavioural/lifestyle preferences. Technological trends do not shift markedly from historical patterns,	Fricko et al. 2017	Fricko, O. et al. (2017) 'The marker quantification of the Shared Socioeconomic Pathway 2: A middle-of-the-road scenario for the 21st century', Global Environmental Change. Pergamon, 42, pp. 251–267. doi: 10.1016/j.gloenvcha.2016.06.004.

						and energy intensity improves at average historical rates. Fossil energy resources: improvement in extraction technologies for unconventional hydrocarbon resources, leading to higher potential cumulative oil extraction. Non-biomass renewable and nuclear resources: technological progress is determined by income developments and narrative-specific assumptions -a technological learning rate comparable to fossil based technologies is assumed for nuclear power (30% cost reduction by 2100 over 2010). Bioenergy resources and use: increased productivity in agriculture reduces competition between bioenergy and food production. Technology cost developments: balanced view of progress for both conventional fossil and non-fossil technologies and technological development in SSP2 is not biased toward any particular technology group. Costs of technology for developing countries follow and catch up to developed countries drvien by costs of labour and capital.		
10	Global	World	SSP1: Describes the possible developments in global energy use and production, land use, emissions and climate changes, a development consistent with the green growth	Policy screening	Energy, Agriculture, Food, Protected areas, Transportati	Use of environmentally friendly technologies, A transition towards less resource intensive lifestyles, Global cooperation, Decreasing population in the second half of the century, High economic growth rate, Reduced energy	van Vuuren et al. 2017	van Vuuren, D. P. et al. (2017) 'Energy, land-use and greenhouse gas emissions trajectories under a green growth paradigm', Global Environmental Change.

					on, Water, Land use, Waste	demand driven by reduced consumption: in industry (reduced demand for steel and cement), buildings (rural electrification, phasing out traditional fuels, behavior change), transport (public transport, car sharing), Supply changes in energy driven by continued trade in fuels and improvment in extraction technologies, phasing out of biofuels by 2030, taxation of biofuels for biodiversity damage, high yields, efficiency, technology improvement, Aichi target on protected areas achieved, restriction in agricultural expansion, crop yield increases, effiency in irrigation, low consumption of animal products, Abolishment of current tariffs and subsidies by 2030, no trade restrictions, preference for regional products.		Pergamon, 42, pp. 237–250. doi: 10.1016/j.gloenvcha.2016.05.008.
11	Global	World	SSP1 x RCP 1.9. Systematic interpretation of the Shared Socio-Economic Pathways (SSPs) in terms of possible land-use changes and their consequences for the agricultural system, food provision and prices as well as greenhouse gas emissions.	Policy screening	Land use, Agriculture, Energy, Food, Forest, Climate	SSP 1 and 2 respectively have high and medium values for regulations, agricultural productivitiy, food consumption, meat diets, international cooperation.	Popp et al. 2017	Popp, A. et al. (2017) 'Land-use futures in the shared socio-economic pathways', Global Environmental Change. Pergamon, 42, pp. 331–345. doi: 10.1016/j.gloenvcha.2016.10.002.
12	Global	World	Investigate the effect of agricultural emission on surface air pollution under present-day and future conditions	Quantitative, Policy screening	Agriculture, Air pollution	Control combustion sources of nitrate aerosol precursors (NOx) to reduce impacts of agriculture pollution. Reduce emission of agricultural ammonia to reduce soil and water acidification	Bauer et al. 2016	Bauer, S. E., Tsigaridis, K. and Miller, R. (2016) 'Significant atmospheric aerosol pollution caused by world food cultivation', Geophysical Research Letters, 43(10), pp.

								5394–5400. doi: 10.1002/2016GL068354.
13	Global	World	SSP1 &3, and nutrient emissions from household water	Quantitative, Policy screening	Water, Pollution	Urbanisation, decreasing inequality within countries, implementation of stringent and effective environmental policies	van Puijenbroek et al. (2015)	van Puijenbroek, P. J. T. M.; Bouwman, A. F.; Beusen, A. H. W.; Lucas, P. L. (2015) Global implementation of two shared socioeconomic pathways for future sanitation and wastewater flows
14	Global	World	Reduce the impacts of huan development on biodivrsity	Policy screening	Agriculture, Forestry, Consumption, Waste, Protected areas	Limit meat intake per capita, reduce waste in agricultural productions chains, less energy intensive lifestyles	Visconti et al. 2016	Visconti, P. et al. Projecting Global Biodiversity Indicators under Future Development Scenarios. Conserv. Lett. 9, 5–13 (2016).
15	Global	World	Determine the expected contribution of protected areas to achieve Aichi target 12 by 2020	Policy screening	Protected areas, Pastures, Forestry, Agriculture	Environmental awareness among the population, changes in consumption patterns, shift to vegeterian diets (ofr health and environment), reduction in personal travel and freight	Visconti et al. 2015	Visconti, P. et al. Socio-economic and ecological impacts of global protected area expansion plans. Philos. Trans. R. Soc. Lond. B. Biol. Sci. 370, 20140284- (2015).
16	Global	Tropical forest countries	Halve carbon emissions by 2020. Halving carbon emissions from tropical deforestation rather than halving its area and reducing gross deforestation rather than net deforestation	Policy screening	Forestry, Climate	Brazil and Indonesia are singled out as major emittes. Brazil pathway elements: Public policy, law enforcement, voluntary actions. Indonesia: price and policy signals. Rest of the tropical forest countries: increase REDD+ financing because most of these countries are experiencing increases in emissions	Zarin et al. 2016	Zarin, D. J. et al. Can carbon emissions from tropical deforestation drop by 50% in 5 years? Glob. Chang. Biol. 22, 1336–1347 (2016).
17	Global	World	Increase fish abundance/target recovery and maximise long term catch	Policy screening	Fisheries	Assumed trajectories, no explicit pathway elements	Costello et al. 2016	Costello, C. et al. Global fishery prospects under contrasting management regimes. Proc.

								Natl. Acad. Sci. 113, 5125–5129 (2016).
18	Global	World	Decrease agricultural land use by 2030	Policy screening	Agriculture	Dietary changes in favour of vegetable food, Decreased food waste, Livestock productivity increases through feed to food efficiency	Wirsenius et al. 2010	Wirsenius, S. et al. How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? Agric. Syst. 103, 621–638 (2010).
19	Global	World	A sustained process of incremental adjustments to achieve sustainability goals. A structural shift to a new development paradigm	explorative	Energy, Agriculture, Transport, Built Environment	Policy instruments (such as eco taxes, market mechanisms, regulation, social programs, technology development and deployment) Lifestyle, values and human wellbeing reassessments: From overconsumption to material sufficiency, Focus on leisure time, family and community, Global democratic management of the world's share risks and opportunities, Restructuring of economic and governance institutions towards human fulfilment, social justice and respect for nature. Political willpower and cooperation among special interests and governments to craft and implement a comprehensive set of internationally-binding initiatives	Gerst et al. 2014	Gerst, M.D., P.D. Raskin, and J. Rockström. 2014. "Contours of a Resilient Global Future." Sustainability (Switzerland) 6 (1). doi:10.3390/su6010123.
20	Global	World	To meet terrestrial carbon storage. To meet biodiversity protection by protecting 17% of terrestrial area by 2020	Target seeking	Agriculture, Forestry, Pastures, Biodiversity protection	Implementation of policies that aim to reduce deforestation in order to reduce GHG emissions. No carbon trading schemes, and no leakage effects. Intensification of existing cropland and reduced expansion	Eitelberg et al. 2015	Eitelberg, D.A., J. van Vliet, J.C. Doelman, E. Stehfest, and P.H. Verburg. 2016. "Demand for Biodiversity Protection and Carbon Storage as Drivers of Global Land Change Scenarios."

								Global Environmental Change 40. doi:10.1016/j.gloenvcha.2016.06.014.
21	Global	World	Achieve sustainable energy supply by leveraging the financial sector investments	policy prescriptive	Energy, Finance	Global structural reforms to the financial sector	Carnicer & Penuelas 2012	Carnicer, J. et al. The world at a crossroads: Financial scenarios for sustainability. Energy Policy 48, 611–617 (2012).
22	Global	World	Achieve Net Zero Land Degradation by 2030	normative	Agriculture, Forestry, Pastures	Management and regulations. Financing of projects (incl. incentive and punitive schemes such as PES & Polluter pays)	Stavi & Lal 2014	Stavi, I. et al. Achieving Zero Net Land Degradation: Challenges and opportunities. J. Arid Environ. 112, 44–51 (2015).
23	Global	World	Determine the role of LAC's agriculture for global food security and for environmental sustainability through closing yield gaps up to 75%	Target seeking	Agriculture	Improved management practices or accelerated technological change. Advocates for high yields from increased agricultural knowledge and science and technology. Increased water use efficiencies through advanced irrigation technologies	Flachsbarth et al. 2015	Flachsbarth, I. et al. The Role of Latin America's Land and Water Resources for Global Food Security: Environmental Trade-Offs of Future Food Production Pathways. PLoS One 10, e0116733 (2015).
24	Global	World	Minimise the impacts on food production and environment of: Threefold increase in first generation technologies from 2010 - 2035 Increase in second-generation technologies by 2035, which reaches 20% of global biofuel supply	normative	Energy	High additional agricultural productivity growth in Sub-Saharan Africa, increasing by 12.5% in 2035. Medium additional productivity growth India, Pakistan, Indonesia, Thailand, Mexico, Argentina, Central and South America, North Africa, Far East Low Income, Middle East Low Income of 6.4% by 2035. No increase in productivity in Brazil, China and the developed world	Prieler et al. 2015	Prieler, S. et al. Land and the Food-Fuel Competition: Insights from Modeling. Adv. Bioenergy Sustain. Chall. 2, 447–464 (2015).

25	Global	World	Great transition: values-led change in the guiding paradigm of global development	Policy screening	Energy, Agriculture, Food, Forestry, Transportation, Water, Land use, Waste, Land use	Driven by "A pluralistic transnational world order". Reduced consumption as human wellbeing is driven by creativity, leisure, relationships and community. Inequality addressed by 'egalitarian income distributions'. Policy reform: government-led effort achieves sustainability without major changes in the state-centric international order, modern institutional structures, and consumerist values	Raskin et al. 2010	Raskin, P. D. et al. The century ahead: Searching for sustainability. Sustainability 2, 2626–2651 (2010).
26	Global	World	The goal is to test the proposition that it is possible to produce enough food for the global population in 2050 while making sustainable use of land and water resources	normative	Agriculture, Water	The sustainable scenario excludes forests from food production and ensures 80% of renewable water supply. Pathway element: dietary improvements in developing countries (3000 kcal/p/d), 20% increase in animal products, offsets in cereal and other crop demand, yield increases in Africa and Latin America.	Springer and Duchin 2014	Springer, N. P. et al. Feeding nine billion people sustainably: Conserving land and water through shifting diets and changes in technologies. Environ. Sci. Technol. 48, 4444–4451 (2014).
27	Global	World	Exploring how stabilization at low atmospheric greenhouse gas concentration can be achieved levels	Policy screening	Agriculture, energy, forestry	High agricultural yields or acceptance of considerable loss of natural areas and biodiversity, dietary patterns with low meat consumption, a low population and/or accepting high conversion rates of natural areas. High demand for bio-energy and improved yields in developing countries.	van Vuuren et al. 2010	van Vuuren, D. P. et al. (2010) 'Bio-energy use and low stabilisation scenarios', Energy Journal, 31(#1), pp. 193–222. doi: 10.5547/ISSN0195-6574-EJ-Vol31-NoSI-8.
28	Global	World	Climate scenarios (SRES scenarios - A2) to assess costs of mitigation across multiple secotrs	Quantitative, Policy screening	Water, Agriculture, Coastal, Infrastructure, Fisheries,	Financing adaptation	Narain et al. 2011	Narain, U., Margulis, S. and Essam, T. (2011) 'Estimating costs of adaptation to climate change', Climate Policy, 11(3), pp. 1001–1019. doi:

					Human health, Climate			10.1080/14693062.2011.582387.
29	Global	World	Global tropics; thresholds wrt rainfall thresholds (Based on RCPs (IPCC) - target-seeking for climate change)	Quantitative, Target seeking	Water, Climate	Changing climate	Chadwick et al. 2016	Chadwick, R. et al. (2016) 'Large rainfall changes consistently projected over substantial areas of tropical land', Nature Climate Change. Nature Publishing Group, 6(2), pp. 177–181. doi: 10.1038/nclimate2805.
30	Global	World	Determing the effects of having conservation areas to protect large mammals by comparing their observed IUCN Red List categories between 1996 and 2008 with the conservation status that they estimated they would have had under a hypothetical scenario where all conservation actions ceased at the start of the period.	Quantitative, Policy screening	Protected areas	Public protected areas, protected areas on private lands	Hoffmann et al. (2015)	Hoffmann, M. et al. (2015) 'The difference conservation makes to extinction risk of the world's ungulates', Conservation Biology. Wiley/Blackwell (10.1111), 29(5), pp. 1303–1313. doi: 10.1111/cobi.12519.
31	Global	World	Target for conservation: to represent every carnivore species in at least one ecoregion of the world, for each of the scenarios	Quantitative, Target seeking	Nature conservation	Minimise land used for conservation, minimise costs of land acquisition, minimise extinction risk	Loyola et al. 2015	Loyola, R. D. et al. (2009) 'Integrating economic costs and biological traits into global conservation priorities for carnivores', PLoS ONE. Edited by W. M. Getz. Public Library of Science, 4(8), p. e6807. doi: 10.1371/journal.pone.0006807.
32	Global	World	Demonstrate the importance of land use and land cover change (LUCC) on future climate projections	Quantitative, Target seeking	Climate, Land use and change	Land use and land cover change	Hua et al. 2015	Hua, W. et al. (2015) 'Assessing climatic impacts of future land use and land cover change projected with the CanESM2 model', International Journal of

								Climatology. Wiley-Blackwell, 35(12), pp. 3661–3675. doi: 10.1002/joc.4240.
33	Global	World	Trade-offs - coffee production expansion due to climate change and associated forest loss/ecosystem degradtion	Quantitative, Target seeking	Climate, Agriculture	Historical growth rate of coffee expansion of 0.1% per year Sustained consumer preference for Arabica coffee	Magrach and Ghazoul 2015	Magrach, A. and Ghazoul, J. (2015) 'Climate and pest-driven geographic shifts in global coffee production: Implications for forest cover, biodiversity and carbon storage', PLoS ONE. Edited by F. Moreira. Public Library of Science, 10(7), p. e0133071. doi: 10.1371/journal.pone.0133071.
34	Global	World	Global warming effects on tropical species based on SRES (IPCC)	Quantitative, Policy screening	Biodiversity, Climate	Distances tropical species will travel toreach suitable temperatures at 1960s levels in 2100	Wright et al. 2009	Wright, S. J., Muller-Landau, H. C. and Schipper, J. (2009) 'The future of tropical species on a warmer planet', Conservation Biology, 23(6), pp. 1418–1426. doi: 10.1111/j.1523-1739.2009.01337.x.
35	Global	World	Explore possible options that may reduce mean species abundance loss on a global scale in light of the CBD targets	Target seeking	Agriculture, Forestry	Climate change mitigation, energy consumption savings, extensive use of bioenergy, increase in plantation forestry, increasing protected areas representing all world ecosystems	Alkemande et al. 2009	Alkemade, R. et al. (2009) 'GLOBIO3: A Framework to Investigate Options for Reducing Global Terrestrial Biodiversity Loss', Ecosystems. Springer-Verlag, 12(3), pp. 374–390. doi: 10.1007/s10021-009-9229-5.

36	Global	World	Review of global scale scenarios for species extinstion, species abundance and community structure, habitat loss and degradation, and species distribution shifts.	Target seeking	Biodiversity	Regulating land use, aggressive climate mitigation, ecosystem restoration, carbon taxes	Pereira et al. 2010	Pereira, H. M. et al. (2010) 'Scenarios for global biodiversity in the 21st century.', Science (New York, N.Y.). American Association for the Advancement of Science, 330(6010), pp. 1496–501. doi: 10.1126/science.1196624.
37	Global	World	Minimise the impacts on food production and environment of: Threefold increase in first generation technologies from 2010 - 2035 Increase in second-generation technologies by 2035, which reaches 20% of global biofuel supply	Target seeking	Energy	High additional agricultural productivity growth in Sub-Saharan Africa, increasing by 12.5% in 2035 Medium additional productivity growth India, Pakistan, Indonesia, Thailand, Mexico, Argentina, Central and South America, North Africa, Far East Low Income, Middle East Low Income of 6.4% by 2035 No increase in productivity in Brazil, China and the developed world	Prieler et al. 2015	Prieler, S. et al. Land and the Food-Fuel Competition: Insights from Modeling. Adv. Bioenergy Sustain. Chall. 2, 447–464 (2015).
38	Global	World	Feeding 9–10 billion people by 2050 and preventing dangerous climate change	Target seeking	Forestry, Agriculture, Food, Climate	GHG reducion pathways. Supply-side. Reducing the net GHG emissions from agriculture and forestry by changes in management (e.g. through better management of soils and fertilizer application, increase energy efficiency in agriculture in countries with below-average energy, protecting and sustainably managing carbon stores by policies such as REDD+) Demand side. Reducing losses and wastes of food in the supply chain and	Smith et al. 2013	Smith, P. et al. How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? Glob. Chang. Biol. 19, 2285–2302 (2013).

						final consumption and changes in diet, towards less resource-intensive food, (e.g. from ruminant meat to pig and poultry), or to appropriate plant-based food to maintain protein supply, as well as reduction in overconsumption in regions where this is prevalent Food security pathways. Sustainable intensification of food productio (e.g. Increase yields per unit area, increase number of crops per growth cycle), reduction in the livestock cereal consumption		
39	Global	World	Reduce the area of land needed for food production by increasing the efficiency of food production	Policy screening	Energy, Forestry, Agriculture, Biodiversity	Increases in the efficiency of food production through advancement of agricultural technology (e.g. increasing the efficiency of production of animal products and a shift from feed from pastures to feed from crops could drastically reduce the area of agricultural land; sourcing land for energy crop production from low productive natural and semi-natural vegetation types such as barren land, scrubland and savannas)	Smeets et al. 2007	Smeets, E. M. W. W. et al. (2007) 'A bottom-up assessment and review of global bio-energy potentials to 2050', Progress in Energy and Combustion Science. Pergamon, 33(1), pp. 56–106. doi: 10.1016/j.pecs.2006.08.001.
40	Global	World	Options for reducing livestock feed components that compete with direct human food crop production and impacts on food provision as well as on natural processes	Policy screening	Agriculture, Food, Forestry	Changes in people's diets, changes of the role of livestock	Schader et al. 2015	Schader, C. et al. (2015) 'Impacts of feeding less food-competing feedstuffs to livestock on global food system sustainability', Journal of The Royal Society Interface. The Royal Society, 12(113), p. 20150891. doi: 10.1098/rsif.2015.0891.

