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Obligation or Innovation: Can the EU Floods Directive Be Seen as a Tipping Point Towards More Resilient Flood Risk Management? A Case Study from Vorarlberg, Austria

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Abstract: Environmental change is subject to discussion among scientists, practitioners, and policymakers. As increasing threats to both environment and society are on the agenda, alternative management approaches are gaining importance. This paper focuses on the influence of policy changes on flood risk management. There is evidence that shifts in settlement patterns and population growth might influence the dynamics of flood damage and loss. There is increased pressure to intensify land use, but also to keep free spaces for hazard mitigation and adaptation. In this paper, we focus on new regulative and management approaches associated with the implementation of the European (EU) Floods Directive in Austria. The concept of tipping points, which are defined as turning points for system change, has been applied. Based on semi-structured interviews we evaluate whether or not the implementation of the EU Floods Directive has triggered a system change in flood risk management. Our results show that triggers for change are past flood events and a general need for action rather than the implementation of the directive itself. Changes related to the EU Floods Directive are likely to happen in the long-term; however, these cannot yet be determined. The main challenges are associated with transparency and communication between policymakers and the affected society. So far, the requirements of the first policy cycle of the directive have been fulfilled. The second policy cycle will show further outcomes and potential needs.

Keywords: EU Floods Directive; flood risk management; risk-based approach; tipping points; Austria

1. Introduction

According to Pelling and Dill [1], disaster policies in the past have primarily focused on pre-disaster management rather than using comprehensive disaster management approaches including both pre- and post-disaster (integrated management) strategies. This is why European flood management and policy practices are undergoing a shift from traditional hazard to risk assessment and associated management [2,3], or from flood protection to flood risk management (FRM) [4]. In parallel, discussions emerge about the effectiveness of conventional management approaches such as dams or retention basins [5]. Besides organisational and administrative challenges, further limiting factors demonstrate the need for an adapted FRM. These limiting factors include scarceness of land needed for technical mitigation, scarcity of resources to finance or subsidise mitigation, and insurance issues. In some European countries, for example, missing insurance schemes and few incentives for risk-minimising behaviour also indicate the need for alternative FRM approaches [6,7].

The awareness of change in natural [8,9] and socio-ecological systems [10,11] urges practitioners to move towards more comprehensive and integrated FRM approaches [4,12]. In order to achieve

more resilient societies, policy and practice have also started to include private adaptation measures which address the effects of natural hazards (e.g., property-level flood adaptation measures such as elevated ground floor levels or backup valves) in addition to public prevention and mitigation measures which focus on the causes of natural hazards (e.g., structural and non-structural measures or land use planning) [13–15]. Areas at risk of flooding need a sustainable policy and planning framework that takes into account environmental processes as well as socio-economic factors [16]. Uncertainty and change are currently more firmly recognised as important considerations in different management approaches and policy perspectives [17,18]. As a result of these emerging ideas a wider range of mitigation and adaptation alternatives need to be considered [6] that effectively resonate with stakeholders [19]. These alternatives arguably include the “competent authorities” that the EU Floods Directive (from now on referred to as FD) requires of member states [20]. Above all, restrictions on implementing structural protection measures as well as adverse effects of floods on socio-economical systems require an amendment in policy making. Its relatively recent implementation makes the FD a fairly new policy instrument which is receiving increasing attention in the international flood risk debate [21–23].

The FD aims at reducing flood impacts on human health, the environment, cultural heritage, economic activity, and infrastructure [20]. These impacts vary among member states because the implementation of the FD, being a fairly new policy instrument, depends on the individual member states. Therefore, the assessment of change and the identification of single drivers for change is rather difficult [24].

While existing research has discussed the FD and its impacts in several countries [22,24–27], there is a lack of research on whether innovative change has occurred through the implementation of the FD or not. Generally, in directives the power of obligation differs significantly, which can affect legal efficiency [28]. This raises questions about whether those measures are sufficient in terms of systematically changing management practices.

Hence, this paper evaluates the response to the FD, taking the authorities responsible for FRM in Vorarlberg (Austria) as an example. Our evaluation employs the notion of “tipping points” to establish whether those FRM measures already implemented are likely to result in significant systemic adaptation or whether their impact/effect is largely business-as-usual. This paper assesses whether shifts in FRM have occurred due to the implementation of the FD, and whether or not the FD promoted a tipping point in Austrian flood management policy and practice. In order to address different impacts of the FD and assess whether a tipping point has been reached, we evaluate (1) whether action was taken in Austria’s decision-making process; (2) if the organisational structure of FRM changed; (3) if changes regarding collaboration and communication as well as engagement processes occurred; and, finally (4) whether management approaches changed.

