

# Charting knowledge co-production pathways in climate and development

Blane Harvey<sup>1</sup> | Logan Cochrane<sup>2</sup> | Marissa Van Epp<sup>3</sup>

<sup>1</sup>Department of Integrated Studies in Education, McGill University, Montreal, Canada

<sup>2</sup>Global and International Studies, Carleton University, Ottawa, Canada

<sup>3</sup>The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Wageningen, The Netherlands

## Correspondence

Blane Harvey, Department of Integrated Studies in Education, McGill University, 3700 McTavish, Montreal, Quebec H3A 1Y2, Canada.

Email: blane.harvey@mcgill.ca

## Abstract

Climate change poses significant global challenges. Solutions require new ways of working, thinking, and acting. Knowledge co-production is often cited as one of the innovations needed for navigating the complexity of climate change challenges, yet how to best approach co-production processes remains unclear. In this article, we explore the ways in which climate and development researchers are approaching the co-production of knowledge and grapple with the extent to which the modalities used are reaching their stated potential. Using a multiple case analysis of six examples of successful co-production, we outline a spectrum of co-production approaches and outcomes and examine the drivers and challenges to co-production in practice. Drawing on the case evidence and literature, we propose a heuristic that maps out this spectrum of aims and approaches to co-production and that could inform reflections on how those planning co-production processes envision them in practice.

## KEYWORDS

climate change, knowledge co-production, programme design

## 1 | INTRODUCTION

It is increasingly recognized that addressing the challenges posed by climate change requires new approaches to designing, undertaking, and applying research (Cochrane et al., 2017; Jones et al., 2018). The need for robust evidence and enabling policies for responding to current and projected climate impacts is perhaps most acutely felt in developing countries where large vulnerable populations face significant threats to their livelihoods and well-being (De Souza et al., 2015; IPCC, 2014). A growing number of voices argue that these challenges call for approaches to knowledge creation that transgress disciplinary boundaries and include the knowledge and perspectives of nonacademics, including impacted communities in developing countries. Doing so, they argue, is critical to ensuring that research findings and resulting recommendations are seen as salient, legitimate, credible, just, and useable (Burman, 2017; Cash et al., 2003; Dilling & Lemos, 2011; Funtowicz & Ravetz, 1995; Van Kerkhoff & Lebel, 2015).

Focal to the approaches being used to respond to these calls is transdisciplinary knowledge co-production (Lemos & Morehouse, 2005; Mauser et al., 2013), broadly understood as a collaborative

process of knowledge production involving multiple research disciplines and stakeholders from other sectors of society (Pohl, 2008, p. 47). For Campbell & Vanderhoven, (2016), co-production offers the potential to generate both academic insight and public benefit, as well as “*different (and greater) intellectual insights*” (p. 15, emphasis in original). Moser (2016) points to evidence about how co-production can challenge, integrate, and transform pre-existing knowledge systems, thereby generating new insights and perspectives.

The growing body of empirical evidence on transdisciplinary knowledge co-production offers a wealth of approaches, success factors, and potential outcomes that might be achieved (e.g., Cochrane et al., 2017; Pohl et al., 2010; Reed & Abernethy, 2018). For researchers, programme developers, and other stakeholders drawn to the stated promises of co-production, navigating this range of possible approaches presents an important new challenge that this paper explores. The challenge in navigating the myriad promises and approaches to effective co-production is reflected in Filipe, Renedo, and Marston's (2017) statement that “despite an apparent consensus around the potential of co-production, it is not always clear what counts as or what is meant by ‘co-production’, what it entails in practice, or what it is that is being co-produced” (p. 1). The structure of

much of the work studying and responding to the impacts of climate change presents an additional dimension to the challenge. This work is increasingly undertaken through multipartner collaborations spanning two or more countries, and often between partners in the global North and South (Cundill et al., 2018; Jones et al., 2018), bringing added complexity to the facilitation of co-production.

This study seeks to better understand how knowledge co-production processes translate into particular outputs or outcomes in applied and use-inspired research (*sensu* Stokes, 1997) to address the impacts of climate change, particularly in developing countries. To do so, it uses a review of recent literature and a sample of six self-identified “successful” cases of co-production in international collaborations related to climate change adaptation, climate risk management, and climate compatible development. The initiatives under study feature participation that extends beyond researchers, involving broad community-based participation in some instances and policy makers and/or development practitioners in others. In studying the cases, we focus our attention on three interrelated questions:

1. What kinds of questions or problems are successful co-production approaches being used to answer or resolve in climate and development?
2. In these successful cases, how does the co-production context and process influence its outputs and outcomes?
3. How do drivers and barriers to success vary across different co-production approaches or problem types?

On the basis of our analysis across these cases of co-production, we propose a heuristic that maps out the spectrum of approaches and potential outcomes that fall within the realm of transdisciplinary knowledge co-production, in order to better understand the relationships between processes and outcomes, and ultimately enable better informed practice.

