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Issues of Natural Resources Law for Adopting Catchment-Based Measures for Flood Risk Management in Sweden

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Abstract: The EU Floods Directive calls for integrated flood risk management at a catchment scale. The potential of this directive to integrate relevant policy areas and deliver catchment-based measures may however be undermined by sectoral laws and policies in the Member States. This article focuses on the legal issues affecting the integration of catchment-based measures for managing flood risk in three relevant policy areas, namely, energy (in the form of hydropower production), agriculture, and forestry, in Sweden. The results show that that the present legal frameworks not only can restrict attempts to introduce catchment-based measures through compulsory means, but in some cases can also encumber collaborative and voluntary initiatives. It is therefore important to reinforce the catchment perspective in the processes leading to the adoption of flood risk management plans, in terms of assessing flood risks, evaluating measures and engaging stakeholders.

Keywords: catchment approach; flood risk management; hydropower; agriculture; forestry; Sweden

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1. Introduction

The EU Floods Directive (FD) [1] calls for integrated flood risk management at a catchment scale. Member States must establish flood risk management plans (FRMPs) coordinated at the level of the river basin, which take into account "(. . .) flood extent and conveyance, areas which have the potential to retain flood water, such as natural floodplains, the environmental objectives of [the Water Framework Directive (WFD) [2]], soil and water management, spatial planning, land use, nature conservation (. . .) [1] (art. 7.3). The FRMPs may even include "the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event" [1] (art. 7.3).

Adopting a catchment-based approach to flood risk management entails recognising that catchments are complex systems of interdependent components: events and interventions in one part of the river have consequences elsewhere [3–5]. Therefore, instead of relying solely on local flood protection measures, vulnerable downstream areas can also benefit from measures taken on river channels, floodplains, reservoirs, and land uses in upstream areas, often aimed at restoring or enhancing natural features and processes of the catchment [6,7]. These measures can be taken to reduce runoff generation (e.g., arable reversion, buffer strips, and afforestation), increase upstream storage of water (e.g., wetlands, washlands, and on-line or off-line storage areas), or reduce conveyance (e.g., river and floodplain restoration) [8].

In comparison to traditional flood protection measures, catchment-based measures are more sustainable as they, in general, (a) are less expensive, as regards to both investment and maintenance costs in the long-term; (b) deliver multiple benefits, not just reducing flood risk, but also increasing biodiversity, improving water quality and offering recreation and tourism opportunities; and (c) are more adaptive, as they can remain effective under different conditions [3,9,10]. Concepts commonly associated with catchment-based measures are natural flood management [6,8,11], sustainable flood management [12], ecosystem

services [13], green infrastructure [3,14], watershed management [15], floodplain management [16] and flood mitigation [17].

There are several challenges to implementing catchment-based measures for dealing with flood risk. In terms of management, there remains uncertainty in relation to the effectiveness (and cost-effectiveness) of such measures in different contexts [6,9,18]. For instance, while it is known that forest cover reduces and regulates run-off, studies in Europe have put into question the protective role of forests in preventing larger floods [19]. Further, contradictory results have been obtained when comparing the water retention capacity of protected and managed forests [20]. Efforts to evaluate the suitability of areas for woodland and floodplain woodland plantation show that it is not possible to predict the exact consequences of flood mitigation in the area or the reduction in the peak flows [21].

In terms of governance, which is in focus in this article, the approach requires for the flood issue to be integrated into and coordinated across multiple policy areas at a scale beyond common administrative boundaries [22–24]. At the heart of this lies the difficult task of reconciling the competing views, interests and needs of a plurality of upstream and downstream stakeholders [25,26]. The literature therefore highlights the importance of advice, incentives and instruments for stakeholders both to consider and act upon the adverse impacts of their activities on flooding as well as to cooperate with each other at a catchment scale [12,27]. Such mechanisms may, however, be insufficiently supported by legal frameworks [7,28–31].

Thus, the potential of the FRMPs required by the FD to integrate relevant policy areas and deliver catchment-based measures in a manner experienced as legitimate by the affected stakeholders [22] may be undermined by existing sectoral policies and laws in the Member States [11,32–35]. At the same time, attempting to reform existing policies to increase integration is fraught with difficulty as policies are embedded in complex systems of rules, beliefs, values and interests [36].

