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Agriculture and water policy changes

STOCKTAKING AND ALIGNMENT WITH OECD AND G20 RECOMMENDATIONS

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Agriculture and Water Policy Changes: Stocktaking and Alignment with OECD and G20 Recommendations

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This report takes stock of agriculture and water policy changes from 2009 to 2019 and assesses the alignment of these changes with relevant sections of the OECD Council Recommendation on Water and the 2017 G20 Agriculture Ministerial Action Plan on water and food security. The analysis builds on results from a 2019 survey on agriculture and water policy changes which gathered responses from 38 countries – including OECD countries, Costa Rica, Colombia, and Cabo Verde – and the European Union. A methodology was developed to convert survey responses into indices of alignment of policy changes with OECD and G20 recommendations. Results show that changes in water and agriculture policies from 2009 to 2019 were uneven across countries and investigated policy areas (water governance, water quality, water quantity and water risks), with some countries undertaking important reforms whereas others mainly improved existing policies. On average, alignment indices suggest that agriculture and water policies in responding countries progressed towards the OECD Council Recommendation on Water. In order to advance further, relatively water abundant countries should pay attention to their approach to manage water quantity and risks under climate change, all countries should consider improving their policies to reduce pollution from agriculture, and selected countries should consider making additional efforts to recover water charges and to use pricing instruments, in line with the OECD Council Recommendation on Water. Policy changes by responding G20 member countries have also been in the direction of the 2017 G20 Agriculture Ministerial Action Plan. However, some of these changes are partial, particularly those on water use efficiency and resilience, and those supporting responsible investment in agriculture and water.

Keywords: Water governance, policy evaluation, reform process, water pollution, water scarcity, water risks

JEL Codes: Q18, Q25, Q28, Q58

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Executive Summary

Agriculture is facing growing water risks, mainly due to more damaging climate-related disasters and increased water demand. Droughts and floods are intensifying, impacting key agricultural regions in many countries. These risks are exacerbated in many semi-arid regions by the growing competition for water from energy, industry and expanding cities. Global water demand is projected to increase significantly, putting more pressure on agriculture to efficiently use available water in order to feed a growing population.

At the same time, agriculture also contributes to water risks and generates negative environmental impacts on water resources and wider ecosystems. Agriculture remains the largest user of water accounting for about 70% of total global freshwater demand. Furthermore, agricultural water pollution by nitrates, phosphorus, and pesticides is a growing concern in most countries.

Governments have a role to play in addressing these growing challenges in order to ensure future water and food security. This requires re-assessing and possibly revising agriculture and water policies – defined here as all policies that affect the interaction of agriculture production with water – especially policies to (1) manage agricultural water demand, (2) reduce agriculture's water pollution, and (3) bolster the resilience of farmers to water risks, including prioritising efforts in areas facing more concentrated risks.

OECD and G20 countries have taken a step towards addressing these issues by making commitments to improve their agriculture and water policies. In December 2016, the OECD Council adopted the Recommendation on Water, a legal instrument providing coherent guidance on all areas of water policies and governance, including the management of water in agriculture. In parallel, in January 2017, G20 Agriculture Ministers adopted a Declaration and an Action Plan on water and food security, committing to take actions on policy, investment and research needs to improve the sustainability of water use in food and agricultural production.

However, there is limited evidence on the extent to which governments' agriculture and water policies have evolved to address these growing challenges. This report accordingly takes stock of agriculture and water policy changes from 2009 to 2019 and assesses the alignment of these changes with relevant sections of the OECD Council Recommendation on Water and the G20 Agriculture Ministerial Action Plan on water and food security.

The analysis draws from a 2019 survey on agriculture and water policies sent to OECD countries, the European Union (EU), a G20 member, OECD accession countries (Costa Rica and Colombia) and pending adherents to the OECD Council Recommendation on Water (Brazil and Cabo Verde). Thirty-eight countries and the European Union responded to this survey.[1] In order to obtain an understanding of agriculture and water policy changes, the survey largely builds on a 2009 OECD questionnaire on the management of water resources in agriculture. A methodology was developed to turn the questionnaire's responses into quantitative indices of alignment of policy changes with OECD and G20 recommendations.

Results first show that countries reported no change more frequently than a change in any given agriculture and water policy. Second, reported changes in water and agriculture policies from 2009 to 2019 are uneven across countries and areas; some countries undertook important reforms and others mainly improved existing policies.

[1] Colombia was still an OECD accession country in 2019. All OECD countries except Luxemburg, and all other listed countries except Brazil responded to the questionnaire. Other G20 members were queried but did not respond to the questionnaire.

- Almost all responding countries undertook at least some cross-cutting policy or governance changes related to agriculture and water, including by introducing new data and information to guide decision making.
- Many individual policy changes occurred in the area of agriculture and water quality, particularly in water abundant countries, for example via research and development initiatives to improve agriculture's management of nutrients.
- Fewer but more important policy changes were observed in the management of water quantity in agriculture, particularly in relatively water scarce countries. At the same time, the recovery of costs by irrigators has not strengthened significantly and close to a third of responding countries still face illegal groundwater abstraction.
- Many responding countries acknowledged an increased trend in droughts and floods over the past decade, but they reported relatively few changes in water risk management related policies.

Nonetheless, derived indices of alignments suggest that, in overall terms, agriculture and water policies in responding countries progressed towards the OECD Council Recommendation on Water from 2009 to 2019. On average, the level of alignment improved most with respect to general policy recommendations (Chapter 2), followed by water risk and disasters management (Chapter 5). Yet, because policies pertaining to water quantity were relatively well aligned with the OECD Council Recommendation on Water in 2009, they remain the most aligned with the OECD Council Recommendation on Water in 2019.

While customised recommendations would be needed for each country given the diversity of agriculture and water contexts, the results suggest that relatively water abundant countries should upgrade their policies to manage water quantity and water risks in agriculture in line with the OECD Council recommendation on Water, in order to adapt to climate change related water supply shocks. Given the continued challenges of tackling agriculture pollution, all countries, and particularly water stressed countries, should consider making further steps to align their policies with the OECD Council Recommendation on Water on water quality. In addition, despite measurement challenges, the results suggest that more efforts may be needed for some countries to recover water charges and use pricing instruments, where possible, in line with the OECD Council Recommendation on Water.

At the G20 level, agriculture and water policy changes in the responding countries have been directed towards all the parts of the 2017 G20 Agriculture Ministerial Action Plan. However some of these changes are partial, pointing towards areas for further improvements. While G20 members consistently engaged in efforts consistent with the Action Plan on water quality, limited policy improvements were observed towards the Action plan's objectives on water use efficiency and resilience. Furthermore, responding G20 members showed limited progress in fulfilling their engagement on responsible investment in agriculture and water compared to other areas, dedicating more efforts towards research exchanges or reducing food loss and waste.

1. Responding to a changing agriculture and water landscape

Are agriculture and water policies adapting to growing water risks?

Agriculture is facing growing water risks. In many regions, agriculture is increasingly subject to droughts, floods, storms, and sea-level rise (OECD, 2014[1]; OECD, 2017[2]; OECD, 2018[3]). For example, approximately three-fourths of the global harvested areas of maize, rice, soy, and wheat experienced drought-induced yield losses over the 1983 to 2009 period, and the cumulative production losses corresponded to USD 166 billion (Kim, Iizumi and Nishimori, 2019[4]).[2] More recently, the extreme drought event that affected Central and Northern Europe in 2018 resulted in cereals yields declining by up to 50% for certain crops; while the disastrous flooding event in the Midwestern United States in the spring of 2019 cost several USD billions, washed up soils, and resulted in major delays in planting. These extreme weather events will likely increase in frequency and intensity as climate change progresses (IPCC, 2019[5]).

These risks are exacerbated in some countries by the growing competition for water from energy, industry, or domestic use in urban areas (OECD, 2017[2]). The global water demand is projected to increase significantly mostly from manufacturing, electricity and domestic users due to population and economic growth. The growing demands of these water uses by non-agricultural sectors will compete with demand for irrigation water, which is expected to decline in some regions (OECD, 2012[6]).

At the same time, agriculture contributes to these risks and generates significant negative environmental impacts on water resources. The sector accounts for an estimated 70% of total water withdrawal globally and over 40% in many OECD countries and a much larger proportion of total water consumption (OECD, 2010[7]; Scheierling and Tréguer, 2018[8]). Over-exploitation of water resources by agriculture in specific areas is damaging ecosystems by reducing water flows below minimum flow (stock) levels in rivers, lakes and wetlands, which is also detrimental to recreational, fishing and cultural uses of these ecosystems (OECD, 2010[7]). Intensive groundwater extraction for irrigation in semi-arid regions decreases aquifer levels, which increases the cost of access and reduces the long term sustainability of groundwater reserves, while generating negative environmental impacts, drying rivers and lakes, encouraging salt intrusion and driving land subsistence (OECD, 2015[9]). Furthermore, agriculture remains a prime source of water pollution. Agricultural fertiliser and pesticide run-offs and livestock effluents contribute to the pollution of surface and groundwater, and lead to eutrophication and acidification of water. This in turn has a negative impact on biodiversity, and degrades drinking and bathing quality (OECD, 2017[10]; OECD, 2019[11]; OECD, 2019[12]).

Governments have a role to play to address these challenges that are central to future water and food security. This requires assessing and possibly revising agriculture and water policies – defined in this report as agriculture policies, water policies, and intersecting policies that affect the interaction of agriculture production with water – to manage water demand where water is scarcer, reduce water pollution, and bolster the resilience of farmers to water risks. This encompasses improving water allocation systems and providing appropriate signals for irrigators (OECD, 2015[13]; OECD, 2010[7]), particularly in the case of groundwater (OECD, 2015[9]), deploying a combination of regulatory, information and economic instruments to reduce the impact of agriculture on water quality (OECD, 2012[14]), fostering better collaboration with cities (OECD, 2015[15]), and assessing and addressing agricultural water risks (OECD, 2014[1]; OECD, 2016[16]) while prioritising efforts to water risk hotspot areas (OECD, 2017[2]).

[2] As a reference, the annual gross production value for these commodities during this period was USD 364 billion (constant 2004-2006 USD) (FAO, 2020[42]).

Governments of OECD and G20 countries have taken a step towards addressing these issues by making commitments to improve their agriculture and water policies. In December 2016, OECD member states adopted the OECD Council Recommendation on Water, a concise and coherent legal instrument providing guidance on all areas of water policies and governance, including the management of water in agriculture (OECD, 2016[17]). In parallel, in January 2017, G20 Agriculture Ministers adopted an Action Plan entitled "Towards food and water security: Fostering sustainability, advancing innovation", in which they committed to take actions on policies, investment and research needs to improve the sustainability of water use in food and agricultural production (G20, 2017[18]).

There is limited evidence, nonetheless, that these growing challenges have been reflected in actual agriculture and water policy changes, or that such changes have been aligned with the OECD and G20 recommendations. Indeed, governments in some countries may have kept their past policies; others may have made policy changes following different approaches or directions.

The present report aims to address this gap by reviewing the main agriculture and water policy changes that happened from 2009 to 2019. These policy changes are then screened using the relevant sections of the 2016 OECD Council Recommendation on Water and the 2017 G20 Agriculture Ministerial Action Plan as references.

There are multiple benefits of tracking policy change in a wide set of countries. First, it can help gauge the general direction of agriculture and water policymaking in a wide set of contexts over the medium term and help determine the convergence or divergence with commonly agreed policy directions. Second, it can help governments in countries considering a policy change in this area share experience and lessons with others having implemented a similar policy change. Third, reviewing the types and dynamics of policy changes can help further understand reform processes, identify the possible obstacles to change, and thereby better understand how envisioned improvements could be introduced when the time is right (Gruère and Le Boëdec, 2019[19]).

Tracking agriculture and water policy changes: Scope and methodology

This study mainly relies on a policy survey sent in June 2019 to government officials of OECD countries, OECD accession countries (Costa Rica, Colombia[3]) and pending adherents to the OECD Council Recommendation on Water (Brazil, Cabo Verde) and to the European Union (for a total of forty one sent surveys). Thirty-nine responses were obtained as of December 2019; only Brazil and Luxemburg did not respond. The respondents' affiliations varied; in some cases the survey was filled by the ministry of agriculture or the ministry of environment in charge of water resources, in other cases it was a collaboration of several ministries.

To facilitate the tracking of policy changes and understand their evolution, the 2019 survey built on questions from a 2009 survey of agriculture water resource management in OECD countries.[4] Complementary questions were added to cover areas not included in the 2009 survey, particularly on water quality and relevant sections of the OECD Council Recommendation on Water and the G20 Agriculture Minister's Action Plan. A draft survey was reviewed and validated by two OECD countries.

The 2019 survey covers four areas of particular relevance to the management of water in agriculture, in line with the structure of the OECD Council Recommendation on Water.[5] General agriculture and water policy changes pertain to changes in the definition of roles and responsibilities of the relevant government

[3] Colombia was still an accession country in 2019 and is therefore referred to as such in this paper.

[4] The results are available at http://www.oecd.org/agriculture/44763686.pdf.

