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Implementation of the European Union Floods Directive—Requirements and national transposition and practical application: Lithuanian case-study

Katažyna Mikša[a,b,*], Marius Kalinauskas[b], Miguel Inácio[b], Paulo Pereira[b]

[a] Institute of International and European Union Law, Mykolas Romeris University, Ateities s. 20, Vilnius, Lithuania
[b] Environmental Management Laboratory, Mykolas Romeris University, Didlaukio s. 55, Vilnius, Lithuania

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ABSTRACT

This work investigates the implementation of the European Union (EU) Floods Directive (FD) in Lithuania. First, it analyzes the requirements set in the EU law for the correct and effective implementation of the directive. Second, it addresses the implementation of the FD in the national law of Lithuania and the practical application of it, particularly in regard to the amendments of the land use regulations. The assessment revealed that Lithuanian authorities comply with the deadlines and requirements set in the FD. However, not all measures are considered to be effective. The distribution of tasks, among particular authorities, especially the potential role of the river basin district council, is not clear, which can lead to an inconsistent decision-making process. The urbanization in the flood hazard territories is still growing, and the usage of hazardous chemicals in agriculture in these areas is allowed. Therefore, the legal limitations of construction and intense agriculture were not sufficiently effective. These drawbacks in the effectiveness of the implementation of the FD can significantly affect the contribution of Lithuania in achieving European and global sustainable development goals.

1. Introduction

Since the beginning of the 21st century, destructive floods have been affecting Europe (Kundzewicz et al., 2013). The expansion of the urban areas and the growing number of extreme rainfall events increased the damaging capacity of floods (Sofia et al., 2017; Berndtsson et al., 2019). Moreover, it is estimated that the number of climate-related extreme weather events such as floods, will be more frequent (IPCC, 2014). The impact of floods on the environment, economy, and society, including life losses, cannot be overlooked. In 2017, global weather-related costs were higher than US$300 billion (Jongman, 2018). Between 1980 and 2017, hydrological disasters in Europe cost 166 billion EUR and are expected to increase as consequence of climate and economic changes. The magnitude of flood events is getting extreme. In May and June of 2016, floods caused losses of more than 13 million EUR and killed 26 persons (EU, 2018). Therefore, flood risk management became an urgent issue. For this purpose, both structural (e.g., grey infrastructure) and non-structural (e.g., green and blue infrastructures) measures could have been adopted. The investment in sustainable approaches to reducing flood impacts in the environment, society, and economy is a crucial step to achieve United Nations Sustainable Development Goals (SDGs) by 2030.

The ecosystems have the capacity to regulate and mitigate floods' impacts (de Groot et al., 2002; Jones et al., 2016). Human activities such as deforestation, intensive agricultural practices, and urban expansion are disturbing the ecosystems. This reduces importantly the ecosystem's ability to supply flood protection and increases the exposure of humans to floods (Nedkov and Burkhard, 2012; Paleari, 2017). During the past 150 years in Europe, the urban area exposed to flooding increased 1000 % (Paprotny et al., 2018). Therefore, proper regulation of human activities in flood hazard areas could maintain and increase the potential of ecosystems to regulate floods (Tarlock and Albercht, 2018). The legal regulation can be of three levels: international, national, or regional. Their effectiveness depends on several factors, such as their comprehensiveness and compatibility, proper distribution of tasks, and cooperation between different authorities.

There are no binding global documents related to floods management. The most relevant example of the international document is the European Union Floods Directive (FD) (2007/60/EC, FD, 2007). The main goal of the FD is to assess, reduce, and manage the risk of floods on human health and life, the environment, cultural heritage, and economic activities. The FD complements the European Water Framework Directive (WFD) (2000/60/EC, WFD, 2000), which seeks to restore the ecological status of all surface waters in Europe. The FD applies to all kinds of floods (defined in Art.2 of the FD, 2007) in all the European Union (EU) Member States (MS), introducing a set of

* Corresponding author at:Institute of International and European Union Law Ateities s. 20, Vilnius, Lithuania.
E-mail address: kbogdzevic@mruni.eu (K. Mikša).

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requirements together with deadlines for the reporting of their implementation. The effectiveness of the European Floods Directive depends on its implementation in each particular MSs.

Floods are a recurrent problem in Lithuania, causing substantial losses, especially in floodplain areas after the snowmelt (Krisciukaitiene et al., 2015; Stonevicius and Valiskevicius, 2018). Spring floods in the Nemunas delta (western part of Lithuania, near the Baltic Sea) have a positive impact on the diversity of small mammals' community in flooded meadows. Nevertheless, these impacts are negative in flooded forests (Balciauskas et al., 2012). Previous works observed a decreasing trend in spring floods between 1922 and 2010 in Baltic countries (Sarauskiene et al., 2014). Meilutyte-Lukauskiene et al. (2017) observed that flash floods are decreasing in magnitude in this period. The timing of floods is changing, with a shift from late March to February, and this is attributed to global warming (Bloschl et al., 2017). Nevertheless, floods may become a problem during summer since extreme rainfall is predicted to increase in the future (Toll and Post, 2018). Although the relevance of flood impacts, previously to the implementation of the FD, no flood risk assessment or management plan was carried out by the Lithuanian authorities. Therefore, it is relevant to know if the implementation of the FD is effective and practically applicable. So far, Lithuanian authorities seem to comply with the timetable provided in the FD. The preliminary flood risk assessment was carried out, flood hazard and risk maps were presented, and finally, a flood risk management plan was provided. However, it remains questionable, and further investigation is needed, whether documents presented by the MS are comprehensive and if they provide effective and practically applicable measures and comply with FD.

The aim of this paper is to investigate how the EU FD is being implemented in Lithuanian national law. Mainly how FD implementation influences land-use planning. The floods risk increases due to land-use changes, particularly urbanization (Hegger et al., 2016; Kalantari et al., 2019). However, to our knowledge, no previous studies were undertaken to investigate whether states, while implementing the directive, adopt effective policies and legislations in the land use planning domain. The importance of land-use planning for flood risk management was strongly emphasized in different EU documents related to the implementation of the FD (e.g., EU, 2018). Lithuania is an excellent example of the case study because questions of land ownership are very sensitive since, in the times of the Soviet Union, the land was nationalized, and the private property rights were abolished (Pakalniškis and Vaitkevičius, 2013). Thus, any interference in those rights established by constitution may create tensions. Therefore, they have to be justified and adequately regulated. The specific objectives are 1) to determine what are the criteria for the effective and correct legal implementation; 2) how these criteria are being met in Lithuania, and 3) to assess the practical implications of the implementation in land use planning. This work provides a first critical analysis of the correctness and effectiveness of the implementation of the FD in one EU MS and their implication on land use planning changes process. It will contribute to mutual learning about the implementation of the FD and to future comparative analysis. Also, to a broader understanding of whether provisions set out in the FD are sufficient for an effective flood risk management. The results of it can be beneficial to other EU MS.

2. Floods Directive and general criteria for its correct transposition and effective implementation

Despite the intention of the EU legislator to create a comprehensive directive, it remains imprecise in terms of the implementation. The MS has to find their own way of including the FD measures into their national legal systems (Hartmann and Spit, 2016a, 2016b). The integration of the FD provisions may be complicated, since the laws related to property rights have constitutional groundings, making construction regulation a problematic issue (Tarlock and Albercht, 2018).