Sweden has experienced a number of flooding events with significant societal costs [37]. For reference, the most severe floods in recent times, which occurred in the municipality of Arvika and around Lake Vänern in 2000/2001, are estimated to 313 million SEK (about 30 million euros) [38] and 140 million SEK (about 16 million euros) in direct costs, respectively [39,40]. These events, together with a series of official investigations on the effects of climate change, have caused flood risk to move up on the national agenda over the last fifteen years. However, flood risk cannot be said to constitute a distinct policy area at national level, although this may be the case at the local level, where the effects of floods are primarily felt and management measures undertaken [41]. In line with this, catchment-based measures to deal with floods have only recently come into national discussion and often in reference to climate change adaptation within different natural resource policy sectors, e.g., [42–44]. These discussions have for the most part taken place in parallel to the implementation of the FD. Note that in its assessment of first cycle FRMPs, the European Commission called for Sweden to reinforce coordination with the WFD and make greater use of natural water retention measures [45].

This article delves into the challenges that the sectorial approach to natural resource policy in Sweden [24,40,41,46–48] poses to the implementation of the catchment-based approach promoted by the FD. More concretely, the article focuses on legal issues affecting the integration of catchment-based measures for managing flood risk in three relevant national policy areas, namely energy (in the form of hydropower production), agriculture, and forestry. The article is oriented, not towards an exhaustive review of all the applicable national laws and regulations, but rather towards providing further insight on how the structure and design of legal frameworks can enable or hinder flood risk management at the catchment scale [23,29,49,50], which fits into the broader body of literature addressing the role of law in the governance of complex environmental problems [51–53].

Guided by this objective, the article builds on a qualitative analysis of national legal sources, principally statutory texts and preparatory works, aimed at establishing applicable law in relation to catchment-based measures to manage flood risk in the three natural

resource policy areas. Case law is included only for exemplary purposes. Official investigations, guidelines and reports serve to place the legal analysis in relation to national flood risk and flood risk management. Finally, the results of the legal analysis are complemented through available legal and policy literature addressing challenges to integration of environmental and adaptation goals in the different natural resource policy areas in Sweden.

2. Results

2.1. The Implementation of the Floods Directive in Sweden

The FD was implemented in Sweden through Government Ordinance (2009:956) on flood risks [54]. The choice of instrument is not minor: ordinances issued by the government on the basis of its autonomous normative power have only limited effects on municipalities and private persons [55] (ch. 8, s. 2, pts. 2 and 3), [56]. This has two significant consequences. Firstly, only state agencies, at national and regional level, have been tasked with producing the assessments, maps and plans required by the directive. Municipalities and private actors (including hydropower, forestry and agricultural operators) must however be given an opportunity to participate in these processes [54] (s. 16), [57] (p. 33), [58].

Thus, the overall responsibility for the implementation of the FD is on the Swedish Civil Contingencies Agency (MSB). The fact that a different national authority, namely the Swedish Agency for Marine and Water Management, oversees the implementation of the WFD has been previously identified as a potential hinder to integration and coordination in water management [59]. The MSB has moreover been tasked with producing, reviewing and, if necessary, updating the preliminary flood risk assessment and identification of areas with significant flood risk required by the directive [54] (ss. 4–6). The MSB even produces the required flood hazard maps [54] (s. 7). Also involved in the implementation of the directive are the county administrative boards (CABs), which are representatives of the state at regional level. Each of the 21 Swedish counties has a CAB. In connection with the implementation of the WFD, five super-regional river basin districts were created and, in each district, one CAB was designated as water district authority [60] (Ch. 2). Responsibility for the production and update of flood risk maps of the FD is on the five CABs that are water district authorities [54] (ss. 8–10). The FRMPs are produced by the CABs corresponding to each of the identified areas with significant flood risk [54] (ss. 12–13). These CABs are however called to coordinate the FRMPs at the level of the river basin districts and with the instruments of the WFD [54] (ss. 14–15).

Secondly, FRMPs are not legally binding. In its original guidelines for FRMPs, the MSB explicitly stated that there is neither an obligation nor a legal possibility to ensure that the included measures are implemented in accordance with the plans, although in some cases, the measures may be mandatory on the basis of other laws [57] (p. 33). While the CABs were encouraged to discuss and describe measures that in the future can come to be needed, they were also recommended not to include measures whose implementation is uncertain as a result on their dependence on the issuance of permits or on assessments of responsibility or other legal possibilities for implementation [57] (p. 23).

In the first cycle of implementation, the MSB identified 18 urban areas with significant risk of flooding from lakes and rivers [61]. While the assessment was limited to urban areas, as that is where potential adverse consequences are concentrated, the MSB did note that from a risk management perspective it was necessary to consider the whole catchment [61] (p. 15). Flood hazard maps and flood risk maps were produced for different scenarios, including the 50-year flood (present climate), the 100-year flood (adapted to climate at end of the century) and highest calculated flood (based on a combination of all natural factors that contribute to high flows, roughly comparable to a 10,000 year flood) [62]. For the delimitation of FRMPs, the MSB considered that the flood risk maps for the highest calculated flood should be used as a point of departure, but that the CAB could also modify this based on the measures included in the plans. An expansion could thus be motivated if the FRMP focuses on mitigating flows upstream or on increasing discharge possibilities downstream of the urban area [57] (p. 10). The guidelines moreover stated that protective

measures in the FRMPs could include "natural flood protection" (e.g., enhancing retention or infiltration capacity, river restoration, and reforestation) as well as "flood regulation" (as the construction, modification or removal of water retaining structures) [57] (p. 26).

