Who should do what in environmental management?
Twelve principles for allocating responsibilities
Accepted for publication in Environmental Science and Policy, DOI 10.1016/j.envsci.2014.10.008[1]

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Abstract
In environmental management there is often discussion on the allocation of responsibilities. Such discussions can continue for a long time and can form an obstacle for effective action. In this article twelve normative principles for the allocation of responsibilities are identified, coming from three different sources: the arguments used in discussions on responsibilities, Dutch and European law, and the environmental management literature. The principles are 1) capacity, 2) lowest social costs, 3) causation, 4) interest, 5) scale, 6) subsidiarity, 7) structural integration, 8) separation, 9) solidarity, 10) transparency, 11) stability (but not standstill), and 12) acquired rights. These principles point to fundamental tensions in environmental management and sometimes conflict with each other. At the same time they may help to resolve conflicts by providing common points of reference that are independent from the often conflicting interests of the discussants.

Key words: institutions, decentralisation, polycentric governance, integration, the Netherlands, water

1. Introduction

This article is based on the assumption that responsibilities in environmental management matter. The argument is simple: how the environment is managed depends on who manage it, and this depends at least partly on the allocation of responsibilities. This argument seems to run counter to modern governance approaches that emphasize collaboration in networks rather than formal responsibilities (e.g. Crona and Hubacek, 2010; Rhodes, 2007; Sørensen and Torfing, 2009). Yet, much of this collaboration takes place in the shadow of formal arrangements (Bulkeley et al., 2012). Formal arrangements such as the allocation of responsibilities structure the arena where collaboration takes place. They can set up new management organizations, platforms and procedures and provide governmental and non-governmental actors with sources of legitimacy and legal powers, thereby helping them to gain access to or increase their influence in the relevant networks. Depending on the complexity of the arrangements, they can facilitate or complicate collaboration. Besides, not all environmental management is collaborative: much still follows a top-down regulatory approach (Klijn, 2008).
According to the Oxford English Dictionary, "responsibility" refers to a specific task, obligation, duty or assignment; to the capability of fulfilling this task, etc.; and to accountability for this task, etc. (Simpson and Weiner, 1989). Applied to environmental

[1] NOTICE: This is the author's version of a work that was accepted for publication in Environmental Science and Policy. Changes resulting from the publishing process, such as editing, corrections, structural formatting, and other quality control mechanisms may not be reflected in this document.
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management, we may distinguish between responsibility for policy making, for taking measures, and for financing measures. From a legal point of view, responsibility may entail the competence to act to fulfil this responsibility, in many cases excluding others to do so. Moreover, it usually entails financial liability for damage that occurs if the responsibility has not been fulfilled well.

Responsibilities are not always regulated clearly or to everybody's satisfaction. Often different parties claim responsibility and thereby influence, as happened for instance in the Netherlands in the 1970s and 1980s, when the ministry responsible for water management and the ministry responsible for environmental management quarrelled extensively over the question who should become responsible for water quality control (Mostert, 2006). In other cases nobody wants to take responsibility because of the costs of necessary measures and of possible financial claims ("policy avoidance": Glasbergen, 1989). A clear example of this is the discussion on urban groundwater control in the Netherlands, which lasted for almost a quarter of a century, from 1983, when the issue was first raised in Parliament, to 2007, when the Dutch water management act was modified and the municipalities were made responsible.

Unclear or contested responsibilities and in particular policy avoidance can form an obstacle for effective action, and closure is often difficult. Many political and financial interests are involved, and what one party gains in terms of political influence or lower contributions, the others may lose. Yet, the allocation of responsibilities is not a pure zero-sum game. Some allocations may result in lower costs, more benefits or a distribution of costs and benefits that is considered more fair than others.

There is currently little guidance on what constitutes a good allocation of responsibilities. The well-known principles of "good governance" are not very specific on this issue (e.g. Graham et al., 2003; Hill, 2013; Lockwood, 2010). Other strands of literature are much more specific, such as the literature on polycentric governance (e.g. Galaz et al., 2012; Hooghe and Marks, 2003; Ostrom et al., 1961; Skelcher, 2005), transnational governance (Bulkeley et al., 2012), fit and interplay (Moss, 2012; Young, 2003, 2008) common pool resources management (e.g. Agrawal, 2001; Cox et al., 2010; Ostrom, 1990; Ostrom, 2010), scale (e.g. Dewulf et al., 2005; Gibson et al., 2000) and adaptation (Mees et al., 2012). These literatures yield important insights in different aspects of the issue, such as the role of community-based organizations and local governments and the relation between management scale and the scale of the management scale. The problem is that these different insights have not yet been integrated into a more comprehensive approach.

The aim of this article is to develop such an approach. It will identify twelve normative principles for the allocation of responsibilities. In the next section, the methodology that was used for identifying these principles will be presented. This is followed by a discussion of the principles themselves (Table 1, next page). In the final section, the potential use of the principles in practice will be discussed. In addition, the methodology used will be discussed and recommendations for further research will be given.[3]

2. Methodology

The principles presented in this article come from three different sources. The first is law, in particular Dutch and European water law (Mostert, 2013b; Rijswick and Havekes, 2012). Law reflects social values, as well as power relations, and although it is not always observed in practice, it has a special status and usually cannot simply be ignored.

