

Full-length article

The role of knowledge in water service coproduction and policy implications

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ABSTRACT

More than 50 years after the seminal studies of Elinor Ostrom, the concept of water service “coproduction” is of interest due to its ability to achieve a delicate balance of governance in the sector. This novel analysis applies a systematic literature review to the water coproduction policies to identify the factors that promote their successful development. The results show that knowledge is the decisive element for newly shared governance. From this study, implications for water management and research are derived.

1. Introduction

The ‘coproduction’ of water services is not new to the literature. In the late 1970s, Nobel Prize winner Elinor Ostrom introduced the concept of coproduction, which drew great interest among academics, practitioners, stakeholders, and policymakers.

Ostrom (1996, p. 1073) defined coproduction as “*the processes through which inputs, used to provide a good or a service, are contributed by individuals who are not in the same organization.*” The coproduction concept appeared in the 1970s in the work of Ostrom and Ostrom (1977), who showed that citizens could perform as coproducers of public services. The theory of coproduction is based on the idea that the consumption and production of public services should involve the participation of citizens (Alford, 2014). As observed by Parks et al. (1981, p. 1002), consumers can act as consumer producers, “acting outside” of regular producers, and thus “*may contribute to the production of some of the goods and services they consume*”.

While Ostrom (1996) and Parks et al. (1981) investigated coproduction in the form of collaboration between public agencies and citizens, other research focused on the nature of such collaboration by stressing the level of coproduction (individual, group, and collective) (Brudney and England, 1983), the role of relationships (Bovaird, 2007), and dimensions of citizen participation in providing public services (Pestoff, 2009). The latter dimension has become particularly critical in defining coproduction and typologies (see Brandesen and Honingh 2016 for a review). In this regard, coproduction can be seen as the relationship between an organization and individual citizens (or groups), where the

latter are directly and actively involved in the work of an organization without monetary compensation (e.g., Ostrom, 1996; Parks et al., 1981; Brandesen and Honingh, 2016).

Undoubtedly, interest in coproduction has grown over the last two or three decades. Examples can be found in various areas, including healthcare, social care, nursing, education, housing, and public utilities. Scholars from various countries and disciplines, including economics, sociology of science, political science, services management, public choice, health management, consumer psychology and governance, are engaging to investigate the phenomenon, especially concerning public administration (Bovaird et al., 2021).

The literature on public administration has interpreted coproduction in different ways, which has resulted in it becoming “a rather heterogeneous umbrella concept” There is disagreement about who should be a coproducer and which activities should be included in coproduction (Alford 2009). For many scholars, coproducers are not only service users and so should be classified according to their roles in the production process; for example, citizens, volunteers, and non-governmental partners can assume the roles of process consumers, suppliers, and partners (Bovaird, 2007; Alford, 2014; Sicilia et al., 2016). Moreover, in the context of public services, the production in coproduction can refer not only to the service delivery phase but also to other activities within the production process, such as planning, design, managing, monitoring, and evaluation (Bovaird, 2007; Bovaird and Loeffler, 2017). Therefore, coproduction “*captures a wide variety of activities that can occur in any phase of the public service cycle and in which state actors and lay actors work together to produce benefits*” (Nabatchi et al., 2017, p. 769).

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Research has shown the benefits of the coproduction of public services, such as better quality of the services, greater economic and financial sustainability of the system, more efficient use of resources and delivery of services, and an increase in the satisfaction of citizens (e.g., Alford, 2009; Voorberg et al., 2015).

It is well known that citizens are increasingly collaborating with public service organizations, so much so that coproduction experiences in various sectors are covered by the literature (e.g., Wherton et al., 2015; Bovaird et al., 2021), especially in particular contexts and countries, including developing areas and the Global South, where delivery capacity is often limited (Moretto et al., 2018).

While the coproduction of public services is recognized as a trend research topic in various sectors, there is no comprehensive picture of the structure and development of coproduced public services in the field of water management. Voorberg et al. (2015) noted its rarity compared to its widespread adoption in solid waste disposal, library services, healthcare, and education sectors. Similarly, although literature reviews have investigated the implementation of coproduction in the broader context of public services (e.g., Voorberg et al., 2015; Sicilia et al., 2019), only one has focused on the water sector (Lepenies et al., 2018). Despite the lack of attention from the literature, empirical evidence shows several initiatives of services coproduction in the water sector around the world, especially where public utilities are more inclined to collaborate with citizens and advocacy groups to provide social and market benefits. Regarding the water sector, coproduction refers to the active involvement of citizens (or groups) in the work of water utilities to obtain environmental, social, and economic benefits from collaboration.

Lepenies et al. (2018) highlighted sustainability science and public administration as two main research streams in the literature on coproduction in water governance. In the sustainability science literature (e.g., Edelenbos et al., 2011; Llano-Arias, 2015), coproduction is considered a mechanism to increase scientific knowledge to support decision-making, emphasizing the role of knowledge coproduction within global environmental research programs (Lepenies et al., 2018). According to Lepenies et al. (2018, p. 1475), the stream of this literature on public administration research (e.g., Jeffrey et al., 2008; Fledderus et al., 2015; Mangai and De Vries, 2018) is “*decidedly outcome-focused – the normative goal is one of efficiency*”, and the focus is on the achievement of desirable public outcomes (e.g., access to clean water). Moreover, political impacts are poorly analyzed, as is the effectiveness of such public service provision (Lepenies et al., 2018).

Despite the growing interest in water service coproduction, there has been no in-depth, systematic analysis of the research in this area. Moreover, the complexity of and multidisciplinary approaches to the investigation of the area require a systematization of the literature. Accordingly, we present here a systematic, structured literature review on coproduction in water utilities to deepen and systematize the principal policy implications that emerge from the research and thus determine which elements are capable of characterizing and promoting the success of water coproduction, in particular in terms of access to clean water, better-targeted services that are more responsive to users, and greater efficiency and effectiveness of service delivery.

We will answer the following research questions:

- (RQ1) What are the prominent research themes around coproduction in the water industry?
- (RQ2) What are the primary policy implications of the research on coproduction in the water industry?

Regarding the first research question, we systematize the studies around the main research topics through a systematic literature review and a bibliometric analysis. Regarding the second research question, we systematize the policy implications highlighted in these systematized studies to identify the main elements capable of characterizing and promoting the success of water coproduction.

The results highlight a central role for knowledge, transforming the primary output of water coproduction processes into a critical input to guarantee its success. Indeed, the analysis of governance models in the water sector has traditionally underestimated the role of end users, focusing instead on rules, objectives, ownership, tariffs, and infrastructures. Thus, the political role of water utilities has also been understated (Lepenies et al., 2018).

Although the literature covers the role of stakeholder engagement in this regard, there are fewer insights into achieving this objective (Akhmouch and Correia, 2016). Case studies highlight both successes (see Fiorentino et al., 2022 re the grant to Native American tribes, page 9) and failures of water coproduction processes (Landriani et al., 2019; Agovino et al., 2021), and highlight how knowledge is the determining driver. In this sense, knowledge can generate trust and therefore improve accountability in water utility decision-making and outcomes. Knowledge is thus an intangible element of governance, capable of orienting organizational action to political purposes.