A scan of the first cycle FRMPs reveals that catchment-based measures were considered to only to a limited extent, often as an issue to be further investigated, e.g., [63] (p. 40) and in connection with the requirement to coordinate the FRMPs with the instruments of the WFD, e.g., [64] (pp. 36 and 40). Some plans acknowledged possible conflicting interests between municipalities upstream and downstream, e.g., [65] (p. 31). This is in line with the European Commission's 2019 assessment of five Swedish FRMPs, which recommended that to improve flood risk management Sweden should carry out strategic environmental assessments (SEA) for all FRMPs, provide specific and measurable information on the measures, reinforce coordination with the WFD and make greater use of natural water retention measures [45].

For the second cycle of implementation, the MSB updated the preliminary flood risk assessment and, taking even coastal floods into account, identified 25 urban areas with significant flood risk [66]. For this update, the MSB used flood maps based on climate-adapted flows and detailed elevation data, but for larger rivers regulated for hydropower production, the MSB instead used maps produced by Svenska kraftnät (the authority responsible for the power grid) together with dam owners for the purpose of emergency preparedness in case of dam failure or high flows [66] (p. 14). The analysis of potential consequences remains focused on urban areas [66] (p. 19). Some of the areas identified under the first cycle do not fulfil the criteria used in the second cycle, but the implementation of their corresponding FRMPs will be followed up until 2021 [66] (p. 67). The MSB also stated that, for the revision of flood hazard maps and flood risk maps, it would propose and, in dialogue with the affected CABs and the municipalities, decide on delimitation from a hydrological catchment perspective [66] (p. 37).

The MSB also updated its guidelines for the second cycle FRMPs, which are expected to undergo consultation in the spring of 2021 [67] (p. 10). The guidelines reiterate that the delimitation of the FRMPs can include measures upstream or downstream of the risk area identified through the maps, adding that these should be described in relation to the catchment or sub-catchment as a whole [67] (p. 14). More concretely, the FRMPs should consider the hydrological process over the whole catchment or sub-catchment, in order to identify where water can be detained or redirected, but this should not lead vulnerable places to become exposed to floods in the future [67] (p. 22). The geographical context of the urban area and the particular characteristics of the catchment should always be considered [67] (p. 22). The guidelines also call for the plans to include objectives and measures that are specific and measurable [66] (p. 21). For "nature-based solutions", the guidelines state that it must be shown that they have a flood risk reducing effect parallel to the delivery of ecosystem services, that they must be cost-effective, and that their planning often requires different disciplines and an active engagement of different stakeholders [67] (p. 25).

2.2. Legal Issues in Implementing Catchment-Based Meassures in Different Policy Areas

2.2.1. Hydropower Production

Hydropower is a key element of the Swedish energy system. It accounts for about half of the total energy production and constitutes the main balancing source for the power grid [68] (p. 63). Of the approximately 2100 hydropower plants and dams in the country, about 200 are large dams that produce 94% of all hydropower and contribute most of the balancing power [69] (p. 74 ff). Hydropower is regarded as crucial for the transition to a completely renewable energy system, given that its balancing capacity enables the expansion of variable sources such as wind and solar power [70].

Water regulation for the purposes of hydropower production redistributes seasonal flow variations in a river; water is saved during the spring, summer and autumn in order to be released and generate electricity in the winter. In general, this regulation an attenuating

effect in relation to most flows and thus reduces the risk of flooding; however, in case of very high flows, it may instead intensify flood risks because dam safety must always have priority if inflow continues after the reservoirs are at full capacity [40,71].

In the last two decades, not least because increasing awareness on climate change impacts on river flows, there have been several official investigations on the role of hydropower dams in the context of flood risks. These have already led to legislative reforms on dam safety [72]. More contentious has been the idea of adapting water regulation, which is optimised for hydropower production, towards reducing flood risk in surrounding areas or in downstream areas. Indeed, a national investigation finalized in 2002 questioned the socioeconomic sense of "active attenuation" measures in regulated watercourses and called instead for human activities to adapt to high water flows [73] (p. 155 ff). However, only five years later, another investigation concluded that dealing with (and taking advantage of) the effects of climate change on river flows, will require changes in the present-day regulation of many hydropower dams [74] (p. 558 ff), [44].