Before presenting the cases (Section 3), Section 2 reviews some of the main definitional and conceptual aspects of co-production, outlining what co-production is, and why it has been argued as crucial for climate change research. The third section presents a set of cases that have successfully utilized co-production in the context of climate and development. Drawing on our analysis of these cases, and of the wider academic literature, we propose a design heuristic for linking co-production process to outcomes in a more deliberate manner (Section 4). We also call for critical reflection on the intended ends of co-production in climate and development, inviting those working toward these ends to reflect on how well the current practices meet the ambitions.

## 2 | KNOWLEDGE CO-PRODUCTION IN CLIMATE AND DEVELOPMENT RESEARCH AND PRACTICE

### 2.1 | The promises of co-production

Knowledge co-production is seen as a critical aspect of understanding and acting on complex global challenges such as climate change and

sustainable development. This is due to its perceived ability to draw in knowledge from across disciplines; promote shared learning based on collective experience; increase the perceived legitimacy, relevance, and usability of the knowledge being generated among nonacademic stakeholders; and, for some, challenge entrenched norms of “knowing,” and doing, in the sciences (Jasanoff, 2004; Lang et al., 2012; Moser, 2016; van Kerkhoff & Lebel, 2015). The promise of such a significant potential impact has brought the idea considerable attention as a means of addressing the gulf between research, policy, and practice in fields such as climate change and sustainable development (Dilling & Lemos, 2011). Knowledge co-production has also been advocated as a tool to enable more fundamental, or transformative, types of change (Schuttenberg & Guth, 2015).

Although interpretations vary, as we explore below, Armitage Berkes, Dale, Kocho-Schellenberg, and Patton (2011) define co-production as “the collaborative process of bringing a plurality of knowledge sources and types together to address a defined problem and build an integrated or systems-oriented understanding of that problem” (p. 996). The boundaries where co-production processes begin and end are understood differently within the literature. Mauser et al. (2013) propose that co-production sits within a broader, iterative process of cocreation where codesign precedes co-production, and a dissemination of results follows. Elsewhere, co-production is seen to include codesign, collaborative planning and coimplementation, coanalyses, and collaborative advocacy for change, all of which are often enabled by a host of intermediaries, knowledge brokers, and boundary organizations (Reyers, Nel, O’Farrell, Sitas, & Nel, 2015).

Beyond the question of the boundaries of co-production processes, there are other areas of divergence in interpretations of the concept. As set out elsewhere (van Kerkhoff & Lebel, 2015; Wyborn, 2015), two contrasting interpretations of the value of co-production emerge from the literature. The first interpretation, which has been dominant in the field of science and technology studies, sees co-production as an idiom that offers new ways of knowing and representing the world across social and natural orders (Jasanoff, 2004). In this interpretation, the key contribution of co-production is its capacity to challenge the hegemony of particular ways of knowing and to invite a more conscious reflection on how science and society constitute one another (Pohl et al., 2010). The second interpretation of co-production’s value focuses instead on the challenge of creating “useable knowledge.” Here, co-production is seen as an instrument for addressing the pressing need to get knowledge into accessible formats and relevant contexts to inform decision making on major challenges such as the impacts of climate change on the livelihoods of the poor (Clark, Kerkhoff, Lebel, & Gallopin, 2016; Dilling & Lemos, 2011). This means, for Dilling and Lemos (2011, p. 681), bridging interpretations of what is understood to be “useful” from a scientific perspective and what is “useable” from a practical perspective and establishing a shared vision of what knowledge is useable in particular decision-making processes.

Although there are complementarities between these interpretations, there are also tensions. The first interpretation (e.g., Jasanoff, 2004) challenges the universalizing position of science-driven knowledge and its perceived distinctness from localized social contexts, whereas the second (e.g., Dilling & Lemos, 2011) tends to leave these

unchallenged, taking a more prescriptive stance on how these relationships can be better managed to address the priorities of decision makers at a range of levels (van Kerkhoff & Lebel, 2015). Further, the two interpretations reveal a potential tension between valuing the outputs or outcomes of co-production (new knowledge or solutions, as captured in the definition from Armitage et al. above, versus seeing the process of co-production as a good in and of itself). Jasanoff (2004), for instance, suggests that knowledge co-production is better thought of ontologically and normatively: not as a means to a specific, desired result but as a process that represents how knowledge creation ought to be understood—as emergent (see Table 1). These distinctions are reflected in the cases that follow and may have a bearing on what kinds of outcomes can be expected from processes labelled as co-productive, as we explore below.

## 2.2 | The process of co-production

Much as its expected ends may vary, the “processes” through which co-production is best pursued is interpreted differently across the literature. Recent research has focused on how to support particular stakeholders to engage in co-production processes and on how the processes themselves unfold. There is a growing recognition that across the diversity of possible actors involved in co-production processes, certain capacities are needed to ensure that relationships can contribute to scientifically informed social change (van Kerkhoff & Lebel, 2015). These may include specific skills or experience, characteristics (such as credibility), assets (such as financial resources), and more (see Schuttenberg & Guth, 2015; Wyborn, 2015).

Another important dimension of co-production processes is the nature of the interactions between different actor groups engaged in the process—be they researchers, community members, policymakers, or others. Here, Pohl et al. (2010) propose two main approaches, the first being the use of intermediaries or brokers who help to mediate across boundaries and the second being direct interaction between these actors in an overlapping, permeable space they term *the agora* (see Table 2). In the latter approach, they suggest “boundaries between the classical epistemological realms and corresponding roles of academic and non-academic actors are blurred” (Pohl et al., 2010, p. 269). In contrast, Cvitanovic et al. (2015) see intermediary or brokered approaches as separate to co-production, with co-production being a process wherein equal participation occurs from the idea development until the dissemination of outcomes.

