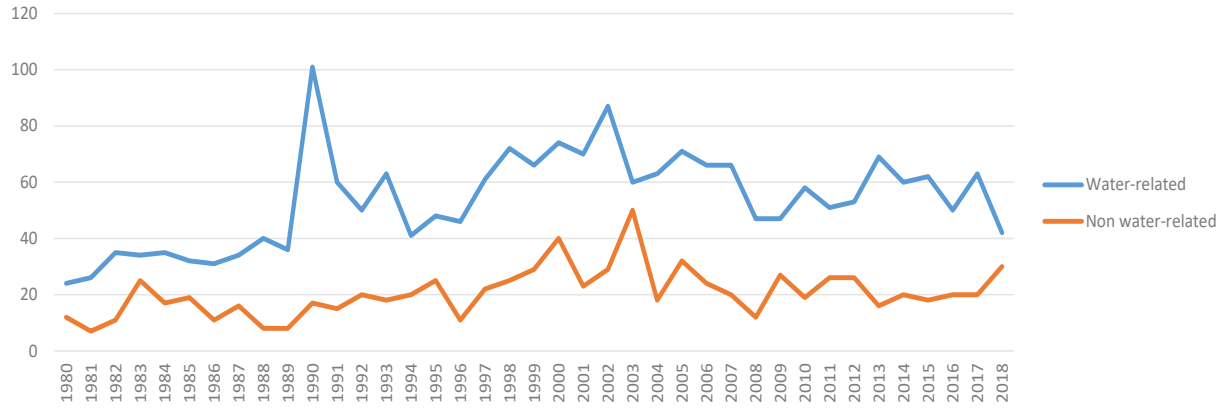
5. Managing water risks and disasters

This chapter presents Adherents' experience with the management of water risks and disasters, in line with the OECD Recommendation on Water. The chapter explores how Adherents manage water risks and disasters in a cooperative way. It highlights examples of risk assessment and awareness raising efforts carried out by Adherents, as well as setting and revising acceptable levels of water risks. It also explores prevention and mitigation, and emergency responses measures. It includes investment in social policies and financial mechanisms to minimise disruption, while ensuring transparency, accountability and public awareness in decision-making. It describes progress in policy coherence across sectors. Finally, the chapter focuses on water risks related to climate change in agriculture and cities.

Every year, water-related disasters such as tropical storms, floods and droughts account for the majority of disasters that take lives, destroy property and cripple livelihoods (Figure 5.1). The number of people at risk from water-related disasters is projected to increase from 1.2 billion to 1.6 billion over the next 30 years (OECD, 2019[1]). This will represent around 20% of the world population. While the majority of these people live in developing economies, the value of economic assets at risk is concentrated in OECD members.

Figure 5.1. Number of water-related and non-water-related disasters in OECD countries



Source: EM-DAT; The OFDA/CRED International Disaster Database, - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium.

The Recommendation calls on Adherents to "manage water risks and disasters in a co-operative way, adopt and review a water risk management policy as an all-hazards approach to country risk governance" (OECD, 2016[2]). Adherents have made steady progress in preparing for water-related disasters by investing in risk assessments, risk awareness, prevention and mitigation measures, and emergency response capabilities. For Adherents that are members of the **European Union**, many of these actions were already given priority pursuant to national implementation of the European Floods Directive, which has been effective since 2007. Other Adherents have established national risk management frameworks that respond to and that take into account of all aspects of water risk management. An overview of recent trends in water related disasters substantiates the need for Adherents to sustain, and in some cases increase, these efforts.

5.1. Managing water risks and disasters in a cooperative way

Cooperation in managing water-related risks and disasters is essential as river basins frequently transcend national borders. The risks and challenges associated with river basin flood management are increasingly shared amongst neighbouring countries. The 2019 OECD Implementation Survey indicates that a vast majority of responding Adherents share monitoring data and information on water levels, flow rates and water quality as means to map and forecast transboundary risks. A smaller number share water management plans or develop joint emergency water management procedures and exercises. Some Adherents even have experience with co-financing structural disaster risk reduction measures. Other forms of cooperation include bilateral conventions and exchange platforms in place for maritime pollution emergencies.

Experience, in particular in Europe, illustrates good practices in cooperation for the management of water-related risks and disasters. The Convention on the Protection of the Rhine establishes international cooperation between France, Germany, Luxembourg, Netherlands, Switzerland and the European Union, including on joint flood prevention and protection measures. Parties to the Convention typically share

information on actions taken in their territory to protect the Rhine. In the event of incidents or accidents that might threaten water quality or in the event of imminent flooding, parties inform the Commission and the Contracting Parties likely to be affected in accordance with the warning alert plans.

The United States and Canada have adopted numerous agreements dealing with water management. The Columbia River Treaty, for example, required Canada to build three hydroelectric dams. In return, Canada received 50% of the electricity generation and payment for increased flood control benefits from the United States. Similarly, water is one of the defining issues in the relationship between the US and Mexico as the two countries share three catchments – the Rio Grande, Colorado River and the Tijuana River. While much of the focus of the cooperation has been on allocating water resources, infrastructure construction and water quality, a trend towards a more holistic and integrated approach to water management has emerged more recently, particularly with respect to the environmental health of the river basins.

The overall challenge that impedes cooperation consists in the numerous jurisdictional layers and a variety of policies on water-related risks. Nonetheless, advancing synergies arising from cooperation offers unique opportunities to enhance the efficiency and effectives of plans and programmes.