2.1. Correct transposition of the provisions of the directive to the national law

The European directives do not have a direct effect on the MSs (Art. 288 Treaty of the Functioning of the European Union, TFEU, 2008). The MSs should transpose the provisions of the FD to the national laws. The stage of transposition is a compulsory precondition for the effective implementation of EU law and policy (Steunenberg and Rhinard, 2010). Only the completely transposed directive can become "*a law in action*"; in other words, it can have an effect in MS's legal system. Thus, the criterion of completeness of the transposition is crucial. The meaning of this criterion can be described as follows: a duty to adopt a corresponding national transposing legal measure for each obligation provided for by the directive (CJEU, 1990). Moreover, national provisions should be mandatory (CJEU, 2010). Completeness is complemented by the conformity of the transposition. It means that if a provision of the directive sets a list of elements that shall be reflected in national laws (e.g., Art. 6 of the FD), all have to be reflected. They have to be clear and unambiguous. Transposition of the directive is correct if it fulfills both the criteria of completeness and conformity. The correct transposition does not presuppose the literal transposition (CJEU, 2006). However, the wording should be close to the wording of the directive and shall have the equivalent legal effect. Correct transposition also means that all the deadlines and course of actions provided for the directive are kept. Therefore, in order to determine if the FD has been transposed to the Lithuanian law correctly, the following has to be evaluated: legal framework of transposition, particularly, if all elements required by the FD are reflected in national law, if they are clear and unambiguous and if all the duties were performed timely.

2.2. Criteria for the effective implementation of the FD

The effectiveness of any directive is a measure of the extent to which its goals have been achieved. It depends on how it is being integrated at the national level since the process of implementation might differ depending on the procedural and legislative nuances of MS. In order to achieve effective flood prevention and mitigation, the FD requires MSs to carry out a preliminary flood risk assessment (Art. 4 & 5), to draw up flood hazard and flood risk maps (Art. 6) and to establish flood risk management plans (Art. 7). All these points have to be reviewed and updated in six years' cycles (Art. 14). The FD requires the involvement of the public in an integrated risk management process (Art. 9 & 10) as well as international cooperation (also with third countries) in the case of the transboundary river basin districts (Art. 4, 5 & 8). The deadlines for the particular activities are: preliminary flood risk assessment had to be carried out until 2011, flood hazard maps and flood risk maps – 2013 and the flood risk management plans – 2015 (Art. 4,6 & 7). Each of these steps has to be reviewed in 6 years cycles. Most recently (until 22 December 2018), the MS had to present the 2nd Preliminary Flood Risk Assessment (Art. 14). So far, the majority of the countries are complying with the deadlines (European Commission, 2015, 2019). Greece and Ireland failed to provide timely flood risk management plans. However, the differences in implementation are evident. For instance, in the first stage, the MS used different criteria to define significant floods events and different methods of the assessment of their impacts (European Commission, 2015).

Imprecise provisions of the FD can lead to further inconsistencies in its implementation in MS. However, this flexibility allows for adapting flood risk management to each MS. For instance, in the third stage, some countries (Austria, Cyprus, Croatia, Hungary, Lithuania, Luxembourg, Malta, Romania, Slovenia, and Sweden) chose to prepare national FRMPs. Others (Belgium, Bulgaria, Estonia, Spain, Finland, France, Italy, Latvia, the Netherlands, Poland, Portugal, Romania) did it for particular river basin districts or sub-basin. Finally, some MS prepared FRMPs of different levels (Germany, Denmark, Slovakia, the United Kingdom), national and river basin districts, or sub-basin (EU,

2019). The legal status of the FRMPs among MSs vary. For example, in Latvia and Finland, the FRMPs were adopted by the ministries of environment, while in France and Italy, the authorities responsible for the FRMPs are river basin districts (EU, 2019).

The European Court of Auditors (ECA), emphasized three main issues for the MSs to improve flood risk management, namely: stronger integration of the climate change, flood insurance, and integration of spatial planning into flood risk management (EU, 2018). Article 7 of the FD requires considering spatial planning and land use in the flood risk management plans and including "the promotion of sustainable land-use practices" (Article 7 of the FD). However, the latter is more an indication than a strict requirement. In regard to the integration of spatial planning into flood risk management, several weak points were emphasized (EU, 2018). The definitions of flood-prone areas were often unclear, and in many cases, a lack of effective enforcement of legal means occurred, e.g., provisions on moving the assets are rarely enforced (usually as a last resort).

Therefore, the assessment of the implementation of the FD in Lithuania should focus on the institutional framework, since only competent authorities can adopt adequate measures. It has to be followed by the assessment of the general fulfillment of the implementation obligations, and identification of drawbacks. Whereas, an assessment of the effectiveness of measures should focus on the land-use planning measures, since they are crucial for the effective flood risk management. Therefore, laws and policies concerning land use are crucial for the effective implementation of the FD. The process and the critical elements of the implementation of the directive are presented in Fig. 1.

3. Transposition and implementation of the floods directive in Lithuania

3.1. Legal framework of transposition of the Floods Directive

The basis for the implementation of the FD in Lithuania is the Resolution of the Lithuanian Government on approval of the description of the flood risk assessment and management procedure (Flood Risk Assessment and Management Procedure, 2009). It provides the procedure for the flood risk assessment and management (PFRAM), determines responsible authorities, and mentions legal acts that could be affected by the FD implementation (Table 1 in **Supplementary material)**.

The transposition of the FD is coordinated with the transposition of the WFD. Lithuanian Government chose the option enshrined in Art. 3 of the FD to use the arrangements made under the WFD. Provisions of the Lithuanian Water Law (WL, 1997) amended in order to transpose the WFD also apply for the implementation of the FD. Therefore, flood risk assessment, mapping, and flood management plans in Lithuania are being done in the four river basins districts (RBD). The RBD, previously used for the WFD are the Dauguva RBD, Lielupė RBD, Nemunas RBD (also includes the coastal catchments and Jarka catchment) and Venta RBD (includes Bartuva and Sventoji catchments) (Fig. 2a). All of them are transboundary. Thus flood risk management requires the cooperation between Lithuania and the neighboring countries: Latvia, Poland, Russia, and Belarus (Fig. 2b). This is a crucial step in decreasing the negative impact of floods and in guaranteeing the effective implementation of the FD. The PFRAM sets the requirements for the preliminary flood risk assessment, for flood hazard and risk maps, and for the flood risk management plans. Table 2 in supplementary material presents the requirements of the FD, their transposition into national law, and their further implementation. PFRAM introduces terms as flood, flood hazard area, flood risk, the extent of the flood, and river into Lithuanian law, which were used in legislation before but were not described. The terminology used in the PFRAM must comply with the other water-related laws (Art. 5 of the PFRAM), mainly used in the Water Law (WL, 1997) and Coastal Zone Law (CZL, 2002). The first regulates water management, and the second sets the conditions of use of the coastal zone and marine waters. The classification of floods used for the preliminary assessment complies with the Resolution of the Lithuanian Government, regarding extreme events criteria (Resolution, 2006). Table 1 presents the classification of the floods and the number of historical events in each category.

The requirements set in the PFRAM for the preliminary flood risk assessment comply with the minimum requirements foreseen in the FD. Therefore, it includes all the aspects pointed in Art. 4 p. 2 of the FD. The inclusion of a definition of the flood hazard area is critical for implementing restrictions of construction in these areas. In the case of existing constructions, particularly in the high flood risk areas, in Lithuania, similarly to some other countries, measures such as expropriation were rarely used (EU, 2018).

