Article

Discovering the Political Implications of Coproduction in Water Governance

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Abstract: This paper asks what lessons can be learned from experiences with coproduction in water governance. For this, we review a comprehensive corpus of articles in the field of water governance that relies on the term. We find that there are radically different understandings of what coproduction means in different branches of the water governance literature. Through this review, we demonstrate how and why coproduction needs to be analyzed for its political implications. Despite being timely and pressing, these questions are not addressed in a sufficient way by the scholarly debate on coproduction. In order to fill this knowledge gap, we first distinguish different historical traditions of coproduction and then explore their political implications along three questions: The "why?", the "who?", and the "how?". We show that these questions find different answers not just between but also within different traditions of using the term. After describing and contrasting these variants, we conclude by summarizing the main lessons from our review and by identifying questions which call for future research.

Keywords: coproduction; stakeholder participation; water governance; complexity; integrated management; adaptive management; polycentric regimes; transformation towards sustainability; politics of water

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1. Introduction

What is coproduction in water governance? This review finds that there is not a single definition that can faithfully synthesize the different variants of coproduction that have been used in the water governance literature. To highlight the starkest contrast, coproduction has been understood by some solely as the joint production of public services while recently, more and more scholars have begun to describe coproduction as the process or outcome of the joint production of policy-relevant knowledge. It is especially the latter understanding that has risen in prominence in recent years.

This may be due to various international science-policy initiatives, which have called for engaging stakeholders in knowledge production to make scientific knowledge more relevant and usable to decision-making on the ground [1]. The call for this type of coproduction in knowledge-making is driven by high expectations in terms of political outcomes. Proponents are guided by the assumption that more of this type of coproduction will achieve a greater political impact and better outcomes. In the theory and practice of water governance, such endeavors have started to come, for example, from the Sustainable Water Future Programme of Future Earth, a global research platform on water scholarship and policy. Yet to limit experiences of coproduction in water governance to this understanding would be to ignore the rich history of the term in the broader literature.

As coproduction becomes increasingly advocated for, the literature reflecting on coproduction is also increasing. Among the most thorough review articles that have been done on coproduction, Miller & Wyborn [2] conclude that co-production requires reflexivity about the "inherently political nature of producing knowledge in the service of changing the social order" (p. 7). They further state: "The only question is how it is designed and practiced, what practices and processes get used, and therefore which producers play which roles (i.e., how power is allocated) and what products (i.e., knowledge, people and socio-ecological arrangements) emerge as a result" [2] (p. 7). It is this inherently political nature of coproduction that is the subject of this review.

Bremer & Meisch argue that there is a "basic division between two areas of co-production research. The first area regards co-production as the deliberate collaboration of different people to achieve a common goal [...] The second area [...] examines how science and society constantly shape each other in unexpected and unintended ways" [3] (pp. 1–2). They argue that also because of these very different understandings of the term, "*self-reflexive transparency*" [3] (p. 1) is necessary.

Following this line of argument, we move the debate towards showing that the question "What type of coproduction do we want?" is connected to the question of "What type of political implications do we accept?". Despite being timely and pressing, these questions are not addressed in a sufficient way by the scholarly debate on coproduction. In order to fill this knowledge gap, our analysis is two-fold: 1. we review the water governance literature on coproduction, and 2. we investigate the political implications of coproduction.

Our review shows that it is necessary not to conflate different historical traditions of coproduction in water governance. Coproduction has implications that can be grouped into three central political questions regarding: its justification (The why?), the way in which it allocates power and responsibilities between state and non-state actors (The who?), and its effectiveness in policy-making, as well as its legitimacy in exerting power (The how?).

This article aims at unpacking the political implications of different understandings of coproduction in the water governance literature. For this purpose, we take *political implications* to describe the consequences that stem from the adoption of coproduction practices and coproduction discourses that relate to the "who gets what, when, and how" of water governance. We hence define the political implications of coproduction as the changes brought about by coproduction to public affairs, and here especially the consequences for power relations between individuals, groups and institutions.

With this, our contribution is similar to other approaches in the literature that look at the unavoidable political implications of water governance concepts [3–5] but focuses more narrowly on the usage of one term across different fields of study. This is complicated by the fact that there is not a unified body of water governance scholarship. Indeed, we are dealing with a "rather dispersed field of research" with many different overlapping disciplines and approaches [5]. Our focus here is on reviewing a corpus of articles in the water governance literature where explicit mentions of coproduction can be found (that is, research in which the term is explicitly mentioned and centrally relied upon). This analysis constitutes a first step to a more systematic evaluation of political implications for these respective different understandings; it also identifies research gaps and questions which call for future research.

For the water governance literature specifically, there are two main traditions which have to be distinguished: the public services view (henceforth: CoP-PS) and the sustainability science view (henceforth: CoP-SS). The political implications of coproduction vary not just between these traditions—but also within them. This then matters directly for water governance: Should coproduction indeed become more popular in water governance, practitioners and theorists ought to be aware of the political implications of the different variants of coproduction. In the discussion, we argue that this calls for a reflexive approach to water governance when advocating or using coproduction. Put simply: instead of calling for just "doing" coproduction, reflexive governance would ask "what kind, to what end, with whom, and how?".

