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# Typologies of citizen co-production in flood risk governance

## Abstract

Citizens in Europe are increasingly being encouraged by policymakers to contribute to flood risk governance (FRG) by taking individual and/or community-based flood risk measures (e.g. implementing property-level measures). This trend might be described as a transition towards 'co-produced' FRG between public authorities and citizens.

The co-production trend is mirrored in literature, with an increasing number of publications discussing citizen involvement in the implementation of FRG. Still, this research is in its infancy and requires more systematic insight into the prevalence, success factors and side effects of co-produced FRG. This article contributes to this endeavour by looking across disciplinary boundaries to critically examine the extent to which co-production types identified in other policy domains match the diversity of co-production forms witnessed in FRG. Taking this co-production literature as a starting point, the authors assemble three typologies to capture the different forms of co-production witnessed in FRG. In order to do so, examples of FRG co-production were identified in England (UK), Flanders (Belgium), France, the Netherlands and Poland, through document analysis and in-depth interviews. These examples were used to test and redevelop co-production typologies described in literature. The resulting typologies concentrate on the i) type of interaction, ii) the role and type of citizen input and iii) the distribution of contributions and benefits. These frameworks have the potential to not only serve as important heuristic devices for future empirical research, but may also facilitate more reflexive governance in practice.

**Key words:** citizen co-production, flood risk governance, flood risk management, public participation, policy implementation, typology

## Introduction

Increasingly, flood defence policy is claimed by academics and policymakers to have reached the limits of its capacity to mitigate flood risks in an environmentally, economically and socially sustainable manner (Aerts et al., 2008; Johnson & Priest, 2008; Hartmann, 2013; Gralépois et al., 2016). Continuing urbanization, projections of climate change and financial constraints have given way to a discourse of flood risk management (FRM) across Europe (Hegger et al., 2014). While flood defence aims to reduce the probability of flooding, FRM embraces a holistic approach, which not only involves traditional protection measures, but further seeks to mitigate flood damages through strategies of prevention (e.g. spatial planning), preparedness (e.g. emergency management) and recovery (e.g. insurance mechanisms).

With this shifting scope, flood risk governance (FRG)<sup>1</sup> has correspondingly broadened in scope, including new rules, resources, actors, discourses and multi-level coordination mechanisms (Hegger et al., 2014). The discourse of FRM has enabled a new range of actors to enter the governance arena in order to fulfil new duties in spatial planning, crisis management and insurance (Meijerink & Dicke, 2008; Mees et al., 2014). Amongst this growing suite of actors, citizens are also increasingly expected to contribute to FRG, arguably signifying a move towards co-produced FRG (Mees et al., 2016). The ways in which citizens can co-produce vary, from the implementation of property-level measures (e.g. flood gates, demountable barriers, airbrick covers, impermeable coatings, etc.) through to the preparation of emergency plans and assisting emergency services during a flood event.

Citizen involvement in the delivery of FRG is an emerging topic in FRG literature, albeit in most cases not under the name of co-production. In the past decade, numerous studies have observed this emerging shift and redistribution of responsibilities in FRM onto at-risk citizens (e.g. Johnson & Priest, 2008; Bubeck et al., 2013; Geaves & Penning-Rowsell, 2016) and its accompanying modification of the 'social contract' shaping citizen-government interactions (e.g. Meijerink & Dicke, 2008; Adger et al., 2013; Wamsler & Brink, 2014; Geaves & Penning-Rowsell, 2015). Some scholars raise implications for policy (e.g. Wamsler & Brink, 2014; Begg et al., 2015). Others provide insights into the motives and capacities of citizens to take (individual) action (e.g. Harries, 2008; Chamlee-Wright & Storr, 2010; Lindell & Perry, 2012). First steps have also been made to distinguish different types of citizen engagement in climate change adaptation, to which dealing with flood risks forms a primary aspect (e.g. Tompkins & Eakin, 2012; Hegger et al., 2017). What is missing, however, is broad and systematic insight in how citizens are involved in the delivery of FRG in different countries.

This insight is important because citizen co-production is accompanied by expectations and concerns about its societal impact. Indeed, several authors have highlighted the negative consequences that co-produced FRG can have on state-society relationships and their adaptive capacity to climate change (e.g. Begg et al., 2015; Mees et al., 2017; Alexander et al., 2017). Hereby, the potential increase of social inequalities is of particular concern (e.g. Johnson et al., 2007; Kammerbauer & Wamsler, 2017). However, it is likely that various forms of citizen co-production will influence these to diverging ways and degrees. In order to enable researchers to analyse this impact, it is necessary to first have a comprehensive overview on the various ways in which citizen co-production can occur. Given the recency with which co-production has emerged in the study of FRG, important lessons are to be drawn from other disciplines, particularly public administration and service management, where co-production has a long legacy.

The article seeks an answer to the following research questions:

1. To what extent do the co-production types described in literature match the diversity of co-production forms in FRG practice?
2. Which typologies can be proposed to capture the different forms of co-production witnessed in FRG?

The article takes co-production types and typologies in literature as a starting point, examines to which extent they 'fit' the types of co-production that are observed in FRG and further develops them in specific relation to this domain. Hereto, it confronts insights from literature with empirical data on FRG

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<sup>1</sup> In this article, flood risk governance refers to the way how flood risks are approached within a certain territory, i.e. by which actors, rules, resources and discourses (see Hegger et al., 2014). Flood risk management, conversely, is a specific approach of FRG that concentrates on the mitigation of flood risks.

co-production in England (UK), Flanders (Belgium), France, the Netherlands and Poland. Based on the literature review and the empirical evidence, the article presents 3 complementary typologies of citizen co-production in FRG, which are critically reviewed in turn.