[3] An earlier version of the list of principles has been published in the Dutch journal *Tijdschrift voor Water Governance* Mostert, E., 2013a. Het waterelftal: verantwoordelijkheden in het waterbeheer. Tijdschrift voor Water Governance, 9-15.

1. Capacity	Responsibility for specific tasks should be given to actors that possess or can develop the resources needed to perform these tasks well.
2. Lowest social costs	Total costs for society should be minimized.
3. Causation	Those causing a problem should be (financially) responsible for its solution.
4. Interest	Those with an interest in a management task should be (financially) responsible for this task.
5. Scale	The management scale should match as much as possible the scale of the management issues.
6. Subsidiarity	Tasks should be performed at the lowest possible level.
7. Structural integration	Responsibilities for closely related tasks should be combined in one hand.
8. Separation	Tasks should be allocated to different actors if a system of "checks and balances" is needed, for instance to prevent that specific interests are overlooked.
9. Solidarity	The risks and burdens that the members of a group have to face or carry should be shared by the group as a whole.
10. Transparency	The allocation of responsibilities should be clear.
11. Stability (but not standstill)	The allocation of responsibilities should not change too often, but it should be adapted to changing circumstances.
12. Acquired rights	Acquired rights – not acquired wrongs – should be respected and if necessary compensation should be offered.

Table 1: Overview of principles for the allocation of responsibilities

The second source is the arguments used in discussions on the allocation of responsibilities. I focus on four Dutch discussions concerning urban groundwater control; flood protection; the future of the water boards, the regional water managers in the Netherlands; and intergovernmental relations generally. I have followed these discussions for years (e.g. Mostert 1998). In addition, I have conducted complementary literature study, focusing on Dutch professional journals, advisory reports and policy documents. The arguments used in these discussions may have been used strategically to legitimize preferred solutions and promote specific interests, but they nonetheless show what counts as a valid argument and therefore can be taken to reflect prevalent values.

While these two sources help to ground the principles in practice, they primarily reflect views and values from the Netherlands. The third source, however, is more global. It is the scientific literature on environmental management that discusses or touches upon the allocation of responsibilities (see the examples given in the introduction). For none of the principles this literature is the only source, but for many it suggested a label and influenced the discussion in this article. Moreover, it could act as a check that the principles based on the first two sources are not typically Dutch but relevant for other parts of the world as well.

In order to limit the total number, closely related principles were combined under one heading, such as the polluter pays principle, which has been placed under the more general heading of causation principle. Moreover, principles that do not deal directly with the allocation of responsibilities, such as most of Ostrom's (1990) design principles, or offer little concrete guidance for this and are more like values to be observed, such as most principles of

"good governance", have not been included as separate principles, but they are often mentioned as part of their justification, such as accountability, which is mentioned under the subsidiarity principle and the transparency principle. Other than that, there is no hierarchy between the different principles, and the order in which they are presented below is meant purely to promote flow and readability.

3. Normative principles

3.1 Capacity

Possibly the most fundamental principle for the allocation of responsibilities is the capacity principle. According to this principle, actors can only be made responsible for a specific task if they can muster all the resources needed to perform this task satisfactory. These include legal powers, authority, expertise, information, time and money. If essential resources are lacking, capacity building may be needed (e.g. Kaspersma, 2013) or responsibility should be given to other actors.

Capacity has been used a lot as an argument for merging small water boards as this would enable them to hire more specialists (e.g. Lambooij and Aten, 2002). More recently, the water boards' expertise has been used as an argument for keeping the water boards as independent water management organizations and for transferring responsibility for regulating emissions onto the municipal sewers from the municipalities to the water boards (e.g. Adviesgroep water, 2011; Denktank, 1996; Havekes, 2008).

The capacity principle sets limits to individual responsibility. Flood protection provides a clear example of this: individual households usually cannot build dikes or undertake large-scale drainage works on their own. They could waterproof their own house, but this is effective only up to a certain inundation depth and may be more expensive than collective solutions. Which brings us to the second principle.

3.2 Lowest social costs

The principle of lowest social costs has been used for instance in discussions on urban groundwater control (Heidemij Advies and TU Delft, 1992). In essence, it means that the cheapest measures for solving a specific problem or reaching specific goals should be chosen, considering not only financial costs but the total costs to society. Whoever is responsible for these measures should be responsible for the management task concerned.

The principle of lowest social costs does not state who should finance the measures. Suppose for example that the cheapest measure for solving groundwater problems in a specific street is installing a drainage system on municipal grounds, which in the Netherlands is a municipal responsibility. In this case the municipality may try to recover the costs from the individual house owners in the street, for instance by means of a benefit tax ("baatbelasting"). Whether this would be justified depends among others on the following principle.

3.3 Causation

According to the causation principle, those causing a problem should be responsible for solving the problem or at least for financing the solution. In the field of environmental management the causation principle is known as the polluter pays principle (e.g. Treaty on the functioning of the EU, 2010, art. 191). The causation principle moreover lies at the root of the concept of legal liability, but the two do not coincide completely. For example, many sewers in the Netherlands leak and in fact function as drains, and when they are replaced groundwater levels may rise locally. Municipalities are usually not liable for the damage this may cause (Sterk Consulting en Colibri Advies, 2012). Nonetheless, municipalities may

decide to compensate the damage because the damage is at least partly caused by their actions.
Practical limitations of the causation principle are that the actor or actors causing a problem are not always known, and if they are known, they do not always have the capacity to solve the problem or finance the solution.