2. Tipping Points in FRM

Tipping points are defined as shifts in complex dynamic system behaviours from one state to an alternative state (see Figure 1). They are sometimes also referred to as regime shifts, and by tipping over they separate thresholds or equilibriums [29,30]. The term “tipping point” is used both in natural and in social sciences and has been increasingly applied to describe changes in socio-ecological systems [31]. The concept was applied in social sciences by Grodzins [32] and others [33,34], by Wolf [35] in urban planning, by Schelling [36] in economics, and by Gladwell [37] in climate systems research. Later on, the term was used in different disciplines including natural hazard management [7,38,39]. Folke, et al. [40] define regime shifts as large, persistent changes in the structure and function of socio-ecological systems, while “transformation” is defined as the fundamental reorganisation of a system [41–43].

Arthur [44] argued that in complex systems, a new phenomenon or behaviour change does not emerge unless parameters of a particular intensity reach a critical point, which then lead to a phase transition. Such phase or regime transitions can occur from equilibrium to complexity, to chaos,

to multiple equilibria, and to non-equilibrium modes [44,45]. The interaction of all these factors makes tipping points a complex but useful concept to depict processes of change.

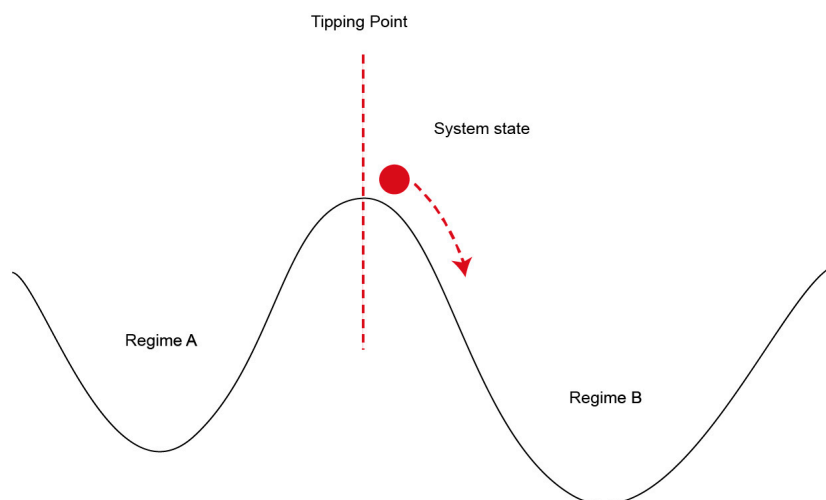


Figure 1. A tipping point is reached when a system tips over from regime A to regime B adapted from [46].

Nevertheless, it is challenging to recognise tipping points per se since transitions often become evident only after their occurrence [47]. For this reason, adaptation tipping points are also considered. Kwadijk, et al. [48] defined adaptation tipping points as the point where the objectives of management strategies can no longer be met, and hence new strategies are required. Similar to tipping points, adaptation tipping points separate thresholds. However, reaching an adaptation tipping point does not mean that the system (e.g. FRM) fails to work. Resulting from environmental change, adaptation tipping points are required to continuously reach policy objectives, which include rules, norms, and values [49]. Furthermore, adaptation tipping points are strongly interlinked with transformational [50] and adaptive change, which might occur incrementally or abruptly [51,52]. Specifically, when talking about policy change [53,54] to maintain a society's resilience, the concept of adaptation tipping points becomes relevant. A potential occurrence of adaptation tipping points is therefore considered in order to analyse whether current policy strategies are suitable under changing situational conditions [48]. Both concepts will be assessed within the scope of both desirable and undesirable changes in the system. Adaptation tipping points and tipping points, refer to the implementation of the FD in 2007 and will be defined as “significant change” based on several indicators (see Section 4) in the system as a result of the implementation.

3. The EU Floods Directive 2007

The FD was issued in 2007 after mounting losses occurred from severe flood events [55,56] and sought to reduce their negative effects on human health, the environment, cultural heritage, economic activity and infrastructure [20]. The directive is strongly linked to the European Water Framework Directive [57], and, therefore, to river basin management planning. Importantly, the FD focuses on cross-border management approaches of entire river basins. In addition to a trans-boundary management, the directive aims to strengthen risk communication and engagement processes and to increase the resilience of local communities by involving them in the formulation of new management strategies [20]. This kind of participation is associated with a paradigm shift from top-down to bottom-up approaches, which is promoted by the EU Water Framework Directive [57]. This includes the shift from a security-based management approach, which aims at the protection from threats mainly by top-down implementation of structural measures as a result of past hazard events, towards risk-based flood management, which considers and develops a strategy for bottom-up human action,

involves non-structural measures and individual solutions to minimise residual risks [24,26,58]. Strategies that address how to reach these objectives are under the responsibility of the individual member states and respective authorities [22].