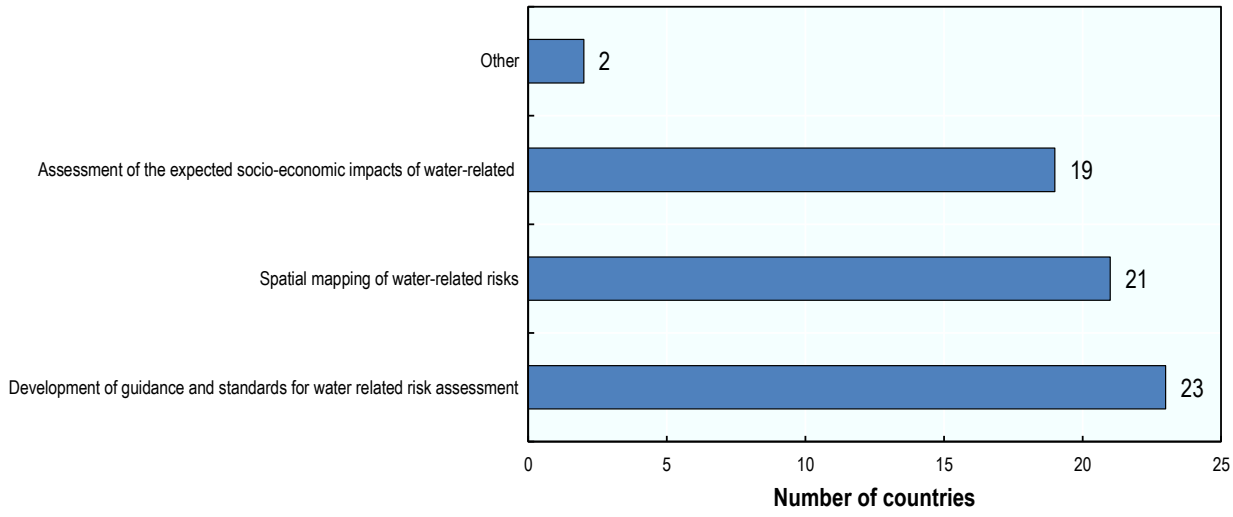
5.2. Risk assessment

Given the inherent uncertainty in the location, timing, severity and impacts of water related hazards, Adherents to the Recommendation should invest in “risk assessment to help prioritise disaster risk reduction, emergency management capabilities and the design of financial protection strategies (which are used to manage the financial impact of disasters, ensure adequate capacity to manage and mitigate the costs of disaster risk, thereby reducing the financial burden and economic costs of disasters and enabling rapid recovery in economic activity). Depending on issues at stake risk assessment could take account of private responses (adaptation) to risk and reactions to disasters (response)”.

Adherents use risk assessments to provide a scientific basis for a wide range of public decisions including: where to develop new communities or expand existing ones; prioritising what communities to protect in a floodplain and which communities to relocate; identifying individual properties to notify about exposure and targeting programmes to increase their resistance and resilience; supporting development of flood detection, forecasting and warning systems; designing emergency response and recovery plans; and calculating potential damages to design insurance programmes that spread risk and accelerate recovery (OECD, 2018[3]).

The majority of responding Adherents have taken multiple steps to improve the accuracy, comparability and utility of sub-national water-related risk assessments. Figure 5.2 shows that 85% of respondents developed guidance and standards to assess water-related risks. It also indicates 78% have undertaken spatial mapping of water-related risks. In **Switzerland**, the federal law obliges cantons and communities to establish hazard maps for a range of natural perils, including floods (OECD, 2018[3]). Adherents use spatial mapping for many purposes, for example to identify water related infrastructure and public services exposed to flood risks. In the **United Kingdom** over 55% of water and sewage pumping stations/treatment works are in flood risk areas, with 34% at significant risk. Among the identified good practices for Adherents to learn from, **Portugal** has completed a flood risk and vulnerability mapping exercise that considers the potential impact of various climate change scenarios.

Figure 5.2. Actions taken to assess water-related risks

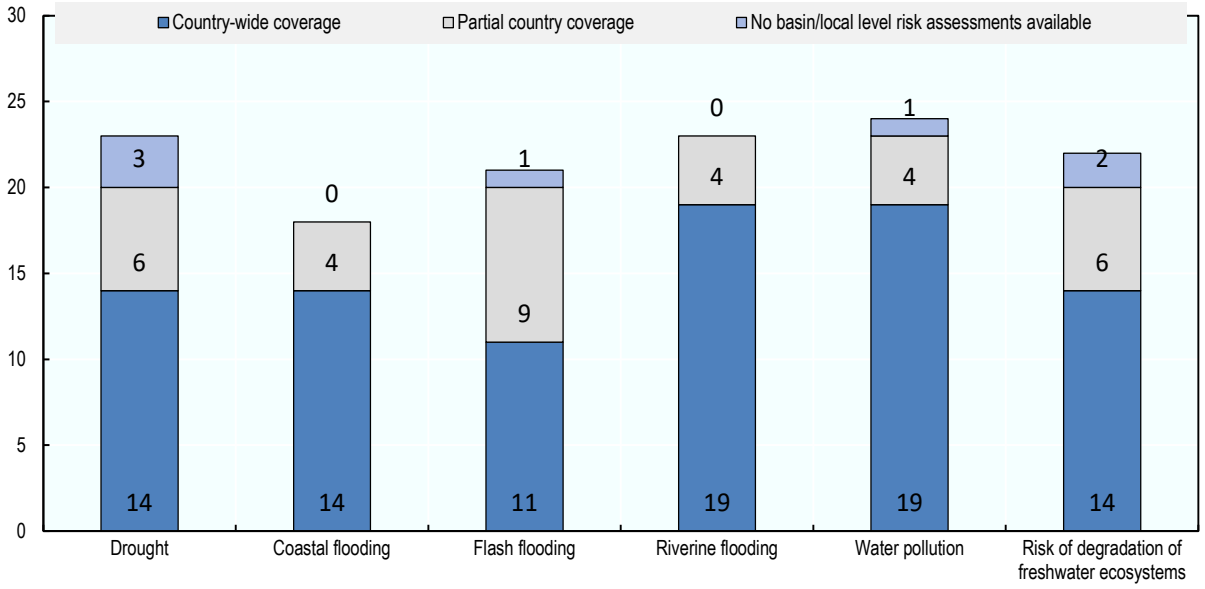


Note: Responses to question: "To assess water-related risks, which of the following tasks have been undertaken?". Multiple responses were possible.
Source: 2019 survey on the implementation of the OECD Council Recommendation on Water; 27 responses received, including 26 Adherents.

Indeed flood risk is likely to increase among many Adherents due to climate change and continued development in hazard prone areas. 70% of respondents have assessed socio-economic impacts of water related risks. In England the expected annual damages to residential and non-residential properties at risk from flooding from rivers and the sea, including hospitals and schools, is over USD 1.2 billion. Already in the **United Kingdom** the national flood risk assessment shows there are 2.4 million properties at risk from flooding from rivers and the sea in England, with more exposed to surface water than other forms of flooding (UK Environment Agency, 2009[4]).

Figure 5.3 indicates a higher number of respondents conduct risk assessments at basin and local levels for river floods and water pollution. This reflects the relatively high frequency of river floods compared to coastal floods, and daily public health risks that polluted drinking water poses. The economic and environmental impacts of coastal floods, however, should not be overlooked. Coastal concentrations of populations, trade infrastructure, tourism and petro-chemical industries underscore the need for coastal risk assessments. Surprisingly, some Adherents with coastlines report that they do not conduct coastal flood risk assessments.

Figure 5.3. Coverage of risk assessments at the basin/local level



Note: Responses to question: "What is the coverage of risk assessments at the basin/local level?".
Source: 2019 survey on the implementation of the OECD Council Recommendation on Water; 27 responses received, including 26 Adherents.

Different institutions are responsible for conducting the risk assessments for different types of water related risks. In most Adherents, hydrometeorological hazards such as hurricanes, typhoons and river floods are not conducted by the same departments responsible for risks related to water-quality. Some countries like **Japan** and **Finland** have government departments that assess all water-related risks. In Ireland, Met Éireann (DHPLG) in collaboration with the Office of Public Works (OPW), which is lead agency for flood risk management, is currently establishing a National Flood Forecasting and Warnings Service to forecast for fluvial and coastal floods, and DHPLG would co-ordinate the response to larger flood events. The diversity of risk ownership for water related risks, even within the same institution, can lead to analytical silos. An identified good practice is for governments to conduct integrated approaches whereby one type of water related risk, such as a coastal or river flood, could also provoke a different type of water related risk, such as water pollution. Most Adherents now use all-hazards "National risk assessments" to promote a coordinated, whole of government approach to identify sequencing between different types of hazardous events. Several Adherents use these tools to inform decisions on prioritization of investments in disaster risk reduction (OECD, 2018[3]).

