

Brussels, 23 June 2017

COST 020/17

DECISION

Subject: **Memorandum of Understanding for the implementation of the COST Action “Natural Flood Retention on Private Land” (LAND4FLOOD) CA16209**

The COST Member Countries and/or the COST Cooperating State will find attached the Memorandum of Understanding for the COST Action Natural Flood Retention on Private Land approved by the Committee of Senior Officials through written procedure on 23 June 2017.



MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA16209 NATURAL FLOOD RETENTION ON PRIVATE LAND (LAND4FLOOD)

The COST Member Countries and/or the COST Cooperating State, accepting the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action (the Action), referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any new document amending or replacing them:

- a. "Rules for Participation in and Implementation of COST Activities" (COST 132/14);
- b. "COST Action Proposal Submission, Evaluation, Selection and Approval" (COST 133/14);
- c. "COST Action Management, Monitoring and Final Assessment" (COST 134/14);
- d. "COST International Cooperation and Specific Organisations Participation" (COST 135/14).

The main aim and objective of the Action is to investigate how can land owners be encouraged to adapt land uses and land management strategies allowing for an increased water retention capacity. the Action aims at identifying synergies between different land uses and the provision of flood storage and ecosystem services. This will be achieved through the specific objectives detailed in the Technical Annex.

The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 80 million in 2016.

The MoU will enter into force once at least five (5) COST Member Countries and/or COST Cooperating State have accepted it, and the corresponding Management Committee Members have been appointed, as described in the CSO Decision COST 134/14.

The COST Action will start from the date of the first Management Committee meeting and shall be implemented for a period of four (4) years, unless an extension is approved by the CSO following the procedure described in the CSO Decision COST 134/14.

OVERVIEW

Summary

Climate change increases the frequency and intensity of future flood events, leading to higher costs of flood damages and increasing the public demand for protective measures. Traditional flood protection measures, mainly based on grey infrastructure (i.e. dikes, dams, etc), are not sufficient to cope with dynamic flood risk alone. Nature-based solutions such as Natural Water Retention Measures (NWRM) are promising options to mitigate flood risks as a complement to grey infrastructure. These types of measures not only serve to reduce risk, they also provide additional ecosystem services including increased biodiversity and recreation opportunities. However, a common characteristic of green infrastructure measures is that they often claim more land than traditional methods.

The challenge is to consider multifunctional land uses, which enable temporary flood retention and flood storage on private land without restricting the provision of other ecosystem services. The reconciliation of flood risk management and land management is needed. Since all NWRM primarily need to be implemented on private land the consideration of multiple aspects includes: economic issues (e.g. how to compensate for or incentivize flood retention services); property rights issues (e.g. how to allow temporary flood storage on private land); issues of public participation (e.g. how to ensure the involvement of private landowners) as well as issues of public subsidies (e.g. how to integrate/mainstream flood retention in agricultural subsidies). LAND4FLOOD cost action aims to address these different aspects and to establish a common knowledge base and channels of communication among scientists, regulators, land owners and other stakeholders in field.

<p>Areas of Expertise Relevant for the Action</p> <ul style="list-style-type: none"> ● Social and economic geography: Spatial development, land use, regional planning ● Economics and business: Public economics, political economics ● Environmental engineering: Risk assessment, prevention and mitigation 	<p>Keywords</p> <ul style="list-style-type: none"> ● land management ● property rights ● flood damage reduction ● flood storage
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Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

- Developing a multi-stakeholder knowledge exchange platform: LAND4FLOOD aims to build a comprehensive understanding of the interrelations between land and water in flood risk management by developing a multi-stakeholder knowledge exchange platform, including scientists, landowners, practitioners such as water engineers as well as policy makers and non-governmental actors.
- Promoting existing and new instruments for land use for flood risk management: LAND4FLOOD deals with the assessment of the practical applicability of particular instruments in different institutional contexts (authoritative vs. democratic, western European vs. post-socialistic, development vs. developing countries, common law vs. Romanian legal tradition).

Capacity Building

- Providing a platform and forum for the exchange of information and identification of strategic research needed for implementing retention and resilience measures on private land in flood risk management plans.
- Encouraging decision/policy makers to take up new transdisciplinary knowledge that addresses correlations between flood damages and land use, and raising awareness of land owners and with their

direct support co-develop best practices of consensual NWRM implementation.

- Supporting interdisciplinary education of Early Career Investigators (water engineers, environmental scientists, planners, economists, etc.) that will better reflect the interconnection of land and flood risk management. A large number of Early Career Investigators are directly involved in the Action.
- Organizing Short Term Scientific Missions (STSMs) for Ph.D students and post-docs, carefully balancing the gender representation and encouraging active participation of members from inclusiveness countries.
- Raising awareness of land owners and with their direct support co-develop best practices of consensual NWRM implementation

1) S&T EXCELLENCE

A) CHALLENGE

I) DESCRIPTION OF THE CHALLENGE (MAIN AIM)

Climate change is likely to increase the frequency and intensity of future flood events, leading to higher costs of flood damages (Munich Re 2014) and increasing public demand for protective measures. Land development in floodplains has been shown to further exacerbate this situation (UNISDR 2011). Traditional flood protection measures mainly based on grey infrastructure (i.e. dikes, dams, etc.) are not sufficient to cope with dynamic flood risk alone. The reasons for this are twofold: (1) grey infrastructure is always designed for a specific threshold and has an inherent likelihood of failure; (2) grey infrastructure provides a sense of security, which often leads to an increase in the area of land use at risk for flooding (Di Baldassare et al. 2009). Both of these factors ultimately increase flood vulnerability and flood hazard.

