

Biophysical Process or System	Control Variable	Public Good	Scale of Public Good	Scale of Externality	Governance / Monitoring	Incentives / Impacts
<b>Ozone depletion</b>	Stratospheric ozone concentration (Dobson units)	Intact stratosphere	Global	Global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-Montreal Protocol on Substances that Deplete the Ozone Layer</li> <li>-Vienna Convention for the Protection of the Ozone Layer</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-NASA's Ozone Monitoring Instrument</li> <li>-Air Pollution and Atmospheric Brown Cloud (ABC) Programme</li> <li>-European Global Ozone Monitoring Experiment (GOME-2)</li> </ul>	<ul style="list-style-type: none"> <li>-regulatory incentives</li> <li>-financial assistance to developing countries to phase-out ozone-depleting pollutants through alternative technologies/replacements</li> </ul>
<b>Climate change</b>	Atmospheric carbon dioxide concentration (ppm by volume)	<p>Stable climate (carbon sequestration)</p> <p><i>Energy security</i></p>	Global	Global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-UNFCCC</li> <li>-Kyoto Protocol</li> <li>-Paris Agreement</li> <li>-Global Atmospheric Pollution (GAP) Forum</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-Greenhouse Gases Observing Satellite</li> <li>-NOAA's Global Greenhouse Gas Reference Network</li> </ul>	<ul style="list-style-type: none"> <li>-fossil fuel subsidies</li> <li>-cap-and-trade emissions trading schemes</li> <li>-carbon pricing</li> <li>-emissions fees</li> <li>-renewal energy subsidies</li> <li>-subsidies for technology improvement/adoption on industry level (positive-return capital projects)</li> <li>-road use and vehicle restrictions</li> <li>-funding incentive to switch to fuel-efficient fleets</li> <li>-urban low emissions zones (LEZs)</li> <li>-congestion pricing</li> <li>-tiered utility pricing</li> <li>-transit-oriented development</li> <li>-electric car rebates</li> <li>-residential/commercial energy efficiency subsidies</li> </ul>

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<b>Atmospheric aerosols</b>	Overall particulate concentration in the atmosphere, on a regional basis	Clean air	Local, regional, global	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-International responsibilities around air pollution/pollutants are spread across multiple organizations, including the WHO, numerous other UN agencies, the international financing institutions, independent secretariats, and regional governing bodies</li> <li>-Global Atmospheric Pollution (GAP) Forum - exploring single global governance mechanism</li> <li>-Geneva Convention on Long-range Transboundary Air Pollution (CLRTAP)</li> <li>-ASEAN Agreement on Transboundary Haze Pollution</li> <li>-Climate and Clean Air Coalition to Reduce Short Lived Climate Pollutants (CCAC)</li> <li>-UNEP's Partnership for Clean Fuels and Vehicles / Global Fuel Economy Initiative</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-many countries still do not have ground-based monitors, or otherwise nationally coordinated systems to monitor and quantify air quality</li> <li>-Global Air Quality Partnership (US-EPA and State Dept)</li> <li>-WHO Air Quality Guidelines / Global Urban Ambient Air Pollution Database</li> <li>-European Monitoring and Evaluation Programme (under CLRTAP)</li> </ul>	<ul style="list-style-type: none"> <li>-incentive for biomass market development - turn peat into a product instead of byproduct</li> <li>-Certification schemes for responsible commodity sourcing and compliance (palm oil, soy, beef, paper and pulp)</li> </ul>

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<b>Ocean acidification</b>	Global mean saturation state of aragonite in surface seawater (omega units)	Sustainable marine ecosystems	Local, regional, global	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-International Maritime Organization</li> <li>-UN Convention on the Law of the Sea / HNS Protocol (Hazardous and Noxious Substances)</li> <li>-International Seabed Authority</li> <li>-Commission on the Limits of the Continental Shelf</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-Global Ocean Acidification Observing Network (GOA-ON)</li> <li>-NOAA Ocean Acidification Program</li> <li>-public-private partnerships for monitoring, e.g. OceaAn pH Research Integration and Collaboration in Africa (ApHRICA)</li> </ul>	<ul style="list-style-type: none"> <li>-blue carbon credit schemes</li> <li>-marine payments for ecosystems services (PES)</li> <li>-pairing coastal areas with inland water quality trading schemes (WQTS)</li> </ul>
<b>Biosphere Integrity</b>	Extinction rate (number of species per million per year)	<p>Biodiversity conservation</p> <p>Pandemic control</p> <p><i>Food security (genetic diversity)</i></p>	Local, regional, global	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-Convention on Biological Diversity (CBD)</li> <li>-International Union for the Conservation of Nature (IUCN)</li> <li>-Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)</li> <li>-Convention on the International Trade of Endangered Species (CITES)</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-Group on Earth Observations - Biodiversity Observations Network (GEO BON) working to fill this gap</li> </ul>	<ul style="list-style-type: none"> <li>-payments for ecosystem services (PES)</li> <li>-mitigation banking</li> <li>-certification schemes / ecolabeling</li> <li>-benefit-sharing/community-based ecotourism</li> <li>-federal tax incentives for conservation easements</li> <li>-catch-share fisheries management (e.g. individual fishing quotas, transferable quotas, rights-based fishing quotas)</li> </ul>