## Theory

In the past, attempts have been made to structure different types of citizen participation into typologies (e.g. Arnstein, 1969; Rowe & Frewer, 2005; Fung, 2006). In most cases, these typologies' scope is limited to participation in decision-making. Some do include categories such as 'citizen control' or 'resource mobilisation' (e.g. Arnstein, 1969; Pretty, 1995), but these participation types are presented as a single category, whereas citizen engagement in policy implementation can take various forms. Since each form will have a distinct impact on FRG governance (Mees et al., 2017), it is important to further unravel these participation types. Valuable insights hereto are offered by the literature on co-production, which has been developed in contexts external to the study of FRG.

Indeed, literature on citizen co-production has only recently emerged in the study of FRG, but it has a long legacy elsewhere. Early proponents of the concept were amongst others Ostrom, Whitaker, Parks, Brudney and England (e.g. Parks, 1981; Brudney & England, 1983). Since, it has been broadly applied both in public administration and services management literature, with varying interpretations (see Osborne & Stokosch, 2013). Considering that services management literature concentrates primarily on producer-consumer relationships in market situations, this article draws mainly from insights from the public administration literature.

Several authors limit the use of the term to cases where citizens both produce and use services (e.g. Fotaki, 2011; Pestoff, 2012), while others apply it also to describe citizen involvement in decision-making (e.g. Albrechts, 2013; Bovaird & Löffler, 2013; Mees et al., 2016). Considering the focus of this research on citizen involvement in FRG delivery as opposed to participation in its decision-making, the definition of co-production in this article excludes the decision-making phase of a policy unless said activities are combined with action in the delivery phase. Therefore, citizen co-production is defined here as the relationship between a governmental or public organization and (groups of) citizens that requires a direct contribution from these citizens to the delivery of a public good or service (see also Brandsen & Honingh, 2016). The public service in this context refers to the avoidance and mitigation of harmful consequences of flooding at a societal level.

Before citizen input can be regarded as a form of co-production, there needs to be a form of interaction between authorities and citizens (e.g. regulation put in place by government, deliberation between authorities and citizens). This way, co-production distinguishes itself from *self-governance*, whereby citizens or communities deliver public goods or services independently from governmental action (see Driessen et al., 2012). Co-production in this sense pertains to the relationship between the State and civil society, which encapsulates individuals or households, as well as organised groups of individuals working together through communities or NGOs.

## Research design

In order to answer the research questions, an analysis has been carried out making use of literature review and in-depth interviews. It included the following steps:

- i. An literature review was conducted to scrutinise typologies described in co-production literature;
- ii. Independently, an empirical analysis has been carried out of co-production types in FRG in England (United Kingdom), Flanders (Belgium), France, the Netherlands, and Poland. This analysis identified citizen co-production based on two main parameters:
  1. Citizens delivered direct input to the delivery of flood risk measures (i.e. not (only) to the decision-making process)
  2. There was a form of interaction between governments and citizens (one- or multi-directional);
- iii. A deductive coding strategy was applied to the collected examples; they were categorised according to the typologies found in literature.
- iv. The typologies were redeveloped in order to best fit the purpose of the analysis (see results section);
- v. Literature on citizen involvement in FRG delivery (and related topics) was used to complement the empirical analysis and to double-check whether no important co-production forms had been overlooked (i.e. triangulation of the results).

### *Literature review supporting analytical steps i and v*

In the literature review, over 140 academic articles have been reviewed. The review addressed 3 general themes:

1. Co-production in policy domains external to FRG, e.g. public health, neighbourhood safety, education, etc.
2. Individual and community-based FRG, climate change adaptation (CCA) and disaster response
3. Public-private interactions in FRG, CCA and disaster response

The first strand gave insight into theoretical perspectives on citizen co-production and its possible categorisation (i.e. analytical step i). The other literature themes supported and complemented the empirical analysis described below (ii and v). To obtain a comprehensive view, FRG literature was scrutinised alongside CCA and disaster management literature more broadly. Indeed, in a large part of the world, dealing with flood risks constitutes a primary aspect of CCA and disaster management. Consequently, the ties between these separate literature strands are growing stronger (see Wamsler, 2014).

The relevant papers have been retrieved from the Web of Knowledge and Google Scholar databases by searching for combinations of the following terms: flood (management/governance), citizen, community, public, private, engagement, co-production, co-delivery, co-financing, typology, climate change (adaptation), disaster and water management. In addition, a snowball technique was used, whereby references in screened literature led to new sources.

The papers have been collected during the time frame of the empirical research, instead of resulting from a structured literature search at a single point in time. The literature has been purposively sampled, specifically searching for information to answer the research questions. Hereby, the

technique of saturation was used: the collection ended at the moment that further reading did no longer provide additional, relevant insights.

#### *Empirical analysis supporting analytical steps ii-iv*

The empirical analysis compares FRG co-production in England (UK), Flanders (Belgium), France, the Netherlands and Poland. Although not a country in itself, Flanders is chosen as the unit for analysis instead of Belgium because FRG competencies in this country are located at the regional level. Similarly, devolved regions exist within the United Kingdom. Here, England is selected as the analytical unit.

The empirical analysis for this research refers to the period 2000-2016. This period has been selected for two reasons. First, it contains a time frame that is comprehensible to look back to in interviews, and of which sufficient accessible data records exists. Second, this period signifies the movement towards citizen co-production in all countries of analysis (see Meijerink & Dicke, 2008; Johnson & Priest, 2008; Mees et al., 2016).