3.4 Interest

The fourth principle is the interest principle. According to this principle, those interested in a specific management task should be responsible for this task. It is a very pragmatic principle because tasks will usually be performed best by those interested in these tasks. It is also a very ancient principle, as witnessed by the old Dutch adage "who is affected by floods should defend himself against floods", summarising the ancient practice of dike maintenance by the land owners and users in the protected area (e.g. Henderikx, 2001; Mostert, 2012).
The interest principle can conflict with the causation principle since those causing a problem are not always the ones interested in its solution. A clear example is upstream pollution of a river, causing water quality problems downstream. Moreover, interested parties may lack the capacity to solve a problem or finance its solution.
The logical complement of the interest principle is that parties should not be made responsible for tasks in which they do not have an interest. This is an important consideration with respect to self-regulation. Self-regulation can be less burdensome for the sector concerned than governmental regulation and equally or more effective, but for self-regulation to work, the sector as a whole and the individual actors within the sector should be genuinely interested in effective self-regulation, either to prevent government regulation or reputational damage or out of a genuine sense of social responsibility (e.g. Héritier and Eckert, 2008; King and Lenox, 2000). In more general terms, how a task is executed depends on the interests of those executing this task. Hence, how the environment is managed depends on who manage it.

3.5 Scale

The fifth principle is the scale principle. According to this principle, the management scale should match or "fit" (Young, 2003) as much as possible the scale of the issue to be managed. Management at a too small scale would mean that tasks are not executed well because the costs have to be born locally but the benefits spill over to other areas. Management at a too large scale, on the other hand, would make it more difficult to consider local circumstances and preferences. Central government often lacks local knowledge and it may be legally impossible to differentiate. Moreover, central provision of local goods and services may results in excessive local demands because benefits are local and costs are spread over the country as a whole, in expenditure that is skewed towards those areas closest to central government, or in both (Besley and Coate, 2003).
The scale principle is central in the old theory of fiscal federalism (Musgrave and Musgrave, 1989; Oates, 1972; Oates, 1999). In the environmental management literature it is often referred to as the "bioregional perspective" or the "river basin approach" (Huitema et al., 2009). In Dutch flood management scale has been an issue for centuries, in particular the issue of balancing local rights and competencies with increasing bio-physical scales (e.g. Mostert, 2012). More recently, scale has been used as an argument for keeping the water boards as regional water managers since their boundaries are based more-or-less on water systems, something which cannot be said of provinces and municipalities (e.g. Denktank, 1996; Havekes, 2008).
For different reasons it can be difficult to determine the scale of a management issue in a specific case. First, in the literature on the politics of scale, scales are seen as the product of social, political, economic and cultural processes that empower actors at one level – often the

national level – and disempower actors at other levels (MacKinnon, 2011). Yet, when the environment is concerned, bio-physical processes should be reckoned with as well. That being said, our knowledge of bio-physical processes is limited and often coloured by our values and interests. Secondly, many management issues can be seen best as multi-scalar. The relevant scales for flood risk management, for example, include not only a) the flood-prone areas downstream, but also b) the upstream parts of the basins where the flood waters are generated; c) areas that are served by public utility infrastructure located in the flood-prone areas; and d) if we consider climate change, the whole earth. Thirdly, many management issues are multi-sectoral, and different sectors often use different scales. Flood risk management, for instance, is linked with land use planning, and whereas in flood risk management hydrological units are often used (e.g. Floods Directive, 2007), land use planning is usually based on administrative units such as municipalities and provinces. And finally, economic considerations may point towards a larger scale since more centralised management could prevent double work and makes it possible to hire specialist staff.

Approaches for dealing with the complexities of scale include polycentric and multi-level governance, characterised by a multitude of often overlapping management bodies (e.g. Berkes, 2006; Blomquist, 2009; Gruby and Basurto, 2014; Ostrom, 1990). These approaches are, however, not without their problems, most notably limited transparency, accountability and legitimacy (Hooghe and Marks, 2003; Mostert, 2012; Skelcher, 2005). Another approach is to separate the provision of goods and services – decision-making and financing – and the actual production (Ostrom et al., 1961). This makes it possible to realize economies of scale without scaling up provision, as long as production is scaled up, for instance by establishing joint specialized units such as laboratories and outsourcing specific services such as tax collection. But again accountability may become problematic, depending on how simple or complex the resulting arrangements are (Fraanje and Herweijer, 2013).

3.6 Subsidiarity and decentralization

The subsidiarity principle forms the complement of the scale principle. According to this principle, competencies and responsibilities should be located at the lowest possible level, implying a preference for small-scale decentralized management (Barber, 2005; Kraemer, 1998). Management at the lowest possible level can be less bureaucratic and expensive and more flexible than more centralized management. It makes it easier to consider local preferences and circumstances and although it could result in some double work, it facilitates experimentation with and learning from different approaches. Moreover, it can promote active participation by and accountability to the citizens (Ostrom, 2005). In ethnically or religiously diverse countries decentralization can promote political stability by introducing a form of self-governance for minorities and reducing grievance of these groups (Faguet, 2014).