Nature-based green infrastructure solutions such as Natural Water Retention Measures (NWRM) are promising options to mitigate flood risk as a complement to grey infrastructure. These types of measures not only serve to reduce risk and provide more robust flood protection; they also provide additional environmental services including increased biodiversity and recreation opportunities (Huq et al. 2013). However, a common characteristic of green infrastructure measures is that they often claim more land than traditional methods (i.e. a retention area requires more land surface than a dike). This land, which is already being used for other purposes is also often privately owned. Mobilizing **private land for temporary flood storage** means coordinating **different actors and institutions** in water management, essentially including landowners in management plans (Hartmann 2011). To accomplish this, there are many different contexts and constructions of property rights that need to be considered. Agreements which include new forms of temporal and spatial land use need to be supported not only by instruments for land management but also embedded in a communication and negotiation strategy. Ultimately, synergies with other land uses (i.e. ecological, agricultural, etc.) need to be identified and supported.

- For NWRM, this implies adopting a wide range of multifunctional retention measures located appropriately throughout river catchments (not just on agricultural and forest land, but also in urban areas).
- For larger scale flood retention this implies retention basins that not only provide temporary water storage but that also include a range of additional services including recreational opportunities and water pollution control.
- For “resilient cities” this implies developing multifunctional measures (sustainable urban drainage systems) which enable temporary storage of excess floodwater at the local scale.

The first step in developing a **holistic approach to flood risk management** is to actively adopt and operationalize a catchment-based approach in which hydrological connectivity between distinct land-use mosaics is clearly articulated. Using a catchment-based approach as mandated by both the EU Water Framework Directive (WFD) and the Flood Directive (FD) would allow NWRM type solutions (green infrastructure) to be integrated into flood risk

management; in the catchment hinterland, in controlled flood retention on the floodplain and in resilient cities. Unfortunately, although much of the natural science evidence base regarding the impact of NWRM on flood risk management exists, the knowledge is splintered and not readily available to practitioners (BBSR/BBR 2015). So as to foster the **implementation of green infrastructure options on private land**, there is a need to find and implement ways to better connect academic interdisciplinary knowledge with real world policy formulation and decision-making. Achieving this aim requires not only access to information on the physical impact of these types of soft engineering measures but also a focus on the motivations, interests, knowledge and capacity of different types of private actors at the local, regional and catchment levels.

While approaches to flood risk management for damage reduction have become more diversified, a dominance of grey infrastructure based solutions still exists, especially in densely populated urban areas (Patt & Jüpner 2013). A wider application of non-structural solutions, however, implies that the focus of managing water quantities, especially water levels, to prevent flood damage needs to widen to also consider the potential impacts of **changing land use and land management on water quality**. To comply with both the FD and the WFD, there is a significant need to bring these two disjointed management remits for water quantity and water quality closer together, to develop and promote multifunctional land uses, which enable temporary water retention and storage on private land for flood risk management without restricting the provision of other ecosystem services. The focus on “private” land is used deliberately to emphasize the tension between public interest (on the catchment level) and private interest (on the local scale).

Since flood risk reduction options that include green infrastructure primarily need to be implemented on **private land** there is a need to consider multiple aspects including: economic issues (e.g. how to compensate for or incentivize flood retention services); property rights issues (e.g. how to allow temporary flood storage on private land); issues of public participation (e.g. how to ensure the involvement of private landowners) as well as issues of public subsidies (e.g. how to integrate/mainstream flood retention in agricultural subsidies).

The **LAND4FLOOD COST** Action will integrate the different issues and interests identified above by establishing a forum which will promote **knowledge sharing** via **multiple channels of communication** to address the following key questions:

- Which synergies can be identified between different land uses and the provision of flood storage and ecosystem services?
- How can the knowledge base about advantages and potentials of NWRM, large scale flood retention and resilient cities be strengthened and their importance communicated to different actors at the local, regional and catchment levels?
- How can land owners be encouraged to adapt land uses and land management strategies which allow for increased water retention capacity?
- How can public and private stakeholders in urban and rural areas engage with each other to reduce flood damage through a comprehensive management plan based on the implementation of retention and resilience measures throughout the catchment?

Due to their complexity, the answers to these questions need to be addressed through a **transdisciplinary lens of various research disciplines** (such as spatial planning, water engineering, economics, law and property rights theory) so as to facilitate close cooperation and **knowledge co-creation with land owners, land users and other stakeholders**.

II) RELEVANCE AND TIMELINESS

In the summer of 2013, the estimated damage of river floods in Central Europe was approximately € 12,900 million. In 2002, the cost of flooding in this area was € 14,000 million. These events were not exceptions to the rule; floods are among the most expensive natural disasters (Munich Re 2014). The Intergovernmental Panel on Climate Change (IPCC) states – with great confidence – that future floods will likely be more frequent and intense. Therefore, river flood damage is most likely to substantially increase in Europe.

Usually, flood risk management deals with technical and hydrological issues first before addressing land management. This contrasts with the urgent need for flood retention and resilience on private land. Private property in Europe is constitutionally protected. Therefore, interventions on private land uses are complex, lengthy and expensive. The LAND4FLOOD Action **reverses the traditional perspective** and prioritises land users and land management in order to mitigate the risk of flood damage. The focus on “private” land is used deliberately to emphasize the tension between the **public interest** (on the catchment level) and the **private interest** (on the local scale). However, private land also includes public authorities acting as if they were private entities (e.g. land that is owned by a municipality in a floodplain can also count as private land, if it is not explicitly designated for a public purpose).