We see these different forms of interaction as a spectrum of options rather than fully distinct approaches. Brokered approaches may still offer direct interaction between scientists and non-scientists, whereas “agora” approaches may be facilitated, for instance. The distinction lies, in our view, in the extent to which participants are

**TABLE 1** Instrumental and emergent co-production ends

Instrumental (knowledge that is useable for practical purposes)	Emergent (from interactions between actors)
Co-production as a vehicle to get knowledge into accessible formats and relevant contexts to inform decision making.	Co-production as a process that represents—and transforms perspectives on—what norms of knowledge production ought to be. Process as an outcome.

**TABLE 2** Brokered and “agora” co-production processes

Brokered co-production	“Agora” framing of co-production
<p>“Boundary organizations” help to stabilize interactions between science and non-science actors (Pohl et al., 2010).</p> <p>Design, convening and facilitation by a third party with a mandate to help establish agreed objectives and generate shared understanding.</p>	<p>Collaborative endeavour of academic and nonacademic actors where these communities “confront one another’s worldviews in a purposefully open intellectual and social space” (Pohl et al., 2010, p. 276).</p> <p>Co-production occurs when interactions between actors minimize differences in their cultural backgrounds and emphasize the collective nature of the endeavour (Schuttenberg &amp; Guth, 2015).</p>

deliberately called upon to deal with the social and cognitive challenges of accommodating contrasting worldviews and potentially conceding aspects of their own. The distinction is captured by Pohl et al. (2010), who contrast brokered approaches that “stabiliz[e] the social identities” of different actor groups, and approaches through which the boundaries between groups are blurred, producing a “‘messiness’ of ‘divided identities’” that ultimately “reshape the involved groups’ ‘perceptions, behaviour and agendas’” (p. 270). Further, we also argue that the role of facilitation may (and does, in the cases below) feature in both brokered and agora framings but that the facilitation function may be distinctly different in each (Reed & Abernethy, 2018).

### 2.2.1 | Challenges to using knowledge co-production in practice

As outlined above, there are strong reasons to advocate for the co-production of knowledge in climate and development. Yet there are many documented challenges and barriers to doing so. Knowledge co-production poses different sets of challenges: Heterogeneous groups of stakeholders have diverse worldviews, cultural backgrounds, interests, objectives, motivations, relationships, institutional structures, and resources (Cvitanovic et al., 2015; Huppe, Creech, & Knoblauch, 2012). The basis for successful collaboration, many argue (e.g., Cundill et al., 2018; Harvey, Pasanen, Pollard, & Raybould, 2017; Huppe et al., 2012), is creating an environment wherein relationships are established, common vision is determined, and shared objectives are clear. Pohl et al. (2010, pp. 270–271) note that “an overall challenge for sustainability researchers [is] that of structuring the agora during the co-production of knowledge.” Even in cases where co-production develops from an existing community of practice where trust and relationships are strong, the transaction costs and time demands for co-production are high.

In our view, however, beyond this growing body of insights on the factors that contribute to co-production’s success, or failure, lies a further question: Which approaches to co-production are most appropriate to which aims? Although we agree with Moser (2016, p. 107) that the “case has been made, convincingly, why engagement of scientists and users of scientific knowledge is superior to research conducted in isolation from its practice context,” we are concerned that the conflation between divergent ends and means of co-production reviewed above can lead to instances where co-production processes fail to deliver what they are seen by many to promise (see Lewis, 2015;

Mitlin, 2008). Flinders, Wood, & Cunningham (2016) have similarly pointed to a “rhetoric-reality gap” between what is promised and what is delivered” in co-production in the social sciences (216, p. 262).

Some recent scholarship has avoided taking a stance on the contrasting interpretations of the ends of co-production. van Kerkhoff and Lebel (2015), for instance, seek instead to identify concepts and approaches that can draw connections between these interpretations and their respective points of focus. We would challenge that, in fact, more work is needed to draw out the distinctions between these differing ends and means and to better understand the opportunities and limitations of each in practice. A similar process emerged from the explosion of attention on participatory approaches to development after criticism of their increasingly utilitarian or depoliticized use (Cooke & Kothari, 2001).

Building on Moser's (2016) and others' consideration of how best to undertake co-production (cf. Briley, Brown, & Kalafatis, 2015; Campbell & Vanderhoven, 2016; Schuttenberg & Guth, 2015), research should also interrogate whether co-production is the best approach for particular types of challenges or settings, which modes of co-production are most appropriate to the aims that have been set out, and which pathways of action effectively link approaches and outcomes. The cases explored in this paper help us begin to address these questions. They offer examples of knowledge co-production that can support the development of a heuristic for co-production design. Our aim here is not to debate the merit of co-production but to recognize how different conceptions of it play out in practice and call for more informed decision making about when, where, how, and for what knowledge co-production may be the most effective and appropriate process.