[5] See Annex B and Annex C for survey questions.

actors, overall policy coherence, research and information systems that frame policy efforts on agriculture and water. Second, water quantity management includes the definition of quantitative water resource plans and targets, and key features of water resource allocation related to agriculture, ensuring that the sustainable use of water in agriculture Third, the management of water quality, which is another pillar of agriculture and water management, encompasses all information, monitoring and policy measures aiming at reducing pollution from agricultural activities in surface water, groundwater and oceans. Fourth, water related risk and disaster management covers risk assessment and policy responses to droughts and floods. As shown in Table 1, the 38 responding countries and the European Union represent a significant diversity of agriculture and water contexts. Specifically, the survey includes 30 OECD countries and the European Union which participated in the 2009 survey, six additional OECD countries that became members to the OECD after the 2009 survey, two countries, candidates to OECD accession (Colombia and Costa Rica), and one pending adherence to the OECD Council Recommendation on Water (Cabo Verde).

Due to the diversity of situations, five versions of the survey were prepared, targeting OECD-2009 participating countries, new OECD member countries, OECD G20 countries, non-OECD G20 countries, and non-OECD adherents, respectively. The survey for OECD 2009 participating countries was sent with responses from 2009, which the countries were asked to update if any change had occurred after 2009. For G20 member countries, additional questions were added based on G20 Agriculture Ministerial Declaration and Action Plan. OECD data and available publications published in the period of 2010-19 for each country were used to complement the collected information. In particular, data from the OECD Agriculture Producer Support Estimate database was used to track progress in potentially most distorting support and water related transfers (OECD, 2019[20]).

Responses to each of the 2019 survey questions were coded into binary (1-0) or categorical indicators of policy status or policy change to help draw conclusions on the general evolution of policies across countries.[6] An evaluation grid, matching responses to questions with specific OECD and G20 commitments was developed to derive indicators of policy alignment with these two texts (see Section 3.1 for details).

As a caveat, the analysis presented in this report is based on data provided by officials from the different countries. The fact that the survey included both water policies and agriculture policies created a challenge for most countries given the separate responsibility of these policy areas. As a consequence, the responses differed significantly in coverage and scope; some respondents were able to address all questions with the relevant authorities, others were only able to cover some of the new questions and primarily provided possible changes since 2009.

The rest of the paper is organised in two sections. Section 2 reviews trends in policy changes observed in the survey, tracing the evolution of policies by area. Section 3 analyses the alignment of policies and policy changes with OECD and G20 commitments.

[6] Individual responses will be used in the form of country profiles, with the aim to provide more information on policy status and changes for other countries to consult. A draft example of a country profile is presented in Annex A.

Table 1. Country coverage of the study

	OECD country	2009 survey participant	OECD accession country	G20 member	Adherent to the OECD Council Recommendation on Water	Received responses
Australia	X	X		X	X	X
Austria	X	X			X	X
Belgium[1]	X	X			X	X
Canada	X	X		X	X	X
Cabo Verde					Pending	X
Chile	X				X	X
Colombia			X		Pending	X
Costa Rica			X		Pending	X
Czech Republic	X	X			X	X
Denmark	X	X			X	X
Estonia	X				X	X
European Union		X		X		X
Finland	X	X			X	X
France	X	X		X	X	X
Germany	X	X		X	X	X
Greece	X	X			X	X
Hungary	X	X			X	X
Iceland	X	X			X	X[2]
Ireland	X	X			X	X
Israel	X				X	X
Italy	X	X		X	X	X
Japan	X	X		X	X	X
Korea	X	X		X	X	X
Latvia	X				X	X
Lithuania	X				X	X
Mexico	X	X		X	X	X
Netherlands	X	X			X	X
New Zealand	X	X			X	X
Norway	X	X			X	X
Poland	X	X			X	X
Portugal	X	X			X	X
Slovak Republic	X	X			X	X
Slovenia	X				X	X
Spain	X	X			X	X
Sweden	X	X			X	X
Switzerland	X	X			X	X
Turkey	X	X		X	X	X
United Kingdom	X	X		X	X	X
United States	X	X		X	X	X
Total count	**35**	**30**	**2**	**12**	**38**	**39**

Notes:
1. Response received from the Flanders region only.
2. No change reported.

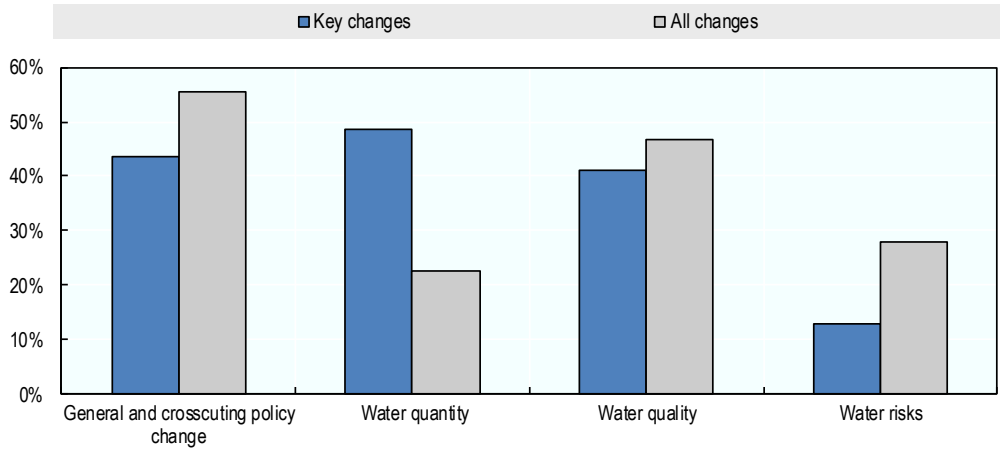
2. Trends in agriculture and water policies from 2009 to 2019

Overall findings: Several important policy reforms, but a relatively limited number of individual policy changes on water in agriculture

The survey first asked respondents to identify three to five key policy changes in water and agriculture, and then explored more specific policy changes. Almost all responding countries (92%) undertook key policy changes in agriculture and water. Looking by thematic area, a majority of key policy developments were concentrated in the management of water quantity (Figure 1) particularly in some of the relatively water-scarce countries. [7] For instance, Israel reformed its agricultural freshwater pricing system in 2017, removing its extraction levy, and undertaking a convergence of prices for users of network and those outside of network (OECD, 2018[21]). Turkey implemented its Action Plan for Effective Use of Water in Agriculture aiming to establish centralised monitoring facilities for irrigation networks and water storages. Turkey also adopted a Regulation on the Control of Water Use and Mitigation of Water Losses in the Irrigation Systems in 2017

Figure 1. Proportion of changes in agriculture and water policies between 2009 and 2019, by water policy area

Proportion of reported key policy changes and of number of policy changes by area



Source: Authors, based on survey responses.

The second thematic area for key policy changes relates to general and crosscutting policy changes. This includes policy framework, improved coherence across areas, and improvement in agricultural water governance. With the European Union's Common Agriculture Policy 2014-2020 and the existing Water Framework Directive, countries in the European Union embarked in new efforts and revised programmes to comply with the EU objectives. For other countries, reforms of national water management policy or governance were conducted. This includes the implementation of Murray-Darling Basin Plan in Australia in 2012 to coordinate water use across the Murray–Darling Basin's four states and the Australian Capital

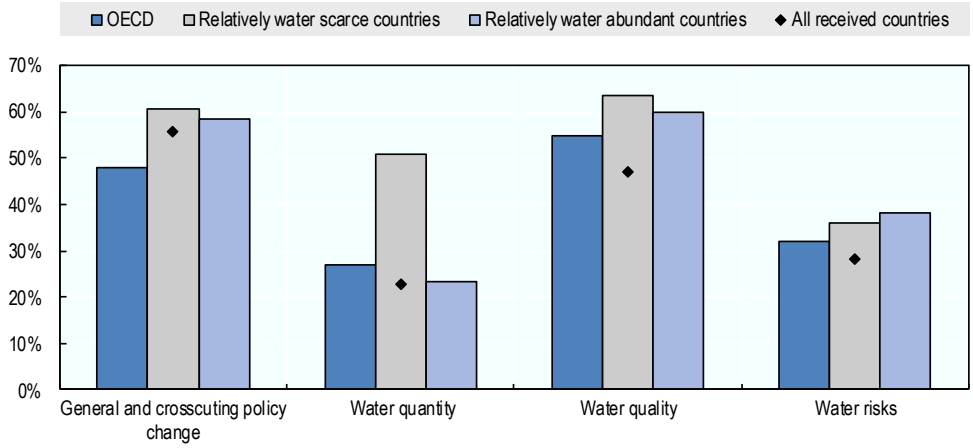
[7] Water-scarce countries in this report comprise Australia, Cabo Verde, Chile, Israel, Italy, Korea, Portugal, Spain, and Turkey.

Territory. In 2011, New Zealand introduced the National Policy Statement for Freshwater Management, which was amended in 2014 and 2017, and Poland introduced a new centralised structure of water administration under the Water Law of 2017.

When looking at the individual responses from specific thematic questions of the survey, however, policy changes were more frequent in the area of general policy followed by improvement of water quality, while fewer policy changes focused on water quantity (Figure 2). A number of responding countries changed policies concerning nutrient management to improve water quality, likely to respond to the fact that nutrient loads from agriculture is still identified a major concern by these countries. For example, Denmark changed its regulation to adopt a more targeted approach focused on watersheds that are threatened by nitrogen pollution. EU Member States implemented action plans for vulnerable zones according with nitrates directive.

Figure 2. Proportion of individual policy changes by water policy area and type of country

Ratio of policy change by total number of questions



Source: Authors, based on survey responses.

Most responding countries reported an increase in water-related natural disasters such as droughts and floods since 2009, however this trend did not translate into an increase in the total number of agriculture and water policy changes related to the management of water related risks. Furthermore, only six countries identified key changes in policy related to risk management. Among those, the United States established the National Drought Resilience Partnership in 2016 motivated in part by several multi-year drought events that impacted production across major agricultural regions. The partnership is a collaboration between the US Department of Agriculture, National Oceanic and Atmospheric Administration, US Department of Interior, US Environmental Protection Agency, and other US federal agencies focused on building long-term drought resilience by helping communities better prepare for future droughts and reducing the impact of drought events on livelihoods and the economy.

Regional differences, especially regarding availability of water, played a role in the observed trends in policy changes (Figure 2). Relatively water scarce countries made more policy changes related to water quantity than the overall set of countries and OECD countries. Conversely, relatively water abundant countries, for which pollution is a more visible and potentially important problem had proportionally more policy changes related to water quality than OECD and overall average of responding countries. Responding countries in Asia and Europe had a relatively higher proportion of policy changes related to water quality, whereas countries in Central and South America and Oceania undertook significant number

of changes related to water quantity. The proportion of changes related to water risk management was higher in North America and Europe.

On the whole, however, the survey response indicates that between 2009 and 2019, responding countries undertook policy changes on only 35% of the agriculture and water issues that the survey investigated. These countries responded that they had not made any change in policy in 42% of cases, while on the remaining 23% of the total policy change questions were left unanswered. These general results suggest that agriculture and water remains a domain where policy changes are not frequent, perhaps because policy cycles exceed ten years. Alternatively it may suggest that existing policies are already adapted to the changing water risks. Responses related to the status of policies suggest however, that there are still significant gaps in agriculture and water policies in many of responding countries. On average, 37% of what could be considered features of water policies focusing on water quantity, quality and water risks were missing in responding countries.[8]

The following subsections describe in more detail trends in policy changes related to the four areas of agriculture and water policy covered in the survey, with examples of changes.

General changes in agriculture and water policy and governance

Water governance – deciding which level of government does what and how – plays an essential role in ensuring that agriculture and water policies can function effectively. Since 2009, less than half of the responding countries undertook key changes in water governance relevant to agriculture. Most changes occurred at the national level and water basin level with implications at more regional and local levels. For instance, Poland's Water Law of 2017 introduced a new centralised structure for water administration bodies that has 11 regional and 50 river basin units and 330 water inspectorates under the State water holding company, Polish Waters. In Portugal, the Inter-ministerial Commission for Water Coordination was created to facilitate coordination among policy makers, regional entities responsible for water governance, and related sectors in order to facilitate the implementation of actions defined in the National Water Plan and Management Plans for Hydrographic Regions.[9]

Ensuring the coherence of agriculture, water and other related policies is a determinant of the expected impact of policy changes. Just above half of the countries introduced measures to increase the coherence of their policies with agriculture and water objectives. In European Member States, the objectives of water management are taken into account in several measures by the Regional Development Programme under Pillar II of the Common Agricultural Policy. The European Union's implementation reports of Water Framework Directive also include the impact of agriculture on water. Similarly, New Zealand's National Policy Statement for Freshwater Management introduced in 2011 and updated in 2014 and 2017 takes into account of regional policy plans.

Robust data and information help guide water policy decision-making and successful planning and implementation of policies that support efficient, effective and sustainable water resource governance. About half of the responding countries reported changes in their measures towards research, modelling and forecasting. A number of the reported initiatives focused on agricultural sustainability such as reducing

[8] Key features are defined here for water quantity as: the presence of future targets, that account for climate change, the presence metering, monitoring and reporting of water use, water rights unbundled from land rights, the presence of scarcity pricing, water efficiency programmes accounting for environmental flows, and collective rights. For water quality this encompasses having targets for quality, tools that are spatially adjusted, multiple policy instruments, and clear enforcement mechanisms. For water risks this encompasses accounting for climate change in water decisions (scores above 2.5/5), and the presence of limits to compensate for droughts and floods.

