

The Roles of Residents in Climate Adaptation: A systematic review in the case of the Netherlands

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ABSTRACT

Climate adaptation literature has hitherto devoted limited attention to the roles of residents. Yet their role is crucial in addressing non- or maladaptation, as their initiative or consent is often necessary to take adaptation measures in or around the house. To address this knowledge gap, this paper explores mainstream and additional roles for residents through a literature review. Mainstream roles are those roles that residents usually take, while additional roles are more specific and local in nature. The latter may, however, provide the seeds for wider change. To structure the results, we made a distinction between three forms of residents' commitment to adaptation: as (1) citizens falling under the jurisdiction of various governmental levels; (2) consumers (including home owners) in the market; and (3) civil society members/partners. While this is an established categorization in other domains of environmental governance, it has not yet been systematically applied to the adaptation domain. The paper's empirical focus regarding mainstream and additional roles is on the Dutch adaptation domains of flood risk management, stormwater management and dealing with heat stress. We found scope for additional roles for residents, especially as consumers in the market and civil society members. The findings are of significance for the global debate on residents' roles in climate adaptation and suggest that addressing all three forms of commitment may enhance the implementation of measures as well as their legitimacy, residents' awareness and societies' potential to innovate. Copyright © 2017 John Wiley & Sons, Ltd and ERP Environment

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Introduction

AN EMERGING LITERATURE DISCUSSES THE ROLES OF PUBLIC AND PRIVATE ACTORS IN ADAPTATION GOVERNANCE (MEES *ET AL.*, 2012, 2013; Runhaar *et al.*, 2012; Tompkins and Eakin, 2012). Governments at different levels appear to be primary actors (Mees *et al.*, 2012, 2013; Tompkins and Eakin, 2012). Various national governments have produced adaptation strategies and are determining the rules of the game for providers in the market, including

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the conditions for offering specific products and services (Mees, 2016). Local governments make concrete local policies or take specific actions in several adaptation domains, including flooding and urban heat stress (Jonsson and Lundgren, 2015; Mees, 2016). The involvement of businesses and citizens is necessary to share responsibilities, fully exploit the resources present in society (Mees *et al.*, 2012, 2013; Tompkins and Eakin, 2012) and identify no-regret measures. It may help to address a lack of adaptation or maladaptation, including such barriers as conflicting timescales; substantive strategic and institutional uncertainty, institutional crowdedness and institutional voids, fragmentation, lack of awareness and communication; diverging motives and willingness to act; and a lack of resources (Adger *et al.*, 2009; Wamsler and Brink, 2014a).

Residents' roles, understood as the expectations and prescriptions regarding their actions, responsibilities and attitudes as held by themselves or others, are crucial for realizing adaptation measures in and around the house (Mees *et al.*, 2012; Tompkins and Eakin, 2012). Residents' initiatives or consent is often necessary (Mees *et al.*, 2012; Tompkins and Eakin, 2012) while they can also play a role in tailoring adaptation measures in terms of technical (im)possibilities, specificities of climate risks and residents' individual needs (Wamsler and Brink, 2014b). Nevertheless, the literature has paid only limited explicit attention to residents' roles (Osberghaus *et al.*, 2010; Wamsler and Brink, 2014b; Wamsler and Brink, 2015). The literature on citizen involvement in adaptation has predominantly focused on issues of participation, social justice and fairness (Paavola and Adger, 2006; Few *et al.*, 2007; Paavola, 2008). Other roles have only been addressed implicitly and in a fragmented way. For instance, Runhaar *et al.* (2012) discuss adaptation measures at building and district level, but they do not explicitly analyse and compare residents' roles. Other issues addressed are social contracts between the state and citizens (O'Brien *et al.*, 2009; Adger *et al.*, 2013); the role of direct democracy in climate change policy (Stadelmann-Steffen, 2011); and the role of residents in flood insurance schemes (Aerts and Botzen, 2011). Tompkins and Eakin (2012) have shown that in many cases private parties, including residents, can be important providers of 'adaptation goods', being specific adaptation benefits resulting from residents' actions for themselves (e.g. limiting home flood damage through sand bags) and/or their communities (e.g. contributing to the water buffering capacity of urban areas by reducing soil sealing on their properties).

An explicit and systematic overview of residents' roles in adaptation may be a useful starting point for exploring whether and to what extent there might be unexploited potential (Wamsler and Brink, 2014b) for engaging residents. Different roles have different implications for the balance between self-interest and the collective interest, as well as the relations between governing actors and residents (Spaargaren and Oosterveer, 2010). Furthermore, residents have become increasingly articulate actors (Spaargaren and Oosterveer, 2010; Hajer, 2011). In domains other than adaptation, for instance food and energy production and consumption, water consumption and sanitation, residents have been shown to be driving forces for desired changes as well as important actors in hindering them (Hegger, 2007; Spaargaren and Oosterveer, 2010).