2. Materials and Methods

Under water governance literature, we refer to research on the efficiency and legitimacy of actors, procedures and organizational arrangements that aim to manage water through formal and informal institutions. Our aim was to create a text corpus containing academic articles that is representative of this broad field of inquiry (which itself comprises a range of overlapping disciplines, theories, methods, and approaches). We conducted an inductive search for academic articles published between 1960–2018 including the terms "co-production" or "coproduction" as well as the term "water" and "governance" for occurrence in the entirety of their texts (The search term was: "((co-production OR coproduction), (water AND governance OR government))" on Google Scholar). Such a search yielded 15,500 articles between 2014–2018, 9780 articles between 2009–2013, 1950 articles between 1999–2003 and 955 articles between 1994–1998, and a total of 1900 articles between 1960–1993. Note that we do not distinguish between different spellings of "co-production" and "coproduction". Only in Science and Technology Studies, the spelling "co-production" is consistently used; in other branches of the literature the more frequent spelling is "coproduction". While there are some conventions of how the term is spelled in different branches of the literature, not all choices are theoretically motivated but are sometimes due to, e.g., spelling conventions of publication outlets. Academic articles which used coproduction as a natural scientific term were excluded (this removes mentions of, for example, carbon monoxide production "CO-production; CO production" but also the usage of coproduction as the simultaneous production of two or more compounds in chemical processes). The search strategy therefore was designed to capture homonymic uses of the term coproduction comprehensively in different areas of the water governance literature. The limitation of this search strategy is that it is possible that some articles on coproduction were not captured in the case the term "water" did not appear in the abstract or title. One example for this is [6] where the authors provide a typology of co-production in flood risk governance.

An inductive conceptual review was performed, aided by existing categorizations from other reviews with similar methodology [3] until conceptual saturation was reached. This means that this review is initial and not systematic as described by [7]. We used an academic citation search engine (Google Scholar) rather than an academic citation database (SCOPUS, Web of Science). As evidenced in several studies, social science articles are underrepresented in Web of Science or SCOPUS reviews [8–10] while publications from outside the natural sciences are more frequently included in academic citation search engines [10]. This inductive search strategy has the limitation of being dependent on the order given by Google Scholar's specific *relevance algorithm*, which ranks results based on citations/occurrence of search terms.

3. Results

The paper is structured as follows: To unpack the political implications of coproduction in the water governance literature we first distinguish between different historical traditions of coproduction (Section 3.1). To these traditions, we pose questions regarding the justification of coproduction (The Why? Section 3.2), the way in which coproduction allocates power and responsibilities between state and non-state actors (The Who? Section 3.3), the effectiveness and legitimacy of coproduction in policy-making (The How? Section 3.4). Finally, we summarize the results in a table before calling for a reflexive approach to coproduction (Section 4).

3.1. Two Main Traditions of Coproduction Concepts in The Water Governance Literature

The genesis of the term coproduction has been studied before, particularly in climate science [2,3]. Miller & Wyborn write that "co-production research developed separately in three academic fields: Public administration [. . .], science and technology studies [. . .], and sustainability science [. . .]" [2] (p. 1). They argue that these different fields "share a set of ideas and theories about co-production that can form the basis for reliably informing sustainability research and practice and designing

sustainability governance" [2] (p. 1). They extract from the "convergences in co-production theories" some recommendations to how global sustainability initiatives could be improved [2] (pp. 4–7). Our review confirms that for water governance, it is helpful to retain the distinction between the different traditions of coproduction that Miller & Wyborn outline. For water governance specifically, we find there is comparatively little written on "co-production" from the perspective of Science and Technology Studies (STS). The STS perspective draws upon "co-production" (not "coproduction") as an analytic approach to understand the mutual legitimation and co-constitution of scientific and political orders [11,12].

Our findings however do not confirm the idea of Miller & Wyborn [2] that different coproduction traditions can be identified that share features from which recommendation on how to do coproduction can be distilled. The practical recommendations given in the respective traditions are too distinct. The review also does not confirm the intuition of Bremer & Meisch [3] who in their mapping of different dimensions of coproduction in climate science suspect a similar pattern to exist for water research (p. 14). In contrast, we find that in the water governance literature specifically, two main traditions of coproduction can be identified: "coproduction" in the public services literature (CoP-PS) and "coproduction" in sustainability science (CoP-SS). These two main traditions see coproduction in a practical-procedural way, as a means to achieve more effective knowledge or service production—even though there is heterogeneity within these traditions. Below we briefly introduce the two main intellectual traditions of coproduction in water governance.