The main doubt regarding the transposition of the FD is the level of the main legal act transposing the provisions of FD. Although it is mandatory, the resolution is a subordinate legislative act. Whereas, flood risk management requires to impose, for instance, restrictions of construction on private land, which can be introduced only by a law (Ruling of the Lithuanian Constitutional Court, 2002). The resolution is

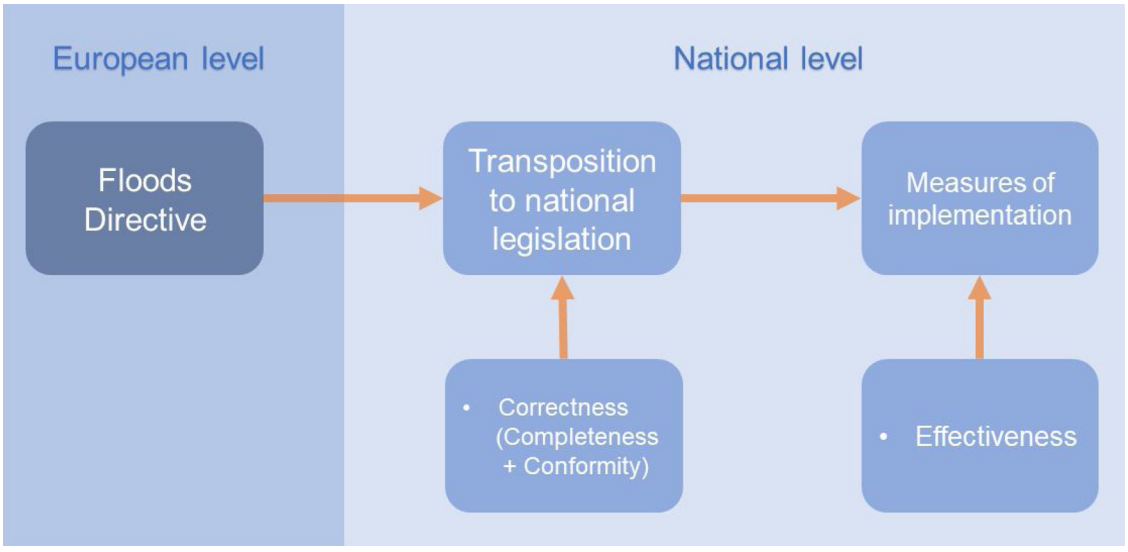

Fig. 1. Steps of Flood Directive implementation.

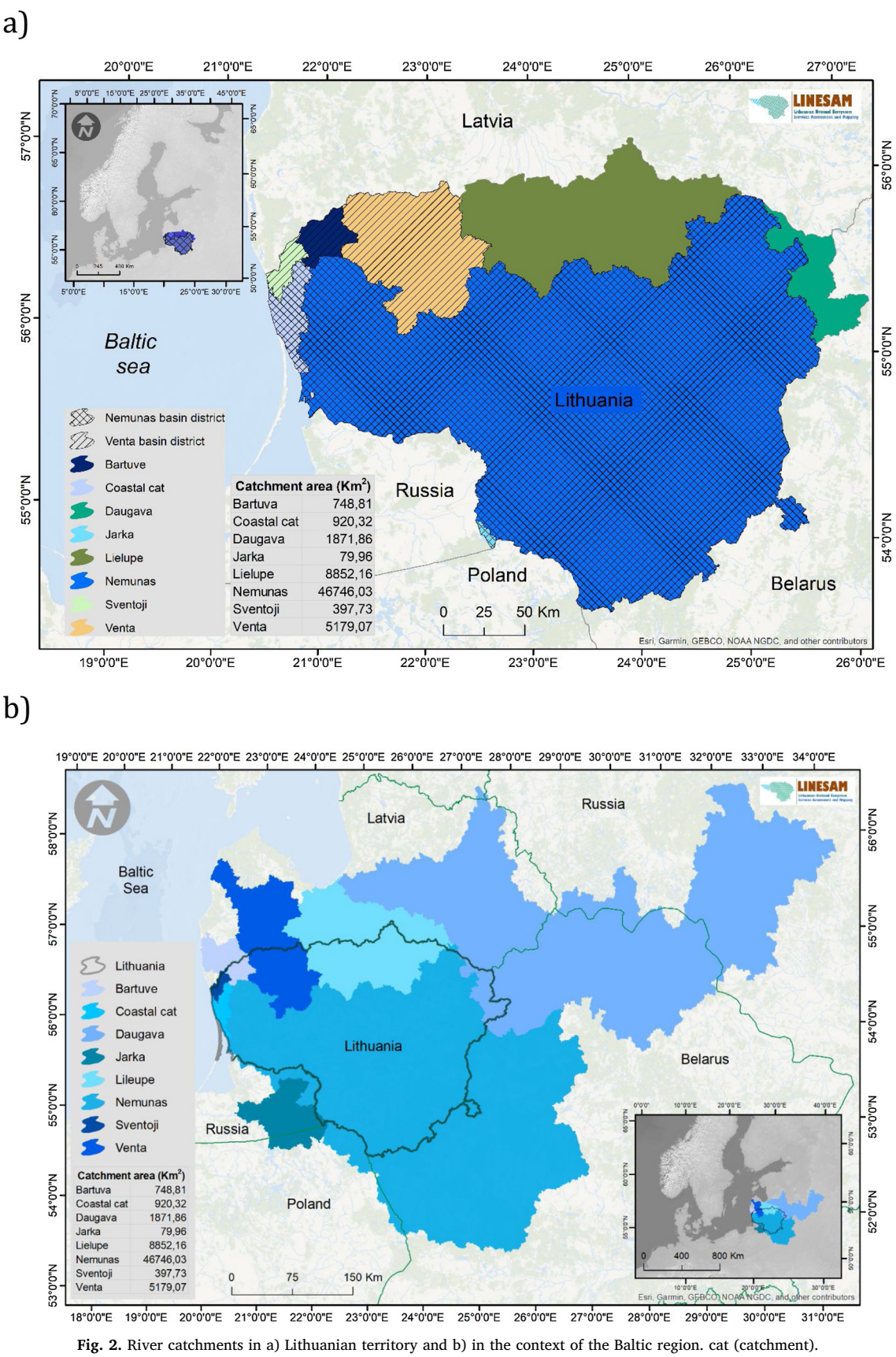

Fig. 2. River catchments in a) Lithuanian territory and b) in the context of the Baltic region. cat (catchment).

sufficient for the distribution of duties. However, to fully implement the spirit of the FD more "hard law" instruments are needed. Overall, the transposition of the FD provisions to the Lithuanian legal system meets the criterion of correctness: they include all the elements required by the FD. The wording used in national laws complies with the FD. On the other hand, national provisions brought little concretization of

Table 1
Classification of the floods and number of historical floods of each category (1812-2010) Source: Decree, 2012.

Category of the flood	Description	Number of the historical events
Elemental flood	Territories flooded during the floods with a probability of 1% or lower	25
Catastrophic flood	Territories flooded during the floods with a probability of 0,1% or lower	1
Elemental water level	Rise of water level above certain level at the water measurement station and above the Baltic Sea level in the Baltic height system	240
Catastrophic water level	Rise of water level above certain level at the water measurement station and above the Baltic Sea level in the Baltic height system	11

particular norms of the FD (e.g., in developing more extensive FRMPs).