The contribution of this study is twofold. First, it is not limited to the systematization of the literature but also systematizes the policy implications. Accordingly, the paper highlights those trends on which future research should be focused. Secondly, our results identify a fundamental “ingredient” of successful water coproduction in the form of knowledge. The knowledge from coproduction allows for better identification of problems and the development of efficient adaptive strategies. The involvement of local actors permits a better understanding of the context in which water management coproduction will take place, integrating local knowledge and defining innovative practices.

This study, therefore, guides scholars in planning research on both innovative governance models and new managerial practices; in fact, the coproduction model is here shown to be the only one capable of ensuring stakeholder engagement, which is, in turn, a guarantee of the effectiveness of the governance itself. Moreover, the knowledge made available through coproduction is seen as an essential tool for promoting the role and responsibilities of local actors according to the values of democracy, equity, and sustainability (Cepiku et al., 2020).

This paper is structured as follows: section 2 explains the research methodology; section 3 reports the results of the systematic literature review and the bibliometric analysis (3.1) and systematizes the principal policy implications (3.2); section 4 discusses the findings; and finally, section 5 presents the conclusions.

2. Research methodology

Building upon the prior literature (e.g., Ali and Golgeci, 2019; Agrifoglio et al., 2021), we used an analytical approach that combines two consecutive stages: Stage 1 (S1), the Systematic Literature Review (SLR); and Stage 2 (S2), the bibliometric analysis, using VOSviewer Co-occurrence Analysis (VCA). While a systematic literature review enables scholars to establish the foundation of further academic inquiry, the bibliometric analysis (e.g., Denyer and Tranfield, 2009; Xiao and Watson, 2019) uses quantitative techniques to explore and analyze large volumes of scientific data (Donthu et al., 2021).

Fig. 1 shows the analytical approach used, with reference to the SLR and VCA schema.

In S1, for the SLR of coproduction in the water industry (for an extensive review, see Xiao and Watson, 2019), data were collected from the Scopus platform, one of the most inclusive online platforms for systematic literature searches. An online search (S1, 1. *Running search string*) was conducted in February 2022 using the subject terms “coproduction” (alternately “coproduction”) and “water”. These were chosen based on the managerial literature on coproduction, and they had to appear in the title, abstract, or keywords (TITLE-ABS-KEY). We identified a total of 1.135 documents, of which 228 were in English and related to economics, management, or social sciences (S1, 2. *Identification*). We then removed duplicates and identified those papers that did not match fall within selected subject areas (S1, 3. *Screening and*

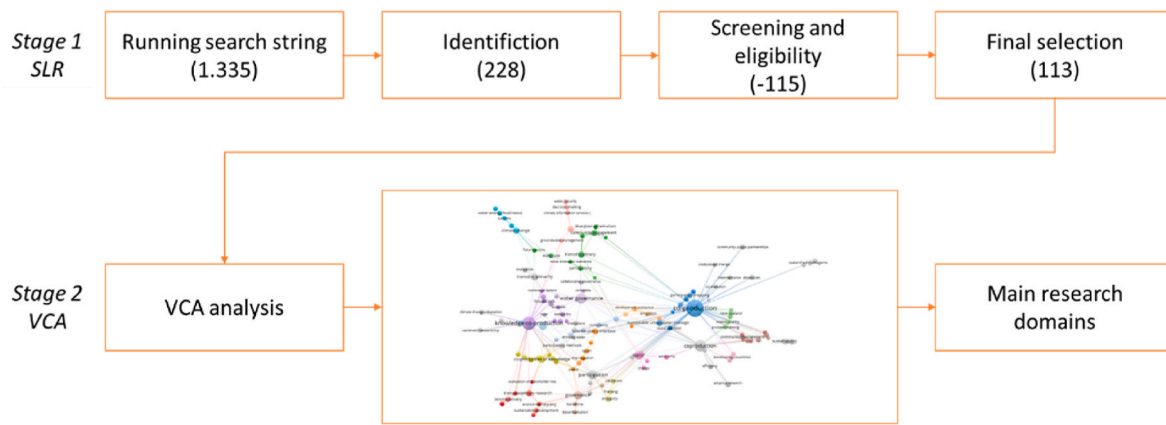


Fig. 1. Schema of the steps in the analysis.

eligibility). This approach left a dataset for analysis of 113 publications between 1998 and 2021 (S.1, 4. Final selection).

In Stage 2, we performed a VCA using VOSviewer, a software tool for constructing and visualizing bibliometric networks (S2, 1. VCA), which led to identifying the main research themes (S2, 2. Main research domains). Before the VCA, descriptive statistics were prepared on publication trends, trends, and most popular sources, and research methods.

2.1. Descriptive statistics

Here we present information on publication trends (Fig. 2), types (Fig. 3), most popular sources (Table 1), and the methodology used in the studies reviewed (Table 2).

Fig. 2 shows a growing interest in coproduction in the water industry, excepting a slight decline in 2019 and 2020. It also shows a significant growth in the number of publications from 2010 to 2018, demonstrating academic interest in the topic.

Fig. 3 shows the types of publication included in the final dataset: journal articles (98, 86.70%), followed by reviews (6, 5.30%), conference papers (4, 3.50%), book chapters (3, 2.70%), books (1, 0.90%), and editorials (1, 0.90%).

Furthermore, we identified which journals published the most papers in the area (Table 1).

The number of articles published in peer-reviewed journals indicates

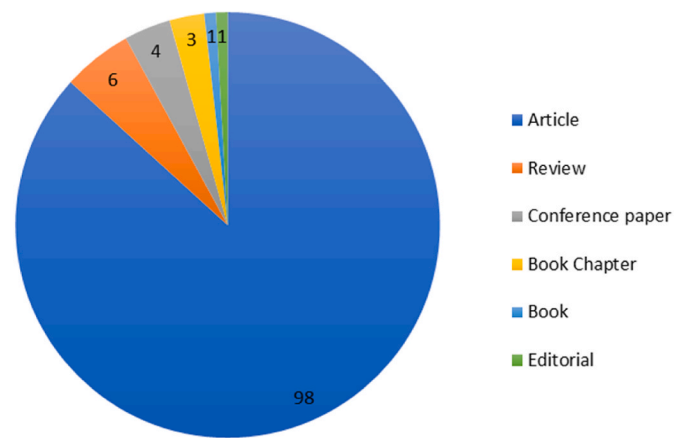


Fig. 3. Types of publication (n = 113).

that the topic is attractive for academics and practitioners. Table 1 shows the relevance of research on coproduction in the water industry to management and economics, as journals in these areas published the most papers on the topic.

Finally, Table 2 summarizes the methodology used in the studies reviewed.