[9] Although legislation has been introduced, the Commission is not yet operational.

water pollution and reducing the impacts of climate change impacts. For instance, Australia has been conducting projections of climate change impacts on water resources. Costa Rica's National Meteorological Institute has also built scenarios on the future vulnerability of water resources due to climate change. Denmark updated the national nitrogen leaching model, which improves the knowledge of the diffuse loss of nitrogen from agricultural land to the sea. A national map of retention of nitrogen from land to sea has been also improved to support the targeted nitrogen regulation.

Innovation and research and development (R&D) have important roles to play in promoting more efficient and sustainable water management. Since 2009, most of the countries undertook R&D initiatives in at least two agricultural and water management areas, particularly on water quantity and water quality. Most often, these innovation and R&D efforts were concentrated in areas which mattered most to the specific countries. For instance, on water quantity, Italy and Spain engaged in efforts aiming to improve irrigation tools and infrastructure. Cabo Verde and Turkey studied the reuse of treated wastewater in agriculture. In the United States, the United States Geological Survey has conducted extensive regional analysis of groundwater availability across the country as part of the National Water Census initiative. On water quality, Denmark, Estonia, Lithuania and Poland conducted research on nutrient management. Latvia, together with other states of the Baltic Sea region, is implementing projects towards a holistic drainage management for reduced nutrient inflow to the Baltic Sea and smarter water management practices in agricultural landscapes of the Baltic Sea Region, such as WaterDrive, Nutrinflow, GreenAgri and Manure Standards (Tamm et al., 2016[22]; Manure Standards, 2020[23]; Water Drive, 2020[24]; NUTRINFLOW, 2020[25]; SuMaNu, 2020[26]) .

Managing water use in agriculture

Most recent data suggest that agricultural water use in OECD countries has moderately increased since 2009, but also shows that much of the growth in agricultural water use occurred in countries such as Mexico and Turkey, where agriculture consumes a large amount of water (OECD, 2019[27]). Moreover, illegal water abstraction is a concern for one-third of responding countries. Moving towards more efficient and effective management of the water resource in agricultural sector is essential.

Water allocation regimes allow right holders to abstract, divert, impound, store or use a specified quantity of water from a natural source (FAO, 2004[28]; OECD, 2016[17]). The survey indicates that Australia and Poland were the only countries that significantly changed their water allocation regimes in the past ten years, with many other countries changing elements thereof. For both surface water and groundwater, licencing schemes are the most commonly used water allocation systems in responding countries, and the national level authorities mostly grant these rights. Total water allocations can be defined as a fixed volume or a proportion of available water. In Hungary, water licences are needed for all water usage activities under the Water Management Act, and are issued based on the assessment of the quantitative and ecological status of the water body by the Regional Water Authorities. With a licence, farmers are entitled to use the allocated amount of water for a predefined period of time. Turkey's water user organisations determine the amount of water that will be needed through the plant pattern and inform the General Directorate of State Hydraulic Works (DSI), who issues water use licences and allocates the quantity of irrigation water.

In more than half of the responding countries, these water entitlements[10] are owned by a combination of farmers and water suppliers for both surface and groundwater. The separation of water rights from land

[10] Water entitlements refer to entitlements "to abstract and use water from a specified water resource pool" (OECD, 2016[17]). They may also be defined as water rights, water users' rights, water contract or abstraction licences or permits (Ibid).

ownership is necessary for flexible reallocation of water rights. Of the responding countries, 67% separate surface water entitlements from agricultural land ownership, and 62% separate them for groundwater entitlements. Changes in this area were only documented in five countries for surface water (Belgium, Czech Republic, Greece, Netherlands, and Switzerland), and two for groundwater (Greece and Switzerland). In Australia, most surface water entitlements are separated from land and can be traded, and most states' groundwater rights have been separated to the extent that water can be traded between properties using the same aquifer.

Less than 50% of responding countries report that they charge water users to recover the cost of water supply in agriculture. For surface water, most countries with water charges use a mixed system of fixed charge and a variable volumetric charge above a certain threshold rather than per hectare (flat rate) water charge. Current implemented water charge systems are diverse. In Germany, farmers who abstract water directly pay a water abstraction fee to the federal states based on the abstraction volume, and farmers who use water from water networks pay a full cost charge to the operator of the network according to its metered water use. Portugal is one of the five countries that changed charging instruments in the last ten years. It now employs a Water Resources Tax, whose value is calculated based on abstractions volumes. In the absence of information on the volume of abstraction, the maximum volume described in the permits or other proxies for water consumption are used. In the case of groundwater, 36% of the responding countries reported to have policy instruments such as allocation (permits), taxes, charges, and agri-environmental payments to recover water costs.

Despite these efforts, however, water cost recovery remains largely imperfect in responding countries (Table 2). In most cases, countries partially recover operation and maintenance costs and/or capital costs. Under the EU Water Framework Directive, EU Member States are required to ensure that the water prices charged reflect the full costs (e.g. operation and maintenance costs, capital costs, environmental and resource costs), although full recovery is not required and derogations are possible for less-favoured areas or on grounds of social welfare. In Germany, operation and maintenance as well as capital costs for abstraction are borne fully by operators and the federal states set different abstraction fees, some of which internalise parts of the environment and resource costs.

Table 2. Water cost recovery in responding countries

		Operations and maintenance cost recovery	
		Less than 100%	100%
Capital cost recovery	Less than 100%	Chile, Korea, Mexico, Norway, Portugal, Spain, Switzerland	Costa Rica, France, Italy, Japan, United States
	100%	Australia, Turkey	Austria, Denmark, Estonia, Finland, Germany, Israel, New Zealand, Sweden, United Kingdom

Note: The cost recovery had not been assessed in Lithuania. Cabo Verde does not license surface water, No responses were given by Belgium, Colombia, Czech Republic, Iceland, and Latvia. The European Union requires full cost recovery under the Water Framework Directive.
Source: Authors, based on survey responses.

In other countries, some innovative approaches have been implemented. For instance, Israel's Water Authority implements set tariffs that reflect the combined costs for all freshwater used in agriculture whether from surface, groundwater or desalinated water. Some responding countries are also making efforts to account for costs and externalities of water. For example, in Costa Rica, water charges take into account the "beneficiary pays" principle; charges account for the value of abstraction, and environmental services, which are differentiated by the type of use, and also groundwater and administrative costs.

Only about 40% of the countries responding to the survey have established quantified national future planning and targets. Policy developments related to planning were observed in 33% of the responding

countries during the last decade. At the same time, 81% of those countries reported that they factor in the effects of climate change in their water quantity policy targets. Portugal reprogrammed its Rural Development Programme (2014-2020) and aims to have 18% of its farmland equipped with more efficient irrigation systems by 2020. This target is supported with knowledge transfer and innovation actions, investment in infrastructure and equipment, and good irrigation and soil practices. Turkey has begun preparation of the Sectoral Water Allocation Plans, and water demands by sector are calculated considering both historical water shortages and effects of climate change on water resources.

Quantitative regulations are the most frequently reported policy instruments used to manage agriculture water demand (59%) followed by pricing (44%). Market mechanisms are used in five countries, Australia, Chile, Mexico, Spain and the United States. Australia and Spain implement all three types of policy instruments. However, less than 50% of the countries answered that they have changed their policy instruments to manage water demand in the past decade. Water pricing or market mechanisms that are related to the scarcity of water can help discourage the depletion of water resources by irrigators. Results from the survey show that 62% of the countries that have water pricing instruments, adjust their pricing mechanisms by region or seasonal conditions to signal water scarcity and encourage water use efficiency. Australia's market mechanism reflects water scarcity factors, geographical limitations and demands of the crops grown in those regions. In Chile, in addition to an active market for water rights, an auction process is used to allocate available water quotas when existing water exceeds water rights. There is a growing use of water trading in the United States, such as programmes in Arizona, California, and Colorado, while other measures have been applied to some cases, such as federal and state funding to retire water rights in over-appropriated sub-basins.

Effective water demand policies generally require metering, monitoring and reporting. Water abstraction is fully or partially metered, monitored or reported in less than half of responding countries. Japan applies metering, monitoring and reporting for most of surface water use and Belgium for all groundwater use. In the case of Belgium, every groundwater extraction site is required to have a water flow meter including groundwater abstractions used for irrigation in agriculture and horticulture since 2010.[11] Improvements in the use of these three mechanisms of water use oversight occurred in about 40% of the countries in the past ten years. For example, Chile's water law was modified in 2018 to increase enforcement capabilities to the General Water Directorate, requiring metering and reporting water extraction level from all users using sensors with online reports.

Less than 30% of responding countries changed their enforcement mechanisms since 2009 to ensure compliance with abstraction permits. In Cabo Verde, water quantity control is conducted on a monthly basis and reported to an improved database. In Chile, online reporting to the General Water Directorate is mandatory on a gradual basis since 2018 and the Directorate is implementing a software for data analysis and to trigger actions if needed. In Israel, inspectors of water authority can now investigate the violations of the water law and rules.

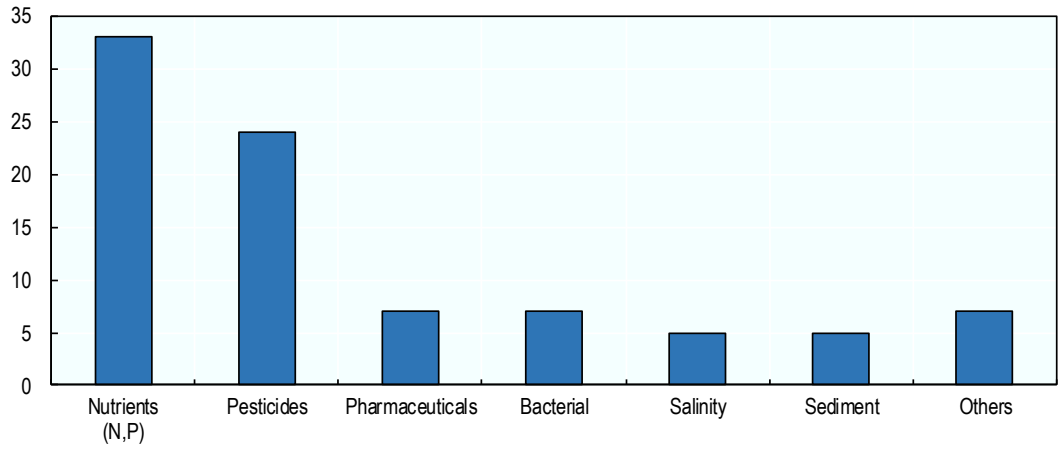
Reducing water pollution from agriculture

Almost all countries identify nitrates and phosphorus from mineral fertilisers and animal waste as the most problematic source of agriculture pollution of water. Pesticides from agriculture also remain an important pollutant in many responding countries. Salinity is also considered a key water quality problem in some countries, and pharmaceuticals such as veterinary drugs have become an emerging significant water pollution problem from agriculture (Figure 3).

[11] Except sites equipped with a hand pump, drainage required for pasture use and abstraction for domestic purposes up to a maximum of 500 cubic meters per year.

Figure 3. Key pollutants of concern coming from the agricultural sector

Number of countries listing a particular type of pollutant



Source: Authors, based on survey responses.

Different tools are used to track water quality; 72% of responding countries employ chemical monitoring, followed by remote sensing or modelling. Of the responding countries, 67% improved their data collection efforts over the 2009-19 period. For instance, Austria increased the number of pesticide parameters in its monitoring system. Spatial tools (e.g. topological, geometric, or geographic data analysis) are also used in 59% of the responding countries to target areas where water quality impacts stemming from agriculture are most acute. In particular, Portugal uses geographic information system (GIS) tools and spatial analysis to evaluate water quality compliance and to model diffused pollution from agricultural areas. A large majority of countries (74%) using these tools introduced or improved them after 2009.

About 70% of responding countries reported setting quantitative targets, objectives, or plans to improve water quality in the agricultural sector, but their level of applications – national, regional or water basin – vary widely. In Australia, all states and territory governments have established water quality targets, objectives and plans in regulation or other policies or both. Eighty-five per cent of countries with targets introduced or revised these water quality targets, objectives or plans in the past ten years. This is the case of most EU Member States. For example, the Czech Republic revised its nitrate vulnerable zones in its action plan in 2016.

To respond to water pollution, most responding countries use a combination of policy instruments, although regulations are the most widely used policy instrument (85%). Seventy-six per cent of these countries with regulatory frameworks changed their regulations since 2009. For example, Poland revised its Water Law in 2017 to introduce new fertiliser management to reduce water pollution caused or induced by nitrates from agricultural sources as part of its application of the Nitrates Directive. Additionally, information and economic instruments are used by more than half of the responding countries (Figure 4).