Considering the fact that inland water systems are strongly entangled, the analysis takes both fluvial and pluvial flood risks into account.

The data for the analysis were collected under the auspices of the EU-FP7 project “STAR-FLOOD”<sup>2</sup> and EU-JPI Climate “TRANS-ADAPT”<sup>3</sup>. In the framework of the STAR-FLOOD project, between 40 and 70 semi-structured interviews were conducted in each country with key actors in FRG from December 2013 to March 2015. These included policymakers, practitioners and a limited number of NGOs/citizen groups operating at national and local scales in the sectors of water management, emergency planning and spatial planning. The interviews did not exclusively focus on citizen involvement but assessed developments in FRG in general.

In TRANS-ADAPT, in-depth analysis has been carried out on 3 local cases in both the Netherlands and France. Each case analysed and evaluated local community-based initiatives in relation to flood alleviation schemes. 30 semi-structured interviews have been conducted in France and 27 in the Netherlands from January 2015 to July 2016. Interviewees represented a range of local actors, including politicians, public officials and citizen groups involved in bottom-up community-based initiatives.

The interview protocols of both research projects are provided in Annex 1.

In both projects, the information gathered from the interviews has been complemented with in-depth policy analysis of purposively selected documents. This entailed both local and national data (legislation, policy documents, websites, reports, etc.).

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<sup>2</sup> The aim of the STAR-FLOOD project was to design principles for resilient, efficient and legitimate FRG in Europe. Hereto, it analysed FRG and its trends in Belgium, France, the Netherlands, Poland, the United Kingdom and Sweden, and identified good practices. The project ran from March 2013 to March 2016.

<sup>3</sup> The TRANS-ADAPT project analysed and evaluated community-based initiatives in relation to flood alleviation schemes in Austria, France, Ireland and the Netherlands. The project ran from November 2014 to October 2017.

A mix of inductive and deductive coding was used to analyse the collected data. Citizen involvement in decision-making and in implementation were two codes used in both projects. In the analysis for this paper, these broad categories have been further unravelled using the parameters of analytical step ii and the typologies of i.

### 3 typologies of FRG co-production

In the co-production (and related) literature, different forms of citizen co-production have been identified with characteristics diverging in terms of:

- public-private interactions: who initiates or steers the co-production (e.g. Mitlin, 2008; Fotaki, 2011; Brink & Wamsler, 2018);
- which interaction takes place among citizens (e.g. Brudney & England, 1983; Needham, 2007; Fotaki, 2011; Bovaird et al., 2015);
- whether it is complementary or substitutive to governmental action (Ostrom, 1996; Needham, 2007);
- the kind of input citizens deliver (e.g. Bovaird & Löffler, 2013);
- the distribution between contributions and benefits (Tompkins & Eakin, 2012; Bovaird et al., 2015; Wamsler & Riggers, 2018).

In most sources found, the categorisation effort was limited to a single parameter. Only in rare cases (e.g. Bovaird et al., 2015), multi-dimensional typologies were established.

In this article, these described types were confronted with the examples of co-production that were identified in the empirical analysis and in literature on FRG and CCA. The types described in literature were then refined and assembled into 3 complementary typologies, which host and structure all the examples observed in the analysis:

1. the type of interaction between governments and citizens:
  - a. *hierarchical co-production*
  - b. *incentivised co-production*
  - c. *deliberative co-production*
2. the role and type of citizen input
  - a. *complementary co-funding*
  - b. *complementary co-delivery*
  - c. *complementary co-production of knowledge*
  - d. *substitutive co-funding*
  - e. *substitutive co-delivery*
  - f. *substitutive co-production of knowledge*
3. distribution of contributions and benefits
  - a. *private individual co-production*
  - b. *philanthropic individual co-production*
  - c. *private collective co-production*
  - d. *philanthropic collective co-production*

In the sections below, each typology is discussed in detail. Per typology, first its origins and application outside the remit of FRG is explained. Following, it is assessed against the data derived from the

empirical analysis and literature related to FRG. Based on this, a typology is proposed adapted to the context of FRG.

The co-production types listed for the examined countries are not intended to be exhaustive, but were selected as analytical examples to elaborate each framework and demonstrate the varied ways in which co-produced FRG has emerged in each country. A more detailed overview of citizen co-production in England, Flanders, France, the Netherlands, and Poland can be found in Mees et al. (2016).

### 1. Types of government-citizen interaction

This typology classifies co-production according to its type of interaction between authorities and citizens. In literature, scholars have distinguished between top-down and bottom-up co-production. Mitlin (2008) employs the term bottom-up co-production to describe cases where local self-help networks evolved into structures of strong citizen-government cooperation. Building upon this, Watson (2014) distinguishes between top-down co-production, which is initiated and steered by authorities, and bottom-up co-production, which is launched by communities themselves. Both authors present the latter co-production type as a way to empower communities. By doing so, it relates to the distinction suggested by Fotaki (2011), i.e. between empowering and dis-empowering co-production. Within the CCA literature, Brink & Wamsler (2018) speak of bottom-up versus top-down adaptation interactions.

When applying this distinction to our empirical analysis, we were confronted with a number of considerations.

First, the distinction between top-down and bottom-up co-production is to a large part a theoretical one and appears in practice often hard to apply, considering the fact that the set-up of co-produced FRG is highly specific to a local situation and dynamic in time. Volunteering in the fire services, for instance, is today a strongly institutionalised form of citizen co-production but in many places it originates from self-governed citizen initiative (e.g. Chesney, 1986). In contrast, examples can be found of co-production initiatives which are launched by authorities but are driven by the desire to promote local ownership and self-governance, as is the case with the pilot projects launched as part of the Flood Resilience Community Pathfinder scheme in England. In this scheme, the English government initiated 13 pilot projects to encourage communities' resilience to flooding (Defra, 2012).