### 3 | METHODOLOGY

To better understand how co-production processes are applied in climate and development practice, we undertook a multiple-case study analysis (Stake, 2013) of six cases of self-identified “successful” co-production (see Tables 3 and 4). For Stake (2013), multicase analysis requires researchers to first examine each case based upon its unique context and then draw observations related to common features across the set under study. The case set was identified through a combination of snowball sampling (Small, 2009) as well as an invitation for submissions circulated through three email listservs.<sup>1</sup> Cases were selected according to standard set of criteria designed to fit with the types of contextual factors found within many transdisciplinary climate and development research programmes (Harvey, Pirani, Cochrane, Cranston, & Van Epp, 2017), namely, that the actors involved are geographically distributed; that they span different disciplines; that they face competing priorities or demands for their time; and that the outputs or outcomes of these processes are not solely academic in nature.

The assessment that the selected cases qualified as a “success” was left to the respondents putting forward the cases. The success of cases was not evaluated any further by the authors beyond

reviewing supporting documentation to better understand the outputs or outcomes that respondents referred to. This was done intentionally, in order to better understand how respondents themselves interpreted the aims of co-production and indicators of success.

The six selected cases were documented through semistructured interviews with one or two respondents per case as well as document analysis. Interview respondents were individuals who were directly responsible for designing and/or facilitating the co-production initiative under study. In one case, the CIP Potato Park, the case study was derived from ongoing research that was examining similar questions (Van Epp & Garside, 2016) and therefore did not require additional interviews. Drawing upon the existing documentation and interview transcripts, the authors then conducted inductive and deductive thematic coding and analysis (Ayres, 2008; Fereday & Muir-Cochrane, 2006) of each of the case studies to allow for comparative analysis (Stake, 2013). Tables 3 and 4 below summarize these results, first looking at the aims, means, and ends of these instances of successful co-production in climate and development (Table 3), and then at the drivers and barriers to success identified by respondents (Table 4).

In this paper, we focus on results emerging from knowledge co-production processes via the selected cases. Although it is beyond the scope of this paper to present and analyse each of the cases in detail, additional detail on the context and features of each case is available as a supplement to this study (Harvey, Pirani, et al., 2017). A further potential limitation is that the cases were explicitly selected as examples where co-production was successful. We did not seek cases from those that did not work well for contrast but recognize much can be learned from exploring such instances.

### 4 | CASE ANALYSIS

#### 4.1 | Characterizing the six cases

One defining feature of all six cases is that they were all funded and programme based. Although the literature suggests that stable funding is one of the keys to successful co-production processes (FAO, 2012; Palmer, Kramer, Boyd, & Hawthorne, 2016), this distinguishes these cases as being drawn from a subset of knowledge co-production types. As such, the majority of these initiatives were not completely emergent processes as one might find in social movement mobilization or autonomous community-based adaptation for instance. Rather, these are operated in an environment influenced by political priorities and donor decisions and are processes that set out with an objective to affect, or support, specific types of change. Cognizant of this, the cases under study serve as examples of knowledge co-production within a particular type of context. Albeit one that is nonetheless representative of a considerable amount of work in the field of climate and development.

This common feature (funding within the context of a time-bound programme) may have a bearing on the co-production activities—which tended toward being more structured and brokered. Programmed interventions often struggle to reconcile slow, emergent processes with the time-bound and output-oriented management

<sup>1</sup>Knowledge Management for Development, the Climate Knowledge Brokers group, and Research to Action.

