Coping with Extreme Events: Institutional Flocking

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Gulf Stream collapses (from a Dutch Newspaper, 21 October 2015)
Recent measurements in the North Atlantic confirm that the thermohaline circulation driving the Gulf Stream has come to a stand. Oceanographic monitoring over the last 50 years already showed that the circulation was weakening. Under the influence of the large inflow of melting water in Northern Atlantic waters during last summer, it has now virtually stopped. Consequently, the KNMI and the RIVM estimate the average temperature to decrease by 3°C in the next 15 years. Summers will become cooler, and in winter, more snow and ice are to be expected. A researcher of the RIVM states: "In some ways, the rise in temperatures we experienced in the past decades will be reversed. But it is hard to predict what the further course of climate change will be. Our models are not validated for this type of abrupt changes." Confronted with the recent events, experts are unable to estimate whether the circulation will re-establish itself in the near future.

1 Introduction

This hypothetical newspaper article sketches the situation, which forms the starting point of our essay. The situation is characterized by a predicted cooling of the climate in the years to come, but more importantly, by fundamental uncertainties on the further development of climate change. Particularly these uncertainties will impact political and societal responses. Several diverging scenarios exist for the 10 to 20 years following this THC collapse. An expansion of snow and ice covers in the Northern Atlantic region may lead to further decrease of temperatures. Changing circulations in oceans and atmosphere may cause the process of cooling to stop and give way to an accelerated process of climate heating. Other scenarios are also possible, in which the climate in relatively short periods of time oscillates between temperature rise and fall. Between episodes of cooling and heating, large amounts of melting water in the catchment areas of Meuse and Rhine may lead to flooding on scales unprecedented in the Dutch delta.

None of these scenarios, we assume, can be strongly privileged or dismissed easily on scientifically plausible grounds. There might be different probabilities and improbabilities, but also large uncertainties. This means the risk profile for the Netherlands that forms the starting point for this essay, significantly diverges from the risk profile of global warming that prevailed up till now. With global warming, society was confronted with a change in climate with uncertain consequences, but the change occurred relatively slowly and the direction was known. The risk profile we deal with in this essay is different, because the pace of change can be relatively rapid, and the sign of change can vary: heating and cooling. Such a situation of 'abrupt' change puts a higher (time) pressure on natural science research and expertise (c.f. Hulme, 2003). Long-term predictions are hardly possible, and at the same time, there is an acute demand for early detection and warnings of climate changes, and reliable quantification of their implications for weather, water management and ecology, and for the related and dependent socio-technical systems that make up our society. Even more strongly than before, citizens and decision makers will have to rely on the eyes and ears of science in shaping their plans for an imminent future. In addition, society needs a better 'adaptive capacity' to deal (quickly) with new incoming information and evidence of rapid climate change.

In this essay we will explore how such a new risk profile affects the distribution of risks among societal groups, and the way in which governing institutions need to adapt in order to be prepared for situations of rapid but unknown change. The next section will first introduce an analytical perspective, building upon the Risk Society thesis and a proposed model of 'institutional flocking'. Subsequently we will analyse three sectors in some detail: urban infrastructures, rural land use planning and water safety and security. Finally, we draw conclusions and offer some tentative policy recommendations.

2 Risk Society and Institutional Flocking

The idea of extreme events and rapid climate change in unexpected directions echoes the concept of the Risk Society, originally formulated by Ulrich Beck in 1986. In his *Risk Society* he argued that in modern societies the distribution of wealth, as a pivotal controversy, would increasingly be superseded by the distribution of risks. The organizing principle in risk societies would not be the distribution of economic prosperity and material assets along class lines, but rather the distribution of (ecological and other) risks among (groups in) societies. Conventional distributional logics, social divisions, ideological controversies and social struggles are dramatically transformed along the new axes of risk and uncertainty. These new axes of distribution, division and debate cause new mechanisms of inclusion and exclusion, and new challenges for coherence in social systems. According to Beck, risks transcend into a dominant feature of everyday life, engendering feelings of anxiety among the populations. But this new risk society profile also triggers changes in existing – and the development of new – institutions to cope with the ecological and technological risks. Risks are produced by modern institutions, but strike these very modern institutions as a boomerang. This will have far reaching consequences for the kind of institutions that are leading in organizing modern societies, the way in which these institutions are (re-)organized, and how they function.

In formulating his idea of the emerging risk society Beck distinguishes two stages. In the first stage environmental impacts and risks, through which modern society threatens itself, are systematically produced, but do not become public issues, or the center of political conflict and institutional reform. In the second stage the features of modern industrial society become socially and politically problematic due to these risks and self-threats; the key institutions of modern society become subsequently the object of self-reflection, launching experiments, initiatives and calls for reform. Reflexive modernization is then the common denominator of societies that find themselves confronted with ecological and technological risks and uncertainties, and turn these into programs for reformulating and reorganizing modern institutions. The conventional self-referential systems of science, politics, agriculture, finances, transport, law, and many others are forced to allow outside criteria into their design formats, and into their definitions of success and failure. This comes together with an increasingly transnational/global dimension and dependency of these social institutions.

The Risk Society and reflexive modernity call for new modes of governance and steering, diverging from the paved ways of conventional politics and government. Reflexive governance institutions need to be flexible in order to adapt relatively quickly to new unexpected situations that follow from the uncertainties of the risk society. It is no longer possible to use one center where all information comes together, and where centrally strategies are developed and implemented. But at the same time, flexible governing institutions in reflexive modernity need robustness, in that they require a degree of predictability, that programs and policies must be related to each other and that they should provide coherence and a degree of continuity to keep society and social sectors together and functioning. These are the challenges of governing in the context of a risk society. In the situation forming the starting point of our essay – which is characterized by potentially rapid, but uncertain and unpredictable changes with far-reaching consequences - these challenges are taken to an extreme.