The current European Flood Risk Management Plan has created a window of opportunity for implementing new ideas. According to the FD, flood risk management plans need to be updated every six years. This is the first time the EU has mandated comprehensive, river basin-wide approaches for dealing with floods. These plans present an opportunity to implement new ideas and paradigms in flood risk management. Unfortunately, analyses of the first round of plans revealed that, due to governance obstacles (Newig et al. 2014) and other non-technical restrictions, the plans will fail to address land management issues on a river-basin level (Hartmann & Jüpner 2014). The LAND4FLOOD will be able to comprehensively address this lack and contribute positively by providing **land management schemes** that enable better implementation of land uses and land management for retention and resilience in river basins to the next round of flood risk management plans in 2021.

B) SPECIFIC OBJECTIVES

I) RESEARCH COORDINATION OBJECTIVES

The overall objective of the LAND4FLOOD is to connect transdisciplinary research with real world policy formulation and decision-making. By bringing together different scientific disciplines and involving multiple stakeholder groups the COST Action will make theoretical and practical knowledge available to support the implementation of flood risk reduction solutions on (private) land at the local, regional and catchment levels. This overall objectives shall be reached through the following actions:

- a. **Developing a multi-stakeholder knowledge exchange platform:** The mobilization of land for flood risk reduction demands a broad scientific and practical knowledge base. Building on a recently established network of academics and practitioners, this COST Action aims to build a comprehensive understanding of the interrelations between land and water in flood risk management by developing a multi-stakeholder knowledge exchange platform. To this end, the LAND4FLOOD brings together a broad spectrum of scientific disciplines and actively involves different actor groups with a practical stake in developing land-use based solutions in flood risk management. Among others, these include landowners and landowner representatives, practitioners such as water engineers as well as policy makers and non-governmental actors.
- b. **Promoting existing and new instruments for land use for flood risk management:** The limited access to private land represents the main obstacle for the implementation of measures such as NWRM which by increasing the retention capacity of the landscape can reduce flood risk. Although numerous theoretical instruments exist (administrative, market-based, compensation, legal, participation instruments), their integration into management strategies are strongly influenced by their institutional background (including legal system and political culture), in short the context strongly matters. The LAND4FLOOD deals primarily with the assessment of the practical applicability of particular instruments in different institutional contexts (authoritative vs. democratic, western European vs. post-socialistic, development vs. developing countries, common law vs. Romanian legal tradition), rather than with their theoretical foundations. The involvement of a large number of countries in the COST Action with different historical, economic and legal traditions represents a great opportunity for both sharing information and comparative studies on the use of instruments.

Establishing the basis for negotiation strategies between private land owners and public interests: Successful programs of measures to enhance flood retention capacities and

reduce downstream flood risks are hampered by the limited availability and accessibility of private land suitable for flood retention. Infringement of property rights and restrictions on land use as well as the lack of incentives for providing flood retention services are major obstacles for implementation. In order to better mobilize private land for flood retention all relevant actors need to have a better understanding of the rights of property owners and how sustainable flood risk reduction solutions can be achieved which do not infringe on these rights. Through annual workshops with a focus on output from the WGs in different regions, the LAND4FLOOD will promote a high degree of interaction between stakeholders and researchers.

II) CAPACITY-BUILDING OBJECTIVES

The LAND4FLOOD will meet the following capacity building objectives by:

- providing a platform and forum for the exchange of information and identification of **strategic research** needed for implementing retention and resilience measures on private land in flood risk management plans,
- encouraging **decision/policy makers** to take up new transdisciplinary knowledge that addresses correlations between flood damages and land use,
- raising awareness of **land owners** and with their direct support co-develop best practices of consensual NWRM implementation,
- supporting interdisciplinary education of **Early Career Investigators** (water engineers, environmental scientists, planners, economists, etc.) that will better reflect the interconnection of land and flood risk management. A large number of Early Career Investigators are directly involved in the Action,
- organizing **Short Term Scientific Missions** (STSMs) for Ph.D. students and post-docs,
- carefully balancing the **gender** representation and encouraging active participation of members from **inclusiveness** countries (as apparent from the Action itself),
- For more information, see specification of impacts in [chapter 2.2](#).

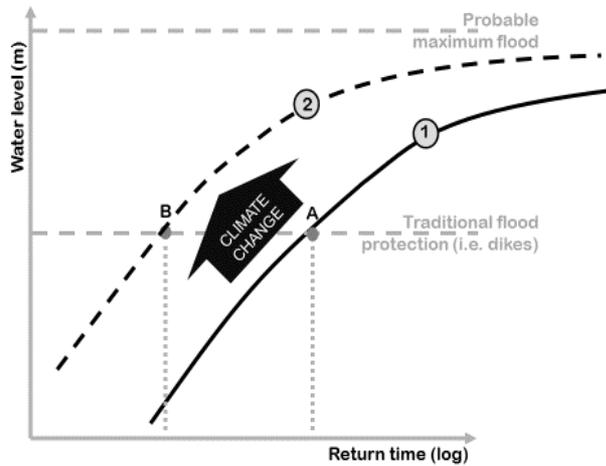
Most of the objectives will be achieved not only over the duration of the COST Action but also continue after the action is completed. There is a continuous need for dealing with flood risk strategies throughout both the EU and beyond and this need will be met through the network of researchers and stakeholders that will evolve through the action.