3.2. The institutional framework of the implementation of the Floods Directive

According to the PFRAM the Ministry of Environment or its authorized institutions shall prepare the assessments, maps, and plans required by the FD, update these documents, and provide the European Commission the reports of FD implementation. Therefore, it requires multi-level cooperation between public authorities (national and regional), which is a common approach for the implementation of both the FD and the WFD (Vinke-deKruijf et al., 2015).

Flood risk management in each RBD shall be coordinated with the RBD management plans. The competence of the latter is delegated to the Ministry of Environment and the Environmental Agency under the Ministry of Environment. Other institutions, namely the Ministry of Agriculture, Ministry of Culture, Fire and Rescue Department under the Ministry of Internal Affairs, Ministry of the Economy and Innovation, Ministry of the Internal Affairs, Ministry of Health, provide the Ministry of Environment and its agencies the necessary information. The institutions and their competencies are presented in Table 2. Furthermore, the RBD Coordination Councils also take part in flood management. The RBD Coordination Councils are composed according to the Resolution of the Lithuanian Government of 14 March 2005 (Resolution, 2005), followed by the Decree of the Minister of Environment regarding the personal composition of the councils (Decree, 2005). Members of the councils are representatives of the state and local government institutions, representatives of Non-Governmental Organizations (NGOs), and other persons related to water management. The main task of the councils is to reconcile the interests of the state and municipal institutions, water users, NGOs, and the society, in the preparation, modification, and implementation of the programs for water protection and management (Resolution, 2005). The functions of the councils are more of a consulting nature and do not include strict measures to enforce the recommendations provided effectively. Both the water and flood management, as well as the initiative in spatial planning (Law on Territorial Planning, 1995), belongs to the Ministry of Environment. Therefore, it can be expected that different aspects of flood prevention, protection, and preparedness will be considered during the process of spatial planning.

The flood risk management is primarily delegated to the public actors, nevertheless the role of the private actor's increases, corresponding to the general trend in the EU (Wiering et al., 2017). However, this role is limited to participation in RBD Councils and public consultations. Thus, in the current situation, the influence of the private sector on flood risk management cannot be considered as significant.

The FD requires the MS to involve the public in the preliminary flood risk assessment, preparation of the flood hazard and risk maps, and flood risk management plans. They should foster active participation of interested parties in all activities of the implementation of the FD (Art. 10). The PFRAM introduces a framework for public participation, specifying the responsible institutions for the dissemination of the information and the deadlines for making the information public. Although the participation of the public is limited, the rules allow the interested parties to give remarks regarding the activities of the authorities (e.g., risk management plans). The Ministry of Environment

Table 2
Distribution of competences among the institutions (Green colour represents the competences of the particular authorities in each stage of the implementation of the floods directive).

Authority	Preliminary flood risk assessment			Flood hazard and flood risk maps			Flood risk management plans			Public consultations	International cooperation	Provision of Information	Spatial planning
	Preparation	Approval	Implementation	Preparation	Approval	Implementation	Preparation	Approval	Implementation				
Ministry of Environment		■	■		■	■		■	■		■		■
Environmental Agency (under Ministry of Environment)	■		■	■		■	■		■	■			
Ministry of Agriculture												■	
Ministry of Culture												■	
Fire and Rescue Department under Ministry of Internal Affairs												■	
Ministry of the Economy and Innovation												■	
Ministry of the Internal Affairs												■	
Ministry of Health												■	
Municipalities												■	■
RBD Coordination Councils	■			■			■			■			

makes flood risk management plans publicly available for comment. If the Ministry receives the remarks and does not take them into account, it has to provide a justified response for the interested party. However, the public does not have any possibility to provide remarks for the flood risk assessment or flood hazard and flood risk maps.

3.3. Drawbacks of the implementation of the floods directive in Lithuania

Lithuanian authorities strive to fulfill their obligations under the FD (Table 2 in Supplementary material). However, the implementation has shortcomings. The drawback of the preliminary flood risk assessment is the weak evaluation of adverse consequences. However, the experience of the states in evaluating flood impacts on human health and life is generally limited (Moster and Junier, 2009). The implementation of the FD also revealed a lack of relevant data both to assess flood risk thoroughly and provide evidence-based solutions.

The Decree of the Minister of Environment (Decree, 2014) completes the preparation of the flood hazard maps and flood risk maps. In Lithuania, flood maps were carried out considering different return periods of 10, 100, and 1000 years. The methodology used in the preparation of the maps is described in detail in the Decree of the Minister of Environment of the Republic of Lithuania No. D1 – 655 (Decree, 2014). For managing purposes and implementation of the FD, despite the fact that this is not mentioned in the directive, it is essential to consider a 1000-year return period (the worst-case scenario). This is important in a context where extreme rainfall events are becoming more frequent and unpredictable. The last IPCC report on the impacts of global warming of 1.5 °C (IPCC, 2018) highlights that climate change impacts are worse than expected. Therefore, it is crucial to implement FD, considering the worst-case scenario (1000-year flood return) in terms of flooding risk. Lithuanian authorities failed to map adverse consequences on the environment.

Finally, the third stage of implementation finishes along with the adoption of the FRMP. Lithuania prepared one FRMP for all Lithuanian RBDs (Nemunas, Lielupė, Venta, and Daugava) (Lithuanian FRMP, 2017). FRMP is a supplementary document for the 2017–2023 Water Development Program (WDP) (WDP, 2017) and the Action Plan for the implementation of the WDP (Action Plan, 2017). The FRMP is, in fact, the institutionalization of the shift from flood protection to flood management (Hartmann and Spit, 2016a, 2016b). The provisions on flood risk management plans reflect the requirements of the FD and provide guidelines on the elements of the initial and revised flood risk management plans. The main drawback of the FRMP is the unclear legal status of this document. Although it is described as a supplementary to WDP and the Action Plan for the implementation of the WDP, none of these documents make any references to the FRMP. The other problem is limited public participation, which included only two public seminars related to the development of the FRMP.

3.4. Ways to overcome drawbacks of implementation

Lithuanian authorities try to overcome data scarcity using knowledge and data produced by scientists through so-called research commissioned by the State. Unfortunately, the data produced by scientists are usually not transferred in a raw form. Thus the authorities have only treated data, usually as a report. Another measure to collect more data is to expand the list of institutions responsible for collecting statistical data. The Law of Official Statistics (Statistics Law, 1993) was recently amended. Currently, statistical data is collected not only by the Statistical Department under the Ministry of Interior Affairs but also by other ministerial and municipal authorities (is not specified which ones). Furthermore, the authorities acquired more rights in collecting statistical data; for instance, they can choose the method to collect data. The Ministry of the Environment, together with other institutions (e.g., municipalities), conducts monitoring of the state of the environment (Environmental Monitoring Law, 1997). The main tasks and goals of environmental monitoring are introduced in the National Environmental Monitoring Program 2018–2023 (Monitoring Program, 2018). However, the program does not include any direct reference to the data of floods. Therefore, the authorities plan to strengthen monitoring with the help of EU funds. Since this strengthening is still ongoing, it is impossible to evaluate if it is effective. However, more comprehensive data collection is needed to fulfill the obligations under the FD. In order to achieve the objectives of the FD, Lithuanian authorities should make references to the FRMP in the WDP. This will make the legal framework more coherent, consistent, and easier to introduce restrictions required to prevent flood risk.