5.2.1. Financial protection strategies

A key use of risk assessment is to inform the design of financial protection strategies for water-related risks. Private insurance companies provide coverage both for flood damage and liability for water pollution. In most Adherents, insurance protection against flood risk is offered as an optional add-on to standard property policies, either as a single peril or in combination with other disaster risks. In **Japan** and **Turkey**, for example, flood coverage is included in standard residential property policies. In **Switzerland**, it is mandatory in 22 cantons to provide insurance coverage for residential and commercial buildings against a number of natural disasters. Flood insurance for residential properties has only recently become available in **Canada** and the **Netherlands** (OECD, 2016[5]).

In some Adherents, the public sector provides financial backing for the insurance coverage of flood risk, either as a direct insurer or as a reinsurer for properties. In France, reinsurance for all-natural disaster risks

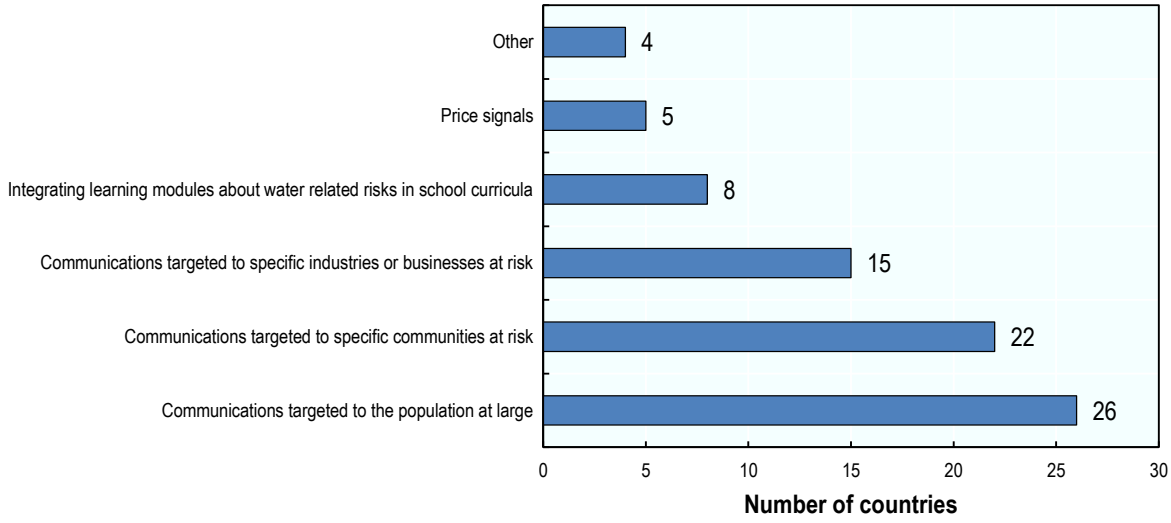
is provided by the Caisse central de réassurance (CCR) for up to 50% of the losses. In the case of Spain, the Consorcio de Compensación de Seguros (CCS) [1] provides direct insurance for flood (and other catastrophe risks) as a mandatory extension to property, life, and personal accident policies issued by private companies which leads to a relatively high-level of insurance coverage for flood risk among businesses and households in Spain. CCS is recognised in Europe as an example of good management of catastrophe risks that enables strong co-operation between public authorities with responsibilities for flood risk management. In Korea, a public scheme (operated by a private insurance company) provides coverage for storm and flood risk to residential properties. In the United States, the National Flood Insurance Program (NFIP) offers direct flood insurance (OECD, 2016[5]).

Compensation, insurance and income-smoothing policies to cope with droughts in agriculture is another area in which one can observe significant differences, as seen when comparing **Australia**, **Canada** and **France** (OECD, 2016[6]). **Canada** has risk management instruments that provide compensation for farmers' reduced margins, with respect to their individual records, irrespective of the cause, including reduced harvests caused by droughts. It also has a multi-peril crop insurance program that compensates for reduced yields caused by drought. **France** has a subsidised insurance system that indemnifies farmers for reduced yields caused by a range of climatic events including droughts. When available in certain countries, insurance provides risk-sharing and risk-transfer means for drought risks, but only for farmers relying on precipitation (rainfed). None of the three countries provides compensation for water shortages. In Canada, France, and to some extent **Australia** there are also instruments available to farmers to smooth their revenues across time as an element of the risk management toolbox. However, the design, policy mix, and degree of public support to these time smoothing instruments vary a great deal across countries: ex ante subsidised precautionary saving tools for risk management purpose (**Canada**, **France**); income tax smoothing schemes with or without subsidies (**Australia**, **Canada**, **France**); or ex post subsidised interest rates to refinance farms in circumstances of natural disaster (**Australia**, **France**) (OECD, 2016[6]).

5.3. Risk awareness

The Recommendation calls on Adherents to invest in *"*risk awareness of population, communities and business exposed or affected". Figure 5.4 shows that all respondents consider addressing the population at large to be a key action to raise awareness for water-related risks.

Figure 5.4. Actions to raise awareness of exposure to water-related risks



Note: Responses to question: "What actions has your country taken to raise awareness of exposure to water-related risks?". Multiple responses were possible.
Source: 2019 survey on the implementation of the OECD Council Recommendation on Water; 27 responses received, including 26 Adherents.

Based on the results of the 2019 OECD Implementation Survey, almost all responding Adherents communicate about risks with specific communities at risk, whereas 56% focus on industries or businesses at risk in order to minimise possible disruptions. Considerably less, only 30% of Adherents, integrate learning modules about water related risk in school curricula. This practice is followed in **Austria, Ireland, the Slovak Republic** and the **Republic of Korea**. Price signals, such as abstraction charges reflecting water scarcity risks, is implemented by less than 20% of Adherents.

Various types of flood risk awareness raising campaigns are implemented to more closely align risk perception with current scientific knowledge. In **the United Kingdom** residents can obtain by email the flooding history for any property based on Environment Agency records. This service is provided free of charge unless it takes more than 18 hours to compile. Efforts are being made to make scientific knowledge more accessible to the general public. In **France,** river festivals attended by tens of thousands include interactive games, cultural and historical presentations to increase public attention to flood risk information (OECD, 2014[7]).