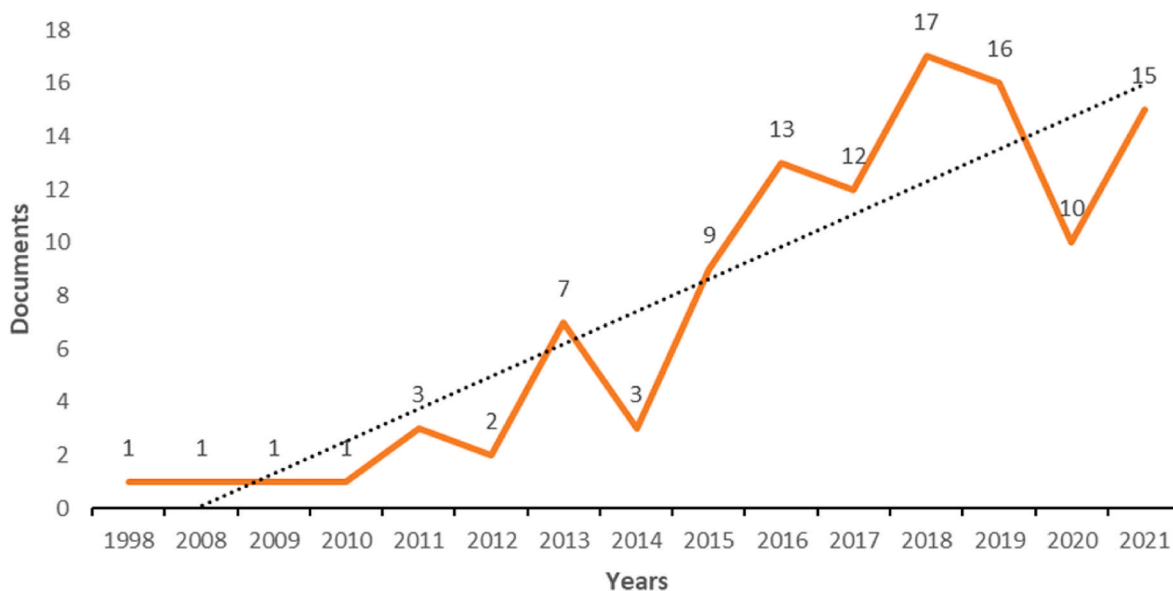


Fig. 2. Publication trend over the years (n = 113).

Table 1

The 15 journals that published the most papers on coproduction in the water industry between 1998 and 2021.

n.	Journal	Count	Citations	Total link strength
1	<i>Environmental science and policy</i>	12	555	186
2	<i>Water alternatives</i>	10	313	220
3	<i>Water (Switzerland)</i>	8	82	189
4	<i>Environment and urbanization</i>	5	67	93
5	<i>Global environmental change</i>	3	68	67
6	<i>Sustainability science</i>	3	106	65
7	<i>Urban research and practice</i>	2	25	154
8	<i>International journal of sustainable urban development</i>	2	1	116
9	<i>World development</i>	2	25	113
10	<i>Habitat international</i>	2	5	68
11	<i>Weather, climate, and society</i>	2	7	58
12	<i>Applied geography</i>	2	15	57
13	<i>Environmental development</i>	2	5	53
14	<i>Coproduction and co-creation: engaging citizens in public services</i>	2	3	51
15	<i>Sustainability (Switzerland)</i>	2	26	35

Table 2

The methodology used in the studies reviewed (n = 113).

Method	Count	Percent
1. Experiment	6	4.05%
2. Case Study	34	22.97%
3. Survey	15	10.14%
4. Interview	28	18.92%
5. Focus Group	12	8.11%
6. Document Analysis	11	7.43%
7. Ethnographic and observational	14	9.46%
8. Mixed Method	25	16.89%
9. None	3	2.03%
Total	148	

3. Results

We first report the results of the VCA (section 3.1) before presenting the policy implications that emerged (section 3.2).

3.1. Results of the VOSviewer Co-occurrence analysis

Consistent with the previous literature (e.g., Van Eck and Waltman, 2010), VCA was used to identify emerging research domains. VCA showed that our “network” of 113 documents is composed of 427 keywords, of which 357 meet the threshold, 1,186 links, with a link strength of 1.207, resulting in 35 clusters. Using VOSviewer, we obtained a map of the co-occurrence network of keywords (Fig. 4) and a map of the co-occurrence network of keywords based on topic evolution by year and density (Figs. 5 and 6).

Based on the VCA and consistent with the literature (Cepiku et al., 2020), we identified three main research themes: (1) the *antecedents* of coproduction, (2) *management tools*, and (3) *outcomes*. Identifying these themes enables us to examine the key dimensions more deeply to understand the success of water coproduction initiatives.

The category “*antecedents*” includes papers that focus on what factors led to the implementation of coproduction and those that affect the collaboration dynamics and the outcomes for the community. As evidenced by Cepiku et al. (2020, p. 15), the emphasis is on the characteristics of the environment in which coproduction takes place and “which creates opportunities and constraints and affects how the coproduction initiative unfolds”.

In developing countries and the global South, there is the challenge of providing clean water (e.g., Zarei et al., 2020). For example, Mangai and De Vries (2018) examine the potential of coproduction in improving access to clean water for domestic use in rural areas in Ghana and

Nigeria. Research in this category has highlighted benefits for local communities. Papers show advantages deriving from coproduction in water management for citizens and, in general, disadvantaged populations, farmers and breeders, and for multiple actors that span the food-energy-water nexus. For example, many studies focus on indigenous communities in general or specific rural areas of Africa, India, and Latin America where the populations have no access to clean water (e.g., Adams and Boateng, 2018; Moretto et al., 2018).

However, the general trend of coproduction concerns a wide array of countries (not just economically weak ones) and sectors of service provision, including European countries (for example, Spain and Portugal), with social innovations as well as increases in the efficiency and effectiveness of public services (Pestoff, 2013). Papers show that coproduction by citizens and public organizations has enabled the local community to develop social practices and multiple ways of knowing about water management, giving rise to communities of practice (e.g., Brugnach and Ingram, 2012; Sletto et al., 2019). As evidenced by Brugnach and Ingram (2012), these new approaches to managing natural resources, particularly water, are based on many stakeholders learning to manage together. However, “the substance of decisions hardly reflects the diversity of meanings and interpretations that the inclusion of multiple actors implies” (Brugnach and Ingram, 2012, p. 60). Brugnach (2017, p. 34) observed that “aligning what we know with what we do is one of the major challenges of contemporary water governance.” Thus, research has focused on the social-learning outcomes of collaboration in environmental management. The concept of “communities of practice,” understood as a social form to manage and generate knowledge, is used to analyze these collaborations. Within communities of practice, groups of people engage in collective learning, which confirms or changes social practice and the associated interpretation. The results of social learning are preserved in communities and their practices through shared solutions and effective stakeholder participation concerning water management goals.

Collaborative governance, based on collective and decentralized decision-making, supports integrated water resource and catchment management and allows the population to access natural resources for essential needs such as water, sanitation and hygiene (e.g., Agrament et al., 2019; Faldi et al., 2019). The “*management tools*” category involves papers that analyze management systems and tools “which play a key role in success or failure, and the sustainability of the coproduced service” (Cepiku et al., 2020, p. 16). Research in this category focuses on processes through which water initiatives succeed and emphasizes best practices. For example, many papers describe the implementation of sustainable drainage systems and blue-green infrastructure that supports water availability and use (e.g., Thorne et al., 2018). Other scholars emphasize citizens’ democratization and empowerment for water management through a participatory design that allows local knowledge to be combined through collaboration between scientists and stakeholders (Popovici et al., 2020).