41	Global	World	Adequate capture of all globally threatened bird and amphibian targets, capture of 17% of all terrestrial ecoregions	Target seeking	Protected areas	Global Protected Area prioritizations should also focus on to prioritize low elevation areas and productive soil types like mollisols, vertisols, and alfisols, which may mean turning more attention to cities, suburbs, and agricultural areas in addition to species and ecoregion targets	Sanderson et al 2015	Sanderson, E. W. E. W., Segan, D. B. D. B. and Watson, J. E. M. J. E. M. J. E. M. (2015) 'Global status of and prospects for protection of terrestrial geophysical diversity', Conservation Biology. Wiley/Blackwell (10.1111), 29(3), pp. 649–656. doi: 10.1111/cobi.12502.
42	Global	World	Feeding the world with zero deforestation	Target seeking	Agriculture, Forestry, Pastures	Supply-side measures including cropland output intensification and cropland expansion; efficiency measures in the livestock system such as increases in feed-conversion ratios; and demand-side measures including quantitative and qualitative changes in the human diet; no trade barriers and therefore trade is assumed to balance deficits of regional production and consumption; cropland expansion into grazing lands when diets with a reduced fraction of livestock products are adopted	Erb et al. 2016	Erb, Karl-Heinz, Christian Lauk, Thomas Kastner, Andreas Mayer, Michaela C. Theurl, and Helmut Haberl. 2016. "Exploring the Biophysical Option Space for Feeding the World without Deforestation." Nature Communications. doi:10.1038/ncomms11382.
43	Global	World	An exploration of future food scenarios with respect to their use of land, water and fertilizers. A vegeterian diet scenario and a low input scenario	Policy screening	Agriculture, Food	Vegeterian or reduced meat diet, low or medium population, medium improvement in productivity of foodcrops and feedcrops and feeding efficiency, improved irrigation, close yield gaps, increase area of irrigated cereal	Odegard and van der Voet 2014	Odegard, I.Y.R., and E. van der Voet. 2014. "The Future of Food — Scenarios and the Effect on Natural Resource Use in Agriculture in 2050." Ecological Economics 97. Elsevier B.V.: 51–59. doi:10.1016/j.ecolecon.2013.10.005.

44	Global	World	Two scenarios which: (1) explore implications for global land availability and productivity of producing sufficient bioenergy feedstock to meet future demand, (2) stricter biodiversity protection	Target seeking	Agriculture, Forestry, Energy	Pathways for scenario 1: Higher carbon price and more ambitious GHG emission reduction targets in the energy sector, land-based bioenergy feedstock is produced in natural forests, harvesting practices that cause deforestation or forest degradation are phased out. Pathways for scenario 2: no further conversion of these ecosystems to cropland, grazing land, or plantations in areas identified as important for biodiversity, current land uses remain constant, or decrease, in the biodiverse zones and continue to produce food or timber	Kraxner et al. 2013	Kraxner, Florian, Eva-Maria Nordström, Petr Havlík, Mykola Gusti, Aline Mosnier, Stefan Frank, Hugo Valin, et al. 2013. "Global Bioenergy Scenarios – Future Forest Development, Land-Use Implications, and Trade-Offs." Biomass and Bioenergy 57 (October): 86–96. doi:10.1016/j.biombioe.2013.02.003.
45	Global	World	Assess how and to what extent the demand for carbon storage and biodiversity protection influence future land use patterns and intensities	Target seeking	Agriculture, Forestry, Pastures, Biodiversity protection	Global implementation of policies that aim to reduce deforestation in order to reduce GHG emissions, Biodiversity protection coming only from natural areas	Eitelberg et al. 2016	Eitelberg, D.A., J. van Vliet, J.C. Doelman, E. Stehfest, and P.H. Verburg. 2016. "Demand for Biodiversity Protection and Carbon Storage as Drivers of Global Land Change Scenarios." Global Environmental Change 40. doi:10.1016/j.gloenvcha.2016.06.014.
46	Global	World	Achieving zero net land degradation	Target seeking	Agriculture, Forestry, Pastures	Restoration, management and regulations (e.g. international legal mechanism committed to land and soil issues), Financing of projects (e.g. polluter pays principle and government guarantee where the polluter doesn't pay)	Stavi & Lal 2014	Stavi, I. and Lal, R. (2015) 'Achieving Zero Net Land Degradation: Challenges and opportunities', Journal of Arid Environments. Academic Press, 112(PA), pp. 44–51. doi: 10.1016/j.jaridenv.2014.01.016.

47	Global	World	Vision for food security in 2030: Vision 2030 foresees a significant reduction in undernourished people while guaranteeing food security	Target-seeking (participatory)	Food production	Vision 2030 foresees a significant reduction in undernourished people while guaranteeing food security. Pathway elements: 1) Significant transformation of agriculture production systems (through investments, research and training), 2) Maintenance of an adequate enabling environment in rural areas (rural development), 3) A food system where production and consumption are balanced between local, regional and global levels (markets and trade), and 4) a largely demand-driven food system where responsible consumer behaviour shapes sustainable objectives	Maggio, van Criekinge, & Malingreau, 2015	Maggio, A., van Criekinge, T., & Malingreau, J. P. (2015). Global Food Security 2030 Assessing trends with a view to guiding. JRC Science and Policy Reports - Forest Series. Luxembourg: Publications Office of the European Union. https://doi.org/10.2788/5992

Table SM 5.2.C - Key pathway elements derived from scenarios related to TERRESTRIAL and FRESHWATER resources (AMERICAS and CARIBBEAN)

No	Scale	Region/ System	Goal/ Vision	Type of scenario	Sectors	Pathway elements (measures, policies, changes)	Scenario short name	Complete reference
1	Regional	Latin America and Caribean	Sustainable future in 2050, considering 2030 Agenda Sust. Dev. SDGs, COP 21 Paris Agreement	Qualitative and quantitative, policy-screening	Water, Agriculture, Forestry, Fisheries and aquaculture	Water saving actions and investment in technology to reduce water use. Systems for integrated ecosystem information, traditional K, protected areas and economic well-being are optimized for ES delivery. Civil society present in formulation environmental policies. Changes in consumption patterns. Mechanisms to rehabilitate and rebuild affected and polluted ecosystems. Joint programs adopted to guarantee fair and equitable access and management of shared resources. Better coordination national and local government. Protected area system in place. Common agenda for sustainable development agreed Systems for integrated ecosystem information, traditional K, protected areas and economic well-being are optimized fo ES delivery. Regional genetic banks developed. Progressive replacement of agrochemicals by organic substances and biological controls Effective protection of LTK.	Sust_GEOLA C4/UNEP (2016)	UNEP 2016. GEO-6 Regional Assessment for Latin America and the Caribbean. United Nations Environment Programme, Nairobi, Kenya.

2	Regional	Latin America and Caribean	Sustainable future in 2050, considering 2030 Agenda Sust. Dev. SDGs, COP 21 Paris Agreement	Qualitative and quantitative, policy-screening	Water, Agriculture, Forestry, Fisheries and aquaculture	Investments in new water saving technologies, national establishment of early warning systems for droughts, better coordination water supply, wastewater treatment improved regulation and enforcement mechanisms. Increase adaptive capacity (e.g., to deal with vulnerability to climate change in the wider Caribbean) Instruments and regulations introduced in areas with low environmental standards for facing urban pollution, solid waste.	Policy_GEO LAC4/UNEP (2016)	UNEP 2016. GEO-6 Regional Assessment for Latin America and the Caribbean. United Nations Environment Programme, Nairobi, Kenya.
3	Regional	Latin America and Caribean	Sustainable future in 2050	Qualitative and quantitative, exploratory, stakeholder consultation	All	High level of integration between different stakeholders in the economic, social and environmental spheres.	UNEP (2010)	UNEP (2010). Latin America and the Caribbean: Environment Outlook (GEO LAC 3). United Nations Environment Programme (UNEP), Nairobi http://www.unep.org/pdf/GEOLAC_3_ENGLISH.pdf
4	Regional	Latin America and Caribean	Green growth in 2025	Qualitative only, target-seeking, stakeholder consultation	Agriculture, Energy, Forestry	Multisectorial mitigation and adaptation policies Biotrade.	Mota-Veiga-Rios et al. (2014)	ESCENARIOS DE CRECIMIENTO VERDE EN AMÉRICA LATINA. (Ref. Pedro da Motta Veiga Rios, Sandra Polónia 2014 and Políticas e impacto del crecimiento verde en América Latina)
5	Regipnal	Amazon Basin	Sustainable development in 2026	Qualitative only, policy-screening, stakeholder consultation	All	Legal framework to ensure property rights. Incentives to invest in sustainabl, productive activities. Regulatory development, management	Geoamazonia_UNEP (2006)	UNEP/Amazon Cooperation Treaty Organization (ACTO) 2009. ENVIRONMENT OUTLOOK IN AMAZONIA – GEO AMAZONIA.

						tools, and interinstitutional coordination. Fight against corruption. Public policies to enable the effective operation of the protected areas, including productive development opportunities offered by the international market, which values environmental goods and services. Reduction on water pollution due to effective operation of the mechanisms that regulate productive activities. Regional coordination		United Nations Environment Programme.
6	Regional	Amazon Basin	Governance scenario in 2050 (no specific vision)	Quantitative, policy-screening	Nature conservation	Extended network of protected areas and also actions on private land (such as international markets environmental restrictions, land-use zoning considering productivity aspects to facilitate deforestation licences, carbono market).	Soares-Filho et al. (2006)	Soares-Filho, B. S. et al. Modelling conservation in the Amazon basin. Nature 440, 520–523 (2006).
7	Regional	Amazon Basin	Sustainable future in 2050 (alingned to SSP1)	Quantitative	Land use, water	(see specific recommendations in the sub-regional aligned studies).	Guimberteau et al. (2016)	Guimberteau, M., Ciais, P., Ducharne, A., Boisier, J. P., Dutra Aguiar, A. P., Biemans, H., De Deurwaerder, H., Galbraith, D., Kruijt, B., Langerwisch, F., Poveda, G., Rammig, A., Rodriguez, D. A., Tejada, G., Thonicke, K., Von Randow, C., Von Randow, R. C. S., Zhang, K., and Verbeeck, H.: Impacts of future deforestation and climate change on the hydrology of the Amazon Basin: a multi-model

								analysis with a new set of land-cover change scenarios, Hydrol. Earth Syst. Sci., 21, 1455-1475, https://doi.org/10.5194/hess-21-1455-2017, 2017.
8	National	Brazil	Goal: without further conversion of natural vegetation until 2040, this scenario explores how to allocate the future demand for agricultural products.	Quantitative, target-seeking	Agriculture, Nature conservation	The results demonstrate the goals are feasible under several alternative combinations of increased pasture carrying capacity and herd productivity. A number of actions are listed to improve pasture productivity, including financial aid for farmers, techology transfer and training the different actors of the beef supply chain. The ABC plan is cited as the begining. Besides, a number of combined actions are necessary to avoid unintend consequences, such as promoting futher deforestation as a result of increased profitability and the exclusion of small farmers from the activity. These actions include: (a) environmental governance, though improving the enforcement of existing environmental legislation; (b) territorial planning; (c) inclusion of original landowners in the productivity programs; (d) land tenure.	CurrentReality/Strassburg et al. (2014)	Strassburg, B. B. N. et al. When enough should be enough: Improving the use of current agricultural lands could meet production demands and spare natural habitats in Brazil. Glob. Environ. Chang.28,84–97 (2014).
9	National	Brazil	Goal: maximizing the area liberated for the restoration of natural ecosystems until 2040, while allocating future demanda for agricultural products.	Quantitative, target-seeking	Agriculture, Nature conservation	In this case, results show that, for instance, an increase of 70% in the carrying capacity could liberate as much as 32 million hectares. This scenario has important biodiversity consequences, as they estimate 17 million hectares could	Restoration /Strassburg et al. (2014)	Strassburg, B. B. N. et al.When enough should be enough: Improving the use of current agricultural lands could meet production demands and spare

						be restored in the Atlantic Forest. The same set of actions pertains.		natural habitats in Brazil. Glob. Environ. Chang.28,84–97 (2014).
10	National	Brazil	Effects of alternative implementations of the Forest Code on GHG emissions and biodiversity in 2050	Quantitative, policy-screening	Agriculture, Nature conservation	Forest code enforcement.	ForestCode_Camara et al. (2015)	Camara, G. et al. (2015) (2015). Modelling Land Use Change in Brazil: 2000–2050. ,. São José dos Campos, Brasília, Laxenburg, Cambridge. doi: 10.22022/REDD/08-2016.12115.
11	National	Brazil	Combined effects of a series of nationally adopted goals for the AFOLU sector leading to a low carbon scenario, including: (a) recomposition of the native vegetation goals; (b) deforestation reduction goals; and (c) agricultural low carbon strategies, including cattle ranching intensification.	Quantitative, target-seeking	Agriculture, Nature conservation, Forestry	The economic analysis indicates that reducing the deforestation and cattle ranching intensification are the best cost-benefit measures in terms of carbon emission reduction. The study presents a comprehensive analysis of law enforcement, economic and educational policy instruments necessary to achieve such goals, emphasizing the importance of integrated actions concerning both deforestation control and pasture intensification, to avoid "rebound" effects.	LowCarbon Emission_MCTI (2017)	Brasil. Ministério da Ciência, Tecnologia e Inovacao (2017) Modelagem integrada e impactos econômicos de opções setoriais de baixo carbono / organizador Régis Rathmann. Brasilia. Available at: http://www.mctic.gov.br/mctic/opencms/ciencia/SEPED/clima/opcoes_mitigacao/Opcoes_de_Mitigacao_de_Emissoes_de_Gases_de_Efeito_Estufa_GEE_em_SetoresChave_do_Brasil.html.
12	National	United States	Projected land use change impacts on ecosystem services in the US, considering different policy options for private lands.	Qualitative and quantitative, policy-screening	Forestry, Agriculture, Nature conservation	Economic and financial instruments: Incentives for afforestation and reduced deforestation, Incentives for conservation of forest and range. Prohibition on urban land expansion. Discusses the difficulty to overcome powerful trends originating from market fundaments or the overall structure of government programs that shape land use change.	Lawer et al. (2014)	Lawler et al (2014). Land-use change impacts on ecosystem services. Proceedings of the National Academy of Sciences May 2014, 111

13	National	United States	Projected human carrying capactity (persons fed by unit land area) under ten alternative diet scenaris (varying the content of meat and dairy consumption).	Quantitative, target-seeking		(a) Diet composition greatly influences overall land footprint, and imply very different allocation of land by crop type. (b) Shifts toward plant-based diets may need to be accompanied by changes in agronomic and horticultural research, extension, farm operator knowledge, infrastructure, livestock management, farm and food policy, and international trade, (c) While agricultural land is often discussed in the aggregate, our analysis shows that accounting for the partitioning of land between grazing land, cultivated cropland, and perennial cropland has a strong influence on estimates of carrying capacity. Indeed, we demonstrate that under a range of land use conditions, diets with low to modest amounts of meat outperform a vegan diet, and vegetarian diets including dairy products performed best overall.	Peters et al. (2016)	Peters, C.J., Picardy, J., Darrouzet-Nardi, A.F., Wilkins, J.L., Griffin, T.S. and Fick, G.W., 2016. Carrying capacity of U.S. agricultural land: Ten diet scenarios. Elem Sci Anth, 4, p.000116. DOI: http://doi.org/10.12952/journal.elementa.000116
14	Sub-national	Argentina/Dry Chaco	No specific vision. Use of empirical data to explicitly compare the conservation and production outcomes resulting from the simulation of five alternative land-use policy scenarios.	Policy-screening, quantitative	Agriculture and nature conservation	(1) Industrial agriculture: the landscape is dominated by land-use systems in which cattle graze on exotic pastures on lands cleared of native forests, i.e., high-intensity systems; (2) land-sparing: 70% of the landscape is covered by high-intensity systems and 30% is covered by undisturbed native forests; (3) land-sharing: the landscape is dominated by silvopastoral systems in which cattle graze on exotic pastures growing under the shade of native trees, i.e.,	Mastrangelo, M et al. (2015)	Mastrangelo, M. E., and P. Laterra. 2015. From biophysical to social-ecological trade-offs: integrating biodiversity conservation and agricultural production in the Argentine Dry Chaco. Ecology and Society 20(1): 20. http://dx.doi.org/10.5751/ES-07186-200120

						intermediate-intensity systems; (4) land-sharing with conservation: 70% of the landscape is covered by intermediate-intensity systems and 30% by forest fragments; and (5) traditional ranching: the landscape is dominated by traditional land-use systems called puestos, in which cattle graze on native forests and grasslands, i.e., low-intensity systems. Results showed that intermediate-intensity silvopastoral systems by multifunctional landholders provided 'big gains' for conservation (30-50% more birds) with 'small losses' for production (10-15% less yields), compared to high-intensity systems. As pathway measures: exogenous incentives and regulations tailored to the behavior of different landholder groups.		
15	Sub-national	Northern sector of the Argentine dry Chaco	No specific vision. Explores trade-offs between bird populations and agricultural production to compare the potential consequences of different land use strategies ('sharing', 'sparing', and intermediate) for populations of bird species sensitive to agriculture, while attaining a regional production target. We evaluated how populations responded to scenarios with different proportions of forest and grasslands, considering three reference states (100% forest, 80:20% and 50:50%	Quantitative	Agriculture and Nature conservation	Under the most probable scenarios of increases in regional meat production, most loser bird species populations were maximized by a land-sparing strategy, suggesting that if meat production targets are going to increase in the region, this can be more efficiently achieved by combining well-protected forests and grasslands, and high-yielding mechanized agriculture (e.g. soybean).	Macchi et al. 2015	Machi et al. (2016), Agricultural production and bird conservation in complex landscapes of the dry Chaco. Journal of Land Use Science 11(2):188-202

			forest and grasslands, respectively) and alternative demand for agricultural products.					
16	Sub-national	Brazil, Cerrado Biome	Greener Cerrado scenario: increasing productivity to 61% of sustainable potential until 2050 would spare all the land needed oor cropland expansion, increase beef production by 49% and still spare 6.38 Mha for restoration, equivalent to the current Forest Code deficit in the Cerrado.	Quantitative, target-seeking	Agriculture and Nature conservation/ restoration	Land sharing pathway. Such a land-sparing strategy carries the risk of a 'rebound effect' (when increased productivity leads to increased profits, which in turn spurs more expansion), but when coupled with complementary conservation measures, as proposed here, these risks are minimized. The main public and private policies needed to retain and restore key Cerrado habitats while enabling agricultural expansion. To make space for deforestation-free agricultural expansion, increasing pasture productivity needs to be coupled with incentives to direct agricultural expansion to already converted lands, from increased climate finance and an expansion of the Soy Moratorium to Cerrado, to sugarcane and to beef. Increased protection would safeguard critical habitats and reinforce pressure for farm expansion into already converted lands. Improved land-use planning is vital to ensure efforts are focused in the most appropriate areas for reconciling agricultural expansion, conservation and restoration.	Strasburg et al. (2017)	Strassburg et al. (2017) Moment of truth for the Cerrado hotspot. Nature Ecology & Evolution volume 1, Article number: 0099 (2017)

17	Sub-national	Brazil, Brazilian Amazon	A vision of a desired sustainable future discussed in a participatory process, aligned to the SSP1. Vision synthesis: A future with well-structured cities, quality of life for the entire population, diversified economic activities in all sectors, natural resources preserved and widely used for different purposes in a sustainable manner and by different stakeholders, integrated land management considering environmental, social and economic aspects.	Quantitative and qualitative, target-seeking, stakeholder consultation		Synthesis of actions to reach the sustainable future: 1. MONITORING SYSTEMS: continuation and enhancement of the satellite based monitoring systems, considered as the key aspect to control deforestation in the Brazilian Amazon. This also includes the development of new systems (to monitor forest degradation), and expansion to other biomes, to avoid leakages. 2. INTEGRATED TERRITORIAL PLANNING: consolidation and enhancement of multiple instruments for territorial and land use planning, in order to concomitantly regulate pressure for land, create sustainable economic alternatives and integrate social programs at a territorial basis (rural and urban areas). Examples of instruments: the SNUC (National System of Conservation Units), ZEE (Ecological Economic Zoning), Land Titling Program, ABC Program (Low Carbon Agriculture), Soy/Beef Moratorium, Certification, PES (Payment for Environmental Services), Poverty eradication programs, Food Purchase program, and others. 3. CITIES RESTRUCTURING: Strengthening of cities to create an interconnected network of medium-sized cities, with infrastructure, proper network of services and education to meet the demands of sustainability. 4. LARGE INVESTMENTS PLANNING: Planning for the implementation of large projects	Aguiar et al 2016	Aguiar, A. P. et al. AMAZALERT stakeholder workshops and interviews: Summary of all participatory activities and results related to scenario development. Delivery report 1.2. (2014). Aguiar, A. P. D. et al. Land use change emission scenarios: anticipating a forest transition process in the Brazilian Amazon. Glob. Chang. Biol. 22, 1821–1840 (2016).