These investigations identified that a significant issue in adapting water regulation relates to contents and legal effects of the permits that govern each hydropower plant and dam. The Swedish Environmental Code (SEC) classifies the construction of structures in water areas and water regulation as "water operations" that generally require a permit [75] (ch. 11 ss. 3, 5 and 9). Some kind of permit requirement existed also under the predecessors to the SEC on this matter, namely the 1983 Water Act (1983:291), the 1918 Water Act (1918:523) and the 1880 Water Operations Ordinance (1880:57). The absolute majority of hydropower dams and reservoirs in Sweden obtained their permits under the 1918 Water Act [76] (p. 95).

Hydropower permits not only authorise the building of the structures, but can also include "water management" conditions on, for instance, maximum and minimum water retention level for the reservoirs, or minimum discharges in the river reach. Older permits seldom have conditions for the protection of the environment [68] (p. 64). The permit for Lake Vänern, which dates back to 1937, even includes rather unique conditions on maximum discharges in the Göta River, aimed at preventing damages from landslides and floods along the river [44] (p. 156 ff).

Regardless of whether they have been issued under the SEC or previous legislation, water operation permits, have legal force [75] (ch. 24, s. 1), [77] (s. 5). Their contents can thus be opposed to everyone, both private and public actors, who could have brought action during the permitting process [78] (Part II, p. 251). Consequently, the holder of water operation permit (i.e., the hydropower producer) has both the right and the obligation to keep the water structure (i.e., the dam or reservoir) and carry out the operation (i.e., regulate the water level and discharge) in accordance with the conditions of the permit. The CABs, which have mandate to exercise supervision in relation to water operations, may principally not issue further requirements on the basis of the substantive requirements of the SEC, if these concern a matter that has been assessed and decided within the permit [75] (ch. 26, s. 9).

It is possible for the hydropower producers to modify their regulation strategies as long as they keep within the conditions of the permit. For instance, in 2008, the hydropower company Vattenfall entered an agreement with a CAB to lower the water level of Lake Vänern within the limits of the permit during a five year test period, and later prolonged the agreement. While the measure is considered to have improved the flood risk situation, it has also been criticised for its effects on ecosystems, landscape and outdoors recreation [40].

If such agreements cannot be reached or the necessary changes go beyond the existing conditions of the permit, a permit revision is required. Revisions at the initiative of the permit holders themselves have a more limited scope than those at the initiative of public authorities [75] (ch. 24, s. 13). The SEC regulates the grounds on which public authorities may seek a permit revision, including that the safety of the structure needs improvement; that the operation significantly contributes to the infringement of an environmental quality standard under the WFD or causes significant damage that was not anticipated when

the permit was issued; or that the conditions in the surrounding area have changed significantly [75] (ch. 24, s. 5), see also [79] (ch. 7, s 13).

Within the permit revision process, the changes to the permit conditions sought by the authority are assessed in relation to the substantive requirements of the SEC, which are more stringent than those in previous Water Acts. There are nevertheless limits to what the permit holder can ultimately be obligated to undertake. The SEC includes a balancing rule, by which the benefits from new or changed requirements on the operation must be assessed in relation to the costs that these entail for the permit holder [75] (ch. 2, s. 7). Therefore, changes in water regulation that significantly reduce flood risk in a populated area may be more motivated than changes that only marginally reduce flood risks in a scarcely populated area. There is also a limitation rule that states the permit revision may not result in conditions so extensive that the operation practically cannot be continued or is made substantially more difficult to continue [75] (ch. 24, s. 9). This means that, regardless of how beneficial it may be in terms of flood risk reduction, the permit holder cannot be imposed changes in regulation if the costs of these changes make it economically unreasonable to continue the operation, which means that permit revision may not be viable, for instance, in the case of small-scale operations with a narrow profit marginal, see [80] (p. 274). Finally, the SEC also establishes a right to compensation in favour of the permit holder that as a consequence of a revision suffers a loss of production beyond a certain tolerance level [75] (ch. 31, ss. 20–21), see however [68] (p. 137 ff).

Unsurprisingly, permit revisions by initiative of public authorities have been quite rare. For reference, only about 80 of the more than 3000 permits for hydropower plants and dams issued under previous legislation have been revised on the basis of the SEC, and often only in relation to singular conditions in the permits primarily for fishing, environmental, or dam safety reasons [80] (p. 270), [81] (p. 9).

The complications associated with the revision of hydropower permits have themselves been the object of investigations and debates on how to make water operations compatible with the principles and rules of the SEC and EU law [69,80]. In parallel, the European Commission has pursued an infringement procedure against Sweden for shortcomings in its transposition of the WFD [82]. One of the criticisms is that Swedish legislation did not ensure that the obligations under the WFD to achieve good water status and prevent deterioration apply in permitting and revision processes for activities with impact on water quality, such as hydropower installations [68] (p. 69–70).

