

What is co-production and Scaling up co-production

What is co-production and why it matters. In many typologies and conceptualizations of interactive/collaborative science, co-production is one mode, often the most iterative and intense between researchers and stakeholders. In practice however, it has been difficult to distinguish between co-production and decades-long forms of engagement with societal actors from action-research to collaborative science, to service provision through consultancy (Mach et al. 2020). In this perspective co-production is part of a range of collaborations that define different relationships between science and society. For example, as described by Bremer et al. 2019, Future Earth's conceptualization of the co-creation of science involved "three phases of a transdisciplinary research process: (i) the *co-design* of the research; (ii) the *co-production* of science through conducting the research work; and (iii) the *co-dissemination* (and co-evaluation) of the results. The level of involvement, including who has a leading role, can vary between stages as well as studies." (p. 46). Similarly, Klenk et al. (2015) suggest that co-production is just one of many forms of interaction between scientists and stakeholders. And while these distinctions are relatively easy to classify in theory, in practice it has been difficult to distinguish among different types of interaction without understanding how they happen in practice. For example, is it co-production if researchers and stakeholders meet just once? If outcomes and co-benefits are not clear (especially for stakeholders?) If the relationship is not sustainable outside the confines of a funded project? (Mach et al. 2020). This matters because co-production should be means not an end in itself. It is a costly process in terms of time, money, emotional investment and expectations; we should know and understand better how to maximize impact and benefits across both solving problems and attending to values that are needed for equitable and sustainable solutions.

Scaling up co-production. One outstanding and important question in scholarship and practice is how to scale up co-production (e.g., broadening participation, inclusion, diversity) and to scale up co-produced information, decision-support tools and interventions to address sustainability problems. If we believe, and evidencing is growing, that co-production accelerates knowledge credibility, relevance, trust, buy-in and use then we need to figure out how to scale it up beyond what is currently happening. We can do that through boundary work (e.g., boundary organizations, objects and people/networks); we can do that through technology (e.g., participatory GIS and modeling, crowdsourcing), we can do that through dissemination of knowledge and tools that have been co-produced by peers at different scales. But at this point, research and practice in this area is in its infancy and the need to accelerate action is rapidly increasing.

**Aligning Co-Production of Environmental Knowledge with Trust, Justice, and Equity Webinar
Research and Best Practices of Co-production Panel**

Complex problems such as the climate crisis require innovative actions and recognizing that no one single knowledge system holds all of the answers. It requires bringing a diversity of knowledge systems and ways of knowing and understanding together to address the crises. However, what are the risks, realities, and challenges to consider within this context of “co-production”, and what are the possibilities for transformative change? I pose here more questions than answers, but ask that we collectively consider the following:

Research can be another form of extraction when done within a transactional, colonial-driven framework. In labeling a research process as “co-production”, it’s important to consider if it is co-production in name only and runs the risk of being another extractive enterprise, or how the collaborative, partnership process happens. Is there actually a co-designed and co-created process or are people coming in 90% of the way through, after the decisions have been made?

Who is driving the research question? Who does the research serve, empower, lift up, and for what purpose? Who is determining the indicators to be used and the data to be collected, and holding the data for that matter? Who is considered an expert, and given voice? Who are not just the stakeholders, but the rightsholders? How can the dominating, and at times extractive and violent, research approach be flipped to consider who and where holds the expertise, knowledge, and wisdom?

In the context of the layered and accumulating environmental and social crises unfolding, it’s critical that research is not being done just for research sake; is it actionable? Especially when considering communities forced onto the frontlines and billions of dollars being poured into research, what are people seeing in terms of action and beneficial results? How can research be most useful for people to problem-solve and translate into action?

What are the tensions, challenges, power dynamics, existing injustices and inequities, and histories brought into a collaboration, and how can we be honest about them? Co-created processes are not linear; they are ongoing, iterative, and messy. This process is not meant to be comfortable and that’s okay; it’s important to acknowledge that and not sweep it away. But rather to hold the space and to understand that the process is going to be different in every context; there is no one-size-fits-all approach.