Numerous case studies, mainly a narrative approach, show an effective coproduction of knowledge to protect water quality (e.g., Brugnach and Özerol, 2019). In these coproduction processes, local people inform and collaborate with professionals to plan, manage, and monitor water facilities (Jackson et al., 2019). The knowledge coproduction and transdisciplinary approaches enable citizens and experts to collaborate to improve water quality for human use, supporting the science-policy interface (Howarth and Monasterolo, 2017).

Many papers have shown that local community engagement through coproduction seems to be a successful strategy (Jackson et al., 2019; ; Mangai and De Vries, 2018). According to Jackson et al. (2019, p. 3), deep engagement is a set of “deliberate strategies for involving those outside government in the policy process,” where the policy process covers the “ways of making policy decisions and ways of implementing them.” Moreover, Stewart (2009) distinguished five levels of citizens’ engagement based on the degree of involvement with the government in service delivery. Thus, the level of interaction between the public sector

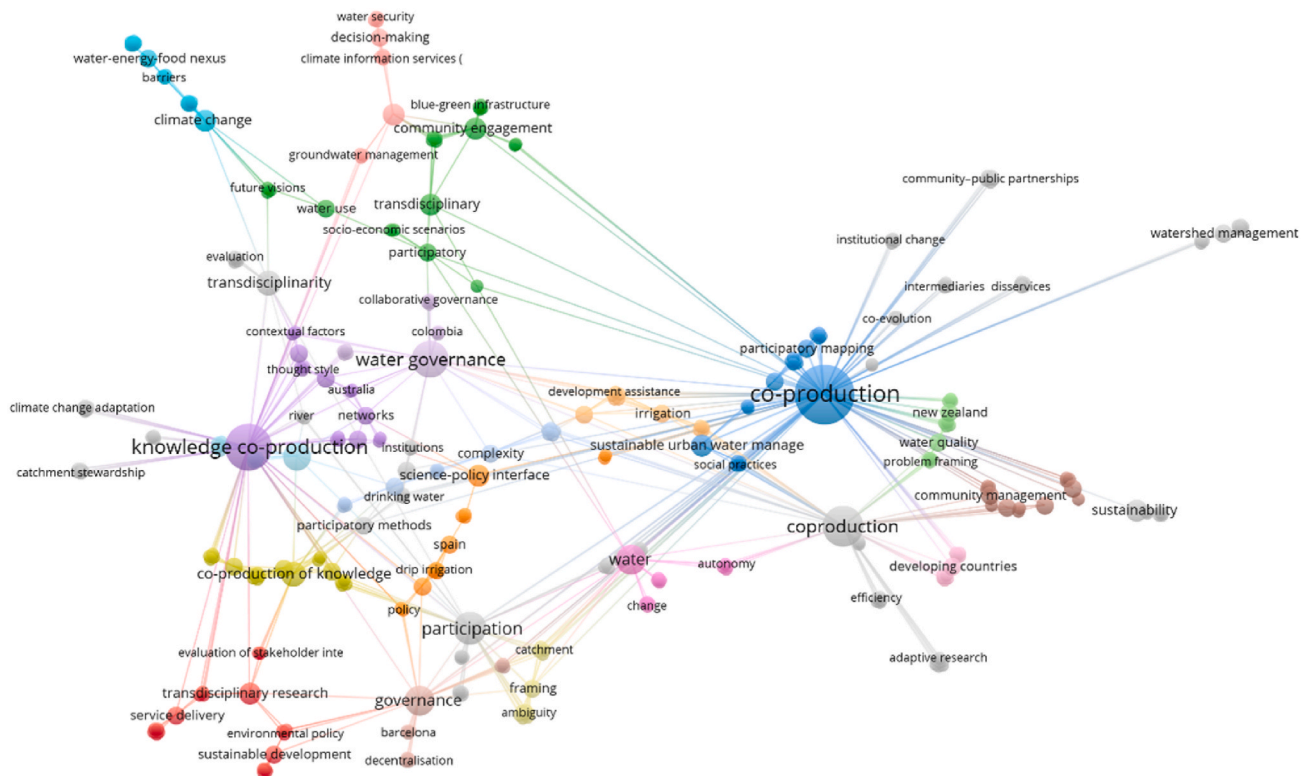


Fig. 4. VCA network visualization.

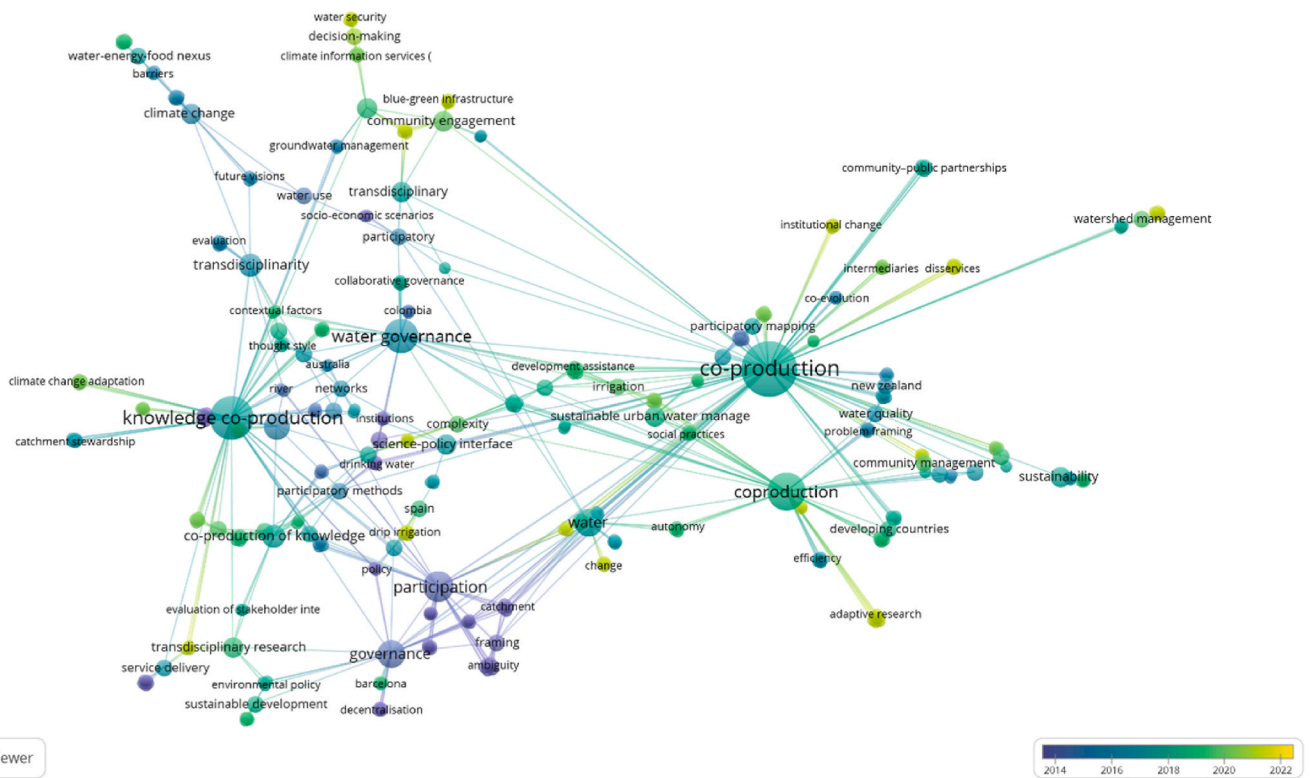


Fig. 5. Topic evolution by year.