						(including infrastructure and mining) combined to the integrated territorial planning (item 2), avoiding the boom-bust economies of the cities. In the case of infrastructure, planning geared both to the needs of the local population (river transport, for example), as well as market demands (commodities production flow through hydroways). 5. LEGAL FRAMEWORK PROTECTION: enforcement and enhancement of the legislation governing the access to natural resources and land use, creating mechanisms to balance the influence of macroeconomic interests in modifying legal marks at the expense of regional, social and environmental aspects.		
18	Sub-national	Brazil/ Brazilian Amazon/ BR163	Sustainable Development for a hot spot of land-use change along the BR-163 highway in Mato Grosso and Pará, Brazil.	Qualitative/ quantitative, Exploratory	Agriculture and Nature conservation	The authors developed a trend and a sustainability scenarii. Sustainability scenario assumptions: global and national change to a vegetarian-oriented diet, a regional reduction in population growth, and an increase in crop productivity. Expected sociopolitical changes included a social model of participation, citizenship, and law enforcement, food sovereignty, local sustainable development initiatives, a growing demand for certified agrarian goods, and clarification of land rights.	Gollnow et al. (2018)	Gollnow, F., Göpel, J., deBarros Viana Hissa, L. et al. Scenarios of land-use change in a deforestation corridor in the Brazilian Amazon: combining two scales of analysis. Reg Environ Change (2018) 18: 143. https://doi.org/10.1007/s10113-017-1129-1

		Colombia/ Central Magdalena region	No specific goal, sustainability assessment of agricultural policy scenarios in rural Colombia.	Qualitative/ Policy screening (network analysis)	Agriculture and Nature conservation	Three environmental and agricultural policy scenarios: the Business as Usual scenario, enforcing a stronger regulatory framework, and adopting incentives. In order to reconcile biodiversity conservation and sustainable development, a policy mix that combines both regulatory and non-regulatory approaches is needed. This includes the design and adoption of strategic land use planning to make agricultural subsidies conditional to social and environmental standards, strengthening local institutions, and designing incentives to foster the implementation of best agricultural practices. At the international level, creating a demand for sustainable agricultural commodities is also crucial.	Varon et al. (2016)	Varon et al. (2016). Achieving sustainable development in rural areas in Colombia: Future scenarios for biodiversity conservation under land use change. Land Use Policy 59 (2016) 27–37
19	Sub-national	Bolivia, Bolivian Low Lands	Vision of a sustainable future, aligned to the SSP1. Vision synthesis: environmental laws are enforeced, policies to reduce deforestation and to preserve and create new PAs and ITs are in place. The study uses a spatially explicit modeling framework to estimate carbon emissions and biodiversity impacts (priority sreas loss).	Quantitative, target-seeking	Nature conservation	A number of actions are mentioned by the author as a pathway to the sustainablitity. a) Harmonized food, fiber, and beef supply, along with natural resource conservation in Bolivia, will depend on broader land use policies and intensification. b) The authors point out the need to solve contradictions between the environmental governance and government practices, including the strong power of agribusiness elites in the lowlands influence and weakens environmental governance. c) Also, the authors indicate the need of measures to minimize the threats of the planed	Tejada et al. (2016)	Tejada, G., E. Dalla-Nora, D. Cordoba, R. Lafortezza, A. Ovando, T. Assis, and A. P. Aguiar. 2016. Deforestation scenarios for the Bolivian lowlands. Environmental Research 144:49–63. Aguiar, A. P. et al. AMAZALERT stakeholder workshops and interviews: Summary of all participatory activities and results related to scenario development. Delivery report 1.2. (2014).

						IIRSA road network. Even in the Sustainable scenario, the analysis indicates negative impacts of the projected deforestation on the biodiversity. The Priority Biodiversity Conservation Zones were well preserved until 2008, with only 5% being affected by deforestation. In 2050, more than 1 million ha will undergo deforestation, affecting 14% of the total Priority Biodiversity Conservation Zones (in the worst scenario, 38% is lost).		
20	Sub-national	Bolivia, Andean region	Mitigation and adaptation strategies for farmers	Quantitative and qualitative, target-seeking, stakeholder consultation	Agriculture	Cross scale integration of early warning systems. Food security at the community scale, change in planting practices and incorporation of weather-related risk.	Validivia et al. (2010)	Valdivia, C., et al. (2010) 'Adapting to Climate Change in Andean Ecosystems: Landscapes, Capitals, and Perceptions Shaping Rural Livelihood Strategies and Linking Knowledge Systems', Annals of the Association of American Geographers, 100: 4, 818 — 834
21	Local	Brazil, Cerrado, Ribeirao Sao Jeronimo watershed	Long term sustainability by designing landscapes that meet human needs while mantaining functioning ecosystems	Quantitative, target-seeking	Agriculture, Water, Nature conservation	Landscape level planning, legal and regulatory instruments. Multi service planning, enforcement of the Forest Code (land owners can compensate their legal requirements within the same biome by protecting habitats on other properties, donating lands to the government or purchasing an Environmental Reserve quota, Trade-offs: yes, there is a discussion on how even when land use decisions are based on maximising sugarcane productions,	Kennedy et al. (2016)	Kennedy et al. (2016). Optimizing land use decision-making to sustain Brazilian agricultural profits, biodiversity and ecosystem services. Biological Conservation 204 (2016) 221–230.

						landscape level Foret Code compliance reduces costs to producers and provide ES As another example, they suggest to minimize the potential of reaching undesirable thresholds and ES losses by requiring and incentivizing the protection and retoration of higher % of natural vegetation in sensitive landscapes. Third, they discuss mitigation of trade offs, but also that more than two envirnmental goods and varying preferences should be accounted for to provide a fuller assessment of the trade-offs between alternative land uses.		
22	Local	Brazil, Amazon, Santarem, PAE Lago Grande	Vision of a desirable future at three comunities and at the settlement level.	Qualitative only, target-seeking, stakeholder consultation	Fisheries and aquaculture, Tourism, Agriculture, Nature conservation	Synthesis of key actions to reach the desirable future: 1. Strengthening of social organizations at different levels, including the quality education (at all levels, including universities) and leadership capacitation was considered the most important action, aiming at: (a) the development of business plans and management models of collective projects; (b) Increase the capacity of negotiating with the mining companies to minimize the mining effects on community life and its impacts on natural resources. 2. Diversification, intensification and industrialization (of forest, river and agricultural products), associated to preservation of forest areas, with the support of a wide	Folhes et al. (2015)	Folhes et al. (2015). Multi-scale participatory scenario methods and territorial planning in the Brazilian Amazon. Futures, 73, pp.86–99, 2015. Full acesss to the reports: http://luccme.ccst.inpe.br/projects/

						technical assistance program; 3. Highways, energy and communication infrastructure for industrialization and distribution of local production. 4. Solve the settlement land tenure problem (old titles and indigenous people); (f) fishing regulation (large commercial boats competing for resouces).		
23	Local	Cuba, Camaguey Province, North Coastal Zone	No specific goal, scenario planning for a sustaible future in 2025	Qualitative only, target seeking	Fisheries and aquaculture, Tourism	Environmental education, clean technologies, cross-sectoral planning and integration. Respect for natural values: typical vegetation, unique landscapes and great biodiversity. Respect for the areas of forests and reforestation of these and mangroves. Increase access by sea. Marine excursions and recreational diving up to the coral barrier following the established norms. Hotels are built in less ecologically sensitive areas, development of nature tourism. Environemntal education a must, also establishment of scientific stations. Compliance with control measures established by legislation, especially regarding the introduction of species. Promotion of local development alternatives: sales of handicrafts etc. Production of various crops, PES implemented. Environmental costs intern in large companies. Improved conditions of fishing fleets and infrastructure. Use of recommended fishing gear and science, aimed at the	Castellanos et al., 2013,	Castellanos et al., 2013, Construction of Scenarios: Planning and Sustainable Development in the Northern Coastal Area of Camagüey Province, Cuba, International Journal of Marine Science, Vol.3, No.31 244-252 (doi: 10.5376/ijms.2013.03.0031)

						achievement of sustainable fishing. Improvements in the conditions of the internal market: improvement of the processes of collection and distribution, purchase and sale prices. Improvement of access roads to farms and cooperatives. Distribution and production of poorly managed land. Reordering of fishing effort.		

Table SM 5.2.D- Key pathway elements derived from scenarios related to TERRESTRIAL and FRESHWATER resources (AFRICA)

No	Scale	Region/ System	Goal/ vision	Type of Scenario	Sectors	Pathway elements (measures, policies, changes)	Scenario short name	Complete reference
1	Global	Africa regional analysis	Explore alternative futures focused on rangeland biodiversity loss, climate change, habitat fragmentation, and the development of infrastructure	Quantitative, Policy screening	Agriculture	1. A Baseline scenario (made by the International Assessment of Agricultural Knowledge, Science, and Technology for Development (IAASTD)) with **high levels of agricultural knowledge, science, and technology (high-AKST) where enhanced uptake of resource-efficient production technologies is assumed.** 2. The area of used rangelands slightly increases globally between 2000 and 2050 in the baseline scenario and reduces under a scenario of enhanced uptake of resource-efficient production technologies, particularly in Africa. Both scenarios suggest a global decrease in MSA (Mean Species Abundance Index) for rangelands until 2050. **Policies fostering agricultural intensification can reduce the overall pressure on rangeland biodiversity, but additional measures, addressing factors such as climate change and infrastructural development, are necessary to totally halt biodiversity loss.**	Alkemade et al. 2013	Alkemade, R., Reid, R.S., van den Berg, M., de Leeuw, J. and Jeuken, M., 2013. Assessing the impacts of livestock production on biodiversity in rangeland ecosystems. Proceedings of the National Academy of Sciences, 110(52), pp.20900-20905.
2	Global	Africa regional analysis	Explore forest conservation scenarios with different land-use	Quantitative, Policy screening	Forestry	1. Four scenarios including BaU were examined. **FC100** assumes **all undisturbed natural forest and unused naturally vegetated land is excluded from the land pool available for cropland expansion**. FC50-Y and FC50-C scenarios assumed that	Krause et al. 2013	Krause, M., Lotze-Campen, H., Popp, A., Dietrich, J.P. and Bonsch, M., 2013. Conservation of undisturbed natural forests and economic

						the area of protected undisturbed natural forest is reduced to 50% globally. F**C50-Y gives priority to the conservation of forest area with the lowest expected crop yields** and thus minimizes expected opportunity costs in agriculture while **FC50-C focuses on carbon-rich area first to maximize carbon storage of undisturbed natural forest** 2. In all the scenarios, the economic impacts on agriculture are relatively low. Production costs would increase due to forest conservation by a maximum of 4%, predominantly driven by increased investments in agricultural productivity increase.		impacts on agriculture. Land Use Policy, 30(1), pp.344-354.
3	Regional	Sub-saharan Africa	Tests Living Planet Index & Red List Index to reflect change in policy and meets targets	Quantitative, Policy screening	Conservation	1. (a) expansion of protected area network, (b) improvement of managent effectiveness of existing protected area network, and (c) combination of (a) and (b) 2. **Improving management effectiveness was predicted to be more beneficial than expanding the coverage of protected areas**	Costelloe et al. 2016	Costelloe, B., Collen, B., Milner-Gulland, E.J., Craigie, I.D., McRae, L., Rondinini, C. and Nicholson, E., 2016. Global biodiversity indicators reflect the modeled impacts of protected area policy change. Conservation letters, 9(1), pp.14-20.
4	Regional	Sahel region	MEA scenarios and survey data use to understand regional trajectories	Qualitative, policy screening	Multiple (conservation and development)	1. Four scenarios were developed according to the general outline of the Millennium Ecosystem Assessment (MEA), so that scenarios are consistent with the realities of the Sahel region along two axes: 1) Globalization or National protectionism, 2)	Lambin et al 2014	Lambin, E.F., D'haen, S.A.L., Mertz, O., Nielsen, J.Ø. and Rasmussen, K., 2014. Scenarios on future land changes in the West African Sahel. Geografisk

						reactive actions that address problems only after they become obvious or proactive ecosystem management that deliberately aims for long-term maintenance of ecosystem services 2. In the near future, the Sahelian region will contain a mix of characteristics described in each of the four scenarios, with significant regional variations.		Tidsskrift-Danish Journal of Geography, 114(1), pp.76-83.
5	Regional	Tropical Africa	Modleing hypothetical (tropical African) landscape to investigate theoretical interventions of mosquito foraging behaviour for mararia control	Quantitative, Policy screening	Pest control	Three scenarios for targeted interventions (T1, T2, T3) aimed at **eliminating all mosquito habitats of within 100m, 200m and 300m of houses**, respectively, were examined.	Gu & Novak 2005	Gu, W. and Novak, R.J., 2009. Agent-based modelling of mosquito foraging behaviour for malaria control. Transactions of the Royal Society of Tropical Medicine and Hygiene, 103(11), pp.1105-1112.
6	Regional	Southern west Africa (Okavango River system flows through Angola, Namibia and Botswana)	Explore costs and benefits of river ecosystem management and resource use requirements to achieve sustainable development and ensure livelihoods	Quantitative, Policy screening	Water	1. **3 types of increasing water use** (low, medium and high water-use) and present condition (BaU), each of which is a combination of irrigation policy, hydropower development policy, and water abstraction policy. 2. There would be a steady decline in river health from the low to the high scenarios, with the impacts becoming increasingly transboundary. Under the high scenario, large parts of the system would be unable to support present beneficial uses. River-related livelihoods and national income would decline through the scenarios, with	King et al. 2014	King, J., Beuster, H., Brown, C. and Joubert, A., 2014. Pro-active management: the role of environmental flows in transboundary cooperative planning for the Okavango River system. Hydrological Sciences Journal, 59(3-4), pp.786-800.

						the medium and high scenarios showing a significant decline in both.		
7	Regional	Africa regional analysis	Use retrospective scenario to assess past spp. richness and comapre to current distributions	Quantitative, Retrospective	Conservation	**Two climate scenarios** used to analyze species distribution of African estrildid finches (Aves: Estrildidae)	Schidelko et al. 2011	Schidelko, K., Stiels, D. and Rödder, D., 2011. Historical stability of diversity patterns in African estrildid finches (Aves: Estrildidae)?. Biological Journal of the Linnean Society, 102(2), pp.455-470.
8	Regional	Mediterranean Basin (biodiversity hotspot, coversing 20 countries, including those located in North Africa)	Using scenarios in exploring coordination of conservation plans	Quantitative, Target seeking	Conservation	1. Three scenarios each of which assumes different level of coordination in conservation planning: fully coordinated (whole Mediterranean Basin), partly coordinatedo (only within EU or non-EU countries), and uncoordinated (single country). 2. A fully coordinated conservation plan is expected to save approximately US$67 billion, 45% of total cost, compared with the uncoordinated plan	Kark et al. 2009	Kark, S., Levin, N., Grantham, H.S. and Possingham, H.P., 2009. Between-country collaboration and consideration of costs increase conservation planning efficiency in the Mediterranean Basin. Proceedings of the National Academy of Sciences, 106(36), pp.15368-15373.
9	Regional	Okavango delta	Use climate and water use scenarios to examine effects on ecology of the delta	Quantitative, Exploratory, Policy screening	Water	1. 13 scenarios as combinations of the four components: (i) degrees of **water abstraction** (called ‘‘low’’ and ‘‘high abs’’), (ii) differing **intensities of catchment deforestation** (‘‘low’’/‘‘high def’’), (iii) **upstream damming** (‘‘low’’/‘‘high dam’’) and (iv) combinations of these (‘‘low’’/‘‘high com’’).	Murray-Hudson et al. 2006	Murray-Hudson, M., Wolski, P. and Ringrose, S., 2006. Scenarios of the impact of local and upstream changes in climate and water use on hydro-ecology in the Okavango Delta,