The question is then, how can we move from a transactional research framework to one that is relational and relationship-based, grounded in mutual trust, respect, commitment, and accountability?

One of the most important elements of the partnership process is the start. And this is the part that is so often skipped over or rushed through based on timelines established by agencies and funding mechanisms, which emphasize quantitative outcomes and products over process and critically important work being done that can lead to transformational change but is not necessarily quantifiable.

A key lesson I’ve learned along the way is working together through agreed values and principles. This requires continuous on-going dialogue with everyone’s input. And the importance of acknowledging when mistakes are made and learning from them. Consider greater value and respect given to the time and space that is required to build relationships and approach partnerships in a culturally appropriate way.

The importance of sharing and commitment over the long-term and not helicopter-style “co-production.” Recognizing the blurred space between research collaborations and advocacy and responding to partners’ priorities as those change over the course of the collaboration. Considering one’s own understanding and “conscientization”, and the lived experiences of those with whom we are collaborating in ethically-engaged, co-created work. It’s critically important to come in with an open heart and an open mind. One of my favorite book titles is ‘listening is an act of love’. To listen, to truly actively listen is an acquired skill that takes practice and commitment over time, and can help build critical understanding of how to center justice and equity throughout the “co-production” process.

Overview

Among the many motivations for science that is responsive to societal needs and easily put into action are: attending to challenges associated with unprecedented environmental changes, tackling complex and wicked problems at the intersections between environment and society, reducing the loss of lives and livelihoods and/or increasing societal wellbeing, addressing desires to use technological innovations in monitoring, observation, and prediction, and demonstrating return on investments in the scientific enterprise. Methods and practices, sometimes referred to as action research, community participatory research, end-to-end science, boundary work, production of actionable science, and co-production of science and policy have gained purchase as means to addressing the aforementioned challenges. Implicit in these forms of applied and collaborative science are shifts in emphasis from typical science outputs, such as peer-reviewed publications, to outcomes, such as increased capacity for members of civil society to use science in decision-making, and to impacts, such as demonstrated use of scientific information, predictions, and mechanistic models in decisions. These types of collaborative science can shorten the typical very long delay from data gathering to analysis to review to publication to uptake in the decision process, but often at the expense of a trade-off whereby the results of the science may be incomplete (“best available information”), fraught with uncertainty, less likely to produce groundbreaking or career-making results, and more time consuming to produce.

In my experience, the work is rewarding in that it addresses substantial real-world challenges; however, it is exceedingly rare for this kind of science to follow a linear track from development of scientific insights to incorporation into decision-making. The deliberate co-production of science, with members of civil society, to inform decisions, as many have noted, requires a humble attitude among research participants, an acknowledgment that science may be a minor factor in decision-making, and a bit of proselytizing—to acclimate people to this mode of collaboration, engagement, and look behind the curtain at the scientific process. Due to the nature of most problems that are addressed through this process, such as recommendations of courses of action to address potential impacts of climate change, the work is inherently multidisciplinary...and, since non-researchers *are the key participants*, the work is inherently transdisciplinary—working across disciplinary and social boundaries. By and large, our system of higher education does not prepare scientists for this type of work.

Brief departure

I need to mention the spectrum of engagement and process in the deliberate co-production of actionable science to inform decisions. The process can involve relatively low transaction costs, if the societal concern can be addressed through repackaging of existing information, or through a straightforward consulting process. On the other hand, co-developing science to address complex problems may require researchers to relinquish some control, for example over the formulation of scientific questions, or the determination of acceptable methods for producing results, and may require putting a premium on engagement and relationship building, development of rules for conflict resolution and ownership of the data and products of the science.