Second, top-down co-production assumes that authorities steer co-production. But they can do so both by imposing co-produced measures or by stimulating them through incentives. Hence, instead of applying the general term 'top-down co-production', it appeared more relevant to distinguish between hierarchical and incentivised co-production. In the case of *hierarchical co-production*, the government legally enforces inhabitants to take flood risk measures, as is in several countries the case with building regulations concerning floor heights, green roofs, etc. If an inhabitant does not comply with these regulations, sanctions can be imposed. *Incentivised co-production* attempts to encourage citizens to co-produce by providing financial and/or non-financial incentives, e.g. subsidies, awareness-raising, etc. A hybrid form can also exist, whereby subsidies for flood risk measures are provided and at the same time sanctions are imposed in cases of non-compliance.

A nuance to be made here is that in order to speak of co-production, the incentives or obligations introduced by authorities must be successful, i.e. citizens must react with flood risk actions. If not, only an attempt to co-production is made.

Last, bottom-up versus top-down co-production seems to assume that co-production involves one-directional communication and influence. In some cases, however, co-production can be built on multi-directional dialogue and cooperation between citizens and authorities. This we named *deliberative co-production*, in reference to the concept of ‘deliberative democracy’ in the citizen participation literature (see Dryzek, 2000; Ryfe, 2005). Deliberative co-production covers a wide variety of co-production types, which range from being strongly steered from the governmental side to approaching citizen self-governance. Hence, it provides more room for bottom-up initiative but it is not inherent to it.

Tables 3-6 provide examples of hierarchical, incentivised and deliberative co-production observed in the countries of analysis. The examples have been structured according to different flood risk strategies (FRS). As has been explained in the introduction, policymakers increasingly pursue an integrated FRM approach, which combines different FRSs. In the EU, this is a requirement of the European Flood Directive (2007/60/EC), which defines three FRSs:

- risk prevention, including spatial planning measures to decrease the risk of flood damage;
- protection, including flood defence infrastructure to decrease the probability of flooding;
- preparedness, including emergency planning to ensure an adequate response to flooding.

In our analysis, we have added a fourth strategy, namely recovery, which is arguably poorly represented within the Directive’s 3P-approach (see also Hegger et al., 2014). This strategy includes insurance systems, recovery funds, clean-up and repair activities.

Each of these strategies is accompanied by a different actor constellation, which has its impact on public-private interactions. Consequently, the FRSs add a valuable dimension to the typology.

<b>Flood risk prevention</b>	
Hierarchical co-production	In England, France, Poland and Flanders (and to a lesser extent in the Netherlands), building regulations are imposed on property owners and/or developers for new buildings to install property-level measures, e.g. minimum floor height, floodable cellars, water infiltration and storage systems, etc.
Incentivised co-production	<p>In France and in some local cases in Flanders, subsidies and/or free vulnerability audits are offered by (local) authorities to install property-level measures. Moreover, the costs of property-level measures can in some cases be deducted from individuals’ annual income tax (max. 10% of the cost) in France. In the Netherlands, some cities experiment with providing incentives to increase rainwater infiltration and storage, such as tax reductions on storm water fees, subsidies to remove paved surfaces, etc.</p> <p>In England, a Household Flood Resilience Grant Scheme was launched following the Winter 2015/16 floods, providing up to £5000 for flooded households and businesses to promote property adaptation.</p>

Deliberative co-production	Local community projects in the Netherlands, in which local policy practitioners and citizens discuss and cooperate on measures to store rainwater on private grounds.
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Table 1: Examples of different interaction types of co-production found in the flood risk prevention strategy in England, Flanders, France, the Netherlands and Poland.

Flood protection	
Hierarchical co-production	In all observed countries obligations exist for property owners to maintain small-scale watercourses on their property (e.g. maintaining its bed and banks, keeping structures clear of debris etc.). In England, costs of remedial action may be reclaimed by the competent authority in case action has been taken by the riparian owner without consent, or conversely if the owner has neglected his common law responsibilities.
Incentivised co-production	Several of the examples listed under ‘deliberative co-production’ could be sorted into this category as well. Indeed, citizen groups such as dyke unions, flood action groups, nature organisations, etc. often receive governmental subsidies to carry out their activities. In Flanders, for instance, so-called ‘polders’ and ‘wateringues’ collect riparian landowners, which receive governmental support to maintain small-scale watercourses. In several countries, financial agreements are made between governments and landowners to allow their land to flood (e.g. England, Flanders).
Deliberative co-production	In Poland, the Dykes Unions are volunteer-based organizations, which carry out systematic observations of dykes’ quality.  Community flood action groups in England may also support protective goals (e.g. clearing blocked culverts, river channels etc.), next to preparative ones (see below). Volunteers also support various ‘slow the flow’ programmes (e.g. building leaky wooden dams).  In Flanders and Poland, cooperation exist in some basins with volunteer-based nature organisations to co-manage nature reserves with flood control as a co-function.

Table 2: Examples of different interaction types of co-production found in the flood protection strategy in England, Flanders, France, the Netherlands and Poland.