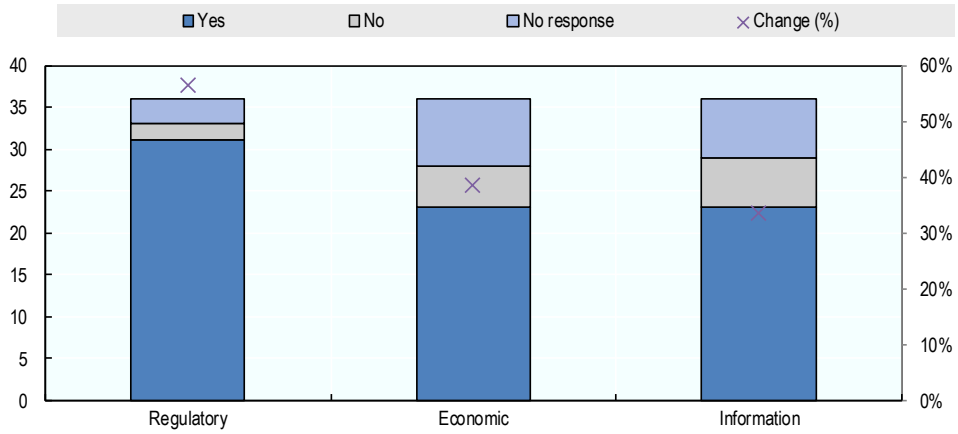
In 72% of responding countries, enforcement measures are in place to better control water quality in agricultural sector. In the Czech Republic, breach of the Water Law, such as unauthorised discharge of polluted water, is subject to fine. Like in other EU Member States, farmers have to comply with an action plan for nitrate vulnerable zones (NVZs). Reports of the implementation of NVZs are reported to the European Commission under the Nitrates Directive. Inadequate compliance can lead to European court litigation. Farmers risk losing support if they do not comply with the rules under the nitrate vulnerable zone

action plan. In the United States, the National Pollutant Discharge Elimination System regulates pollutant discharges from agricultural point sources, including concentrated animal feeding operations.

Good water quality is also essential to maintain healthy ecosystems. To protect and promote sustainable use of water-related ecosystems in and around agricultural areas, 85% of responding countries have set regulatory frameworks and 79% use support payment schemes. Agri-environment-climate measures under the EU's Rural Development Programme 2014-2020 included support payment programmes for protecting selected natural habitats for organisms dependent on water. Beneficiaries voluntarily undertake five-year commitments to implement certain requirements that lead to habitats' protection.

Figure 4. Type of water quality policy implemented in responding countries and policy changes, 2009-2019

Number of countries using the respective policy instruments and the percentage of reported policy change

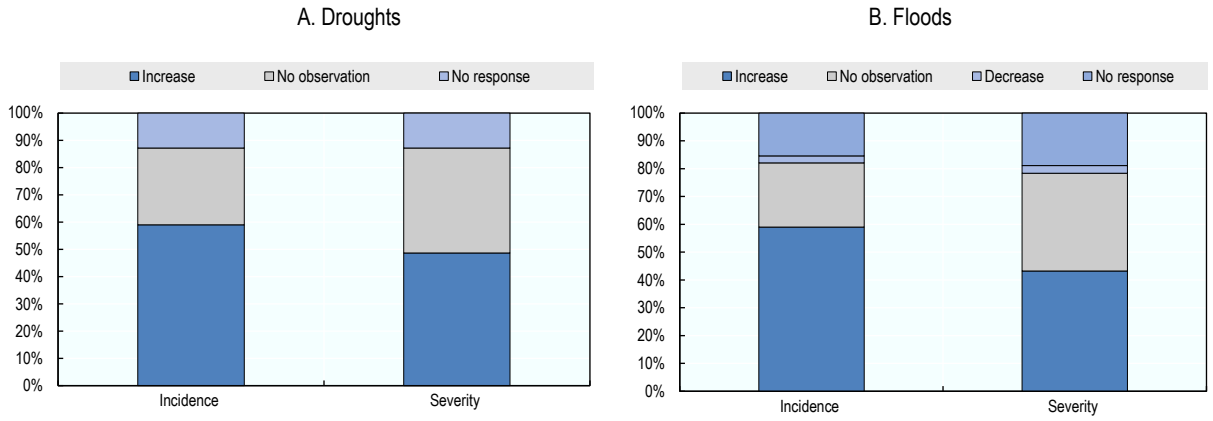


Source: Authors, based on survey responses.

Managing agricultural water risk and disasters

Most responding countries reported an increase in the incidence and severity of droughts and floods in the past decade (Figure 5). Recent events support this trend; the hot and dry 2018 and 2019 summers damaged agriculture across central and northern Europe, severe droughts continue to affect agriculture over Europe's Mediterranean region, while Japan's heavy rainstorms triggered the deadliest floods since 1982, leading to damage valued at about USD 3 billion for the agricultural sector (MAFF, 2019[29]).

Figure 5. Trend of water-related risks, 2009-2019



Source: Authors, based on survey responses.

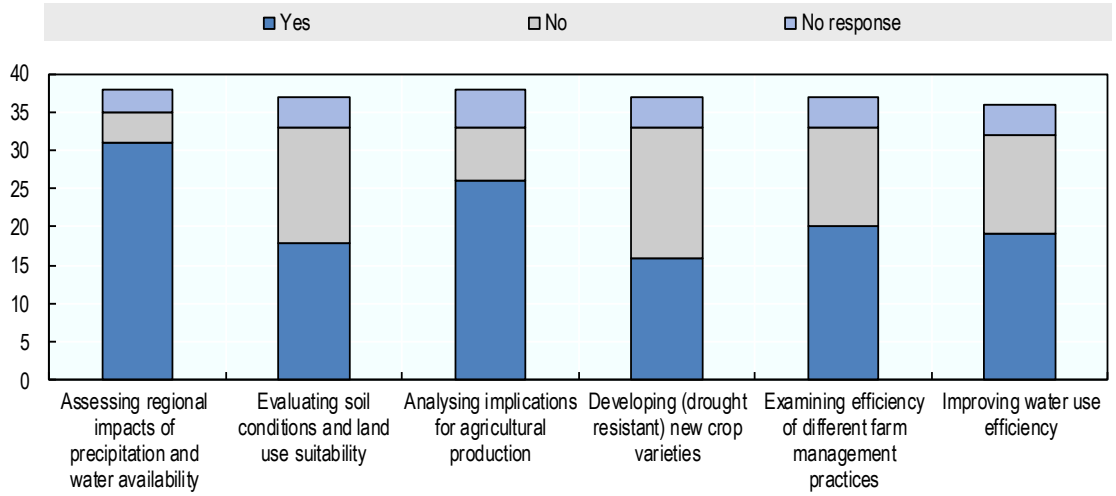
With extreme weather affecting the agricultural sector, almost all responding countries account for climate change impacts in their agriculture and water policies. Public R&D efforts on climate change in agriculture and water focus on the assessment of regional impacts of precipitation and water availability, followed by the analysis of their impact on agricultural production (Figure 6). However, the degree of incorporation of climate change consideration into policies varies greatly across responding countries, probably commensurate with their respective projected impacts. For example, after establishing a Climate Change Law, the National Climate Change Adaptation Plan and the Adaptation Roadmap, Colombia is formulating a Comprehensive Climate Change Management Plan for the Agricultural Sector. Latvia has approved a Climate Change Adaptation Plan until 2030 which includes a specific section for agriculture. The plan includes seven agricultural measures and two measures related to water management. However, only 20% of responding countries reported an increase in the importance of climate change considerations in agriculture water management decisions. The degree of considerations for climate change concerns remained unchanged in 36% of the countries during the last ten years.

Many responding countries have policy instruments for mitigation of, and adaptation to, droughts. In particular, 64% of the countries implement payments to prepare and reduce the impact of droughts. Support is provided for a range of projects including practices that reduce soil erosion and retain soil moisture, reservoirs and irrigation facilities to conserve water, farm advisory services and educational programmes for preparation of drought readiness, response and recovery. For instance, the United Kingdom provides grants to build up reservoirs and to support the use of equipment for water use efficiency, and the United States provides support for irrigation infrastructure, e.g. via improved on-farm irrigation application and off-farm water conveyance technologies, to address water scarcity problems.

Other policy instruments are used by 69% of respondents to manage droughts, including educational programmes and advisory services on irrigation and good practices. Some countries affected by recent droughts changed their existing drought policies. For instance, Korea has introduced drought-warning systems, and bolstered the preparation of the agriculture disaster indemnity. Spain has applied a sophisticated system of water scarcity indicators using satellite data. Among other measures, Denmark has been revising its rules and regulations on water abstraction to be able to respond rapidly to dry conditions.

Figure 6. Focus of major public funded research related to water availability to agriculture, 2009-2019

Number of countries conducting the respective public research



Source: Authors, based on survey responses.

At the same time, 74% of respondents implement policies to manage flood risks through a combination of mitigation and adaptation policies. As in the case of drought, the type and scale of policies varies widely among responding countries. For example, Colombia, Costa Rica, Estonia, the European Union, Italy, Latvia, New Zealand, Norway, Portugal, and Spain have developed national flood risk management plans or frameworks that include plans for agriculture sector. Other tools include creating hazard maps (Japan and Poland) and flood 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. Other countries do not report having direct policies to manage flood risk, but these risks are indirectly addressed through other agriculture and environmental policies. 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.

Various disaster assistance programmes are available to affected farmers in European countries who 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 provides support for clearing ground after major flooding. However, the survey also finds that less than a half of the responding countries define lower and upper limits for natural disaster relief support.

3. Alignment of agriculture and water policy changes with international commitments

The survey used in this study covered all the relevant sections of the OECD Council Recommendation on Water and the 2017 G20 Ministerial Action Plan. Yet, the questions it included did not directly ask countries whether their policies were aligned with these international commitments, for two main reasons. First, the survey was designed to track policy progress since 2009, so it used questions from the 2009 survey that were designed before the adoption of the 2016 OECD Council Recommendation on Water. Second, the OECD Council Recommendation on Water is a concise document with general articles aiming to cover all areas of water management. These articles are not always easy to match with specific information on agriculture and water policies. Similarly, although it focuses on agriculture and water, the paragraphs of the 2017 G20 Action Plan are broad enough to encompass different policy options.

A method was developed to resolve these differences and determine whether reported policy changes are converging or diverging with OECD and G20 policy commitments. As explained in detail in Annex A, the "vector analysis" approach allows survey results on policy changes to be turned into alignment indices or scores (representing direction and amplitude of the changes) with relevant articles of the OECD Council Recommendation on Water, and, for G20 members, with relevant provisions of the G20 Agricultural Ministerial Action Plan. These alignment indices are also able to capture the alignment status of agriculture and water policies in each country with relevant articles of the OECD Council Recommendation on Water in 2009 and 2019. For both policy changes and policy status, the indices are normalised from 0 to 1, with 0 representing a situation of misaligned policy or no change in alignment and 1 fully aligned policy or policy change.

As caveats, the alignment indices should be interpreted as relative distance with the ambition of specific commitments, they do not have any meaning in absolute term (Annex A.1). Second, they are directly dependent on the data obtained from responses to the survey – with the exception of complementary information derived from the OECD producer support estimates for a few articles – so their validity depends on the quality of survey responses. Third, despite adjustment made to address qualifiers such as " where appropriate" or "where possible" in the text of Chapter 8 of the OECD Council Recommendation on Water covering water pricing, indices of alignment in this area need to be interpreted with caution.

Section 3 discusses the results of the analysis with respect to alignment the OECD Council Recommendation on Water and analyses the findings on the alignment of G20 members' policy changes with the 2017 G20 Agriculture Ministerial Action Plan.

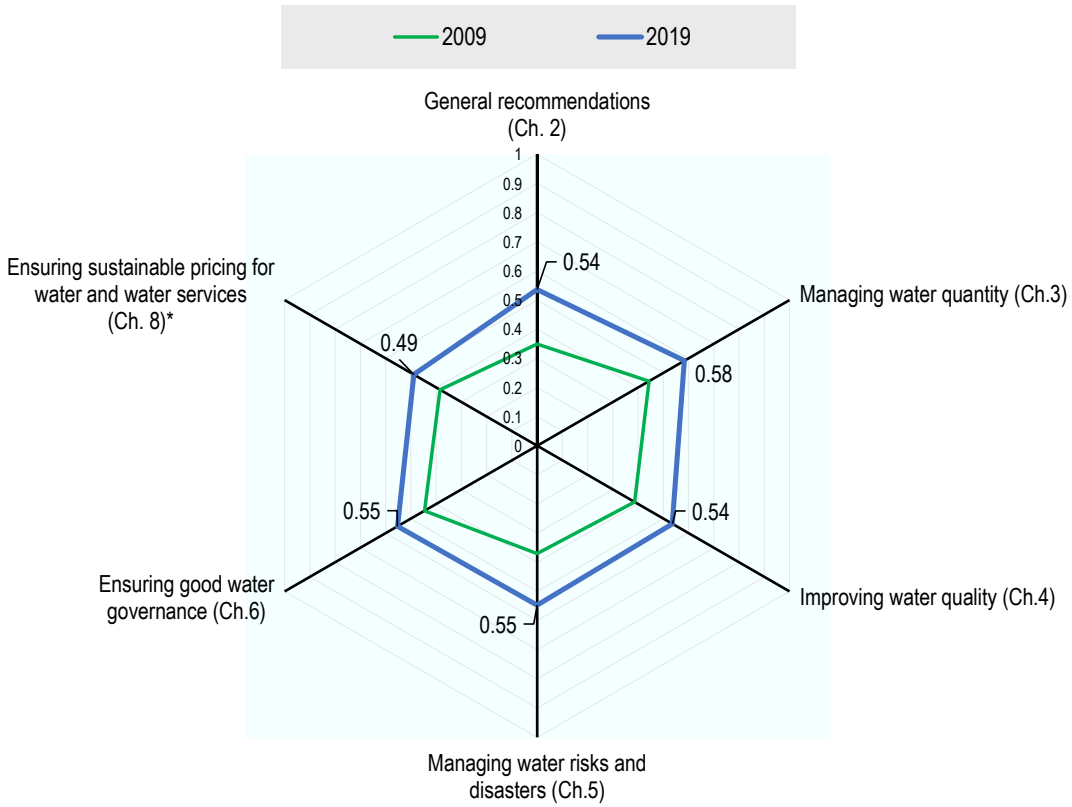
Alignment of policy changes with the OECD Council of Recommendation on Water

The assessment indicates an overall increased alignment of agriculture and water policies with relevant chapters of the OECD Council Recommendation on Water (hereafter "Council Recommendation on Water"). First, the average score for all considered countries increased between 2009 and 2019 for all the concerned chapters of the Council Recommendation on Water (Figure 7), which implies an overall increased alignment in all the relevant areas of the text. Second, average scores for all chapters increased for all of the countries, which implies that on average, all concerned countries changed, at least partially, their policies in the direction of the Council Recommendation on Water between 2009 and 2019.