In order to fulfill the combined requirements of flexibility, robustness and coherence, posed by the situation of abrupt and unpredictable change, we introduce a model of 'institutional flocking', inspired by the metaphor of bird flocking. The coordinated movement of large flocks of birds (or schools of fish) has fascinated observers of all times. Many have wondered how these flocks can fly in such a free flowing and yet organized way, rapidly turning as a collective and immediately reacting to sudden stimuli – as for instance a predator – without an apparent leader or center of coordination. Research on actual flock movements (pioneered by Potts, 1984) involving computer simulations of flock behavior (*e.g.* Reynolds, 1987, 2001) has revealed that this behavior is not governed by one or more leaders, but is an emergent property of the group as a whole. It is determined by the moment-to-moment decisions of each individual bird in accordance to certain principles. Core principles of flocking behavior are the adaptation to nearby flock-mates (avoid collapse, and harmonize speed), the orientation to a common direction (fly in the same direction as most of the flock), and the anticipation of instant movement (watch for any sign of a sudden movement and respond instantaneously). As a result, each bird can start a movement of the flock, but the flock as a whole keeps together and the eventual course will be determined by the interplay of individual actions.

By using the metaphor of bird flocks we indicate the flexibility of actor strategies in taking different routes and directions without a clear centre steering the actors. The 'birds' in the metaphor are the various actors in society (individuals and groups), which constantly assess new incoming information of their social and natural environment in deciding the route to take. 'Flocking' refers to the processes that cause the outcome of these actors' decisions – that is, the course taken by the actors collectively – to remain coherent and robust under sudden changes of direction (caused by internal or external events). With the word 'institutional' we indicate that the mechanisms governing these processes are not based on biological principles, as in the case of real flocks, but are based in institutions made up of social rules and resources (Giddens, 1984). Governance institutions are of particular concern. Institutional flocking, as we will argue, implies that governing is not achieved by hierarchical steering and institutionalized and 'fixed' or corporatist alliances of (stakeholder) groups, but rather through arrangements and networks in which each of the mutually dependent actors can provide initiatives, develop innovations, and start changes of direction. Governance as institutional flocking will affect stakeholder participation (rules of access and inclusion and exclusion), the empowerment of actors involved, and the openness and transparency of policymaking and decision taking processes.

In our analysis of societal response to a risk profile of abrupt and unpredictable changes, we make use of the following key elements of institutional flocking.

- *Adaptation and mutual learning.* This element refers to processes that help actors to keep in pace with others and avoid serious conflicts. By learning from other actors and adapting activities to fit in with the activities of others, patterns of change can easily spread over society without much friction or delay.
- *Coherence and solidarity.* Institutional flocking does not lead to divergence or chaos, because a strong sense of urgency and coherence, and a clear awareness of the need to cooperate are the cement of these networks. In following external information and developing new ideas and strategies, individual and collective actors constantly try to adapt to new situations; but at the same time they stay in course with society as a whole.
- *Flexibility and innovation.* Flexibility refers to the capacity of each actor to rapidly change direction in situations of uncertainty, by continuously anticipating possible changes in social and physical environments. Innovation refers to their capacity to initiate innovative patterns of action, and pro-actively influence the structures of governance in coping with abrupt change.

These elements are roughly grafted on, but certainly not identical with, the core principles identified in research on bird flocking.

As far as we are aware, the way we use the flocking analogy is this essay is new. In a different but somewhat related sense, however, 'flocking' has been used by De Geus (1997) to characterize institutional learning processes in a company. De Geus grafted his concept on evolutionary biology insights of the US zoologist Allan Wilson. In a similar vein, many social science authors have applied evolutionary biology principles to explain dynamics of self-organization, policy, and social learning (Van den Bergh 2007, Richerson *et al*. 2002). In this essay, however, we do not claim that biological principles act as causal mechanisms of institutional flocking. Rather than engaging in this interesting but controversial debate, we emphasize that one should not drive the analogy of bird flocks too far. Human actors and organizations are not like birds, do not behave like birds and do not follow biological laws. There exist clear dangers of using ecological metaphors for social processes, as has been widely discussed regarding for instance the idea of industrial ecology (cf. Boons and Baas, 1997) and the sociology of fluids (cf. Mol and Spaargaren, 2006). It is merely the analogy that helps us to clarify the model needed for future institutions to deal with the unpredictabilities and threats of extreme events.

In analyzing how the Netherlands can cope with extreme events and relatively rapid, but uncertain and unpredictable climate change we will follow a risk society and institutional flocking inspired analysis of three empirical sectors: urban infrastructures, rural land use planning, and water safety and security. The rationale for choosing these sectors is that they represent vital areas of Dutch environmental policy and planning, and together can provide a fairly representative picture of the challenges in this field. Obviously, there are more fields with great relevance to issues of abrupt climate change, as for instance public health care, but it would not be possible to cover them all. For each of the investigated sectors a short indication of the key current status is followed by a 'prospective analysis' on two core issues.

1. *New distributions among groups and sectors of society, both in terms of classical economic gains and benefits, and in terms of new risk divisions.* Who are losing and who are gaining? What are the principles for distributing costs and benefits? And what strategic behavior groups and sectors will develop around risk distributions?
2. *Transformations in governing institutions following the need to cope with extreme, rapid – but uncertain – climate change.* Which elements of the old institutional designs are prone to failure? How are the current governing institutions, and the interfaces of science, politics/governance and citizens, transformed in the process of coping with increasing uncertainties?

3 Urban infrastructures

Urban infrastructures – such as drinking water systems, waste water systems, electricity, piped-gas systems, road and rail transport, waste management systems, and telecommunication systems – are network-bound systems. These large socio-technical systems are often highly centralized and have a physical grid for delivering uniform commodities or services in a constant flow. Often there exists an almost natural monopoly (or sometimes an oligopoly) for service or commodity delivery through the systems, due to heavy investments in these network-bound systems. As a consequence, consumers are so to say 'captured' in the system. Recently, on the wave of neo-liberalism, a discussion has emerged on the desirability of a split of physical infrastructure ownership, which should stay in public hands, and service or commodity delivery, which should be subjected to market competition. At the moment, various models exist for the management of these socio-material systems, ranging from full public management and operation, via different public-private arrangements, to highly privatized systems, with limited roles for public agencies. But in most cases, urban infrastructures are managed, operated and coordinated centrally. Moreover, these systems have increasingly international dependencies, as they are connected to transnational networks, international policy arrangements, and global economic rules. Therefore, they have a highly complex risk profile, which makes it difficult to assess and predict their functioning in situations of abrupt change. Increasingly complex linkages can make systems more robust (for instance, because other network linkages can take over functions of the damaged ones) but they can also increase their vulnerability to external shocks, whether it be of a natural (hurricanes, weather extremes), political (terrorist attacks, mafia control, geo-political powers), economic (raising oil prices, floating financial markets, bankruptcy) or even social (new normative orders, Nimby protests against hubs in networks) nature.