C) PROGRESS BEYOND THE STATE-OF-THE-ART AND INNOVATION POTENTIAL

I) DESCRIPTION OF THE STATE-OF-THE-ART

Since the 1990s, many countries in Europe have experienced several large inland floods that crossed borders of national states (such as the floods in 1993 and 1995 on the Rhine, in 1997 on the Oder and the Danube, and in 2002, 2006 and 2013 on the Elbe and the Danube). These floods were always caused by heavy rainfalls and usually started at the “hydrological” roof of Europe and continued downstream to the southeast or northern part of the European territory. Levees are the predominant and prevailing approach for alleviating the effects of large floods (Hartmann & Jüpner 2014). Levees protect and provide fertile and profitable riverside properties by keeping the water out (Petrow et al. 2006). As a result, they make many socio-economic activities along rivers possible. Nevertheless, levees protect only up to a specific design level. The sheer amount of damage in the past, the vulnerability, particularly in Europe, and the expected increase of future events all point to the need to pursue research that explores ways of coping with this increasing risk.

Figure 1: Flood return times



Statistically, floods of certain water levels return within particular periods of time (Figure 1, line 1) (Patt & Jüpner 2013). Return periods and their discharges are not static (Strobl 2006). Due to climate change, and also due to increasing urban development in riparian areas, there is a demand for heightened and strengthened levees (upstream), which will lead to increased discharge flows at a given point of the river and shorter return periods (Figure 1, line 2). The return period of the event for which a levee is designed decreases from [A] to [B]. This means that levees will overflow more often and that traditional flood

protection levels (measured in return time of floods) will decrease.

The **paradigm shift** from infrastructural flood protection to spatial flood risk management has been ongoing since the 90s (Moss & Monstadt 2008; Mostert & Junier 2009). The Netherlands and Germany played a key role in initiating that shift. The new paradigm is exemplified by the preference of the term “flood risk management” over “flood protection”, implying that protection should not be promised, but rather the risk of flooding should be managed (Begum et al. 2007). This represents a move away from the ideology that flood protection must guarantee the security of humans and economic values by defending against floods and ‘keeping the water out’. Instead, the emphasis has moved toward an ideology of managing flood risks (Johnson & Priest 2008). Water should no longer be excluded; rather, it should be ‘accommodated’ (Wesselink et al. 2007). This idea did not fit in with the working organization of water management because it was not prepared for catchment-wide planning of flood risk management. Levees are still regarded as the boundaries between water and land management. However, according to the new paradigm, levees are no longer boundaries or lines of defence in the ‘battle against the water’ (Wiering & Immink 2006).

Following this paradigm shift, the LAND4FLOOD directly supports the declared aims of the FD regarding the combination of green and grey infrastructure (by “giving rivers more space”) and the coordination of interests (flood risk management plan development).

II) PROGRESS BEYOND THE STATE-OF-THE-ART

No systematic transdisciplinary efforts to address the availability of “land for floods” in its complexity have so far been carried out (see [chapter 1.4.2.](#) for details).

The LAND4FLOOD not only fully reflects the paradigm shift described in the section above, but will also promote adoption of measures by including the perspective of **private land users in the development of flood risk management plans**. Water management in many European countries seeks to develop plans based on complete public ownership of the land to be used for flood risk management. While technical needs and requirements for land used in retention areas and polders justify this position (Schätzl & Hoffmann 2006), it also causes conflicts with land users (Reinhardt 2003). Negotiations over land acquisition often lengthens the time needed for the realization of a project and can also lead to legal disputes. The most common methods in use today by public authorities are freehand purchase, exchanges of land for requested sites or rural-land readjustment (UBA 2003). These methods can be expensive, time consuming and administratively complex (Reinhardt 2003). Expropriation is almost never used, although this instrument is important for water managers as a hypothetical possibility. Instruments of upstream-downstream trade-offs, such as inter-municipal (cross-border) cooperation or cost allocation schemes, are rarely considered.

Despite considerable efforts in flood risk management over the last few decades, the implementation of **measures which increase** retention throughout the catchment and

promote resilience in urban areas are still in their infancy, both in research and in practice (Knieling & Müller 2015, BBSR/BBR 2015, Begum et al. 2007). Most existing research initiatives on flood risk management focus on technical or hydrological aspects, forecasting, disaster management, or institutional governance. In fact, the lack of collaborative approaches with land users remains a major hurdle for flood risk management, a fact that has been confirmed in earlier research (Hartmann 2011). The LAND4FLOOD will lift the discussion on flood risk management by providing a **forum for stakeholders** including private property owners and public authorities to interact with experts within not only hydrology and land use planning but also legal experts and social scientists. This integrated form of dialogue and research will raise among others, issues related to whole catchment management, the use of NWRM on private land to provide public services, the multi-functionality of land area for temporary water storage and the development of tradable development rights to mitigate damage from floods.

III) INNOVATION IN TACKLING THE CHALLENGE

Usually, flood risk management assumes that property rights and land management issues are robust (unchangeable). From this perspective, the critical areas to focus on are technical issues, such as better forecasting, modelling, or disaster management.

Unlike previous research projects and initiatives, the LAND4FLOOD starts with the assumption that land use issues and land ownership are not independent of management plans but critical for them. This perspective has largely been neglected in research and in the practice of flood risk management. Land users are often regarded as mere recipients of flood risk management and not as key stakeholders. Putting them in a central position in working with management plans can lead to solutions for increased retention and resilience that would not be possible from the traditional perspective. New participation methods can be explored to implement flood resilience in cities or realize upstream retention, such as Payments for Ecosystem Services (PES) or Tradable Development Rights (TDR). This unique and innovative methodological and theoretical approach will enable the LAND4FLOOD to have a major impact on the field of research in flood risk management.