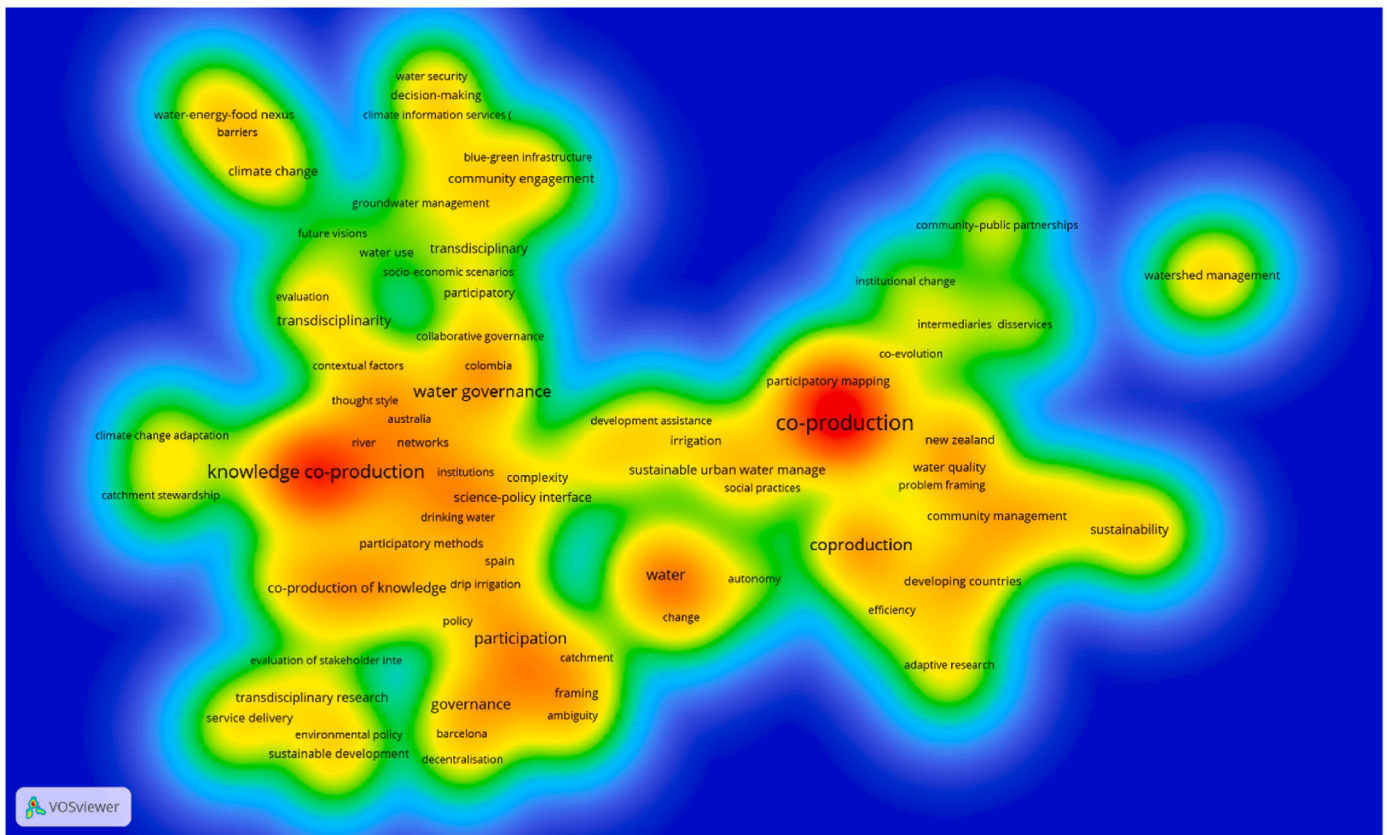


Fig. 6. Density visualization.

and citizens indicates the following forms of engagement: the provision of information only, consultation, deliberation, partnership, participatory governance, and delegation. In Jackson’s model, it is only at the levels of interaction starting from deliberation that citizens contribute in any decisive way to decision-making. According to Mangai and De Vries (2018, p. 84), deliberation, as a “vehicle of learning,” means “processes by which the preferences of the citizen become known and incorporated in the decisions to be made.” Therefore, deep engagement “needs to be promoted at every stage of a policy cycle, from policy preparation, through decision-making to policy implementation and evaluation” (Mangai and De Vries, 2018, p. 85).

Only in this way can new and innovative policies be derived. An example of such community involvement is how, in April 2022, after some environmental disasters, the State of Washington granted the management and protection of water resources and hydroelectric plants to Native American tribes, enshrining the principle that the heirs of the first inhabitants can protect natural resources better than anyone else. Within this engagement process, numerous water users, associations and citizens can have different roles as coproducers and collaborate on policymaking, design, and the delivery of services, giving rise to several forms of relationship with public sector actors (Bovaird, 2007).

Many papers that refer to coproduction experiences highlight the different consequences regarding outcomes on the local communities and regions in which they are embedded (Cepiku et al., 2020). Research in this category examines coproduction in the water management field as an enabler of sustainable cities and development, urban transformation, and environmental policy that favors better land management as well as more effective food-water-energy systems (e.g., Hellström et al., 2000; Hu et al., 2019; Tsani et al., 2020). Moreover, scholars show the role of coproduction within environmental management systems (e.g., Djenontin and Meadow, 2018). This greater environmental participation and collaboration has generated positive results in managing ocean acidification, coastal zones, groundwater, and river

basins. Many positive results have been achieved for rural water supply from organic farming, drip irrigation, centralized fertigation, and rural drinking water (e.g., Hutchings, 2018).

Finally, research focuses on the role of coproduction in knowledge creation and learning to give indigenous communities greater autonomy in water management (e.g., Bradford et al., 2016; Jackson et al., 2019). Coproduction of knowledge is a “practice of co-evolution and co-shaping of knowledge from different sources and types to co-define shared problems and build an integrated understanding of the local problems” (Zarei et al., 2020, p. 262). Through the involvement of experts, government and local stakeholders, the coproduction of knowledge have been used in many developing countries as a strategy to cope with water scarcity. Thus, scholars have focused on knowledge coproduction to emphasize the integration of local and scientific knowledge domains for devising viable environmental management and adaptation strategies.

3.2. Results of policy implications

The 113 papers examined reported 232 policy implications for management and institutions. We grouped these implications into seven

Table 3
Policy implications.

n.	Policy	n	%
1	Local stakeholder engagement	60	25,86%
2	Governance/network	56	24,14%
3	Knowledge/learning	44	18,97%
4	Country contest	22	9,48%
5	Sustainability	21	9,05%
6	Technologies/infrastructure	15	6,47%
7	Communication/accountability	14	6,03%
	TOT.	232	100

categories according to their logical-conceptual affinity, as shown in Table 3. About 90% of the implications are placed in the first five categories. The themes appear not only to be connected but also to be consistent with the results obtained from the SLR discussed above.