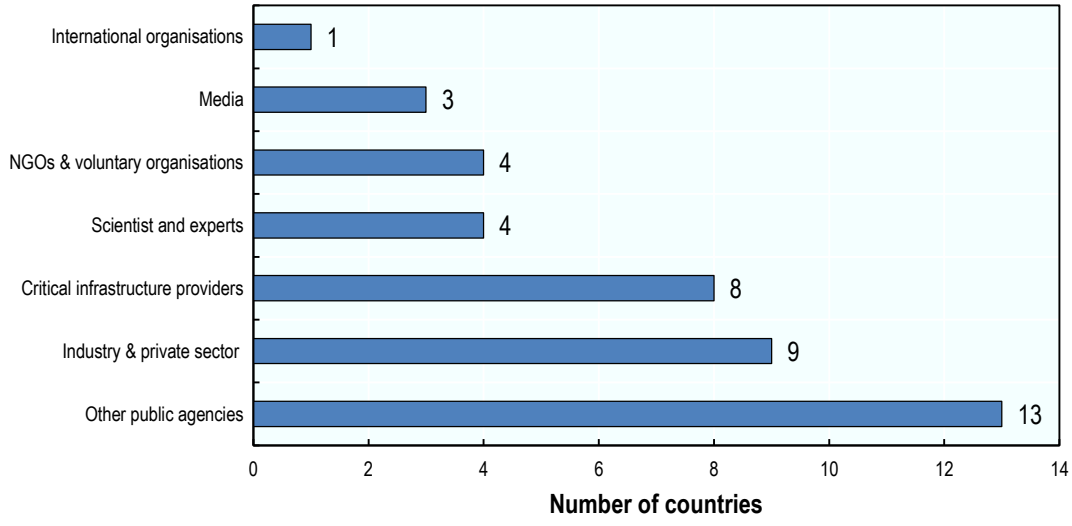
The provision of flood hazard maps to exposed residents and businesses is a good practice to raise awareness of the population to water related risks. Yet, only 66% of Adherents reportedly make flood hazard maps available to the public (OECD, 2016[8]). Information about exposure to natural hazards is in some cases withheld to avoid volatility in real estate markets. In **Japan** local municipalities hand deliver flood hazard maps to households, which include directions to designated evacuation zones (OECD, 2009[9]).

Figure 5.5 shows that Adherents generally follow the good practice of joint responsibility for risk communication. Public authorities at the national level communicate about risks of national significance while local authorities tailor messages to local conditions. In **the Netherlands**[2], for example, the National Risk Profile is a publicly available document that aims to create a better understanding of all hazards and threats, including water related risks such as river and coastal floods, extreme weather and drought. The state, the water boards and the Delta programme share responsibility to inform citizens about the flood

risk in the areas in which they live and work. A web tool enables users to enter a postal code to view its exposure to flood risk.

Adherents continue to distribute informative pamphlets to local residents to communicate about local risks. In **France**, for example, municipalities subject to a flood risk prevention plan (PPRi) are obliged to provide an information document on major risks (DICRIM) that presents a local hazard map and communicates safety measures to critical public infrastructure operators and residents (Ferrer, 2018[10]).

Figure 5.5. Actors with formal responsibilities for risk communication



Note: Total number of responding countries: 19/19
Source: OECD Questionnaire on Risk Communication Policies and Practices, 2015

While Adherents have generally made risk communication a joint responsibility between national and sub-national governments, fewer than 50% of Adherents leverage the private sector and civil society organisations (OECD, 2016[8]) to raise awareness of water related risks. Additional efforts are still needed in most Adherents to achieve a whole of society approach to risk communication.

5.4. Setting and revising acceptable levels of water risk

The Recommendation encourages Adherents “setting, and regularly revising acceptable levels of water risks, that reflect societal values”.

Targets for water risk reduction vary between uses of water. For example large dams might be built to resist a 1:1 000 year flood or probable maximum flood. Residences and major roads might be built to avoid inundation from a 1:100 year flood, while minor roads and recreational facilities might only be secured from a 1:10 year flood. Surprisingly, New York City is protected to only a 1-in-100-year flood event in comparison to other agglomerations such as London, Shanghai, or Amsterdam, all of which are protected to a greater than 1-in-1 000 year flood (Amsterdam is protected against a 1-in-10 000-year return floods).

Similarly, for water supplies, urban potable water might be provided at a service level to meet demand in 95% of years and not cause any human sickness in 99% of years; whilst high security irrigation water for permanent horticulture might only meet demand in 90% of years and have lower water quality requirements

such as salinity levels; and low security water supplies for annual crops and pasture might only meet demand in 50% of years and have a higher threshold of tolerable salinity.

Environmental water requirements can also take a similar form of percentage risk. **Australian** red gum floodplain forests on the Murray River, for example, require flooding for one month or more in 70% of years, while drier floodplain woodland ecosystems only require flooding for two months or more in 25% of years. Each use of water thus has a different level of acceptable risk (in this case a risk of shortage for the ecosystems that require periodic flooding).

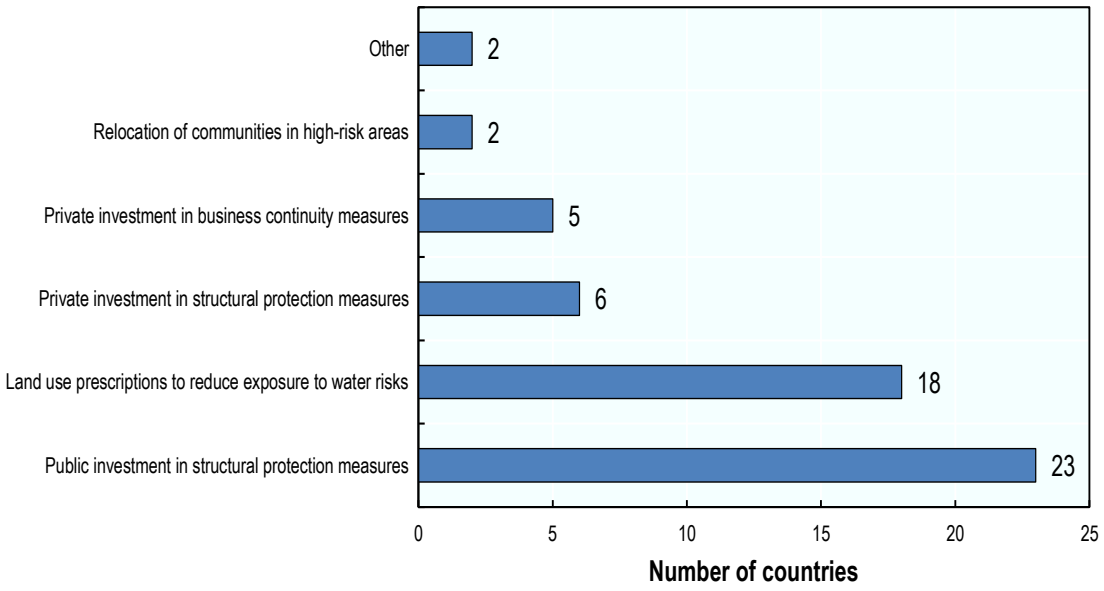
The Delta programme in the Netherlands is a government-led initiative to set the acceptable level of flood risk and drive investment and financing decisions to deliver that level of protection. The governance of the programme reflects the benefit of stakeholder engagement to set the acceptable level of risk (see chapter 6). Cost Benefit Analysis and Multi-Criteria Analysis provide useful information to evaluate water related disaster risk and to set acceptable levels of water risk (HELP, 2019[11]).