These positive conclusions, however, mask significant nuances. First, the levels of alignment of the whole group of countries remains limited (Figure 7). Despite observed alignment efforts, particularly with regard to general recommendations and water risk management, the group's alignment scores reach just above 0.5 for the chapters on general considerations (0.54), water quantity (0.58), water quality (0.54) and water risks (0.55). This essentially means that just above half of the countries' responses to questions are aligned with the relevant recommendations. The lowest scores related to Chapter 8 (0.49), despite adjustments likely to inflate the average (Annex A.1.2), shows that more effort is required in this direction by responding countries.

Figure 7. Overall alignment of agriculture and water policies with specific chapters of the Council Recommendation on Water in all 39 considered countries, 2009 and 2019

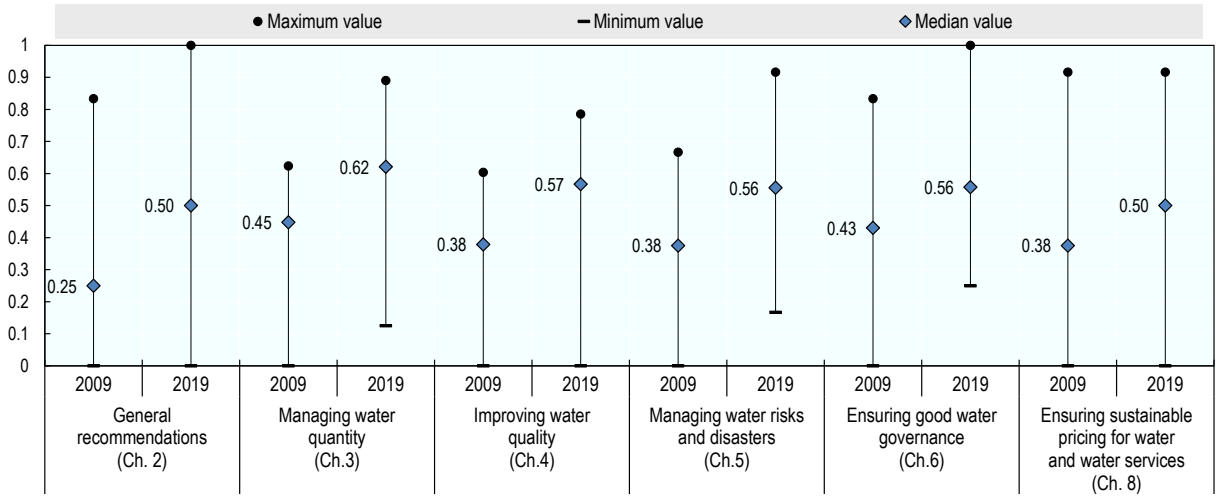
Indices range from 0 to 1, higher indices (outside) indicate a higher alignment



Note: * Chapter 8 indices of alignments were adjusted to account for text caveats, but they remain imperfect and should be subject to cautious interpretation.
Source: Authors, based on responses from the survey.

Figure 8. Range of value and median of alignment indices by chapter of the Council Recommendation on Water in all countries, 2009 and 2019

Indices range from 0 to 1, higher indices indicate a higher alignment



Note: * Chapter 8 indices of alignments were adjusted to account for text caveats, but they remain imperfect and should be subject to cautious interpretation. Countries with no response on certain chapters are omitted in the computation.
Source: Authors, based on responses from the survey.

Going beyond average levels, there are also significant differences in the range and distribution of alignment indices by chapters (Figure 8). In particular:

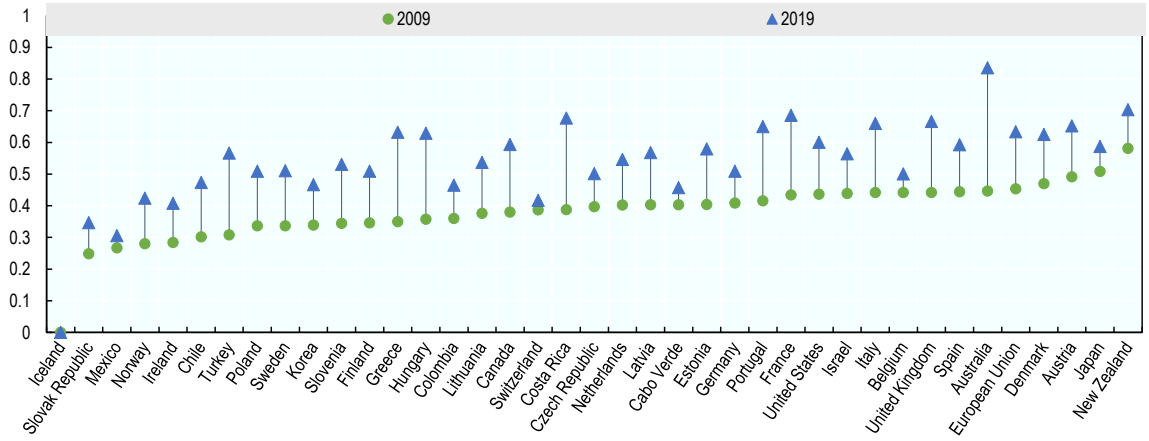
- The largest progress in average alignment indices is observed for general policy recommendations (Chapter 2), with a doubling of the median index of alignment from 2009 to 2019. Many countries upgraded and improved the dissemination of tools to support decision making on agriculture and water, a significant number also increased the coherence of their policies for water quantity and water quality. However, the index has the greatest range and variance in 2019, suggesting that a number of countries' policies remain below the expectations of the Council Recommendation on Water.
- As noted in Figure 7, 2019 policies of surveyed countries are most aligned with the Council Recommendation on Water in the area of water quantity management (Chapter 3). Figure 8 shows that this is due to the fact that policies in this area were already relatively well aligned with the Council Recommendation on Water in 2009 (median index of 0.45). Part 2 of this report shows that this progress may be due to fewer but important policy changes.
- Surveyed countries made the largest number of individual policy changes in the area of water quality management (Chapter 4) from 2009 to 2019 (Part 2). Yet Figure 8 shows similar increases in median and maximum indices, suggesting that improved alignment was largely driven by policy changes in countries with relatively higher scores in 2009. At the same time, the maximum score in 2019 is the most distant from the maximum value of 1, suggesting that progress is still needed for all countries in this area.
- Although indices in this area should be interpreted with caution, Figure 8 indicates that the least progress may have been achieved for policies related to water pricing (Chapter 8) and that such progress was driven by countries moderately aligned with this area of the Council Recommendation on Water in 2009.

Average alignment scores and their evolution also widely differ by country (Figure 9). The largest alignment efforts are observed in an heterogeneous set of countries, including some that were relatively well aligned (e.g. Australia, Italy, France, Portugal or the United Kingdom), moderately aligned (Costa Rica), or relatively less well aligned (Turkey, Greece, or Hungary) compared to others in 2009 (Panel A). The 2019 alignment indices were also found to be homogenous among surveyed countries (Panel B) with only a few countries being separated from the general trend line.

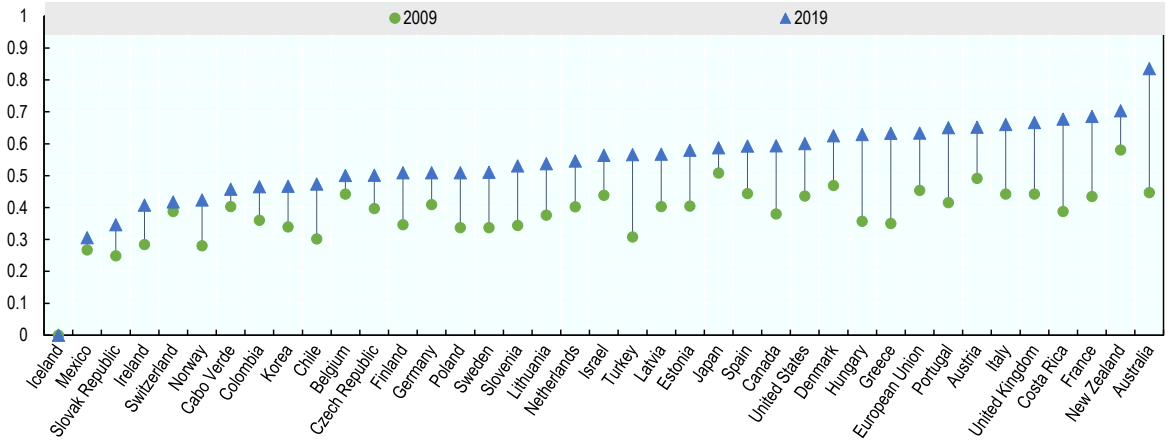
Figure 9. Average alignment of agriculture and water policies with the Council Recommendation on Water by country, 2009 and 2019

Indices range from 0 to 1, higher indices indicate a higher alignment

(A) Ordered by status in 2009 to highlight changes



(B) Ordered by 2019 status

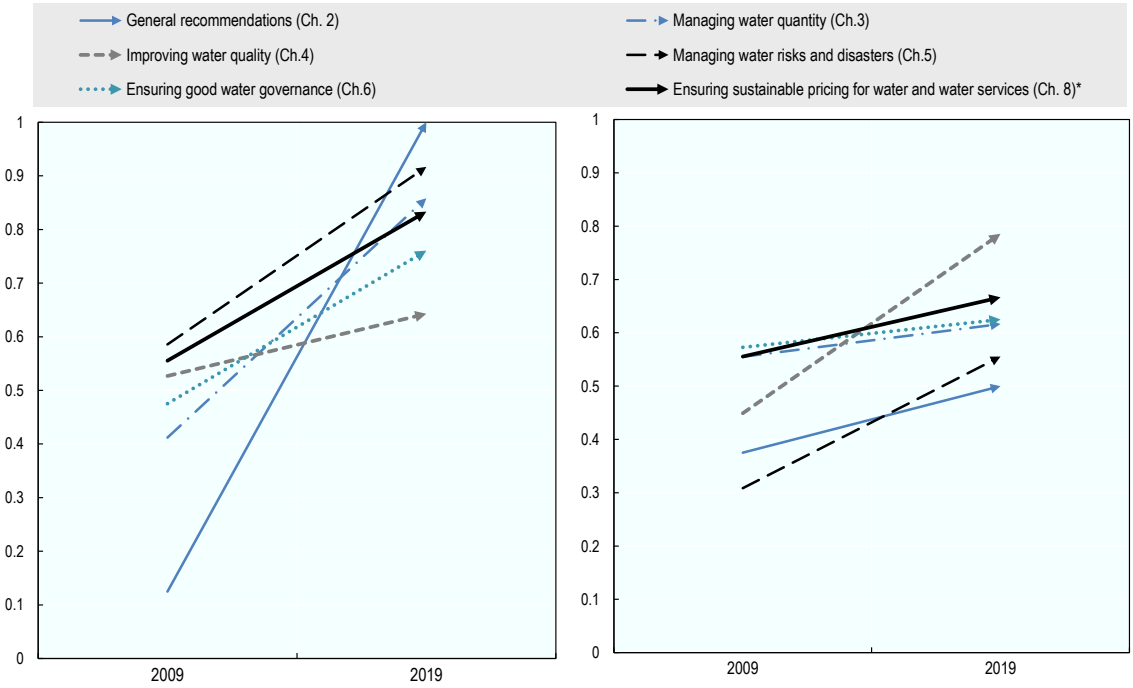


Note: Average indices have been adjusted to cope with the heterogeneity in response rates for each chapter. Chapter 8 indices of alignments were adjusted to account for text caveats, but they remain imperfect and should be subject to cautious interpretation. The EU score is based on partial data as policies are primarily defined at member state level.
Source: Authors, based on responses to the survey.

When looking more at details, specific degrees of alignment vary by area and country. For instance, as shown in Figure 10, Australia's adoption and implementation of the Murray-Darling Basin Plan in 2012, and associated measures, contributed to higher alignment especially with the general recommendation, water risks and water quantity chapters of the Recommendation. In contrast, Denmark's continued improvement of water pollution, with the introduction of more targeted instruments in particular, and its use of regulations and pricing (Box 1), placing it among the leading responding countries in terms of alignments with the water quality chapter.

Figure 10. Alignment of agriculture and water policies with the Council Recommendation on Water: Australia (left) and Denmark (right)

Vectors represent policy changes, indices range from 0 to 1, higher indices indicate further alignment



Note: Chapter 8 indices of alignments were adjusted to account for text caveats, but they remain imperfect and should be subject to cautious interpretation.
Source: Authors, based on survey responses.