More than a quarter of the papers (25.86%) report on the involvement of local communities or stakeholder engagement. It is interesting to note that this is, on the one hand, the main result of the coproduction process but, on the other hand, also a fundamental input of the same process. In other words, our results confirm that the primary feature of the success of coproduction in the water sector is the active involvement of local communities and stakeholders in general. In fact, in the various works, the beneficiaries are numerous and include, alongside the direct beneficiaries (the end users of the service, understood as citizens or farmers), the suppliers, local authorities or regulators, as well as technicians, non-governmental organizations (Birkinshaw et al., 2021), and even schools (Arasteh and Farjami, 2021). Interestingly, Foran et al. (2019) see this multiplicity of stakeholders as potentially problematic rather than an added value because it risks impeding decision-making.

This new network governance model is evidenced in about a quarter of the works (24.14%) and forms the second theme. That is, coproduction produces a new governance model, one that is democratic (Cook et al., 2013), open and participatory. Indeed, precisely these characteristics appear to be necessary to the success of the model itself.

The results, therefore, seem to indicate that the current governance models, based on the almost exclusive involvement of suppliers, local authorities, regulators or the State in the decision-making and production processes, are inadequate or at least insufficient to develop coproduction (Agbemor and Smiley, 2021), given that the active involvement of local communities and other stakeholders is necessary.

Third, according to the analysis, knowledge is seen as underpinning the link between stakeholders and governance (18.97%) and probably is the main output, albeit non-material, of the coproduction (Coletti and Dotti, 2021). That is, in line with what has already been highlighted, knowledge development comes as the main ingredient for the success of coproduction. One of the classic limits in the provision of public services is precisely a lack of knowledge of the end user's needs on the part of the supplier (Nel et al., 2017). It should be remembered that the service is a monopoly and that the steering functions are the granting body's responsibility, not the beneficiaries (Mees et al., 2016). At the same time, knowledge stimulates stakeholder engagement, participation from below, and the creation of bonds of trust (Mubaya et al., 2020), which, overcoming the difficulties of classic governance models, pave the way for the active involvement of actual users. Knowledge also generates greater awareness of the use of the asset, which is especially relevant in the water context, given the general scarcity of the resource, which now also affects rich countries such as Italy (Ranzato, 2018; Arasteh and Farjami, 2021).

Moreover, the debate in the literature on governance models for the water sector is still linked to the classic public/private dichotomy, and there is less research on coproduction, where the end users, or the primary beneficiaries of the service, are involved in strategic decisions (Mangai and De Vries, 2018; Birkinshaw et al., 2021). According to the theories of business efficiency, the most effective ownership system is the one that guarantees the lowest costs that the business generates in its operations, both in the markets and through its governance mechanisms. The most suitable owners of a business are those for whom the costs of market imperfections are high or damage them the most and who therefore seek to reduce them constantly (Hansmann, 1988).

In this regard, in April 2022, after some environmental disasters, the State of Washington granted the management and protection of water resources and hydroelectric plants to Native American tribes, establishing the principle that only the heirs of the first inhabitants of those places can protect their natural resources better than anyone else, based on their established knowledge.

Fourth, linked to the themes or categories discussed above, there is the country theme (9.48%). The analyzed works tend to contextualize

coproduction in a way that suggests that this model is replicable only in certain contexts, depending on the specific and general institutional regulatory frameworks (Sicilia et al., 2019). These are crucial elements in addressing the particularities of governance models at the country level, but the empirical tests appear non-specific in this sense. The countries present in the database are very different, spanning Europe (Spain, Portugal, Holland), Latin America (Scott et al., 2021), Palestine, Vietnam, Australia, Zimbabwe, China, USA, India, Ethiopia (Annala, 2021), and Cambodia. This finding suggests that the country effect is relevant, but not decisive, for the success of the different coproduction models. The poorest countries face water scarcity; the richer ones appear to be more oriented towards productivity increases in the agricultural sector (Das, 2016; Moretto et al., 2018).

The theme of sustainability is reported to be a factor influencing coproduction policy in only 9.05% of the papers. The universality of the topic (across countries and areas of policy concern) probably means that it is often not specified as a factor or keyword in the policies of interest in the present study, even if the links with governance and stakeholders are evident.

In the remaining works, the analysis concerns the instrumental component of coproduction, issues not to be underestimated and understood as weak signals. The least common two themes are the instrumental component of coproduction and communication. The instrument component is infrastructure (6.47%), both technological and innovative (Medema et al., 2014; Sorrentino et al., 2018; Pedregal Mateos et al., 2020), and traditional, such as irrigation systems and aqueducts (Poblador et al., 2021), the importance of which should not be underestimated. Communication is understood, in the works examined, as transparency (6.03%), where again, albeit on a more operational level, the information element (Eden et al., 2016; Bukowski, 2017) is necessary for the involvement of stakeholders and so ensuring the success of coproduction initiatives.

4. Discussion

The results of our research make it possible to group them into three categories: antecedents, management tools and outcomes (Cepiku et al., 2020). Table 4 shows the aggregation.

First, it emerges (because it is apparent in some 60% of the papers) that two antecedents are necessary for coproduction: the involvement of local communities and other stakeholders; and bottom-up governance mechanisms that combine the legal/institutional context with requests from those same local stakeholders. These antecedents, or drivers, must then be able to take advantage of a series of increasingly essential tools in coproduction processes: new information technologies (such as ICT, social networks, internet, and platforms) and water infrastructure.

The main result reported in the literature is knowledge. There is also the question of sustainability, which can sometimes be considered too general, at least if the analysis focuses on management and institutional policies like ours. These two have not been reported in the previous SLRs (Cepiku et al., 2020), which, while detailing a series of results for different categories, remain on a general level. In this sense, coproduction takes on more of a non-material meaning as a political matrix (Miller and Wyborn, 2020), but this is investigated in only a minority of

Table 4
Water coproduction policy according to the framework proposed.

POLICY	framework
local stakeholder engagement	Antecedent
governance/network	Antecedent
country institutional contest	Antecedent
Knowledge	Outcome
Sustainability	Outcome
technologies/infrastructure	Management tools
communication/accountability	Management tools

Source: Cepiku et al. (2020).

the papers (less than 20%); instead, a more in-depth analysis of coproduction would lead to a definition of its prerequisites or enabling conditions (input). This perspective is particularly relevant in the water context, where, given the scarcity of the resource and, at the same time, its vital importance, management inspired by collective logic and unmarked by market logic is especially necessary (Akhmouch and Correia, 2016).

In the literature on the coproduction of public services (Cepiku et al., 2020), the distinction between individual, group and collective benefits is repeatedly present (Nabatchi et al., 2017), as is the classification of the actors (Alford, 2014). In the case of water companies, albeit less analyzed in depth, the collective or political dimension, as will be better explained below (see also Lepenies et al., 2018), becomes the prevailing, if not the only, perspective for interpreting the phenomenon. Much of the research has progressively interpreted the original thinking of Ostrom (2009) to enhance the contribution of the various stakeholders (Thomas, 2012; Alford, 2014), organized in very different ways than the traditional governance models rather than understanding their ultimate purposes (Goodwin, 2019; Osborne et al., 2021).