The information on flood hazards and related risks in all RBD presented in the form of maps becomes more evident and understandable for both the public authorities and the society (Kourgialas and Karatzas, 2017). This awareness and a more in-depth understanding of flood hazard could have threefold implications. First, the society, mainly those people whom the flood could potentially affect, can demand the authorities to implement measures for flood protection. In the case of flood risk management, society participation in public consultation was rather weak. However, there are good recent examples of public participation in decision-making. In 2013, authorities decided to cut all the trees on the Gediminas Hill and in three years the hill was affected by severe landslides. In the following years, society started to track the decisions of the authorities regarding spatial planning, particularly the management of the parks, more carefully and in several cases stopped the works that were planned but could potentially harm the environment (according to the society). Second, to manage flood risk, the authorities can more easily implement controversial measures in the eyes of society, such as restrictions for construction. The Eurobarometer survey shows that 41 percent of the respondents of Lithuania agree to prohibit economic development in protected areas because they are the most important nature areas (European Commission, 2018). Third, they can influence the willingness of the individuals potentially endangered by the floods to acquire insurance (Paleari, 2019). However, private insurance companies can exclude the possibility of paying the insurance in case of the flood if the property is located in a flood area of high risk (Hanger et al., 2018). Finally, in legal terms, the flood hazard maps and flood risk maps have a great value for future spatial planning. Neither the public authorities during the process of preparation of land use plans nor the courts or other institutions during enforcement of those plans could ignore the fact that a particular area is a flood hazard or flood risk area. This makes the process of law-making and law enforcement in regard to flood hazard and flood risk territories more transparent and coherent. It means that the measures restricting construction and other activities in these areas would be more effective.

4. Effectiveness of the measures adopted for the implementation of the Floods Directive in terms of land use

The effectiveness of the implementation of the FD can be measured by the effectiveness of the adopted national measures. Special attention should be paid to the issue of land use and climate change, which are usually not sufficiently integrated into flood risk management (EU, 2018). The significance of the following documents: the PFRAM, flood hazard maps, and flood risk maps and the FRMP, particularly for the spatial planning legislation, cannot be overestimated. The urbanization of flooded areas is not a rare situation in Lithuania. Fig. 3 shows that despite the awareness of the flood risk in certain areas, urbanization continues to grow there over the years. This was caused by the fact that the restriction existent before the implementation of the FD was not effective enough to prevent the construction in those areas. According to the Lithuanian FRMP, one of the measures of flood protection in the areas of 10 and 100 years of the flood return period (high and medium flood probability, respectively) is the restriction of the construction of houses, industries and other infrastructures (e.g., roads) and both economic and agricultural activities. The urban expansion in Lithuania is

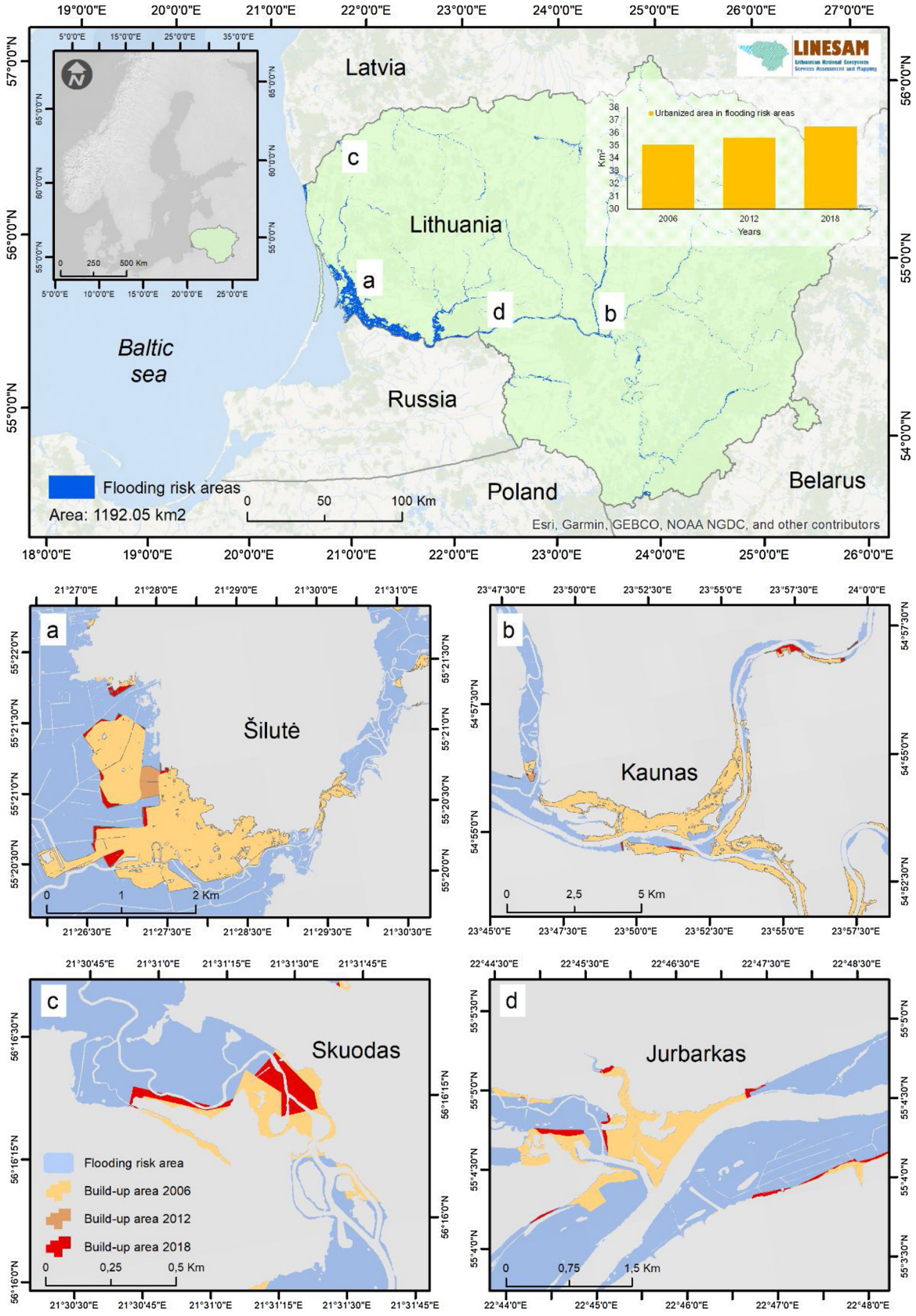

Fig. 3. Build-up areas in flood risk areas (return period of 1000 years) in 2006, 2012 and 2018: a) Silute, b) Kaunas, c) Skuodas and d) Jurbarkas. Land use data is from Corine land cover (level 3) (https://land.copernicus.eu/pan-european/corine-land-cover). Urban areas classification was carried out according the ecosystem types of mapping and assessment of ecosystems and their services (MAES). Urban areas (1.1.1. Continuous urban fabric, 1.1.2. Discontinuous urban fabric, 1.2.1. Industrial and commercial units, 1.2.2. Road and rail networks and associated land, 1.2.3. Port areas, 1.2.4. Airports, 1.3.1. Mineral extraction sites, 1.3.2. Dump sites, 1.3.3. Construction sites, 1.4.1. Green urban areas and 1.4.2. Sport and leisure facilities) (https://biodiversity.europa.eu/maes/correspondence-between-corine-land-cover-classes-and-ecosystem-types). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