The same pattern can be seen depending on countries' relative water status. Countries that are relatively water stressed in the group – such as Chile, Cabo Verde Greece, or Korea – have increased their alignment with the recommendations of Chapters 3 and 5, covering water quantity and water risk management. In contrast, many relatively water abundant countries – such as Canada, Ireland, the Netherlands, or Poland –experienced policy changes that were more aligned with the Recommendations' Chapter 4 on water quality, perhaps because this is a more visible and relatively important issue. Although this distinction is not applied to all countries, the overall average alignment indices for these two groups of countries followed the same pattern. The alignment scores for these and other countries are shown in Table 3. While some individual policy changes scored negatively when assessed with respect to specific recommendations, prompting cases of misalignments, average changes per chapter are overwhelmingly positive (except for PSE variables assessments in some cases for Chapter 8).

Box 1. Progressing towards the Recommendation: Agriculture and water quality regulations in Denmark

Denmark is employing a combination of policy instruments to limit nutrient losses from agricultural activities to the aquatic environment. This includes the following policies.

- **Farm nitrogen quotas**: The majority of farmers in Denmark are obliged to register in the Danish Register of Fertiliser Accounts. In the fertiliser plan, the annual amount of nitrogen fertiliser permitted to be applied is calculated for the farmland registered. For this reason, the overall nitrogen quota depends on the specific crop, but also on the type of soil, the pre-crop, climatic conditions, precipitation and irrigation. Nitrogen fertiliser up to the fertiliser quota calculated for the farm for each planned period only can be applied. Farmers are penalised if they apply in excess of the quota. Additionally, the harmony rules entail requirements for a minimum size of farm area for spreading livestock manure from the respective livestock production. The rules implement the European Union Nitrates Directive's requirement to limit the amount of manure per hectare to the amount containing 170 kg of nitrogen.
- **General catch crop requirements:** Farmlands with more than 10 hectares have an obligation to sow catch crops. The farmer may fulfil the requirement by alternative measures such as establishing energy crops and early establishment of winter crops.
- **Targeted measures:** In 2017, Denmark introduced a targeted initiative to reduce nitrogen losses through promoting the targeted establishment of additional catch crops. The scheme consists of a voluntary part but also a mandatory part where targeted requirements for catch crops are set in case the voluntary scheme does not reach its targets. The targeted catch crop scheme implement the European Union Water Framework Directive based on the need to reduce nitrates contents in groundwater bodies and in coastal waters. For catch crop requirement for agricultural land using livestock manure, until 2017, the Danish harmony rules also regulated the application of phosphorus indirectly by setting limitations on manure nitrogen applied to the field. A revised phosphorus regulation was introduced in 2017 introducing directly setting phosphorus ceilings at different levels throughout the country, depending on geographical location and livestock manure type. These ceilings were accompanied by individual requirements for certain farmlands using livestock manure to establish additional catch crops aimed at ensuring the sufficient reduction in nitrogen leaching. The individual requirements are aimed at ensuring the sufficient protection towards nitrogen leaching to sensitive Natura 2000 areas in catchment areas, where the amount of applied manure has increased since 2007, and at contributing to the reduction of nitrogen leaching to coastal water bodies.

Source: Authors, based on survey.

Table 3. Alignment indices by country and chapter of the Council Recommendation on Water, 2009 and 2019

	General recommendations (Ch.2)		Managing water quantity (Ch.3)		Improving water quality (Ch.4)		Managing water risks and disasters Ch.5)		Ensuring good water governance (Ch.6)		Ensuring sustainable pricing for water and water services (Ch.8)[1]	
	2009	2019	2009	2019	2009	2019	2009	2019	2009	2019	2009	2019
Australia	0.13	1.00	0.41	0.86	0.53	0.64	0.59	0.92	0.48	0.76	0.56	0.83
Austria	0.25	0.50	0.56	0.83	0.57	0.69	0.38	0.50	0.63	0.65	0.56	0.75
Belgium	0.50	0.50	0.42	0.55	0.60	0.65	0.21	0.25	0.51	0.55	0.41	0.50
Canada	0.25	0.50	0.57	0.73	0.45	0.75	0.45	0.83	0.18	0.25	0.38	0.50
Cabo Verde	n.d.	n.d.	0.32	0.43	0.50	0.50	0.46	0.61	0.24	0.25	0.50	0.50
Chile	0.13	0.50	0.29	0.59	0.29	0.30	0.31	0.50	0.36	0.45	0.44	0.50
Colombia	0.83	1.00	0.10	0.13	0.00	0.00	0.39	0.67	0.83	1.00	0.00	0.00
Costa Rica	0.25	0.67	0.50	0.83	0.35	0.74	0.43	0.78	0.42	0.56	0.38	0.50
Czech Republic	0.50	0.50	0.41	0.48	0.39	0.56	0.29	0.56	0.42	0.42	0.38	0.50
Denmark	0.38	0.50	0.56	0.62	0.45	0.79	0.31	0.56	0.57	0.63	0.56	0.67
Estonia	0.25	0.50	0.56	0.69	0.46	0.56	0.42	0.63	0.50	0.72	0.23	0.38
European Union	0.25	0.50	0.56	0.67	0.44	0.58	0.41	0.75	0.63	0.80	0.44	0.50
Finland	0.21	0.33	0.40	0.46	0.43	0.57	0.39	0.58	0.30	0.49	0.35	0.63
France	0.25	0.50	0.45	0.89	0.54	0.75	0.29	0.61	0.65	0.74	0.43	0.63
Germany	0.25	0.50	0.46	0.52	0.42	0.50	0.25	0.25	0.39	0.45	0.69	0.83
Greece	0.29	0.50	0.32	0.80	0.47	0.65	0.32	0.56	0.36	0.79	0.33	0.50
Hungary	0.19	0.75	0.39	0.55	0.38	0.56	0.44	0.75	0.50	0.50	0.25	0.67
Iceland	0.00	n.d.	0.00	n.d.	0.00	0.00	0.00	n.d.	0.00	n.d.	0.00	0.00
Ireland	0.31	0.50	0.16	0.19	0.34	0.57	0.26	0.39	0.26	0.30	0.38	0.50
Israel	0.69	0.83	0.56	0.72	0.22	0.33	0.42	0.56	0.44	0.61	0.31	0.33
Italy	0.33	0.67	0.57	0.77	0.37	0.63	0.39	0.56	0.55	0.68	0.44	0.67
Japan	0.75	1.00	0.62	0.73	0.30	0.33	0.67	0.67	0.52	0.54	0.19	0.25
Korea	0.25	0.50	0.46	0.63	0.34	0.42	0.43	0.63	0.48	0.50	0.08	0.13
Latvia	n.d.	0.50	0.51	0.56	0.30	0.64	0.39	0.63	0.43	0.50	0.39	0.58
Lithuania	0.25	0.50	0.52	0.68	0.45	0.68	0.28	0.39	0.45	0.56	0.31	0.42
Mexico	0.00	0.00	0.31	0.37	0.30	0.41	0.38	0.38	0.43	0.43	0.19	0.25
Netherlands	0.38	0.50	0.53	0.72	0.38	0.50	0.41	0.58	0.35	0.48	0.38	0.50
New Zealand	0.50	1.00	0.50	0.55	0.54	0.57	0.42	0.50	0.62	0.69	0.92	0.92
Norway	0.13	0.50	0.32	0.37	0.47	0.56	0.22	0.44	0.37	0.55	0.17	0.13
Poland	0.28	0.33	0.35	0.43	0.27	0.63	0.32	0.50	0.43	0.67	0.38	0.50
Portugal	0.44	0.67	0.45	0.63	0.45	0.65	0.39	0.78	0.40	0.76	0.36	0.42
Slovak Republic	n.d.	0.50	0.24	0.31	0.22	0.35	0.13	0.17	0.24	0.25	0.42	0.50
Slovenia	0.19	0.25	0.41	0.45	0.37	0.57	0.31	0.75	0.42	0.67	0.38	0.50
Spain	0.42	0.67	0.59	0.73	0.37	0.51	0.32	0.46	0.55	0.68	0.42	0.50
Sweden	0.13	0.50	0.60	0.63	0.30	0.51	0.34	0.58	0.28	0.33	0.38	0.50
Switzerland	0.25	0.25	0.46	0.48	0.35	0.44	0.67	0.67	0.32	0.33	0.28	0.33
Turkey	0.50	1.00	0.25	0.54	0.29	0.54	0.29	0.50	0.39	0.57	0.13	0.25

	General recommendations (Ch.2)		Managing water quantity (Ch.3)		Improving water quality (Ch.4)		Managing water risks and disasters Ch.5)		Ensuring good water governance (Ch.6)		Ensuring sustainable pricing for water and water services (Ch.8)[1]	
United Kingdom	0.50	0.50	0.39	0.85	0.41	0.67	0.25	0.42	0.53	0.82	0.56	0.75
United States	0.38	0.50	0.49	0.83	0.49	0.60	0.29	0.50	0.43	0.67	0.54	0.50

Note: n.d.: not determined.
1. Chapter 8 indices of alignments were adjusted to account for text caveats, but they remain imperfect and should be subject to cautious interpretation.
2. Results for Colombia are based on a partially filled questionnaire particularly for Chapters 3, 4 and 8 so results are less comparable to that of other countries.
3. Partial data in some cases as policies are defined at member state level.
4. No change was reported for Iceland, only PSE variables were reported.
Source: Authors, based on the survey.

Due to the presence of contextual conditions in the introduction of Chapter 8 on water pricing instruments, the results of the analysis for this chapter are more difficult to interpret. Without knowing more about countries' interest on the use of such instruments, and their appropriate level in different context, it is impossible to say whether countries with relatively lower scores are actually misaligned with the Council Recommendation on Water. Given that the chosen adjustment method, which only assigns scores for pricing instruments that have been used thus far (Annex A.1.2), mathematically boosts average alignment scores for this chapter, the fact that the average alignment index is low still suggests that there is room for improvement.

Taken together, these results suggest that responding countries have been undertaking policy changes on agriculture and water in line with the OECD Council Recommendation on Water from 2009 to 2019. This evolution is particularly clear when observing that the number of countries with alignment scores above 0.5 increased from two countries in 2009 to 29 countries in 2019. Several responding countries have undertaken policy change that made important steps towards the ambition of the OECD Council Recommendation on Water, including some starting from low levels of alignments in 2009. Other countries have made limited changes in policies or made policy changes that did not change their overall alignment with the Recommendation.

To progress further towards the Recommendation, the governments of responding countries should consider initiating or reinforcing their policies in areas with relatively low alignment indices in 2019. In particular, relatively water abundant countries should pay attention to their approaches to water risks, especially in an increasingly changing climate. All countries, and particularly water stressed countries, should consider making further steps to align their policies with the OECD Council Recommendation on Water to reduce pollution form agriculture. In addition, despite measurement challenges, the results suggest that more efforts may be needed for selected countries to recover water charges and use pricing instruments, where possible, in line with the OECD Council Recommendation on Water.

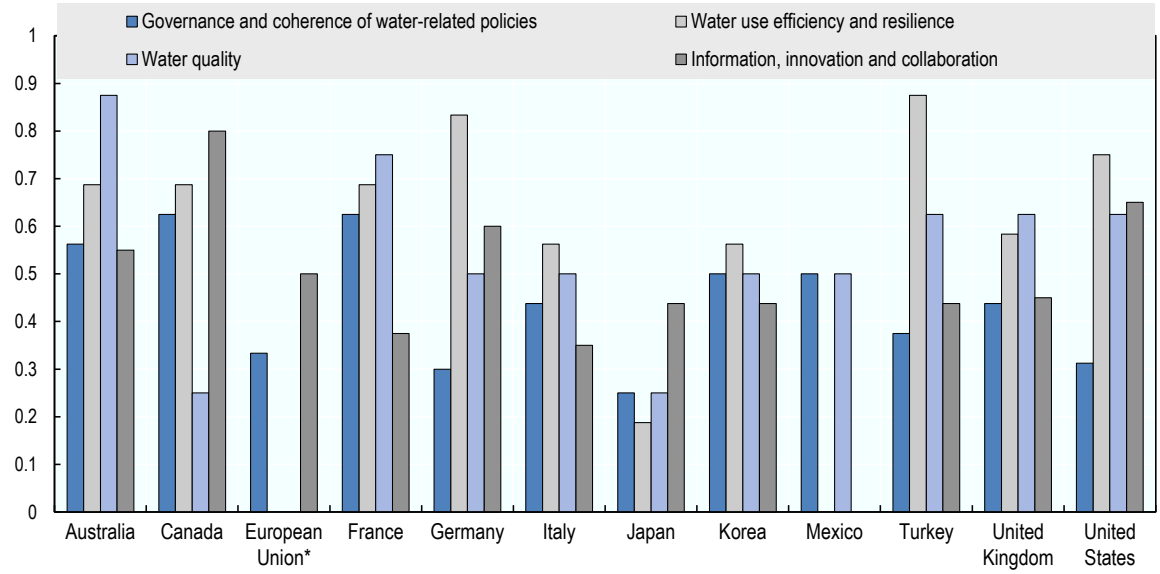
Alignment of agriculture and water policy changes with the 2017 G20 Agricultural Ministerial Action Plan

In analysing the alignment of policy changes with the 2017 G20 Agriculture Ministerial Action Plan (hereafter "2017 G20 Action Plan), responses were gathered from the twelve OECD G20 members: Australia, Canada, the European Union, France, Germany, Italy, Korea, Japan, Turkey, Mexico, the United Kingdom, and the United States. The questionnaire involved fewer questions, in many cases directly related to 2017 G20 Action Plan articles. The focus on policy changes simplified the assessment.

