# Table 1. Literature by data collection methods informing the development of the tool

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference** | **Desktop research** | **Participatory Data Collection Methods (PDCM)** | | | | | **Total (PDCM)** |
| **Interview** | **Survey** | **Workshop** | **Focus Group** | **Community engagement** |
| [1] |  | x | x | x |  |  | 3 |
| [2] | x | x |  | x |  |  | 3 |
| [3] |  | x |  | x | x |  | 3 |
| [4] |  |  |  |  | x | x | 3 |
| [5] | x |  |  |  |  |  | 0 |
| [6] | x |  | x | x |  |  | 2 |
| [7] |  | x |  |  |  | x | 2 |
| [8] |  | x | x |  |  | x | 3 |
| [9] | x |  |  | x |  |  | 1 |
| [10] |  | x |  | x |  |  | 2 |
| [11] | x |  |  |  |  |  | 0 |
| [12] | x | x |  | x |  |  | 2 |
| [13] |  |  | x | x |  |  | 2 |
| [14] |  |  |  | x |  |  | 1 |
| [15] |  |  |  |  | x | x | 2 |
| [16] |  |  |  | x |  |  | 1 |
| [17] |  |  | x | x |  |  | 2 |
| [18] |  |  | x | x | x |  | 3 |
| [19] |  | x | x | x |  |  | 3 |

# Table 2. Summary of studies employing co-concept processes for informing tool development

|  |  |  |  |
| --- | --- | --- | --- |
| **Reference** | **Co-concept Process** | | **Participant Types** |
| **Framework used** | **Theoretical foundation of the co-concept framework used in the study?** |
| [1] | co-create | Yes, authors discuss the co-creation process by the Public Innovation Lab (2017) | Academic, Community (civil society), Government, Organized civil society, Private Organizations |
| [2] | co-design | No, authors discuss "user-centered design" by Witteman et al. (2015) | Academic, Civil society, Organized civil society, Private Organizations |
| [3] | co-produce, co-design | No, authors define that “The current study uses the term “coproduction” to refer to participatory engagement between researchers and a group of farmers and extension agents in the design of tools and the production of weather data and forecasts” (Gbangou et al., 2020, p. 2) by referencing the Vedeld et al. (2019)  study, which actually discusses co-design  The authors also say "following a user-driven design approach" (Gbangou et al., 2020, p.6) | Academic, Community (civil society), Organized civil society |
| [4] | co-design | No, authors define "participatory design process" | Academic, Community (civil society), Organized civil society |
| [5] | co-design | No, authors mention following universal design goals inspired by Harold et al. (2016) | Academic, Community (civil society), Government, Organized civil society |
| [6] | co-create | No | Academic, Community (civil society), NGO, Organized civil society |
| [7] | co-develop | No | Academic, Community (civil society), Government |
| [8] | co-design | Yes, authors discuss Moser’s (2016) theory of co-design | Academic, Community (civil society), NGO |
| [9] | co-design | Yes, authors discuss community-based co-design by Winschiers-Theophilus et al. (2012) | Academic, Community (civil society), Organized civil society |
| [10] | co-develop | No | Academic, Government, Organized civil society |
| [11] | co-design | No, but the authors do not define this platform as fully co-designed yet | Academic, Community (civil society) |
| [12] | co-create, co-produce, co-design | No, authors discuss “participatory mapping” | Academic, Community (civil society), NGO, Organized civil society |
| [13] | co-design | No, authors discuss "participatory involvement" | Academic, Community (civil society), Government, Organized civil society |
| [14] | co-design, co-develop | No, authors define “experience design” | Academic, Community (civil society), Private Organizations |
| [15] | co-create | No, authors discuss an "ethical consideration" framework | Academic, Community (civil society) |
| [16] | co-design | No, other than "in co-design, users collaborate in exploring, developing and testing solutions to shared challenges. Co-design is a form of co-creation in which the initiative lies with a public organization (Voorberg et al., 2015; Ramaswamy and Ozcan, 2018) and is considered to be useful for solving complex issues and realizing changes" (Verweij et al., 2019, p.2) | Academic, Government, NGO |
| [17] | co-produce | No, authors define the Living Lab (2017) method, which involves co-creation and activities that take place in real-life environments | Academic, Community (civil society), Government, Organized civil society |
| [18] | co-design | Yes, authors discuss the co-design process by Sanders and Stappers (2008) | Academic, Community (civil society) |
| [19] | co-develop | Yes, authors discuss co-development as proposed by Grainger et al., (2018) & Khosravi et al., (2021) | Academic, Community (civil society) |

# Table 3. Types of engagement (number of articles)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Role** | **Co-design** | **Co-create** | **Co-produce** | **Co-develop** |
| Initiator | Identify a need for a climate service and initiate projects to address it | Academic (n=10), Community (n=8) | Academic (n=5) | Academic (n=3), Government (n=3) | Academic (n=4), Community (n=3) |
| Implementer | Work alongside other actors to implement climate service projects | Academic (n=9), Community (n=8) | Academic (n=4), NGO (n=1) | Academic (n=2), Government (n=2), Community (n=1) | Community (n=2) |
| Advisor | Contribute expertise to inform the design, development, and evaluation of climate service projects | Government (n=3), NGO (n=2) | Academic (n=3), NGO (n=2) | Government (n=2), NGO (n=1) | Academic (n=2), Government (n=2) |
| Facilitator | Bridge the gap between climate information providers and end-users | Organized Civil Society (n=2), Academic (n=5) | Academic (n=3) | Academic (n=1) | Academic (n=2) |