Best Practices

Recent literature is replete with best practice recommendations, prescriptions, and suggestions. Some of these, like the generation and use of social capital, may seem like magic. Nevertheless, here are *a few* that rise to the top of my checklist for engaged research to produce usable science:

- Invest much effort in understanding the decision context—everything from sensitivity to the timing of scientific input (e.g., predictions) to examining the non-science factors that play a role in the decision and the use of science in the decision, such as organizational, political, legal, jurisdictional constraints.
- Get a handle on your collaborators' perception of risk and tolerance for risk.
- What are the cultural norms and practices of your collaborator? What's their experience in working with researchers? Do they articulate the research question? Do they have the capacity and the cultural acceptance to incorporate cutting-edge science into their decision process?
- Understand communication flow within the organization and among parties that influence decisions—How does the information flow? What formats are best for the decision-making entity? Who is the best messenger? Who are the influencers and gate-keepers?
 - Corollary: understand communication flow within the project—who best facilitates meetings? Who resolves conflicts?
- Plan, plan, plan and be flexible. This is a process. So, the process must be deemed worthy and *safe* by all participants. It's a deliberate process, so it helps to have an *explicit* plan for just about everything, from understanding of the inputs and resources available to the project, to how to engage participants, to the roles and responsibilities of participants, to establishing an environment and process for mutual learning, to managing relationships among the parties, to the criteria for judging success. I've found that a *logic model* works well—because it forces me (and others) to state our process ideas and assumptions aloud.
 - Yet, we're talking about a process, so it's inherently dynamic and there is a need for flexibility. Things will inevitably evolve—perceptions, perspectives, personnel, public opinion, focusing events (e.g., a natural disaster, in the midst of the research process). Stuff happens!
- Develop trust and social capital. This is time consuming. The quickest path may be through intermediaries (e.g., an extension agent or an institution that has already facilitated strong relationships among players in the decision landscape). Thus, a funding process that aims for 2- and 3-year projects may only serve the consulting end of the co-production spectrum.
 - A steering committee or leadership core, consisting of research and decision-making or community partners, may help with trust building.
- To the degree possible, connect the co-produced science, information, strategies, etc. to *existing* workflows—practitioners are busy enough and no one wants to take on an unfunded mandate.

Successes

In my collaborations to produce seasonal climate-fire outlooks, we had to develop temporary institutions (i.e., a series of workshops and annual meetings) to learn, understand each others' institutional language, build trust, develop capacity to use the products of science, and to develop a product that was trusted by the community of project participants and the community of end users. Once the partners had developed sufficient relationships with climate forecast providers and capacity to generate products trusted by fire management practitioners, we dispensed with

the workshops. The process was operationalized and there was only occasional need for climate researchers to contribute, through breakthroughs in prediction accuracy, or technological innovations to foster synthesis of decision-relevant information.

In my work to co-develop a network of researchers and practitioners to co-produce information and education to reduce the public health risks of extreme heat in U.S.-Mexico border cities, again we needed to develop and/or leverage institutions to incorporate new knowledge. The process was motivated by the need of an agency to address risks by making the most of its early warning capabilities; science included new predictions and studies of risk perception. In the end, key civil society partners, e.g., urban sustainability managers, had less motivation to articulate the initiative as early warning to reduce heat-health risks (“scientist lingo”; “not sexy”), but as an initiative to increase the sustainability and livability of their cities (i.e., the messaging norm that would motivate elected officials to endorse the science pointing to increasing risks).

Challenges

The process is time consuming. It involves people and relationships. Even a world where a mostly white and predominantly male culture of American society dominates, the deliberate co-production of science involves *crossing cultural boundaries*. You can employ shortcuts, making the most of existing relationships and leveraging organizational partnerships, but trust in the process and products involves active participation in developing social capital.