Hence, this paper aims to contribute to the adaptation governance literature by systematically exploring the roles of residents in climate adaptation. Through a literature review, we explore roles that seem mainstream and additional roles that are less often observed or thought of. The latter are roles that are less widespread and more specific and local in nature. By systematically mapping them and comparing them to mainstream roles, we expect to facilitate the inventory of unused potential in adaptation governance. As will be further justified in the methods section, our empirical focus will be on The Netherlands, enabling a coherent analysis that provides a starting point for future comparisons with other countries.

We confine our analysis to roles in and around the house, while acknowledging that residents can be linked to institutions in different ways, as signified by the multitude of terms that are used in the literature to denote their relationship with institutional actors such as 'citizens' (O'Brien *et al.*, 2009; Barr *et al.*, 2011), 'consumers' (Barr *et al.*, 2011), 'citizen-consumers' (Spaargaren and Oosterveer, 2010) and 'end-users' (Hegger, 2007). We acknowledge that there are also normative reasons for assessing residents' roles in climate change adaptation. For instance, one may find that democratic legitimacy requires residents to be able to co-decide about issues in which they have a stake (Adger *et al.*, 2009; Driessen and Van Rijswijk, 2011). Such normative considerations fall beyond the scope of this paper.

First, the paper introduces our conceptual framework and provides our methods. We then discuss the roles of residents as citizens, consumers and civil society members/partners, respectively. We end with a discussion and concluding remarks.

Conceptual Framework

Three Forms of Commitment of Residents: Citizens, Consumers and Civil Society Members/Partners

The environmental governance literature often distinguishes between the three societal spheres of state, market and civil society (Driessen *et al.*, 2012). Driessen *et al.* use this categorization as an overarching framework for distinguishing between different modes of environmental governance. Many governance scholars make a distinction between hierarchies, markets and networks (Thomson *et al.*, 1991). This literature thus moves beyond a dominant focus on governmental actors, considering all three societal spheres when analysing, evaluating and designing aspects of environmental governance. In line with this distinction, residents can be conceived as (1) citizens falling under the jurisdiction of various levels of government, (2) consumers in the market or (3) members of civil society (Spaargaren and Oosterveer, 2010). We have operationalized this distinction as follows:

- (1) The role of citizens vis-à-vis governmental actors pertains to social contracts between citizens and governmental actors at different levels (e.g. O'Brien *et al.*, 2009; Adger *et al.*, 2013). This paper focuses on the roles related to action taken in and around the house, while acknowledging the several other angles from which the relationship between citizens and governmental actors can be viewed (e.g. from the perspective of participatory governance; Few *et al.*, 2007; Burton and Mustelin, 2013)
- (2) The role of residents as consumers vis-à-vis providers in the market pertains to the extent to which companies approach residents with adaptation-relevant products and services and the extent to which these are actually purchased;
- (3) Regarding the role of residents as members/partners of civil society, we focus on residents' actions as community members and their relationships with civil society organizations, whereby notions of reciprocity, solidarity and morality become more important (Spaargaren and Oosterveer, 2010).

The distinction between these three forms of commitment has been established in the field of environmental governance more generally but is relatively new for the adaptation domain. For instance, Tompkins and Eakin (2012: 7) implicitly hint at this distinction by identifying three different types of motivations for private actors to provide public adaptation goods: pleasure of giving; non-financial compensation through, for example, risk reduction; and financial compensation. These seem to be implicitly related to the roles of residents as civil society members, residents as citizens vis-à-vis governmental actors and residents as consumers in the market, respectively. However, in their analysis they still seem to see governmental actors as the primary actors in adaptation governance (see also: Mees, 2016).

Mainstream vs. Additional Roles of Residents

While recognizing that the distinction between 'mainstream' and 'additional' is not clear-cut, we have identified the following heuristics to make this distinction.

Mainstream roles of residents pertain to roles that are widespread. These include those rights and responsibilities of citizens that have been embedded in law, national policies or in many local policies. In relation to the market, mainstream refers to products and services that are readily and widely available and usually applied, to such an extent that there can be said to be a relatively large and saturated market. In relation to residents' commitment to civil society, mainstream refers to facilities for which it is considered normal that they are available at community/neighbourhood level, or actions that are usually taken at community level.

Additional roles of residents pertain to roles that are not usually taken and to examples that are very local and specific in nature. These include local projects or (non-formalized) pilots initiated by actors from the state or by civil society actors that are so rare that an (almost) exhaustive list of examples could be given. In relation to the market, 'additional' can refer to market niches (smaller market), often with higher prices. We see the additional roles as potential seeds for change (see also: Schot and Geels, 2008). However, some action would be required to facilitate scaling up of the initiatives through replication. Also, one can logically assume that relatively new roles of residents

require corresponding shifts in modes of governance to enable these roles. This is an issue that will be further addressed in the Discussion.