From the theoretical point of view, the public governance framework (Osborne, 2006; Sorrentino et al., 2018; McMullin, 2021), although it puts participatory decision-making at the center, instead of uncritical acceptance of the market, implicitly underestimates the more comprehensive public purposes of the governance. For example, in the well-known work of Nabatchi et al. (2017), the authors, while classifying the phenomenon according to the different categories of beneficiaries, finally ask only three questions to understand the phenomenon of coproduction: who, when and what.

In another SLR (Sicilia et al., 2019), it is interesting to note how the theme of knowledge is instead placed as a facilitating input for coproduction. In our results, however, although the boundary may appear subtle (Lepenies et al., 2018), the theme of knowledge is more affirmed as a policy implication, as if to signal that there is an upgrade from one level of knowledge (primary) to a higher, incremental, new learning level. The knowledge output thus becomes an input for the success of water coproduction, acting as a sort of initial condition for developing learning, awareness, and empowerment.

Finally, the theme is taken up in the paper by Lepenies et al. (2018): the only SLR specifically on coproduction for the water sector. The analysis focuses on the overall purposes of coproduction that emerge from the literature and makes an interesting distinction between the sciences of sustainability and the more traditional ones that study public administration and public services. In the latter case, Lepenies et al. investigated why coproduction has received little research attention compared with the abundance of studies on procedural dynamics. That is not the case, though, if we consider the research carried out in the field of sustainability sciences. That research, therefore, concludes by highlighting the need to implement new research on the political matrix of coproduction choices capable of reorienting its governance.

In this sense, our results, in the same field but from different premises, are consistent with those of previous studies, confirming the prevalence of “process” approaches to coproduction but at the same time highlighting the theme of learning as the main political output of coproduction (investigated in just a few papers). The present work advances the SLR on water coproduction.

The complex debate on water governance (Lieberherr et al., 2012; Beecher, 2013; Guerrini and Romano, 2014; Berg, 2016; Akhmouch and Correia, 2016; Bel and Fageda, 2017; Schoute et al., 2018; Romano and Akhmouch, 2019; Warner, 2021) suggests that a dynamic approach is needed, based precisely on learning, and not a static or universal solution, the impossibility of which the literature has already confirmed (Warner and Bel, 2008). Instead, the various institutional solutions tested need to be continuously and incrementally upgraded, linked to the ability to directly involve stakeholders at a “polycentric” level (Ostrom, 2008). Continuous knowledge and learning modify governance structures, improving them for an ever-wider audience

(Pahl-Wostl et al., 2013; Lautze et al., 2011; Jiménez et al., 2020). This situation is particularly true in the case of water governance, where the multilevel approach has been reported in the literature (Gupta and Pahl-Wostl, 2013; Gupta et al., 2013).

The same conclusion can be drawn, more generally, from the results reached by the SLR of Palumbo and Manesh (2021, p. 26): “*Future research should be directed at investigating what are the factors that stimulate – or constrain – the citizens’ engagement in individual, group, and collective co-production. Collecting evidence from exceptional public challenges will provide us with some guidelines to inspire a reconfiguration of the value creation model adopted by public sector entities, informing the design of a sustainable people-centred public governance model*”.

They discuss the theme of motivation (Fledderus and Honingh, 2016), which could represent the first step towards knowledge, which we have identified as the main result. Other studies that highlight and detail the role of motivation do not, however, refer to an increase in knowledge (Cepiku et al., 2020). It is interesting to note that, in our review, the concepts of “empowerment”, “awareness”, and “learning” all refer to an increase in knowledge, but the term “empowerment” is present in our database in only two articles (Ranzato, 2018; Sletto et al., 2019) and the word “awareness” in none. This finding further highlights that managing water coproduction processes concerns a broader dimension of a “common” nature (Taylor et al., 2019).

In this sense, there is a difference between water coproduction and the coproduction of public services: knowledge, on a collective level, thus becomes the guarantor of the success of water coproduction and generates empowerment, awareness, and learning. Moreover, knowledge generates trust by stimulating a spontaneous dialogue between stakeholders, institutions, and politicians.

5. Conclusions

More than 50 years after its first definition by Elinor Ostrom, the theme of coproduction remains of considerable relevance and, indeed, according to some authors, its relevance has “risen” (Cepiku et al., 2020). The reasons for this appear to be multiple.

On the one hand, it is a simple yet complex approach, therefore capable of being adapted to multiple contexts and indeed of often presenting itself as a salvific solution, where other frameworks have mostly failed (Cepiku et al., 2020; Dudau et al., 2019; Voorberg et al., 2015). Its simplicity lies in the possibility of it being understood by broad categories of stakeholders (D’Amore et al., 2021), the same ones for which the model aims to stimulate active participation. On the other hand, the multidisciplinary nature of the studies that have addressed the issue of coproduction is significant and has helped to move the frontiers of knowledge forward. Indeed, it is still an open area of research, above all, because, in the opinion of the writers, its empirical applications have been much less than would appear to be warranted by the theoretical research. Moreover, numerous studies have used the SLR method and contributed to the consolidation of a framework for public services in general (Cepiku et al., 2020), one that opens new avenues for research that promise to have important empirical implications. Our work is part of this trend. Nevertheless, as far as we know, this is the first attempt to systematize the coproduction policies on the management of water utilities.

The literature has investigated in depth at least three dimensions of coproduction in public services: antecedents, management tools and outcomes (Cepiku et al., 2020). The studies that fall into all three groups emphasize, directly or indirectly, the role of knowledge that allows users, especially the less well-off, to access water resources to satisfy essential needs through coproduction.

To give a few examples, some studies have reported several experiences of coproduction that have enabled the local community to develop social practices and multiple ways of knowing about water management, giving rise to communities of practice (e.g., Brugnach and Ingram, 2012; Naiga, 2018; Sletto et al., 2019) and favoring a collaborative

governance approach based on collective and decentralized decision-making (e.g., Agramont et al., 2019; Faldi et al., 2019). Another study highlighted the rise of a process of democratization and empowerment of citizens concerning water management through a participatory design that combines local knowledge and collaboration among scientists and several groups of stakeholders (Popovici et al., 2020). Numerous studies show the strategic role of coproduction of knowledge and stakeholder engagement in protecting water quality (e.g., Brugnach and Özerol, 2019; Jackson et al., 2019; Mangai and De Vries, 2018; Howarth and Monasterolo, 2017; Mangai and De Vries, 2018). Moreover, other studies focus on the role of coproduction for knowledge creation and learning to support the emancipation of indigenous communities through greater autonomy in water management (e.g., Bradford et al., 2016; Naiga, 2018; Jackson et al., 2019).

The results presented in the first part of this paper (the SLR) confirm those of previous studies on the water sector, which has seen numerous experiments and coproduction practices, not only in the poorest countries, as might be intuitively expected, but also in the more developed economies, in Europe, China and the USA. The theme of water, in truth, always has naturally and historically lent itself to hosting experiences and debates on coproduction, which make cross-country comparisons always relevant.