5.5. Prevention and mitigation measures

The Recommendation calls on Adherents to invest in "risk prevention and mitigation through a mix of structural protection measures (i.e. engineering or civil work prevention measures aimed at reducing exposure to hazards by protecting assets or communities, or controlling the variability of natural phenomena) and non-structural measures to prevent and reduce risks (including ecosystems based solutions and green infrastructures, when appropriate), and, where needed, the provision of incentives and tools to foster private self-protective and resilience building measures".

Figure 5.6 indicates that 85% of the respondents invest in structural protection measures like dikes, dams and waterways that protect riverine and coastal populations, and that public investments still dominate over private such investments. In some cases, public-private partnerships can be appropriate when risks and opportunities for revenues are shared in fair and appropriate ways between partners. The Thames Barrier (**United Kingdom**) is a good practice example of a public-private partnership financed protective infrastructure that holds back storm surges and high tides. The Thames Barrier helps protect 1.3 million people, USD 330 billion in property and infrastructure, and places of high historical and cultural value from flooding.

Figure 5.6. Actions to reduce water-related risks through prevention and mitigation measures



Note: Responses to the question: "What actions has your country taken to reduce water-related risks through prevention or mitigation measures?". Multiple responses were possible.
Source: 2019 survey on the implementation of the OECD Council Recommendation on Water; 27 responses received, including 26 Adherents.

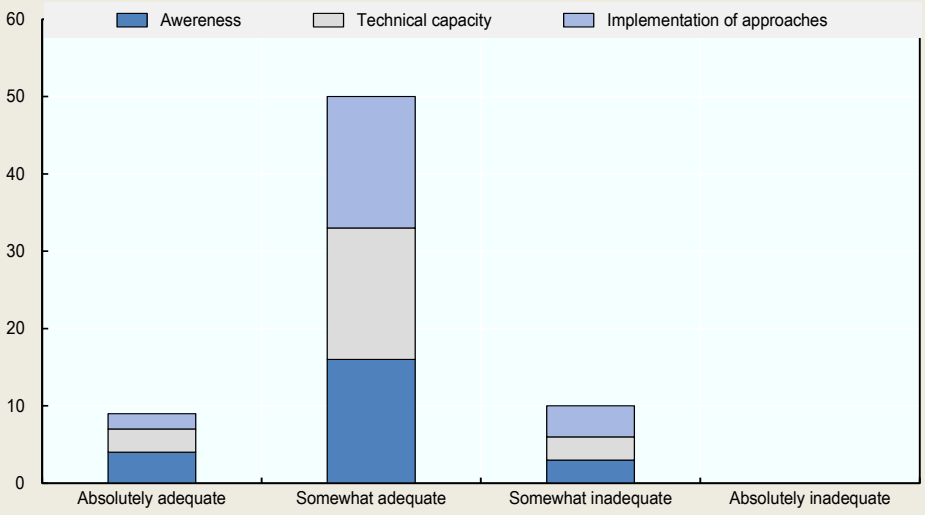
Ecosystem-based approaches to flood management, such as upper watershed restoration and increasing green space in cities, can complement and in some cases replace structural protection measures. An increasing number of OECD countries are promoting the use of such approaches to manage flood risks (see Box 5.1). Some countries have enacted policy measures of financial support to encourage their use. In the **United States**, Army Corps of Engineers has streamlined the permitting process for the use of natural shorelines as coastal buffers, in an effort to incentivise these measures and correct the comparative advantage held by engineered infrastructure projects in terms of shorter time frames to receive permits (OECD, 2019[12]). In **Europe**, the EU Horizon 2020 framework programme for research and innovation, has allocated approximately EUR 185 million to research and pilot applications between 2014 and 2020 (European Parliament, 2017[13]).

Box 5.1. The use of ecosystem-based approaches to manage water-related risks

Countries are gaining more experience with using ecosystem-based approaches to manage water-related risks. The great majority of respondents to the 2019 survey on the implementation of the OECD Recommendation on Water confirm their countries include ecosystem-based approaches in national water management strategies. Both research and cases of early adoption have presented evidence of the multiple benefits of ecosystem-based approaches. For example, protecting coastal marshes can provide ecosystem services including flood abatement, carbon and nutrient sequestration, water quality maintenance, and habitat for fish, shellfish, wildlife and other flora. Green roofs and urban parks can be used to absorb floodwater and reduce temperatures, while providing recreational value and improving wellbeing.

While ecosystem-based approaches are being promoted in water management strategies, most implemented on the ground have been launched as pilot projects and at relatively small scale (a notable exception being the *Room for the River* programme in the **Netherlands**). Only 2 respondents to the 2019 survey found current implementation of ecosystem-based approaches to be absolutely adequate, whereas 17 saw room for improving implementation (Figure 5.7)

Figure 5.7. Level of awareness, technical capacity and implementation progress for NbS



Note: Response to the question "How adequate are the following features in relation to eco-system-based approaches to water management in your country/basin?" Multiple responses were possible.
Source: 2019 survey on the implementation of the OECD Council Recommendation on Water; 27 responses received, including 26 Adherents.

70% of responding Adherents report the adoption of land use management as a tool in territorial planning to increase socio-economic resilience to water related risks. A good practice followed in several Adherents is to establish flood-vulnerability classifications of different types of developments and uses. The higher the economic value of a construction or use, such as transport, communication or energy infrastructure, the lower should be the flood hazard in the area where it is located. Inappropriate land-use development can have significant socio-economic impacts. In the **United States**, for example, high-risk properties accounted for 38% of all flood payment claims between 1978 and 2004 (OECD, 2016[5]).

As indicated in Figure 5.6, relocation of communities in high-risk areas is one possibility to correct for past land-use management decisions. After Hurricane Sandy hit New York, the state government implemented

a buyout program to compensate homeowners with the full pre-storm market value of their properties. To mitigate against the possibility of community deterioration, the program offered a premium of 10% for residents that participated collectively in the program. In Australia, residents of the town Grantham were relocated to higher grounds through a voluntary land swap program following the deadly flash flooding in 2011 (OECD, 2016[5]).

Relatively few responding Adherents reported government sponsored programmes to promote private investment in business continuity measures in face of water related risks. Good examples can be found, for example in the Loire river basin in **France** where a dedicated programme provides a free vulnerability diagnosis of businesses to floods (OECD, 2017[14]).

Regarding the agricultural sector, 28 responding Adherents implemented policies to manage flood risks through a combination of mitigation and adaptation policies. For example, **Colombia, Costa Rica, Estonia, Italy, Latvia, New Zealand, Norway, Portugal** and **Spain** have developed national risk management frameworks specifically for flood, which include plans for agriculture sector. Other countries have different flood management tools such as hazard maps (**Japan** and **Poland**) and warning systems (**Japan**, **Korea** and **Turkey**). **France** and **Japan** use farmlands or rice paddy fields as a means to store and slow water to mitigate flood risks for urban areas.