						2. Damming and abstraction scenarios yield broadly similar results: a drying trend throughout the Delta. Deforestation scenario increased inflows throughout the year, with stronger effects seen during peak flood. The combination scenarios integrate all the above factors.		Botswana. Journal of Hydrology, 331(1-2), pp.73-84.
10	Regional	Africa regional analysis	Habitat management for reductions in incidence and prevalence of malaria	Quantitative, Policy screening	Conservation	1. **3 types of Larval control** of Anopheles mosquitoe (S1, S2 and S3): S1 represents a situation in which all habitats are identical in contribution to the total productivity P. S2 is **untargeted interventions** where aquatic habitats are randomly chosen for treatment. S3 is **targeted interventions** where control interventions are targeted toward highly productive habitats. 2. **It is unnecessary to manage all aquatic habitats to obtain significant reductions in incidence and prevalence of malaria in situations of low and intermediate levels of transmission. Informed larval interventions featured by identifying and targeting prolific habitats can play a critical role in combating malaria in Africa.**	Gu & Novak 2005	Gu, W. and Novak, R.J., 2005. Habitat-based modeling of impacts of mosquito larval interventions on entomological inoculation rates, incidence, and prevalence of malaria. The American journal of tropical medicine and hygiene, 73(3), pp.546-552.
11	Regional	East Africa	Climate change implications based on SRES (IPCC)	Policy screening	Climate change	**Pathway elements are implicit** in this study as it used IPCC SRES A2 scenario, which assumed **slow technological change, high population growth, and regionally oriented economic growth.**	Doherty et al. 2010	Doherty, R.M., Sitch, S., Smith, B., Lewis, S.L. and Thornton, P.K., 2010. Implications of future climate and atmospheric CO2 content for regional biogeochemistry, biogeography and

								ecosystem services across East Africa. Global Change Biology, 16(2), pp.617-640.
12	Regional	Not defined	Analysis of food production and biodiveristy loss	Policy screening	Forestry	1. 5 different harvesting and planting scenarios for *Allanblackia* trees (seeds of *Allanblackia* trees produce edible oil with significant global market potential). 2. **Scenario with natural and planted trees combined**, with harvesting resulted in the largest number of mature Allanblackia trees.	Jamnadass et al. 2010	Jamnadass, R., Dawson, I.K., Anegbeh, P., Asaah, E., Atangana, A., Cordeiro, N.J., Hendrickx, H., Henneh, S., Kadu, C.A., Kattah, C. and Misbah, M., 2010. Allanblackia, a new tree crop in Africa for the global food industry: market development, smallholder cultivation and biodiversity management. Forests, Trees and Livelihoods, 19(3), pp.251-268.
13	National	Cape Verde	Protected area expansion associated with conservation of reptile taxa	Quantitative, Policy screening	Conservation	1. Two scenarios for conservation planning examined: a 'realistic' (**considering planning units inside PAs with lower cost**) and an 'ideal' scenario (**considering all non-humanized planning units with higher potential for conservation**) 2. The 'realistic' scenario should be largely followed because the total area selected in 'ideal' and 'realistic' prioritization scenarios are identical on most islands analyzed	Vasconcelos et al. 2012	Vasconcelos, R., Brito, J.C., Carvalho, S.B., Carranza, S. and Harris, D.J., 2012. Identifying priority areas for island endemics using genetic versus specific diversity–the case of terrestrial reptiles of the Cape Verde Islands. Biological Conservation, 153, pp.276-286.
14	National	Madasagcar	Modelled species range effects to climate change and determined the costs of ensuring maintainance of	Quantitative, Exploratory	Conservation, Climate change	**Pathway elements are implicit** in this study as this study used two IPCC SRES scenarios, namely A2a and B2a. A2a assumes	Busch et al. 2012	Busch, J., Dave, R., Hannah, L.E.E., Cameron, A., Rasolohery, A.,

			management action under future climate			moderate economic growth, very high population growth, and regional development. **B2 assumes slow economic growth, low population increase, focus on ecnvironmetnal sustainability, preference on regional development**		Roehrdanz, P. and Schatz, G., 2012. Climate change and the cost of conserving species in Madagascar. Conservation Biology, 26(3), pp.408-419.
15	National	South Africa	Analysis of **national biofuels target** in relation to anticipated climate change effects	Quantitative, Exploratory, Policy screening	Agriculture	Two land-use strategies were analyzed considering influence of climate change scenarios. Land-use Strategy 1 excludes maize and wheat and Strategy 2 includes maize and wheat (**pathway elements: changes in crop combination).**	Peter et al. 2009	Peter, C., de Lange, W., Musango, J.K., April, K. and Potgieter, A., 2009. Applying Bayesian modelling to assess climate change effects on biofuel production. Climate Research, 40(2-3), pp.249-260.
16	Local	Niger Delta (Mali)	Explore scenarios of dams construction	Quantitative, Policy screening	Multiple (water, agriculture, fisheries, conservation, development)	1. Different **water management strategies**, including dam construction, were considered in the sceanrio 2. **Building new dams is not an efficient way to increase economic growth and reduce poverty** in the region	Zwarts et al. 2006	Zwarts, L., Beukering, P.V., Koné, B., Wymenga, E. and Taylor, D., 2006. The economic and ecological effects of water management choices in the Upper Niger River: development of decision support methods. Water Resources Development, 22(1), pp.135-156.
17	Local	South Africa (West Coast National Park)	Management scenarios for herbivores in a contractual park	Quantitative, Target seeking	Park management	1. Six management scenarios considered for **managing herbivory concerns associated with large mammals at the Postberg Private Nature Reserve** 2. Given the parks'dependence on annual flower displays to generate income and the	Cowell et al. 2015	Cowell, C. and Ferreira, S., 2015. Challenges managing herbivores in the contractual Postberg section of West Coast National Park. African

						ecological disturbance this requires, **removing herbivore species that occurred outside their native range, removing fences, and reducing indigenous herbivore numbers was the most suitable scenario.**		Journal of Wildlife Research, 45(1), pp.28-54.
18	Local	South Africa (Eastern Cape)	Land managment scenarios evaluated against management targets	Quantitative, Target seeking	Agriculture, tourism and conservation	1. Three land management scenarios (combination of agriculture, tourism, and conservation), the Diversity of Farming (DoF), Living with Nature (LwN) and Room for Nature (RfN), with a vision for the year 2040. The DoF scenario reflects the farmers' preferences for agriculture and related tourism. The LwN scenario is a compromise between agriculture, restoration and nature conservation. The RfN scenario reflects the Eastern Cape Parks and Tourism Agency's preference for extended restoration and nature conservation. 2. **A combination of light grazing, low input agriculture, nature conservation and restoration is the best for the sufficient provision of multiple ecosystem services.**	Petz et al. 2014	Petz, K., Glenday, J. and Alkemade, R., 2014. Land management implications for ecosystem services in a South African rangeland. Ecological indicators, 45, pp.692-703.
19	Local	Ethiopia (Borana, southern Ethiopia)	Management scenarios of cattle production in response to drought	Quantitative, Policy screening	Grazing	1. **Two management options of cattle grazing** were examined to see how management option affects the response to drought: Scenario 1: Response of cattle herds to inter-annual rainfall variability (IRV) under a regulated grazing management system. Scenario 2: Regardless of the management system, similar trends in cattle populations will be	Angassa et al. 2013	Angassa, A. and Oba, G., 2013. Cattle herd vulnerability to rainfall variability: responses to two management scenarios in southern Ethiopia. Tropical animal health and production, 45(3), pp.715-721.

						observed in response to IRV. 2. **Fluctuations in cattle numbers, herd mortality and calving rates were highly correlated with IRV, with stronger linear impacts in accordance with scenario 2.** A management system based on control of stocking densities did not improve herd survival, as compared with traditional drought management strategies.		
20	Local	Tanzania (Pangani Basin)	Three management and three climate scenarios (IPCC SRES A1B), focussed on modelled watershed services (energy, agriculture and water for people).	Quantitative, Policy screening	Water	1. Combination of three management and three climate change scenarios for the year 2025 examined. Management scenarios differ by the priority given to water uses: **maximize agriculture, maxmize hydropower, and sustainability.** Sustainability scenario assumes balancing requirements and assumes "good practice" in terms of efficiency of use (irrigation efficiency of 45%, compared to 32% in the other 2025 scenarios). Three of the IPCC SRES scenarios were used as climate scenarios. 2. Investments in distribution infrastructure can improve water provision even with increased demand. The decline of natural vegetation increases vulnerability of subsistence farmers.	Notter et al. 2013	Notter, B., Hurni, H., Wiesmann, U. and Ngana, J.O., 2013. Evaluating watershed service availability under future management and climate change scenarios in the Pangani Basin. Physics and Chemistry of the Earth, Parts A/B/C, 61, pp.1-11.
21	Local	South Africa (Cape Floristic Region (Western Cape)	Management scenarios for the clearing of invasive alien plants	Participatory, Exploratory, Target seeking	Conservation	1) Explored four key senarios related to the managment and clearing of invasive alien plants from landsacpes: a) agencies responsible for clearing IAP lack the management capacity and financial resoures to do so efficiently; b)	Roura-Pascual et al. 2011	Roura-Pascual, N., Richardson, D.M., Chapman, R.A., Hichert, T. and Krug, R.M., 2011. Managing biological invasions: charting courses

						problem becomes unmanageable, due to previous reasons, and multiple stakeholers don't play their required role, there is a lack of coordination, and the environment is highly fragmented; c) capacity in place but human activites promote the spread of IAP; d) managing to keep ahead and bring IAP under control (good implementation) with suficient financial and managerial resources and political comitment to the environment.		to desirable futures in the Cape Floristic Region. Regional Environmental Change, 11(2), pp.311-320.
22	Local	South Africa (Little Karoo)	Conservation planning scenarios were spatially modelled to analyse ecosystem service and economic costs and benefits of different biodiveristy and ecosystem service targets	Quantitative, Exploratory, Target seeking	Conservation	1) Explored the trade-offs between biodiversiy conservation and ecosystem service protection. Ecosystem services of carbon storage, water recharge and fodder provision were all protected to a degree whilst focussing on biodiversity conservation (30%), integrating ecosystem service information into biodiveristy conservation strategies additional ecosystem service gain can be derived (20%), by reducing the focus on conservation fairly substantial ecosystem service gains can be derived.	Egoh et al. 2010	Egoh, B.N., Reyers, B., Carwardine, J., Bode, M., O'Farrell, P.J., Wilson, K.A., Possingham, H.P., Rouget, M., De Lange, W., Richardson, D.M. and Cowling, R.M., 2010. Safeguarding biodiversity and ecosystem services in the Little Karoo, South Africa. Conservation Biology, 24(4), pp.1021-1030.
23	Local	Tunisia (Northern Tunisia, Ghar El Melh basin/delta/ estuary)	Sediment and nutrient loads modeled to detemine future water quality effects	Quantitative, Policy screening	Water	Deteriorating water quality in the Ghar El Melh lagoon, largly driven by flash flooding events that dump untreated sewrage form developing settlements, nurtients and sediments from the surrounding catchment into the lagoon. High concentration of sediments and nutrients in coastal waters further exacerbate the condition of the lagoon that imports these from the sea.	Rasmussen et al. 2009	Rasmussen, E.K., Petersen, O.S., Thompson, J.R., Flower, R.J., Ayache, F., Kraiem, M. and Chouba, L., 2009. Model analyses of the future water quality of the eutrophicated Ghar El Melh lagoon (Northern

						Simulations indicate that vegetation recovery in the lagoon is uncertain.		Tunisia). Hydrobiologia, 622(1), pp.173-193.
24	Local	Cameroon (8 agricultural regions: Bamenda, Batouri, Garoua, Kribi, Maroua, Ngaoundere, Tiko, Yaounde)	Exploring adaptation options for crop production associated with climate scenarios (IPCC SRES)	Quantitative, Exploratory, Policy screening	Agriculture, climate change	1. Examined **two adaptation options** under two climatic scenarios (which built on SRES A2 and B2): **changes in sowing date**, and **the use of new crop cultivars with specific genetic traits.** 2. Sowing dates may not be very effective in mitigating the adverse effects of climate change while the use of **new crop cultivars with specific genetic traits was found most effective** in reducing the adverse effects.	Tingem et al. 2009	Tingem, M., Rivington, M. and Bellocchi, G., 2009. Adaptation assessments for crop production in response to climate change in Cameroon. Agronomy for sustainable development, 29(2), pp.247-256.
25	Local	South Africa (Little Karoo)	Exploring the cost-benefits of rehabilitation scenarios in shifting towards more sustainable land-use practives	Quantitative, Policy screening	Conservation, agriculture	1. Calculated and compared net present values for rehabilitation and no rehabilitation scenarios to raise awareness, at a private landowner level, to the opportunity costs incurred through unsustainable land use practices of ostrich farming. 2. Rehabilitation of Gannaveld vegetation after unsustainable ostrich farming is costly and not financially feasible over a period less than 20 years largely due to low seedling survival rates of *Tripteris sinuatum*.	Herling et al. 2009	Herling, M.C., Cupido, C.F., O'Farrell, P.J. and Du Plessis, L., 2009. The financial costs of ecologically nonsustainable farming practices in a semiarid system. Restoration Ecology, 17(6), pp.827-836.
26	Local	South Africa (Western Cape)	Land-use scenarios (multifunctional, production, nonconversion), and trade-offs in CO2 emissions and other impacts (e.g. soil quality, water) in contrasting production foresty and the use of indigenous vegetation	Quantitative, Policy screening	Forestry	1. Three land use conversion scenarios were examined to evaluate the potential of establishing Pinus radiata plantations as a CDM project: conversion of natural vegetation into multifunctional forest (MUf), into production forest (PRf) and non-conversion (NCf).	García-Quijano et al. 2007	García-Quijano, J.F., Peters, J., Cockx, L., Van Wyk, G., Rosanov, A., Deckmyn, G., Ceulemans, R., Ward, S.M., Holden, N.M., Van Orshoven, J. and Muys, B., 2007. Carbon

						2. Production forest scenario causes higher impacts than the multifunctional scenario, but with the latter being less efficient in avoiding CO2 emissions. **Multifunctional scenario is the best option for CDM on the long term when both greenhouse gas mitigation and land use impacts are taken into account.**		sequestration and environmental effects of afforestation with Pinus radiata D. Don in the Western Cape, South Africa. Climatic Change, 83(3), pp.323-355.
27	Local	South Africa (Underberg, KwaZulu-Natal)	Land use change scenarios (dairy and forestry intensification) impacts on biodiversity and total economic value	Quantitative, Policy screening	Conservation, agriculture	1) Six possible scenarios of future land-use examined: a) extensive grazing, b) status quo, c) fully utilised forest permits, d) current forestry and maximum dairy, e) maximum dairy and maximum forestry, f) maximum aforestation. 2) Changing land cover (through increased forestry and dairy) resulty in biodiversity loss through transformation of natural grasslands. Whilst transformation yields considerable economic benefits at considerable environmental cost. Timber prodution impacts on water supply aswell. Income differences between beef production and timber are driving the shift towards timber. Stock theft and labour requirements are also contributing to this shift. Social changes also exacerbate this with communities being disrupted and threshold effects resulting in accelerated shifts to timber.	Turpie et al. 2007	Turpie, J.K., O'Connor, T., Mills, A. and Robertson, H., 2007. The ecological and economic consequences of changing land use in the southern Drakensberg grasslands: environmental and ecological economics. South African Journal of Economic and Management Sciences, 10(4), pp.423-441.
28	Local	South Africa (KwaZulu-Natal)	Simulated river flow scenarios (based on abstraction) in determining potential effects on bird fauna	Quantitative, Policy screening	Water, conservation	**Eight scenarios, each representing alternative environmental flow levels**for the Thukela Estuary, were developed **to analyze potential effectas on bird fauna**.	Cyrus & MacKay 2007	Cyrus, D.P. and MacKay, C.F., 2007. The Environmental Reserve and its role in retaining the

						Only two out of eight scenarios were discussed: (1) River Category B Scenario allows the greatest abstraction of water without jeopardising the functioning of the ecosystem, and (2) Worst Case 1 Scenario illustrates a level of flow reduction that would have major negative impacts on the Thukela Estuary as a River Mouth ecosystem.		diversity of birds at the Thukela Estuary. Ostrich-Journal of African Ornithology, 78(3), pp.621-631.
29	Local	Botswana (North-West District)	Management/intervention scenarios highlighting upstream and downstream implications in the Okavango Delta	Quantitative, Retrospective	Water	**Water abstraction scenarios** were developed, each representing alternative abstraction levels **from Okavango Delta** to study major upstream and local interventions and their expected impacts in the Delta. The intention of scenario analysis was not to present policy options but for model calibrations.	Bauer et al. 2006	Bauer, P., Gumbricht, T. and Kinzelbach, W., 2006. A regional coupled surface water/groundwater model of the Okavango Delta, Botswana. Water Resources Research, 42(4).
30	Local	Tanzania (Ngorongoro Conservation Area, northern Tanzania)	Using scenarios and models in resolving rangland conflicts associated with population growth and agricultural policies	Quantitative, Exploratory, Retrospective	Agriculture, conservation	Scenarios as the combination of **different population growth** (3% or 6%) and **cultivation (no-agriculture or agriculture allowed)** to improve human welfare without compromising conservation value. Results suggest that conservation–people conflicts in the Ngorongoro Conservation Area are bound to exacerbate under the status quo.	Gavin et al. 2006	Galvin, K.A., Thornton, P.K., De Pinho, J.R., Sunderland, J. and Boone, R.B., 2006. Integrated modeling and its potential for resolving conflicts between conservation and people in the rangelands of East Africa. Human Ecology, 34(2), pp.155-183.
31	Local	South Africa (KwaZulu-Natal)	Exploratory climate change scenarios to determine management options in small-holder cropping systems	Quantitative, Exploratory, Policy screening	Climate change, agriculture	1) The **sustainability of small holder agroecosystems** was investigated by examining 4 different tillage practices, 2 fertilizer practices, and 6 climate scenarios	Walker & Schulze 2006	Walker, N.J. and Schulze, R.E., 2006. An assessment of sustainable maize production under different

						2) Inorganic fertilizer is a key input into the system over the long term, and factors affecting its application are avaliable credit and transport. Competing capital needs also affect this. Ground water rechage and dry periods also impact on production levels. **Conventional tillage practices yielded the greatest results**, but in reality conservation tillage showed increased benefits indicating model issues. Supplementary income through off-farm work for revenue, and rainfed systems remain vulnerable.		management and climate scenarios for smallholder agro-ecosystems in KwaZulu-Natal, South Africa. Physics and Chemistry of the Earth, Parts A/B/C, 31(15-16), pp.995-1002.
32	Local	South Africa (Western Cape)	Water resource planning - understanding water flow scenarios, trade-offs between water users, and biophysical effects of trade-offs	Quantitative, Policy screening	Water	1) A DRIFT model was developed to provide flow scenarios for the Dooring River in the Western Cape South Africa, for different total annual volumes of water relating to Dry season low flows (3), wet season low flow (4) and flooding conditions (3). River abstraction opportunities are presented whist maintaining current river ecological status. Actions of farmers adjacent to rivers may in fact be limiting amount they can abstract. Without restoring dry season flows, the condition of the system will deteriorate. Wet season abstraction for dry season use needs to be factored into buisness plans.	Brown et al. 2006	Brown, C., Pemberton, C., Birkhead, A., Bok, A., Boucher, C., Dollar, E.D., Harding, W., Kamish, W., King, J., Paxton, B. and Ractliffe, S., 2006. In support of water-resource planning–highlighting key management issues using DRIFT: A case study. Water Sa, 32(2), pp.181-192.
33	Local	South Africa (Eastern Cape)	Catchment scale modeling of land-use change focussing on afforestation scenarios in determing trade-offs between plantations and water availability/run-off	Quantitative, Policy screening	Forestry, water	1) Modeling the hydrological and ecological dynamics and effects on 2 wetlands in South Africa, for scenarions of pre and post afforestation. 2) Afforestation results in rainfall being	Helmschrot et al. 2005	Helmschrot, J., Lorentz, S. and Flügel, W.A., 2005. Integrated wetland and landscape modeling. A case study from the

						intercepted and evalotransporated, and significantly reduces avaliable run-off to wetlands by 13 -21% dependent on Spp. The size and type of wetland determines the degree of impact. Aforestation programs neeto to plan in conjunction with wetland types and landscape feature to restrict impacts.		Eastern Cape Province, South Africa. In MODSIM 2005 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand (pp. 1382-1388).
34	Local	South Africa (Limpopo Province)	Simulation scenarios for water resource management and determining ecological reserve requirements	Quantitative, Policy screening	Water, conservation	1) A MIKE SHE/MIKE11 model was developed to simulate key hydraulic and hydrologica processes in 5 land-use change scenarios to use in a decision support system for determining environmental water requirements for non-perennial river flow systems in South Africa to facilitate ecosystem-based management of water resources. 2) Conversion of irrigated land to game farming significantly increased mean flows of water.	Prucha et al. 2016	Prucha, B., Graham, D., Watson, M., Avenant, M., Esterhuyse, S., Joubert, A., Kemp, M., King, J., le Roux, P., Redelinghuys, N. and Rossouw, L., 2016. MIKE-SHE integrated groundwater and surface water model used to simulate scenario hydrology for input to DRIFT-ARID: the Mokolo River case study. Water SA, 42(3), pp.384-398.
35	Local	South Africa (Limpopo Province)	Testing methods for establishing environmental water requirements (ecological reserve) in non-perennial rivers	Quantitative, Policy screening	Water, conservation	1) A DRIFT model was developed and tested based on field data, which in turn was used in a decision support system to test the impact of 5 development scenarios in the Mokolo catchment South Africa.	Seaman et al. 2016	Seaman, M., Watson, M., Avenant, M., Joubert, A., King, J., Barker, C., Esterhuyse, S., Graham, D., Kemp, M., le Roux, P. and Prucha, B., 2016. DRIFT-ARID: Application of a method for environmental water requirements (EWRs) in a non-perennial river (Mokolo River) in