Methods

The study's empirical focus is on the adaptation domains of fluvial flooding, pluvial flooding and heatwaves in the Netherlands. These are significant adaptation domains in terms of the country's (future) vulnerabilities (Runhaar *et al.*, 2014) and are of widespread concern in other countries. The Netherlands, furthermore, has a rich tradition when it comes to participatory policy-making for environmental issues and beyond (Driessen *et al.*, 2012). Therefore, the Netherlands will to some extent be an extreme case: if efforts to engage residents in climate adaptation are shown to be problematic in the Netherlands, this finding will probably be of more general relevance. To this we must add, however, that this participatory tradition holds less for the domain of fluvial flood risk management (FRM) in which public actors (Office of Public Works and regional water authorities) have strong legally embedded responsibilities towards citizens (Van Rijswick and Havekes, 2012).

The three adaptation domains differ considerably in terms of their degree of institutionalization as separate policy domains and the extent to which responsibilities between public and private actors and between institutional actors and residents have been sorted out, and here the heat stress domain lags behind the other two domains (Mees *et al.*, 2012, 2013, 2014b). In the Netherlands, the domains of fluvial and pluvial flooding constitute very different policy domains with the involvement of different actors and different relevant rules and regulations. Fluvial and coastal flood management, in the Netherlands referred to as 'water safety', falls under the responsibility of the Office of Public Works and the regional Water Authorities. These have a legal obligation to provide a basic level of safety to citizens. Municipalities are responsible for dealing with pluvial flooding. In general, the consequences of pluvial flooding will be much less severe than those of fluvial flooding (Van Rijswick and Havekes, 2012).

Since relevant papers are available, but have not been brought together in an explicit and systematic analysis based on a coherent conceptual framework, we used a literature review as our main data collection method. Berrang-Ford *et al.* (2015) would characterize our approach as a narrative review. We used 'pre-defined eligibility criteria for documents and explicitly outlined and reproducible methods' (Berrang-Ford *et al.*, 2015: 756) for the collection of literature and making selections therein. However, analysis of the documents found was conducted in a more interpretative way. This systematic search was complemented at some points by referring to policy documents known by the authors that could help to provide more context to the reader.

A literature search in Scopus was carried out, using search terms that to our knowledge are widely used to refer to climate adaptation more generally and to specific domains relevant for adaptation. These were combined with terms that denote residents' relations with institutional actors. Table 1 provides an overview of the results.

In the literature found, we made a first selection based on article title. Papers with an empirical focus on non-Western countries were dismissed from the analysis as well as papers that did not deal with the roles of residents related to adaptation. The remaining papers were studied in more detail. Since we distinguish between three forms of commitment, three adaptation domains and between mainstream vs. additional roles, Table 2 contains 18 ($3 \times 3 \times 2$) cells. For a paper to be retained in the review, its content should provide insights pertaining to at least one of these 18 cells. The nine cells on mainstream roles were addressed by analysing literature with an empirical focus on the Netherlands, while the nine cells on additional roles were also addressed by looking at literature from outside the Netherlands.¹ The content of the cells of Table 2 is a summary of the detailed findings presented in the upcoming sections. To provide the reader with an overview, we have chosen to provide this summary here. We have made available a fully referenced version

¹Some references have been omitted from the Results to reduce its length, but a thoroughly referenced version of the Results can be viewed as supplementary material to this article.

Search terms (title/abstract/keywords)	No. of hits in Scopus	Selected based on title	Focus on the Netherlands	Cited
Residents AND				
Climate change adaptation	298	22	2	4
Disaster risk reduction	113	4	0	0
Disaster risk management	359	9	0	0
Natural hazards management	209	4	0	0
Floods (both keywords article title only)	1199/43	4	0	0
Heat stress (article title only)	17	0	0	0
Citizens AND				
Climate change adaptation	159	4	3	8
Disaster risk reduction	50	2	0	1
Disaster risk management	235	3	2	1
Natural hazards management	97	3	0	0
Floods	432	11	7	3
Heat stress	13	1	1	1
Citizen-consumers AND				
Climate change adaptation	1	0	0	0
Disaster risk reduction	0	0	0	0
Disaster risk management	0	0	0	0
Natural hazards management	0	0	0	0
Floods	1	0	0	0
Heat stress	0	0	0	0
End-users AND				
Climate change adaptation	40	0	0	0
Disaster risk reduction	14	0	0	0
Disaster risk management	61	0	0	0
Natural hazards management	33	0	0	0
Floods	183	0	0	0
Heat stress	46	0	0	0
Consumers AND				
Climate change adaptation	150	2	0	1
Disaster risk reduction	26	1	0	0
Disaster risk management	104	0	0	0
Natural hazards management	95	2	0	0
Floods	392	3	0	0
Heat stress	225	0	0	0
Sustainable housing AND				
Climate change adaptation	28	0	0	0
Disaster risk reduction	8	0	0	0
Disaster risk management	27	0	0	0
Natural hazards management	12	0	0	0
Floods	52	1	0	0
Heat stress	3	0	0	0
Sustainable dwelling AND				
Climate change adaptation	2	0	0	0
Disaster risk reduction	2	0	0	0
Disaster risk management	3	0	0	0
Natural hazards management	4	0	0	0
Floods	2	0	0	0
Heat stress	1	0	0	0
Civil society AND				
Climate change adaptation	143	7	3	3
Disaster risk reduction	82	1	0	0