New distributions

Extreme, sudden and unpredictable weather events may have various consequences for these type of large scale, centralized, network-bound, socio-material systems. The most direct consequences are related to the physical infrastructures of these networks. Extreme weather requires that such systems can operate under a larger bandwidth of conditions. Freezing of water or other fluid transporting systems is one clear danger, but also ice-storms that endanger above ground electricity and telecommunication networks, or problems with keeping road and rail transport system running at low (or very high) temperatures or heavy snow (also with respect to for instance solid waste collection, maintenance and repair of grid-based systems). The consequences of extreme weather events and of relatively sudden and unpredicted weather changes for the functioning of a network-bound system and for continuing commodity and service delivery depends very much on the kind of system as well as the organization, operationalisation and management of that system. But if there are serious consequences, how are these distributed among various groups and classes in society? Research into extreme weather events such as 2005 hurricane Katrina that hit New Orleans (Burby, 2006), the 1998 ice-storm at the border of Canada and the US, and heat extremes such as the 1995 US heat wave (causing wildfires, water shortages and death) learns us that the distribution of these risks do only partly run along class or income division lines. With hurricane Katrina, rich and poor were affected by the collapse of most network-bound systems, although the rich and white had more opportunities to escape the disaster area in time than the poor and black (Elliott and Pais, 2006). With the Canadian-US ice-storm, rich and poor areas were almost equally affected by the collapse of electricity supply and the subsequent disfunctioning of numerous other urban infrastructure systems (Murphy, 2001), but rural area inhabitants and farmers were among the last to be reconnected to the grid. Moreover, it was not so much rich or poor which was decisive in coping with these extremes, but rather the sense of community in neighborhoods (or the degree of social capital; Putnam, 2000) and the reaction and management of local authorities. Hence, we can expect that infrastructure-related risk following extreme events, only partly run along class and income divisions. New divisions seems equally relevant: those dependent on centralized systems versus those have access to decentralized back-ups (such as the Amish, which were hardly affected by the 1998 ice storm), those living in neighborhoods with high levels of social capital versus those living in neighborhoods with low levels of social capital, cities with flexible management institutions and good emergency plan versus cities with conventional rigid, centralized management and emergency institutions.

Institutional transformations

In dealing with larger oscillations between weather extremes in shorter periods of time, there is a need for robust systems that function under a variety of (extreme) conditions. At the same time infrastructure management and operation need to become more flexible, to be able to adapt performance quickly to new situations. This has clear consequences for the technical properties of such systems. Properties needed under extreme conditions are reciprocity (instead of hierarchy), redundancy (instead of one-to-one determination), and multifunctionality (instead of unique specialization). This is, however, not just a technical issue. It equally affects design, management, operation and collapse back-up strategies for such systems, which equally have to be geared towards reciprocity, redundancy, and multifunctionality. What we in fact need is robustness in the physical and technical properties of network-bound systems, in combination with flexibility in the management, operation, and collapse back-up. With respect to the former point, major challenges are there for innovations in materials, construction, physical layout of networks, knowledge on underground systems, etc. We will not further elaborate on that (see for instance Infrastructure Canada, 2006). With respect to the flexibilisation in management, operation and collapse back-up, new perspectives, institutional designs and arrangements are needed in order to function under these new conditions. As an example, we can present the case of electricity provision. The extreme events hypothesized in this article imply that electricity networks should be able to cope with sudden grid damage through storms, as well as sudden rises in electricity use as a result of extreme temperature shifts. Technically speaking, this implies that there need to be sufficient auxiliary linkages to other grids, as well as emergency provisions for additional local electricity generation. From a social perspective, this means that the management structure should be prepared to handle the changes needed, but also that arrangements exist for instantly involving business managers and citizen-consumers in taking industry, office, and household measures to avoid over-burdening the grid. We will now elaborate such institutional transformations in more theoretical detail.

As was observed above, the strengths of the current network-bound systems that make up urban infrastructures have always been uniformity, centralization (in technology and management), large scale, and the exclusion of consumer/end-user in their operation. Hence, these network-bound systems are typically modernized systems, but from a first or simple modernity type, as Ulrich Beck (1994) would call it. They have been developed during a modernization process out of a diversity of small scale, often inefficient, low-technological, decentralized systems where end-users and consumers were stronger involved. Similar to Perrow's (1984) analysis of *Normal Accidents*, the normalization of extreme weather events requires less tightly coupled systems, or what we have elsewhere called 'modernized mixtures' (Spaargaren et al., 2005; Hegger, 2007; Figure 1). First generation modernized systems need to be further developed into inbuilt reflexivity and flexibility. The institutions that govern and maintain urban infrastructures should enable to pro-act, design and react in more flexible ways to all kinds of short-term predictions and unexpected events. Normalization of extreme weather events asks for globally-linked, decentralized systems, which can be easily coupled and decoupled, adapted, and reconfigured; and can thus function in large network-bound systems but also as relative independent (stand-alone) units at smaller scales. Decentralized – but globally coupled – energy generation and distribution, decentralized water production and storage, medium-sized waste collection and recycling, and the possibility of decoupling telecommunication systems from a global network could make these systems less vulnerable. But this requires also a decentralization and thus flexibilisation of maintenance, emergency repair, and disaster management, and a higher level of involvement of end-users in such systems.