Management at a low level is no panacea, however. It works best when there are no powerful local elites that capture local institutions; when the power of local government and central governments are balanced, preventing both encroachment on local rights by national government and capture of central government by local governments; and when there is open competition for political power, as there is in well-functioning democracies, forcing local politicians to seek support among their constituencies and be responsive to their needs (cf. Faguet, 2014; Lago-Penas et al., 2011). Moreover, the management issues should be local and local management capacity should be sufficient (see section 3.5) On top of that, the resulting allocation of responsibilities should be transparent (León, 2011, see section 3.10). But first and foremost, decentralization should be “real.” Any decentralization of responsibilities and competencies should not be offset by elaborate mechanisms of central supervision and control, as it is sometimes in the Netherlands (cf. Raad van State, 2013).

3.7 Structural integration

In the past decades a lot has been written about integrated approaches to environmental management (e.g. Biswas, 2004; Imperial, 2012; Margerum and Born, 1995; Mitchell, 1990; Mostert et al., 2008). Structural integration is one of the two main means of achieving integration, the other being collaboration. It involves combining responsibilities for closely related tasks and giving them to one actor (cf. Cabinet, 2008/9; Glasbergen, 1989). This would reduce transaction costs, facilitate collaboration, promote a holistic approach, and improve effectiveness and efficiency. Examples of closely related tasks are groundwater control in urban areas and the management of the urban public space. In the Netherlands the latter is a municipal task and it would therefore make sense to make groundwater control a municipality responsibility as well, as has in fact been done in 2007.

If a task is related to several other tasks and they cannot all be combined, it makes sense to combine at least the tasks that are related most strongly and coordinate for the other tasks. But in practice it may be hard to tell which tasks are related most strongly. For example, the Dutch water boards proposed in 2009 to take over management of the sewers from the municipalities because they were already responsible for urban wastewater treatment and combined management would result in large efficiency gains. The municipalities from their side emphasized the link with road maintenance, arguing that combining sewer replacement with maintenance works on the roads could reduce costs significantly. In the end, the water boards and municipalities settled for improved collaboration without changing the allocation of responsibilities.

3.8 Separation

In some cases it may be better to keep related tasks separate, for instance when there is a risk that a task would not get enough attention if combined with the other task or tasks (e.g. Imperial, 2005; Imperial, 2012). This has in fact been used as an argument for keeping the Dutch water boards independent and not merging them with the provinces, which are responsible, among others, for spatial planning. According to this argument, spatial planning is based on short-term economic considerations, and merging the water boards with the provinces would therefore threaten the long-term safety of the Netherlands against flooding (Havekes, 2013). In a similar vein, the Cabinet argued a few years earlier that regional water management should remain the task of single-purpose management bodies – the water boards – because this would make the balancing of water-related interests and other interests a “more conscious process” (Cabinet, 2003/4a, p. 5). In effect, the Cabinet argued for maintaining a system of checks and balances between different policy sectors, as there is in many countries between the legislative, executive and judiciary branch of government (cf. Hamilton et al., 2013, federalist paper nr 51).

Combination or separation is also an important issue for policy development and policy implementation and for decision-making and financing. Combining policy development and implementation can result in better-informed policies and better implementation, but also in less ambitious objectives and more lenient control of implementation (cf. Junier et al., 2010). The official Dutch policy since the 1990s is to separate the two in order to improve implementation, transparency and control (e.g. Cabinet, 2003/4b). Combining decision-making and financing can ensure an optimal balance of costs and benefits and prevent both under-expenditure (because the funds are not made available) and over-expenditure (because the costs are born by others). Yet, financial contributions from others can be considered in order to internalise positive externalities, i.e. when actions in one jurisdiction benefit other jurisdictions as well. Likewise, charges can be used to internalize negative externalities (Musgrave and Musgrave, 1989). Moreover, financial contributions from others can also be considered if those causing a problem or interested in its solution lack the capacity to solve

the problem but can contribute financially (see section 3.3 and 3.4), and for reasons of solidarity.

3.9 Solidarity

Principle number nine is the solidarity principle. The key idea of solidarity is that the risks and burdens that the members of a group face or carry should be shared by the group as a whole (Dawson and Verweij, 2012). But what is the relevant group? According to Prainsack and Buyx (2012), belonging to a specific group, e.g. having the same nationality, does not automatically result in feelings of solidarity. It would be rather the other way around: feelings of solidarity, of being similar and connected in some way, create group identity.

Especially during natural disasters feelings of solidarity may extend far beyond the scale of the disaster, as local disasters often spur national action and national disasters international action. This can develop into more structural support. A good example is dike maintenance in the South-West of the Netherlands. Until the 1950s, every polder was responsible for its own dike. There were, however, several small polders facing the sea that had an insufficient tax base for keeping their own dike in good order, and if their dike broke other polders would be threatened as well. For these polders provincial subsidies for dike maintenance were introduced, as this was cheaper and more effective than emergency relief (Schorer, 1897). In 1810, when government funds were tight, these subsidies were replaced for the most part by contributions from the other interested polders (Maas, 1963; Pauwels, 1937). Nowadays the problems are smaller because of large-scale mergers of polders since the 1950s. This has had an equalizing effect on the local tax burden. In addition, financing of dike strengthening has been centralized, but this trend is currently being reversed (Hoeben, 2012; IPO et al., 2011).

The solidarity principle matches very well with the capacity principle, but it can conflict with the causation principle and the interest principle (if we take interest in a narrow sense and do not consider feelings of solidarity). Moreover, it can conflict with the subsidiarity principle because subsidiarity is biased towards decentralized management, whereas the solidarity principle may lead to a more centralized approach (Barber, 2005; Spahn and Werner, 2007). The key issue is the relevant groups again. Decentralized management will lead to different policies and regulations, different levels of service provision and different tax burdens (Cabinet, 2008/9). This may be deemed acceptable when the relevant communities are local, but not when people see themselves primarily as members of a larger community.