**TABLE 3** Summary of six cases of co-production on climate and development

Case	Aim(s) of co-production	Co-production approach	Outputs and/or outcomes
Climate Knowledge Brokers Group (CKB): Climate knowledge brokers' manifesto	<i>Instrumental:</i> Production of a set of joint principles on the role of knowledge brokering for climate change	<i>Brokered:</i> The CKB secretariat approached a range of potential contributors to the manifesto, who collectively undertook a process of gathering viewpoints from a wider set of actors. The group then analysed the findings and crafted the results into the manifesto through a two-day facilitated workshop.	<i>Primary:</i> The primary output was the Manifesto book and an accompanying summary. <i>Complementary:</i> The process also provided a networking and "bonding" experience as the team collaborated on topics that drew group members together. It helped to push the CKB group forward in its thinking about its role in the wider climate change community and how best to play it. Finally, the process connected climate knowledge brokers to climate knowledge users.
Red Cross Climate Centre: Writeshop process	<i>Instrumental:</i> Documenting experience from practice and collective learning through a facilitated peer editing and review processes.	<i>Brokered:</i> Interdisciplinary teams of authors, editors, reviewers and facilitators come together to develop case studies of experiences on a common theme over the course of a week. Through the process participants refine their understandings of their own cases and expand their learning through their reviews of others' experience. In some cases a joint synthesis output is also produced, bringing together the shared perspectives.	<i>Primary:</i> Production of a set of peer-reviewed case studies from each of the participating author teams. <i>Complementary:</i> Identification of common lessons that can be learned and synthesized from across a range of related experience.
Climate & Development Knowledge Network (CDKN) and Fundacion Futuro Latinoamericano (FFLA): Latin American & Caribbean Learning Exchange Workshops	<i>Instrumental:</i> Sharing and documenting the challenges and lessons learned from a diverse (and often disconnected) range of programming activities on climate compatible development funded in Latin America and the Caribbean through CKDN.	<i>Brokered:</i> The design of the agenda aimed to create a balance between creative and rational thinking, generating a suitable environment for dialogue, learning exchange and the collective construction of knowledge. Facilitation techniques aimed to create a space where participants could cocreate a set of lessons learned across the different initiatives.	<i>Primary:</i> Participants cocreated 30 lessons learned, around the design, implementation, governance and priorities for future research on climate compatible development in Latin America and the Caribbean. The lessons were packaged into 1-page documents for each of the projects presented in the workshop, as well as in blog posts, a working paper, and a public webinar. <i>Complementary:</i> The process allowed participants to put forward recommendations for CDKN to improve project implementation in the region and to create a Network in Latin America and the Caribbean. Participants decided to set up a Facebook group continue to exchange ideas on climate compatible development in their region.
Global Forum on Food Security and Nutrition (FSN): "Climate Change and Food Security and Nutrition" dialogue	<i>Instrumental or emergent:</i> A facilitated online forum that is used to either obtain stakeholder inputs into draft reports or policies for further development; or to host more open-ended dialogue around a theme, with the specific output or outcome of that dialogue left open. In the case of the dialogue on climate change and food security and nutrition objectives were more instrumental in nature.	<i>Brokered:</i> The FAO facilitates the forum using two approaches: (1) Consultations—A draft document (e.g., global guidelines, national policy documents) is shared for feedback; there are some instances of radical changes to drafts, in others not, and (2) Open discussions, with opening comments and key questions posed. Both are participatory processes to enhance knowledge sharing/dissemination. In general, FSN believes 50% of participation is for the input itself and 50% is for knowledge sharing and learning for the community.	Varies depending on the approach used. For consultations the output is a revised report/policy/set of guidelines that takes into account stakeholder priorities. For discussions the outcome is a synthesis or scoping of multistakeholder perspectives on selected themes. In the climate change dialogue, outputs included a webinar following the discussion, and summaries in three languages.
CGIAR's Climate Change Agriculture and Food Security (CCAFS) programme: Climate	<i>Emergent:</i> A facilitated online forum used to catalyze interaction and initiate new	<i>Agora:</i> The vision was that the Sandbox could evolve into a self-governing community of practice and act as a	A mix of outputs and outcomes that included: a collective narrative on the importance of social learning to

(Continues)



TABLE 3 (Continued)

Case	Aim(s) of co-production	Co-production approach	Outputs and/or outcomes
Change and Social Learning (CCSL) Sandbox	collaborations between CCAFS team members and external partners using a social learning approach.	reflection of how social learning may work in practice. It focused on encouraging conversations and a slow, organic and sustainable growth of a community of collaborators.	climate change, agriculture and food; collective frameworks on social learning; gatherings of the members; innovation grants to ideas proposed through the sandbox; and a series of publications.
International Potato Center (CIP), Quechua-Aymara Association for Sustainable Communities (ANDES), and the Potato Park: Agreement for the Repatriation of Native Potatoes in Peru	<i>Emergent:</i> For the Potato Park communities, a key objective was to enable a reciprocal (two-way) exchange, and enhance the recognition of their rights over native potatoes collected from their communities.	<i>Agora:</i> Potato Park farmers work with CIP scientists to repatriate and experimentally grow potato varieties native to the indigenous communities. <i>Asociacion ANDES</i> , an NGO which works closely with the Potato Park communities, plays an important role in capacity building and facilitation to enable indigenous farmers to engage in collaborative research with CIP scientists.	<i>Primary:</i> Increased crop diversity resulting from the agreement has provided more options in the face of increased pest infestation, and other changing climate conditions.

processes that tend to govern them (Harvey, Pasanen, et al., 2017). In the two cases that tended towards more emergent outcomes using less brokering, the CIP-ANDES-Potato Park Agreement was grounded in a community partnership that dates back to December 2004 (see Harvey, Pirani, et al., 2017)—far longer than a traditional project or programme cycle, whereas the CCSL Sandbox featured a large core set of collaborators who were part of, or long-time contributors in, the CGIAR system.<sup>2</sup> That these two cases built closely on well-established relationships may have encouraged the design of co-production approaches that favoured emergence and deep interaction. Indeed, lessons from researchers in the Potato Park initiative (see Tables 3 and 4) highlight how adopting a commitment to allowing anticipated outcomes emerge from interaction rather than predefined questions or goals has been a key to effective engagement with the community. This view is supported elsewhere in the literature (Huppe et al., 2012).

It is also possible that the more bounded nature of the co-production activities that emerged from these kind of programmes led to an increased rate of perceived success, given that objectives were clearly defined and achievable within a fixed timeframe. Recent analysis of participatory processes for addressing policy problems ranging from structured to unstructured offers parallels here. Hurlbert and Gupta's (2015) study of a "split ladder of participation" revealed that cases of participation in policy processes tended towards more structured to moderately structured and technocratic problem types, with fewer examples of unstructured or "wicked" policy problems that they posit are the most appropriate contexts for expanding participation and adaptive governance. These unstructured problems, Hurlbert and Gupta (2015) note, are areas where values are likely to be in question and consensus may be out of reach. Thus, for the cases of co-production described here, it is perhaps unsurprising that such examples were less likely to be put forward as instances of "success" in the case sourcing process. Cases within our sample where objectives are classed as emergent either featured participation from a pre-established community (CCSL Sandbox and Potato Park cases) or

explicitly set out to take stock of differing perspectives (FAO's FSN Discussions).