Flood risks are also addressed indirectly by agriculture and water policies designed to fulfil other policy objectives. For instance, **Mexico, Poland** and **Portugal** support afforestation and restoration wetlands to slow water flows across agricultural land, which contribute to mitigate flood risks. **Finland, Hungary** and **Sweden** provide support for wetland that also indirectly contributes to flood mitigation. **Czech Republic** and **Norway**'s erosion and runoff reduction programmes also aim to reduce the risk of flooding.

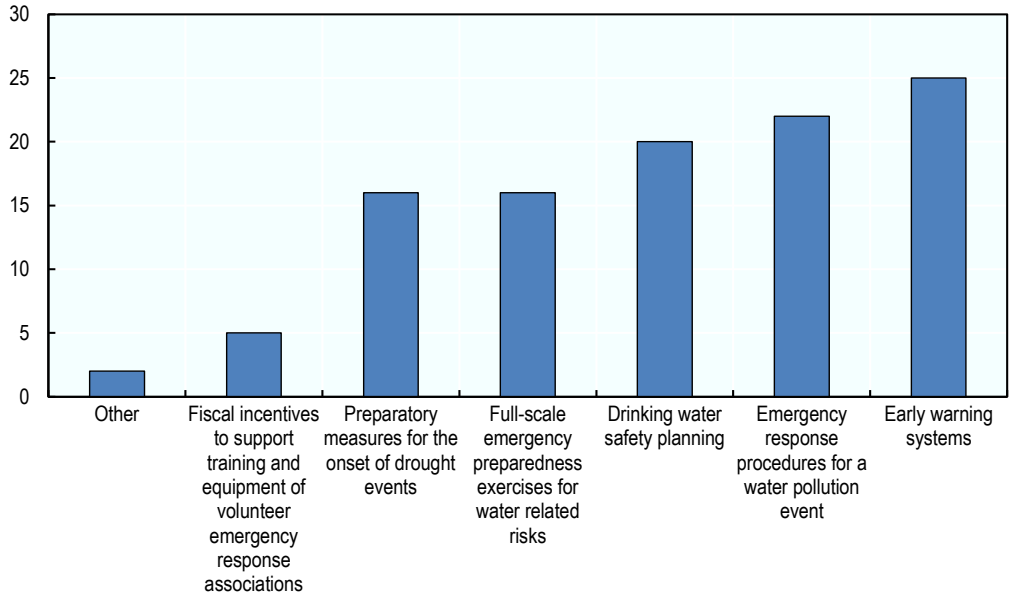
24 Adherents implement payments to prepare and reduce the impact of droughts in agriculture. Programmes support practices that reduce soil erosion and retain soil moisture, reservoirs and irrigation facilities to conserve water, and farm advisory services as well as educational programmes for preparation of drought readiness, response and recovery. For instance, the **United Kingdom** provides grants to build up reservoirs, and the **United States** supports irrigation infrastructure, e.g. improved off-farm water conveyance technologies, to address water scarcity problems. In 2019 **Australia** established the National Water Grid Authority (NWGA) to develop a national framework for investment in water infrastructure to increase security and reliability of supply, funded through a mix of grants and loans. Increased international attention has been given to improve effectiveness of disaster risk reduction investments. The High-level Experts and Leaders Panel on Water and Disasters (HELP) provided practical guidance on the principles on investment and financing for water related disaster risk reduction (HELP, 2019[11]).

5.6. Emergency response measures

The Recommendation calls on Adherents to invest in "emergency response capabilities for both known hazards and threats as well as novel, unforeseen and complex events".

Based on the 2019 OECD Implementation Survey, Figure 5.8 shows that respondents have adopted a variety of emergency response measures that reflect the multi-dimensional nature of water-related risks. More than 90% of the respondents have put in place early warning systems for water related risks.

Figure 5.8. Emergency preparedness and response measures for water related risks



Note: Responses to the question: "What emergency response measures are in place for water-related risks?". Multiple responses were possible.
Source: 2019 survey on the implementation of the OECD Council Recommendation on Water; 27 responses received, including 26 Adherents.

Early warning systems provide crucial lead-time to exposed individuals and communities to take precautionary measures. In **France**, for example, the *Vigicrue* platform collects information on water levels in near real time and issues flood alerts for all river and major tributaries in the national territory. Since its inception, this system has gradually evolved to cover heavy rainfall warning and storm surge warnings. Warnings are widely disseminated through well-established partnerships with the media. Regular surveys demonstrated that the Vigilance map is known by 96 % of French citizens.

The **Japan** Meteorological Agency (JMA) develops flood forecasts and together with the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and prefectures works hand in hand to issue flood warnings. The **European** Flood Awareness System (EFAS) is the first operational European system that monitors and forecasts floods across Europe. It provides complementary, flood early warning information up to 10 days in advance to its partners including the National and Regional Hydrological Services as well as the Emergency Response and Coordination Centre of the European Commission. **Costa Rica, Korea** and **Turkey** also employ early flood warning systems for the farming sector. Across Adherents strong attention is also placed on emergency response to water pollution and drinking water safety. In **Austria**, **Finland**, **Sweden**, **Ireland** and the **Slovak Republic** the training and equipment of volunteer emergency response associations plays also a key role.

Conducting emergency response exercises further enables countries to spot weaknesses. The EU SEQUANA 2016 exercise in Ile-de-**France**, for example, aimed to test coordination between crisis management agencies in the event of a one-hundred-year flood of the River Seine, meaning an event with a 1% probability of occurring in any given year. The purpose of the exercise was to improve crisis management preparedness, but also to raise awareness among the population about the risks of a major flood.

In Italy, where floods are the most frequent type of natural hazard, the state provides fiscal advantages to certified volunteer civil protection organizations. These include tax breaks for the purchase of equipment, technical preparation and training to ensure the safety and security of volunteers. Salary refunds are also guaranteed to employers who allows certified volunteers to mobilize for rescues or trainings. In agriculture,

disaster assistance programmes are available to affected farmers. Farmers in European Union countries can benefit from **EU** level and national disaster support when affected by droughts and floods. Farmers in **Israel** receive payments based on the Property Tax and Compensation Fund Regulation during declared drought years, and compensation based on the Natural Disaster Law is paid to agricultural infrastructures that have been damaged by floods. **Japan** and **New Zealand** provide support for clearing ground after major flooding.

5.7. Social policies and financial mechanisms

The Recommendation calls on Adherents to invest in "social policies and financial mechanisms to mitigate the welfare impacts of losses and ensure a quick recovery and reconstruction that reduce future vulnerability". Financial assistance for households, businesses and in some cases sub-national governments affected by water-related disasters enables to reduce hardship and minimize economic and social disruption.