Search terms (title/abstract/keywords)	No. of hits in Scopus	Selected based on title	Focus on the Netherlands	Cited
Disaster risk management	342	3	0	0
Natural hazards management	94	1	0	0
Floods (article title only)	2	0	0	0
Heat stress	76	0	0	0
NGOs AND				
Climate change adaptation	64	1	0	0
Disaster risk reduction	49	2	2	0
Disaster risk management	71	4	0	0
Natural hazards management	25	1	0	0
Floods	94	0	0	0
Heat stress	1	0	0	0
Community-based AND				
Climate change adaptation	240	7	0	1
Disaster risk reduction	137	4	0	1
Disaster risk management	182	1	0	0
Natural hazards management	63	1	0	0
Floods	189	1	0	1
Heat stress	19	0	0	0
Grass roots AND				
Climate change adaptation	26	0	0	0
Disaster risk reduction	8	0	0	0
Disaster risk management	17	0	0	0
Natural hazards management	6	0	0	0
Floods	21	0	0	0
Heat stress	0	0	0	0

Table 1. Number of articles found through searches in article title, abstract and keywords (Scopus); some references have been omitted from the main text of the results to reduce its length, but a thoroughly referenced version these sections has been included as supplementary material

of the Results, containing all the results of the literature review, as supplementary material. The following sections are a ‘lean’ version of this document from which some references were omitted, especially those that did not provide additional insights but only evidence for insights already conveyed.

Residents as Citizens vis-à-vis Governments

Mainstream Roles

Flood Risk Management

The mainstream role of residents as citizens vis-à-vis governments is rather limited in the case of FRM. National-, regional- and local-level governments are primary actors in Dutch adaptation planning, because these actors have many formal (legal) responsibilities, including those for flood management and civil protection (Hegger *et al.*, 2014a). Flood protection through dikes, dams and embankments is the dominant strategy (Hegger *et al.*, 2014a). Dutch citizens living in dike-protected areas (about two-thirds of the Netherlands; Pieterse *et al.*, 2009) are legally entitled to a minimum safety level regarding flood protection, which varies between different regions but is generally higher than the safety norms in other countries (Van Rijswick and Havekes, 2012). National and regional water authorities have a joint responsibility for complying with these norms (Van Rijswick and Havekes, 2012). A smaller group of residents live in so-called un-embanked areas. These have a relatively high flood probability but are not protected by dikes. They formally live there at their own risk, without being aware both of the level of risk

Form of commitment of residents	Adaptation domain	Mainstream roles of residents in the Netherlands	Additional roles of residents that are less widely present in the Netherlands, and examples from other Western countries
Residents as citizens vis-à-vis governmental actors	Flood risk management (FRM)	Limited involvement	Addressee of pro-active risk communication; carrying out formal responsibilities in FRM (e.g. Flutschutzgemeinschaften Hafency Hamburg)
	Stormwater management	Addressee of local governments as potential action taker regarding the retaining of rainwater on their own premises	Taker of measures (e.g. green roofs or replanting green; rainwater harvesting on premises, leading to disconnection of rainwater from the sewer)
	Preventing or dealing with heat stress FRM	No explicit or formal roles for residents Limited involvement	Taker of measures (e.g. incentive programmes and mandatory requirements for new buildings) Customer of flood insurance scheme (niche development) Purchasers of floating houses and property-level flood protection Customer of flood insurance schemes and flood doors/barriers (internationally)
Residents as consumers vis-à-vis providers in the market	Stormwater management	Customers of green roofs and rainwater retention measures more generally (for reasons of functionality only)	Customers of green roofs and rainwater retention measures for other considerations than pure functionality only, e.g. because of their aesthetic value
	Dealing with heat stress	Customer of products for reacting to heat (re-active adaptation, e.g. air conditioning, blinds and ventilators) Limited involvement	Customers of pro-active adaptation to heat, including green/white roofs and tree planting
Residents as members/partners of civil society organizations	FRM	Limited involvement	Volunteer in flood preparation
	Stormwater management	Limited involvement	Initiator of eco-villages that included measures for rain water retention/green roofs
	Dealing with heat stress	Lobbying for measures to deal with heat stress	Member of community groups working with public health officers in staffing heat lines

Table 2. Mainstream and additional roles of residents related to three forms of commitment of residents and three adaptation domains – A summary

and of the fact that they are not legally entitled to flood protection (De Boer *et al.*, 2012). Planning instruments are available that could in principle be used to discourage urban development in areas with high flood risk, but such development continues to take place (Van Rijswick and Havekes, 2012).