Given this context, considerable debate has emerged regarding the actual implementation of new FRM strategies. The FD is a fairly new policy instrument; hence, changes in management approaches and their implementation are difficult to assess at this time [24]. Another challenge is that the directive sets a standard for managing flood risks and may therefore be criticised as being very prescriptive and possibly hindering innovation [19]. Objectives are only loosely defined so as to enable each EU member state to manage floods differently [4]. This reflects variations in types of floods, magnitudes, and frequencies, and also different legal regulations and administrative responsibilities in flood hazard and risk management of different EU countries. In short, a pan-European flood mitigation strategy demands a type of governance that is pro-active and adaptive, yet direct and measurable [59].

The FD comprises three planning steps, including the preliminary assessment of flood risk and the identification of Areas of Potential Significant Flood Risk (APSFR) (until the end of 2011), the establishment of flood hazard maps and flood risk maps (until the end of 2013), and finally the FRM plans (until the end of 2015). These steps are to be repeated, reviewed, and, if necessary, updated every six years [20]. This is referred to as a policy cycle. In Austria, 22 measures have been formulated that aim to prevent new flood risks, reduce current ones, decrease all adverse effects of floods, and increase public awareness. Such measures include e.g., preparing, considering, and updating hazard zone plans, managing retention areas, implementing structural and non-structural flood measures, encouraging participation in flood risk discussions, increasing educational activities on flood risk, establishing monitoring and warning systems, and carrying out and analysing event documentation (for a full list see Appendix A) [60].

4. Study Area and Methodology

The Austrian FRM system includes a wide range of different actors. Key actors within the federal state are: (1) the federal government, (2) the nine provincial governments, and (3) more than 2000 local authorities. Each of these actors have different responsibilities and tasks within FRM [12].

4.1. Study Area

Vorarlberg is the most western province in Austria, with an area of 2601 km² and a total population of almost 400,000 [61]. The mean annual precipitation in 2018 was 1376 mm. [62]. Fuchs, Keiler and Zischg [10] showed that communities in Austria's western (and therefore mountainous) regions are especially exposed to hazards. In the past two decades, several areas in the province of Vorarlberg have frequently been affected by flood events (e.g. 1999, 2001, 2005). Most notably, the flood events in 2005 led to significant losses, during which large parts of the region were strongly affected. These events caused substantial economic damage (around €180 million) to residential and non-residential buildings [63]. As a response to the floods in 2005, the public administration invested more than €300 million into flood mitigation measures such as inter-local flood retention, dikes, planned relocation, early warning systems etc. [12,63]. As pressure on land use is generally apparent in alpine regions [64], FRM is also substantial due to high population densities and intensive commercial and industrial activities in the valleys [10]. This is especially relevant for the Rhine valley in Vorarlberg [61,65]. The study area is likely to be increasingly exposed to flood risk in the next few years [8], which highlights the need for adapted management approaches. In addition, critical infrastructure is vulnerable to such events. This includes: (1) the Austrian Railway, as the main West–East axis crosses the province as part of the European high-speed railway network connecting international destinations; (2) major power lines in the European Power Transmission Network; and (3) the main W–E motorway connection of Austria.

4.2. Data Collection

We made use of qualitative research methods and combined case study research [66] with semi-structured interviews [67]. The aim was to analyse and explain the innovation of the FD in the FRM system in Vorarlberg. The first step included an assessment of the national and regional legal and policy documents dealing with the FD. Additionally, we conducted six semi-structured in-depth interviews with all FRM experts who are directly involved in the implementation and management of the FD in Vorarlberg. The actors, who were situated at different public administrative levels (local, regional, national), were interviewed between June and July 2016 (see Appendix B) using an interview guide (see Appendix C). The selection of the actors was based on their background and involvement within the implementation of the FD. Therefore, we used snowball sampling as a non-probability sampling method to identify and recruit our interviewee partners [68]. The interviews were conducted face-to-face and lasted between 45 minutes and an hour. The interviews were fully transcribed and analysed line-by-line together with the additional notes made during the interviews [67]. The interviews supplement the policy document analysis by adding background information to the legal and policy documents on how the FD was implemented in practice.