Government compensation schemes are particularly present where flood risks are uninsurable. In the **Netherlands**, for example, the Calamities and Compensation Act enables the national government to compensate households impacted by freshwater flood events. The amount of compensation awarded to households is decided on a case-by-case basis, although the legislated aggregate of EUR 450 million cannot be exceeded. In the case of **Canada**, damages from overland flooding are usually excluded from residential insurance policies. The governments of Provinces and Territories may step in to provide financial assistance to households that have suffered from losses (OECD, 2016[5]).

Financial assistance and government compensation is also offered in Adherents where flood insurance is available. In **Belgium,** for example, affected businesses and households may approach the *Caisse nationale des Calamités*, if they consider the compensation of private insurance companies to be insufficient. Despite the absence of legal requirements in **Germany**, the Federal States have assisted households with damages incurred by past major flood events. The **United States**, in addition to providing subsidized flood insurance offers federal loans to homeowners (up to USD 200 000) and businesses to repair or replace damaged buildings (up to USD 2 million). These loans are available one time to all households and businesses affected by flood damages, although subsequent loans can only be granted, if the homeowner or business has secured flood insurance coverage (OECD, 2009[15]).

In **Austria,** the State budget provides for *Katfonds,* which cover up to 60 per cent of losses, and constitute the main source for financing mitigation measures. A lack of legal entitlement, however, leads to ambiguity and uncertainly concerning how much individual assistance the State will provide in any given case. It is conceivable that *KatFonds* might leave some affected citizens with low or no compensation at all (OECD, 2017[16])In France a public-private initiative funded by a surcharge on home insurance enables compensation for disaster damages, without drawing directly on a State budget. Each party has access to the insurance market and coverage against disasters under the constitutional principle of solidarity. (OECD, 2014[7]).

In addition to the losses households and businesses suffer from water-related disasters, central and sub-national governments incur costs of relief and recovery, reconstruction of public assets, as well as compensation and financial assistance. These expected costs are managed through public sector investments in cost-effective risk reduction measures. **Japan** exemplifies the efficiency that flood discharge works can offer. Following typhoon Ida in 1958, a single discharge channel was completed that lowered the Kano river water level around 1.85 meters. In 2019 typhoon Hagibis hit the same area at an even higher intensity, but no flooding was reported, resulting in estimated avoided damages of around US 7 billion.

5.8. Transparency, accountability and public awareness

The Recommendation calls on Adherents to invest in "transparency, accountability and public awareness in water risk related decision-making".

Transparency and access to hazard information on water risks is key to raising public awareness about local water related hazard exposures, and informing public debate on land use policy. It is also useful to contextualize public warnings, inform emergency response plans and support the accountability of public officials. Without access to accurate hazard information, public risk awareness is uninformed or misinformed, and disaster risk reduction measures undermined.

Access to water hazard data is needed to develop flood hazard maps, which are one tool to raise public risk awareness and inform prevention measures in urban planning. In **Switzerland** and the **United Kingdom** detailed hazard maps are made available on-line, for each canton and county. In **France**, municipalities subject to a 'Risk Prevention Plan' must provide accessible information including a map of hazardous areas within their jurisdiction to raise public awareness of risks.

Hazard data on specific geographic areas is the scientific basis for contentious land use decisions that may decrease or increase land values. Measures to support hazard data transparency are key to the credibility of these decisions. Good practices include multi-stakeholder platforms and commissions that can access the development of hazard plans and corroborate, or contest, the scientific basis for plans. In **Austria**, the process of adopting hazard maps includes public consultations, which are a crucial safeguard against bias (OECD, 2017[16]).

Accountability of public officials in the exercise of their duties to manage water related risks can support effective policy implementation. Good practices are found in **Austria** and **France** where local authorities may be held liable for damages occurring to persons and property, if they grant building permits in known flood zones (OECD, 2017[16]).

5.9. Policy coherence

The Recommendation calls on Adherents to "improve policy coherence across climate change adaptation, water management, land management, spatial planning, ecosystem and biodiversity protection and disaster risk reduction".

Policy coherence across climate change adaptation, water management, land management, spatial planning, ecosystem and biodiversity protection and disaster risk reduction is needed to identify both trade-offs and synergies between different areas (OECD, 2018[17]). For example, inappropriate land-use development can be a substantial driver of increased losses due to flooding (OECD, 2016[5]). Regulatory instruments such as spatial planning can reduce the exposure of new assets to water-related hazards, as well as reduce the impact of hazards by dedicating land to natural buffers and retention areas, such as wetlands. One illustration of a coherent approach between land use planning, disaster risk management and climate change adaptation is of **Ireland's** National Planning Framework, which contains specific policy objectives linked to adapting to sea-level rise (OECD, 2019[12]).

A survey of adaptation strategies across OECD countries (OECD, 2013[18]) suggested that, in the development of adaptation strategies or plans, water is nearly always addressed as a priority sector or cross-cutting theme vital for a number of key policy domains (e.g. energy, agriculture, infrastructure, biodiversity, and health). Climate change adaptation is also be being mainstreamed into existing water policies. Both approaches are important to ensure coherence and effectiveness.

5.10. Water risks related to climate change in agriculture

The Recommendation encourages Adherents to "take into account the specificities of water risks related to climate change for agriculture, in particular by fostering an enabling environment for adaptation of agriculture and water systems and by combining the dimensions and scales whereby climate, water and agriculture policies intersect".

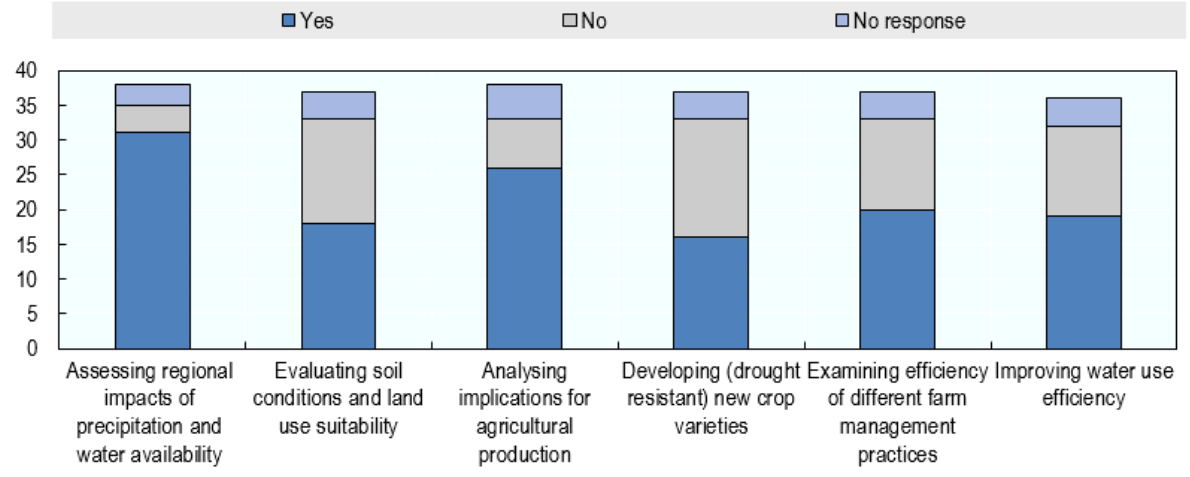
The agricultural sector is particularly vulnerable to water-related risks and disasters (OECD, 2017[19]). Water related disasters have direct impacts on farmers, can generate losses of crop and livestock production, and damage to farmland, machinery or agricultural facilities. They can also result in indirect losses caused by interruptions to farm business activities.