Most responsibilities regarding civil protection lie primarily at the municipal level (mayor and aldermen) (Security Regions Act of 2010). If necessary, these responsibilities can be scaled up to the level of one of the 25 security regions (a governance level dedicated to civil protection at the supra-municipal scale led by the mayor of the largest municipality in the security region) and, ultimately, to the national level where the Minister of Interior Affairs is in charge.

This institutional context, combined with limited recent flood experiences and reliance on measures with a collective character (e.g. dikes), has led to a low level of citizens' awareness and disaster preparedness and high reliance on governmental actors (OECD, 2014; Runhaar *et al.*, 2014). The efforts of the Dutch Ministry of Interior Affairs to increase emergency preparedness (<http://www.nederlandveilig.nl/noodsituaties/>) were relatively unsuccessful. A governmental campaign to request residents to have a so-called 'emergency package' in their home has led to only limited participation (e.g. one study found a participation rate of 10.8% among its respondents; Baan *et al.*, 2008).

Stormwater Management

In the domain of stormwater management, the main role of citizens is that of being addressed by local governments as potential action takers regarding the retaining of rainwater on their own premises. From the beginning of the 21st century, it has been national policy to strive towards the decoupling of rainwater from the sewer system (Directoraat Generaal Milieu, 2004). Various municipalities have chosen to implement this policy by initiating subsidy programmes and providing advice to residents regarding the installation of retention measures on their premises. Nevertheless, residents' awareness of action perspectives and potential involvement is relatively low.

Dealing with Heat Stress

No explicit or formal roles for residents in dealing with heat stress have been identified, partly because there is still much debate on the desirable division of responsibilities between public and private actors, and between the individual and the collective level (Mees *et al.*, 2014b). A National Heat Plan was developed in 2007 which became operational during heat waves in 2012, 2013 and 2016. This plan states, among other things, that citizens should adapt their behaviour and look after their family members and neighbours. However, residents' awareness of the dangers of heat stress, including the possibility of dying because of heatwaves, is very low (Mees *et al.*, 2014b).

Additional Roles

Flood Risk Management

A first additional role for citizens in FRM is that of addressee of more proactive risk communication, and to some extent participant in participatory governance processes. In the Netherlands several local examples can be given. In the un-embanked areas in Dordrecht and Rotterdam, local governments proactively communicate risks to the residents concerned (De Boer *et al.*, 2012; Hegger *et al.*, 2014a). In Dordrecht, there are sustained positive experiences with participatory processes of the municipality and the inhabitants of un-embanked areas. These residents have a high degree of flood consciousness and at times of high water they make proactive and coordinated efforts to protect against flooding (Hegger *et al.*, 2014a). Both in Dordrecht and in Rotterdam, residents have been shown to be able to understand water-related risks, although risk awareness has sometimes led to anxiety (De Boer *et al.*, 2012). There is also anecdotal evidence that residents' risk awareness is greater where the risk is more conceivable; for example, flood risks can be more easily imagined at locations where the threatening water body is actually visible or where there is a history of regular flooding.

International literature documents various ways to increase flood consciousness as well as awareness of climate change consequences more generally. Shaw *et al.* (2009: 461) have found that 'addressing climate change in a participatory way, with credible but easily accessible visuals, and at a scale that matters to people, may be critical in building capacity for climate change action'. Baron and Petersen (2015) argue that a lack of residents' concern for local flood risks can be explained by people's experiences with and connections to their local landscape, while

Buys *et al.* (2012), in their study on conceptualizing climate change in the context of rural Australia, found it to be more fruitful to speak of 'weather variability' than of 'climate change' (Glaas *et al.*, 2015 reached similar findings). Taylor *et al.* (2014), in a UK context, have found that a moderate amount of fear may also help in mobilizing the public, if this is coupled with a clear scope of action. This paper also stresses the importance of a country-specific approach, pointing out that specific forms of climate change (e.g. higher temperatures in the UK) are not necessarily seen as negative in a certain context. However, the sole provision of information is not sufficient to foster climate action and it is suggested that information provision needs to be complemented with the offer of concrete action perspectives (Osberghaus *et al.*, 2010).

A second additional role pertains to residents undertaking formal responsibilities in FRM. In several European countries, governments ask residents living in un-embanked areas to take additional property-level measures to deal with flood risks (e.g. Flutschutzgemeinschaften in Hafencity Hamburg; Mees *et al.*, 2014a). The latter is an example in which local governments take very specific actions, including the delegation of responsibilities for flood management to citizens, and make dedicated regulations through a hierarchical governance arrangement.