# Table 4. The “what” in co-concept community-centered tools (number of articles)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Type** | **Role** | **Co-design** | **Co-create** | **Co-produce** | **Co-develop** |
| Initiator | Identify a need for a climate service and initiate projects to address it | Academic (n=10), Community (n=8) | Academic (n=5) | Academic (n=3), Government (n=3) | Academic (n=4), Community (n=3) |
| Implementer | Work alongside other actors to implement climate service projects | Academic (n=9), Community (n=8) | Academic (n=4), NGO (n=1) | Academic (n=2), Government (n=2) | Community (n=2) |
| Advisor | Contribute expertise to inform the design, development, and evaluation of climate service projects | Government (n=3), NGO (n=2) | Academic (n=3), NGO (n=2) | Government (n=2), NGO (n=1) | Academic (n=2), Government (n=2) |
| Knowledge  Broker | Bridge the gap between climate information providers and end-users | Organized Civil Society (n=2), Academic (n=5) | Academic (n=3) | Academic (n=1) | Academic (n=2) |

# Table 5. The “why” in co-concept community-centered tools (number of articles)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Dimension** | **Purpose** | **Example** | **Co-design** | **Co-create** | **Co-produce** | **Co-develop** | **Total** |
|  |  |  |  |  |  |  |  |
| Normative Dimensions |  |  |  |  |  |  |  |
| Empowerment | giving voice and agency to local or marginalized groups | "empowers Sitka residents to make their own decisions regarding landslide risk" (Lempert et al., 2023); “center the needs and priorities of local land defenders" (Ryan et al., 2023, p.3) | 2 | 3 | 2 |  | **7** |
| Inclusion | ensuring inclusive and participatory processes | "ensuring a high degree of participation, interest and usefulness to prospective users" (Willis et al., 2024, p.4) | 2 | 1 |  | 2 | **5** |
| Knowledge Integration | weaving together different types of knowledge (e.g., scientific, Indigenous, experiential) | "integrate their perspectives of the flooding events, record their perceptions" (Grajales et al., 2022, p.3) | 1 |  |  |  | **1** |
| Instrumental Dimensions |  |  |  |  |  |  |  |
| Effectiveness | improving performance or results | "stimulate and propel meaningful innovation" (Muashekele et al., 2022, p.6) | 2 |  |  | 2 | **4** |
| Relevance | tailoring tools to user contexts and needs | "provide farmers with information, action options and notifications" (Myllynpää et al., 2020, p.2) | 3 |  |  |  | **3** |
| Adoption & Sustainability | ensuring long-term use and ownership | "foster trust and increase the local uptake of scientific model-based forecasting knowledge" (Gbangou et al., 2020, p.2) | 2 |  | 1 |  | **3** |

# Table 6. The “when” in co-concept community-centered tools (number of articles)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Dimension** | **Definition** | **Co-design** | **Co-create** | **Co-produce** | **Co-develop** | **Total** |
| Problem framing | Defining the issue or challenge and deciding what to address and why | 2 |  |  | 2 | **4** |
| Needs assessment | Understanding user/community needs, goals, experiences, and constraints | 5 | 2 | 2 | 2 | **11** |
| Ideation | Generating and sharing ideas for potential solutions collaborative | 1 |  |  |  | **1** |
| Design & Prototyping | Developing concepts into tangible or testable forms — including mockups, storyboards, or code | 8 | 3 | 2 | 3 | **16** |
| Testing & Iteration | Trialing prototypes and refining the design based on user feedback | 1 | 1 | 1 | 2 | **5** |

# Table 7. The “where” in co-concept community-centered tools (number of articles)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Dimension** | **Example** | **Co-design** | **Co-create** | **Co-produce** | **Co-develop** | **Total** |
| Expert dominance | "measures were compiled based on workshop results and on expert knowledge " (Vollstedt et al., 2021, p.7); “co-developed with experts in regional flood intervention, intervention planning, and civil protection” (Munz et al., 2023, p.3) | 2 | 4 | 3 | 3 | **12** |
| Marginalized groups | "support First Nations to develop their own WSP process informed by Indigenous world views and ways of knowing" (Lane et al., 2023, p.12); "vital connection to the community’s Indigenous population, including representatives for the project’s deliberative processes " (Lempert et al., 2023, p.17) | 1 | 1 |  | 1 | **3** |
| Barriers to access | "there are still some dependencies within Mapeo. It does require some tech literacy" (Ryan et al., 2023); “The challenge will also reside in balancing access, quality, and precision; understandable information for the overall population” (Fallon et al., 2022, p.16) | 3 | 2 | 1 |  | **6** |

# Table 8. Co-concept characteristics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **5W** | **Co-design** | **Co-create** | **Co-produce** | **Co-develop** |
| Who | Inclusive and multi-actor (academia, civil society, community, NGOs) | Expert-driven (academics, NGOs, organized civil society) | Technocratic (academia + government); consultative roles for others | Trust-based dyads (academic + community) |
| What | Facilitated, iterative, blends tacit and explicit knowledge | Synthesis-focused, limited iteration | Validation-focused, top-down | Contextual integration of needs and expectations |
| Why | Normative + practical (empowerment and usability) | Strategic: legitimacy, alignment | Instrumental: performance, compliance | Normative: long-term relevance and shared learning |
| When | All stages: framing to testing | Mid-to-late phase | Late-stage (testing, rollout) | Mostly mid-phase; sometimes early design |
| Where | Community-embedded, local institutions | Policy/institutional spaces | Technical or administrative environments | Peripheral or governance-sensitive settings |