Flood preparedness	
Hierarchical co-production	<i>The National Flood and Coastal Erosion Risk Management Strategy for England</i> (Defra/EA, 2011) emphasises the importance of community engagement to encourage the public to manage their personal risk and enhance their property

	<p>resilience. According to legislation, Risk Management Authorities must act consistently with the national strategy.</p> <p>In France, the preamble of the 2004 Act on Civil Security stipulates that ‘citizens are responsible for their own safety’. This has so far remained a symbolic step, however, no binding stipulations have resulted from it.</p>
Incentivised co-production	<p>In the Netherlands, England and France (and in local cases in Poland), awareness-raising campaigns exist, which provide citizens with tools and knowledge to prepare themselves for flooding and to stimulate appropriate behaviour during a flood (i.e. through websites, apps, videos, etc.).</p> <p>In England, national guidance is provided online on how to prepare community resilience emergency plans, including additional guidance for flood action planning more specifically.</p>
Deliberative co-production	<p>In England, many cases are found of citizens forming ‘community flood action groups’ (CFAGs), which may support preparedness-based activities such as producing ‘community flood action plans’ with the support of certain Risk Management Authorities. Such groups may also include voluntary flood wardens to help disseminate official warning messages.<sup>4</sup></p> <p>Similar to the English flood wardens, flood emergency programmes including citizens acting as local coordinators during floods were found in France and Poland.</p> <p>In all countries professional emergency responders are supported to varying degrees by citizen volunteers, e.g. through volunteer-based fire and rescue services. There is greater reliance on this within France, Flanders and Poland than is the case in England and the Netherlands. In all countries, however, emergency services tend to receive considerable support from voluntary organisations (e.g. Red Cross) and local volunteers during an emergency.</p>

Table 3: Examples of different interaction types of co-production found in the flood preparedness strategy in England, Flanders, France, the Netherlands and Poland.

<b>Flood recovery</b>	
Hierarchical co-production	<p>In France and Flanders, flood insurance mechanisms are in place, which oblige citizens to insure their belongings against flood damage. These mechanisms constitute primarily a co-production between citizens and businesses, but the government takes up a steering or regulatory role. In France, for instance, every citizen purchasing a car or house insurance is contributing to the government-led National Fund System which will cover economic damages after a flood.</p>

<sup>4</sup> For specific examples of CFAG activities, please consult the online Community Resilience Case Study Library: <https://www.gov.uk/government/publications/community-resilience-case-study-library>

Incentivised co-production	In England, the flood reinsurance scheme “Flood Re” constitutes a formalised, temporary agreement between government and the Association of British Insurers to ensure the provision of affordable insurance amongst high risk properties, whilst supporting the transition to risk-reflective pricing in 2039. Arguably, Flood Re reflects a complex form of co-production between the State, the private market insurance sector and citizens eligible for the scheme, which strives to incentivise property-level adaptation measures (via a premium reduction) and adaptive flood recovery.
Deliberative co-production	In England, the voluntary sector supports the identification of vulnerable groups, as well as assisting recovery efforts (e.g. supporting the needs of displaced people). Voluntary sector engagement within the national emergency management framework is actively promoted by the Voluntary Sector Civil Protection Forum and may be formalised through emergency planning within Local Resilience Fora and in Mutual Aid Agreements.

**Table 4: Examples of different interaction types of co-production found in the flood recovery strategy in England, Flanders, France, the Netherlands and Poland.**

The categories of this typology are not entirely exclusive. In principle, hierarchical and incentivised co-production are government-steered, while deliberative co-production allows for more partnership-based government-citizen relationships to form. But in praxis it is not easy to define whether the deliberative criterion is sufficiently fulfilled. Moreover, deliberative co-production is often incentivised by authorities, e.g. through subsidies. Consequently, there exists a certain overlap between these different co-production types.

## 2. Role and type of citizen input

Scholars have observed how citizen co-production may either be complementary or substitutive to governmental action. The distinction has, amongst others, been touched upon by Ostrom (1996). Ostrom concludes that co-production is useful in cases where inputs from government and citizens are complementary rather than substitutive. Indeed, *substitutive co-production* refers to situations, in which citizen efforts replace actions that would otherwise have been taken by governmental actors. Needham (2007) refers to this as zero-sum co-production. In the context of FRG, the substitution may concern either implemented actions or budget spending. In the former, actions or tasks once exclusively carried out by governmental actors are transferred to citizens, whereas in the latter, public funds are substituted with citizen contributions (thus not via general taxation). This may result from the desire to reduce reliance on public sector funding or perhaps to enable more schemes to progress. In contrast, *complementary co-production* pertains to efforts to co-produce aspects of FRG in a way that complements (instead of replacing or reducing) existing governmental activities .

In reality, it appears hard to distinguish these types. Whether a citizen co-production is considered as complementary or substitutive depends on:

- Whether one considers only the actions taken and budget spent in a specific area, or in the overall operational territory of the authority in charge. For instance, an authority can decide not to protect a certain part of a basin in order to have more budget to protect another part. Hence, its overall budget does not decrease but, to the population of the unprotected area, the imposed co-production becomes substitutive rather than complementary.

- Whether one considers flood risk measures taken by authorities so far or the measures they could take in principle. Take for instance the case of a basin that is currently insufficiently protected against flooding. Should newly introduced co-produced flood risk measures be considered as complementary to the already existing inadequate collective protection, or as substitutive to the protection that could have been?

A clearer conceptualisation might be offered by Brandsen & Honingh (2016), who distinguish between complementary and non-complementary co-production to outline whether citizens contribute to core tasks of the service or to complementary activities. But also the separation of core and complementary tasks in a service is a hard one to make. Concerning FRG, it could be made in some cases, e.g. the Dutch approach to river and coastal flooding, where a fixed protection level is defined by law. Mostly, however, authorities' core tasks in FRG are less strictly defined.