#### 4.2 | Drivers and barriers of co-production processes across the cases

Analysing the drivers and barriers that shaped success across the six cases (Table 4) identifies a number of common factors. These factors align closely with the elements of co-production processes set out by Schuttenberg and Guth (2015), namely,

- focusing on meaningful issues, which we describe as the relevance and/or resonance of the themes;
- engaging representative stakeholders, which we termed participation;
- facilitating shared, iterative learning;
- using constructive decision-making and conflict resolution processes, which feature under "facilitation and design factors" in Table 4; and
- producing a boundary object (often a co-produced knowledge product in the cases reviewed), which featured strongly under "incentives."

In addition to these factors, the cases consistently highlighted the particular influence that language barriers and time constraints can have on the success of co-production across the contexts we have studied. These new features may stand out particularly strongly within the sample of cases due to their international and programme-based nature.

The coherence of drivers and barriers across this sample suggests that many preconditions span approaches to co-production, regardless of whether they are instrumental or emergent, brokered or representative of "the agora." Whether particular criteria are more critical to success depending on the approach was not assessed in this study but could be a useful area for future investigation.

There were some factors that differed across the sample, however. These include sustained investment in a process and a shared sense of ownership.

<sup>2</sup>The CGIAR, formerly the Consultative Group on International Agricultural Research, is a global research partnership dedicated to agriculture, food security, and nutrition in developing countries.

**TABLE 4** Drivers and barriers to success within the cases

Case	CKB Manifesto	RCCC Writeshops	CDKN Exchange	FSN Dialogue	CCSL Sandbox	IPC Potato Park
Drivers	<p>Relevance/resonance: Focus on a topic and content that resonated with the group</p> <p>Facilitation: Strong and experienced facilitation critical for dealing with fluidity and emergence.</p> <p>Ownership: Collective ownership of the process and content throughout the process.</p>	<p>Efficient Format: The writeshop process is a fast and efficient. It avoids drawn-out e-mail conversations and the delays of collaborating over long distances amidst competing priorities.</p> <p>Diversity of expertise and skill sets.</p> <p>Incentives: It delivers a product for participants by the end of the workshop.</p> <p>Design: Provides a constructive platform for feedback, and a pleasant cocreation environment.</p>	<p>Design: Facilitators ensured a good balance between creative and analytical/reflective sessions.</p> <p>The facilitation of the workshop. Relevance/resonance: Captured the interest of participants.</p> <p>The incentives for the participants.</p>	<p>Investment: High-level, long-term support from FAO.</p> <p>Relevance/resonance: topics reflect ideas and interests of the community.</p> <p>Diversity: in both themes and participants.</p> <p>Accessibility: Ensure the processes &amp; technology are easy-to-use, clear and engaging.</p>	<p>Participants: Identifying and engaging those with experience and interest in the area.</p> <p>Relevance/resonance: The group worked to define new issues for investigation.</p> <p>Design: Modelling a social learning approach for activity development and building connections between different disciplines and institutions</p> <p>Incentives: Supporting and promoting publications by members.</p>	<p>Language: The ability of a CIP scientist to speak Quechua was crucial for the integration of traditional knowledge.</p> <p>The facilitation role of ANDES ensured active farmer participation and an equitable partnership.</p> <p>Participants: Active participation of farmers ensured commitment to reaching the project goals.</p> <p>Flexibility: CIP scientists have learned to use an idea as a spark to build a project rather than presenting projects to the communities; and to not be blinded by conventional data collection methods/needs.</p> <p>Investment in capacity building by both CIP and ANDES.</p>
Barriers	<p>Time: Difficult to find sufficient time for strategic conversations in a network.</p> <p>Documentation: Maintaining consistency of structure and content among contributors.</p> <p>Language: The Manifesto was only produced in English.</p>	<p>Time and guidance: Sufficient preparation time and clear guidance for authors are critical.</p> <p>Participants: Challenging when participants are not those with direct experience of the subject matter.</p> <p>Skills: Not having the right skills in the room.</p> <p>Time: Competing priorities and busy schedules make it hard to secure the right participants.</p>	<p>Keeping the momentum: Maintaining momentum and connection after the event ends is a challenge.</p> <p>Participants: Having the right people participate is critical to achieving the workshop objectives.</p> <p>Comfort with sharing—People don't necessarily know how to share their lessons learned, especially deep lessons.</p>	<p>Focus: Balancing specificity with inclusion/accessibility in exchanges.</p> <p>Language barriers: Translation presents significant cost and time barriers.</p> <p>Time: Some users feeling overwhelmed with communications.</p>	<p>Time: Competing priorities detract for collaboration;</p> <p>Format: Members aren't very interested in working online but accept it as a 'necessary evil'.</p> <p>Ownership: Project was nobody's central focus. It was building into the interstices of people's lives.</p>	<p>Time: Regular communication supports information sharing and increased understanding, but CIP's time in the field is quite limited.</p> <p>Documentation: A more systematic process for documenting, storing and sharing information and results of collaborative research is needed.</p>

