**Supplementary material**

**Appendix 2:** A non-exhaustive set of tools and approaches that can be used in transdisciplinary co-production for connecting pollution science to society, decision- and policy-makers.

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| --- | --- | --- |
| **Scope (covering specific user need)** | **Tool, approaches and main use: diagnosis (D) 1; transfer (T) 2; services (S) 3** **(for definitions see underneath table)** | **References** |
| **Identify the impact of coastal and marine pollution on the multiple-sectors within and users of the large social-ecological systems**  | **Stakeholder mapping (D and T).** Stakeholder analysis is a way to identify a project’s key stakeholders, assess their interests and needs, and clarify how these may affect the project’s viability. From this analysis, project managers can make plans for how these social and institutional aspects will be addressed. | (Antunes, Santos, & Videira, 2006; Argent et al., 2006; Gray et al., 2018; Moore, Brown, Kobryn, & Strickland-Munro, 2017; Videira, Antunes, & Santos, 2009; Voinov & Bousquet, 2010; Williams et al., 2020) |
| **Climate projection and climate hazards (D and T).**  Adaptation and risk management in response to the coastal hazards require improved deterministic and probabilistic predictions in the short-term as well as estimation of historical events and statistics and future projections**.** | (Falconer et al., 2020; D. Lawrence, 2020) |
| **Vulnerability analysis (D and T)**, includes three dimensions, (i.e., exposure, sensitivity, and adaptive capacity) as a multidisciplinary coverage (e.g., pollution, climate, social, economic)**.** Social Ecological Vulnerability as the magnitude to which a coastal system, including both social and ecological components, is susceptible to and unable to cope with the pressures caused by given economic activities or blue economy sector. | (Lazzari, Becerro, Sanabria-Fernandez, & Martin-Lopez, 2021; Weis et al., 2016; Whitney, Conger, Ban, McPhie, & Cooke, 2020) |
| **Economic impact analysis (D and T),** on Blue Economy sectors under different Representative Concentration Pathways and pollution scenarios**.** | (de Ruig et al., 2019; Tol, 2020; Vrontisi et al., 2022) |
| **Sustainable development pathways scenarios (e.g., scenario planning, “what-if scenarios, “nature future” scenarios; T and S).** Includes a set of multidisciplinary approaches and for the active involvement of a diversity of actors in decision-making processes. This tool is adapted for assist decision-making by promoting anticipatory adaptation approaches.  | (Campos et al., 2016; Coulter, Serrao-Neumann, & Coiacetto, 2019; Pereira et al., 2020; Reimann et al., 2021; Rocle et al., 2020; Sanchez-Arcilla et al., 2016; Sharpe, Hodgson, Leicester, Lyon, & Fazey, 2016; Soergel et al., 2021) |
| **Identify the range and relationships of stakeholders and users of pollution information services** | **Social network analysis, for analysing social ecological networks (T),** aims to assess the relationships between individuals or actors that for analytical purposes are regarded as interlinked, even though in reality the boundaries of the networks are ambiguous. It is valuable for examine how different domains of adaptive capacity are related to adaptive and transformative actions. | (Barnes et al., 2020; Cunningham, Jacobs, & Measham, 2021; Ernoul & Wardell-Johnson, 2013; Roca, Villares, Oroval, & Gabarró, 2015) |
| **SWOT analysis (e.g., sustainable development of given economic sectors; D, T and S),** aims to facilitate the design of structures, processes or items for decision-makers. The main goal is identification of changes that will strategically and consistently improve it by maximizing strengths, reducing weaknesses, exploiting available opportunities, and avoiding threats. | (Berte & Panagopoulos, 2014; Goffetti et al., 2018; McKinley & Ballinger, 2018; Panigrahi & Mohanty, 2012; Pesonen & Horn, 2014) |
| **Archetype analysis (T).** Archetypes are representative patterns of the interaction between society and nature bringing about global environmental change and/or being a response to such changes. They explain basic underlying processes and are made to tie connections between regions and to assist decision-makers understand their distinct situation within a broad set of conditions and background. | (Horcea-Milcu, Martín-López, Lam, & Lang, 2020; Karrasch, Klenke, & Kleyer, 2019; Moser, Ekstrom, Kim, & Heitsch, 2019; Rocle et al., 2020; Tribaldos, Oberlack, & Schneider, 2020) |