It is of course impossible and even undesirable to turn end-users into full experts on the various network-bound systems, in order to make them co-managers of these infrastructure systems. Experts and expert systems should keep their central role in designing and functioning of these systems. But the current organization of commodity and service delivery 'behind the back' of consumers may have to be reconsidered. As was hinted by the example of electricity provision, citizen-consumers need to become more involved. Various decentralized water, energy, waste recycling and mobility technologies ask for more consumer/end-user involvement (van Vliet, 2002; Hegger, 2007). But citizen-consumer involvement is also required in assessing the new supply of all kind of technologies and services that will emerge on the market, in response to the increasing vulnerabilities and unpredictabilities related to climate change. We will see entrepreneurs offering bottled water (potentially undermining drinking water form the tap), home water purification systems, all kind of home or neighborhood based energy generation services and technologies, new solid waste services (*e.g.* piped, underground, decentralized composting), new insurances for extreme events, alternative service and maintenance contracts (with or without extreme events being covered), and other innovations that use the new frame of vulnerability of contemporary network-bound systems. Increasingly, this 'market of unpredictable vulnerability' makes that consumers/end-users will no longer solely rely and trust upon one central – often public – utility company. A strategy of relying on fully decentralized local systems, however, offers as little perspective for coping with extreme events as does the conventional centralized grid. Without economies of scale production efficiencies will decrease, and without network connections over larger areas, local shortages are more difficult to substitute. What will be needed, in many cases, is a combination of wide-area networks with major production centers on one hand and local networks with decentralized production and back-up facilities on the other hand. To come up with balanced solutions, a scattered flight of individual citizen-consumers and business managers in fragmented, individual solutions is to be prevented. In metaphorical terms: the flock should be kept from being dispersed.

This asks for constant judgments of consumers on risks, trust, sense and non-sense of these alternatives, and thus for knowledgeable and capable consumers/end-users who find they own ways, trustful information, and assessments. The increasing variability of options and arrangements to protect one-self against weather vulnerabilities, will come along with new questions of risk and trust. In the field of environment, civil society organizations have proven to be the most trusted actors among the European population (cf. Eurobarometer studies, as reported in Mol, 2008). Hence one can expect that civil society actors will become increasingly involved in new arrangements in marketing alternative services that can – or claim to be able to – cope with extreme weather events. Thus the state-market arrangements that currently dominate many urban infrastructure arrangements will open up for civil society actors.

Hence new modes of governance emerge, with new arrangements, new ways of state operation and tasks, and new relations between scales of governance (local, national and supra-national). Different localities, also within the Netherlands, ask for a differentiated approach towards weather extremes, challenging the current universal, national and harmonized approach to water, energy, solid waste, transportation and telecommunication deliveries. Hence the following questions will emerge on the urban infrastructure agenda of the future: Are network-bound systems still the best option for sparsely populated rural areas? Can we differentiate (in tariffs, services, technologies, responsibilities) between areas below and above sea level? How far do solidarity and personal responsibilities go (in geography, time, social groups, type of consequences)? And should we organize it publicly (via the state) or privately (via insurances)? It is not possible to answer such question on beforehand; the answers will depend on the specific nature of the extreme events and the concomitant changes in the social and physical environment of the urban areas. On base of the argument presented we hold that the outcomes will diverge from the conventional centralized systems (large scale, centralized, uniform, no consumer involvement) and go more towards 'modernized mixtures' of large and small scale, central and decentral, and heterogeneous systems (figure 1).

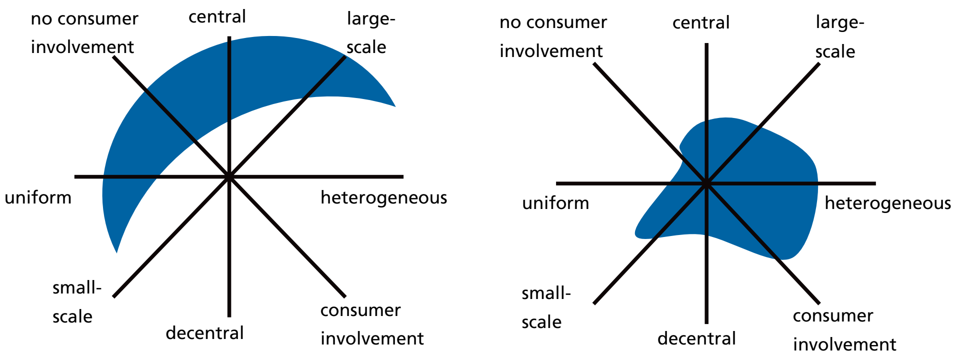

Figure 1: Modernized network-bound system (left) and a modernized mixture example (right) (after Hegger, 2007)

States will remain the primary responsible agents for the formulation and implementation of conditions for urban infrastructures, and are thus key agents in dealing with these questions. But the need for flexible operation and management, and the diversification of management models and technologies, will call for a different mode of governance: institutional flocking. So, what is institutional flocking with respect to urban infrastructures following extreme and unpredictable weather events? The ability to quickly adapt infrastructures to new, unexpected circumstances and requirements requires systems and responsible actors to have: larger flexibilities, more context and locality dependence, less lock-in effects (caused by rigid pathways of development that do not allow for diverging strategies), more sensitive monitoring of and adaptability to changes in the social and physical environments. At the same time, the challenge is to keep these variations in urban infrastructure models, practices and institutional designs glued together, as a flock. Urban infrastructures cannot go back to – say – the pre-World War II period, where bus services were regionally organized but not nationally coordinated, where the power grid had no national back-up, and where solid waste was handled without any national standards setting and enforcement. Institutional flocking needs to combine flexibility and adaptivity with robustness and coherence. Not only in technical terms of coupling decentralized systems, so as to guarantee back-up when certain regions face weather-induced collapse. But also in terms of solidarity, inclusion of vulnerable groups and social cohesion in society. Civil society organizations will play an important role in maintaining the relations of trust that are needed to ensure cooperation and mutual adaptation of actors.

4 Rural land use planning

The Dutch tradition of land use planning is characterized by a combination of strong regulatory planning – vital for the protection against see and river flooding, but also for accomodating the many competing claims on land – and a consensual style of policy making. To reconcile the two, a complex formal system of land-use decision-making has developed.