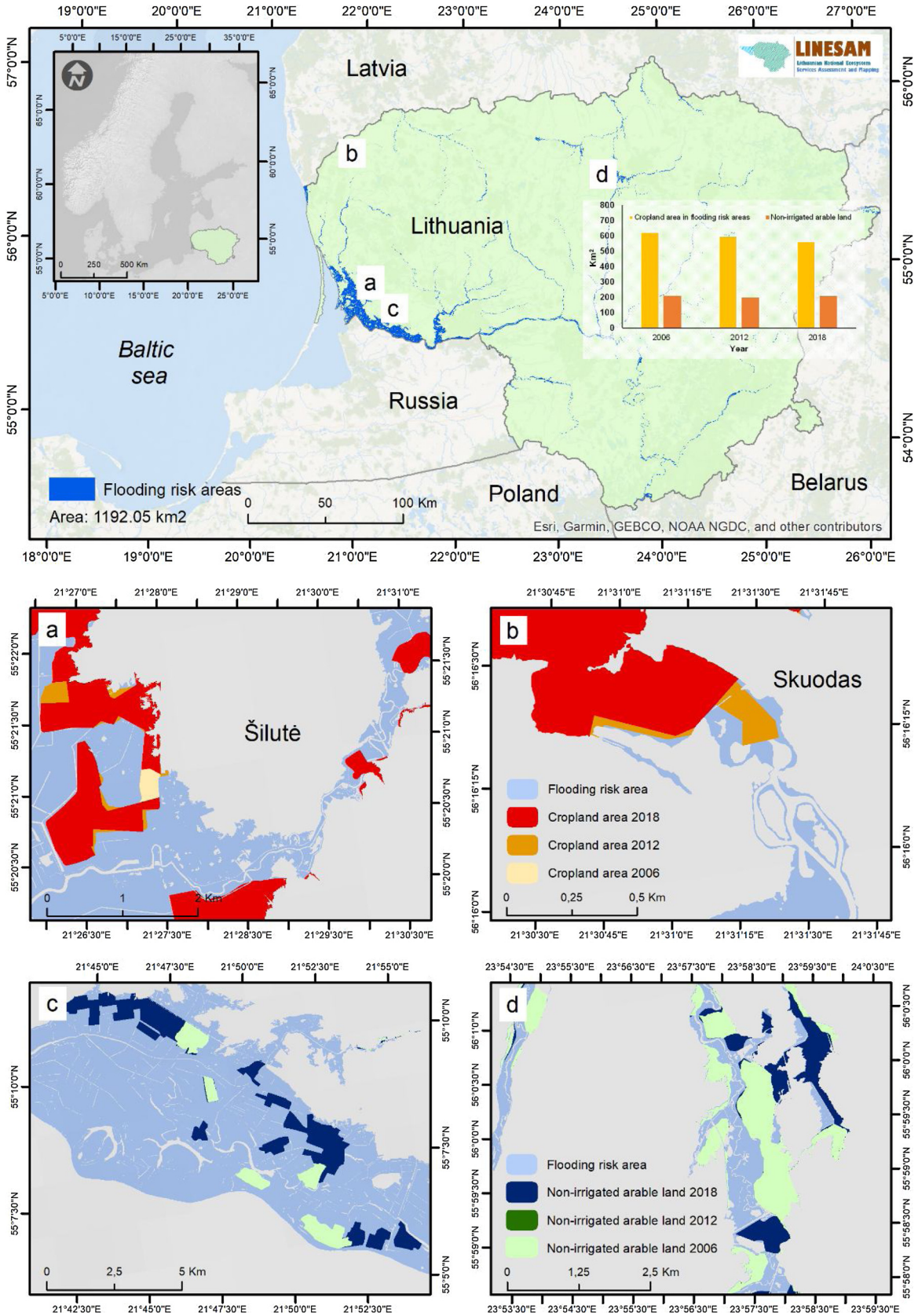

Fig. 4. Cropland areas and non-irrigated arable land in flood risk areas (return period of 1000 years) a) Silute, b) Skuodas, c) near Nemunas delta and d) near Panevezys. Land use data is from Corine land cover (level 3) (https://land.copernicus.eu/pan-european/corine-land-cover). Urban areas classification was carried out according the ecosystem types of mapping and assessment of ecosystems and their services (MAES). Cropland areas (2.4.1. Annual crops associated with permanent crops, 2.4.2. Complex cultivation patterns 2.4.3. Land principally occupied by agriculture, with significant areas of natural vegetation)(https://biodiversity.europa.eu/maes/correspondence-between-corine-land-cover-classes-and-ecosystem-types).

being done by occupying agricultural and pasture areas, as can be observed in Fig. 4a and b (Silute and Skuodas) in flood risk areas. Also, there is evidence of agriculture expansion and intensification (conversion of semi-natural grasslands into arable lands) (Fig. 4**c** and **d**). Even though the cropland area is decreasing in flooding risk zones, the area occupied for non-irrigated arable land increased slightly from 2012 (198 km^2) to 2018 (207.8 km^2) (Fig. 4), that may be subjected to fertilization practices. These land-use changes reduce the capacity of the ecosystems to reduce flood risk and increase the vulnerability (e.g., population exposure) and degradation (e.g., soil sealing, land consumption, pollutants transport to water bodies) of these areas. For safeguard properties and reduce ecosystems degradation, the restriction to construction and conversion to intensive agriculture areas should be extended to the 1000 year return affected area, given the unpredictability of extreme rainfall events and the impact of the urbanization on flood destruction. This would prevent casualties and reduce the environmental, social, and economic costs associated with floods (Paprotny et al., 2018). In order to implement the restriction to urban and agricultural expansion in flooding risk areas, changes in at least the following legal acts were needed: the laws on protected areas, spatial planning laws, and the special rules on land and forest use.

4.1. Restriction of the construction in the flood hazard territories

The European Commission emphasizes that one of the most effective prevention measures is the avoidance of constructing houses and industries in flood-prone areas (European Commission, 2004). Restriction of the construction in the flood-prone territories was known to Lithuanian law before the implementation of the FD. The restriction to construct in these areas was introduced in 1996 in special conditions on land and forest use (Land Use Conditions, 1992). Moreover, there was a special restriction provided in Art. 20 of the Law on Protected Areas (Protected Areas Law, 1993), which prohibited to construct buildings in flood-prone territories (except for the homesteads located therein) as well as on slopes of water bodies whose fall exceeds 10 degrees. Unfortunately, the implementation of the restriction was not easy due to the lack of a valid definition of what the “flood-prone territories” were. No maps or other documents were specifying the restriction, thus allowing its circumvention. An individual seeking to build in the flood-prone area was in a favorable position in case of a court dispute since there were no delimitations for flooding risk areas. For instance, in one case, the court stated clearly that restriction to build in the flood-prone territory was not based on concrete factual data (Decision of the Lithuanian Supreme Administrative Court, 2012) and therefore ruled in favor of the claimant, who was seeking to build a house in a potentially flooded area.