- Honoring social and cultural norms is necessary for a legitimate process. Cleaving to norms implies stasis. Yet, we often expect or need change—sometimes, transformational change. What a contradiction! Transformation may occur through a long process of preparation, through capacity building and shared learning, and will finally be triggered by a crisis. Expecting transformation, no matter how much it is needed, may be akin to expecting instant spiritual enlightenment through mere intention. How often does repeating the mantra “I will be enlightened, dammit!” result in enlightenment? I think of California’s forward thinking climate change policy and, still, the state is overwhelmed by fire-related disasters...or...New York City’s not unsubstantial climate change preparations before Superstorm Sandy.

Another challenge is in evaluating the success of this type of research endeavor. Establishing causality between the process, the research outputs, the outcomes (e.g., behavioral changes), and impacts (e.g., policy change) is often not straightforward. Despite the promise of action, through the deliberate co-production of actionable science, there may be lags in implementation of the science. The uptake of the science may be through participants’ mental models of change, and the implementation may lag, again, until other external factors provoke change—e.g., existence of funding or public support. Moreover, some organizations or communities need “cover” or the safety of another entity serving as the early adopter of an innovation. In this case, what’s needed is an outlet for science-based case studies...a *Journal of Reproducible Science*, to legitimize the science and/or the process in the eyes of civil society partners. This kind of outlet exists in some disciplines, notably public health, but is lacking from most disciplines, where a high premium is put on innovation.

Ethics—there is a fine line between activism and active research. Perceptions of activism may undermine scientists' credibility, and render their predictions, or other scientific contributions, unusable.

Opportunities

Among the opportunities to promulgate the deliberate co-production of science are (a) the societal needs to address concerns generated by the growing annual list of environmental disasters; (b) the appeal of teamwork and developing a shared sense of purpose and contribution through collaborations across disciplines and societal boundaries; (c) the hunger of budding scientists for demonstration of the relevance and use of their science and to learn and exchange insights across disciplines. The latter offers opportunities for transformational change through training and professional development that supplements disciplinary scientific method (e.g., training in team science, active listening, institutions and culture, facilitation, mediation, communication, and so on).

Summary Remarks by Michael Dockry, University of Minnesota

- An acknowledgement: I live and work in the traditional, historical, and contemporary lands of the Dakota people. I am obligated to build relationships with Dakota and other Indigenous people of the region and to support their goals for natural resource management. I teach about and research tribal forest management so others can too.
- I approach co-production of knowledge with Indigenous communities and within the academy as partnerships. Partnerships where all partners are equal and are recognized for their unique knowledge and experience.
- I also support and respect tribal sovereignty, the inherent rights that tribes and Indigenous people have for their own knowledge, data, and cultural resources.
- I support treaty rights. Treaty rights were not granted to tribes from the US government but are rights that were never ceded to the US in the first place. These can be explicit in the treaty language or understood by the tribe at the time as not being ceded during the treaty making process.
- Finally, the federal government has a legal responsibility to consult with tribes on anything that may be of interest or impact them. Land management decisions, programmatic decisions, and rulemaking. This stems from the fact that tribes were sovereign governments before the US was a country, is affirmed in the US constitution, supreme court decisions, executive decisions, case law, and federal regulations. Many states are now explicitly requiring tribal consultation as well. It remains to be seen how Universities respond to this, but I would argue that every university and research institution should have tribal/Indigenous consultation policies.
- This brings me back to partnerships. Co-production of knowledge requires robust tribal consultation which leads to strong partnerships with tribes. For the remainder of this summary, I will discuss some of the research we have published with insights into forming tribal partnerships. Hopefully these examples can provide insights for other institutions to do the same.

Partnership lessons from Kawe Gidaa-Naanaagadawendaamin Manoomin (First We Must Consider the Wild Rice)

Ten tenets for responsible university research with Indigenous people include: honor Indigenous sovereignty and rights; address past and present harms as an essential part of building accountable relationships; be on the path together with researchers and Indigenous partners; recognize, respect, and value Indigenous participation and intellectual labor; encourage the robust exchange of ideas for stronger collaborative research; recognize that documents formalizing a relationship are not the whole relationship; make a plan for identifying and protecting sensitive Indigenous data; be prepared to navigate institutional obstacles; seek, support, and collaborate with diverse students; and actively listen and be open to different ways of engaging with the world.