Rural planning in the Netherlands, as it has developed over the last two decades, can be characterized by four institutional developments (Louw *et al*. 2003; Ministerie LNV 2004; Ministerie VROM 2004). First, there exists a tendency towards decentralization, however, within rather tight frameworks of central regulation. This implies that on one hand, provinces have gained authority on many issues of rural planning, but on the other hand, national government – and through the national level, the European level – keeps control over the key aspects of rural planning. A second characteristic of rural planning is the increasingly interactive process of policy making, involving private and civil actors in decision making and implementation. Third, the relationships between agriculture and nature protection have become closer in land us planning, among others because of a growing awareness of the importance of agricultural areas for nature protection and green recreation, and an increasing readiness of farmers to participate in nature management. Finally, rural planning has been influenced by the increasing importance of international policies and markets. In case of agriculture, EU Common Agricultural Policy and international markets are of key influence. For nature protection, international policy agreements, and in particular EU directives and regulations are of major importance.

To analyse how climate uncertainty may impact the complex structures of rural planning, we will review the expected changes in three interfaces: between national and provincial and municipal levels; between governmental and non-governmental actors; and between scientific specialists and non-scientific professionals. First, we will look at the distributional effects of climate change uncertainties.

New distributions

The changes on the countryside, caused by a period of rapid cooling followed by a period with extreme and unpredictable climate oscillations, will lead to even stronger claims on land use than the Netherlands have known before. As prices of food and non-food agricultural products will rise because of biofuel production and efforts to buffer food supplies, new claims will emerge from the agricultural sector on rural land. Nature management organizations will stress the need of larger areas, buffer zones, corridors and stepping-stones to increase nature's resilience to climate change. Water management authorities will claim areas for buffering peak river flows. All this will result in serious land allocation and distribution problems, for instance because farmers have to give up lands with good production potentials, and because houses and other buildings need to be removed for flooding areas or even nature conservation.

Most likely, such extreme events will affect farmers disproportionally. While the evaporation of the traditional corporatist system of agricultural policy making in the 1980 and 1990s (Frouws, 1993) has affected interest representation of the agricultural sector strongly, the need for flexibility in rural land use planning and in changing land use modes between various function will further affect farmers' interests. With increasing land claims from non-agricultural interest groups, and increasing need for flexibility in land use functions, the distribution of land will shift. That means that especially land-related agriculture will be loosing, while the more industrialized livestock farms, aquaculture or greenhouse producers will also be affected, but to a lower degree. The latter categories might also better be able to protect or adapt their production systems to the uncertainties and unpredictabilities of climate extremes (water shortages, temperature changes). In addition, one can expect geographical distributions, with residents in relatively high areas being better of than those in areas threatened with floods.

Institutional transformations

Following climate extremes and unpredictability of climate change interfaces between (inter) national and provincial/local level policy authorities will change. Rapid changes in climate do not allow for a policy model where central decisions are made after long procedures of local consultation and consequently are rolled out carefully from top to bottom. To speed up the reaction process to (new information on) sudden climate changes, provincial and local authorities have to take initiatives in adaptation measures. At the same time, however, central direction cannot be missed. For instance, nationally and internationally designated ecological corridors, buffer zones and stepping stones are badly needed for increasing the capacity of protected species to migrate in adaptation to and following climate changes. For agriculture, national coordination is vital in supporting farmers in their competition on international food and biofuel markets, which due to climate impacts, are heavily fluctuating in time. As a consequence, very effective cross-level policy making bodies and arrangements are necessary. Thus, existing deliberative platforms between the different levels of government with limited power and authority (such as the presently existing and somewhat rusty "DUIV" platform, where the Ministry of Environment, the Association of Municipalities, the Interprovincial Platform, and the Union of Water Boards deliberate on matters of environmental policy and administration) will be replaced by much more intensive multi-level exchange arrangements, with more political power and authority. In a similar way, deliberations between municipalities and provinces on land use planning will get a more frequent and binding character. Increasingly, one can expect that innovations and new directions in governmental land use planning are developed and implemented locally and not (only) nationally. Institutional flocking then refers to the process by which successful local initiatives and innovations are rapidly picked up by 'neighboring' actors, without directives from a central coordinating and commanding authority.

In addition, the interface between governmental and non-governmental organizations will witness new modes of interaction. Networking with businesses and civil society actors, a process that was initiated in the 20th century rural policy, continues to be of great importance to achieve the flexibility and effectiveness needed for adapting to rapidly changing environments. This process will even gain in force, in two ways. First, the awareness of climate uncertainty will create a common and shared sense of urgency that will bind actors to cooperation. Using network relations only to advance self-interest will be interpreted as anti-social behaviour. Willingness to join in networks and strive for common results in coping with climate fluctuation will increase, thus enhancing the capacity for network-based policies. Second, initiatives and innovations by non-governmental actors will play an enlarged role in directing such interactive policies. For instance, farm-level innovations can provide new ideas for adapting agricultural practices to climate changes, soon to be spread through the 'flock' of rural actors and harmonizing mindsets and action patterns. On the basis of the climate scenarios sketched above, we can expect that in particular innovations in crop selection (e.g. salt resistant crops) and rotation, and innovations in drainage and irrigation will be crucial in adapting to shifting climate circumstances. Nature management observations of non-governmental organizations at provincial and national level are crucial in rapidly modifying nature management practices and policies where needed, e.g. in changing water management regimes when target species start disappearing. In cooperating with government, civil society organizations of different sorts can be instrumental in communicating changes to a larger audience, creating the necessary coherence and shared perceptions to move into new directions with nature conservation. Careful communication is needed, among others, when it becomes unavoidable to 'give up' certain long-standing and highly appreciated nature monuments as a consequence of the shifts in climate.