The strongest innovative potential of the LAND4FLOOD, however, is that cooperation and collaboration across disciplines will create new frontiers for solutions between water management, land use planning, law, and economics. In other words, it **interconnects previously isolated knowledge domains**. The proposed COST Action addresses flood risk management through various disciplinary contributions in catchment-wide land governance with multi-level perspectives that consider academic and practical aspects.

D) ADDED VALUE OF NETWORKING

I) IN RELATION TO THE CHALLENGE

The main aim of the LAND4FLOOD is to address the development and implementation of strategies for including flood retention and resilience on private land. This approach is on the cutting edge of contemporary debate. While there are many discussions about making space for the rivers and other successful individual projects, the LAND4FLOOD turns the traditional paradigm of retention and resilience around by focusing on the land user's perspective. The COST Action network has the following main functions:

1. **Promote an interdisciplinary understanding of land for flood risk management:** To combine the relevant disciplines in an exchange of concepts and ideas. This is important because the topic affects the fields of soil science, agriculture, forestry, landscape ecology, hydrology, civil engineering, spatial planning, law and property rights, economy, policy science and others. Creating a forum for exchanging these disciplinary perspectives is essential to establish the new approach to flood retention and resilience because, alone, each discipline lacks essential knowledge and skills (i.e. water engineering needs to be complemented with land use planning; property theory and economics need to be combined with law, etc.).

2. **Increased actor involvement:** To establish a forum and network for discussion and communication between stakeholders and researchers of results relevant for catchment flood risk management, including those that cross-administrative borders. Most large rivers (particularly in Europe) cross borders and therefore require concepts of flood risk management that work across these boundaries. To achieve this, scholars from different countries (or rather catchments) must be able to collaborate. Among these catchments, not only are institutional contexts different (e.g. spatial planning) but also hydrological conditions and economic circumstances. Networking will serve to develop concepts for flood retention and resilience that are applicable all across Europe (and beyond). Practical experiences of stakeholders involved will support contextual issues in the debate.

Applicability in different legal contexts: In addition to integrating research on flood retention and resilience across Europe with a focus on interdisciplinary approaches, the participation of non-European partners (from the USA and Australia) will help to improve the relevance of the activities for large common law countries outside of Europe. Particularly as the participants from the USA and Australia are property rights experts and specialists in environmental and water law.

II) IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

Currently, there is **no COST Action with a focus on floods** (or natural disasters in general). Many recent research projects on floods span only a few research disciplines (STARFLOOD focused on governance and law; FLOODPROBE's and SMARTeST predominantly focused technologies) or did not address large floods in particular (e.g. CORFU focused on resilience and the urban realm instead of the retention aspect of large floods). Furthermore, PRO-FLOODPLAIN evaluates the effectiveness and efficiency of enlarging floodplains on large rivers as a non-structural measure of flood risk reduction. RIMAX (a German research initiative addressing many aspects of flood risk management including long-term change and the effectiveness and efficiency of near-natural controlled flood polders) and FLOODCHANGE deal predominantly with early warnings systems, forecasting, and operational flood management as well as with other conventional flood protection. 'Freude am Fluss' and also CORFU address the collaborative aspect of flood resilience. LABEL, the predecessor of ELLA, focused on legal and planning instruments as well as risk mapping also considering transnational collaboration along the Elbe (similar to FLOODWISE). SUFRI (Sustainable Strategies of Urban Risk Management) focuses on floods on small and medium rivers in urban areas.

The LAND4FLOOD addresses large inland floods with a strong emphasis on cross-border areas (this is why flash and coastal floods are not the main focus). Also, the COST Action focuses on transdisciplinary approaches. It gathers together perspectives from the fields of economics, law, spatial planning, water engineering, and property right theory, elements that have not extensively been included in the previously mentioned projects. Further, it emphasizes the active role of stakeholders (with special focus on land owners) in all planned activities.

2) IMPACT

A) EXPECTED IMPACT

The primary expected impact of the LAND4FLOOD is a raised awareness among private land owners, policy makers, regulatory bodies, national decision makers and the scientific community about the benefits of using private land as part of a holistic flood management strategy. The key impact will be a paradigm shift in flood management away from over-reliance on grey infrastructure solutions towards a greater reliance on green infrastructure which takes advantage of the water storage potential on private land.

I) SHORT-TERM AND LONG-TERM SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS

The following long-term impacts of the LAND4FLOOD are expected:

Reduction of flood damages: The LAND4FLOOD makes an important contribution to solving a pressing societal problem through development of novel arrangements for reducing the socioeconomic consequences of floods. As such, the proposed action links directly to FD requirements and redevelopment of flood risk management plans in 2021. This has clear relevance for river basins throughout all of Europe.

Awareness raising: Private landowners, all levels of government, NGOs and water engineers will be made aware of the potential for mobilizing private land for flood risk management. Such awareness is a necessary precondition for further dialog and implementation of institutional, engineering and land use measures.

New use of water engineering: The LAND4FLOOD will promote smarter, more resilient use of grey infrastructure (dams, mobile barriers, etc.) by embedding them in a more holistic approach to flood risk management. By strongly focusing on land management and the property owner's perspective, the use of traditional grey infrastructure will be complemented by the strong land management perspective.