Summary from: Matson, L., Ng, C., Dockry, M., Nyblade, M., King, H J., Bellcourt, M., Bloomquist, J., Bunting, P., Chapman, E., Dalbotten, D. and Davenport, M.A.

2020. **Transforming research and relationships through collaborative tribal-university partnerships on Manoomin (wild rice).** Environmental Science & Policy, 115, pp.108-115. <https://doi.org/10.1016/j.envsci.2020.10.010>.)

Partnership lessons from the US Forest Service Tribal Relations (Dockry et al. 2016)

Partnership building strategies include: building formal relationships; building informal relationships; respect, listening, and building trust; institutional leadership and engaged leaders; and collaborative land management projects (working together). Barriers to partnership include: bureaucratic structures; competing agency missions (e.g. enhancing treaty resources and oil and gas development); differences in perspectives and expectations; a lack of resources (e.g. money and personnel); and turn-over in personnel and government leadership.

Summary from: Michael J. Dockry, Sophia Gutterman, and Mae Davenport.
2017. **Building Bridges: Perspectives on Partnership and Collaboration from the US Forest Service Tribal Relations Programs.** Journal of Forestry 116(2): 123-132. DOI: 10.5849/JOF-2016-106. <http://treearch.fs.fed.us/pubs/54758>.

Conclusion:

Why is this important? Many Indigenous leaders are calling for society to understand their values in order to confront the myriad social, economic, and environmental problems of today. Researchers, agency leaders, and land managers are looking to learn how to incorporate Indigenous knowledge into their decision making. Building strong partnerships with American Indian tribes is a way to engage with Indigenous people and ideas to learn different ways to understand the world. Finally, research shows us that supporting Indigenous rights and tribal sovereignty supports positive outcomes for conservation and the environment and forming robust partnerships are critical to support these inherent rights.

Why focus on co-production now?

- A reaction to the devastating and ongoing impacts of COVID-19?
 - A reaction to the “racial reckoning” of the past three years?
 - A potential case of interest convergence?
 - A recognition of the need to include frontline communities in the research industrial complex?
 - I think it is important that we identify why we are focusing on co-production in this moment? It is not a new idea (Ostrom 1996; Goodwin 2019).
 - We need to have clear goals for this endeavor
 - We need to avoid the continued exploitation of frontline communities for scientific advancement in the name of “co-production”.
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Frame for the following remarks

- My comments focus mainly on Black populations in the southeastern United States; even with that caveat, this is a highly heterogeneous population.
 - Relationships and trust must be built/based on a willingness to learn about the community of interest.
 - I think the key to developing research priorities/projects that serve frontline Black communities is to develop trusting relationships.
 - Frontline Communities: refers to “often Black, indigenous, or Latinx majority communities that feel the impacts of climate change irrespective of whether they can actually see the change happening.” (Sanders 2021)
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Social Trust (Siegrist & Cvetkovich 2000)

➤ Social Trust & Confidence

- The willingness to rely on those who have the responsibility for making decisions and taking actions related to the management of technology, the environment, medicine, or other realms of public health and safety.
 - Governments, schools, scientists, doctors, etc.
 - This social trust is driven by the perception of shared values between laypeople and decisionmakers.
 - This perception is often measured by proxy based on the following factors:
 - Use similar rhetoric or language
 - Look like you
 - Perceived shared life experiences
 - Social connections
 - A history of trust
- Social trust is what supports governance in a technocratic society
 - Social trust does not exist or has been severely eroded in most Black frontline communities.

Trust with Black communities?

- The Black community is not monolithic, but issues of trust with government and governance systems cuts across a diverse community (Okorodudu & Okorodudu 2021).
- Social Trust has never been fully functional in this community
 - History of racism and ostracization from decision makers and decision making processes in the US.
- There is a need to build trust with Black communities before co- production can occur
 - Symmetrical trust relationships

Empowered as equal partners, difficult but necessary

Building Trust with Black communities for research?