The inadequacy of the state/market management dichotomy is still debated in the literature today (Warner, 2021). As a critical and vital resource, water is characterized globally by profound social inequities in distribution, access, and tariffs (Bakker, 2001; Liao et al., 2019; Neto and Camkin, 2020). The water crisis is, in the first instance, a crisis of its governance (UNESCO, 2006), and we find little political and decision-making legitimacy, a lack of trust and a lack of participation of citizens, as well as a managerial lack of ability and responsibility (Bovaird and Loeffler, 2017).

Numerous initiatives, such as the water governance principles (Akhmouch and Correia, 2016) or the Water Framework Directive of the European Union (Brugnach and Özerol, 2019), have sought to overcome the problems mentioned above relating to: trust and stakeholder engagement, integrity & transparency, innovative governance, data & information, clear roles & responsibilities, and monitoring & evaluation.

The recent review by de Paula and Marques (2022) confirms just how the studies on the water sector have as a fundamental input “values” or motivation, which, due to the peculiarities of the sector, are often in conflict with each other. In this sense, those authors instead suggest an integrated approach, we could say “political”, aimed at setting priorities among the different values (such as equity, efficiency, and environmental protection) for water management (de Paula and Marques, 2022). Therefore, the contribution that knowledge can offer to integrate these often-conflicting values is evident.

Coproduction thus seems to be the tool to implement the principles of promoting the role and responsibilities of local actors, management, and governments according to values of democracy, equity, and sustainability (Cepiku et al., 2020). Our research question concerned how coproduction could favor the realization of these values in water management. We combine a systematic literature review and a bibliometric analysis to systematize the evidence on coproduction in the water sector and outline the policy implications highlighted in this systematization of the studies to identify the main elements capable of characterizing and promoting the success of water coproduction. The findings are interesting because they differ in outcomes while confirming the results of the framework on coproduction in public services (Cepiku et al., 2020) in terms of the antecedents and management tools. This perspective relates specifically to the context of the present work, namely the water sector. The main difference, albeit still a minority policy implication, concerns the role of knowledge. Previous research had identified other benefits, such as empowerment, awareness and learning, only at the individual level.

Our study, in contrast, highlights how water management requires a broader shared vision, one that overcomes the traditional division

between individual, collective and social benefits (Cepiku et al., 2020), and is based on knowledge management, as a pillar of the new governance, with dialogue and trust between the various categories of stakeholders, institutions and politicians.

Knowledge in managing water coproduction is to be understood as a collective and, therefore, the initial vision of empowerment, awareness and learning, thus recovering the original shared vision of the Nobel Prize winner Elinor Ostrom. Knowledge can represent, on a non-material level, a sort of “yeast” of the coproduction processes, able to favor the operational mechanisms and stimulate contextual empowerment, awareness, and learning, creating a virtuous circle (Ostrom, 1990; Cox et al., 2010; Naiga, 2018). The recent analysis by de Paula and Marques (2022) also showed that, in water management, shared values such as health, food safety and resource conservation are predominant over economic issues in the strict sense. Unsurprisingly, the only SLRs conducted on water coproduction have highlighted the same “political” implications (Lepenies et al., 2018) or “values” for governance orientation (de Paula and Marques, 2022).

The implications of the findings of the present study are numerous. From a theoretical point of view, the purpose of studies on water governance seems to be to recover the “polycentric” approach suggested by coproduction, meaning that the traditional debate over ownership can be replaced by recovering the centrality of the stakeholders, the weaker parties. This view is also confirmed by de Paula and Marques (2022), who endorse the values-based or political approach to water management. This approach is a potential alternative governance and control mechanism capable of more effectively safeguarding public interests than authorities or proprietary regimes (van Gestel et al., 2008).

In fact, through participation in coproduction, users of water services, directly and indirectly, condition decision-making processes, adapting the services to their own needs, thus fueling the creation and development of participatory, democratic, and effective governance models that adapt to the institutional context of the country in which the utilities operate. In this way, a governance model suitable for “common goods” is created, in which the users of the service, owners in the broad sense of the “common good”, are also the subjects who, more than any other, can be entrusted with the governance of the service itself in order to guarantee democracy, equity, and sustainability (van Gestel et al., 2008; Lankao, 2011; Frischmann, 2012; Naiga, 2018; D’Amore et al., 2021). In this way, knowledge generated by the coproduction processes becomes an essential tool for promoting the role and responsibilities of local actors according to the mentioned values (Cepiku et al., 2020). This approach could resolve the conflicts over “political values” that often characterize water management (de Paula and Marques, 2022).

The link between coproduction and water governance materializes in knowledge, which means knowledge of the context and the actors, but above all, political knowledge or identification of the overall aims of the coproduction process (van Buuren, 2013; Lepenies et al., 2018; Brugnach and Özerol, 2019; Neto and Camkin, 2020). Van Buuren says (2013: 171): “*the literature on adaptive, integrated, and collaborative water management is strongly dominated by a rather rationalistic and technocratic idea that management frameworks, tools, and methods are sufficient to structure decision-making processes and to guarantee that principles and heuristics from these paradigms are applied correctly. This tendency can also be witnessed with regard to the question of how to organize knowledge for water governance. However, it is questionable whether this depoliticized and managerial view of water is realistic. Knowledge is not neutral and is used as an instrument to defend interests and influence policy choices. Governance of knowledge can only be legitimate when its political function is considered. Organizing consensus about knowledge is thus a crucial precondition before the other functions of knowledge (in terms of learning, reflexivity, and experimentation) can be realized. At the same time, it is important to stress that water management is essentially about value conflicts*”.

Furthermore, the same line of studies on sustainability, the line that is by far the most prevalent in recent years, needs, according to our results, a more effective adaptation to the theme of water, capable of

repositioning the well-known triple bottom line of Elkington and Rowlands (1999) towards a more social and equitable orientation in governance.

From a managerial point of view, our research highlights how knowledge is no longer just an input for water coproduction (Sicilia et al., 2019) but an outcome and a lever to ensure the success of these processes. As previously highlighted, knowledge management represents the most critical issue for local stakeholder engagement and accordingly, appropriate tools must be implemented to stimulate and encourage learning, sharing and transparency in devising and establishing paths and mechanisms. Brugnach and Ozerol (2019: 2) affirm that “*The identification of what needs to be known, what type of knowledge is needed, and how this knowledge is produced and communicated can vary, and even [be] contested, across different actor groups, reflecting institutional diversity, power asymmetries, and inequalities*”.

From an institutional point of view, our work supports the hypothesis that water governance needs to be polycentric. Policymakers identify local stakeholders’ needs to create an institutional design, an architecture capable of generating knowledge, as the primary outcome (van Gestel et al., 2008). This analysis also has numerous limitations, which can be considered the first step on a research path that must necessarily be broader. The SLR was conducted only on the general theme of coproduction in water, without considering, for example, the possible interactions between the main identified results, such as the theme of knowledge and the link with water governance. Furthermore, it would be interesting to extend the research to different institutional contexts, primarily through empirical verification (i.e., case studies). Finally, future studies could examine knowledge management in water coproduction processes.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jup.2022.101439>.

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