4.3. Data Analysis

To assess whether the FD led to a tipping point in Vorarlberg's FRM system, we used a heuristic framework to analyse our data (see Figure 2). For analysing our conceptual framework and research questions, we conducted a thematic analysis based on the main themes of the conceptual framework. The thematic analysis focused on identifying common themes and patterns within the interviewees. The aim of the conceptual framework was to organise the indicators in categories to interpret results as follows:

- First, the decision-making process refers to the aspect of planning and policy documents which influence the decision-making process of FRM. In our case, the FD is the central policy instrument. However, the Water Framework Directive (WFD) and the Water Act 1959, as well as planning instruments, are directly linked to decision-making processes.
- Second, the organisational structure refers to actions which are necessary within the risk cycle (see Appendix A), such as planning and emergency planning. Furthermore, the structure includes actors which are necessary to grant performance within FRM and are therefore included in the risk cycle (e.g., working groups), as well as other factors which influence the performance of the FD such as the administrative burden or financial means.
- Third, collaboration, communication, and engagement processes are based on the concept of participatory FRM [69] which is strongly called for in the FD. We consider both changes of awareness among society as well as coordination and participation of public authorities and among stakeholders in our analysis.
- Finally, the management approach is strongly interrelated with the shift away from hazard-based flood management and towards risk-based flood management. In order to evaluate this, it is necessary to discuss institutional change [70], which is often lacking despite incremental change happening in other aspects of the conceptual framework.

Indicator	Management approach	Description
Decision-making process	Public policy	The change of public policy shows whether changes in the decision-making process are apparent, based on FD in Vorarlberg.
Organisational structure	Action taken	This section assesses action that has been taken after the implementation of the directive.
	Organisational structure and working groups	The change of the organisational structure is described here and shows whether new working groups emerged with the implementation of the FD.
	Administrative burden	The administrative burden is assessed. It is clear that certain adaptation processes have to be overcome with the implementation of a new political framework.
	Financial means and risk-transfer	It is shown how the assessment of financial aspects and risk-transfer in flood management works.
	Planning	Changes and issues regarding land-use planning are outlined in this section.
	Emergency planning	The research analysis the impact of the FD on local and regional emergency management and planning.
Collaboration, communication and engagement	Co-operation and participation	This section deals with cooperation and participation. Increasing public- and stakeholder participation is aimed at in order to increase co-operation processes.
	Awareness	The outcomes in regard to communication processes and awareness raising as one of the main goals of the FD are shown here.
Management approach	Risk-based flood management	Risk-based flood management focuses on outcomes and allows a comparison of options so that knowledgeable decisions can be made. The approach is compared to the hazard-based approach and the application of both is evaluated.
	Institutional change	This section assesses whether the implementation of the FD triggered institutional change.

Figure 2. Conceptual framework describing the indicators as analysed in the results. FD: EU Floods Directive.

5. Results

The results show the impacts of the FD in Vorarlberg, which are summarised in Figure 3. The different indicators are subsequently discussed based on the assessed interview results.

Indicator	Management approach	Result
Decision-making process	Public policy	<ul style="list-style-type: none"> • The FD led to smaller changes in ongoing administrative practices • Comprehensive but abstract on the local level • Needs to be linked to tangible measures
Organisational structure	Action taken	<ul style="list-style-type: none"> • Action was increasingly taken, but mostly due to external factors
	Organisational structure and working groups	<ul style="list-style-type: none"> • Slightly better co-operation • Due to a general need for action • Mostly existed before
	Administrative burden	<ul style="list-style-type: none"> • Increased with the implementation of the FD • Results to be seen in future
	Financial means and risk-transfer	<ul style="list-style-type: none"> • Not politically desired • More effective solutions needed
	Planning	<ul style="list-style-type: none"> • Blue zone was implemented before the FD • Limitations seen as positive change towards improved preventative planning
	Emergency planning	<ul style="list-style-type: none"> • Enforced communication but still difficulties • Improved evaluation due to past disasters
Collaboration, communication and engagement	Co-operation and participation	<ul style="list-style-type: none"> • Better stakeholder communication • Still challenging to involve wider public
	Awareness	<ul style="list-style-type: none"> • Improved due to several events and projects • "risk" still hardly understood by the affected and wider public
Management approach	Risk-based flood management	<ul style="list-style-type: none"> • General shift in flood risk management apparent • Risk-based approach not given
	Institutional change	<ul style="list-style-type: none"> • Did not occur

Figure 3. Conceptual framework summarising the results.

The conceptual framework structures the results and supports the identification of tipping points. We differentiate between the FD's general impacts on policy making in Austria, the organisational structure, communication, and participation processes, and management approaches.

5.1. Impacts of the FD on the Decision-Making Process

The implementation of the FD as an amendment of the Water Act in 2011 caused a political reaction, and therefore, impacted flood risk policy making in Vorarlberg (Interviews 2,4). The provinces were autonomously responsible for implementing the directive, which involved over 20 public authorities from different sectors (Interview 2). Such broad involvement might pose a political issue, as each of these measures has to be coordinated. However, certain measures cannot be enforced without being linked to the legal basis of the directive. Although the intention of the directive is clear among experts, it is argued that the FD operates on a rather abstract level and some measures are barely feasible on the local level (Interview 1). This situation can be linked back to the lack of enforcement of the directive (Interview 2). Additionally, the fact that suitable management and funding instruments existed before the implementation made the realisation of the directive at the provincial level easier. Thus, the goals of the directive have to be organised and communicated better, and the coordination among all stakeholders (e.g., agreement on measures) has to be developed further.