Aware of these constraints, we attempted to sort the observed co-production forms in Table 7. We hereby took into account the time dimension of the typology; how did the co-production change the government's usual operations that existed before? In the countries observed, few examples were found of co-production that was clearly substitutive.

To structure the table, a further distinction was made between citizens' different types of input, namely co-funding, co-delivery and co-production of knowledge. *Co-funding* means that citizens engage in FRG by financially contributing to it (see Bovaird & Löffler, 2013). This form can be combined with co-delivery, if these citizens also implement the financed measures, as is mostly the case with property-level measures. Alternatively, inhabitants can co-finance the collective protection of the area they live in. This form of co-production does not include general taxes, the financial contribution should be issue- and area-specific. In case of *co-delivery*, citizens engage human and/or material resources to implement flood risk measures (see Bovaird & Löffler, 2013). These resources can consist of time, specific skills, manpower, technical devices, vehicles, etc.

A specific case of co-delivery is the '*co-production of knowledge*', in which citizens contribute their expertise to FRG. There exists an extensive literature on knowledge co-production (e.g. Callon, 1999; Nowotny et al., 2001; Jasanoff, 2004). Most of these authors, however, concentrate on the involvement of citizens in policy phases prior to or after implementation (i.e. agenda-setting, decision-making & evaluation), which falls out of the scope of this analysis. In the investigated countries, some cases have been found in which citizens contribute to FRG implementation through knowledge, for example by monitoring watercourses or protective infrastructure. These kinds of citizen observatories have also been described by, amongst others, Wehn et al. (2015).

	Complementary to governmental action	Substitutive of governmental action
<b>Co-funding</b>	The government maintains its level of government spending, but invites citizens and communities to complement them with private	No examples found in the conducted analysis.

	investments. The Flood and Coastal Resilience Partnership Funding scheme in England is intended to supplement public funding and centrally-administered Grant-in-Aid (GiA) through the diversification of funding sources (including in some cases civil society contributions) (Alexander et al., 2016).	
<b>Co-delivery</b>	Preparedness measures are delivered in addition to, or as part of, collective protection, e.g. awareness-raising campaigns in the Netherlands, flood warden programs in France, Poland and England.	<p>Instead of collective protection, property-level measures are implemented by citizens. In some cases, this form of co-production emerges after flood events in areas with insufficient collective protection.</p> <p>In the Netherlands, citizens are obliged to provide own protection in a small number of unembanked areas.</p> <p>Several examples of this type of co-production are found related to crisis management. In Poland, for instance, several local cases exist of volunteer-based networks, which help to coordinate and execute flood response and recovery activities.</p>
<b>Co-production of knowledge</b>	<p>In some English flood action groups, inhabitants self-monitor watercourses in addition to official monitoring. Furthermore, local citizens act as important gatekeepers to identify vulnerable groups.</p> <p>In a limited number of Dutch areas, Dike Patrols, which are made up of citizen volunteers, help to monitor the dikes. A similar role is adopted by the Dyke Unions in Poland.</p>	No examples found in the conducted analysis.

Table 5: Examples of different types of co-production found in England, Flanders, France, the Netherlands and Poland with regard to their role in FRG and type of input

### 3. Type of distribution between contributions and benefits

Finally, co-production can be divided into four different types, depending on who contributes and who benefits from it. A typology hereto has been developed by Bovaird et al. (2015), which is based on a survey study on citizen co-production in health, environmental and neighbourhood safety policies (see Table 6). This typology builds onto the distinction between individual and collective forms of co-production, as was previously discussed by Brudney & England (1983), Fotaki (2011) and Tompkins &

Eakin (2012). Recently, the distribution of contributions and benefits of CCA has been further unravelled by Bisaro & Hinkel (2016) and Wamsler & Raggars (2018).

		Benefits of co-production	
		Individually enjoyed	Collectively enjoyed
Input to co-production	Individually provided	<i>Private individual co-production</i>  i.e. provided on an individual basis for the private benefit of the person directly involved in the activity	<i>Philanthropic individual co-production</i>  i.e. provided on an individual basis for the benefit of a wider group of people
	Collectively provided	<i>Private collective co-production</i>  i.e. provided by a group of citizens for the private benefit of those directly involved in the activity	<i>Philanthropic collective co-production</i>  i.e. provided by a group of citizens for the benefit of a wider group of people

Table 6: Individual and collective co-production types, adopted from Bovaird et al. (2015).

Table 7 examines how this categorisation fits to examples identified within the investigated countries. *Philanthropic collective co-production* is interpreted here as flood risk measures that are not merely the sum of plural individual actions but the result of coordinated action. The most common form hereof are volunteering fire brigades. *Philanthropic individual co-production* will in most cases be provided by individuals who benefit from the actions themselves, but this does not need to be the case. Citizens can also decide to co-produce because of ideological reasons or because they pursue other benefits apart from flood damage reduction. An example is green roofs, which have important co-benefits in terms of house insulation, life quality, roof protection, etc. The examples included in the category *philanthropic collective co-production* can in some cases resort just as well under a *philanthropic individual co-production* scheme. Flood wardens, for instance, can be organised through individual volunteering or can be embedded in a flood action group. Observed examples of *private collective co-production* consist of subsidised property-level measures, e.g. by the Barnier Fund<sup>5</sup> in France or municipal subsidies in some cases in Flanders. These measures are (in part) collectively funded through tax revenues but individually implemented and enjoyed.