3.10 Transparency

A very different principle is transparency. A transparent allocation of responsibilities reduces possibilities for scapegoating and blame shifting and can improve accountability and legitimacy. Moreover, it can prevent many conflicts and may reduce transaction costs (Hill, 2013; Stoker, 1998). But transparency is not the same as uniformity. Environmental issues can differ in different parts of a country and hence it is logical that management systems differ as well (Raad van State, 2013, p. 69). Moreover, transparency does not mean that overlaps in responsibilities should be avoided at all costs. Overlaps are almost inevitable and can increase resilience of environmental governance because if one management organization fails, others may take over its function (e.g. Andersson and Ostrom, 2008; Hooghe and Marks, 2003). That being said, governance can become too complex and opaque, which will increase transaction costs and create problems of accountability (e.g. Huitema et al., 2009; Imperial, 2005; Skelcher, 2005).

3.11 Stability (but not standstill)

Changing responsibilities is difficult and takes much time and energy, not only to effect the change, but also to adapt to the new allocation (North, 1990). Incremental changes are

therefore to be preferred to fundamental changes: they are less difficult and do not make all previous experiences irrelevant (Imperial, 2012). Moreover, it is better not to change the allocation too often ("policy rest": Raad van State, 2009). Nonetheless, change is sometimes necessary. If for instance the scale of a management issue has increased but the management scale has not, transaction costs and coordination problems may increase and public goods may be provided at a suboptimal level (see section 3.5).

3.12 Acquired rights

To complicate matters, changes in responsibilities often affect acquired rights. For example, until the 20th century many plots of land in the Netherlands protected by dikes did not contribute to the upkeep of these dikes (e.g. Flier, 1946; Mostert, 2012, annex 2). This situation went back to agreements and conditions of centuries earlier. The main argument for not changing the situation was that non-contributable land was worth more and often had been bought more dearly than contributable land. Making all land contributable would therefore lead to unjustified losses for the owners of these lands and to unjustified benefits for the other landowners (e.g. Anonymous, 1839).

If it is inevitable that acquired rights are affected, compensation may be in place; sometimes this is even legally required. A key issue is that some acquired rights may be acquired wrongs. For example, some areas might have been exempted from contributing to dike maintenance for no other reason than the power and influence of their former owner. In that case exemption was an unjustified advantage. But later landowners may have acquired the land in good faith, trusting that it was rightfully exempted.

Discussion

In this article twelve principles for the allocation of responsibilities in environmental management have been discussed. The discussion has focused on the allocation of responsibilities to existing organizations, but the principles are equally relevant when setting up new organizations, such as new river basin organizations, or merging existing ones, such as environmental and water management authorities, as has happened for instance in the United Kingdom (the creation in 1996 of the Environment Agency in 1996 out of the National Rivers Authority and Her Majesty's Inspectorate of Pollution) and in the Netherlands (the creation in 2010 of the Ministry of Infrastructure and the Environment). Moreover, although the twelve principles are based mostly on Dutch sources, the principles are relevant for other parts of the world as well. They have been formulated in general terms and most are supported by scientific literature from outside of the Netherlands. Nonetheless, the list of principles probably would have looked a bit different if they had been based more on sources from other countries: emphasis might have differed and different labels might have been used, such as “federalism” instead of “subsidiarity.”

The twelve principles cannot be used as a blueprint for the allocation of responsibilities. Although they are more concrete than the principles of “good governance”, they are still too abstract for that purpose. Moreover, they can conflict with each other. But what they can do is to inform discussions over responsibilities. As stated in the introduction, the allocation of responsibilities affects many political and financial interests, which makes discussions over responsibilities highly political. The twelve principles offer a common point of reference for such discussions that is independent from the parties in the discussion and their interests. This can help in reaching agreement and justifying the agreement to the different constituencies. It is true that each of the twelve principles can be used strategically, to further specific interests and legitimize preferred solutions, but if that happens counter arguments are immediately

available, and this may raise the level of the discussion. This assumes that there is discussion over responsibilities, which is most likely in well-functioning democracies, where there is open competition for power and politicians have to justify their actions.
The twelve principles point to fundamental tensions in environmental management, such as the tension between structural integration and separation. These tensions are interesting topics for further research. In addition, individual principles could be developed in more detail using different strands of literature. A promising candidate is the scale principle since most other principles have a spatial dimension and could be subsumed under this principle. But it would be equally interesting, if not more so, to study in detail specific controversies over responsibilities and analyse how they evolved and were resolved, if at all, and what role normative principles played in all this. Questions to be addressed in such research would be which principles were brought into action by whom; how were they interpreted and applied and for what purpose; and to what effect (both in terms of the resulting allocation of responsibilities and of the effect of this allocation on costs and benefits and their distribution over the different stakeholders)? Research along these lines, combining both a political and a normative perspective, could enrich our picture of the evolution of environmental management.

References

Adviesgroep water, 2011. De kracht van water; Naar één ge(s)laagde Omgevingswet. Advies https://omgevingswet.pleio.nl/file/download/442313.