The directive is seen as an important instrument that enables an integrative approach to collectively work on risk reduction and risk awareness, which can be seen as policy change (Interview 6). Generally, the directive is considered to be a superior tool. However, stakeholders argued that it might take some time until major impacts of the FD will become obvious (Interview 6). Often, past flood events are considered to be the main influence on existing FRM processes in Vorarlberg, rather than the FD which is considered to be a minor driver of change (Interview 1). In more detail, flood events in the years 1999, 2002, 2005, and 2015 pushed certain developments in the flood risk debate (Interviews 1 and 3). However, it is unclear to what extent increased discussions were influenced by the FD, whether change was triggered by past flood events, or whether both factors resulted in the changes we observed (Interviews 1 and 3).

In the case study area, a positive development was highly influenced by past floods, after which immediate action was taken. More precisely, it was more effective to inform society and initiate change right after being affected by a disaster. Such developments were observed after the floods in 2005 (Interview 4). This factor is very important to consider, especially because “risk” and “residual risk” are difficult to communicate. However, raising awareness to increase private adaptation (individuals locally implementing property-level flood adaptation measures) is seen as a successful tool in the management plan (Interview 4). However, the implementation of the FD has not yet impacted citizens directly (Interview 3).

Moreover, the degree of formalisation poses the largest obstacle to the implementation process. It might transpire that the actions foreseen in the FD are fully complied with in the future; however, FRM processes are business-as-usual. In spite of the broad acceptance and recognition of the directive among authorities, the implementation is still not seen as a task with the highest priority (Interview 2).

Hence, the objective of the FD is to create a better policy instrument with an adequate planning basis (Interview 6). Among regional actors, the FD was criticised on the basis that it required additional effort for implementation. Although Vorarlberg was generally well prepared before the implementation of the FD, there was an administrative burden largely because a translation of information was required in order to be compatible with the directive's requirements (Interviews 3 and 5). Such additional efforts could have been reduced by better organisational processes. However, it can be expected that the workload will be decreased during the second policy cycle (2016–2021), whereas during the first policy cycle, certain processes and consequences were unknown. Finally, it has to be considered that the FD is a relatively new instrument, which not only poses difficulties but also raises opportunities (Interview 6).

5.2. Impacts of the FD on the Organisational Structure

In FRM, the trend towards applying non-structural measures has been recognised and evidence of changes occurs in planning and water management. Adequate planning and a combination of flood mitigation measures play an increasingly important role in FRM. Even though significant investments were made to implement technical measures, it has become clear that absolute security cannot be reached. Although the FD aims to improve the application of technical measures, new ideas regarding such measures have not been introduced yet (Interviews 1, 2, and 3). However, after the occurrence of several severe floods in the recent past, current management strategies were reconsidered. As the FD is a rather new instrument, impacts on the organisational structure cannot be directly ascribed to the FD or to past flood events. A need for action was not demanded in the case study area, as FRM strategies were well-developed before the FD. Yet, two major changes were the inclusion of hazard zone planning and regional development concepts in the Water Act, such as non-structural measures (Interview 6).

New working groups formed in order to discuss the development of FRM between interdependent authorities. A political discussion also exists at the local level (Interview 3). Such new working groups did not change their organisation. Certain initiatives and programmes are interlinked and overlap with the FD. New disaster plans and training programs are available. However, these developments were not necessarily triggered by the FD (Interview 3). A political discussion also did not emerge through the implementation of the FD (Interview 5). Although co-operation increased, authorities did not merge and an establishment of permanent working groups did not happen. Smaller changes occurred with regard to responsibilities of certain organisations and their structure. However, these cannot be seen as significant (Interview 3). Competences as well as the responsibilities shifted (Interview 1). New working groups in the form of internal working groups were established, such as discussion panels. At the national level, the Working Group Floods Directive formed with five sub-working groups that are responsible to harmonise issues between the national and the regional level. In addition, a round-table discussion (*“Runder Tisch Wasser”*) was introduced which aims to give stakeholders the opportunity to participate in the process (Interview 6). However, major shifts or changes in the organisational structure did not occur. (Interviews 1 and 2).