The recent water related disasters illustrate this. **Japan**'s heavy rainstorms in 2018 triggered the deadliest floods since 1982, leading to damage valued at USD 3 billion for the agricultural sector (MAFF, 2019[20]).The heavy rain and flooding across the Midwestern **US** in 2019 cost several USD billions, washed up soils, and resulted in major delays in planting. Droughts also cause tremendous damage to the agriculture. The extreme drought event that affected Central and Northern Europe in 2018 resulted in cereals yields declining by up to 50% for certain crops. Some estimate that the US maize production losses may double during the next decades if the frequency of extreme rains and flooding were to increase, causing additional damages totalling an estimated USD 3 billion per year (Rosenzweig et al., 2002[21]).

With extreme weather events, including heavy precipitations, affecting the agricultural sector, most Adherents account for **climate change impacts** in their agriculture and water policies[3]. Almost all Adherents are engaged in public R&D efforts on climate change in agriculture and water. More specifically, a majority of Adherents are conducting assessments of regional impacts of precipitation and water availability, followed by analysis of climate change impact on agricultural production (Figure 5.9).

Figure 5.9. Focus of major public funded research related to water availability to agriculture

Number of Adherents conducting the respective public research, 2009-2019



Source: (Gruère, Shigemitsu and Crawford, 2020[22])

Some Adherents have incorporated climate change considerations into their agriculture and water policy frameworks. For example, **Colombia** is formulating a Comprehensive Climate Change Management Plan for the Agricultural Sector in addition to establishing a Climate Change Law, the National Climate Change Adaptation Plan and the Adaptation Roadmap, **Latvia** has approved a Climate Change Adaptation Plan

until 2030, which includes a specific section for agriculture. This plan includes seven agricultural measures and two measures related to water management. However, the degree of incorporation of climate change consideration into policies varies greatly across Adherents, probably commensurate with their respective projected impacts. Only 8 of responding Adherents reported an increase in the importance of climate change considerations in agriculture water management decisions from 2009 to 2019. The degree of considerations for climate change concerns remained unchanged in 13 of the Adherents during the last ten years (Gruère, Shigemitsu and Crawford, 2020[22]).

More generally, the results of the alignment analysis suggest that most Adherents, and especially relatively water abundant Adherents, still have progress to do to align their policies to manage water risks in agriculture with the OECD Council recommendation on Water, to adapt to climate change related water supply shocks (Gruère, Shigemitsu and Crawford, 2020[22]).

5.11. Water risks related to cities

The Recommendation calls on Adherents to "take into account the specificities of water risks related to cities, acknowledging that urban areas and their hinterland are interconnected through watersheds and groundwater systems, and, in particular use urban policies and infrastructure finance to promote water sensitive urban design".

As urban areas host approximately 50% of the global population (estimated to increase to 60% by 2050), ensuring good water governance in cities is crucial. Projections also show global water demand increasing by about 55% by 2050, leading to increased competition across water users, including agriculture, energy and urban dwellers. If cities remain in a business as usual outlook towards water governance, water risks of too much, too little and too polluted water will threaten their water security (OECD, 2016[23]). To respond, it is important to raise awareness among citizens and policy makers; engage with stakeholders, including property developers and long-term institutional investors, to build consensus on the acceptable level of risk and secure willingness to pay for water services; and strengthen water-related data and information for more robust early-warning systems, monitoring and evaluation. Good practices include the Bologna Local Urban Environment Adaptation Plan for a Resilient City (BLUEAP) in **Italy**, which involved 150 stakeholders, 70 project ideas and 6 pilot actions to come, amongst others, with solutions to water scarcity. The Water Observatory of the municipality of Paris, **France** provides a multi-stakeholder consultative platform prior to discussions at the City Council. Information and communications technologies are used to display water quality and quantity data in a number of cities including Marseille, **France**, while communication campaigns such as "Max 100" in Copenhagen, **Denmark** raised awareness of citizens and fostered water savings (OECD, 2016[23]).

The high quality of urban water services in OECD countries is threatened by an investment backlog impeding the upgrading, renewal and maintenance of water-related infrastructure. There is a need to address public investment issues including multilevel co-ordination and capacity challenges; foster cross-sectoral approaches to infrastructure; adopt an approach that encompasses multiple purposes; manage trade-offs across water users in rural and urban areas and between current and future generations in terms of who pays for what; and reduce investment needs by ensuring stable regulatory frameworks to catalyse finance and enhance efficiency. Financial tools will also be needed to support the digital transformation in the water sector, mainly for municipal water supply systems. Similarly, they will be needed for climate change adaptation measures to boost cities' resilience, for example, against floods or re-naturalisation management of green urban areas. In the **United States**, the EPA Water Infrastructure and Resiliency Finance Centre set up in April 2015 to help US municipalities efficiently use federal and local funds for water infrastructure, explore financing options and showcase best practices (OECD, 2016[23]).

Water in cities is affected by decisions taken in other sectors and vice versa, in particular agriculture, energy, finance, solid waste, transport and land use. There is a need to ensure that water is recognised

as a key factor of sustainable growth in cities. Such a strategic vision is essential for strengthening policy coherence for an integrated urban water policy, mitigating split incentives whereby those generating future liabilities do not bear related costs, and fostering a whole-of-government approach that builds on horizontal and vertical co-ordination. For instance, in the **Netherlands** "water assessments" are carried out in municipalities to factor in water-related stakes and costs in spatial planning decisions; the city of Cologne, **Germany** co-ordinates water and spatial planning for new building areas to prevent flood damages because of heavy rainfalls; in France, Eau de Paris put in place concrete actions to promote organic agriculture for the preservation of water and natural resources through signing contracts with farmers associations (OECD, 2016[23]).

Water boundaries cut across administrative perimeters. Multi-level approaches are needed from basin to local levels depending on the water function (protection against floods or droughts, water supply, sanitation, drainage, etc.). A functional approach is key to addressing linkages between urban areas (where most people live) and the surrounding environments (rural and watersheds) that sustain them. This would also help optimise the opportunity cost of investments and the efficient use of water. Rural-urban partnerships should be seen as win-win-win solutions, benefiting cities, upstream and downstream communities and ecosystems. Good practices include multi-stakeholder committees such as the technical committee created in Montreal, **Canada,** composed of representatives from community organisations, the industrial sector, government departments, other levels of government and municipal services, to improve the quality of discharged water in catchment areas. Other practices include contracts between the Utility and watershed communities to preserve both water quality and the economic dynamism as in the case of New York City, **United States** (OECD, 2016[23]).

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