								South Africa. Water SA, 42(3), pp.362-382.
36	Local	Kenya (Aberdare Conservation Area and surroundings, Central Kenya)	Understaning trade-offs and synergies between land aquisitions and payments for ecosystem services as conservation tools in relation to agricultural suitability and livelihood strategies	Quantitative, Policy screening	Agriculture, conservation	1) Contrast of PES to **Land Purchases or Easements** in Central Kenya to determine the relative effectivness of these conservation tools, and effects of land markets, property value fluctuations, rising agricultural productivity and climate change were considered. 2) **Land purchases lead to larger reserves and better representation of mammals.** Use of land purchases is limited by restrictions on foreign ownership. **PES is more immediate with simpler insititutional arrangements even if less effective**.	Curran et al. 2016	Curran, M., Kiteme, B., Wünscher, T., Koellner, T. and Hellweg, S., 2016. Pay the farmer, or buy the land?—Cost-effectiveness of payments for ecosystem services versus land purchases or easements in Central Kenya. Ecological Economics, 127, pp.59-67.
37	Local	Morocco (Nadoor lagoon, Northeast Morocco)	The use of food web models in exploring sensitivity to eutrophication scenarios and cycling efficiencies	Quantitative, Retrospective	Agriculture, water, conservation	1) Food web models were used to evaluate the ecosystem status of a moroccan lagoon contrasting past with present secnarios. 2) **Highlights the need for establishing focussed ecological monitoring of the lagoon and the coordination of surounding land-uses.**	Bocci et al. 2016	Bocci, M., Brigolin, D., Pranovi, F., Najih, M., Nachite, D. and Pastres, R., 2016. An Ecosystem Approach for understanding status and changes of Nador lagoon (Morocco): application of food web models and ecosystem indices. Estuarine, Coastal and Shelf Science, 171, pp.133-143.
38	Local	Kenya (Embu county)	Climate change models in considering farming 'winners' and 'losers' to climate change as associated	Quantitative, Target seeking	Agriculture, climate change	1) Modeled the impacts of climate change (5 models) on household welfare (net farm returns, per capita incomes, and poverty) in current agricultural production systems in	Mulwa et al. 2016	Mulwa, R., Rao, K.P., Gummadi, S. and Kilavi, M., 2016. Impacts of climate change on

			with farm location, a welfare indicator, and crop selection			Embu county, central Kenya. 2) 36-66% of households in areas of limited rainfall will be impacted by Climate change. Crop models indicate mixed results for net farm returns, per capita income and poverty levels for different agricultural zones. **Highlights the need for adaptation approaches and policies in certain areas to either cope with or to boost returns.**		agricultural household welfare in Kenya. Climate Research, 67(2), pp.87-97.
39	Local	Ethiopia (Two highlands sites and a Rift Valley site)	Exploration of risks linked to water contaminants associated with agricultural inputs	Quantitative, Policy screening	Water, agriculture	1) Scenarios for pesticide registration procedures in Ethiopia, focussed concentration estimates of agricultural surface water in streams and ponds. 2) The risks associated with consumption of surface water is low to negligible, whereas agricultural use in some crops may result in medium to high risk to aquatic species. This allowed for the establishment of protection goals.	Teklu et al. 2015	Teklu, B.M., Adriaanse, P.I., Ter Horst, M.M., Deneer, J.W. and Van den Brink, P.J., 2015. Surface water risk assessment of pesticides in Ethiopia. Science of the Total Environment, 508, pp.566-574.
40	Local	Ethiopia (Lake Tana)	Examining trade-offs between energy, agricultural production and ecosystem service by translating narative scenarios into quantitative scenarios	Participatory, Quantitative, Policy screening	Agriculture	1) Compare the impacts of alternative development trajectories relating to agriculture, energy and environment for the Lake Tana Subbasin, Ethopia, using 3 participatory developed scenarios. 2) **Agricultural transformation (development and industrialization) and energy transition are interdependent (as agriculture becomes increasingly intensified, it relies on more energy).** Water is needed for energy and agricultural production, and to sustain ecosystem services, sometimes exceeds water availability. Biomass production is	Karlberg et al. 2015	Karlberg, L., Hoff, H., Amsalu, T., Andersson, K., Binnington, T., Flores-López, F., de Bruin, A., Gebrehiwot, S.G., Gedif, B., Johnson, O. and zur Heide, F., 2015. Tackling complexity: understanding the food-energy-environment nexus in Ethiopia's Lake tana sub-basin. Water Alternatives, 8(1).

						relatively the same as needs to fuel, fodder and food.		
41	Local	South Africa (KwaZulu-Natal Midlands)	Exploring trade-off relating to investments in sugar cane and poverty alleviation with environmental integrity	Quantitative, Policy screening	Agriculture	1) A runoff, sediment and nutrient (NO3 and P) production model is used to evaluate 5 scenarios of farming practices and land-use changes on crop yields, water discharge, sediment and nutrient loads in the Mkabela catchment, South Africa. 2) There are a**lternative pollution control measures that can be applied in catchments. Landscape connectivity needs to be factored into planning and managment in how it relates to sediment and pollution. Infrastructure can be strategically used to attenuate river flows.**	Kollongei et al. 2015	Kollongei, K.J. and Lorentz, S.A., 2015. Modelling hydrological processes, crop yields and NPS pollution in a small sub-tropical catchment in South Africa using ACRU-NPS. Hydrological Sciences Journal, 60(11), pp.2003-2028.
42	Local	Ethiopia (Didessa River Basin, South-western Ethiopia)	Seeking opportunities for reconsiling biodiversity conservation and coffee production through predictive modeling	Quantitative, Target seeking	Conservation, agriculture	1) Predictive modelling used to map potential understory coffee and evaluated how projected changes in climate would affect the suitability. 2) Given its strategic economic importance understanding spatial production possibilities of understort coffee production vital. Land-use planning that steers prodution towards riperian areas and away from dense forest seems appropriate. With increasing temperatures and precipitation under conditions of climate change, higher altitude areas need to be considered as well.	Hailu et al. 2015	Hailu, B.T., Maeda, E.E., Pellikka, P. and Pfeifer, M., 2015. Identifying potential areas of understorey coffee in Ethiopia's highlands using predictive modelling. International Journal of Remote Sensing, 36(11), pp.2898-2919.
43	Local	Kenya (River Kuywa basin, Mt Elgon)	Exploring management scenarios and farmers preferences for PES and	Participatory, Quantitative,	Agriculture, conservation	1) Farmers preferences for different managment scenarios were assessed using conjoint analysis.	Kisaka et al. 2015	Kisaka, L. and Obi, A., 2015. Farmers' preferences for

			how these relate to food security and environmental quality	Policy screening		2) Farmers preference for **PES** is affected by commitment periods, proportion of their land area that is to be affected by the instrument. T**heir decision to participate in the application of a policy instrument is affected by age, gender, household size, awareness, land tenure arrangements and annual income.**		management options as payment for environmental services scheme. International Food and Agribusiness Management Review, 18(3), pp.171-192.
44	Local	Tunisia (Ichkeul Basin)	A prototype for spatial decision support that examines trade-offs between water provision and ecological functioning	Quantitative, Policy screening	Water	Highly dammed watershed, new dams proposed. Reservations on data ("one of the mandatory conditions for this is to enrich the data of the SDSS"), but preliminary results suggest: 1) **Water transfers from outside the catchment have a positive ecological and water supply effect. 2) New dams are highly detrimental to ecology, but contribute a small improvement for water supply.**	Chakroun et al. 2015	Chakroun, H., Chabaane, Z.L. and Benabdallah, S., 2015. Concept and prototype of a spatial decision support system for integrated water management applied to Ichkeul Basin, Tunisia. Water and Environment Journal, 29(2), pp.169-179.
45	Local	Tanzania (Eastern Arc Mountain “blocks” (tourist areas))	Economically quantify land-use change scenarios that explore the effects on visitor numbers and associate profit to tourism industry	Quantitative, Exploratory, Policy screening	Tourism	2 scenarios of producer surplus (PS) generation for nature-based tourism in Tanzania's Eastern Arc Mountains. 1) **Stricter enforcement of forest conservation and an assumed ehanced reputation for sustainability**generates 16% higher PS than BAU over 25 byears. 2) **Well-defined and enforced policies** must generate funding for forest management, enable profit-sharing and employment and generate compensation for foregone forest conversion and exploitation	Bayliss et al. 2014	Bayliss, J., Schaafsma, M., Balmford, A., Burgess, N.D., Green, J.M., Madoffe, S.S., Okayasu, S., Peh, K.S.H., Platts, P.J. and Douglas, W.Y., 2014. The current and future value of nature-based tourism in the Eastern Arc Mountains of Tanzania. Ecosystem Services, 8, pp.75-83.

46	Local	Malawi (Makanjila, on the shores of Lake Malawi)	Modelling scaling relationships between growth in height, stem diameter and crown size and from these relationships detemining appropriate planting densities.	Quantitative, Policy screening	Forestry	Varying densities of the "conservation agriculture" species Faidherbia albida were modelled to find an optimum. **Starting intervals of 4 x 4m recommended followed by thining by approximately 50% based on development of stem diameter.**	Sileshi et al. 2014	Sileshi, G.W., Nyoka, B.I., Beedy, T.L. and Chanyenga, T., 2014. Modelling the scaling of stem growth with crown size and optimum stocking densities for systematic grid plantation of Faidherbia albida. New forests, 45(5), pp.699-714.
47	Local	Madagascar (Andoy dry forest)	Examining trade-offs, poverty, local economic development, traditional production systems in relation to forest loss and conversion rates in determing sustainale forestry appraoches	Quantitative, Target seeking	Conservation	Scenarios of traditional subsistence agriculture are constructed for the Androy region in Madagascar. 1) **Population stabilisation and reduction of net deforestation are needed to maintain current living standards. 2) Improved living standards with the same lifestyle requires major reduction of population. 3) Improved living standards without reducing population cannot be achieved without changing the traditional production system.**	Andrés-Domenech et al. 2014	Andrés-Domenech, P., Saint-Pierre, P., Fanokoa, P.S. and Zaccour, G., 2014. Sustainability of the dry forest in Androy: a viability analysis. Ecological economics, 104, pp.33-49.
48	Local	Madagascar (Four watersheds and coral reefs along the coastline (mainly west))	Exploratory climate change scenarios (Based on IPCC SRES) and policy screening scenarios (land-use change scenarios) in developing regional land-use management approaches for mediating climate change effects	Quantitative, Exploratory, Policy screening	Climate change	1) **The management of land-use** offers a practical solution to reducing sedimentation and contributing to the resilience and adaptability of coral reefs facing both direct and indirect threats of rising CO2. 2) **Local-scale mitigation through curbing sediment pollution** is particularly relevant for many tropical coastal communities who depend directly on marine resources for their livelihood. 3) **Afforestation applied comprehensively**	Maina et al. 2013	Maina, J., De Moel, H., Zinke, J., Madin, J., McClanahan, T. and Vermaat, J.E., 2013. Human deforestation outweighs future climate change impacts of sedimentation on coral reefs. Nature communications, 4, p.1986.

						through a policy and action framework offers promise for sustainability of coral ecosystems.		
49	Local	Ghana (Western Region)	Forest degradation vs cocoa expansion - understanding the trade-offs related to cost and benefit of high tech production compared with the development of sustainability programmes	Quantitative, Policy screening	Agriculture	1) **Transforming current low yield cocoa production systems** is necessary to achieve Ghana's national goals without destroying the remaining forest reserves. 2) Certified (Rainforest Alliance, Sustainable Agriculture Network) cocoa has lower profitability despite higher prices per tonne than other production systems simulated; "standards may not be welfare-producing to the extent claimed". 3) **Highest profitability is generated by intensified non-shaded production, which also permits a reduction in land requirements to achieve the production goal.**	Gockowski et al. 2013	Gockowski, J., Afari-Sefa, V., Sarpong, D.B., Osei-Asare, Y.B. and Agyeman, N.F., 2013. Improving the productivity and income of Ghanaian cocoa farmers while maintaining environmental services: what role for certification?. International Journal of Agricultural Sustainability, 11(4), pp.331-346.
50	Local	Zambia (Kafue Basin, central Zambia)	Understanding trade-offs and thresholds associated with water hypoxia (resulting in fish mortality) and nutrient load (replenishing nutrients removed in sediments elswhere)	Quantitative, Policy screening	Water	1) Releases of hypolimnetic (deeper, nutrient-rich) water from hydropower reservoirs cause hypoxia that may persist for long periods and great distances downstream. 2) Simulated "selective" releases of a mix of hypolimnetic and epilimnetic (shallower, low nutrient) water could remove hypoxia and increase DO, N and P. 3) Although optimised releases do not reproduce "no-dam" conditions, they do not necessarily imply reduced power generation ability.	Kunz et al. 2013	Kunz, M.J., Senn, D.B., Wehrli, B., Mwelwa, E.M. and Wüest, A., 2013. Optimizing turbine withdrawal from a tropical reservoir for improved water quality in downstream wetlands. Water Resources Research, 49(9), pp.5570-5584.
51	Local	Sudan, Egypt (Nile Basin)	Exploring the effect of land cover change on malaria vector spread	Quantitative, Exploratory,	Health, conservation	1) Development of large contiguous areas of irrigation drives a very large increase in suitable habitat for the example mosquito	Fuller et al. 2012	Fuller, D.O., Parenti, M.S., Hassan, A.N. and Beier, J.C., 2012. Linking land

				Policy screening		species. 2) Linked **Land Cover Models and Species Distribution Models should be routinely applied to assess potential impacts of potential future agricultural development projects in arid areas.**		cover and species distribution models to project potential ranges of malaria vectors: an example using Anopheles arabiensis in Sudan and Upper Egypt. Malaria journal, 11(1), p.264.
52	Local	Kenya (Kakamega-Nandi Forests, western Kenya)	Investigationg the negative consquences of deforestation and the positive concequences of reforestation for bird species, through the use of exploratory and policy screaning scenarios	Quantitative, Exploratory, Target seeking	Conservation	1) Hindcast assessment of change shows that faunal losses greatly exceed declines in forest cover. 2) A simulation of reforestation with a mix of indigenous trees results in strong recovery of forest specialist bird species.	Lung et al. 2012	Lung, T., Peters, M.K., Farwig, N., Böhning-Gaese, K. and Schaab, G., 2012. Combining long-term land cover time series and field observations for spatially explicit predictions on changes in tropical forest biodiversity. International journal of remote sensing, 33(1), pp.13-40.
53	Local	Tanzania (Eastern Arc Mountains)	Exploring the effects of land cover change on ecosystem services and socio-economic welbeing using scenarios. Two carbon storage scenario case studies used in a "methods" paper: A sustainable and a BAU; preliminary findings presented as proof of concept	Participatory, Quantitative, Exploratory, Target seeking	Conservation	The **Protected Area network appears** to play an important role in maintaining carbon stocks; **curtailing BAU agricultural expansion and charcoal extraction** needed to reduce loss of C storage	Swetnam et al. 2011	Swetnam, R.D., Fisher, B., Mbilinyi, B.P., Munishi, P.K., Willcock, S., Ricketts, T., Mwakalila, S., Balmford, A., Burgess, N.D., Marshall, A.R. and Lewis, S.L., 2011. Mapping socio-economic scenarios of land cover change: A GIS method to enable ecosystem service modelling. Journal of environmental management, 92(3), pp.563-574.