5.3. Impacts of the FD on the Collaboration, Communication, and Engagement

As already mentioned above, FRM competences are split-up so that various players are involved at different levels. The FRM plan aims at integrating the authorities and stakeholders through 22 measures. Co-operation with all players is intended in order to find common solutions (Interview 1). Networking has been strengthened regarding preventive flood management (Interview 2). An improved co-operation is apparent between planning and flood and disaster management (Interviews 1 and 2). Coordination between authorities is important due to the broad legal basis. Here, the strongest interaction took place between hydrography (flood warning) and the civil protection authority (e.g., organisational measures). However, it is not clear whether this can be attributed to the FD or to other external factors (Interview 2).

Similarly, on a local level, although citizen initiatives exist, awareness needs to be raised and participation increased. Both awareness and participation are part of the implementation of the FD as well as the WFD (Interview 6). Further, local authorities in Vorarlberg have also become more sensitive to the flood risk debate, but again, it is unclear whether or not this is a result of the FD. A positive development regarding personal provision cannot be recognised (Interview 1).

Risk communication almost exclusively happens among authorities and participation is rather low among society (Interview 3). Risk is a concept which is difficult to communicate since risk perception and acceptance vary for different types of risk. In order to strengthen awareness and to communicate risk, regional authorities offer events (e.g. field trips to river catchments) for school classes, so that the pupils learn about the importance, characteristics, and potential dangers of rivers and torrents (Interview 4). Moreover, information is publicly available through the online platform HORA (Natural Hazard Overview and Risk Assessment Austria, [71]). Another way to communicate risk is through

hazard maps. Overall, sources of information have developed on a broad spectrum and they are intended to raise awareness more intensively. Platforms like “Water Active” [72] and “Generation Blue” [73] also support the risk communication processes (Interview 6).

5.4. Influence of the FD on the Management Approach

A change towards risk-based planning in FRM could also be a tipping point. Even though risk-based FRM is frequently discussed, it is rarely applied in Austria (Interviews 1 and 2). The focus remains firmly on hazard reduction. Although it is known that measures are risk-effective, the way such measures might change risk cannot be measured (Interview 2). Hence, flood mitigation measures are “risk-oriented” rather than risk-based. Similarly, the FD is a tool for risk communication, as the directive shows indicators of risks rather than evaluating indicators. Risk maps are not directly relevant for decision making, but hazard maps and land-use plans are. Therefore, risk maps are informative tools that are risk-oriented but do not show the calculated risk. Flood and disaster management in Austria, therefore, uses a hazard-based approach (Interview 2). A risk-based approach has not been applied in Austria yet, as neither values nor damages are included in the risk calculations. Currently, cost-benefit analysis is the norm, where the costs of (technical) measures are compared to the expected benefit. However, a benefit can only arise when a risk is present (Interview 3). Hazard zone plans are laid out in such a way that individual areas of risk (e.g. yellow or red hazard zones) are depicted. In the building process, hazard zone planning is important, while risk is something that has to be better understood by society. However, it is still difficult for the wider society to understand risk, and hazard zone plans remain somewhat abstract. Unfortunately, risks are often not recognised until individuals are directly affected by floods. Finding a solution to such challenges is supposed to be the objective of the 22 measures in the management plan. Hence, the aim of the directive is to make society risk-aware (Interview 4). The inclusion of APSFRs should contribute to the debate about the risk-based approach, even though the general approach remains to be based on cost-benefit analysis (Interview 6).

A change in the behaviour of different stakeholders in particular institutions can be recognised. Furthermore, improved coordination has appeared in FRM. Despite the fact that some smaller changes occurred regarding the allocation of responsibilities and proved to have become more efficient, this development emerged after previous flood events. Austria had well-prepared management strategies before the implementation of the FD. Institutions remain largely in the same form, which is why institutional change is not evident, despite showing minor shifts of main priorities (Interview 2). New organisations have not formed and neither have organisations merged nor separated (Interview 4). Minor developments, such as the introduction of a coordinator for FRM in some provinces, could be seen as a trigger for institutional change. However, these changes were not introduced nationwide. Some areas of responsibility shifted, but institutional change in the form of e.g., a new department for the implementation of the FD, did not occur (Interviews 2 and 6). Thus, we can conclude that institutional change has not happened (Interviews 1 and 3).

An allocation of funds in APSFR would be of interest as such areas need financial resources due to higher flood risks. The challenge, however, is to correctly allocate flood risk estimations (Interview 3). Nevertheless, more funds cannot be related to high-risks areas at this time, even though such a strategy is desired for the future. The aim is to decrease potential risk and manage remaining risks effectively, but risk transfer in the sense of insurance for natural disasters is not politically desired. Compensation works through taxes (for disaster funds) but does not exist as financial provision (Interview 2). Thus, for the future, a monetary system might not be the best solution (Interview 4).