| **Define the role and utility of pollution information services within the context of a large social-ecological system**  | **Knowledge Co-production (participatory approach; T and S).** Stakeholders’ perceptions and perspectives can be incorporated at any level from de design to the implementation phase. Common approaches include think-tanks, workshops, brain storming sessions, focus groups, polls, and dialogues on impacts of climate change and coastal pollution. | (Hoerterer et al., 2020; Molino, Kenney, & Sutton-Grier, 2020) |
| **Participation action research (PAR; T and S)** is defined as an iterative process of research and actions in the field or in a community that allows for the engagement of various actors with researchers. The aim is to co-define the issues at stake, discuss solution options, analyse them, and make decisions or recommendations that are usually socially, economically, and environmentally acceptable. PAR therefore requires a continuous involvement and exchange among actors, scientists, and decision makers. | (Meriläinen, Kelman, Peters, & Shannon, 2022; Ottosson, 2003; Vasseur, 2021) |
| **Integrated planning products and decision-support tools (S). Climate and pollution services for coastal management tools and strategies (e.g., climate projections).** These products aim to cope with climate and pollution related issues as land–sea interaction by supporting planning approaches which can holistically support coastal development, such as Marine Spatial Planning (MSP). These tools aim to transfer climate knowledge and information to coastal plans, management bodies and structures. Climate and pollution information and services adapted to coastal managers as for management plans and strategies (e.g., MSP, Marine Protected Areas, Integrated Coastal Zone Management).  | (J. Lawrence, Stephens, Blackett, Bell, & Priestley, 2021; Maragno, dall’Omo, Pozzer, Bassan, & Musco, 2020; Raub & Cotti-Rausch, 2019; Terorotua, Duvat, Maspataud, & Ouriqua, 2020; Tribbia & Moser, 2008) |
| **Identify pathways for the conversion of pollution information services to inform policy- and decision-making** | **Visualization tools (S and T).** These tools, e.g., GIS visualisation, Story Maps, aim to facilitate the visualization of climate and pollution risks, threats and vulnerabilities into the decision-making process and also promote accessibility of information to the general public. They can also increase knowledge within the broader stakeholder community. The goal is the transfer of information for connecting people to their environment, capacity building, engagement of civil society, and relevant economic actors, private sector groups and stakeholders. | (DeCock-Caspell, Vasseur, & Swart, 2021; Vollstedt, Koerth, Tsakiris, Nieskens, & Vafeidis, 2021) |
| **Web-based decision-support tools (S and T).** Aims to disseminate end-to-end climate and pollution risk information. Rapid assessment web tools are information systems developed to automate and expedite the calculation or estimation of climate and pollution risks. The web-tool offers a user-friendly interface for specific users with interactive graphs and the ability to produce standardized reports. The tool can serve spatial maps of specific hazard, socio-economic vulnerability, and climate risks under different scenarios.  | (Engelstad et al., 2022; Mohanty & Karmakar, 2021; Rammer et al., 2014) |
| **Literacy (S and T). Formal education, trainings, science communication, digital and games.** Development and delivery of integrated information centred on climate, pollution, social, economic information. Integrated and multidisciplinary literacy with emphasis on empowerment through reasoning skill. Literacy could be delivered in different forms from primary education to and university and capacity building courses.  | (Alves et al., 2021; Corner, 2012; Harker-Schuch, Mills, Lade, & Colvin, 2020; Johnston, 2020; Kuthe, Körfgen, Stötter, & Keller, 2020; Schrögel & Kolleck, 2019) |

**Definitions**

1 Diagnosis-oriented tools and methods are applied for initial assessment and scientific analysis. Tools can address social, environmental or economic aspects at different levels, such as analysis of stakeholder groups, coastal hazards, vulnerabilities, economic impacts etc.

2 Transfer-oriented tools and methods are applied to bridge the knowledge gap between science and society. These tools support the transfer of scientific knowledge amongst interest groups.

3 Service-oriented tools and methods are applied to provide an information service to final users. These tools offer a range of scientific services and products to defined stakeholder groups to assist decision-makers in finding solution-oriented approaches (e.g., supporting spatial or urban planning

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