- **Sustained investment:** The role of sustained investment, both in terms of financing and commitment from organizational leadership, was particularly highlighted in cases where co-production objectives were emergent. In contrast to more instrumental co-production processes that offer efficient means of reaching specific outcomes (for instance, the RCCC Writeshops), emergent approaches that do not feature predefined outcomes may depend more on demonstrated organizational commitment to the value of the co-production process. In contexts where investment in a co-production process cannot be maintained, it may therefore be advisable to adopt more instrumental approaches or to avoid using a co-production approach.
- **Ownership:** While ownership was highlighted across the set of cases, it varied from being a driver to a barrier or, in the case of the Potato Park, remained a key challenge that participants had to navigate by adjusting their approaches over time. The case evidence suggests that ownership of co-production may be more easily developed in instrumental approaches, at least within the context of the cases examined here. This may be due to the more clearly-defined and time-bound nature of these activities, in contrast with the challenges confronted by emergent processes with less focus on specific outputs towards which all members were collectively working. Co-production process design should consider the competing demands that participants will face in determining what kinds of co-production processes are appropriate, indeed if any.

## 5 | DISCUSSION AND DESIGN HEURISTIC

In reflecting on the multicase analysis above and results summarized in Tables 3 and 4, we revisit the three questions posed at the outset of this paper to structure our discussion.

### 5.1 | What kinds of questions or problems are successful co-production approaches being used to answer or resolve in climate and development?

The cases reveal a spectrum of co-production aims in climate and development initiatives. These range from more instrumental aims of improving the usability or relevance of particular information or knowledge to more emergent aims related to changing the framing of problems, the nature of the questions, and the norms of knowledge production. The cases of successful co-production identified for this sample span this spectrum but tend to be more concentrated toward creating useable knowledge. As we have highlighted throughout the paper, the context in which these cases are operating is typical of much of the “programmed” work in this field but excludes co-production activities initiated by social movements, citizens' groups, and so forth, which may influence the questions and aims set out for the process.

We also considered whether the nature of the question, or problem, that co-production is intended to address has influenced the likelihood of perceived success. This appears possible as more bounded

and instrumental ends might be deemed more answerable, or achievable. Four of the cases here also have a clear emphasis on producing collectively owned boundary objects (or knowledge product) as a central aspect of the co-production process. This may make reaching a specific endpoint where success can be declared more feasible (e.g., a co-production event is concluded; a question answered; or a product finalized). Further study is needed to understand how perceptions of success vary across this spectrum of questions/aims and the extent to which that influences investment, engagement, or ownership of particular co-production approaches.

### 5.2 | In these successful cases, how does the co-production context and process influence its outputs and outcomes?

Drawing upon existing literature on approaches to co-production, we characterize co-production processes in two broad categories. In the first, brokered approaches, engagement across different stakeholder groups is mediated, and groups' respective disciplinary or epistemic boundaries are maintained, whilst enabling the production of new hybrid knowledge or boundary objects. Alternatively, through “agora” approaches, interactions seek to disrupt these differences, yielding new perspectives on the collective nature of the challenge in question. Although our sample of successful cases offered examples of both approaches, the use of brokered approaches was more prevalent, perhaps owing to their less disruptive and more structured nature.

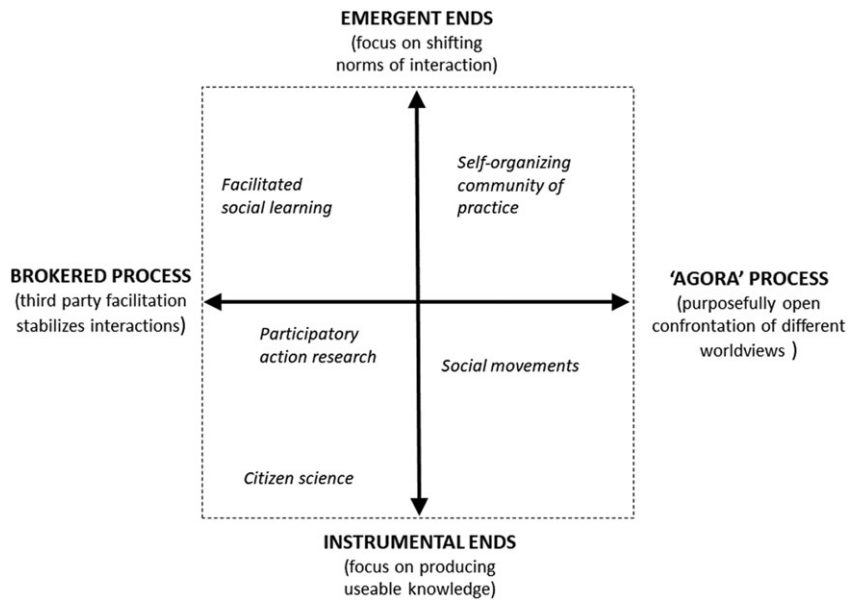
Across all process types, despite the difference in anticipated outcomes, the generation of outputs (or boundary objects) was seen to contribute to the success of the co-production. The centrality of these outputs to the overall aims of the co-production activity differed however, ranging from being the anticipated “end” of the co-production itself to being an incentive that catalyses and sustains participation in the process. These distinctions appear significant in terms of informing the design of co-production processes.