As a planning instrument, the blue zone was enacted in Vorarlberg. This zone includes areas that are required for flood mitigation or maintenance purposes and are to be kept free from development. Therefore, the blue zone is an essential step towards preventive planning (Interview 3). Vorarlberg has developed a regional development concept and, locally, planning modified aims and criteria regarding hazard areas. Another advance is the identification of hazard zones as well as “flood-secure” buildings with regard to natural hazards in the building law (Interview 1). Such concepts are of high relevance in

flood-prone regions and densely populated areas. The pressure to utilise, but also to keep space free is tremendous. However, the blue zone was enacted before the implementation of the FD (Interviews 4, 5, and 6).

6. Discussion and Conclusion

Adaptation has occurred. However, we cannot conclude that a system tipping point has been reached. As the FD is an amendment of the Water Act, the directive is not a completely new policy instrument. The FD involves the modification of regulations, which are based on existing legal documents [74,75], rather than an innovative approach. An alignment between measures, plans, and different actors is challenging, and issues might arise regarding the coordination between involved authorities. This is especially relevant in Austria, where competencies in FRM are split up [76,77]. Nevertheless, FRM was well developed and arranged before the implementation of the FD. Through the regular occurrence of flood events, the regional authority of Vorarlberg had already initiated a wide range of innovative policy solutions to respond to future flood risks in an anticipatory way [78]. The FD is a relatively new policy instrument, which is why impacts are still vague and outcomes are expected to be more visible after the second policy cycle (2015–2021) [79] and after processes have been evaluated [80]. Effects of the directive will be measurable through changes in long-term risk potentials, as well as higher awareness among society. Therefore, processes need to be strengthened and evaluated more extensively regarding participatory approaches, as has been discussed in Cyprus [80]. Hitherto, a change of such factors has not been observed at length.

(1) Was Action Taken?

Action was taken; however, the main triggers for most courses of action and policy change were past flood events [53]. In this case, the flood events of 1999, 2001, and 2005, played a significant role. The general requirements of the FD were met. Action was taken in order to make information available for experts and the wider public. Additionally, certain projects were implemented, and events were organised. At the local level, the occurrence of flood events and subsequent high levels of concern were the main drivers for taking action.

(2) Did the Organisational Structure Change?

As it becomes more widely believed that top-down approaches are not always effective [81], the FD aims to involve stakeholders and engage communication, encouraging a bottom-up approach. It has been argued that in regions with high flood risk, risk-based budgeting should be applied, so that affected communities receive financial resources for adaptation and mitigation measures. Nevertheless, this might result in lack of funding in less-developed regions in turn and might therefore stimulate debates about social justice [82]. Risk communication still faces issues, but it is still a key topic within FRM [83]. A study in Germany shows similar results regarding coordination and public consultation [22]. Radical rethinking processes are not expected to happen, as changes normally occur slowly in Vorarlberg. The involvement of relevant sectors was given before the implementation of the FD. Yet, shifting away from the implementation of solely structural measures cannot be linked to the FD and although a positive development towards a more resilient FRM is apparent, significant changes in the organisational structure are not a result of the FD.

(3) Did Changes Regarding Collaboration, Communication and Engagement Processes Occur?

Participation and awareness-raising are key objectives of the FD. However, the communication strategy of concepts like risk and residual risk remains abstract, especially to the general society. Co-operations between public sectors existed before the implementation of the FD, but they have been strengthened to some extent. Participation works better amongst experts than among society. Major improvements through the FD are not apparent in Vorarlberg.

(4) Have Management Approaches Changed?

The FRM strategy did not change due to the FD in the province of Vorarlberg. A development towards a risk-based flood management is desired. However, it is not seen at a regional level yet. Institutions have not formed nor separated. Hence, institutional change did not occur [84]. The decree of the blue zone with the aim keeping flood-prone areas undeveloped is an innovative approach. However, the adoption of the blue zone happened before the implementation of the FD. Therefore, all factors that could have led to a tipping point did not cause the expected change. The implementation of the FD cannot be identified as a tipping point, because the development that FRM had undergone in the past few years was mainly caused by external factors (e.g., past flood events, a general need for action, policy windows); this was also supported by [85].

Nevertheless, tipping points occur progressively and are difficult to predict [47]. Hence, the present policy cycle might be recognised as a tipping point after the current policy cycle. The consideration of adaptation tipping points is therefore relevant. Adaptation tipping points occur when new adaptive strategies are needed because existing policies do not seem to be adequate any longer [48,86,87]. After analysing the occurrence of tipping points in FRM, it becomes clear that, rather than tipping points, mostly adaptation tipping points were reached, with the aim of implementing more sustainable policies and management approaches to adapt to changing conditions. The initial theory leads to the investigation whether the FD can be seen as a tipping point in FRM. By breaking down the individual outcomes of the FD on policy making in Vorarlberg (organisational structure, communication, and participation as well as the management approach) it becomes clear that changes were mainly triggered by external factors.