3.1.1. CoP-PS: Coproduction in Public Service Provision

There exists a particularly long-standing use of coproduction that we here call the "Public Services" (CoP-PS) view of coproduction that historically has featured many examples from water governance within the broader framework of public administration studies. The sizable literature on coproduction in the field of public administration has its roots in the Indiana University Workshop in Political Theory and Policy Analysis in the 1970s which was co-founded by Elinor Ostrom [2]. Since then, coproduction has denoted the successful provision of public services through joint actions of citizens and state agencies. Coproduction in this literature is always the coproduction of public services. Early accounts by Parks et al. [13] show that coproduction stood shorthand for consumer-production denoting how citizen-consumers became citizen-coproducers in public services. From the beginning, coproduction was understood as citizen participation in service delivery: "citizens co-produce public services by requesting assistance, cooperating with service agents and by negotiating" [14,15]. Over time, critiques from within the public administration literature have been mounted against the concept as either an explanatory term or as denoting a desirable state of affairs [16]. Hence, within CoP-PS, there are contrasting views of what coproduction is for, even though there is consensus of what it is.

Looking across different articles in public administration studies, one can call this a conceptual consensus: scholars generally agree on what is meant by Cop-PS, even if they criticize it [17,18]. With this, the intellectual trajectory of CoP-PS can be clearly delineated from other concepts of coproduction. Coproduction in the tradition of CoP-PS spans all domains in which public and private agents interact [19]. For this survey, we have only considered those articles in public administration that also refer to case studies relating to water management or governance. Voorberg et al. [20] note that coproduction of public services is frequently discussed in relation to topics such as garbage disposal, library services, health care and education, but that it is comparatively rare in water governance. They argue that this "can be explained by the more direct relationships established between citizens and public officials in these sectors" (p. 7).

3.1.2. CoP-SS: Coproduction in Sustainability Science

The concept of coproduction has also been introduced in the context of *Sustainability Science* [2,3] which will here be called CoP-SS. Coproduction is developed here as a mechanism to increase the usability of information or knowledge to support decision-making [21]. In this strand of scholarship,

coproduction is not located in public service production as it is in CoP-PS, but rather in the *knowledge production* in global environmental research programs, specifically emphasizing the role of knowledge users in coproduction. In this perspective, coproduction is "the outcome of iterations between producers and users of knowledge in which both sides are affected and respond to each other's needs, motivations and limitations (in terms of what can be produced and how it can be used in decisions)" [22] (p. 3).

Such knowledge coproduction has been regarded in the water governance literature as a dialogical process that supports learning processes and transformations and the generation of new blended knowledge forms [23]. Integrated Water Resource Management (IWRM) is often heralded as a key example for successful coproduction processes in water governance [24]. IWRM considers the human and natural dimensions of water advocating an integrationist agenda based on sustainable principles of resource protection, multiple socio-ecological needs (interests of different water users in different sectors of society) and economic development. Proponents of IWRM hold that a cross-sectoral coordination and integration of knowledge for water, food, nature, and industry is required to organize knowledge production for sustainability. Here, under the assumption that technical disciplinary knowledge may not be sufficient to solve complex current water problems, coproduction is seen as a mechanism for integrating (or rather, blending) different types of knowledge, and knowledge holders, in solving a problem. Stakeholders are supposed to also identify issues, risks and solutions missed by traditional science and thus contribute to enlarging the knowledge base for decision-making, complementing science with knowledge that stakeholders find relevant and useful [23,25,26]. With IWRM, we encounter a spectrum of different forms of participation ranging from mere consultation to full collaboration. Building on these concepts, adaptive management (AM) focuses on coping with the irreducible uncertainty present in complex systems, linking knowledge production with social learning processes able to generate knowledge and relationships among actors that are flexible and adaptable to changes. As Pahl–Wostl et al. [27] argue: both concepts are highly theoretical and existing frameworks "have been criticized for struggling to live up to their ambitions [28], and in suffering from problems in translation from research to practice. For example, Biswas [29] has argued that the kind of institutional and organizational integration demanded by IWRM may not be possible, whilst Walters [30] noted that many AM initiatives have 'vanished with no visible product'" (p. 845). Critics of both AM and IWRM have argued that expectations and ambitions have not been met when these concepts were implemented in practice [24,31]. Jeffrey et al. [31] enumerate the political preconditions for making IWRM a success, which comprise "institutional reform [. . .] correct policies, viable political institutions, workable financing arrangements, self-governing and self-supporting local systems". Likewise, for AM they argue that "[s]ocial dynamics and institutional rigidity may complicate the implementation of the AM approach".

Coproduction is not a simple answer to these challenges; coproduction must be accompanied with reflection about its necessary institutional requisites in order to become useful. The participatory elements of IWRM and AM might become either means for empowerment of stakeholders or lip-services. As will be discussed in Section 4, variants of coproduction might be similarly accused of either.

The emergence of the concept of coproduction as *knowledge coproduction* has been reconstructed in various accounts [2,32] with some highlighting the tensions and complementarities between different traditions of coproduction. In the vast majority of CoP-SS research, however, the implicit assumption is made that there is a singular concept of coproduction that can be applied, and that different intellectual traditions have lead up to a concept of coproduction. This point is made explicit by Miller & Wyborn [2] who trace how co-production as an analytical concept in Science and Technology Studies (STS) migrated into the vocabulary of the first proponents of sustainability science literature through the work of Gary Kofinas and Fikret Berkes while also being influenced by the work of Elinor Ostrom. In this argument, the concept found its way into sustainability science through the collaborations of scholars of different disciplines: "Rather than seeing co-production of services (in this case knowledge) as a de facto reality

to be acknowledged and negotiated, sustainability science makes co-production into a normative aspiration: science should be co-produced with its users" (p. 3). However, the usage of coproduction in water-related CoP-PS and water-related CoP-SS differs markedly, and despite the work of certain scholars who personally link different traditions, coproduction in the water governance literature developed along largely insulated intellectual trajectories, as different bodies of work continue to use the term differently.