In 2016, the major Swedish political parties reached a long-term energy agreement [70], which highlighted the central role of hydropower in present and future renewable energy generation, but also stipulated that hydropower operations must have "modern environmental conditions". Furthermore, the agreement entailed that property tax imposed on hydropower producers would be lowered stepwise, but that they in turn would carry the costs associated with achieving compliance with EU law. Two years later, the Swedish Parliament passed a bill introducing reforms to the regulatory framework governing hydropower operations [68].

In short, these reforms entail that all who carry out hydropower production operations must initiate, investigate and finance a permit revision process to obtain modern environmental conditions, understood as conditions issued on the basis of the SEC through a decision not older than 40 years [75] (ch. 11, s. 27). These revisions should lead to the change or repeal of existing conditions or the issuance of new conditions that are necessary for the protection of human health and the environment [75] (ch. 24, s. 10, par. 1). Furthermore, the balancing rule of the SEC may not be applied so that it results in conditions that conflict with obligations under the WFD [75] (ch. 2, s. 7 and ch. 5, s. 4). A specific limitation rule is created for these revisions: conditions that make the operation substantially more difficult to continue may be decided if it is necessary to comply with the WFD or EU-law [75] (ch. 24, s. 10, par. 2). At the same time, the government means that the reforms entail more limited possibilities for the authorities to obtain a revocation of

the permit and consequent removal of the structures against the will of the permit holder, see [75] (ch. 24, s. 10, par. 3), [68] (p. 116).

Furthermore, the national government must adopt a plan to ensure that the revisions of the hydropower permits take place in a coordinated manner and are permeated by a national perspective on the balancing between the need for measures to protect aquatic environments and the need for a national effective access to hydroelectric power [75] (ch. 11, s. 28). After a joint proposal from the national agencies with responsibility over marine and water resources, energy and the power grid, this plan was adopted in June 2020 [83]. The plan provides "revision groups" in the form of geographical areas, principally catchments, where hydropower dams and plants have such environmental connections that the revision of their permits should be coordinated, as well as a 20-year "time plan" for when the owners of the dams and plants in each group must apply for a revision their permits. In relation to benefits to aquatic environments, the plan focuses on the environmental objectives of the WFD and on Natura 2000 and species protection. As for a national effective access to hydroelectric power, the plan includes a target value limiting national production losses to 1.5 TWt (2.3% of the total yearly hydroelectric power production), also giving priority to regulating power and available effect, contingency planning, and dam safety. In terms of implementation, there will be regional cooperation processes aimed preparing the supporting materials that are necessary for individual permit revision processes [84] (ss. 42a–b).

The national plan itself does not address the potential role of hydropower dams in reducing flood risk in the catchment (other than in terms of dam safety). It is possible that this issue will come up in the regional cooperation processes or, later on, in the individual permit revision processes, in connection with the assessment of the effects of potential environmental measures on other public or private interests, more so if the removal of a dam is considered. At present, however, there is little to suggest that the implementation of the national plan will be seen or used as an opportunity for adapting hydropower regulation to reduce flood risks in the catchment.

2.2.2. Agriculture

Access to productive agricultural land is key to the implementation of the national food strategy [85]. Most agricultural land in Sweden is dependent on drainage through ditches and embankments, but these structures are often old, not dimensioned for the highest flows, or not in the best conditions, and have moreover been affected by building development that over the years taken has place on and around agricultural areas [74] (p. 346), [86,87]. For parts of the country, climate change impacts are expected to lead to longer growing seasons, but also to increased and more intense precipitation, with a tangible risk that the capacity of drainage structures will regularly be insufficient [74] (p. 349).

Adaptation in the agricultural sector is therefore often discussed in terms of maintaining and improving the drainage function of ditches and embankments, but even in terms of "greening" these structures, including the creation and protection of wetlands, mainly for the benefit of nutrient retention, biodiversity protection and good water quality [74] (p. 357), [86], see also [47]. The possibility of using agricultural land as controlled flooding areas in favour of downstream urban areas has only recently come into discussion [43] (pp. 210–211), [88].