Results from this exercise suggests that policies in the twelve surveyed G20 members are increasingly aligned with the ambition of the 2017 G20 Action Plan (Figure 11). This is true for the four areas distinguished in the 2017 G20 Action Plan: 1) agriculture and water governance and the coherence of water-related policies, 2) the management of water quality, 3) promotion of water use efficiency and resilience, and 4) plans to bolster information, innovation and collaboration.

Figure 11. Alignment of policy changes by G20 members with the 2017 G20 Action Plan

Indices range from 0 to 1; higher indices indicate higher alignment of the change



Note: *Data is missing for the questions on water quality and water use efficiency.
Source: Authors, based on the survey.

While there is variation, alignment scores bear some similarities across member countries. Scores for water governance and the coherence of water-related policies do not vary much, with average alignment indices ranging from 0.3 to 0.6, indicating overall progress towards the ambition of the 2017 G20 Action Plan. Eleven members reported increased alignment on water quality and information, innovation and collaboration, with average alignment scores from the group close to 0.5. This suggests that eleven of the twelve G20 members who responded to the survey have engaged in efforts to improve data and knowledge on water and agriculture and/or to conserve water and soils, albeit differently. The highest but most disparate scores were observed for water use efficiency and resilience, with scores ranging from 0 to 0.9 and significant changes reported by only nine members. This encompasses private and public investments, strengthening efforts to increase the resilience of farmers to water risks, risk management and the reduction of food losses and waste.

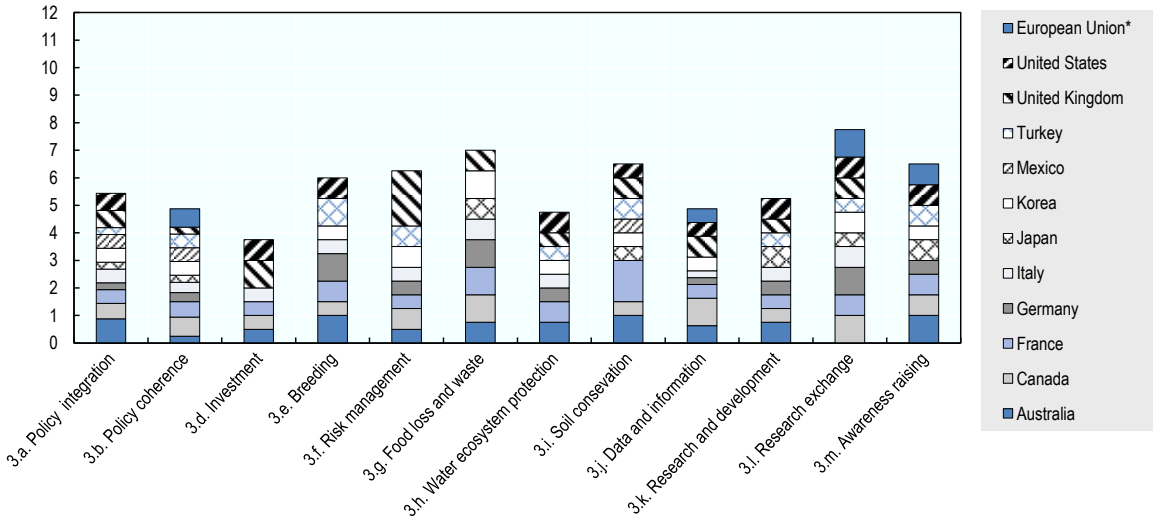
Decomposing alignment efforts by specific articles of the 2017 G20 Action Plan helps to better understand the type of efforts undertaken by each of the G20 members that provided responses to the survey (Figure 12). Policy changes undertaken by Australia, Canada, and France are aligned with over eleven of the twelve studied articles of the 2017 G20 Action Plan. In contrast, Mexico, the European Union and Japan's policy changes are aligned with three, four and seven articles of the 2017 G20 Action Plan, respectively, which may signify either limited policy changes or changes that may not have been aligned with these articles. More specifically, examples of actions undertaken by G20 members for each area of the 2017 G20 Action Plan are shown in Figure 12).

The aggregate alignment scores in Figure 12 also show that the responding G20 members undertook efforts that were more aligned with the articles on research exchanges and reduced food losses and waste than under other articles of the 2017 G20 Action Plan. In the first instance, this may be because research exchanges may have been reoriented towards agriculture and water related issues. Food loss and waste efforts were likely driven by other factors that go beyond the work on agriculture and water. In contrast, few responding members reported significant changes under the investment article of the 2017 G20 Action Plan, which encourages "responsible public and private investment to conserve protect and ensure the sustainable use of water". This may be due to the fact that this type of action may take some time or that it is still not customary among these G20 members. Other areas showed moderate alignment indices, suggesting that some effort has been undertaken by the responding members but more efforts are needed in at least some members to match the ambition of the 2017 G20 Action Plan.

In conclusion, the results of this first assessment of policy changes from twelve G20 economies suggest that progress has been made towards the ambition of the 2017 G20 Agricultural Ministerial Action Plan. At the same time, significant steps were observed only for some countries in specific areas of the 2017 G20 Action Plan, while other recommendations have not been applied significantly in many of the represented G20 economies. This assessment would be more complete, however, to guide discussions and offer opportunities for exchanges, if data were to be obtained from other G20 members.

Figure 12. Alignment of policy changes with agriculture and water sections of the 2017 G20 Action Plan

Indices ranges from 0 to 1 so aggregate indices range from 0 to 12; higher indices indicate better alignment



Note: *Incomplete data.
Source: Authors, based on questionnaire.

Table 4. Examples of actions undertaken by G20 members in different areas of the 2017 G20 Action Plan

Article	G20 member	Example of actions taken since 2009
3.a. Integrate the sustainable use and management of water in food and agricultural policies	United Kingdom	Farming rules for water requires testing for nutrients and encourages the management of soil structure, grants have been offered for farmers towards improved water resource management, rainwater harvesting and water use efficiency.
3.b. Improve the coherence of policies related to water and agriculture	Australia	The 2012 Murray Darling Basin Plan balances social, economic and environmental demands on the Basin's water resources.
3.d. Encourage responsible public and private investment to conserve, protect and ensure the sustainable use of water	Canada	Investment for innovation and science activities and programmes, including, for example, support for research that considers managing water on the agricultural landscape and protecting the quality of water that runs off farms.
3.e. Improve plant and animal breeding to enhance water-use efficiency and resilience	Germany	Promoting national plant breeding projects in terms of water use efficiency and drought stress tolerance and support for international activities.
3.f. Development of cost-effective agricultural risk management instruments	Korea	Building an early warning system for agro-meteorological disasters and promoting preventive measures against such disasters on each plant growth stage.
3.g. Commit to actions that reduce food loss and waste, acknowledging that such actions can alleviate pressure on water	Japan	Setting a target to reduce the edible part of food loss and waste (FLW) originated from the food industry to 50% by 2030, based on the Food Waste Recycling Law and the Act on Promotion of Food Loss and Waste Reduction. Modifying the inappropriate business and consumer practices to reduce FLW.
3.h. Protect water and water-related ecosystems by encouraging water-friendly, sustainable agricultural practices and technologies	Turkey	Adoption of a Code of Good Agricultural Practices for the Prevention of Nitrate Pollution Caused by Agricultural Activities in Waters, which includes measures to protect water from pollution caused by agricultural activities.
3.i. Use, conserve and protect soils in ways that prevent erosion, sedimentation and increased salinisation	Mexico	Efforts towards the conservation of drainage networks in irrigation districts, and setting up of parcel level drainage to reduce salinity.
3.j. Improvement of data and information for sustainable water and soil management	France	Irrigation efficiency (materials, tools for precision irrigation management, genetic selection) and development of agro-ecological farming systems are among priorities of national research and development programmes and of public calls for innovation projects
3.k. Increase support for research and development on agriculture and water	Italy	Funding research projects to develop a tool to support decisions for irrigation water use, and investigating scenarios of adaptation to climate change in Italian agriculture
3.l. Encourage the exchange of research outcomes, technologies and knowledge on a voluntary basis between states and between the public and private sectors	United States	Providing the results of internal and external research in public forums via websites, presentations at conferences, and publications and supporting research findings through onsite demonstration projects and review of practice standards for best management practices eligible for financial assistance.
3.m. Awareness raising	European Union	Organise three workshops of the taskforce on water and agriculture, bringing together all the relevant stakeholders and providing insights into existing initiatives at policy and planning level with some concrete examples and solutions.

Source: Authors, based on survey.

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Annex A. Methodology used to derive indices of alignment

A.1. Measuring alignment: A vector analysis

A.1.1. Policy assessments in comparison with international commitments: Recent developments

Policy indicators are generally used to track progress in a defined direction. This is seen for example in the case of progress of policies towards green growth (OECD, 2015[30]) or green economy indicators (PAGE, 2017[31]). Some indicators aim to measure progress towards specific targets. Qualitative indicators are also used to consider more complex policy information, for instance tracking whether there is a positive or negative influence of certain policies on an outcome. Setting quantitative indicators to track progress in policies (qualitative information) towards policy commitments (qualitative information) is a more elaborate exercise.

In recent years, international organisations have been particularly interested in monitoring policy efforts towards achieving the 2030 Sustainable Development Goals (SDGs) and the Paris Agreement on climate change. The main method they have used relies on the analysis of existing SDG indicators at least for those country where the data is available. For instance, OECD (2019[32]) used a subset of the 255 UN global list of indicators to assess how distant OECD countries are compared to SDG targets. Adherents to the Paris Agreement have set their targets in National Determined Contributions, so even as they can report on progress, these targets largely vary in scope and ambition. Assessing their progress will require to compare plans with achievements, which will be feasible again if the outcome indicators are sufficiently well defined and measurable (GHG emissions typically).

Qualitative matching of policies with multiple objectives has been done in the context of assessing the coherence of existing policies affecting set of related issues. A number of reports have explored policy coherence in the context of the water-energy-food nexus (Tsurita, Burnett and Orencio, 2017[33]; Water in the West, 2013[34]) and other policy areas, such as policy interactions between agriculture and rural development (Diakosavvas, 2006[35]), or the coherence between policies affecting the productivity and sustainability of agriculture and food systems (OECD, 2019[36]). Typically, these coherence assessments require defining levels of coherence and comparison criteria. For instance, OECD (2020[37]) looked at the coherence between land use, biodiversity and climate change policy plans in six countries (Brazil, France, Indonesia, Ireland, Mexico and New Zealand). The report assesses the coherence across national strategies and action plans institutional co-ordination and coherence, and policy instruments relevant to the land-use nexus. Interactions between the different factors are characterised as either synergetic, trade-offs, or cases where the context affect whether they are in synergies or trade-offs.

Turning qualitative policy information into a quantitative analysis of alignment with a reference policy text necessitates an extra step. It requires the definition of indicators for state of alignments that are consistent across policies and possibly across countries, and that are able to measure the degree of alignment. For instance, Hutniczak et al. (2019[38]) use a set of recognised best policies and practices to characterise the propensity of government's regulatory systems to tackle illegal, unreported and unregulated (IUU) fisheries. They then use a country survey to elicit whether governments have implemented these best practices and policies. The indicators are then applied to different dimensions of government intervention in relation to IUU fishing: as flag states, as coastal states, as port states, as markets, as regulators, and as members of the international community, and compared internationally. In the context of water, OECD (2018[39]) developed voluntary self-assessment tools for national, regional or local governments to evaluate the alignment of their water governance systems with the 2015 OECD principles of water governance. The

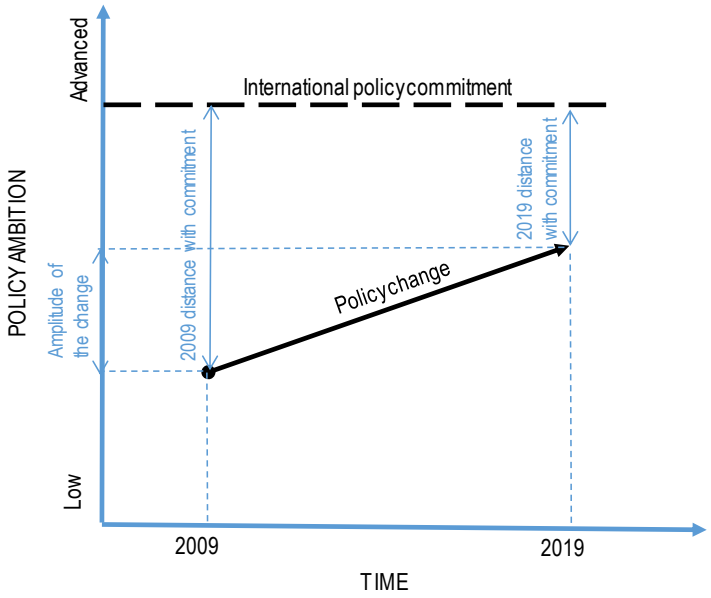
framework indicators suggested in that report, include a set of 36 traffic-light conditions (red, orange, and green) on the implementation of the principles and a yes/no checklist covering more specific governance questions. The report then provides guidelines as to how to interpret indicators and develop action plans to prioritise actions over the short, medium and long term (Ibid.).

A.1.2. An evaluation grid to characterise "vectors" of policy changes

Building on the reviewed literature, the proposed methodology aims to translate qualitative, semi-qualitative, or categorical responses into a set of binary indicators aiming at measuring the evolving distance of agriculture and water policies with respect to the commitment.