54	Local	Tanzania (Eastern Arc Mountains)	Aims to contribute to systematising ES measurement and modelling. Exploring the effects of change in ecosystem services on welfare across across scales (local, regional and global scales)	Participatory, Quantitative, Exploratory, Target seeking	Conservation	Systematic structured approach to mapping and modelling ES needed; Approach must include costs and benefits of ES.	Fisher et al. 2011	Fisher, B., Turner, R.K., Burgess, N.D., Swetnam, R.D., Green, J., Green, R.E., Kajembe, G., Kulindwa, K., Lewis, S.L., Marchant, R. and Marshall, A.R., 2011. Measuring, modeling and mapping ecosystem services in the Eastern Arc Mountains of Tanzania. Progress in Physical Geography, 35(5), pp.595-611.
55	Local	Tanzania (Ruaha National Park, south-central Tanzania)	Understanding value trade-offs between conservation and development where global and reginal priorities and contrasted with local priorities	Participatory, Quantitative, Policy screening	Conservation	Deliberative, participatory quantification of cross-scale value trade-offs of different National Park management scenarios. **Current management serves national and inetrnational values at expense of local. Policy mechanisms that reverse this should be designed.**	Zia et al. 2011	Zia, A., Hirsch, P., Songorwa, A., Mutekanga, D.R., O'Connor, S., McShane, T., Brosius, P. and Norton, B., 2011. Cross-scale value trade-offs in managing social-ecological systems: the politics of scale in Ruaha National Park, Tanzania. Ecology and Society, 16(4).
56	Local	Liberia (Central Liberia)	Feasibility benefits of linking forest conservation (and reforestation) to biofuel cultivation through explicit regulations	Quantitative, Policy screening	Agriculture, conservation	Policy implications of the study: **1) carbon credits to subsidize the cultivation of biofuel feedstocks on recently deforested or other degraded landscapes; 2) Policy needs to explicitly link forest conservation to reforestation on degraded landscapes and to cultivation of woody perennial biofuel crops; 3) Conserved forest should**	Killeen et al. 2011	Killeen, T.J., Schroth, G., Turner, W., Harvey, C.A., Steininger, M.K., Dragisic, C. and Mittermeier, R.A., 2011. Stabilizing the agricultural frontier: leveraging REDD with biofuels for sustainable development. biomass and

						exceed Biofuel plantation by predetermined ratio (Brazil has 4:1)		bioenergy, 35(12), pp.4815-4823.
57	Local	Kenya (Kakamega Forest, western Kenya)	Using retrospective scenarios in validating the asumption that forest cover data is a good proxy for historical animal population sizes	Quantitative, Retrospective	Conservation	To maintain minimum viable population of keystone ant species, **1) forest patches should be above a size threshold (113ha in this case); 2) landscapes should have >11% forest cover; 3) high protection status for all remaining forest area.**	Peters et al. 2011	Peters, M.K., Lung, T., Schaab, G. and Wägele, J.W., 2011. Deforestation and the population decline of the army ant Dorylus wilverthi in western Kenya over the last century. Journal of Applied Ecology, 48(3), pp.697-705.
58	Local	Cameroon (Manyu Division, southwestern Cameroon)	Impacts of farm management on the carbon stocks and farm gate prices - determining species with the highest ecological and economic value	Quantitative, Policy screening	Agriculture, conservation	**Partial cuts (half) of non-timber woody species is better than full rotation (clear-felling)** for C accumulation and for Carbon credit potential.	Egbe et al. 2011	Egbe, E.A. and Tabot, P.T., 2011. Carbon sequestration in eight woody non-timber forest species and their economic potentials in southwestern Cameroon. Applied Ecology and Environmental Research, 9(4), pp.369-385.
59	Local	Kenya (Nairobi National Park, Ahti-Kaputiei Plains, south-central Kenya)	Determinig the most desirable urban future through participatory modeling of alternative futures for conservation and urban development	Participatory, Quantitative, Policy screening	Conservation	1) Step-wise Participatory Stakeholder modelling used to develop Bayesian Belief Network models. 2) **BBNs are useful to organize thinking and generate adaptive management hypotheses**. 2) Multiple working hypotheses are needed to make this approach useful in an Adaptive Management framework.	McCloskey et al. 2011	McCloskey, J.T., Lilieholm, R.J., Boone, R., Reid, R., Sader, S., Nkedianye, D., Said, M. and Worden, J., 2011. A participatory approach for modeling alternative future land use scenarios around Nairobi National Park using Bayesian Belief Networks. WIT Transactions on

								Ecology and the Environment, 144, pp.43-57.
60	Local	Botswana (North-West District)	Determining changing ecoregions within the Okavango Delta by using hydrological climate change models	Quantitative, Exploratory, Policy screening	Climate change	1) **High-efficiency irrigation technology** should be used to mitigate reduced flows due to abstraction. 2) **State-to-State subsidies** could help to pay for this (downstream to upstream). 3) **The international community could contribute to PES** for contribution of Okavango Delta to global biodiversity.	Milzow et al. 2010	Milzow, C., Burg, V. and Kinzelbach, W., 2010. Estimating future ecoregion distributions within the Okavango Delta Wetlands based on hydrological simulations and future climate and development scenarios. Journal of Hydrology, 381(1-2), pp.89-100.
61	Local	Kenya (Taita Hills, south-eatern Kenya)	Understanding agricultural expansion in relation to irrigation requirements and biodiveristy impacts	Quantitative, Exploratory, Target seeking	Agriculture	1) Reduce the fragmentation effect of agricultural expansion. 2) Use modelling to identify priority regions with respect to land allocation and environmental risks.	Maeda et al. 2010	Maeda, E.E., Clark, B.J., Pellikka, P. and Siljander, M., 2010. Modelling agricultural expansion in Kenya's Eastern Arc Mountains biodiversity hotspot. Agricultural Systems, 103(9), pp.609-620.
62	Local	Tunisia (Segdoud Oasis, south-west Tunisia)	Developing conceptual hydrological models for managing irrigation networks (and associated issues like soil salinity)	Quantitative, Retrospective	Agriculture, water	Implementation of irrigation interval <10 days in summer should result in higher water storage and less salt accumulation, and >10 days in winter should cause a decline in water table reducing near-surface salt accumulation	Askri et al. 2010	Askri, B., Bouhlila, R. and Job, J.O., 2010. Development and application of a conceptual hydrologic model to predict soil salinity within modern Tunisian oases. Journal of hydrology, 380(1-2), pp.45-61.

63	Local	Malawi (Linthipe Catchment, southern Malawi)	Managing agricultural inputs and their impacts on hydrological systems	Quantitative, Policy screening	Water	Address agricultural and deforestation activities, which appear to constitute the largest source of sediment and nutrient loading. This is most pronounced during the rainy season.	Chikondi et al. 2010	Chikondi, G.M., Joshua, V. and Phiri, S.J., 2010. Modeling the fluxes of nitrogen, phosphate and sediments in Linthipe catchment, Southern Lake Malawi Basin: Implications for catchment management. African Journal of Agricultural Research, 5(6), pp.424-430.
64	Local	Ethiopia (Chilomo Forest, Central Ethiopia)	Understanding the long-term versus short-term benefits to livelihhods from forest management	Participatory, Quantitative, Policy screening	Forestry	1) **Strengthen community technical, managerial and administrative capacity. 2) Improve short-term incentives from participatory forest management. 3) Ensure active participation of communities. 4) Regulatory frameworks should create an enabling environment to strengthen local institutions. 5) Make regulatory frameworks clear and coherent at all levels**.	Kassa et al. 2009	Kassa, H., Campbell, B., Sandewall, M., Kebede, M., Tesfaye, Y., Dessie, G., Seifu, A., Tadesse, M., Garedew, E. and Sandewall, K., 2009. Building future scenarios and uncovering persisting challenges of participatory forest management in Chilimo Forest, Central Ethiopia. Journal of Environmental Management, 90(2), pp.1004-1013.
65	Local	South Africa (Western Cape)	Exploratory and retrospective scenarios relating to freshwater inflows and fish populations in estuaries	Quantitative, Exploratory, Retrospective	Water, fisheries	1) Reduced freshwater flows will probably cause reduced fish abundance in the Olifants (western) estuary. 2) This will be exacerbated by fishing. 3) Future flow reductions (decreased rainfall, dams) indicate low biomass, low diversity marine	Lamberth et al. 2008	Lamberth, S.J., Van Niekerk, L. and Hutchings, K., 2008. Comparison of, and the effects of altered freshwater inflow on, fish assemblages of two

						dominated system. 4) Fisheries dependent on estuaries will suffer from reduced production. 5) In southern estuaries, marine and partially estuarine dependent fish will probably increase, as will overall diversity. 6) Freshwater and estuarine-breeding species will decline. 7) **Management actions must address both maintenance of freshwater flows and fishing activities.**		contrasting South African estuaries: the cool-temperate Olifants and the warm-temperate Breede. African Journal of Marine Science, 30(2), pp.311-336.
66	Local	Ghana (Atwima District, Ashanti Region)	Scenarions for understanding the cost-benefit ratios of planting cocoa under different shade conditions	Participatory, Quantitative, Indigenous and local knowledge, Policy screening	Agriculture	1) Better internal rate of return (IRR) realised with hybrid cocoa strains. 2) Hybrid cocoa produces better IRR without planted shade, but higher agrochemical costs are expected. 3) Hybrid cocoa requires a shorter rotation period if unshaded.	Obiri et al. 2007	Obiri, B.D., Bright, G.A., McDonald, M.A., Anglaaere, L.C. and Cobbina, J., 2007. Financial analysis of shaded cocoa in Ghana. Agroforestry systems, 71(2), pp.139-149.
67	Local	Tunisia (Ain Snoussi, Ain Draham region, north-western Tunisia)	Understanding the conflicts between restrictions to forest access aimed at promoting sustainable use and cash incomes for local communities	Quantitative, Policy screening	Forestry	1) Cork oak conservation generates multiple ES. 2) Regeneration of cork oak forest requires human inputs. 3) **External interventions (compensation) may be needed to adequately compensate livestock owners for lost income in conserving cork oak in North Africa**	Campos et al. 2007	Campos, P., Daly-Hassen, H. and Ovando, P., 2007. Cork oak forest management in Spain and Tunisia: two case studies of conflicts between sustainability and private income. International Forestry Review, 9(2), pp.610-626.
68	Local	Madagascar (Southern Androy)	Thresholds linked to pollination and seed dispersal between habitat patches	Quantitative, Policy screening	Conservation	1) Taboo system (ILK) (unintentionally) protects forest patches. 2) Patch ESs (pollination and seed dispersal) coverage is high despite highly fragmented landscapes.	Bodin et al. 2006	Bodin, O; Tengo, M; Norman, A; et al. (2006) The value of small size: Loss of forest patches and

						3) **Forest patch location is more important than size. 4) Small forest patches should be viewed as essential for maintaining ES.**		ecological thresholds in southern Madagascar
69	Local	South Africa (Western Cape)	Conserving outside protected areas - exploring the effects of a 25% target for natural and semi-natural land conservation	Policy screening	Conservation	**Conservation measures outside protected areas**	Cox & Underwood 2011	Cox, R.L. and Underwood, E.C., 2011. The importance of conserving biodiversity outside of protected areas in Mediterranean ecosystems. PLoS One, 6(1), p.e14508.

Table SM 5.2.E - Key pathway elements derived from scenarios related to TERRESTRIAL and FRESHWATER resources (ASIA and PACIFIC)

No	Scale	Region/ System	Goal/ Vision	Type of scenario	Sectors	Pathway elements (measures, policies, changes)	Scenario short name	Complete reference
1	National	Australia	food, carbon, water, and biodiversity are considered	Qualitative and quantitative, policy screening	water, agriculture	Global emission abatement efforts was indiredctly considered	Connor et al. (2015)	Connor, J. D., Bryan, B. A., Nolan, M., Stock, F., Gao, L., Dunstall, S., … Hatfield-Dodds, S. (2015). Modelling Australian land use competition and ecosystem services with food price feedbacks at high spatial resolution. Environmental Modelling and Software, 69, 141–154. https://doi.org/10.1016/j.envsoft.2015.03.015
2	National	China	Climate change mitigation	Qualitative and quantitative, policy screening	agriculture	Management practices for paddy soil carbon sequestration, such as tillage, residual retuen, manure incorporation and combined measure, were examined in scenario analyses	Xu et al. (2011)	Xu, S., Shi, X., Zhao, Y., Yu, D., Li, C., Wang, S., … Sun, W. (2011). Carbon sequestration potential of recommended management practices for paddy soils of China, 1980-2050. Geoderma, 166(1), 206–213. https://doi.org/10.1016/j.geoderma.2011.08.002
3	National	Australia	1. Composition of scenarios: global outlooks of environmental and economic change with domestic policy measures addressing high priority environmental issues, on Australian land-use and its economic and environmental	Quantitative, policy screening		1) Land use policy (with an incentive payments for the voluntary adoption of environmental plantings in agricultural land, and a levy on carbon plantings), 2) bioenergy policy: a range of distributed, small-scale biofuels (ethanol as mobile	Bryan et al. (2016)	Bryan, B. A., Nolan, M., McKellar, L., Connor, J. D., Newth, D., Harwood, T., … Hatfield-Dodds, S. (2016). Land-use and sustainability under intersecting global change and domestic

			sustainability. Four global outlooks specified within CSIRO's Australian National Outlook (Hatfield-Dodds et al., 2015a), trajectories in the key land-use drivers—climate; prices for carbon, oil, and electricity; and demand for crops and livestock. These scenarios were superimposed by two domestic policy drivers—a land-use payment policy that shifted the focus of carbon incentives to include biodiversity objectives, and a biofuels/bioenergy policy. 2. Sustainability indicators analyzed: area of land-use, economic returns to land, emissions abatement, food/fibre production, water resource use, biodiversity services, and energy production.			transport fuel) and bioenergy (renewable electricity) processing options using either wheat grain/residue or biomass from short-rotation woody perennials as feedstock		policy scenarios: Trajectories for Australia to 2050. Global Environmental Change, 38, 130–152. https://doi.org/10.1016/j.gloenvcha.2016.03.002
13	National	Australia	Achievement of SDGs 2, 6, 7, 13 and 15 (those directly related to land-sector)	648 scenarios (pathways) as combinations of global climate outlook, domestic land-use policy, and key uncertainty dimensions		1) Biodiversity payment with a carbon plantings levy (which shifts land-use priorities from emissions abatement to also considering biodiversity values) Findings: 1) The achievement of all relevant targets by the land-sector may be impossible (target achievement is very sensitive to global efforts to abate emissions, domestic land-use policy, productivity growth rate, and land-use change adoption behaviour and capacity constraints) 2) Land-sector must prioritize the food production and biodiversity and land	Gao et al. (2017)	Gao and Bryan. (2017). Finding pathways to national-scale land-sector sustainability, Nature volume 544, pages 217–222

						degradation components of sustainability 3) Nations require globally coordinated, national-scale, comprehensive, integrated, multi-sectoral analyses to support national target-setting that prioritizes efficient and effective sustainability interventions		
4	Sub-national to Local	Mallee, Lower Murray (southern Australia), Australia	6 environmental tatgerts identified from regional plans were used as constraints to explore possible economic, environmental and societal impacts induced by the implementation of 4 policy options that takes different spatial prioritization strategy for Natural Rerource Management (NRM), for each of 4 scenarios: I. Environmental Targets 1) 20% improvement in condition of remnant vegetation across all conservation significance levels 2) Increase vegetation cover of Ecological Vegetation Classes to 15% of pre-1750 extent 3) 20% reduction in groundwater recharge from farming systems 4) 30% native vegetation cover across each bioregion 5) Reduction in land threatened by salinisation from 10% to 8% of total land surface 6) Confine wind eroding land to 3% of land surface in dry years	Quantitative, policy screening		II. Scenarios Four climate scenarios with varied degree of temperature, rainfall, carbon price, biomass price, and biofuel price. III. Policy options 1) Select spatial units for NRM actions randomly 2) Select spatial units for NRM actions to minimise net economic cost including establishment costs and opportunity costs of foregone agricultural production net of returns generated. 3) Select spatial units for NRM actions to maximise benefits for multiple environmental objectives: biodiversity, salinity, wind erosion and climate change. 4) Potential NRM actions for addressing specific environmental targets 1) Vegetation management 2) Ecological restoration 3) Conservation farming 4) Deep-rooted perennials 5) Biomass 6) Biofuels V. Impacts Analyzed	Bryan et al. (2011)	Bryan, B. A., Crossman, N. D., King, D., & Meyer, W. S. (2011). Landscape futures analysis: Assessing the impacts of environmental targets under alternative spatial policy options and future scenarios. Environmental Modelling and Software, 26(1), 83–91. https://doi.org/10.1016/j.envsoft.2010.03.034

						1) Total area of NRM actions required (Millions ha) 2) Net economic returns to agriculture ($M/yr) 3) Total biodiversity benefit score (millions) 4) Area at high risk of salinisation managed ('000s ha) 5) Area at high risk of wind erosion managed ('000 s ha) 6) Carbon benefits ('000stCO2 e/yr) 7) Contribution to Gross Regional Product ($M/yr) 8) Employment (FTE jobs) 9) Population (# persons)		
5	Sub-national	Guangdong Province, China		Qualitative and quantitative, policy screening	urban	Only the regulation of urban expansion was consired	CHINA_GUANGDONG_2015	Pei, F., Li, X., Liu, X., Lao, C., & Xia, G. (2015). Exploring the response of net primary productivity variations to urban expansion and climate change: A scenario analysis for Guangdong Province in China. Journal of Environmental Management, 150, 92–102.
6	Sub-national	Western China, China	mininization of regional disparities	Qualitative and quantitative, policy screening		Examined which plicy options can better minimize regional disparities bwteen western and eastern China. Oprionts considered are environment oriented development, regional immbalance development, and regional balance development	CHINA_2006	Dong, S., Ju, H., Li, X., Liu, J., Ouyang, H., Ouyang, Z., … Wu, S. (2005). Integrated Ecosystem Assessment of Western China. China Meteorological Press. Retrieved from http://www.hceis.com/home/book_view.aspx?id=3926&ISBN=7502939415&EnName=Integrated+

								Ecosystem+Assessment+of+Western+China
7	Local	Australian alps, Australia		qualitative, plocyscreening	nature conservation	Not addressed	AUSTRALIA_ALPS_2015	Mitchell, M., Lockwood, M., Moore, S. A., & Clement, S. (2015). Scenario analysis for biodiversity conservation: A social–ecological system approach in the Australian Alps. Journal of Environmental Management, 150, 69–80.
8	Local	Naban River Watershed National NatureReserve, China	trade-off between TCM (Traditional Chinese Medicine) agroforestroy and rubber plantations	Qualitative and quantitative, policy screening	agriculture	(a) A stronger protection of the most ecologically valuable land usetypes, (b) reforestation of farmland on sloping to reduce soil erosion. (c) Introduction of more sustainable alternatives to rubber monoculture based on an increasing demand for Traditional Chinese Medicine plants	CHINA_2014	Cotter, M., Berkhoff, K., Gibreel, T., Ghorbani, A., Golbon, R., Nuppenau, E. A., & Sauerborn, J. (2014). Designing a sustainable land use scenario based on a combination of ecological assessments and economic optimization. Ecological Indicators, 36, 779–787. https://doi.org/10.1016/j.ecolind.2013.01.017
9	Local	West Kotawaringin and Kapuas, Indonesia	Climate change mitigation	Qualitative and quantitative, policy screening	agriculture, forestry	Forest moratorium and livelihood supports, The latter includes a) Increasing the market prices for NTFP, agroforestry products and community timber, and b) Local demand for timber can only be supplied from community timber plantations	Suwarno et al. (2016)	Suwarno, A., van Noordwijk, M., Weikard, H. P., & Suyamto, D. (2016). Indonesia's forest conversion moratorium assessed with an agent-based model of Land-Use Change and Ecosystem Services (LUCES). Mitigation and Adaptation Strategies for Global Change, 1–19. https://doi.org/10.1007/s11027-016-9721-0

10	Local	Assir National Park, Saudi Arabia	Environmental assessment	Quantitative, policy screening	nature conservation	1) Raise public awareness, capacity building, training program, and 2) strong government policies control measures for sustainability	Saudi Arrabia (2010)	Presidency of Meteorology and Environment Kingdom of Saudi Arabia. (2010). Sub-Global Arab Millennium Ecosyustem Assessment Summary for Decision Makers. Retrieved from http://www.pme.gov.sa/en/Summary2.pdf
12	Local	Central Kalimantan, Indonesia	(1) carbon storage and sequestration, (2) biodiversity conservation, (3) water yield, and (4) palm oil production were analyzed under four scenarios	Qualitative and quantitative, BaU and 3 policy screening scenarios	forestry	I. 1) Continuation of forest moratorium (moratorium scenario), 2) land use regulation to prohibit expansion of oil palm involving deforeatation (zero gross deforestation scenario) and 3) oil palm expansion on the potentially suitable areas and improvement (sustainable intensification scenario) on yield II. Zero gross deforestation secenario demonstrated most favourable outcomes in terms of ecosystem service provision, which is followed by sustainable intensitication scenario	Sharma et al., (2017=	Sunil K Sharma, Himlal Baral, Pablo Pacheco and Yves Laumonier. (2017). Assessing impacts on ecosystem services under various plausible oil palm expansion scenarios in Central Kalimantan, Indonesia, CIFOR Infobrief no. 176, Center for International Forestry Research (CIFOR), Bogor, Indonesia, DOI: 10.17528/cifor/006479.