Finally, scientific specialists and non-scientific professionals will be affected when coping with (potential) extreme climate events and the related unpredictability of that. Contacts between scientific experts and professionals in the field will intensify, so that results from policy and governance interventions and signals of emerging patterns are rapidly communicated to science, and scientific insights from monitoring and experiments can feed into new interventional strategies without delay. To illustrate this process in more concrete detail, we invoke the (hypothetical) example of the Permanent Land Use Conference (PLUC), which we assume will be established to cope with the described climate changes. Central to the PLUC is an Internet *wiki*, with several theme pages (the workshops), which are constantly edited, expanded, and discussed by participants. Facilities are provided so that each participant at any moment can instantly convene a workshop meeting or a collective field visit (either virtual or actual). Examples of prominent workshop themes at the PLUC are Cultural Landscapes and Climate Change (assessing and reducing the vulnerabilities of cultural landscapes to changes in climate); Migratory Bird Management (how to accommodate and financially compensate rapidly changing bird fouraging patterns); Corridor Adaptation (how to optimize corridors for species migration between protected areas); and Pests and Exotics (coping with new pests and other kinds of bioinvasion). Other workshops focus on the coordination between land use changes in different domains (nature, agriculture, flood control) and between land use in the Netherlands and international developments. Typically, a workshop consists of experts/scientists, professionals working at operational levels (*e.g*. farmers, forest service staff, water management officers), and representatives of governmental agencies and non-governmental organizations. The presence of the latter is vital for direct communication of climate impact assessments and proposed measures to policy makers and key stakeholders. The structure of the workshops is inspired by the programme "Overlevingsplan Bos en Natuur" (Forest and Nature Survival Plan; OBN, 2008). This programme was installed in 1989 to develop and implement measures against the environmental problems of acidification, nutrification, and desiccation. Because of its success it was continued for two decades. In 2006, it was broadened to "Kennisnetwerk Ontwikkeling en Beheer Natuurkwaliteit" (Knowledge network for nature quality development and management). Close interaction between policy, research and operational measures is characteristic of this programme. Funds are provided for research projects were scientific experts and operational managers worked in close cooperation on developing nature protection measures. In a similar way, the workshops of the PLUC are provided with research funding for cooperative research as well as knowledge transfer to policy makers and operationally involved actors.

In building on already existing trends in cooperative rural planning, such as the Knowledge network for nature quality development and management, and by fostering a sense of common interest in coping with climate problems, Dutch society will be able to deal with these conflicting claims. Solid mechanisms for compensating damages suffered by individuals and groups will reinforce the sense of cooperation.

5 Water safety and security

Until the 1990s water policy was dominated by the security discourse with the central story lines 'protecting against the sea and rivers' and 'guarantying safety against flooting'. Civil engineers from Rijkswaterstaat and the Water Boards fought this battle against water. From engineering, command-and-control approach, safety norms were defined and dikes were built. Based on technical knowledge and risk analyses the lower land was protected against the water. For the coastal zones, the *pièce de résistance* of this etatist arrangement was the Flood Defenses Act 1996 (Wet op de Waterkering 1996), which defined the rules of security, the safety norms for each so-called 'dijkringgebied' (area surrounded by a dike), and the procedures for managing dams and dikes.

Also for rivers for a long time the dominant discourse was 'battle against the water', focusing on building and strengthening dikes. Initially the (near) river floods of 1993 and 1995 resulted in a well-known policy reaction: by analogy with the Delta Works (to protect land against the North Sea), the 'Major Rivers Delta Plan' and 'Major Rivers Delta Act' was developed. These initiatives focused on strengthening the river dikes. But more and more, policy makers and other actors realized that by building higher dikes and strengthening dikes safety was not secured automatically. Uncertainty about the effects of climate change, sea level rise (+10 to + 45 cm in 2050), soil subsidence, urbanization force governments to rethink issues of water safety and water management, both for the sea and the rivers.

More recently, we increasingly witness the co-existence of discourses. Besides the 'security discourse' and 'the battle against water discourse', new discourses emerged, such as 'living with water', 'accommodating water' and 'giving room to the river'. 'Accommodating water' refers to forms of integral water management to minimize the damage resulting from water nuisance, while 'giving room to the river' refers to enlarging the capacity of river basins by designating specific water overflow or retention areas. The basic idea behind the overflow areas is that in emergency situations water pressure can be relieved by a controlled 'harmless inundation' of areas that have minor economic value such as nature areas and grasslands (Voogd, 2006). These discursive shifts resulted in shifts in power (money, knowledge and infrastructure), changing rules (legislation, new procedures such as the water test, and a change in the political and policy culture of Rijkswaterstaat), and new coalitions (in general we are talking about the same players, but changing patterns of interaction).

An example of an institutional arrangement emerging from these shifts in discourses, policies, and coalitions is *Rijkswaterstaat's* innovation programme WINN (WaterINNovation). This programme constitutes the platform for the future water challenge. "WINN shall engage on a joint search with the country's society, business community and scientific sector for durable and innovative combinations of the use of space and society – both with respect to the technology and to process innovation" (Rijkswaterstaat, 2008). WINN will be developed in close collaboration and in dialogue with market parties, civil society actors and the scientific sector. Recently debated innovations are new water-control methods (such as multifunctional flood management schemes with a more gradual transition from sea to land), innovative dike-reinforcement techniques and the reuse of sludge (for construction of terps, conversion into raw materials). However, the question is whether these 'robust' adaptations as suggested in WINN, developed through flexible governance arrangements, will not jeopardize the ability to cope with uncertainty and unpredictability of changing water regimes through climate change? Will these options not result in path dependency, lock-in and robustness, and thus limit the flexibility of governance arrangements and frustrate the principles of institutional flocking?

New distributions

A period of rapid cooling down, caused by the Gulf Stream collapse, will not have a direct effect on water management. However, the following period of rapidly warming and extreme and unpredictable climate oscillations will have direct consequences for water management and water policy. Like urban infrastructures, water infrastructures have a certain robustness, resulting in path dependency: historical developed practices, institutions and infrastructural works will reduce the possible strategies of actors involved. Focusing on traditional proved solutions alone, such as building higher dikes will be insufficient (Van Tatenhove and Hajer, 2001; Wolsink, 2006). Rising levels of river and seawater will threaten all economic and social activities within the areas protected by the dikes. According to Kolkman and colleagues (2007) the challenge of learning to live with risks of flooding implies three activities: becoming aware of extreme events and their risks (sources of risks), estimating the effects of extreme events, and building resistance or resilience against extreme events. For the latter a shift from pure engineering towards a more integrated (flood management) approach is needed, because in complex systems isolated engineering solutions do not offer a sustainable solution. Safety is no longer improved by more and heavier infrastructure alone (Wolsink, 2006).