Ditches and embankments fall under a specific type of water operation denominated "land drainage" [75] (ch. 11, s. 2). Like hydropower dams, the majority of existing land drainage operations have their legal basis in previous legislation, primarily the 1918 Water Act and the 1879 Ditching Act [76] (p. 82). These Acts required a permit only in case the operation concerned several properties and the owners were in disagreement on the placement, design, or maintenance of the structure. Many existing land drainage structures and operations have therefore "legal" status without having permits [69] (p. 201 ff), [80] (p. 326 ff). Only with the 1983 Water Law, land drainage came to fall under the general

permit obligation applicable to water operations, and with an amendment to the then in force Nature Conservation Act (1964:822) in 1986, an absolute permit requirement was established. Through another amendment in 1991, the Government was given power to prohibit land drainage in areas where the preservation of wetlands is of particular importance. Permits granted under previous legislation have, however, legal force in the same manner as permits granted under the SEC (see previous sub-section).

The SEC also includes an absolute permit requirement for land drainage: a permit is always necessary, even if the operation evidently does not cause damage to public or private interests [75] (ch. 11, s. 13). Land drainage prohibitions are moreover in force for most of southern and central parts of the country as well as for Ramsar sites [75] (ch. 11, s. 14, par. 1), [84] (ss. 4-4c). The CABs may grant exemptions from these prohibitions only in "special circumstances" which presuppose that the area lacks significance from a nature protection perspective [75] (ch. 11, s. 14, par. 2), [78] (Part II, p. 136). Other permit and exemption requirements may be applicable in case the measures affect formally protected areas, such as biotope protection areas, shore protection and Natura 2000, see [75] (ch. 7). Even if an exemption is granted, the permit application can still be rejected based on the substantive requirements of the SEC. Alternatively, these requirements translate into permit conditions to reduce the impacts of land drainage on the environment. For example, an increase in the meandering of a ditch or the creation of wetlands can be required in order to slow down the water flow [89] (p. 41).

At present, land drainage in agricultural land primarily consists on maintaining or improving existing structures [90] (p. 46). Drainage structures are dependent on maintenance to continue functioning reliably. Therefore, in the system of the SEC, maintenance appears as both an obligation and a right. The owners of land drainage structure, regardless of whether they have a permit or not, have an obligation to maintain it in a way as to prevent damages to public and private interests by changes in the water conditions [75] (ch. 11, s. 17), [78] (Part II, p. 139). The owners of the structure cannot unilaterally decide to discontinue maintenance to achieve a natural recovery, if this can cause damage to others. Maintenance as a right exists only for structures that count with a permit, although this does not necessarily mean that maintenance measures are exempted from permit and exemption requirements [75] (ch. 24, s. 1, par. 1), [80] (p. 367 ff), [89], (p. 73). It is quite unclear, however, how far maintenance obligations and rights extend in a context of changing conditions in the catchment, not least as a result of climate change, cf. [80] (p. 366), [87] (pp. 57 and 69), [91].

For the topic at hand, this all means that initiatives to implement measures to detain or retain water in areas affected by land drainage will often require legal proceedings. Because land drainage operations are not covered by the obligation to obtain modern environmental conditions, the general permit revision rules of the SEC apply (see previous sub-section). In some cases, it may also be necessary to revise land drainage associations created to share the costs of construction and maintenance of structures benefiting several properties, see [79] (ch. 7, ss. 17–18).

The creation of wetlands can be used as an example to illustrate potential complications. It should be noted that, for many years, municipalities and landowners have been able to get subsidies for creating, restoring or maintaining wetlands, primarily with environmental and water quality objectives, see [92–94]. Previous studies have identified that farmers are willing to create wetlands, as long as it is on unproductive land, if there are adequate subsidies and if perceived hindrances, not least of administrative kind, are removed [95,96]. The active engagement of and cooperation among municipalities in the catchment has also been shown to positively affects the willingness of landowners to participate in wetland creation programmes [24].

The creation of wetlands constitutes a water operation, albeit not land drainage. It is therefore necessary to seek a permit revision in relation to the original land drainage operation (and/or the drainage association) as well as either make a notification or seek a permit for the creation of the wetland, depending on its size [75] (ch. 11, s. 3), [84]

(s. 19, pt. 1). In some cases, municipalities have been able to undertake the measure in their own land, reaching agreements to exclude restored areas from existing land drainage operations and overtake responsibility for their maintenance, although not entirely without disputes with neighboring landowners, e.g., [97] or national authorities, e.g., [98]. Courts have, however, been more reluctant to make land drainage associations responsible for the operation and maintenance of restored sections—even when affected landowners have agreed to the measures and the municipality offered compensation—reasoning that the restoration measures serve another purpose than that of the original land drainage operation [99], cf. [100,101].

The official investigations examining how water operations can be made compatible with the principles and rules of the SEC and EU law (see previous sub-section) questioned whether these interpretations had been too strict, but also conceded that permit revisions cannot be used to create wholly different operations within a land drainage operation [80] (p. 418 ff). The government has not yet tackled suggested reforms to the legal framework, aimed at simplifying permit revision processes to environmentally adapt land drainage structures even though, for instance, the national environmental authority considers this necessary in order to reach wetland protection goals [90].