Transdisciplinary knowledge creation: The LAND4FLOOD addresses the challenge of how to make land for flood risk management available through various disciplinary contributions to catchment-wide land governance with a multi-level perspective considering both practical and academic aspects. The proposed action synthesizes insight from the fields of soil science, hydrology, civil engineering, spatial planning, law and property rights, economy, policy science and others. The proposed action develops a novel and much-needed transdisciplinary approach to flood risk management focussing on the key role of land governance and private sector engagement.

Whereas the aforementioned impacts are mainly long-term, the LAND4FLOOD also has more direct and short-term effects, both practically and scientifically:

Common research agenda: The synergies between disciplines leads in the short-term to more effective and efficient research and finally better practical implementation of its results. A first step towards such a common research agenda is the special issue on "Land for Flood Risk Management" in the Journal of Flood Risk Management that is currently being produced by some of the members of the network.

Transdisciplinary knowledge production: By bringing together stakeholders and practitioners, the COST Action contributes towards the co-creation of scientific and practical knowledge, which may be immediately relevant for developing novel instruments for the mobilisation of e.g. flood retention services on private land.

B) MEASURES TO MAXIMISE IMPACT

I) PLAN FOR INVOLVING THE MOST RELEVANT STAKEHOLDERS

In order to realize the long-term and short-term impact, different groups of stakeholders are involved in various ways with different aims, such as:

- Policymakers and NGOs (on the national and international level)
- Land owners and land users (in affected cities and in potential retention areas)
- Water management and water engineers (associations)
- Academics in various disciplines

The table below shows different types of stakeholders that have an interest in the LAND4FLOOD and describes their potential involvement. The Action will also invite ad-hoc participants to contribute to planned activities (a conference, workshops, training school) etc.

Stakeholders group	Aim of involvement	Type of participation	Targeted stakeholders
Policymakers and NGOs			
Short-term	Get input from governance arena	Participation at workshops and the conference Providing feedback on instruments	OECD Water Governance Initiative Baltic Environmental Forum (BEF)
Long-term	Disseminate flood+land approach	Policy brief & policy advice Publication in specialized EU journals	Centre Européen de Prévention du Risque inondation (CEPRI) International River Commissions (Rhine, Elbe, Odra, Maas, Danube) City councils and local representatives
Land owners			
Short-term	Knowledge co-development	Demonstrator descriptions Feedback on instruments Participation at workshops	European Landowners' Organization (ELO) Civil Initiatives Farmers' associations
Long-term	Raise awareness	Newsletter distribution Press releases Guide to implementation and best practices	
Water engineers			
Short-term	Raise the issue of land	Practitioner workshops & action research	German Flood Competence Centre
Long-term	Educate land management in FRM	Policy brief (IWRA) Guide to best practices for grey green infrastructures	NWRM network Int. Water Resources Association (IWRA)
Academics			
Short-term	Research agenda coordination	Special sessions at int. conferences	Association of European Schools of Planning
Long-term	Reflect & disseminate research	Special Issues & book publication	Int. Ac. Ass. on Planning, Law and Prop. Rights Int. Water Resource Association European Society for Ecol. Econ. European Forest Institute (EFI)

II) DISSEMINATION AND/OR EXPLOITATION PLAN

The LAND4FLOOD addresses the pertinent challenge of how to better mobilise land for flood risk reduction measures by bringing together different scientific disciplines, policy and decision makers and other stakeholder groups.

To this end the LAND4FLOOD will use different means of communication and dissemination to specifically address the needs of the key target groups.

Means of Communication and Dissemination	Researchers	Policy-Makers and NGOs	Water engineers, landowners and other stakeholder groups
Action website+Newsletters	x	x	x
Special issues	x	x	
Book	x	x	x
Policy Briefs		x	x
Stakeholder Workshops		x	x
Guidance doc.+ Final report	x	x	x

As a **general information channel** an Action website will be set up. The website will incorporate success stories related to flood risk reduction through mobilization of private land, guidance on best practices, and a forum for dialog amongst the network of researchers and practitioners. All Action's outputs (newsletters, papers, reports, policy briefs) will be published here and distributed through an email list of followers. The COST Action logo and the unified templates will be developed in order to build up the easily recognized identity of the Action and the network.

Regarding the dissemination of findings within the scientific community the Action plans two **special issues** in peer-reviewed research journals. The first special issue (in the Journal of Flood Risk Management) is in progress. The second is planned with Water International. Papers published in Water International will also be presented in a Webinar in collaboration with International Water Resource Association (IWRA).

An **Action's book** will document and reflect on large-scale demonstrators of land for flood risk reduction solutions where each case will be discussed from both a practical and a theoretical perspective. The book targets a wide audience with an interest in the issue of land and flood risk management.

National decision-makers and water management agencies responsible for developing flood risk management plans will be specifically targeted through at least two **policy briefs**.

As the LAND4FLOOD aims for the active involvement of different stakeholder groups, in total three **stakeholder workshops** will be conducted, each focusing on a specific issue of land and flood risk. These workshops will be documented in short reports which will be made available to all participants.

The main findings of the LAND4FLOOD will be documented in a **final report and a guidance document** of best practices. These will be made available for stakeholders and policy-makers (both online and in print) at the end of the COST Action.