3.1.3. Other Uses of the Term in the Literature

Our review finds two dominant ways in which coproduction has been understood in the context of water governance: CoP-PS and CoP-SS. Other usages exist but are much less frequent. For example, the term sometimes appears in work on "co-evolution", a term that describes the way in which institutions react and adapt to their environment and that is derived from complexity theory [33,34].

Similarly, while there is a growing literature in the field of Science and Technology Studies (STS) looking specifically at water governance, the term co-production is not used frequently here [35,36]. The term is used more often by articles in human geography. Here, the term is used to describe the co-constitution of the materiality of water and social relations (for example, using the concept of waterscapes). Coproduction is not understood as a "normative aspiration" [2] but as a description of the ontology of water [35]. Scholars are aware of the political implications stemming from this kind of "co-production": "However, whereas scientists investigate in a specific waterscape, they select some categories as relevant, create new ones, and ignore others, in relation with current social and political issues. The co-production of science and social order result [sic] in both new spaces of equivalence and hierarchy of interest" [37] (p. 256).

In the next section, we begin to describe the political implications of coproduction in water governance. We investigate to what end coproduction is invoked in different strands of the literature.

3.2. The Why and to What End?

3.2.1. CoP-PS: Between Value-Neutral Description and Normative Goals of Efficiency

In the infrequent cases that CoP-PS makes a normative claim about the desirability of coproduction (of public service provisions), such processes are evaluated in terms of effectiveness and efficiency criteria [17,20]. Normative claims, i.e. what coproduction *should* be and do, do not go much further than this in the public administration literature. Coproduction processes are here not framed as strategies that could or should be adopted but simply as a class of phenomena that can be empirically investigated. As Voorberg et al. [20] note in a meta-review of coproduction studies, most CoP-PS studies *on* coproduction merely try to identify the factors that are influential in bringing coproduction about—only few studies evaluate the outcomes of coproduction [38,39].

Instead, scholars in CoP-PS try to formulate analytical success conditions while they abstain from making evaluative judgments about the desirability of such arrangements. Overwhelmingly, this is how coproduction is understood in water-related public administration studies. However, and as will be seen below, there are radical conceptions of CoP-PS which disagree, and which attempt to uncover and contest normative claims of what they view as mainstream CoP-PS. Within the tradition of CoP-PS we hence identify two different variants: one that can be called *instrumental*, and one that can be called *empowering*.

Success in coproduction in the public services view was, from the very beginning and in contrast to CoP-SS, about the conditions that allow effective and efficient public service delivery in a way that is attentive to institutional and societal contexts. Nevertheless, most work here can be called instrumental, as it focuses on the achievement of a certain state of affairs, rather than how a participating agent is treated.

Elinor Ostrom [40] featured a case involving water network management, tackling the layout of smaller water feeder lines branching off from larger trunk lines which are laid by residents themselves.

Citizens are here "activated" from the very beginning of the planning process and engaged throughout the project. Ostrom defined coproduction as "the process through which inputs used to produce a good or service are contributed by individuals who are not "in" the same organization" [40] (p. 1073). Famously, Ostrom aimed to describe arrangements beyond the binary abstractions of either state or market governing of public services. Ostrom targeted here a failing top-down technocratic conception of delivering public services. Yet, she also painted a nuanced picture of the role of the citizen, even calling out mainstream economic theorizing and political science as depicting citizens as mono-dimensionally (that is, as merely "casting ballots and watching the action"). For Ostrom, coproduction worked better in a "polycentric political system [rather] than in a monocentric (or, highly centralized) political system".

Coproduction in CoP-PS is a particular form of organizing water management decisions. Mangai & De Vries compare models of public service provision in water management in rural Ghana and Nigeria and describe how citizens have assumed managerial roles within coproduction processes and achieved "deep engagement" [41]. Here, and in similar research, coproduction is an achievement that describes not just the successful outcome of citizen–state interactions but a highly developed form of citizen engagement. Coproduction is synonymous to "[p]articipatory governance delegation", which means "[g]iving full authority to bodies outside government to make key decisions" [41] (p. 84). In CoP-PS, coproduction does not denote engagement for engagement's sake however: Coproduction in this body of literature is functionally defined as achieving desirable public outcomes, e.g., access to clean water sources. The aims of coproduction are decidedly outcome-focused—the normative goal is one of efficiency [14,31,42].