### 5.3 | How do drivers and barriers to success vary across different co-production approaches or problem types?

Across the case set, we found high degrees of similarity in factors, as well as a few key distinctions. The common factors confirm and build on features of co-production set out elsewhere in the literature (Schuttenberg & Guth, 2015). The addition of “sustained investment” and “ownership” as factors within the context of this case set offers important insight about what questions ought to be asked when considering and planning co-production processes. Yet questions remain as to whether the constraints imposed by the project and programming norms in applied and use-inspired research on climate and development actually allow for the full harnessing of success factors that can enable and sustain co-production with agora-style approaches and emergent outcomes (Harvey, Pirani, et al., 2017).

One of the observations on co-production processes that we shared at the outset of this study was that planning and design decisions are not as purposeful and informed as they could be, particularly





**FIGURE 1** A heuristic for reflecting on knowledge co-production processes and outcomes

about how and why particular co-productive approaches should lead to anticipated outcomes that projects or programmes set out. Our analysis has identified that there are different processes, outputs, and outcomes along the spectrum of co-production. On the basis of the literature and the cases analysed, we present a heuristic (Figure 1) that can contribute to a shared understanding of process aims and determine which modality and process are most appropriate for their respective resources, timelines, and objectives. This can be complemented by a review of lessons on the drivers and barriers associated with each dimension of the heuristic, as provided above. This would allow planning to be driven by fundamental questions related to the pathways envisioned for co-production activities to affect the type of change desired, and the approaches that are best suited to the intended aims.

This heuristic draws together the two spectrums of co-production set out earlier in this paper around its aim/ends (from instrumental to emergent) and its approach (from brokered to “agora”). Drawing on the case evidence and the literature, we suggest that brokered and instrumental approaches—where the intended outcome of the process has been clearly defined and interactions are mediated in ways that do not seek to disrupt stakeholder roles or identities—are more likely to yield tangible output-oriented knowledge products within limited timeframe. However, they are less suited to more intentionally transformative aims, such as disrupting norms or worldviews. Conversely, emergent “agora” approaches are suited to the disruptive and potentially transformative aims owing to their more evolving and intersubjective nature. To illustrate this, we have plotted indicative types of co-production activities that may be appropriate to processes that fit in the relevant quadrants. Their placement is, of course, approximate and may differ based on how each activity might be pursued in practice. We have not plotted the six cases reviewed here against this spectrum, as they represent a much narrower range of approaches owing to their contextual similarities, as we have outlined. Future research could test the validity of these observations against a wider range of initiatives.

## 6 | CONCLUSIONS

Emphasis on co-production in responding to climate change and development challenges has grown considerably, as we have recognized how central collective reflection and action are to lasting solutions (Adger, 2003). Although we agree in principle with claims that co-production offers real benefits in addressing the complex, or “wicked,” nature of these challenges (Lemos & Morehouse, 2005; Mauser et al., 2013; Moser, 2016), we caution that the more transformative outcomes that are frequently associated with co-production risk being overstated, or at least misunderstood. Evidence from the sample of cases of self-described “successful” instances of co-production reviewed in this study reveals a strong emphasis on more bounded (in scope and time) and output-oriented processes centred around creating “usable knowledge.” Although this does not represent a shortcoming per se, it does call into question whether such approaches significantly contribute to the “transformative understanding of a sustainability problem” (Schuttenberg & Guth, 2015) such as climate change, or on disrupting or transforming norms of practice.

We have also provided some cautionary observations about the potential limits to co-production within the context of time-bound and project-based climate and development projects and programmes. These cautions point to the potential limits of pursuing more transformative outcomes through co-production within the bounds of conventional climate and development projects. Amidst calls for transformative adaptation capable of shifting existing onto alternative development pathways (Pelling, O'Brien, & Matyas, 2015), as well as the continued dominance of project-based approaches to adaptation, these cases may signal a need for rethinking how the promises of co-production are pursued in this arena. To better understand these limits, future research could compare the approaches and outcomes of co-production processes occurring within and outside of formal projects and programmes. Such research might reveal whether transformational approaches to co-production have greater potential through social movements, citizen-led initiatives, and other nonformal

forms of organizing and invite further debate on the roles such spaces play in transformative adaptation.

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#### AUTHOR BIOGRAPHIES

**Blane Harvey** is an assistant professor at McGill University. He studies how climate change knowledge is produced, validated, and communicated and how facilitated learning and knowledge sharing can support collective action.

**Logan Cochrane** is a Banting fellow at Carleton University in Global and International Studies. His research covers broad thematic areas of food security, climate change, social justice, governance, and collective action.

**Marissa Van Epp** is the Global Communications and Knowledge Manager for CCAFS. Her research spans learning, research-into-use, and monitoring and evaluation in the fields of climate change adaptation, food security, and forest governance.

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