C) POTENTIAL FOR INNOVATION VERSUS RISK LEVEL

I) POTENTIAL FOR SCIENTIFIC, TECHNOLOGICAL AND/OR SOCIOECONOMIC INNOVATION BREAKTHROUGHS

The LAND4FLOOD has a high potential for socioeconomic and technological breakthroughs with a minimal level of risk. The main breakthrough accomplished by the action will be an increased awareness of the potential to mobilize private land for flood risk management. Increased awareness is a necessary precondition for increased uptake and consequent reductions in flood damage. The proposed action is in line with current research which clearly shows that providing more space for water retention and runoff storage is a guiding principle of modern flood risk management policies. In addition to attenuating and/or delaying flood peaks and thus reducing downstream flood risk, enhanced retention capacity can deliver multiple benefits including improvements in water quality, biodiversity and/or recreational opportunities. However, changing the hydrological functioning of the landscape so as to reduce flood risk requires changes in land use and land management, which will infringe on existing rights to land use and property.

The different legal and institutional backgrounds relating to e.g. land use and property rights provides a considerable level of risk with regard to the **transferability of results**. While certain instruments may be suitable to mobilise land for flood risk reduction in some countries, these same instruments may prove ineffective in different administrative and legal contexts. This lack of transferability will be considered by striving for a broad applicability of results, e.g. by developing generic approaches of land mobilisation rather than focusing on legal measures that are particular to national settings.

3) IMPLEMENTATION

A) DESCRIPTION OF THE WORK PLAN

I) DESCRIPTION OF WORKING GROUPS

To design and implement the portfolio of measures needed to reduce flood risk requires a better understanding of the relationship between land management effects on catchment-scale hydrological functioning, property rights and instruments for mobilization of actions on private land.

The LAND4FLOOD will address this need in a transdisciplinary manner through three thematic working groups (WGs) where new knowledge is co-created by scientists and stakeholders. All WGs will work in parallel sharing results of their work directly with the other WGs through cross-participation of WG members and through the COST Action coordination.

WG1 – **RETENTION and FLOWS: the effects of land on catchment-scale hydrology:**

A comprehensive understanding of the effects of land use and land management on local and catchment-scale hydrology is needed to support programs of measures, which make use of private land to reduce downstream flood risk. The hydrologic and hydraulic expertise underlying grey infrastructure solutions for local-scale flood risk reduction is thoroughly documented and well understood. However, this expertise is incompletely integrated with the knowledge base on green infrastructures for water retention and flood risk reduction. Furthermore, a unified framework supporting local-scale decision-making about green and grey infrastructure potential for flood risk reduction is lacking. More critically, our understanding of the aggregate impact of local-scale land use decisions on catchment-scale flood risk is fragmented and in large part lacking.

Tasks of WG1 will be:

- synthesise current knowledge on green and grey infrastructure local-scale flood risk reduction
- identify knowledge gaps concerning hydrologic and hydraulic consequences of local-scale land management on catchment-scale flood risk reduction
- develop a more comprehensive understanding of the role of land use on flood risk and the potential for enhancing retention capacity at a range of spatial scales ranging from individual property parcels to large catchments
- develop the evidence base needed to support decision makers responsible for flood risk management
- provide guidance related to hydrologic and hydraulic best practices for flooding of private land so as to reduce downstream flood risk

Deliverables:

D1.1: Policy Brief on Grey vs. Green Infrastructure

D1.2: Book on large-scale demonstrators (M18)

D1.3: Workshop with policymakers and water engineers on interconnections of land and flood risk + Workshop report (M24)

D1.4: Guidance document identifying best practices for land management targeting downstream flood risk reduction (M33)

WG2 – RETENTION and LAND: property rights and land use in river catchments:

Increasing the flood retention capacities of river catchments demands a better understanding of the types of land uses prevailing along rivers as well as of the ownership structure of land suitable for flood retention. Despite the strong public interest to increase retention capacities i.e. in order to better protect settlements and economic assets, surprisingly little is known about the land-related conditions that enable the provision of flood retention services for the downstream benefit. In particular scientific knowledge is fragmented concerning landownership of potential flooding land, the organisation of property and land use rights in catchments as well as the regulation of retention services in different legal contexts.

Based on the different legal backgrounds of the partners involved in LAND4FLOOD, WG2 tasks will be:

- develop an overview of the types of land uses (and the correlating structure of land ownership) for different flood risk reduction measures
- analyse the tension between the collective interest to increase flood retention capacities and the private interest to limit the infringement on individual property rights
- share developed transdisciplinary knowledge with young scholars

Deliverables:

D2.1: Special Issue with the Journal of Flood Risk Management (M12)

D2.2: Workshop with policymakers and landowners + Workshop report (M18)

D2.3: Policy brief on the role of land for flood risk reduction (M20)

WG3 – RETENTION and INSTRUMENTS: mobilizing private land for flood retention services:

Successful programs of measures to enhance flood retention capacities and reduce downstream flood risks are hampered by the limited availability and accessibility of private land suitable for flood retention. In order to better mobilize private land for flood retention all relevant actors need to have a better understanding of the rights of property owners and how sustainable flood risk reduction solutions can be achieved which do not infringe on these rights. WG3 aims to develop a comprehensive set of instruments for the mobilization of private land for flood retention.

Tasks of WG3 will be:

- classification of available instruments (administrative, market-based, compensation, legal, participatory)
- assessment and comparison of practical applicability of instruments in different institutional contexts
- recommendation for policy-makers in terms of future policy pathways

Deliverables:

D3.1: Workshop on instruments – practical experiences worldwide + Workshop report (M8)

D3.2: Special Issue with the Water International (M24)

D3.3: IWRA Policy Brief (M26)

COST Action Coordination:

Coordination activities are undertaken by the Steering Committee (SC) of the COST Action throughout its entire duration. These involve the following actions: web-site development, newsletter production, annual report development, MC meeting organizations and the organization of the final conference (about 200-250 people). Also, the final report for stakeholders and policy-makers will be coordinated by the SC.