Over time, what was understood as "joint production of services" did change, but not by much. Recently, more emphasis has been given to repeated instances of coproduction. These repeated instances of coproduced public service provision are now summarized under the title of *institutionalized coproduction*. Joshi & Moore [43] define this as "the provision of public services (broadly defined, to include regulation) through a regular long-term relationship between state agencies and organized groups of citizens, where both make substantial resource contributions" (p. 31). Despite an increasing sophistication of how coproduction is described and studied in the CoP-PS literature, considerations of political impacts usually do not go beyond a relatively narrow understanding of making public service provisions more effective.

3.2.2. CoP-SS: Knowledge Coproduction as Participation in Support of Sustainability

Armitage et al. [44] define coproduction as the process of bringing a plurality of knowledge sources and types together as a way of supporting the generation of knowledge that is relevant, robust, actionable, and inclusive. In CoP-SS, this is directed at achieving sustainability. Here, coproduction has the additional feature of including other forms of knowledge than scientific knowledge (i.e., indigenous knowledge): Such a concept of CoP-SS is relevant at multiple scales (e.g., global, like in the intergovernmental science-policy platform IPBES, or in studies focusing on local and traditional know-hows).

In CoP-SS, coproduction denotes the normative aspiration of a new form of knowledge production. However, it is not immediately clear to what end coproduction is argued for in different definitions of the concept in sustainability science. Arguably, there are different justifications for such a kind of participatory knowledge coproduction [45,46]. A good summary of justifications can be adapted from [47]. One justification for CoP-SS is normative, arguing that governance without "meaningful public participation" is not sufficiently democratic unless empowered citizens and affected stakeholders are involved. Other justifications aim at creating public legitimacy and increasing the trust between newly-involved actors and decision-makers, particularly when issues under discussion are complex, uncertain and contested. A third possible justification concerns "the substantive quality of policies and solutions. Non-experts will often identify issues, risks and solutions missed by experts."

The argument here is that diversity of views may make co-produced knowledge and subsequently adopted policies more relevant, usable and actionable (p. 627).

For the water governance literature, we expected to find in CoP-SS a sharp distinction between *instrumental* and *empowering* variants, just like we did in CoP-PS. The major difference is that there are no critiques of coproduction in the water governance specifically. In CoP-SS, nearly all contributions advocate a variant of coproduction that can be labelled *empowering*. The lack of critical accounts of coproduction in the CoP-SS sense contrasts with meta-reviews of co-production in environmental science [32] which come to a different conclusion and criticize that careless implementation of instrumental coproduction strategies can be counterproductive. The category of instrumental CoP-SS (see Table 1) is therefore an abstraction of critical points that *could* be made against coproduction processes, but one that unexpectedly has not been made in the literature. In order to highlight the features of the *empowering* variant of CoP-SS, we use the category here for illustrative purposes.

Table 1. The main implications and differences of two main traditions of coproduction in the water governance literature. CoP-PS: the public services view; CoP-SS: the sustainability science view.

	CoP-PS		CoP-SS	
Context	Public service provision State–citizen interaction Public administration literature		(Global) environmental change research Identification of long-term sustainable solutions to water governance problems Sustainability science literature	
Variants	Instrumental	Empowering	Instrumental	Empowering
Why & to what end?	Output-oriented legitimacy Effectiveness of "products" Effectiveness of polycentric governance	Effectiveness of "products" but rethinking of citizen–state relationship Attention to community values and collective action	Unreflected calls for participation No attention paid to power differentials	Legitimization of different knowledge forms Comprehensive, multiperspectival and creative understanding of water governance problems and solutions Process-oriented legitimacy Generation of blended knowledge Awareness of power differentials
Who?	Citizens and public officials	Communities of citizens and public officials	Scientists in the driving seat; Stakeholders; Policy makers	Scientists as brokers or facilitators; stakeholders; policy makers
How?	Technocratic	New forms of public services provision with meaningful community involvement	Coproduction viewed as purely procedural	Through dialogue and collaboration Supporting interactive processes through reflexive governance

Instead, CoP-SS in water governance literature tries to link a normative aim (science in support of sustainability) with empirical case studies on the performance of knowledge production. It focuses on the quality of the process (such as its salience, credibility and legitimacy, and other input criteria) to make knowledge production more effective and thus enhance its policy impact [48]. Yet in the context of CoP-SS, proponents justify coproduction by the substantive results it will bring about. It is the increasing complexity of water systems which justifies the need for concepts of integrative and adaptive management, co-management and reliance on local knowledge [49] (p. 850). Complex systems are those which are constituted by hierarchies of interacting components with nonlinear and unpredictable behavior, and are characterized by irreducible uncertainties and unexpected responses [50]. Here, humans—and their ability to self-organize—enable a dynamic socioecological system capable of adapting and changing itself [50–52]. This assumption, if taking seriously, implies that disciplinary knowledge silos must be overcome. The awareness of such complexity that gained particular relevance in the water governance literature during the past years has challenged the generation and use of knowledge and called for new ways of organizing governance and producing knowledge for addressing water governance issues. These ideas spawned the development of paradigms that rely on ecosystem management and collaborative decision making rather than the more conventional technical approaches of problem solving supported by disciplinary knowledge [49,53,54]. In these

contexts, knowledge coproduction has been promoted as a mean to achieve sustainable solutions to water problems.