Against this background, it is understandable that a recent report examining the possibility for controlled flooding areas in agricultural land [88] is less than optimistic. To begin with, the national agricultural authority considers that such measures would require more agricultural land than there is available, reason by which there is only potential for them in smaller catchments and rivers under special technical, economic, and legal conditions. As for the latter, controlled flooding areas are identified as water operations subject to a permit under the SEC, even if existing structures, such as agricultural embankments, are used, given that the purpose of the new operation differs from that of the original operation. The authority also notes that, within the permitting process, the proposed measures need to be assessed in terms of impacts on public interests, including safety and environmental protection under the SEC, but also in relation to damages to private interests, with a scope of stakeholders that can be wide and include landowners and owners of various water operation structures [88] (p. 37). The report also draws attention to different issues that must be negotiated and agreed upon between the urban area that benefits from the measure and the farmers that provide the land for it, including assigning responsibility and determining compensation in relation to the construction, maintenance, and operation of the controlled flooding area [88] (p. 36).

2.2.3. Forestry

About 70% of the total land area of Sweden consists of forests and the forest products industry plays a major role for Swedish economy [102]. Swedish forests also serve other interests such as habitat preservation, reindeer husbandry, and recreation [46]. Forestry measures such as felling, ditching, afforestation, and road construction can have impacts on the hydrological system [103] (p. 56 ff), [20,104]. In a future with milder winters, the felling and transportation of timber may require more intensive ditching as well as new or improved forest roads, but this may lead to further negative consequences on water quality, biological diversity, and the natural water regulating capacity of forests and wetlands [43] (p. 206 ff), [74] (pp. 339–340), [105] (p. 153 ff), [106] (p. 52).

Some indication of potential challenges to the implementation of catchment-based measures for flood risk management in forest land can be found in previous studies on integration of environmental and adaptation policies in the Swedish forestry sector. These highlight the ownership structure of forest land, the tradition of self-management in relation to sectoral goals, the "freedom with responsibility" approach of forestry legislation, and the focus of Swedish forestry on active management [107–109]. Furthermore, unlike most land use activities, forestry and forestry planning are not included in municipal planning, even though many municipalities comprise large areas of forest land [46].

Most forest land is used for timber production, see [110]. Almost all productive Swedish forests are owned by individual owners (48%), private-sector corporations (24%), and state-owned corporations (13%) [111]. The sector is also highly deregulated: it is the owners who largely determine how two equal goals stated in the Swedish Forestry Act (SFA), namely timber production and biodiversity conservation, are to be reached in their forests [112] (s. 1), [113] (p. 47 ff), [108,114].

The SFA, which applies in parallel to the SEC, sets the minimum environmental requirements on forest management. These entail that the Swedish Forestry Agency (SwFA) may issue binding regulations aimed at preventing or limiting the damages to nature interests in connection with forestry measures, but these may not substantially impede on-going land use [112] (s. 30), [115] (s. 30), [116]. Since forestry measures such as felling, ditching and forest road construction for the most part fall under on-going land use (i.e., forestry), the possibilities for the authority to prescribe environmental requirements are limited [46]. To impose more far-reaching environmental requirements, the authority must apply the formal protection instruments of the SEC, which give forest owners a right to compensation [75] (ch. 7 and ch. 31, s. 4), [117] (p. 111). Furthermore, by the principle of *lex specialis*, once the SwFA regulates a specific matter based on the SFA (e.g., buffer zones, ditch clearing), this regulation has precedence over the more general consideration rules of the SEC [118] (p. 241), which would provide grounds for more stringent requirements without need for compensation [117] (p. 111). It has been argued, however, that the regulations issued by the SwFA should have precedence only insofar they are compatible with the objectives and consideration rules of the SEC, since these were intended to provide the minimum level of environmental protection [117] (pp. 112–113), [119] (p. 514 ff). The government has previously rejected a suggestion to replace the regulations and general recommendations of the SwFA with a Government Ordinance regulating the minimum level of environmental consideration in forestry [106] (p. 125 ff), in favour of dialogue and awareness-raising among forestry actors [105] (p. 155 ff).