II) GANTT DIAGRAM

In the diagram, milestones for particular deliverables are inserted.

Quarter of the year	III 2017	IV 2017	I 2018	II 2018	III 2018	IV 2018	I 2019	II 2019	III 2019	IV 2019	I 2020	II 2020	III 2020	IV 2020	I 2021	II 2021	III 2021
Action Coordination / Networking Tools																	
MEETINGS/CONFERENCE	Kick Off	MC Meeting	MC Meeting				MC Meeting				MC Meeting			MC +Final Conference			
Webpage		→															
Newsletters			→				→				→					→	
STSMs			→														
Training School										→							
Progress Reports																	
WG1: RETENTION and FLOWS																	
D1.1 Policy Brief		→															
D1.2 Book									→								
D1.3 WG Meetings/Workshop		WG meet		WG meet			Workshop+report				WG meet						
D1.4 Guidance document													→		WG meet		
WG2: RETENTION and LAND																	
D2.1 Special Issue			→														
D2.2 WG meetings/Workshop		WG meet		Workshop+report			WG meet				WG meet			WG meet			
D2.3 Policy brief							→										
WG3: RETENTION and INSTRUMENTS																	
D3.1 WG meetings/Worshop		WG meet	WG meet				WG meet						Workshop+report	WG meet			
D3.2 Special Issue														→			
D3.3 IWRA Policy Brief																	→

III) PERT CHART (OPTIONAL)

IV) RISK AND CONTINGENCY PLANS

Risk No. 1: Delays in the development of special issues (due to standardized journal procedures). To avoid this risk, timely communication with the journal editors will be pursued. The development of special issues must respect the good practice of a two-round approval, reviewing, etc. The key guest editor(s) of special issues needs to be established to push the work further.

Risk No. 2: Low number of stakeholder participants for workshops and the conference. This risk has been addressed by the direct participation of some NGOs and field expert partners in the LAND4FLOOD consortium. Also, other academic members do have direct connection to associations and policymakers listed in [chapter 2.2.1](#). Moreover, the COST Action builds on the existing network of researchers and practitioners as a basis for mobilising participants.

Risk No. 3: Low number of early career investigators/students interested in the training school and exchange programs. To avoid this risk, a good dissemination of invitations among potential candidates is necessary – the structure of the consortium (mostly researchers teaching at universities) helps to lower this risk through the direct access to potential participants. Also, there are more than dozen of early career investigators directly participating in the LAND4FLOOD consortium.

In order to avoid all risks, the COST Action activities will be carefully monitored against planned objectives, deliverables and milestones. Internal evaluation processes will be established and the Management Committee will control the progress.

B) MANAGEMENT STRUCTURES AND PROCEDURES

Management structures and procedures of the LAND4FLOOD are organized through the activity of the Management Committee - MC (consisting of all participants) and 3 WGs.

The MC is responsible for the development of the COST Action structures – such as the Core Group (CG) consisting of the Action Chair, Vice Chair and the Grant Holder of the Action, WG Leaders and co-Leaders, *ad hoc* participants, webmaster etc. The MC is also responsible for the development of Progress Reports according to COST forms. The MC is collectively

responsible for the successful fulfilment of the Action tasks and it makes decisions on annual activity plans, the budget, etc.

The Core Group takes care of:

- Development of communication channels among its members (via on-line meetings/calls, twice a year) and
- Coordination of the Action, such as the creation of the annual activity plan (in line with the approved Action's proposal)
- Creation and update of the COST Action web-page through cooperation with the webmaster

The Grant Holder is responsible for proper budget allocation with respect to planned activities and deliverables. He/she also supports the communication of the Action Chair and Vice Chair with the MC.

WG Leaders: a) organize the progress within a WG based on the approved annual activity plan, b) develop annual activity reports of their respective WG, c) collaborate with other WG chairs, d) propose *ad hoc* participants, e) update the Action web-site and undertake other dissemination activities.

C) NETWORK AS A WHOLE

The LAND4FLOOD will be managed by the experienced university team from the Czech Republic – this will further support the development of research and coordination capacities in an **inclusiveness country** (usually inclusiveness partners within COST Actions formally participate but they have factual problems with active involvements in particular activities).

The LAND4FLOOD consortium is represented by more than 30 participants from 20 COST Countries, 2 near-neighbouring countries and 2 IPCs. **Women** represent 48 % of participants. There are 17 **early career investigators** directly involved in the network. About 50 % of participants come from **inclusiveness countries**.

The participants represent the **critical mass** needed to address cross-border challenges of large floods in Europe and neighbouring countries. The intention is to actively invite more representatives from **Near Neighbouring Countries** that are currently underrepresented within the Network.

The LAND4FLOOD participants cover a wide range of scientific backgrounds, such as spatial planning, water engineering, economics, sociology, social geography, law, and policy sciences. However, the consortium includes **not just people from universities** and research organizations but also involves NGOs, business enterprises and local government organizations. Therefore, the network is fully capable of undertaking a transdisciplinary Action and integrating different types of knowledge. In the future, the goal is to further enlarge the number of non-university participants in the network.

MUTUAL BENEFITS with IPCs: Within the COST Action, participants from the **USA and Australia** are involved. The benefit for the European research community is access to the IPCs' legal expertise in water and environmental law and property rights theory. These partners also represent an important contribution from large common law countries with a strong property right focus. On the other hand, IPCs appreciate learning about the European approach to flood risk management (particularly the European Flood Directive). The academic exchange of cross-continental perspectives is mutually beneficial.

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