Coproduction is often linked to an adaptive water management paradigm that is "*polycentric*" and is balanced "*between bottom-up and top-down processes*" and includes "*broad stakeholder representation*" [49] (p. 846). Coproduction processes might be, according to the water governance literature, organized under the paradigm of finding consensual solutions or for the purpose of increasing the effectiveness of implementations later on. We can find such justifications in both the literature on IWRM and AM. Edelenbos et al. [25] define coproduction as "ongoing interactions between experts, bureaucrats and stakeholders in developing usable knowledge that crosses different actor domains [. . .]. It involves exploration, discussion and negotiations on the relevance of the different knowledge domains [. . .], but in the end leads to a certain common ground that can be used as a starting point for assessment and decision-making" (p. 677).

3.3. The Who?

Significant differences exist in the type of participants that take part in coproduction. Likewise, differences exist in the proposed procedural and institutional arrangements that enable and constrain real-world coproduction processes. Are actors included into coproduction as passive recipients or active participants? In order to address the political implications of coproduction, it is important to ask: How are processes of coproduction set up and designed? How is coproduction institutionalized and embedded into the broader political context? Can salient, credible and legitimate processes of coproduction (input) increase the scientific, deliberative and participatory quality of expertise (outcomes)? How do coproduction processes effect established power relations and actor constellations?

3.3.1. CoP-PS: Public Officials and Citizens Coproduce Public Services

Most articles that describe CoP-PS typically only involve two groups: public agents and groups of citizens. Indeed, researchers (and experts generally) are usually absent in this literature. Ostrom: "we realized that the production of a service, as contrasted to a good, was difficult without the active participation of those supposedly receiving the service. [. . .] Coproduction is one way that synergy between what a government does and what citizens do can occur" [40] (p. 1079).

Coproduction in this part of the water governance literature is mainly about instrumental citizen-state relations. Within COP-PS, there has however been a contrasting critical empowerment conception. McMillan et al. [16] show how the coproduction concept, whose instrumental usage they trace to the urban governance literature of Ostrom in the 1970s, can be leveraged to become explicitly politicized and part of a larger emancipatory approach. Coproduction is criticized as an outcome of neoliberal policies, seeing participatory processes as a relatively powerless substitute to intentional regulatory failure. Analyzing water and sanitation services in McMillan et al. [16] state accordingly: "In the contemporary context of neoliberal austerity, the concept of co-production has been mobilized to justify shrinking public spending and the withdrawal of the state from guaranteeing the conditions of social citizenship" (p. 202). In this view, "co-production arrangements work to legitimate unequal power relations" (p. 203).

A similar approach can be found in Mitlin [55], who talks about "*grassroots co-production*" as the way in which collectively organized poor can increase their voice in public affairs. With this, Mitlin is explicitly critical of much of the research in public administration on coproduction:

"[Coproduction] research has focused on the contribution of co-production to service delivery rather than looking at more fundamental political issues such as its implications for the distribution of power between organized citizens and the state. The research focus has been on joint forms of service delivery within contextual and institutional analysis rather than on contributing to new forms of democracy and democratic practice" (p. 345). Mitlin [55] speaks about coproduction in public administration in general, and uses some cases from water governance. The point of grass-roots

coproduction has indeed important political implications, as it aims to break with the mainstream view that "the only legitimate agents for the planning and construction of infrastructure are state agencies" [16] (p. 207).

3.3.2. CoP-SS: Scientists and Non-Experts Coproduce Knowledge

Coproduction in water governance literature (particularly knowledge CoP-SS) is assumed, often unproblematically, to advance the *usability* of expertise, to improve science–politics interactions and to democratize politics. According to Pahl–Wostl et al. [49] there is a change from "*command and control* to a more systemic approach rooted in the co-production of knowledge and acceptance of uncertainty" (p. 845)—whereas knowledge production is often located at the local scale, some advocates also call to experiment beyond the local scale:

"Sustainable Water Future frames the sustainability question through a water lens. The science agenda should generate new knowledge through co-production of knowledge of researchers and stakeholders, at and for different scales, from regional to global. The co-production of knowledge will help to ensure clear policy relevance" [27] (p. 710).

When coproduction is understood as such a normative ambition, the participation of non-experts politically implies that stakeholders are brought to the table for instrumental reasons. It is based on the democratic instinct that coproduction also may give stakeholders a voice, giving them a say in decisions that affect their own lives. This reflection about stakeholder and non-expert participation is very frequent in the literature. There has however been much less written about who the scientists are that are involved in—and often propose and push—coproduction processes in water governance. While there is agreement that scientists and non-experts should coproduce knowledge, there is little written about the (type of) scientists who can—and who cannot—participate in transdisciplinary research projects (e.g., can scientists who engage in fundamental research also be part of coproduction?).

Analyzing water stress in the Alpes, Schneider describes coproduction in water governance as a process of collecting different perspectives and views on unsolved problems:

"From this view, the form of integration needed in transdisciplinary research is not only integration proper, as strived for with integrated modeling approaches, but also processes of social learning which, in turn, produce multidimensional spaces of understandings. In other words, an important challenge in co-producing and integrating systems, target and transformation knowledge is to design and implement a research process adopting the suitable means for each issue" [56] (p. 116).