Table SM 5.2.F - Key pathway elements derived from scenarios related to TERRESTRIAL and FRESHWATER resources (EUROPE and CENTRAL ASIA)

No	Scale	Region/ System	Goal/ Vision	Type of scenario	Sectors	Pathway elements (measures, policies, changes)	Scenario short name	Complete reference
1	Regional	Europe	Launch and promote a new paradigm in management and view of wild nature in European conservation with emphasis on recognizing, restoring and allowing natural processes,	Visioning (not scenario analysis)	Conservation	This report presented the following action points as outcome of the 10th World Wilderness Congress. 1. Ensure full protection of all existing wilderness areas across the European Continent, both on land and at sea, as an immediate step 2. Allow nature to take care of itself in wider land/seascapes 3. Recognize the underestimated ecological and economical value of wildlife and the importance of ensuring its continued comeback 4. Support the rewilding of Europe 5. Invest in businesses linked to the values of wild nature and wildlife 6. Invite and inspire landowners, communities and managers of land/water/sea and natural resources to embrace “A Vision for a Wilder Europe” 7. Inspire and invite all funding institutions to support this vision 8. Reach out to large constituencies across Europe through communications and education programmes 9. Learn from existing knowledge, experiences and new research 10. Promote the new conservation vision	Sylvén, M., & Widstrand, S. (2013)	Sylvén, M., & Widstrand, S. (2013). A vision for wilder Europe. Saving our wilderness, rewilding nature and letting wildlife come back. For all. Salamanca. Retrieved from http://www.wildlandsresearch.org/media/uploads/WILD10-Vision-Wilder-Europe-2015-ver-2-FINAL.pdf

						vis-à-vis key constituencies and develop an action-oriented strategy		
2	Regional	Europe	Sustainable lifestyles by 2050	Paticipatory backcasting, qualitative, sustainability	Households, global atmospheric carbon and geological hydrocarbon budgets, Technology and social institutions, Markets, Communities.	**Singular super champions:** Transform makets. R&D investments, disinvestments for the conventional technologies. Reduce states' public expenses. Invest in resource efficinecy. Emphasis on education, local economies, community and self-sufficiency. Values transcend materialism. **Governing the commons:** Digital experiences replacing real life experiences. Social networks continue to gain power. Technologies like 3D printers enable more convivial ways of production and consumption. Learning new skills has become easier with peer-to-peer communication ("wiki democracy"). **Local loops:** Happens with energy crises and uneffortable energy costs. People are linked to global networks by mind and heart but value the local in production and consumption. Definition of work changes, since most of the "work" is devoted to local communities through memberships in guilds. **Empathetic communities**: The meaning of infrastructure changes, share use and maintenance of infrastructure.	Mont et al. (2014)	Mont et al. 2014. Sustainable llifestyles 2050: stakeholder vision, emerging practices and future research, Journal of Cleaner Production, 63, p.24-32
3	Regional	Europe	Food security and land conservation	Meta-models of crop, forest yield and farm profits	Farmlands and forests	Reducing ruminant meat preferences, reducing non-ruminant preferences, bioenergy production on farmlands, crop yields increase through higher investments in breeding research	Audsley et al. (2015)	Audsley etal 2015. Interactively modelling land profitability to estimate European agricultural and forest

								land use under future scenarios of climate, socioeconomics and adaptation, Climatic Change V. 128, 215-227
4	Regional	Europe	Sustainable use of forest resources	NA	Forestry	Innovation, responsible management, industrial leadership	Vision 2030 for the European Forest Based Sector	The European Forest Based Sector Technology Platform (2013), Vision 2030 for the European Forest Based Sector
5	Regional	Europe	Sustainable growth	NA	Cross-sectoral	Research, innovation, entrepeneurship, education	The European Bioeconomy in 2030	Bioeconomy Technology Platforms (2011), The European Bioeconomy 2030
6	Regional	Europe	Sustainable forest management	NA	Forestry	Improvements in monitoring and enforcements in forestry	Forest Europe 2013	Pan-European Follow-Up of the FOREST EUROPE Ministerial Conference, Oslo June 2011
7	Regional	Europe	Three visions for 2040: Best land in Europe, Regional connected, and Local multifunctional, developed based on participatory approach, all of which assumes that **multi-functionality**as a way of ensuring an optimal delivery of goods and services.	Participatory, qualitative, target-seeking	Comprehen-sive (including agriculture, forestry, conservation)	Pathway elements for three visions 1) **Best land in Europe:** optimal use of land including urban agriculture, recreation, and nature, intensification of agricultural production (includign biofuels), industrial forest, introduction of strict conservation areas where human activity is prohibited, nature restoration to improve green connectivity, declining rural areas are abandoned and usef for nature 2) **Regional connected:** compact city with vertical growth, sustainable agricultural	Pérez-Soba, M., Paterson, J., Metzger, 2015	Pérez-Soba, M., Paterson, J., Metzger, M. (2015). Visions of future land use in Europe. VOLANTE project report. Wageningen: Alterra Wageningen UR. Retrieved from https://www.volante-

						production (including high nature farming), marginal farmland convereted to productive forest, emphasis on green and blue infrastructure connecting different areas with big investments in green and blue corridors, rural areas maintained connected with big cities 3) **Local multifunctional:** new village emerges in former forest and abandoned rural land, local food production and consumption, conversion of marginal land to agroforestry, multifunctional wood production, protected areas opened to sustainable agriculture and forestry with focus on multifunctionality, nature is pervasive and ubiquitous even in dense urban areas, communal farms allowing new ways of living and contributing to rural viability		project.eu/docs/visions.pdf
8	Regional	Europe	Vision of food and drink sector for 2030	Qualitative, participatory	Food and drink industry	FoodDrinkEurope's Environmental Sustainability Vision for 2030 includes a set of key actions detailing commitments across three core areas: 1) sustainable sourcing, 2) resource efficiency, and 3) sustainable consumption and production. 1) Sustainable sourcing: mainstream sustainable sourcing 2) Resource efficiency: an integrated approach with particular attention on the availability of agricultural raw materials for the production of food and feed, exchange of best practices, promote closed loop supply chains, work with supply chain partners, etc.	Food Drink Europe, 2012	Food Drink Europe. (2012). Environmental Sustainability Vision Towards 2030. Brussels: Food Drink Europe

						3) Sustainable consumption: inform consumers about the impact of their diet on sustainability to change lifestyle		
9	Regional	Europe	2030 vision for food and farming to foster the further development of organic movement	Qualitative, participatory and target-seeking	Agriculture	First develop four future scenarios, namely i-Food, Phoenix, ORGANIC VS ECO-TECH, WHEN ALL GOES WELL, as future framework conditions and then idenftified a vision. **Pathway elements**: a) achieve more than half of Europe's agricultural land managed according to **organic** principles, b) improve the resilience and environmental performance of organic production systems, c) uphold the integrity of the supply chain promote trust, d) recognise and value the contribution of organic farming to the delivery and support of vital ecosystem services, e) support a culture of innovation based on holistic principles, f) **grow new and indigenous, locally adapted varieties and breeds for organic farming**, g) improve welfare of farm animals, h) remunerate farmers and all workers in the organic supply chain	Barabanova, Zanoli, Schlüter, & Stopes, 2015	Barabanova, Y., Zanoli, R., Schlüter, M., & Stopes, C. (2015). Transforming food & farming: An organic vision for Europe in 2030. Brussels: IFOAM EU Group.
10	Regional	Europe	The vision of the European **aquaculture**industry is, by the year 2030, to provide annually 4.5 million tons of sustainable food products, worth € 14 billion, and supporting more than 150,000 direct jobs.	Target-seeking	Aquaculture	Pathway elements; seven principles to flourish, the European aquaculture industry should 1) provide the European consumer with desirable products of the highest quality at an aordable price, 2) assure that aquaculture's impact on the environment is minimal, 3) respect the conditions for optimal livestock health and	EATIP, 2012	EATIP. (2012). The Future of European Aquaculture - Our Vision: A Strategic Agenda for The Future of European Aquaculture. European Aquaculture Technology

						welfare, 4) develop and integrate new technologies within the entire value chain, 5) improve economic performance at each level of the value chain, 6) guarantee the training and skill development of those working in the sector and attract talented professionals, and 7) provide clear contributions and benefits to society. The report also identified 39 key goals and 145 sub-goals.		and Innovation Platform. Retrieved from http://eatip.eu/wp-content/uploads/2018/02/EATIP-SRIA-2012.pdf
11	Regional	Europe	2030 vision for the forest-based sector: it will provide society with renewable energy (heat, power and transport fuels), more sustainable wooden buildings and constructions and furnishings, replacing petroleum-based plastics in packaging and other applications, clean water technologies, future-oriented communication media, novel medicines and healthy food ingredients as well as alternative European raw materials for the production of clothing. It will also continue to provide society with a sustainably managed forest, resilient to climate change, while significantly reducing CO2 emissions by providing low carbon alternatives to energy-intensive materials.	Target-seeking	Forest sector	Pathway elements to achieve vision were grouped grouped under the following strategic themes: 1) Responsible management of forest resources, 2) Creating industrial leadership, and 3) Fulfilling consumer needs, each of which has specific vision targets.	The Forest-based Sector ETP, 2013	The Forest-based Sector ETP. (2013). Horizons – Vision 2030 for the European Forest-based Sector. Brussels: The European Technology Platform for the Forest-based Sector. Retrieved from http://www.cepi.org/system/files/public/documents/publications/forest/2013/FTP_Vision_final_Feb_2013.pdf
12	Regional	Europe	No clear visions stated, comprehensive environmental assessment	Quantitative (used climate scenarios	Environment (comprehen-sive)	No clear visions stated but the report presented seven elements to improve environmental governance in the region as	UNEP/UNECE,.2016	UNEP/UNECE. (2016). GEO-6 Assessment for the pan-European

				including SRES A2, SSPs and RCPs)		follows. 1. Multi-level and pluralistic environmental governance systems tend to be more effective 2. Strategic policy formulation and integrative environmental planning, particularly in lower-capacity countries of the region, and within as well as across different environmental priority areas 3. Promote research on and development of environmental technologies to foster innovation 4. Strengthen financial instruments to support implementation in all policy areas of common interest, including the environment 5. Trans-national cooperation plays an important role in moving countries towards better environmental performance and compliance with MEA commitments 6. Increasing the formal and informal level of citizens' involvement in all environmental matters is key to good performance of environmental policies but also to inclusiveness and overall justice 7. Effective use of science, data, indicators and monitoring		region (rev. 1). Nairobi, Kenya: United Nations Environment Programme.
13	Regional	Europe	EU biodiversity strategy to 2020		Biodiversity	The report set out out six targets (and 20 actions). Six actions are as follows: 1. Full implementation of existing nature protection legislation and network of natural reserves, to ensure major improvements to the conservation status	EC, 2011	EC. (2011). Our life insurance, our natural capital: an EU biodiversity strategy to 2020. Communication from the Commission to

						of habitats and species 2. Improving and restoring ecosystems and ecosystem services wherever possible, notably by the increased use of green infrastructure 3. Ensuring the sustainability of agriculture and forestry activities 4. Safeguarding and protecting EU fish stocks 5. Controlling invasive species, a growing cause of biodiversity loss in the EU 6. Stepping up the EU's contribution to concerted global action to avert biodiversity loss.		the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions, COM (2011) 244 final. Brussels: European Commission, http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/EP_resolution_april2012.pdf brochure: http://ec.europa.eu/environment/nature/info/pubs/docs/brochures/2020%20Biod%20brochure%20final%20lowres.pdf
14	Regional	Europe	A vision for 2050 around three themes: 1) Land Resources, Food and Biodiversity: EU produces the same quantity and quality of agricultural products as today, but in more diverse landscapes that host more biodiversity, while reducing its footprint. 2)Energy and Climate Change: an 80% reduction on 1990 levels in energy-related carbon dioxide emissions within the EU. and 3) Transport and Mobility: reducing carbon dioxide emissions from all	Target-seeking	Land, water, and energy	Looks at long-term visions on the world of 2050 and identified key decisions for today on land and water resources, and low-carbon energy systems for EU. 1) Land Resources, Food and Biodiversity pathways: I**ncreased agricultural productivity** and system resilience, smaller demand for animal products and reduced food losses, protection of nature with protected areas, financial arrangements, and targeted payments 2) Energy and Climate Change pathways: Non-carbon and energy-efficient end-use	Netherlands Environmental Assessment Agency & Stockholm Resilience Centre, 2009	Netherlands Environmental Assessment Agency, & Stockholm Resilience Centre. (2009). Getting into the Right Lane for 2050: A primer for EU debate. Bilthoven: Netherlands Environmental Assessment Agency (PBL)

			transport modes. Low carbon means 80% reduction, compared to 1990 levels, of total carbon dioxide emissions (well-to-wheel) from European transport.			such as electricity or hydrogen from low-carbon sources or biofuels, Centralised use of fossil energy with the use of carbon capture and storage technology (CCS), Large-scale power generation based on different sources of energy, Small-scale energy production by end-users, A power grid that facilitates diversity, Diversification of energy sources 3) Transport and Mobility pathways: use the range of low-carbon technologies such as low-carbon fuels, improving vehicle energy and logistic efficiency, reducing traffic volumes and shifting to more energy efficient modes, increase in zero-carbon road passenger vehicles, use of biofuels and improved efficiency in road freight transport, graudal change to biofuels		
15	Regional	Europe	Vision and strategy to increase biofuel poroduction and use in the EU for 2030	Target-seeking	Biofuels	Vision: EU covers as much as one fourth of its road transport fuel needs by clean and CO2-efficient biofuels **Pathway elements:** The vision requires substantial investment in biomass production, harvesting, distribution and processing. Strategic research agenda was identidfied, which includes 1) Improving existing conversion technologies, 2) Production of ethanol and ethanol derivatives from cellulosic biomass, 3) Production of synthetic fuels through gasification, 4) Development of integrated refining concepts, 5) improve vehicle engines, 6) Biomass resources and logistics	EC, 2006	EC. (2006). Biofuels in the European Union A vision for 2030 and beyond. Final report of the Biofuels Research Advisory Council.

						and 7) Sustainable land strategies compatible with the climatic, environmental and socio-economic conditions.		
16	Regional	Europe	Visions for the future of agriculture and land related activities. Three clear visions emerged: 1) farming competitiveness and profitability; 2) conservation of the environment and natural resources; and 3) increasing the connectedness between farming and rural communities.	Qualitative, participatory, target-seeking approach	Agriculture and land-related activities	A participatory, transdisciplinary approach to identify visions for the future of agriculture and land related activities, as well as the pathways to achieve those visions (can be classified as a sort of, qualitative, target-seeking approach). Pathways identidied through a series of workshop were summarized as follows. • maintenance or re-emergence of farming activities; • innovation in farming; • new concepts of farming, farmers and rural areas; and • overall policy and institutional change	McKee & Holstead, 2014	McKee, A., & Holstead, K. (2014). Farm Path Visions. FarmPath "Visioning" Final Workshop. Aberdeen, Dundee, UK: The James Hutton Institute. summary of https://cordis.europa.eu/result/rcn/164382_en.html
17	National	Switzerland	Terrestrial biodiversity conservation	Model analysis built on exploratory scenarios	Agriculture, forestry	Decreased market interventions, ecological direct payments, income from conservation contracts. Further liberalization of markets of agricultural commodities. Lowerd agricultural production under strong conservation policy.	Bolliger et al. 2007	Bolliger at al. 2007. Spatial sensitiviy of species habitat paterns to scenarios of land use change (Switzerland). Landscape Ecology 22: 773-789
18	National	Sweden	16 environmental quality objectives of Sweden	Exploratory, qualitative/ quantitative	Land, water, and the built environment	Participatory, one predictive and four explorative scenarios assessing a rich set of land use and agricultural policy instruments ranging along the dimensions of "regulation-markets" and "embeddedness-dissembeddenes", the	Svenfelt at al. 2010	Asa Svenfelt, Rebecka Engström, Mattia Höjer, 2010. Use of explorative scenarios in environmental policy-making—Evaluationof policy instruments for

						latter emphasizing the role of social norms. Knowledge dissemination.		management of land, water and the built environment. *Futures*, V 42, pp. 1116-1175.
19	National	Georgia	By 2030, the people of Georgia will be living in a harmonious relationship with nature, whereby biodiversity is valued, conserved, restored and wisely used, ecosystem processes and services are maintained, a healthy environment is sustained and benefits essential for the society are delivered.	NA	Protected habitats, forest ecosystems, agricultural biodiversity and natural grasslands, inland water ecosystems, biodiversity of the balcksea	National goals and standards of general education, communication mechanisms on biodiversity, access to updated information, legal framework and public participation, legal reform, institutional development and enforcement mechanisms, introducing biodivesity into decision making mechanisms across econoic sectors via EIA, SEA, spatial planning, economic valuation of biodiversity	Ministry of Environment and Natural Resources Protection of Georgia, 2014	Ministry of Environment and Natural Resources Protection of Georgia. National Biodiversity Strategy and Action Plan of Georgia 2014-2020 (2014). Retrieved from https://www.cbd.int/doc/world/ge/ge-nbsap-v2-en.pdf
20	National	Kyrgyzstan	The overall aim of the project is the protection and rational use of biologicaland landscape diversity for the sustainable social and economic developmentand landscape diversity for the sustainable social and economic development of the Kyrgyz repubic 1999-2004	NA	Wild and protected areas	Organisational capacity for biodiversity management, human resources, physical infrastrucutre and equipment, information transfer, research, experinece form international projects, participation, public awareness, legislative reforms, enforcements	Ministry of Environmental Protection of Kytgyzstan, 2014	Ministry of Environmental Protection of Kyrgyzstan. (1998). Kyrgyz Republic Biodiversity Strategy and Action Plan. Retrieved from https://www.cbd.int/doc/world/kg/kg-nbsap-01-en.pdf
21	National	Turkmenistan	Biodiversity conservation and sustainable useof biological resources and equitable sharing of benefits from them	NA	Wild, protected areas and agriculture	Research, information systems, education and public awareness, monitoring systems, incentives, international coopeation	Ministry of Nature Protection of Turkmenistan. (2002).	Ministry of Nature Protection of Turkmenistan. (2002). Biodiversity Strategy