Stormwater Management

The main additional role of citizens regarding stormwater management is that of a taker of measures (e.g. green roofs or replanting green; rainwater harvesting on premises). In a few cities, citizens are being made aware of their role in and contribution to the hardening of garden surfaces. The municipality of Rotterdam, for instance, has started the action 'tile out, plant in'. Both Amsterdam and Rotterdam have conducted actions together with market parties, in which plants were given away to citizens for free. Other measures related to stormwater management are policies to stimulate the installation of green roofs. These also have other benefits such as reducing the urban heat island effect (collective benefit), (slightly) improving the insulation capacity of the roof (private benefit) and improving the quality of urban spaces and biodiversity (collective benefits). Several Dutch municipalities have subsidy schemes for green roofs, but these are changing from year to year due to available budgets (Mees *et al.*, 2013).

Dealing with Heat Stress

An additional citizens' role in dealing with heat stress is that of taking measures. International examples highlight the engagement of citizens in the installation of green and/or white roofs through incentive programmes or even through mandatory requirements for new buildings (various cities in North America) and tree planting programmes for residents on private property (Toronto) (Mees *et al.*, 2014b).

Residents as Consumers vis-à-vis Providers on the Market

Mainstream Roles

Flood Risk Management

Regarding FRM, including disaster preparedness, the involvement of consumers is very limited. With the exception of the un-embanked areas in the Netherlands, flood protection is almost entirely publicly organized. Furthermore, in the Netherlands the role of insurance companies is very limited. Until recently, it was not possible to insure against flood risks and currently there is only one provider of such insurance. The Netherlands differs strongly from neighbouring countries, including the UK, France, Germany and Belgium, where flood insurance is available and widely purchased, and in the case of the UK even mandatory (Kleindorfer and Kunreuther, 1999).

Stormwater Management

Regarding stormwater management, there is a (hitherto) limited role of consumers as customers of green roofs and rainwater retention measures more generally (Mees *et al.*, 2013). Providers of such systems point to their functionality and aesthetic value and strongly emphasize the economic aspect of such rainwater retention systems. They inform consumers about the possibilities of getting governmental subsidies. These differ per region, because both some regional water boards and some municipalities have (sometimes overlapping) subsidy schemes.

Dealing with Heat Stress

Regarding dealing with heat stress, the consumers' primary role is that of purchasers of heat-reactive products (re-active adaptation, e.g. air conditioning, blinds and ventilators). Measures that are meant to pro-actively deal with heat stress are much less widely purchased.

Additional Roles

Flood Risk Management

In FRM, we have identified the following three additional roles. A first role is that of consumers of flood insurance schemes. While these can be considered mainstream in countries such as Belgium, Germany and the UK, there is only one provider of an insurance scheme for disasters including floods in the Netherlands (<http://neerlandse.nl>). This niche development draws on the arguments: (1) that residents can be encouraged to take actions themselves through an incentive system ensuring that taking action is in their own interest – if flood insurance premiums are risk-based, they may form a source of information to residents and a way to increase their flood consciousness (Botzen *et al.*, 2009); (2) that risk-based premiums may also provide an incentive not to live in high-risk areas or to move away from them; and (3) that premium reductions may stimulate residents to take adaptive measures themselves (Botzen *et al.*, 2009). The principles upon which the insurance scheme is based are quite unlike the current institutional organization of flood management.

A second role is that of residents as consumers/users of floating urbanization. In some cases, floating urbanization is seen as an economic opportunity (e.g. the municipality of Rotterdam has explicitly denominated floating urbanization as such). In the Harnaschpolder in Delft, consumers can buy so-called water plots, several of which have been sold, where floating houses are being created (<http://www.architectuurcatalogus.nl/locatie/delft-waterkavels/>) and there are companies specialized in such floating urbanization (<http://www.deltasync.nl/deltasync/index.php?id=homepage&L=1>). One can logically expect that residents will not primarily buy floating houses out of the wish to reduce risks, but instead because they want to live on or close to water, or because of the houses' aesthetic value.

A third additional role is that of consumers as purchasers of flood barriers for private property. In the Netherlands, this role can be said to be virtually non-existent. In other countries, however, various private property protection measures are more common, such as flood doors and barriers in the UK (e.g. <http://www.boxbarrier.com>).

Stormwater Management

An additional role of consumers in stormwater management may be that of customers of green roofs, also for reasons other than pure functionality, including their aesthetic value or even because they are seen as a status symbol or as sustainable behaviour (Mees *et al.*, 2013).

Dealing with Heat Stress

An additional role regarding dealing with heat stress is that of customers of pro-active adaptation to heat, including green/white roofs and tree planting. The implementation of such measures in the Netherlands lags significantly behind that in frontrunner countries (Mees *et al.*, 2014b).