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Land use	Land surface converted to cropland (percent)	Sustainable landscapes <i>Mineral security</i>	Local, regional	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-Reducing Emissions from Deforestation and Forest Degradation (REDD+)</li> <li>-WRI The Governance of Forests Initiative Indicator Framework</li> <li>-UN Convention to Combat Desertification (UNCCD)</li> <li>-UNFCCC</li> <li>-International Tropical Timber Agreement</li> <li>-UN Forum on Forests</li> <li>-EU Forest Law Enforcement, Governance, and Trade (FLEGT)</li> <li>-Tropical Forest Alliance</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-WRI Global Forest Watch</li> <li>-Global Forests Observations Initiative</li> <li>-FAO Global Forests Resource Assessment</li> <li>-CGD's Forest Conservation Performance Rating</li> </ul>	<ul style="list-style-type: none"> <li>-performance based payments/agreements (e.g. REDD+)</li> <li>-payments for ecosystem services (PES)</li> <li>-subsidies for sustainable soil management and irrigation practices</li> <li>-commodity roundtables</li> <li>-certifications schemes</li> <li>-land title reform</li> <li>-mitigation banking</li> <li>-legal trade incentives (multi-/bilateral agreements)</li> <li>-contaminated land redevelopment incentives</li> </ul>
Freshwater	Global human consumption of water (km <sup>3</sup> /yr)	Sustainable freshwater ecosystems <i>Water security</i>	Local, regional	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-consists of a patchwork of resolutions across several UN and other international organizations</li> <li>-Global Water System Project – exploring a unified global water governance mechanism</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-International Groundwater Resources Assessment Centre - Global Groundwater Monitoring Network</li> <li>-NASA's Gravity Recovery and Climate Experiment to monitor Freshwater</li> <li>-Several regional and national systems are in place to continuously monitor ground and freshwater sources</li> </ul>	<ul style="list-style-type: none"> <li>-subsidizing efficient irrigation systems/methods</li> <li>-subsidizing rainwater catchment systems</li> <li>-incentives for revegetation and groundwater catchment development</li> <li>-conservation entitlement program / access to conservation funds</li> </ul>

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<b>Chemical pollution</b>	Concentration of toxic substances, plastics, endocrine disruptors, heavy metals, and radioactive contamination into the environment	Clean water  Clean soil	Local, regional	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-Given the ubiquitous nature of chemical pollutants, several UN agencies and conventions are involved in governance (in patchwork fashion)</li> <li>-UNEP Global Monitoring Plan for Persistent Organic Pollutants (POPs)</li> <li>-Rotterdam Convention (chemical pollution)</li> <li>-Stockholm Convention (POPs)</li> <li>-Basel Convention (hazardous waste)</li> <li>-Minamata Convention (mercury)</li> <li>-Strategic Approach to International Chemicals Management (Endocrine Disrupting Chemicals)</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-UNEP's Global Chemical Outlook</li> <li>-public-interest groups (e.g. Environmental Working Group)</li> </ul>	<ul style="list-style-type: none"> <li>-waste disposal tax</li> <li>-effluent trading schemes</li> <li>-recycling/waste-sorting financial incentive and/or penalty</li> <li>-deposit-refund systems (containers, liquid/gaseous waste)</li> <li>-creating markets for recovered/recycled materials/products</li> <li>-incentives for biological processing / energy recovery from waste processing</li> <li>-fair trade / ecolabel certification</li> </ul>
<b>Biogeochemical</b>	(a) anthropogenic nitrogen removed from the atmosphere (millions of tonnes per year)	Pollution mitigation	Local	Local, regional, global	<p><i>Governance:</i></p> <ul style="list-style-type: none"> <li>-International Fertilizer Association</li> <li>-no coordinated governance structure for the trade and movement of nitrogen or phosphorus</li> <li>-National/regional networks include - Phosphorus Sustainability Research Coordination Network (US), Phosphorus Recycling Promotion Council (Japan), European Phosphorus Platform</li> </ul> <p><i>Monitoring:</i></p> <ul style="list-style-type: none"> <li>-no coordinated/integrated global monitoring system for anthropogenic nitrogen or phosphorus</li> <li>-some national and regional monitoring systems track phosphorus for agricultural purposes</li> <li>-global fertilizer trade-flow, production, and consumption map created by ICIS (largest petrochemical market information provider)</li> </ul>	<ul style="list-style-type: none"> <li>-fertilizer subsidies</li> <li>-fertilizer tax</li> <li>-subsidies for intensive high-yield farming</li> <li>-financial/technical assistance to implement efficient fertilizer applications</li> <li>-government-funded incentive programs for farmers to adopt organic agriculture</li> <li>-mitigation banking (wetlands)</li> <li>-organic certification programs (supply chain/end-consumer)</li> <li>-crop-based carbon offset protocols</li> </ul>
	(b) anthropogenic phosphorus going into the oceans (millions of tonnes per year)					