As this is a specific case study which does not mirror the situation throughout Austria, this contribution might show limitations. As the levels of detail vary in the assessments of different studies [88], as do the management approaches in the nine Austrian provinces, implications for other regions are difficult to grasp. Likewise, authors of a Swedish study argue that specific recommendations are difficult to generalise from a case study perspective [25]. Although action was taken to fulfil requirements of the FD and generally efforts were made to improve FRM, a re-examination of this contribution will be required once the policy cycle ends in 2021 in order to assess whether an adaptation tipping point occurred. At the EU level, the implementation might be seen as an adaptation tipping point rather than a tipping point. However, whether adaptive policies that lead to adaptation tipping points arose needs to be assessed in more detail [89].

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Appendix A

Based on the risk cycle, 22 measures were identified to manage flood risks according to the Flood Risk Management Plan 2015.

Table A1. Catalogue of measures.

Number	Risk Cycle	Measure
M01	Provision	Developing and revising hazard zone plans
M02		Considering hazard zone plans
M03		Developing basin-specific concepts to improve the water regime and the sediment budget
M04		Considering local and regional (land use) planning
M05		Setting a framework for realising and maintaining of flood risk management measures
M06	Protection	Retention-efficient management of surface areas in the catchment
M07		Recovery of flood plains and sediment deposits
M08		Planning and implementing structural protection measures
M09		Realising and adapting property-level flood risk adaptation measures
M10		Assessing and realising rezoning and resettlement
M11		Improving and carrying out water supervision
M12		Maintaining, operating, and improving structural protection measures
M13		Developing regulations for operating flood prone or flood influencing facilities
M14	Awareness	Preparing and providing information about flood risks for the public
M15		Encouraging active involvement regarding flood risk issues
M16		Organising flood-education activities
M17	Preparedness	Setting up and applying flood monitoring, forecasting, and warning systems
M18		Developing emergency plans
M19		Ensuring prerequisites for the implementation of emergency plans
M20	Recovery	Realising structural measures and restoration at water bodies directly after a flood event
M21		Assessing and removing flood damage at buildings and infrastructure and ensuring settlement of claims
M22		Performing event documentation and damage analysis

Appendix B

The information from Interviews 1, 2, and 6 refer to impacts that have been observed at the national level. Interviews 3, 4, and 5 were conducted at the local and regional level.

Table A2. List of interviews.

Interviews	Date	Position/function of interviewee
Interview 1	June 23, 2016	Academic/Researcher
Interview 2	June 24, 2016	National authority
Interview 3	June 29, 2016	Regional authority
Interview 4	June 29, 2016	Regional authority
Interview 5	June 30, 2016	Regional authority
Interview 6	July 6, 2016	National authority

Appendix C

The interview guide was established on basis of the 22 measures which were developed in the Flood Risk Management Plan 2015 and an underlying literature analysis. The interviews were

conducted in German, which is why the guide was originally prepared in German and later translated into English for this publication.

Introductory question on flood management before and after the EU Floods Directive 2007

1. How did the Flood Directive 2007 influence policymaking in Austria?

Questions on flood management before and after the EU Floods Directive 2007

2. What changes have you observed since the implementation of the EU Flood Directive in 2007?
 - a. Did changes in the organisational structure occur? Did new working groups form? What type of cooperation did the EU Floods Directive result in? Why did those changes happen?
 - b. Did changes in the decision-making process occur?
 - c. Did changes result in the bureaucratic burden?
 - d. Did the process result in a different selection of flood risk measures or did new ideas for measures arise? How were measures selected? For example, was hydraulic engineering in cooperation with the Austrian Service for Torrent and Avalanche control or in cooperation with other actors?
 - e. Did changes affect financial means or the distribution of funds?
 - f. Did this initiate a prioritisation/weighting of financial resources?
 - g. Did changes affect risk communication?
 - h. Did disaster management change?
 - i. Did the participation process change?
3. How was the EU Floods Directive implemented? Have indicators been developed to monitor the implementation process? (update every six years)
4. What are the difficulties or obstacles of implementation?
5. Can the change(s) through implementation be seen as significant?
 - a. Has change already happened independently of the EU Flood Directive?
6. Please briefly describe the political discussion between actors in flood risk management.
 - a. Was there a focus within the amendment e.g., on disaster management, the protection of agricultural land, institutional change, risk and responsibility sharing, risk transfer, restrictions in spatial planning ... ?
 - b. To what extent have these changes actually been implemented?
7. In natural hazards management, does Austria follow a safety- or a risk-based approach? What role did the EU Flood Directive 2007 play in this regard?
8. Are there tangible examples of change?

Closing Questions

9. Can you identify a direction for future development?
10. Do you have any further comments?

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