Given the uncertainties and unpredictabilities of abrupt climate change, water security and safety policy, especially flood protection, will become more and more a risk management approach in a situation of institutional ambiguity. Institutional ambiguity refers to those situations in which there are no generally accepted norms to conduct policy and no pre-given rules that determine who is responsible and who has authority over whom. In such a situation the development of 'robust' infrastructure still is important, but at the same should not pin down and fix institutional arrangements and forms of governance.

Traditionally, the distribution of risks could be broadly painted as one between those living in areas above flood levels, and those in areas below. For the latter, in a sense, risks were more or less equally divided, affecting all activities and people living in areas under sea level, polders and (river) forelands. This situation will crucially change, however, when certain designated areas will deliberately be opened to flooding under specified conditions, while the policy rules for deciding on these areas and conditions are ambiguous. The new situation, characterized by integrated flood management approaches and institutional ambiguity, will result in new distributional patterns of winners and losers. New policy practices in coastal zone and river areas networks will have to deal in new ways with distributional issues of security and safety. One of these new policy practices, as we will further explain below, is the establishment of local 'nodes' of river and coastal zone management planning, called 'junctions'. Planning and policy-making in these 'junctions' are characterized by forms of what Beck calls 'sub-politics': in each junction not only the distribution of safety and security issues are constantly negotiated by the different stakeholders, but also the rules of the game can be altered. Because there is no longer a central authority that unilaterally defines processes and recipients of distribution, stakeholders in each junction have to negotiate them over and over again. Who are the winners and losers in specific situations will be contingent on these negotiations. The mechanisms of institutional flocking will make it possible for all actors involved to reflect on distributional issues, for instance by mutual learning on negotiated arrangements, and to influence them, for instance by making appeals for socially fair compensation.

Institutional transformations

Climate uncertainty and unpredictability will affect the policy practices and the institutional setting of water security policy in several ways. Changes are expected in the relation between state, civil society and market actors on different levels (EU, national, provincial, municipalities and Water

Boards), and between different epistemic communities. In each of these interfaces new governance patterns and structures will have to emerge, in line with our model of institutional flocking.

Traditionally water safety and security in the Netherlands is the domain of *Rijkswaterstaat* (Director General for Public Works and Water Management within the Ministry of Transport, Public Works and Water Management), the provinces and the Water Boards. As a result of climate uncertainty water policy will become increasingly a multi-level game. Of course, with the entrance of the EU in the arena, water policy became already a multi-level game some years ago. EU legislation, such as the EU Water Framework Directive, the EU Marine Strategy Directive, the Birds and Habitat Directive and the Drinking and Bathing Water Directive, already influenced Dutch policymaking, requiring Dutch governmental authorities to adopt integrated and innovative approaches. However, the management of risk in this new constellation of unpredictability and uncertainty requires new forms of multi-level governance in which flexible solutions and institutional designs are formulated in close cooperation between public and private actors on several levels of government.

An example of institutional flocking design is 'coastal and river junctions'. Junctions consist of interrelated and interdependent nodes in the physical and social network of coastal zones and river areas. By making a distinction between high dynamic nodes (housing, industrial activities and intensive forms of recreation) and low dynamic nodes (openness, nature, space) it is possible to understand the dynamics within different junctions. Characteristic for this form of institutional flocking design is its flexibility to define problems and look for solutions on both the level of the whole network and on the level of the junctions. On the level of the whole coastal zone and river area network (in which all junctions are embedded) public and private actors define the general long-term objectives concerning the relation between the nodes, the forms of participation, and the robustness and flexibility of institutions needed to deal with climate uncertainties. On the level of each junction negotiations take place between the involved stakeholders. On this level, actors have a considerable degree of flexibility in defining problems, solutions, risks and uncertainties. For each junction stakeholders make an inventory of activities, threats and possible solutions for adopting water infrastructure to climate change. In this new planning and management approach the dynamics of the whole network is related to the specific dynamic (involved actors, activities, economic and ecological vulnerabilities) of each of the junctions. Flexibility, adaptation and mutual learning come together in this multi-centered and multi-level institutional governance setting. In an incremental way best practices are being developed. Depending on the specific dynamics of each coastal and river junction, contracts between the stakeholders will be signed which will guide the actions and decisions of those involved in the junction.

The unpredictability of climate change in the near and further away future goes hand in hand with uncertainty about knowledge needed for the definition of problems and the selection of solutions. This means that in Dutch water and flooding policies several epistemic communities will co-exist, none of them having the power to monopolize the definition problems and solutions. Epistemic communities are networks "of professionals with recognized expertise and competence in a particular policy domain and an authoritative claim to policy relevant knowledge within that domain or issue-area" (Haas, 1992: 3). Climate uncertainties call for both institutional flexibility and institutional learning between different epistemic communities (Haas, 2001; Meijerink, 2005) and the development of new institutional arrangements, which can deal with the risks, and uncertainties of the management of water. Existing epistemic communities – such as the Delft civil engineers as strong defenders of the 'water safety' discourse on the one hand, and the ecologist epistemic community defending the 'room for water' discourse, based on ecosystem-oriented water management on the other – have to enter into continuous and flexible knowledge exchange and cooperation. This will also involve the epistemic communities of spatial planners and water managers. The joint development of flexible information and communication instruments as the water opportunity map will give policy makers the possibility to quickly react to new information, for instance regarding land-use planning and allocation and regarding sustainable water and flood management (cf. Fopma, 2001 in: Voogd, 2006). In this respect, existing policy initiatives, such as the 'WARO-principle' (Water-as-ordering for all spatial developments, in the "Room for the River" Directive of 1996) and the Space-Water-Adjustment Management Principle (SWAMP) (cf. Wolsink, 2005) could be seen as possible forerunners of forms of institutional flocking, where governance is characterized as anticipation, collaboration, mutual learning, deliberation and participation, and decentralized flexibility.