Agrawal, A., 2001. Common Property Institutions and Sustainable Governance of Resources. World Development 29, 1649-1672. http://dx.doi.org/10.1016/S0305-750X(01)00063-8

Andersson, K., Ostrom, E., 2008. Analyzing decentralized resource regimes from a polycentric perspective. Policy Sciences 41, 71-93. http://dx.doi.org/10.1007/s11077-007-9055-6

Anonymous, 1839. Beschouwing van de dijkbesturen en hoogheemraadschappen in derzelven oorsprong, ontwikkeling en voortduring. Van der Meer & Verbruggen, Rotterdam.

Barber, N.W., 2005. The limited modesty of Subsidiarity. European Law Journal 11, 308-325. http://dx.doi.org/10.1111/j.1468-0386.2005.00261.x

Berkes, F., 2006. From community-based resource management to complex systems: the scale issue and marine commons. Ecology and Society 11, 45.

Besley, T., Coate, S., 2003. Centralized versus decentralized provision of local public goods: a political economy approach. Journal of public economics 87, 2611-2637. http://dx.doi.org/10.1016/S0047-2727(02)00141-X

Biswas, A.K., 2004. Integrated Water Resources Management: A Reassessment. Water International 29, 398-405. http://dx.doi.org/10.1080/02508060408691775

Blomquist, W., 2009. Multi-level Governance and Natural Resource Management: The Challenges of Complexity, Diversity, and Uncertainty, In: Beckmann, V., Padmanabhan, M. (Eds.), Institutions and Sustainability; Essays in Honour of Konrad Hagedorn. Springer, s.l., pp. 109-126. http://dx.doi.org/10.1007/978-1-4020-9690-7_6

Bulkeley, H., Andonova, L., Bäckstrand, K., Betsill, M., Compagnon, D., Duffy, R., Kolk, A., Hoffmann, M., Levy, D., Newell, P., 2012. Governing climate change transnationally: assessing the evidence from a database of sixty initiatives. Environment and Planning-Part C 30, 591. http://dx.doi.org/10.1068/c11126

Cabinet, 2003/4a. Interdepartementaal beleidsonderzoek: bekostiging van het regionale waterbeheer; Kabinetsstandpunt Kamerstukken II, 2003/4, 29 428, nr. 1.

Cabinet, 2003/4b. Kabinetsvisie “andere overheid” Kamerstukken II, 2003/4, 29 362, nr. 1.

Cabinet, 2008/9. Brief van de Minister en Staatssecretaris van Binnenlandse Zaken en Koninkrijksrelaties (decentralisatiekader)Kamerstukken II, 2008/9, 31.700 VII, nr. 100.
Cox, M., Arnold, G., Tomás, S.V., 2010. A review of design principles for community-based natural resource management. Ecology and Society 15, 38.
Crona, B., Hubacek, K., 2010. The right connections: how do social networks lubricate the machinery of natural resource governance? Ecology and Society 15, 18.
Dawson, A., Verweij, M., 2012. Solidarity: a moral concept in need of clarification. Public Health Ethics 5, 1-5. http://dx.doi.org/10.1093/phe/phs007
Denktank, 1996. Water centraal; Waterbeheer in de volgende eeuw. Unie van Waterschappen, Den Haag.
Dewulf, A., Gray, B., Putnam, L., Aarts, N., Lewicki, R., Bouwen, R., Woerkum, C.v., 2005. Disentangling approaches to framing: mapping the terrain, 18th IACM Conference, Seville, 12-15 June 2005.
Faguet, J.-P., 2014. Decentralization and governance. World Development 53, 2-13. http://dx.doi.org/10.1016/j.worlddev.2013.01.002
Flier, G.v.d., 1946. Het Hoogheemraadschap Noordhollands Noorderkwartier 1920-1945. Meijer, Wormerveer.
Floods Directive, 2007. Dïrective 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks. Official Journal of the European Union 6.11.2007, L 288/27.
Fraanje, R., Herweijer, M., 2013. Innoveren in samenwerking: een alternatief voor herindeling? Bestuurswetenschappen, 58-76.
Galaz, V., Crona, B., Österblom, H., Olsson, P., Folke, C., 2012. Polycentric systems and interacting planetary boundaries—Emerging governance of climate change–ocean acidification–marine biodiversity. Ecological Economics 81, 21-32. http://dx.doi.org/10.1016/j.ecolecon.2011.11.012
Gibson, C.C., Ostrom, E., Ahn, T.-K., 2000. The concept of scale and the human dimensions of global change: a survey. Ecological economics 32, 217-239. http://dx.doi.org/10.1016/S0921-8009(99)00092-0
Glasbergen, P., 1989. Naar een actief grondwaterbeheer? Een beschouwing over Zwarte Pieten in het stedelijke grondwaterbeheer, In: Gelderland, P. (Ed.), Grondwateroverlast in stedelijk gebied; technisch en/of bestuurlijk probleem. Provinciaal Bestuur van Gelderland, Arnhem, pp. 35-47.
Graham, J., Amos, B., Plumptre, T., 2003. Principles for good governance in the 21st century; Policy brief nr 15. Institute On Governance.
Gruby, R.L., Basurto, X., 2014. Multi-level governance for large marine commons: Politics and polycentricity in Palau's protected area network. Environmental Science & Policy 36, 260-272. http://dx.doi.org/10.1016/j.envsci.2013.08.001
Hamilton, A., Jay, J., Madison, J., 2013. The federalist papers. Project Gutenberg.
Havekes, H., 2008. Functioneel decentraal waterbestuur: borging, bescherming en beweging; De institutionele omwenteling van het waterschap in de afgelopen vijftig jaar. SDU Uitgevers, Den Haag.
Havekes, H., 2013. Koude douche voor waterschappen. Het Waterschap, 26-27.
Heidemij Advies, TU Delft, 1992. Aanbevelingen stedelijk grondwaterbeheer; bestrijding grondwateroverlast stedelijke gebieden; proefproject Roosendaal. Heidemij Advies, s.l.
Henderikx, P.A., 2001. Land, water en bewoning: Waterstaats- en nederzettingsgeschiedenis in de Zeeuwse en Hollandse delta in de Middeleeuwen. Verloren, Hilversum.
Héritier, A., Eckert, S., 2008. New modes of governance in the shadow of hierarchy: self-regulation by industry in Europe. Journal of Public Policy 28, 113-138. http://dx.doi.org/10.1017/S0143814X08000809