Following a similar rationale, Brugnach [26] claims that knowledge coproduction must support the development of relationships that promote mutual understanding among actors. But she argues that beyond the dictum that participation is good and that it enables different stakeholders to exchange views, coproduction processes must be able to account for the power differentials, inequalities, and conflicts of interests that exist among actors: "This implies creating conditions for dialogue, learning, and negotiation, so actors listen to each other and express their expectations and assumptions, and together can arrive at a mutually acceptable solution. However, doing so is not simply participation. It needs to pay close attention to 'what is going on' in the interaction among actors" (p. 49). Brugnach continues: "Dominant actors may tend to impose their ideas to favor their particular interests [57]. Often, co-production processes must be complemented with empowerment efforts and mechanisms that restore power balance among actors (e.g., legal support, access to information, capacity building) together with the continuous reflection on the rules of participation" [26] (p. 49).

CoP-SS, if justified in the water governance literature in an instrumental way, resonates with maintaining the political status quo, and is not linked to a reconfiguration of allocation of decision-making authority power. More empowering justifications for coproduction are linked to learning and also include the readjustment of political constellations.

3.4. The How?

3.4.1. CoP-PS: Coproduction Pays Attention to Effectiveness or Power, But Not Both

We have seen above that there is a mainstream instrumental view of CoP-PS, and a more radical empowerment view. The latter conception of coproduction [16,55] challenges power relations between citizens and the state, and aims to empower less powerful voices, e.g., the poor, to make their voices heard. McMillan et al. [16] put this critical grass-roots view of coproduction in a direct perspective of water governance. The function of coproduction in water governance should be one of radically rethinking notions of citizenship. This is done through the analysis of Venezuelan water boards, in which community plans have been developed on when potable water is piped up to poor barrios. McMillan et al. show how coproduction in one empirical case has achieved both equity and efficiency in service delivery and led to an empowered sense of citizenship with residents, for example, improving on the decisions of water engineers employed by public agencies. Such a radical perspective on CoP-PS explicitly aims to introduce questions of power into the debate—and therefore questions both the input and output legitimacy of coproduction in public service provision. Indeed, it is noted critically that the instrumental or mainstream view of coproduction in public administration "tends to be simply defined as an organizational form into which any ideological content can be poured" (p. 202) and that, problematically, in "the contemporary context of neoliberal austerity, the concept of co-production has been mobilized to justify shrinking public spending and the withdrawal of the state from guaranteeing the conditions of social citizenship" (p. 202).

Instead, in the radical perspective, coproduction explicitly challenges mainstream instrumental conceptions of CoP-PS that hold that only state agents are legitimate providers of public services. Instead, this variant question so-called social contract views between citizens and the state where citizens "agree to be ruled in exchange for certain privileges" (p. 209). The radical perspective sees coproduction as technocratic. Rather than only bringing about effective and efficient public services, critics argue that coproduction should be much more politically encompassing and transform the very meaning of citizenship [58].

Radical CoP-PS authors in the water governance literature argue in favor of a strategic utilization of coproduction to renew citizen-state relationships, and to put unequal power relations into question, contrary to other coproduction arrangements that, in their view, frequently legitimate these asymmetries. In this variant of CoP-PS, there is an emphasis on both empirical case studies and formulating normative demands upon water governance arrangements. Both instrumental and more radical CoP-PS study instances where water governance is not characterized by traditional top-down administrative command. While the radical interpretation focuses on the emancipatory potential of coproduction, the mainstream interpretation is rather more narrowly focused on finding out more technical success conditions. Hence, the political implications between variants of CoP-PS differ. Here it is important to again note a distinction between all variants of CoP-PS and other understandings of coproduction. CoP-PS does not, unlike other understandings of coproduction, have a pronounced epistemic dimension. Therefore, the focus of CoP-PS is on public services, not jointly produced knowledge.

3.4.2. CoP-SS: Coproduction as Both Paying Attention to Effectiveness and Power?

The political implications of coproduction in CoP-SS raise questions about who has authority and who gets to assert agency, and consequently, about the accountability, representativeness and legitimacy of actors included in joint knowledge production for water governance [32,59]. We know from other fields that efforts to make coproduction "work" often underestimate "the extent to which knowledge and power can be unequally available and differentially composed" [60] (p. 73). They also tend to ignore the unequal power relations concerning how problems are defined and how appropriate problem-solving strategies are adopted [1]. This is true for coproduction across environmental fields generally, and also for water governance in particular [61]. According to Pohl et al. [62] "Power relations

were not blamed as such but were made visible as an obstacle to achieving better collaboration and moving towards more sustainable solutions" (p. 278).