6 Epilogue

The THC collapse and the uncertainty and unpredictability of what will happen with climate afterwards – in the short and medium-long terms – presents us with an entire new situation in terms of governance. The need to be prepared for the unpredictable requires governance arrangements and scientific information collection and dissemination structures with large flexibilities, with potentials for rapid acceleration, and with the ability for swift changes of direction. At the same time, society needs to remain glued together and show coherence, as in coping with these uncertain climate changes the Netherlands will need solidarity, the preparedness to make sudden changes in direction, and trust in the correctness of the new flexible institutions that they 'do the right thing'.

In some respects, the picture of institutional flocking may appear to the reader as rather similar to a country at war, as for example the United Kingdom in World War II. As the example shows, a democratic and pluriform society can transform itself under conditions of war into a society with a strong coherence and a common goal. However, there are crucial differences with institutional flocking, as we understand it. First, the wartime efforts of the UK were driven by a clear and unequivocal cause: the attack of an enemy. This act of aggression provided in a most pervasive way a common stimulus, focus, and rationale for action. Second, the wartime coordination of society was realized in a predominantly hierarchical and military way, which was accepted as both functional and legitimate by a large majority of the British citizens. In the case of abrupt and unpredictable climate change, the causes are much more complex and uncertain, and our model of institutional flocking will likewise differ. Climate change is fluctuating and trends are not easily perceived. Its deeper causes can only be unveiled by scientific expertise. While at some point, it will be obvious that societal action is needed; the reasons and focus of action remain subject to interpretation and debate. Moreover, as we have argued, in the context of a risk society a hierarchical model of governing is no longer adequate. Rather than a single and powerful center of command, flexible linkages between government, science, civil society organizations, and citizen-consumers are vital in developing and distributing the innovative measures needed to cope with abrupt climate change. Institutional flocking as a mode of governing climate change will not be established overnight. It can only emerge in a process of transformation that already bears the marks of interactive policy making.

In three case studies we have illustrated what such a model of institutional flocking may mean, allowing the particularities of the sector to come to variations in sectoral scenarios. We still think that the diversity of new institutions that we have sketched for the three case studies has all elements of our model of institutional flocking. We have constantly tried to remain in touch with tendencies of existing governance arrangements in designing desired institutional flocking developments. In that sense our sectoral sketches of institutional flocking are not utopian, but rather radicalization of specific tendencies that already exist.

In the case of urban infrastructures, we observed a narrow relationship between the design and operation of technical systems and the socio-political systems linked with them. In these socio-technical systems, as they rightly may be called, we observe shifts from a one-sided emphasis on centralized and uniform systems towards 'modernized mixtures' which combine large-scale grids with decentralized, heterogeneous systems, and expert-driven operation with bottom-up involvement of citizen-consumers. Such shifts fit in institutional flocking arrangements. In the case of rural land use, the physical substrate is less malleable than in urban infrastructures. Here, flexible adaptation to changes in nature and agro-productivity are central to our analysis, and distribution of costs and benefits have a strong geographical aspect, necessitating well-functioning mechanisms of compensation. In the case of water safety and security, finally, we described how a strong tradition of dyke construction and water engineering geared to 'keeping the water out' has to shift

to a much more flexible and variegated strategy of water management.
To clarify the new 'extreme events' requirements for governance and science that are common to all three cases we have used the metaphor of the flocking of birds, and have called our application of this metaphor to the social domain: institutional flocking. Institutional flocking refers to institutions that allow actors a large degree of flexibility in reacting to new external or internal conditions or information, and that enable them to react swiftly to these stimuli, through creative forms of collaboration and participation to commit all sectors in society and through rapid learning processes of actors and rapid institutionalization of the learned insights. But these institutions also have a certain robustness in that changes are resulting in coherent reactions of different parts of society in one direction; that institutions bind the various parts of the 'flock'; that solidarity is embedded in these patterns of rapid change; and that no parts of the flock are left alone. These institutional properties resemble the dynamics of mutual adaptation, common orientation, and instant innovation that characterize bird flocking. We have stressed, however, that this analogy cannot be pushed too far, as institutional flocking is created in processes of social and political agency, rather than grafted on biological laws.

What actual policy recommendations could follow from an analysis projected into a hypothetical future of abrupt climate change and unpredictable extreme events? It would go much too far to recommend a radical shift to institutional flocking in present-day Dutch society, where climate uncertainty clearly exists, but in a much less extreme and pervasive way than was assumed in this essay. Nonetheless, it might be recommendable to facilitate and evaluate programmes and arrangements that could be considered as forerunners and experiments for institutional flocking. Some of them have been mentioned in the cases; many others could be identified on base of the attributes of institutional flocking outlined above. Our analysis suggests that these forerunners could act as seeds for larger scale institutional adaptation, if increased risks from climate or other environmental changes would demand so. Another recommendation suggested by the essay is to pay more attention to the dynamics of cohesion. As it appears, the biggest challenge for coping with uncertainty is not in stimulating innovation and pluriform arrangements. In Dutch society today, many successful innovations are initiated in all kind of sectors, and there is a broad spectrum of social arrangements to manage such innovations. Much more difficult, it seems, is to prevent that these initiatives and arrangements result in a fragmented landscape of dispersed and isolated groups, areas and organizations. Keeping the 'birds' in the 'flock', while guarding the power of flexible and rapid adaptation, is perhaps the key feature of institutional flocking. It seems that such mechanisms of flexible cohesion would have political value today as well as in the future. In our case studies we have pointed at some conditions that enable this cohesion: balancing local and larger scale provision; a major role for civil society organizations in generating trust; involvement of citizen-consumers to engage them in societal change; social learning in networks of experts, policy makers, and practitioners; and solid mechanisms for compensating vulnerabilities so that cost en benefits are distributed in a socially fair way.

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