- There needs to be ongoing relationships between Black communities, researchers and funding agencies that are not based on a project or the typical grant schedule (4-5 years)
- There is the need for structural changes
 - Invest in communities of interest
 - Provide access to decision making power (inclusion on standing committees that make decisions that matter)
 - Pay for people's time
 - Provide pathways for members of that community to careers in the agencies and research organizations
 - Pathways for children and adults
 - Share power and resources
 - Power: Black communities need to be involved in the design of research questions, these communities also need to be involved in the crafting of grant calls and the evaluation of grant proposals
 - Resources: Sustained investment in research infrastructure and capacity in Historically Black Colleges and Universities that already have ties to members of the community (Beyond Howard).
 - Sustained investment in HBCU cooperative extension service to reach rural Black communities

Why this is important?

- It's the right thing to do.
- Co-production is key to science credibility. Unfortunately, co-production has traditionally only occurred with affluent, white populations.
 - This type of co-production that focuses on affluent, white populations is the majority of the science/academic-industrial (Culliton 1982) complex.
- This will lead to better research and an expansion of basic and applied knowledge

- This could help science become more open to integrating information and potential methods from other ways of “knowing”
- The Black community is the canary in the coal mine
 - Social trust is eroding between a number of populations and governance actors, including researchers (Macdonald 2020).
 - There is a need to revisit trust relationships for numerous stakeholders in the United States
 - The future credibility of science and it’s role in policy creation and decision making processes is at stake

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Reflections on a Decade of Indigenous Knowledge Research in the Yukon River Basin

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In the past decade, what was once considered novel and potentially risky has become a new focus where research is encouraged. The NSF's Navigating the New Arctic (NNA) program, for example, seeks to fund research that is convergent across the social, natural, environmental, and computing and information sciences, and engineering and addresses the intersection of natural, social, and built systems in the Arctic. NNA is also focused on the diversification of Arctic researchers and co-production with stakeholders.

While this level of encouragement and support by a large funding organization like NSF to take the time to build relationships and co-produce with our community collaborators is heartening, the next step is to promote our Indigenous partners to lead the research themselves. NNA and other similar initiatives provide the opportunity to build capacity in the communities we work in and elevate not only Indigenous voices, but also Indigenous skills, talents, expertise, and right to self-determination to decide for themselves what adaptation to climate change looks and feels like.

Indigenous communities have come to be characterized as vulnerable and portrayed as such in popular media. Recently, the Academy (Marino and Faas 2020) and Indigenous Peoples (Inuit Circumpolar Council 2020) themselves have pushed back against this portrayal of vulnerability. As we seek to conduct science that supports the capacity of our partner communities to adapt to the changes they are faced with, we can also honor these partner communities by naming the many factors that contribute to vulnerability to climate

change. Labeling the people of the Arctic and Subarctic as vulnerable does them a disservice (Haalboom and Natcher 2012). Arctic and Subarctic communities are resilient, though sectors of society may be more or less resilient due, in part, to the outside constraints of the institutions of the state they must work within, which can impact their ability to adapt. When communities are labeled as vulnerable, the historic roots of racism and colonialism that have hobbled Indigenous institutions are masked and Indigenous agency to overcome the obstacles they are faced with and create new institutions is removed (Marino and Faas 2020).

Over the years working at the intersection of natural and social science, Indigenous Knowledge and environmental data, I have learned that the goal is not necessarily point by point integration but instead understanding and working in areas where these two ways of knowing complement one another. As we move forward in this new era of convergent research and knowledge co-production, finding these complementary areas can help to tell the story of climate change in the Arctic and Subarctic. Listening to the needs of our community partners can help produce science that is meaningful and useful for the communities we seek to serve. In this way we may be able to move towards a holistic understanding of climate impacts on Arctic social systems and environments that will allow us to support resilient communities.

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