		Benefits of co-production	
		Individually enjoyed	Collectively enjoyed
Contribution	Individually provided	<i>Private individual co-production</i>	<i>Philanthropic individual co-production</i>

<sup>5</sup> Since 2003, flood-resilient building measures can be co-funded through this fund if they are located in an area for which property-level measures are prescribed by a ‘risk prevention plan’ (Larrue et al., 2016).

	Property-level protection measures. Found to some extent in all countries, but most developed in England.	Citizen monitoring in England, Poland and the Netherlands.  Rainwater infiltration and storage systems at household level in Flanders, France and the Netherlands.
Collectively provided	<p><i>Private collective co-production</i></p> <p>Subsidised (and sometimes collectively implemented) property-level measures, found in local cases in France, England and Flanders. In England, property-level measures have also been consciously embedded within large-scale flood alleviation schemes (such as the River Thames Scheme).</p> <p>Community flood action groups in England (in some cases this could also be framed as a form of <i>philanthropic collective co-production</i>)</p>	<p><i>Philanthropic collective co-production</i></p> <p>Flood wardens in France, England and some local cases in Poland</p> <p>Fire brigade volunteering in Flanders, France, the Netherlands and Poland.</p> <p>Co-funding public FRG measures, but few examples found except for some exceptional cases in the English Partnership Funding Scheme (Begg et al., 2015; Alexander et. al, 2016)</p>

Table 7: Different types of co-production found in England, Flanders, France, the Netherlands and Poland with regard to who contributes and benefits

## Discussion and conclusions

This research analyses the extent to which co-production types described in literature match the diversity of co-production forms witnessed in FRG practice. The involvement of citizens in the implementation of flood risk measures has been understudied in FRG literature so far. Therefore, this article draws primarily from insights of the literature on co-production in other policy fields. Still, well-developed typologies on co-production appear rare. Most authors limit their categorisation efforts to a single defining parameter, e.g. complementary versus substitutive, bottom-up versus top-down, etc. An exception is made by Bovaird et. al (2015), who defined a more sophisticated co-production typology based on its contributors and beneficiaries. This research has applied co-production theory to a new field, i.e. FRG literature. Here, it has brought frameworks from the co-production literature in confrontation with insights from CCA and disaster management literature (e.g. Tompkins & Eakin, 2012; Brink & Wamsler, 2018) and with empirical observations, to assemble 3 complementary typologies on FRG citizen co-production.

The exercise of developing co-production typologies is more than a theoretical one, it enables a deeper understanding of the various ways in which governments and citizens can co-produce FRG, it offers a framework to study their impact and it enables more conscious governance practice.

First, an increasing number of articles describe an emerging trend of citizen involvement in FRG delivery and the accompanying shifts in public-private interactions. However, a broad and systematic insight in how citizens are involved in the delivery of FRG in different countries is missing. In order to offer this insight, this article applies a broad conceptualisation of co-production, which also includes more 'passive' forms such as awareness-raising campaigns and regulations. This is in line with the work of some co-production scholars (see Brandsen & Honing, 2016) but might meet critique from others. In our view, a comprehensive approach to co-production is needed to sufficiently capture its prevalence in reality. Indeed, these hierarchical and incentivised co-production forms are in many countries the most applied method for politicians to activate citizens (e.g. Wamsler & Brink, 2014; Mees et al., 2016).

Second, this exercise contributes to a better understanding of the impact of co-production. Indeed, several scholars have cautioned against the (potential) consequences of increased citizen involvement in FRG delivery, particularly in concern to its social impact (e.g. Adger et al., 2006; Johnson et al., 2007). But considering the fact that citizen co-production entails a wide range of activities and citizen-government relationships, one might expect the impact of these different co-production forms to vary correspondingly. Several authors, for instance, favour bottom-up/collective/deliberative co-production forms (e.g. Ostrom, 1996; Needham, 2007; Mees et al., 2017), while they can also increase inequalities between different social groups (Thaler & Priest, 2014; Geaves & Penning-Rowsell, 2015). Therefore, the categorisation exercise presented in this article can provide the groundwork for further empirical research into the impact of different co-production forms on key aspects of governance.

Third, beyond the research agenda, this article advocates a more conscious approach to co-production in governance practice. In several of the observed countries, policy documents and discourses prevail calling for citizens to engage in FRG delivery, e.g. the National Flood and Coastal Erosion Risk Management Strategy in England (Mees et al., 2016). But the framing of this co-produced FRG will impact its results. For instance, whether co-production is considered to be complementary or substitutive of governmental action could have ramifications for a policy's perceived legitimacy (Mees et al., 2017). Hence, identifying different co-production types and their impact may be a valuable exercise for practitioners (see also Osborne & Stokosch, 2013). Moreover, different behavioural and motivational drivers may be relevant for certain forms of co-production. Bovaird et al. (2015) for example, observed higher rates of collective co-production amongst younger generations and those with stronger perceived self-efficacy. Thus, different target groups might require different co-production strategies. This is an important research avenue that warrants further study.

Despite its value, the exercise of categorisation needs to be handled with care. It inherently involves a simplification of reality, which need not be problematic but must be recognised. When distinguishing different co-production types, there is always a risk of pre-selecting examples that neatly fit the typology. Moreover, in some cases the choice for a certain category is dependent on interpretation, for example when distinguishing between complementary versus substitutive co-production. Further mapping of FRG co-production forms is recommended to investigate the adequacy of the defined typologies, and the prevalence and reach of different co-production types in various countries. Next to that, further research is required into the impact and implications of different co-production forms on the 'success' of FRG, however this might be defined.