Different variants of coproduction differ also in terms of how they allocate decision-making power, e.g., between experts, civil society and elected decision-makers. This depends, for example, on whether they view coproduction as a discrete phase, whether it is a more metaphorically understood attitude, or whether there are clear guidelines and principles associated in projects to attempt to establish coproduction processes. The answer to the questions "who speaks for science"; "who is invited" and "how are rules of procedure set up" matter greatly [60,63,64]. Observers point out that coproduction, if done carelessly, "obfuscates the inevitable power differences and political conflict in and among scientists, communities, and others with an interest in local or global outcomes, as well as any attempt to reconfigure the relationship between these groups and between knowledge and action" [2] (p. 3).

4. Discussion

The review of the state of research has shown a variety of concepts of coproduction in the literature. Two main traditions could be found: coproduction in a public services perspective, and coproduction in a sustainability sciences perspective. We illustrate that each perspective comes with variants that we call instrumental and empowering, respectively. Our review outlines how and why different traditions and variants of coproduction in the water governance literature have different political implications.

While we stylize our results in Table 1, our results are tentative. Particularly in CoP-SS, we find that the aspiration to "do" coproduction has been more frequently voiced than there have been descriptions of coproduction processes that actually took place. In CoP-PS, it is the other way around: only some scholars have questioned what coproduction is actually for, while descriptions of how coproduction processes take place abound.

There remains little clarity about what coproduction is—and even less clarity about what would constitute "successful" coproduction. Our investigation of the corpus of water governance literature does not allow us to analyze how coproduction took place in the articles under question, and, for example, how it was understood by newly-included participants and stakeholders. Further empirical research is necessary for this. We hope that our review can aid future empirical work by supplying a clearer demarcation of different concepts of coproduction with which to undertake such studies. In particular, a systematic review [7] will be helpful to analyze this.

Given the variety of political implications and the growing significance of coproduction in support of transformations towards sustainability, it is not enough to simply "do" coproduction. A prior decision has to be made on which tradition of coproduction should be followed in water governance, and even more specifically, which variant within those traditions. Different forms of expertise in "doing" and "thinking about" coproduction are available and have been mapped in this article. Maybe what is needed now is a more reflexive approach to coproduction in water governance. We follow here an approach developed elsewhere in the context of global environmental expertise [65]: "The reflexive turn differs from prevailing approaches to [...] institutional design [...] in two constitutive features. First, it calls attention to their epistemological and normative frameworks and thus, second, it opens up a space to consider and evaluate the full range of alternative institutional design options as opposed to implementing a one-size-fits-all model [...]" [65] (p. 81).

In this paper we have demonstrated that concepts of coproduction need to be analyzed for their political implications. Given the political significance, solution-oriented research itself merits full and thorough consideration as to its responsibility in terms of societal goals and values. As Mollinga says: "Reflexivity problematizes the politics of knowledge rather than adopting a simple neutrality or objectivity standpoint" [5] (p. 15). Our review indicates a variety of justifications given for coproduction (see "The why & to what end?" in Table 1). Concepts mainly differ when it comes to political ends—whether coproduction is thought to enhance the effectiveness or legitimacy of water

governance. Further, the water governance literature describes political dynamics in coproduction processes ("Who?" and "How?" in Table 1).

Coproduction is often framed simply as the decision to involve non-experts in water governance arrangements. Yet such inclusion of non-experts can follow different paths. Scientists, decision-makers, and stakeholders ought to recognize the political character of coproduction. A reflexive approach would recommend that all participants engage in modest reflection about their own positions. It also suggests, as Esguerra et al. argue [60] that there is "need for renewed attention to be paid to avowedly normative questions about whose visions are being accorded legitimacy at the expense of [others] [. . .]. What alternative options and voices have been excluded? Are those who insist on legitimacy the right ones to be speaking of it?" (p. 73).

Lastly, by clarifying the potential impacts of putting coproduction into practice, we hope to contribute by opening up and demonstrating a broad range of options how to frame and design coproduction. Indeed, the reflection of having a "choice" of how to do coproduction at all, in the sense of discovering a variety of "coproduction pathways", is often exactly the point at issue. This means both avoiding simplification, and showing different options for doing coproduction, while at the same time holding decision-makers and other powerful actors accountable for concrete choices made [66]. Given the complexity of water related problems and persistent challenges, there is no "one size fits all" concept of coproduction which can be applied to all cases and contexts. Our review has shown that there is also no intellectual convergence towards a singular concept of coproduction.

The quest for a unified account to coproduction does not constitute a robust and equitable response to the challenges raised by complex water problems. Such a narrow understanding of coproduction as a silver bullet to water governance serves to place constraints on the imagination with regard to both knowledge production and the provision of public services in water governance [32]. Hitherto neglected voices and sources of knowledge ought to be included. Similarly, coproduction is often done in a spirit of experimentation and motivated also by an attempt to try new formats of engagement. This is to be commended. We believe however that such engagement also means listening to voices of the past and to understanding the different trajectories that coproduction has taken in the water governance literature and the different lessons that can be learned from these traditions. When putting into practicing coproduction, choices must be made about to what end, who and how coproduction is to be used. Opening up to a broad range options how to frame and design coproduction, we argue, could not only contribute to rendering it more responsive, responsible and democratically accountable but also to catalyzing important political debates about societal transformation towards sustainability.

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