The situation has changed due to the implementation of the FD, particularly the implementation of its second stage, namely the preparation of flood hazard and risk maps. So far, the implementation of the FD has not led to all the desired changes in legislation. Nevertheless, the first steps towards comprehensive and coherent legislation were taken. For instance, the Law on Protected Areas, 1993 was amended and “flood-prone territories” were changed to “high and medium flood risk territories”, the same as used in the documents implementing the FD. Even though the amendment does not seem very significant, it has far-reaching implications. It is one of the first steps towards the unification of the relevant terminology in legislation and thus making it more difficult to circumvent the law and, consequently, adopting the measures that allow the effective implementation of the FD.

The next step towards the full implementation of the spirit of the FD is the adoption of the Law on Special Land Use Conditions (Law on Special Land Use Conditions, 2018; hereinafter referred to as the Land Use Law), which would change the current Special Conditions on Land and Forest Use (Land Use Conditions, 1992). The Land Use Law introduces descriptions of the floods of different extent and flood hazard territory (Art. 2). Furthermore, the restriction for the constructions is dependent on the level of the flood risk on a particular territory. In the territories of high flood risk, constructions are prohibited (Art. 104 par.1). In the territories of medium and low flood risk, there is no restriction to construct, with the exception of industrial buildings that require an integrated pollution prevention and control permit, and warehousing buildings, if they contain hazardous materials (Art. 104 par. 2–3). The restrictions compared to the current regulation are clear and leave less room for the circumvention of the law. The adoption of a new law is important in terms of constitutional protection of the ownership. The flood protection, management, and related restrictions often require interference in the management of private land, by imposing on the owners the restriction of construction or any other activity. During the time of the Soviet occupation of Lithuania (1940–1990), the ownership of any kind of estate or property was highly restricted, thus making it one of the most sensitive issues after the restoration of independence. Property rights were one of the first ones to be restored and embedded into the fabric of the Constitution of the Republic of Lithuania.

According to Art. 23 of the Constitution of the Republic of Lithuania, the ownership is inviolable and protected by law (Lithuanian Constitution, 1992). Subsequently, the Lithuanian Constitutional Court in several rulings explained that the ownership could be restricted only by law. In fact, before the implementation of the FD and proposed amendments in land use conditions, restriction of construction in flood-prone territories was introduced in the subordinate legal act. Thus its practical effectiveness was often questionable since urbanized, and agriculture areas are growing in flooding risk areas (Figs. 3 and 4).

The urbanization of flood risk areas does not only increase the vulnerability to flood impacts but also reduces the capacity of the ecosystems to supply services in quality and quantity. Soil sealing has tremendous impacts on the ecosystems and represents an important form of land degradation and affects all ecosystem services. It is acknowledged as the most critical soil threat and an irreversible process. Basically, it interrupts the connection between soil and the other ecological spheres (atmosphere, biosphere, and hydrosphere) (Tobias et al., 2018; Hunder and Bodle, 2019). Sealing destroys all soil ecological functions and represents a loss of biodiversity (Pereira et al., 2018), food, and fodder provisioning (Gardi et al., 2015). It reduces water storage, groundwater recharge (Tobias et al., 2018), and other soil regulating capacities such as pollutant filtration, carbon storage and sequestration (Yao and Kong, 2018) and micro-climate (Artmann, 2014). Impervious surfaces change surface albedo and, therefore, air temperature, contributing importantly to the urban heat island effect (Corstange et al., 2017; Marando et al., 2019). Overall, urban expansion in flood risk areas, especially in floodplains represents a critical loss for the ecosystem services supply of those areas, since these are the environments where the most fertile soils are located, have the highest infiltration rates (groundwater recharge areas), flood protection areas (e.g., wetlands). The continuous sealing of these areas will increase the risk of the existent urbanized areas to flash floods as a consequence of the destruction of natural areas for flood retention.

4.2. Restriction of economic and agricultural activities

Agricultural and industrial activities can cause contamination of the surface and groundwater and represent a threat to human health and life (European Commission, 2004). Therefore, restrictions of such activities in flood hazard territories could be a good measure to protect water from contamination. Currently, the Lithuanian law prohibits to establish solid household waste landfills in the flood-prone territories. The Land Use Law introduces more extended, but still not sufficient restrictions. In the territories of high flood risk, it is forbidden to install animal storage, slurry and manure storage facilities and thick manure stacks. In the territories of medium and low flood risk, it is forbidden to install storage buildings if they contain hazardous materials. The restrictions imposed in high flood risk should be extended to the medium-

risk since agricultural and industrial activities are two of the most important causes of surface and groundwater pollution. Intensive agriculture practices (herbicides, pesticides, inorganic fertilizers, and cattle farms) and industrial activities have been reported to degraded water quality and affect human health (Wang and Yang, 2016; Evans et al., 2019). According to Eurostat (2017), Lithuania is the Baltic country that uses more fertilizers (Nitrogen and Phosphorous) in agriculture and has the highest livestock population and industrial activity. These intensive activities have an important impact on water quality. The levels of biological oxygen demand in Lithuania are higher than in other Baltic states (Eurostat, 2018).

It would be important to limit intensive agriculture practices or subsidize organic farming practices in flood risk areas since the increase of the frequency and intensity of extreme rainfall events would promote their faster transport to water bodies. In the latest report about EU MS water quality (EEA, 2018a), information about Lithuania RBD's ecological status was lacking. A national report carried out by the Lithuanian environmental agency (2010–2015) indicated that 9% of the rivers had a very good ecological status, 40 % good, 35 % medium, 11 % bad, and 5% very bad. In relation to lakes and ponds, 6% were considered to have a very good quality, 54 % good, 26 % medium, 11 % bad, and 3% very bad quality (AAA, 2017). Despite the relatively good ecological status, previous studies observed that an important amount of Nitrogen and Phosphorous is transported into Lithuanian rivers (Povilaitis, 2008; Povilaitis et al., 2014). Restrict intensive agriculture and industrial activities in flood risk areas would also reduce the eutrophication in the Baltic Sea, which is considered one of the largest hypoxic water bodies (McCrakin et al., 2018). This would also contribute to the transport of other pollutants, such as polycyclic aromatic hydrocarbons (Stakeniene et al., 2019) and heavy metals (Remeikaite-Nikiene et al., 2018). The practical implementation of these measures is crucial to achieving WFD targets as well.

Noteworthy are the other restrictions in the water protected zones introduced by the Law on Protected Areas. According to its provisions in protection zones of surface water bodies, established by the Government or other delegated institution, is prohibited from applying slurry or liquid manure on the soil. In the coastal protection zone is prohibited from using fertilizers, pesticides, and other chemicals, from working the land, from demolishing the turf (except for the regeneration of cultural meadows), to feed animals less than two meters from the shore. The restrictions are enshrined in one of the main laws regarding land use. Therefore their circumvention should be rare. To sum up, the implementation of the FD has not significantly influenced the restrictions of the economic activities in the flood hazard territories (Figs. 3 and 4).