Hill, M., 2013. A Starting Point: Understanding Governance, Good Governance and Water Governance, Climate Change and Water Governance. Springer, pp. 17-28. http://dx.doi.org/10.1007/978-94-007-5796-7_2
Hoeben, C., 2012. Financiële verhoudingen tussen waterschappen en rijk. Tijdschrift voor Openbare Financiën 44, 58-65.
Hooghe, L., Marks, G., 2003. Unraveling the Central State, but How? Types of Multi-Level Governance. The American Political Science Review 97, 233-243. http://dx.doi.org/10.1017.S0003055403000649
Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., Yalcin, R., 2009. Adaptive water governance; Assessing adaptive management from an institutional perspective. Ecology and Society 14, 26.
Imperial, M.T., 2005. Using Collaboration As A Governance Strategy; Lessons From Six Watershed Programs. Administration & Society 37, 281-320. http://dx.doi.org/10.1177/0095399705276111
Imperial, M.T., 2012. Developing a Framework for Analyzing Partnerships for Integrated Water Resources Management (IWRM): An Institutional Analysis of Watershed Partnerships, Design and dynamics of institutions for collective action, Utrecht November 29 - December 1, 2012.
IPO, Ministerie van Infrastructuur en Milieu, Unie van Waterschappen, Vewin, VNG, 2011. Bestuursakkoord Water. Ministerie van Infrastructuur en Milieu, Den Haag.
Junier, S., Borowski, I., Bouleau, G., Interwies, E., Mostert, E., 2010. Implementing the Water Framework Directive: lessons for the second planning cycle, In: Quevauviller, P., Borchers, U., Thompson, K.C., Simonart, T. (Eds.), The Water Framework Directive: Action Programmes and Adaptation To Climate Change. RSC Publishing, Cambridge, pp. 80-96.
Kaspersma, J.M., 2013. Competencies in context: Knowledge and capacity development in public water management in Indonesia and the Netherlands. CRC Press/ Balkema, Leiden.
King, A.A., Lenox, M.J., 2000. Industry self-regulation without sanctions: the chemical industry's Responsible Care programme. Academy of management journal 43, 698-716. http://dx.doi.org/10.2307/155636
Klijn, E.-H., 2008. Governance and governance networks in Europe: An assessment of ten years of research on the theme. Public Management Review 10, 505-525. http://dx.doi.org/10.1080/14719030802263954
Kraemer, R.A., 1998. Subsidiarity and water policy, In: Correia, F.N. (Ed.), Selected issues in water resources management in Europe Vol. 2. Balkema, Rotterdam, pp. 387-417.
Lago- Peñas, I., Lago-Peñas, S., Martinez-Vazquez, J., 2011. The Political and Economic Consequences of Decentralization. Environment and Planning C: Government and Policy 29, 197-203. http://dx.doi.org/10.1068/c2902ed
Lambooij, H., Aten, D., 2002. "De held sterft niet"; Waterschapsconcentratie in Noord-Holland, 1916-2003. Uitwaterende Sluizen, Edam.
León, S., 2011. Who is responsible for what? Clarity of responsibilities in multilevel states: The case of Spain. European Journal of Political Research 50, 80-109. http://dx.doi.org/10.1111/j.1475-6765.2010.01921.x
Lockwood, M., 2010. Good governance for terrestrial protected areas: A framework, principles and performance outcomes. Journal of environmental management 91, 754-766. http://dx.doi.org/10.1016/j.jenvman.2009.10.005
Maas, W.J.M., 1963. De Dijkwet van 1810; een algemene bijdragenwet in de Franse tijd Nijgh & Van Ditmar, Rotterdam/ 's-Gravenhage.