								and Action Plan for Turkmenistan. Retrieved from https://www.cbd.int/doc/world/tm/tm-nbsap-01-en.pdf
22	National	Armenia	To ensure the conservation, sustainable use and regeneration of the landscape and biological diversityof the Republic of Armenia, for sustainable human development 2000-2004	NA	Wild, protected areas and agriculture	Development of institutional potential and training, ecological education and public participation, identification and monitoring, research, information exchange and accessibility, impact assessment, technical and scientific cooperation, legislative reforms, creating economic incentives	Ministry for Nature Protection of Armenia. Biodiversity Strategy and Action Plan for the Republic of Armenia (1999)	Ministry for Nature Protection of Armenia. Biodiversity Strategy and Action Plan for the Republic of Armenia (1999). Retrieved from https://www.cbd.int/doc/world/am/am-nbsap-01-en.pdf
23	National	Russia	The conservation of the biodiversity of bio-systems at a level that ensures their stable existence and sustainable use as well as the conservation of the diversity of domesticated and cultivated forms of living organisms and human-created ecologically-balanced environmental-cultural complexes at a level that **ensures efficient economic growth and an optimal environment for human life.**	NA	Cross-sectoral	Inter-agency cooperation, plan for build up of capabilities, financial resource mobilisation, monitoring and reporting	Ministry of Natural Resources and Environment of the Russian Federation 2014	Ministry of Natural Resources and Environment of the Russian Federation. Strategy and Executive Plan for the Conservation of Biodiversity within the Russian Federation (2014). Retrieved from https://www.cbd.int/doc/world/ru/ru-nbsap-v2-en.pdf
24	National	Belarus	Goals of implementation of the Strategy are: to prevent the population decline of wild animal and plant species, reduction of their	NA	Cross-sectoral	Building awareness, **economic valuations,** information systems development, mobilization of financial resources, managemement plans for	Council of Ministers of the Republic of Belarus. Strategy on the Conservation and	Council of Ministers of the Republic of Belarus. Strategy on the Conservation and

			habitat's area and loss of their biological, including genetic, diversity, degradation of ecological systems, natural landscapes and biotopes; to restore the population size of rare and endangered wild animal and plant species, their genetic diversity and to maintain them at the rate, ensuring the sustainable existence of these populations; to use the biological diversity in such a manner and pace, which in the long term prospects will not lead to its depletion and will let to preserve its capacity to satisfy the economic, aesthetic and other needs of present and future generations; to maintain the reproducing capacities of the biosphere, to ensure regional and global ecological balance under conditions of possible climate changes.			equitable sharing of benefits from biodiversity	Sustainable Use of Biological Diversity (2015).	Sustainable Use of Biological Diversity (2015). Approved by the Resolution of the Council of Ministers No. 1707 on 19.11.2010, amended on 03.09.2015. Retrieved from https://www.cbd.int/doc/world/by/by-nbsap-v2-p2-en.pdf
25	National	Azerbaijan	The main goals of the National Strategy are: sustainable use of genetic resources; conservation of biodiversity and transfer to future generation; poverty alleviation; maintenance of ecological balance; ensuring transition to a **"green economy";** promotion of environmental education; restoration of endemic and local fauna species; development of the protected areas	NA	Cross-sectoral	Ensuring broad extension of environmental education, improving biodiversity monitoring systems, developing and effectively managing the protected areas and expansion of the current network, improving regulatory framework for ensuring the sustainability of biodiversity, increasing public participation in biodiversity conservation at the national and local level, developing collaborative management in biodiversity conservation, strengthening institutional capacities in the	President of the Republic of Azerbaijan. (2017).	President of the Republic of Azerbaijan. (2017). National Strategy of the Republic of Azerbaijan on Conservation and Sustainable Use of Biodiversity for 2017-2020. Retrieved from https://www.cbd.int/do

			network; and reducing the threats to biodiversity.			planning, management and use of biodiversity		c/world/az/az-nbsap-v2-en.pdf
26	National	Sweden	Desired forest futures from the perspectives of four stakeholder groups - Biomass and Bioenergy (BB) group, the Conservation (C) group, the Sami Livelihood (SL) group and the Recreation and Rural Development (RRD) group.	Qualitative, target-seeking (visioning)	Forest	Representatives from 40 organizations from four stakeholder groups - Biomass and Bioenergy (BB) group, the Conservation (C) group, the Sami Livelihood (SL) group and the Recreation and Rural Development (RRD) group - created group's visions. While BB, C. SLI reached an agreement within their respective group on onecommon vision of the desired future for the forest, RRD could not agree on onecommon vision of the desired future, and came up with two different visions as follows. * Only the visions were presented in the paper. 1. Biomass and Bioenergy: Swedish authorities continue the forest policy of ‘‘freedom under responsibility’’ and simplify rules for landowners and forest companies 2. Conservation: sustainable forestry is carried out on half of the forested land area, while the other half is conserved or usedfor tourism, hunting and recreation. 3. Sami Livelihood: Society recognizes the rights of the Sami people and gives reindeer herding communities’ crucial power over decisions about land use and land sale in the reindeer management zone.	Sandström et al., 2016	Sandström, C., Carlsson-Kanyama, A., Lindahl, K. B., Sonnek, K. M., Mossing, A., Nordin, A., … Räty, R. (2016). Understanding consistencies and gaps between desired forest futures: An analysis of visions from stakeholder groups in Sweden. Ambio, 45(January), 100–108. https://doi.org/10.1007/s13280-015-0746-5

						4. Recreation and Rural Development (1) a new Swedish forest policy introduced to ensures that forestry considers ecological and social values, and gives local stakeholders an influence over large forestry companies. 5. Recreation and Rural Development (2) Swedish authorities recognize that the forest owners are best suited to care for the forests by themselves, and therefore avoid imposing regulations		
27	Local	Biscay, Spain	Ecosystem services and human well being	Normative backcasting approach, participatory	Cross-sectoral	Environmental education, regulations and directives, urban planing, land-use planning	Palacios-Agundes et al 2013.	Palacios-Agundez, I., Casado-Arzuaga, I., Madariaga, I., & Onaindia, M. (2013). The relevance of local participatory scenario planning for ecosystem management policies in the Basque Country, northern Spain. Ecology and Society, 18(3), UNSP 7.
28	Local	Vipstal, Valais, Switzerland	Future ecosystem services supply and demand	Multimethod backcasting, participatory process	Cross-sectoral, land use	**Market opening, targeted direct payments, structural interventions, restrictive spatial planning**	Brunner et al 2016	Brunner, S. H., Huber, R. Gret-Regamey, A. 2106. A backcasting approach for matching regional ecosystem services supply and demand. Environmental Modeling and Software, 75.

29	Local	Southern Transilvania, Romania	Natural capital: arable lands, orchards, pastures, scenic beauty, utility as hunting area, pollinator abundance, carbon stocks, farmland biodiversity	Partcipatory (a five step scenario building process)	Tourism, agriculture, population, land conservation (e.g., forests)	Farmland intensification, farmland abandonment, forest exploitation for timber and firewood, agricultural and land use policies along the axis of government versus markets and social norms versus external drivers.	Hanspach et al 2014	Hanspach, J., T. Hartel, A. I. Milcu, F. Mikulcak, I. Dorresteijn, J. Loos, H. von Wehrden, T. Kuemmerle, D. Abson, A. Kovács-Hanspach, J., T. Hartel, A. I. Milcu, F. Mikulcak, I. Dorresteijn, J. Loos, H. von Wehrden, T. Kuemmerle, D. Abson, A. Kovács-Hostyánszki, A. Báldi, and J. Fischer. 2014. A holistic approach to studying social-ecological systems and its application to southern Transylvania. *Ecology and Society* 19(4): 32
30	Local	Seyhan Basin, Turkey	Sustainable irrigation by 2030	Participatory backcasting	Water and agriculture	Infrastructure development, regulations, farmers' education, investment in appropriate technology	Çakmak et al 2010	Çakmak et al 2000. Visions for the Future of Water in Seyhan Basin, Turkey: A Backcasting Application International Environmental Modelling and Software Society (iEMSs) 2010 International Congress on Environmental Modelling and SoftwareDavid A. Swayne, Wanhong Yang,

								A. A. Voinov, A. Rizzoli, T. Filatova (Eds.)

Appendix 5.3: Global studies details

Table SM 5.3.1 - Roads to Rio+20 pathways: sustainable development targets used in the study (van Vuuren et al., 2015)

Category	Objective	Targets	Source/rationale
Food	Eradicate hunger	Halve, between 1990 and 2015, the proportion of people who suffer from hunger; halve this again by 2030, and fully eradicate hunger by 2050;	The target to eradicate hunger was derived from MDG1 and extrapolated to 2050 based on overall MDG ambition to eradicate hunger (UN, 2000)
Biodiversity	By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people	Halve the rate of loss of biodiversity by 2020 and maintain biodiversity at the 2020/2030 level by 2050 (depending on region). By 2020, at least 17 % of terrestrial and inland water areas are conserved effectively	The analysed biodiversity target was derived from the CBD's long-term vision to *conserve, value, restore and wisely use biodiversity* as well as the CBD's Aichi target 5 that aims to *at least halve, and where feasible bring close to zero, the rate of loss of all natural habitats by 2020.* (CBD, 2010).
Energy	Ensure universal access to modern energy	Achieve universal access to electricity and modern cooking fuels by 2030;	Proposed goal UNSG and AGECC (AGECC, 2010); JPoI-Para 9(a)
Climate	Prevent dangerous anthropogenic interference with the climate system	Avoid an increase of global mean temperature above 2 °C; keep atmospheric greenhouse gas concentrations below 450 ppm CO2 equivalent;	UNFCCC (1992) – Art. 2; Cancun agreement (UNFCCC, 2010)
Air pollution	Improve air quality in their cities in order to protect people's health	Keep annual PM2.5 concentrations below 35 µg/m3 by 2030	(WHO, 2005)
Water scarcity	*Ensure sustainable use of water resources*	*Ensure full access to safe drinking water by 2050 and reduce the level of people exposed to water scarcity*	*The JPoI Paragraph 26(c) calls for an 'efficient and well-balanced use of freshwater resources' as well as for 'safeguarding drinking water quality'.*
N-cycle	*Avoid acidification of terrestrial ecosystems and eutrophication of coastal and freshwater systems*	*Reduce N/P use where possible (but without harming the ability of the agricultural system to meet the hunger target)*	
Human health	*Reduce environmental health threats*	*Reduce environmental health deaths such as those related to lack of access to food, safe drinking water and modern energy (for instance resulting from indoor air pollution and hunger).*	*The JPoI Paragraph 7(f) calls to 'reduce environmental health threats, taking into account the special needs of children'.*

Table SM 5.3.2 - Roads to Rio+20 pathways: Key assumptions for measures introduced in each pathway (based on (Kok et al., 2018; van Vuuren et al., 2015))

	Trend	Global Technology	Decentralized Solutions	Consumption Change
Access to food	Trends driven by historically observed relationships with income	*Trend*	Inequality in the distribution of global per capita consumption rates reduced so that all people are above the minimum consumption level in 2050	Inequality in the distribution of global per capita consumption rates reduced so that all people are above the minimum consumption level in 2050
Trade	No further liberalization beyond current policies	Full liberalization of trade in agricultural products	*Trend*	*Trend*
Consumption	Income driven consumption trends	*Trend*	*Trend*	Meat consumption levels off at a twice the level suggested for a healthy diet (Stehfest et al., 2009)
Supply chain waste and losses	At historical values	*Trend*	*Trend*	Waste and losses are halved (to 15% of production) (IMECHE, 2013)
Agriculture productivity	Based on trends in FAO scenario (Bruinsma, 2011)	In all regions, yield improvement 30% higher for crops and 15% higher for livestock than Trend scenario	In all regions, yield improvement 20% higher for crops and 15% higher for livestock than Trend scenario, only in those areas that are least vulnerable for biodiversity loss	In all regions, 15% improvement in crop yields.
Land planning	Default rules in IMAGE model	Expansion of agricultural areas close to existing areas in order to retain highly distinct land functions	Production areas shared with nature elements to reinforce ecological network. Keep at least 30% of landscape as nature elements.	*Trend*
Protected areas	No change in protected areas	17% of each of the 8 biodiversity realms protected. Protected areas far from agriculture.	17 of each of the 779 ecoregions protected. Protected areas close to agriculture	17% of each of the 65 realm/biomes combinations protected. Protected areas far from agriculture.
Forestry	Wood demand increases driven by increase in income	Forest plantations supply 50% of timber demand. 50% of selective logging is RIL (Putz et al., 2012).	Forest plantations supply 50% of timber demand. Selective logging is RIL	Forest plantations supply 50% of timber demand. Selective logging is RIL
Infrastructure	Impact of infrastructure on biodiversity increases based on historic correlations	*Trend*	Slower expansion of infrastructure (2050 values equal to 2030 values of *Trend*)	Slower expansion of infrastructure (2050 values equal to 2030 values of *Trend*)
Bio-energy	Default bio-energy potential (around 100–200 EJ/yr in 2050)	Constrained by sustainability criteria restricting potential for purposely grown bio-energy crops to less than 100 EJ/yr in 2050		

Table SM 5.3.3 - Roads to Rio+20: Synergies and Trade-offs among goals (* denotes that the linkages is addressed quantitatively by the modelling framework.) (van Vuuren et al., 2015)

	Eridicate hunger	Halting biodiversity loss	Access to energy	Reduce air pollution	Mitigate climate change	Access to clean water	Balance nitrogen cycle
Eradicate hunger					More emissions from increased production (fertliser, land expansion, tractors) (*)	Increased water use for agriculture (*)	More emissions from increased production (fertliser, manure) (*)
Halt biodiv. Loss	Less land for food production (*) Preservation of ecosystem services helps safeguard long-term food supply			Intact ecosystems contribute to better air quality	Fewer CO_2 emissions from land conversion and agriculture, new CO_2 sinks (*)	More gradual and uniform water flow, cleaner water Increased water use by permanent vegetation	More contribution of ecosystems in balancing nitrogen cycle
Access to energy	Increases income opportunities due to reduced time for fuel collection, better health.	Less disturbance of local biodiversity for food collection		Less indoor and urban air pollution (*)	New emissions from modern energy offset by reduced traditional energy emissions (*)	Water requirement for power generation (small) (*)	
Reduce air pollution	Less negative impact of air pollution on crop yields	Less air pollutions impacts on biodiversity (*)	Higher energy prices		Depends on which air pollutants are reduced (*).	Less water pollution	Helps to reduce nitrogen deposition (*)
Mitigate clim. Change	Reduces negative impacts on yields (but also positive impacts) (*) Bio-energy competes for land with food production	Reduces negative impacts of climate change (*) Additional land for bio-energy (*)	Higher energy prices (*)	Less emissions of air pollutants due to lower fossil fuel use (*)		Negative impacts on precipitation patterns and evapotranspiration reduced (*)	Some positive impact N_2O emission reduction (*)
Access to clean water	Improved water for cooking Competition between agriculture and domestic purposes						
Balance nitrogen cycle	Reduction of fertilizer use (but also prevents toxic fertilizer levels)	Reduces pollution		Reduces air pollution	Some reduction of N_2O emissions		

Appendix 5.4: Leveraging telecoupling pathway elements

Table SM 5.4 - Leveraging telecoupling pathway elements for biodiversity and ecosystem services

Telecoupling Processes	Possible Pathway Elements	Examples
Trade	*Create new supply chain interventions that reduce impacts on biodiversity and ecosystem services	Supply chain interventions can reduce deforestation from expansion of commercial agriculture, as more multinational companies agree not to buy products from farms with recent forest clearing (e.g., zero-deforestation cattle agreements signed by major meatpacking companies in the Brazilian Amazon state of Pará´a) (Gibbs et al., 2016)
Human migration	*Improve school education and help children in biodiversity hotspot areas to receive higher education and move away from those areas	In Wolong Nature Reserve for giant pandas in China (within one of the global biodiversity hotspots), many children have migrated and settled in cities after going to college and technical schools, thus having reduced pressure on biodiversity in the reserve and contributed to the transformation of panda habitat from decades of degradation to recovery (Liu et al., 2016)
Tourism	* Promote effective and efficient tourism (e.g. control the tourist flows under a threshold, reduce impacts, increase the benefits to local people)	In Machu Picchu, Perú, the establishment of daily visitors limits has not been successful enough to preserved ecosystem services and cultural heritage (Knight et al., 2017; Larson & Poudyal, 2012). An adaptive resource management framework would help facilitate the creation of cohesive goals and objectives among the various agencies responsible for conservation and development in the Historic Sanctuary Key and the potential to address multiple management considerations that affect local residents, foreign tourists, private tour operators and regional governments. Pathways include a substantial international investment that addresses environmental, economic and social challenges (Larson & Poudyal, 2012). Experiences in

		successful ecosystem restoration through increasing local participation in the area (Knight et al., 2017; Larson & Poudyal, 2012; SCBD - Secretariat of the Convention on Biological Diversity et al., 2014)
Conservation investment	*Increase effectiveness of conservation investment (not only amount but also efficiency)	Investments in conservation programs (Natural Forest Conservation Program and Grain-to-Green Program) have led to improvements of ecosystem services (carbon sequestration, soil retention, water retention, flood mitigation, sandstorm prevention, food production) in China (Ouyang et al., n.d.; Viña et al., 2016)
Waste/pollutant transfer	*Do not transfer waste/pollutant to areas with high biodiversity and ES	Minimizing agrochemical use and livestock wastes in high-input production systems can reduce high-nutrient or toxic run-off into waterways can greatly benefit aquatic biodiversity such as wildlife (Scherr & McNeely, 2008)
Water transfer	*Minimize impacts of water transfer on sending and spillover systems *Minimize feedback effects that further increase water demand in receiving systems	The world's largest and longest water transfer project (South-to-North Water Transfer Project) provides freshwater to five major cities and provinces in North China as well as other services including cultural services (tourism) in spillover systems (areas along the water transfer channels), but more payments are needed to minimize negative impacts on biodiversity and ecosystem services in the sending systems of South China (Liu et al., 2016).
Knowledge/ information transfer	*Convey knowledge/information about biodiversity and ES especially their benefits to people around the world	The Global Biodiversity Information Facility has helped replicate the efforts of CONABIO,Mexico's Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (www.conabio.gob.mx/) that has systematically gathered data about specimens of plants and animals collected in Mexico from natural history collections and herbaria worldwide. Such efforts have promoted the optimal placement of biosphere reserves, and understanding of future effects of invasive species and climate change (Edwards, 2004).
Spread of governance policy	*Create win-win optimization solutions for economic development and conservation while implementing governmental policies	In Brazil, multiple ecosystem services land planning and land optimization for economic and environmental goals at a landscape-scale, agricultural sector can expand production and meet regulatory requirements (Forest Code), while maintaining biodiversity and ecosystem service provision (Kennedy et al., 2016)

Species migration	*Protect habitat for migratory species in breeding, wintering, and stopover sites	Studies on migratory species such as Kirtland's warblers in the United States and the Bahamas indicate that populations increase as a result of habitat conservation across various sites for full life-cycle requirements (Hulina et al., 2017).
Environmental flows	*Maintain environmental flows (water flows) for biodiversity	Native and total aquatic species richness are higher with increased percent of unaltered stream length in Europe (Corbacho Amado & Sanchez, 2001)

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