Finding opportunities to consider and address the impact of concrete forestry measures on flood risk in the catchment can be difficult. For instance, felling (except e.g., in mountainous forests [112] (ss. 15–19), and remedial ditching (shallow ditching to drain temporary excess water after clearcutting) do not require a permit. It suffices with a notification to the SwFA, in which the forest owner must explain how they plan to satisfy nature interests as well as secure forest regrowth [112] (s. 14), but an environmental impact assessment is not required [113] (p. 72 ff), [117] (p. 120 ff), [46]. The SEC requires, however, a notification for the purposes of consultation with the SwFA in case forestry measures, including ditch clearing and forest road construction, can significantly alter the natural environment [75] (ch. 12, s. 6), [120]. An environmental impact assessment may be required in these cases [121] (s.8), [122]. Although the SwFA may issue orders or prohibitions to ensure environmental requirements in connection with notifications [112] (s. 35), it is more common that the authority limits itself to providing advice and information [123] (p. 63). Land drainage measures in forests are subject to the permit and exemption requirements of the SEC (see previous sub-section). As mentioned above, forest land can also be protected through formal instruments regulated in the SEC, including nature reserves and biotope protection [74] (ch. 7), [124].

The "freedom with responsibility" approach in the forestry sector presupposes that, in order to reach environmental goals, the forest owners must do more than comply with the requirements in legislation. For instance, forest owners are expected to, on a voluntary basis and without compensation, set aside productive areas from measures that can harm nature, culture or social interests. These types of voluntary environmental measures are taken not least within forest certification schemes, which are widely used in Sweden [105] (p. 122). The certifications schemes under the Forest Stewardship Council (FSC) and the Programme for Endorsement of Forest Certification Schemes (PEFC) both require, for instance, that at least 5% of the productive forest area is set aside for nature conservation purposes, that

new ditches are not placed in land which has not previously been ditched, and that buffer zones along water bodies and wetlands are protected or created [125,126].

In 2018, the SwFA co-produced a report on nature-based measures against flooding [127], promoting the voluntary and collaborative implementation of smaller measures, often eligible for environmental subsidies (e.g., buffer zones, planting trees and bushes, adapted ditches, refilling unproductive ditches, and wetland restoration). The authority reasoned that "many smaller measures are more effective than a large one that never is realized" [127] (p. 27). The authority also considered that, in order to keep down the costs of the measures and avoid negative impact on agricultural and forestry production, land without intensive production should be prioritized, but at the same time acknowledged the creation of wetlands on fertile and nutrient-rich soil was preferable from a water quality and climate perspective [127] (p. 31).

3. Discussion and Conclusions

The FD introduced the FRMPs as instruments for managing flood risk though the coordinated implementation of various types of measures across whole catchments. This requires a holistic perspective over the catchment, inclusive of all activities and stakeholders that can have an impact on the generation and the reduction of flood risk. The EU further promotes the adoption of measures that can provide multiple benefits for various sectors and that are overall cost-effective in contributing to the achievement of multiple policy goals.

In Sweden, the FD and the FRMPs meet a complex and fragmented landscape of natural resource law and policy. Even though the SEC sought to bring the protection of the environment under a modern and coherent regulation, it was not fully able to break with the prioritized goals, special rules, acquired rights, and established practices governing the exploitation of different natural resources. This is not least because strong interests, with private and public dimensions that are not always easily distinguishable, dominate these policy areas. The results show that that the present legal framework not only can restrict attempts to introduce catchment-based measures through compulsory means, but can also encumber collaborative and voluntary initiatives. The results also show that environmental law instruments that could provide an opportunity to consider the impact of exploitation measures on flood risk in the catchment, such as impact assessments and consultation instances, are regulated and applied differently across the policy areas.

Though quite overdue, the implementation of the WFD is bringing about important changes to Swedish natural resource law and policy. The adoption of the national plan to provide hydropower operations with modern environmental conditions—while still a sectoral approach with clear elements of zero-sum thinking—is an ambitious step away from a system of individual, eternal permits. As concluded in previous investigations, while it is doubtful whether a similar plan can be adopted for land drainage operations, there would be significant value in clarifying the extent of maintenance obligations and rights as well as simplifying legal processes for environmentally adapting existing operations. It would also be beneficial to more explicitly include flood regulation or to promote multifunctional measures in the criteria for the subsidies available for restoration measures. These types of suggestions are, however, more difficult to implement in relation to forestry measures. This is because the sector is resistant to regulation, even if it concerns measures that already are included in the advice issued by the national authority or in private certification schemes.

While there are many advantages to bringing the FRMPs closer to the instruments of the WFD, this alone does not resolve the challenges posed by fragmentation and rigidity in national natural resource law and policy. Even though catchment-based measures to reduce flood risk often aim at restoring and enhancing natural features in catchments, it should not be assumed that all measures that are implemented to restore and enhance natural features in the catchment (through e.g., environmental conditions to permits, formal protection decisions, or voluntary undertakings) have a flood risk reducing effect. It is therefore

important to reinforce the catchment perspective in processes leading the adoption of FRMPs, in terms of assessing flood risks, evaluating measures and engaging stakeholders.

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