MacKinnon, D., 2011. Reconstructing scale: Towards a new scalar politics. Progress in Human Geography 35, 21-36. http://dx.doi.org/10.1177/0309132510367841
Margerum, R.D., Born, S.M., 1995. Integrated Environmental Management: Moving from Theory to Practice. Journal of Environmental Planning and Management 38, 371-391. http://dx.doi.org/10.1080/09640569512922
Mees, H.L., Driessen, P.P., Runhaar, H.A., 2012. Exploring the scope of public and private responsibilities for climate adaptation. Journal of Environmental Policy & Planning 14, 305-330.
Mitchell, B., 1990. Integrated water management; international experiences and perspectives. Belhaven Press, London.
Moss, T., 2012. Spatial Fit, from Panacea to Practice: Implementing the EU Water Framework Directive. Ecology and Society 17, 2. http://dx.doi.org/10.5751/ES-04821-170302
Mostert, E., 2006. Integrated Water Resources Management in The Netherlands; How concepts function. Journal of Contemporary Water Research & Education 135, 19-27. http://dx.doi.org/10.1111/j.1936-704X.2006.mp135001003.x
Mostert, E., 2012. Water management on the Island of IJsselmonde 1000-1953; Polycentric governance, adaptation and petrification. Ecology and Society 17, 12. http://dx.doi.org/10.5751/ES-04956-170312
Mostert, E., 2013a. Het waterelftal: verantwoordelijkheden in het waterbeheer. Tijdschrift voor Water Governance, 9-15.
Mostert, E., 2013b. Water Law and Organization (Dutch version); Course CIE 5500. TU Delft, Faculteit CITG, Delft.
Mostert, E., Craps, M., Pahl-Wostl, C., 2008. Social Learning: the key to integrated water resources management? Water International 33, 293-304. http://dx.doi.org/10.1080/02508060802275757
Musgrave, R., Musgrave, P., 1989. Public Finance in Theory And Practice; International edition, 5th ed. McGraw-Hill, New-York.
North, D.C., 1990. Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge.
Oates, W.E., 1972. Fiscal Federalism. Harcourt Brace Jovanovich, New York.
Oates, W.E., 1999. An essay on fiscal federalism. Journal of economic literature 37, 1120-1149. http://dx.doi.org/10.1257/jel.37.3.1120
Ostrom, E., 1990. Governing the commons: the evolution of institutions for collective action. Cambridge University Press, Cambridge.
Ostrom, E., 2005. Understanding institutional diversity. Princeton University Press, Princeton.
Ostrom, E., 2010. Beyond markets and states: polycentric governance of complex economic systems. American Economic Review 100, 641-672. http://dx.doi.org/10.1257/aer.100.3.641
Ostrom, V., Tiebout, C.M., Warren, R., 1961. The organization of government in metropolitan areas: a theoretical inquiry. The American Political Science Review 55, 831-842.
Pauwels, A., 1937. De oorsprong van de Belgische polderwetgeving : de politiek van Frankrijk (1794-1814) ten aanzien van de polders : de wording van de organieke keizerlijke decreten van den 11 Januari en van den 28 December 1811. De Sikkel, Antwerpen.
Prainsack, B., Buyx, A., 2012. Understanding Solidarity (With a Little Help from Your Friends) Response to Dawson and Verweij. Public Health Ethics 5, 206-210. http://dx.doi.org/10.1093/phe/phs018

Raad van State, 2009. Decentraal moet, tenzij het alleen centraal kan; Tweede periodieke beschouwing over interbestuurlijke verhoudingen. Raad van State, 's-Gravenhage.
Raad van State, 2013. Het kán beter; Interbestuurlijke verhoudingen opnieuw beschouwd. Raad van State, 's-Gravenhage.
Rhodes, R.A., 2007. Understanding governance: ten years on. Organization studies 28, 1243-1264. http://dx.doi.org/10.1177/017084060707658
Rijswick, H.F.M.W., Havekes, H.J.M., 2012. European and Dutch water law. European Law Publishing, Groningen.
Schorer, J.A., 1897. De geschiedenis der calamiteuse polders in Zeeland tot het reglement van 20 Januari 1791. IJdo, Leiden.
Simpson, J.A., Weiner, E.S.C., 1989. The Oxford English dictionary, 2nd ed. Clarendon Press, Oxford.
Skelcher, C., 2005. Jurisdictional Integrity, Polycentrism, and the Design of Democratic Governance. Governance: An International Journal of Policy, Administration, and Institutions 18, 89-110. http://dx.doi.org/10.1111/j.1468-0491.2004.00267.x
Sørensen, E., Torfing, J., 2009. Making governance networks effective and democratic through metagovernance. Public administration 87, 234-258. http://dx.doi.org/10.1111/j.1467-9299.2009.01753.x
Spahn, P.B., Werner, J., 2007. Germany at the Junction between Solidarity and Subsidiarity, In: Bird, R.M., Ebel, R.D. (Eds.), Fiscal Fragmentation in Decentralized Countries: Subsidiarity, Solidarity and Asymmetry, . Edward Elgar Publishing, Cheltenham (United Kingdom) pp. 89-113.
Sterk Consulting en Colibri Advies, 2012. Handreiking Juridische Helderheid Grondwaterbeheer.
Stoker, G., 1998. Governance as theory: five propositions. International Social Science Journal 50, 17-28. http://dx.doi.org/10.1111/1468-2451.00106
Treaty on the functioning of the EU, 2010. Consolidated version of the Treaty of the functioning of the European Union Official Journal of the of the European Union C 83/47, 30.03.2010.
Young, O.R., 2003. Environmental governance: the role of institutions in causing and confronting environmental problems. International Environmental Agreements 3, 377-393. http://dx.doi.org/10.1023/B:INEA.0000005802.86439.39
Young, O.R., 2008. Institutions and environmental change: The scientific legacy of a decade of IDGEC research, In: Young, O.R., King, L.A., Schroeder, H. (Eds.), Institutions and environmental change; Principal findings, applications, and research frontiers. The MIT Press, Cambridge, Massachusetts/ London, England, pp. 3-45.