Residents as Members of Civil Society

Mainstream Roles

Residents as civil society members play a rather limited role in climate adaptation regarding all three adaptation domains under consideration. While in general organized civil society plays a strong role in the Netherlands (Hajer, 2011), civil society organizations do not often deliberately organize themselves around adaptation goals, although, as in other countries, organized civil society plays an important role in dealing with extreme weather events. Organizations providing first aid, including charities, churches and the Red Cross, are cases in point. In that

sense, there could be said to be implicit involvement of organized civil society in climate change adaptation as in other countries (e.g. Adger *et al.*, 2013). Some environmental non-governmental organizations (NGOs) (e.g. Natuur en Milieu Federatie Utrecht) are actively appealing for measures to be taken (<http://www.nmu.nl/zoeken?search=hittestress&x=0&y=0>) and the Dutch Red Cross is involved in this domain, being co-author of the Dutch National Heat Plan.

Additional Roles

Flood Risk Management

An additional role found in other countries is that of volunteering in flood preparation. Examples can be found in Belgium, France and the UK, where there are specific local examples of the engagement of residents in flood preparation (e.g. filling sand-bags; volunteers playing a role in looking after vulnerable community members) (Hegger *et al.*, 2016).

Stormwater Management

Regarding stormwater management, residents can be initiators of eco-villages that include measures for rainwater retention and green roofs. Eco-villages are often bottom-up initiatives by residents' groups and NGOs (Hegger, 2007). Residents have been shown to become involved in eco-villages for different reasons, including (1) an 'inner directed' wish to live what they perceive to be the good life (Hegger, 2007) and (2) a more 'outer directed' opinion that they can and should contribute to societal transformations. Bottom-up initiatives are often pursued as part of overarching 'green' lifestyles (Hegger, 2007).

Dealing with Heat Stress

An additional role of civil society members in dealing with heat stress is that of members of community groups working with public health officers in staffing heat lines. Such initiatives have taken in Philadelphia and the Dutch Red Cross is currently trying to set up similar arrangements (Mees *et al.*, 2014b). Other examples include block captains and the Philadelphia Corporation for Aging which actively engage with vulnerable citizens through phone calls and home visits (Philadelphia). In other cities community groups work side-by-side with public health officers in staffing heat lines (Kassel, Toronto, Philadelphia) (Mees *et al.*, 2014b). In addition, in various countries including the Netherlands, community initiatives for urban agriculture are increasingly being taken. Although these initiatives do not deliberately aim at climate adaptation, they do contribute to the amount of green space in the urban environment, thus reducing the urban heat island effect.

Discussion

Chosen Research Approach and Research Agenda

The results of a literature review were structured using a conceptual framework that distinguishes between (1) three forms of commitment of residents, (2) mainstream vs. additional roles and (3) three adaptation domains. *Grosso modo* this has provided a useful and instructive way to analyse residents' roles in adaptation. As we have seen, in most cases residents relate primarily to one of the three types of institutional actors with a dominant role of residents as citizen, consumer or member/partner of civil society organizations. While the distinction between 'mainstream' and 'additional' is hard to make conceptually, it was not problematic empirically. In most cases, we found a large difference between mainstream and additional. Below we reflect on the implications that shifts towards the additional roles might have for public policies.

Obviously, the most country-specific part of the framework is the selected adaptation domains. If our analyses were performed in other countries, other adaptation domains would have been more prominent (in terms of urgency and in terms of the magnitude of the consequences in case of non-adaptation). It would be interesting to expand the analysis by taking into account other adaptation issues such as dealing with drought. Nevertheless,

the addressed issues are of widespread concern in several countries, contributing to the external validity of our findings.

The scope of our literature review also necessarily had its limitations. While we did take into account a rich international literature on FRM, disaster risk reduction and heat stress, our perspective may be skewed by focusing on papers that mention terms such as ‘citizens’, ‘consumers’, ‘residents’, etc., in their title, abstract and keywords. But for our goal of providing an elaborate sketch of mainstream and additional roles of residents, we deem this approach legitimate.

Further comparative national empirical analyses are needed regarding the different ways in which residents have been involved in climate change adaptation, assessing which relationships between residents and institutions can be found in practice in different countries and adaptation domains. In addition, analyses at case study level can also be performed, whereby case studies can be geographical units (e.g. neighbourhoods, municipalities, business sectors) but also adaptation domains. Finally, more design-orientated research can be carried out in which researchers reflect, together with actors from practice, on the possibilities and impossibilities of arranging adaptation through other relationships between residents and institutional actors (see, for instance: Few *et al.*, 2007; Hegger *et al.*, 2014b). The effectiveness of certain forms of engagement of residents and the more fundamental question of whether certain roles belong with residents should also be evaluated (Driessen and Van Rijswick, 2011). These questions need contextualized answers, taking into account current legal frameworks, and preferences for divisions of responsibilities, as well as the question of who is in the best position to act.