Finally, we expect that the typologies described in this article can be used in a wide range of policy fields, apart from FRG. Of course, this does not hold for the typology distinguishing between different flood risk strategies. It can however easily be adapted, either by exchanging it for a similar parameter fit to the policy field at issue, or by changing it to a one-dimensional typology. Therefore, we encourage further research beyond the remit of FRG to further validate these frameworks.

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# **Annex 1. Overview of the interview protocols used in the STAR-FLOOD and TRANS-ADAPT research**

## **EU-FP7 STAR-FLOOD**

Below, a non-exhaustive overview is provided of the types of questions and interview themes explored through semi-structured interviews in the STAR-FLOOD project. The interviews have been carried out with professional stakeholders and a limited number of civil society actors between December 2013 and March 2015. The list focuses on those questions/themes that centred on the issue of citizen involvement and co-production in FRG. However, it should be borne in mind that these were embedded within a wider conversation on flood risk governance. The interviews were conducted in the mother tongue of the respondents.

Questions asked to professional stakeholders in crisis management:

- What actions do individuals, households and communities generally take by themselves to prepare and/or respond to flood events?
- Do emergency services (first and second responders) make use of citizen volunteers in the preparation and/or response to a flood incident?
  - Is this actively encouraged by the emergency services?
  - Do citizen volunteers make a significant contribution to the official response effort?
  - How is this volunteering initiated? Is it organised prior to the event?
- In your opinion, has this changed over time? E.g. is there a greater interest/willingness for citizens to volunteer today than in the past or vice versa?
- Are citizens involved in the draft of flood emergency plans? What aspects of flood emergency planning or risk assessments are they able to participate in (if any)?
- How are issues of accountability and liability dealt with?

Questions posed to professionals in aspects of water and/or specific flood risk management:

- What is the role of citizens in the management of flood risks?
- Do citizens have statutory responsibilities with regards to flood risks? If so, in what ways are citizens made aware of their responsibilities?
- Are citizens expected to take individual measures to mitigate their flood risk?
- Are individual/property-level measures actively encouraged or incentivised in some way, e.g. through subsidies, expertise, etc.?
- Are citizens/citizen groups in other ways encouraged to engage in the delivery of flood risk measures?
- Does your organisation actively collaborate with citizens or civil society actors in the delivery of flood risk measures?
- In your experience, are citizens willing to adopt responsibility / take personal measures to mitigate their flood risk?

- Are there citizen groups actively dealing with floods in this area? How would you describe your professional relationship with these groups?
- To what extent are citizens involved in the development of flood risk policy? And NGOs?
- To what extent can/do citizens actively participate in the decision-making process? (nationally and/or at the local scale)

Examples of questions asked to civil society actors (NGOs, voluntary neighbourhood groups, National Flood Forum (England, only), etc.):

- What is the role of citizens in the management of flood risks?
- To what extent do you think citizens should be involved in managing flood risks? In what aspects and why?
- Do you think you/citizens are sufficiently involved by authorities in the development of flood risk plans and their implementation?
- If not, how could/should/would you like to see citizens becoming more involved?
- Is there an interest amongst citizens to participate in flood emergency planning/response e.g. draft emergency plans at neighbourhood level?
- To what extent do individuals/households/communities prepare for flooding, and/or take measures to protect their house from flooding? Help others?
- Did people help each other during and after the flood? In which way?
- Are citizens supported by authorities to take flood risk actions, e.g. subsidies, material support, expertise,...?

## **EU-JPI TRANS-ADAPT**

Below, a non-exhaustive overview is provided of the types of questions and interview themes explored through semi-structured interviews in the TRANS-ADAPT project. The interviews have been carried out with professional stakeholders and a limited number of civil society actors between January 2015 and July 2016.

The questions addressed the topic of citizen involvement in community-based initiatives in FRG. These were embedded in a general conversation on flood risk governance, which discussed the governance arrangement and the roles of actors therein, the drivers and barriers of such initiatives, and the evaluation of such initiatives, based the criteria of effectiveness, efficiency, legitimacy, accountability, social justice and social capacity. The interviews have been conducted in the mother tongue of the respondents. Respondents were public officials, politicians and civil society actors.

Examples of questions regarding the type of governance arrangement:

- What was your role in the project?
- Which roles did citizens play in the project?
- In which phases and in which decisions were citizens involved?

- To what extent did citizens influence the decisions and chosen flood risk measures?
- Which actor had most influence on the decisions made?
- Which coordination mechanisms existed among the different types of actors?
- Which forms of participation were organized for engaging citizens?

Examples of questions regarding the barriers and drivers:

- What are the main drivers for the start of the project, according to you?
- What are the main drivers for the implementation of the project, according to you?
- What are the main barriers for the start of the project?
- What are the main barriers for the implementation of the project?

Examples of questions regarding the evaluation of the project:

- What are the main successes of the project?
- What are the main failures of the project?
- How have you contributed to the project with time, money, knowledge?
- To what extent has the flood risk problem been solved?
- To what extent have all interests been represented in the project?
- To what extent do you find the outcomes of the project acceptable?
- To what extent do citizens find the outcomes acceptable?
- To what extent have responsibilities been delineated and made transparent for all stakeholders?
- To what extent were citizens able to hold the municipality/project managers accountable, and which pressure mechanisms (e.g. media, sanctions) did they use?
- To what extent was the distribution of benefits equal among stakeholders?
- To what extent were vulnerable citizens considered in the distribution of benefits?
- To what extent did the municipality supply sufficient information and resources to citizens?
- To what extent did citizens think they have responsibility themselves for dealing with flood risks?