4.3. Implications for achieving regional and global targets

The restriction of urban expansion and industrial activities in the 1000-year return period flood-affected area would be an excellent step for Lithuania to meet regional (e.g., EU FD, WFD) and global targets (UN SDG's), which the EU is strongly supporting. These areas could be used for sustainable agriculture practices (e.g., organic farming), grassland, and forest land use. This would minimize the impacts of floods in human infrastructures, decrease the flood severity by increasing the area for water infiltration, and reduce diffuse pollution. Correct land use planning and agriculture policies are crucial to prevent floods, as it is highlighted as well in WFD (EU, 2005) and is also an important part of the Nitrates Directive (91/676/EEC). Conventional agriculture practices are well known for increased soil compaction and runoff as a consequence of the use of heavy machinery, herbicides, and pesticides, decreasing their capacity for water regulation (Chen et al., 2015; Gao et al., 2017; Alaoui et al., 2018). Encouraging sustainable agriculture in flood risk areas would increase the capacity of these areas to decrease flood impact and reduce the transport of pollutants to groundwater and surface water bodies such as Baltic Sea that is one of the most polluted seas in the world, and urgent actions are needed as stated in recent EU reports (EU, 2016; EEA, 2018b). Agriculture is the most important contributor to Baltic Sea eutrophication (HELCOM, 2010). It has been challenging to reduce the pollution associated with eutrophication, mostly from agriculture and animal explorations (Bohman, 2018). Several reports highlighted the importance of good agriculture practices to reduce Baltic Sea pollution (**e.g.,** Nilsson and Bohman, 2015; McCrakin et al., 2018; Raike et al., 2019).

If the 1000-year return period areas are affected by floods (e.g., agriculture areas), to minimize the damage, the owners could apply to subsidisation, such as United Kingdom (Morris et al., 2016), France (Erdlenbruch et al., 2009) and Austria (Thaller and Hartmann, 2016) or compensation mechanisms to mitigate the losses. Nevertheless, in Lithuania, the current FRMP's do not consider this option (EU, 2019). The implementation of compensation measures would be necessary for the correct management of flood risk areas in Lithuania.

In article 1 of the FD it is clearly stated that the purpose of the directive is *"to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community*." The limited restrictions to construct in medium and low flood risk areas are insufficient to reduce flood risk since soil sealing increases the vulnerability of humans and goods to floods. In addition, the areas of medium and low flood risk act as a buffer to the areas of high risk. If these areas are urbanized, the risk of floods and the damage in areas of high risk may increase. It is worth saying that with climate change and economic development, the risk of flooding may increase as well, and this is considered under the framework of the FD.

Other global strategies such as the UN SDG's for 2030, which was considered as one of the most significant achievements of all humanity, share the same vision and promote wellbeing at the global level (Constanza et al., 2016; Hak et al., 2016). The EU is strongly devoted to achieving the targets described in the 17 SDGs, and they should be implemented in the MS as well (European Commission, 2017). Despite the understanding of these principles, at the current level, better development of policies and a stronger governance for the correct implementation of SDG's (Joshi et al., 2015) is needed. The success of the SDGs depends on the several institutional factors such as the commitments, strong global governance efficiency, and transposition of global ambitions to national policies and management (Biermann et al., 2017). In this context, it is crucial that Lithuania could adapt the SDGs to the national context in order to meet the expected targets by 2030. Water/flood regulation ecosystem services are directly linked with more than 10 targets from different SDG's (e.g., zero hunger, good health, clean water, sustainable cities, climate action and life on land) (Wood et al., 2018). Therefore, the current policy to permit construction and intensive agriculture in flood risk areas decreases food security by occupying the best soils for agriculture (zero hunger), increases the vulnerability of the urban areas to the flood risk (good health and sustainable cities) as well as the soil and water pollution with intensive agricultural practices (clean water) and reduces the vegetation cover and biodiversity (climate action and life on land). This is an example that more efforts are needed to link global strategies with national contexts.

5. Conclusions

The implementation of the FD requires the MSs to transpose its provisions timely, fully, correctly, and to adopt the measures, which ensure an effective flood risk management. The choice of implementation measures is left for the MSs; however, the FD sets minimum standards in this regard. These standards include international cooperation, specific management for each river basin as well as preparing the flood hazard and risk maps according to different scenarios, enabling to set the priorities and further decision-making. The

newest report of the ECA (EU, 2018) revealed that effective measures are still lacking in the inclusion of climate change, insurance, and spatial planning into flood management. In Lithuania, both the policy formation, in general, and legislative initiative belongs to the Ministry of Environment. Thus the flood risk management issued should be considered in the process of spatial planning. This is crucial to ensure the effective implementation of the FD.

Lithuanian authorities comply with the requirement of the correct and timely transposition of the FD in national law; however, in most cases, they fulfill only the minimum requirements. One of the main obstacles for the correct implementation of the Directive is the lack of data, limiting the correct assessment of the possible adverse consequences in the future.

The effectiveness of the implementation of the FD in Lithuania could be endangered by the circumvention of the prohibition to construct in flooded areas. These circumventions were caused primarily by introducing the restriction of the legal act that is low in the hierarchy of legal acts, as well as inconsistency in definitions of the flood-prone area. In order to improve the current situation, the laws related to land use are being changed. For instance, the above-mentioned restriction to construct is foreseen in the Law on Special Land Use Conditions. However, the effectiveness of the provided provisions could still be considered insufficient—Lithuania, as well as other MSs, based on the flood risk assessment on historical data. Moreover, the impact of climate change was not taken sufficiently into consideration while implementing flood risk management measures. Namely, the construction was restricted only in the territories of a high flood risk probability, although it would be considered as more effective to prohibit construction and some activities related to industry or agriculture also in medium and low flood risk territories. This would safeguard populations and goods from the impacts of climate change and is crucial to contribute to FD and UN SDG's targets.

CRediT authorship contribution statement

Katažyna Mikša: Conceptualization, Investigation, Methodology, Writing - original draft, Writing - review & editing. **Marius Kalinauskas:** Formal analysis, Writing - review & editing. **Miguel Inácio:** Data curation, Validation, Visualization, Writing - review & editing. **Paulo Pereira:** Supervision, Investigation, Funding acquisition, Project administration, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

None.

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Appendix A. Supplementary data

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Katažyna Mikša has been an associate professor in the Institute of International and European Union Law at Mykolas Romeris University in Vilnius since 2015. She has received her Master Degree in Law (2006) and her Doctorate Degree (2014) from the Faculty of Law and Administration of the Jagiellonian University in Krakow. Dr. K. Mikša research interests include European Law, environmental law, international law and human rights.

Marius Kalinauskas is a lecturer at Mykolas Romeris University. In 2009 he obtained a Master Degree in Law and in 2017 he has received a Doctorate Degree in Social Sciences from the Mykolas Romeris University. Mr. Kalinauskas research interests focus on law, educational technologies. He has experience in creating and editing video content, working with dot and vector graphics editors and content management systems.

Miguel Inácio is a PhD student in Ecology and Environmental Sciences at Klaipeda University (Lithuania). He was a researcher at the Leibniz Institute for Baltic sea Research in Rostock (2015–2019). He is a researcher in LINESAM project at Mykolas Romeris University. His research interests focus on marine ecosystems, ecosystem services and environmental policy.

Paulo Pereira has been a full professor at Mykolas Romeris University. He is a head of the Environmental Management Laboratory at Mykolas Romeris University. He has obtained a Doctorate Degree from the Barcelona University in 2010. He was a post-doc researcher at Michigan State University in USA. Mr. Pereira is an associate editor of the journal Science of the Total Environment (Elsevier), also he was/is editor/guest editor of recognized journals such as Current Opinion in Environment and Health (Elsevier), Geoderma (Elsevier), Catena (Elsevier). His research interests focus on land degradation, ecosystem services.