Reflections on Implications for Public Policies

Regarding residents’ commitment as citizens vis-à-vis governmental actors, the presented examples suggest that action by residents is enhanced in cases in which local governments take a significant level of public responsibility, tailored to specific measures or innovations (see also: Mees *et al.*, 2013, 2014a; Porter *et al.*, 2014). This would make a case for what Driessen *et al.* (2012) have termed a shift towards more decentralized as opposed to centralized governance. This implies that lower levels of government become empowered (in terms of formal competences, possibilities to make autonomous decisions as well as the availability of resources such as manpower and finances). Decentralized governance provides more room for stakeholder involvement and for the consideration of issue-, time-and-place-specific knowledge, as well as more generic expert knowledge (Driessen *et al.*, 2012). However, for governmental actors to improve their orientation on citizens regarding adaptation, it will probably also be necessary to engage more in interactive governance (as suggested also by Edelenbos *et al.*, 2017 and Mees, 2016), in which centralized or decentralized governments are not the only initiating actors. This may imply that residents get a more equal role vis-à-vis governmental actors. Moreover, forms of network governance based on trust rather than formal authority may become more prevalent, and policy instruments such as negotiated agreements, trading mechanisms and covenants may enter the arena (Driessen *et al.*, 2012). Financial incentives for individual adaptation can be offered; and (in)formal agreements with individuals who engage in improving city–citizen collaboration can be made (Wamsler, 2016).

Regarding residents’ commitment as consumers in the market, there seems to be potential for innovative practices. While residents may employ economic rationalities in some circumscribed situations (e.g. purchasing insurance schemes), they may also be motivated by the pleasure of giving; non-financial compensation through, for example, risk reduction; and financial compensation. Residents may take certain actions not out of the wish to realize adaptation measures but because it is seen as a co-benefit of something else.

A strengthened role of residents as consumers in the market requires creativity and the recognition of relevant opportunities by providers in the market. Governmental actors may facilitate and stimulate these actions. Markets can be created or regulated through incentive-based instruments such as taxes, subsidies and grants (implying a shift towards more public–private governance). Governmental actors can also stimulate entrepreneurship through education or the offering of credit. A concrete example is a business competition organized by Climate KIC, the European Union climate innovation initiative, together with the Dutch national research programme Knowledge for Climate. Such stimulating actions in the short to mid-term would stimulate the implementation of adaptation measures by market actors, so that less government involvement will be necessary in the long run.

The role of governmental actors who want to promote the activities of residents in their capacity as civil society members will often be a facilitating one. To a large degree, these activities will be bottom-up forms of self-governance which by definition are not orchestrated by governmental actors. An adaptive and receptive stance towards such initiatives is necessary (Edelenbos *et al.*, 2017) and governmental actors may facilitate them by establishing knowledge-sharing dialogues to stimulate social learning, deliberations and negotiations (Driessen *et al.*, 2012; Wamsler, 2016); schooling and other forms of capacity development; and allowing for experimentation by providing legal exemptions or financial support (Schot and Geels, 2008; Wamsler, 2016).

Concluding Remarks

The role of citizens, and residents in particular, has largely been overlooked in the adaptation literature. This role can be addressed systematically by distinguishing between mainstream and additional roles related to three forms of residents' commitment to adaptation: as citizens vis-à-vis governmental actors, consumers vis-à-vis providers of market goods and as members/addressees of civil society.

In the Netherlands, the mainstream role of citizens vis-à-vis governmental actors in the adaptation domain can be described as a passive one, with governmental actors taking the lead, especially in the major adaptation domain of FRM. Efforts to 'delegate responsibilities from governmental actors to citizens' are underway, but often with limited success. The main challenges in the Netherlands seem to be a lack of risk awareness and uncertainty regarding residents' scope of action. The discussion of additional roles has shown, however, that barriers against increased involvement of residents are not insurmountable. Local governments were involved in all examples of a sustained active role of residents.

The most scope for additional roles of residents pertains to their involvement as consumers and civil society members. For consumers, adaptation will be only one among a range of arguments for promoting certain products and services. There is also scope for actions to be taken by residents as members of or collaborators with civil society organizations, but the number of concrete initiatives is still relatively low and fragmented in scope.

Further engaging residents in climate adaptation may hold substantial potential for realizing more adaptation (e.g. Mees *et al.*, 2013), although this needs to be further quantified. More importantly, however, is that a focus on residents promises other advantageous points, including increased legitimacy of adaptation measures, increased awareness, more innovative capacity, less (financial) pressure on governmental actors and enhanced mainstreaming of adaptation into other activities (Runhaar *et al.*, 2012; Uittenbroek *et al.*, 2013).

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Figure S1. Supporting info item