Comparing a policy change to an international reference is similar to determining the direction and length of vector with reference to a stable axis. A policy change can be defined as a vector in a policy space (Figure A A.1). It can be determined by the difference between the initial policy status (in the case of this study, 2009) and the final policy status (here 2019), or by one of these policy statuses and a measurement of the direction and amplitude of the policy change. This characterisation can then help draw inference about the alignment of the policy change with the international policy commitment.

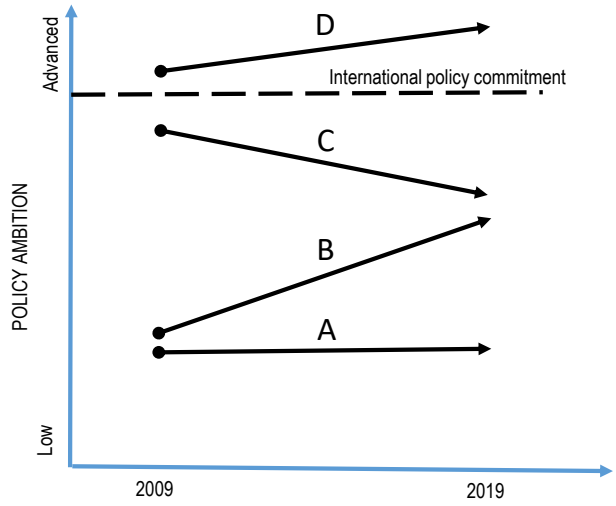
Figure A A.1. Measuring alignment of policy changes with policy commitment



Note: Policy ambition levels are used as vertical axis, because the survey does not inquire about implementation.

Figure A A.2 illustrates how information about direction, amplitude and status matter. In Case A, there is no policy change, but without knowing the policy ambition level, one cannot infer whether policies are aligned or not. Cases B and D illustrate an increased ambition in policies, but case B shows a more significant policy change (larger amplitude of the change, vertical axis) than D, and Case D is already exceeding the level defined by the international commitment. Finally, Case C shows a case of policy divergence from the policy commitment.

Figure A A.2. Illustrations of possible policy changes



On this basis, and acknowledging the difference between the survey instruments and the referred two sets of international recommendations, the evaluation was carried out in two steps. First, an evaluation grid was determined to match each survey question with a set of articles from the OECD and G20 recommendations. This mapping exercise was done to ensure that all the information of the survey was used the best way possible and that all relevant sections of the recommendations were considered in the analysis. Only those cases where links to a recommendation were unambiguous were kept, and indirect or remote links which could have related some parts of the recommendation to any questions were left out. In total, 58 matches were made, with 113 resulting indicators of policy status and policy changes in the case of the Council Recommendation, and 17 matches between responses were made for the G20 Action Plan corresponding to 17 policy changes.[12] Table A A.1 shows the basic information on the matching exercise.

Table A A.1. Coverage of the assessment

	Covered sections in the recommendation and action plan	Question-section matches
OECD Council Recommendation on Water		
Chapter 2.General recommendations	2.1, 2.3, 2.5	3
Chapter 3.Managing water quantity	3.1, 3.2, 3.3, 3.4, 3.5	17
Chapter 4.Improving water quality	4.1, 4.3, 4.5, 4.6, 4.7, 4.8, 4.9	14
Chapter 5.Managing water risks and disasters	5.1, 5.2, 5.3	6
Chapter 6.Ensuring good water governance	6.1, 6.2, 6.3, 6.5, 6.6, 6.7, 6.11, 6.12	13
Chapter 8.Ensuring sustainable pricing for water and water services	8.1, 8.2, 8.3, 8.5	4
G20 Agriculture Ministerial Action Plan		
Governance and coherence of water-related policies	3.a, 3.b	6
Water use efficiency and resilience	3.d, 3.e, 3.f, 3.g	4
Water quality	3.h	2
Information, innovation and collaboration	3.j, 3.k, 3.l, 3.m	5

* Excludes the use of the same questions for different sections of a particular area or chapter.

[12] Questions related to the G20 Agriculture Ministerial Action Plan focused on policy changes, without asking the status of policies.

Not all filled surveys included explicit responses to all questions. Box A A.1 discusses how the analysis treated incomplete or missing responses. All unsure and undetermined responses were noted as such and not considered further in the analysis.[13]

Box A A.1. Assumptions taken into account in the case of a lack of response

In the case of ambiguous or incomplete responses to particular questions of the survey, the following criteria were used to fill the evaluation grid.

First, in cases where the survey question was split into status and changes since 2009 (e.g. *Q20-1. What types of policy instruments are used to improve water quality? Please indicate the type of instrument, and whether there have been any developments since 2009*).

- If the survey filler responded to the "changes since 2009" section – reflect response as either a change towards or away from recommendations.
- If the survey filler responded to the "initial question" section, though not the "changes since '09" section – reflect response as no change, unless the first response signifies the absence of a policy instrument; there, the response to the change is considered not applicable
- If neither the initial question nor the changes since 2009 sections have been filled – reflect response as undetermined.

In cases where the survey question is not split- status and changes since 2009 are combined in one question (e.g. *Q10-2. What are the main policy instruments used to recover costs of groundwater allocated to farmers?*):

- If changes and status are clear – reflect response as a change either towards or away from recommendations.
- If status is clear though changes since 2009 are not clear – reflect response as undetermined. This may happen in selected cases where the country did not participate in the 2009 survey.

Lastly, in cases where only a few questions have been answered in the entire survey: the policy change and status were set as undetermined.

All the unsure or undetermined responses were removed from the analysis for the relevant country to avoid making false assumption about the variable.

An example of the exercise is shown in Table A A.2 for the case of question 6.1 of the survey and Article 3.1 of the Council Recommendation on Water. Criteria are elicited for the three levels of categorisation: policy status, direction of the policy change and amplitude of the policy change. For a given country, the three corresponding sets of indicative variables standing are sufficient to determine the policy change. Similar criteria are defined to characterise the alignment of policies in any particular agriculture and water area to the corresponding recommendation sections for all responding countries.

[13] The method used here aims to ensure no bias in the analysis, however it does not prevent the fact that countries with fewer responses may have inflated average alignment indices compared to those that responded to more questions. As noted above, the analysis aims to determine what can be inferred based on the data received.

Table A A.2. Example of an evaluation grid: Question 6.1, Article 3.1 of the OECD Council Recommendation on Water*

General question: Are there new quantified targets or projections to inform water demand policies?					
Status in 2019					
Characterisation	**Close or beyond recommendation (High)**	**Partially aligned (Medium)**	**Misaligned (Low)**	**Status not determined**	
Criteria	Evidence of quantified targets that inform water demand policies	Evidence of projections or general targets	No targets or projections	No information	
Indicative variable (1= most fit option)	0 or 1	0 or 1	0 or 1	0 or 1	
					Policy change since 2009
Characterisation: direction of change	**Towards the Recommendation (Aligned)**	**No change (Same)**	**Further away from the Recommendation (Misaligned)**	**Unsure of the direction**	**Change not determined**
Criteria: Direction of change	Development of targets or new projections to inform water policies		Reduced efforts to project water demand or cancelling existing targets	Uncertain	No information
Indicative variable (1='most' fit option)	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1
Characterisation: amplitude of change	**Extensive**	**Partial**	**Limited**		
Criteria: amplitude of change	Adoption of brand new broad targets or first projections	Changed targets or projections	Limited revisions or updated projections or targets		
Indicative variable (1= most fit option)	0 or 1	0 or 1	0 or 1		

Note: *Question. 6.1: Have you established any quantified national future planning targets for the use of water resources (surface and/or groundwater) in the agriculture sector? If so, what are they?
Article 3.1: Water demand management policies at national or sub-national levels of government, which: reflect short and long term projections and account for uncertainties on current and future water availability and demand
Source: Authors based on questionnaire and OECD (2016[17]).

The binary responses were then used to obtain alignment scores for policy status and policy changes ranging from 0 (not aligned) to 1 (very well aligned) for each country and question-recommendation match. Specifically, in the case of policy status, score values were attributed as follows: 2 for high, 1 for medium and 0 for low. The total status score was obtained by dividing the resulting value by 2 to stand in the [0, 1] range. For policy change, the score was computed as the multiplication of the change direction—with values of 1 for aligned, 0 for no change and -1 for misaligned— with the amplitude of the change, with values of 2 for extensive, 1.5 for partial and 1 for limited. The total score was also divided by 2. For instance, a country with indicative variables equal to 1 for medium status, 1 for aligned direction of change and 1 for extensive amplitude of change in Table A A.2 would be attributed a score of 0.5 for status and 1 for change. This case represents a country that would have adopted new and previously inexistent albeit quantitative targets between 2009 and 2019, even if these could still be more comprehensive. Such a country would therefore be increasing its alignment with article 3.1 of the Council Recommendation, although it would remain below the full compliance level (similar to case B in Figure A A.2).

As a complement to the questionnaire, data was used from the OECD Producer Support Estimates database, to gauge whether government transfers towards agriculture, and towards irrigation were consistent with the explicit requirement of policy coherence in the Council Recommendation (Chapters 2, 3 and 8) and the G20 Action Plan (Section 3b). Two sets of indicators were developed, one for potentially

most distorting support,[14] representing how agriculture policy may affect nutrient balance and therefore water quality (Henderson and Lankoski, 2019[40]), the second focusing on water-related PSE transfers for irrigation[15] that may encourage use (Gruère and Le Boëdec, 2019[19]).[16] In these two cases, data from the year 2009 was compared to the most recent available data (average 2016-18) to analyse policy changes.[17]

Since the data used for theses extra indicators were continuous variables, they were translated into indicative variables for level, direction and amplitude of changes. The new set of indicative variables were then entered as additional scores to complement scores for questions addressing policy coherence and harmful incentives.[18] The reference levels for most distorting support were set to below 2.5% of gross farm receipts for high status, between 2.5% and 7.5% for medium status, over 7.5% for low status. The amplitude of policy change was set using the same boundaries: below 2.5% for limited, between 2.5% and 7.5% for partial, over 7.5% for extensive change. These levels were defined to reflect what a low level is in the PSE database, other reference levels were tested and lead to no or minimum changes of scores, mostly for non-OECD countries. For irrigation PSE, the respective reference levels were set to below 0.1% (high status, limited change), between 0.1% and 1% of total value added (medium status, partial change), and over 1% of total value added (low status, extensive change). Again, these reference levels differentiated clusters of countries in a way that was stable to changes and representative of the overall dataset.

The policy status and policy change scores obtained from the above method were then averaged by areas of the two international reference texts, i.e. by chapter of the Council Recommendation on Water and by section of the G20 Action Plan for each country. For each of these areas, the average score was computed as an average between all the relevant question-recommendation matches, and where relevant, additional PSE variables (see Annexes B and C for detailed matches).

The same method was applied to all sections of the G20 Action Plan and chapters of the Council Recommendation on Water with the exception of Chapter 8 on water pricing and financing. Unlike other chapters of the Council Recommendation on Water, this chapter includes a chapeau paragraph that considers the importance of context: “Economic instruments should reflect each country’s social and economic conditions” and invites adherents that are “considering pricing instruments” to follow the proposed specific recommendations to design their pricing schemes. Section 8.1 encourages countries to set abstraction charges that reflect water scarcity, Section 8.2 recommends the use of water pollution charges, and Section 8.3 recommends that water service users recover the costs of water (cost recovery) “where possible”. These conditions for application challenge the proposed method in this report, because it is very difficult to assess a) what a relevant context may be for economic instruments, b) the interest in governments on the use of pricing of water from 2009 to 2019, and c) the possibility to use cost recovery.

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[14] These transfers are defined as the market price support, support based on output payments and on the unconstrained use of variable inputs (OECD, 2019[41]).

[15] These irrigation related transfers come from the PSE categories of payments based on input use (PIF, PIV, PIS categories), and for one programme in the case of Australia, a payment based on non-current area, animal numbers, receipts or income, with production not required (PHNR).

[16] It should be acknowledged that a large share of water-related transfers in agriculture are not made in the form of payments to producers (they are considered support for general services). This is particularly the case for investment to support hydrological infrastructures.

[17] The EU score was replicated for all EU Member States.

[18] Annexes B and C show where these variables were used.

To cope with this limitation, using the available data, it was assumed that countries not adopting any given pricing recommendation (abstraction charge, pollution charge, or charge to recover costs) were not interested in doing so, potentially due to context or plausibility constraints. In practice, average alignment indices were set to only include scores from countries that have a specific water pricing or water charging regulations (including all EU countries on cost recovery as per the Water Framework Directive). This ensured that any country not intending to use water pricing was not considered to be misaligned with Chapter 8. Yet, at the same time, this method mathematically boosted the average alignment scores for this chapter, as it removes any chance for countries possibly interested to use pricing and/or where charges is possible to be assigned a score of zero. At the same time, scores for Section 8.5 of the chapter on removing harmful subsidies, for which pricing caveats did not apply, were kept for all the countries.

Annex B. Evaluation grids to assess the alignment of policy changes with the OECD Council Recommendation on Water

Table A B.1. Matches between general survey questions and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 1/2)

Survey question	Article of the Council Recommendation	Assessment question
Q2. Key changes for the governance of water as relevant to agriculture since 2009	6.1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster coordination across these responsible authorities.	Have roles and responsibilities been updated or clarified? Have coordination mechanisms been implemented (working groups, joint bodies, advisory boards etc.)?
	6.2. Manage water at the appropriate scale(s) within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.	Have water governance regimes as related to agriculture been further decentralised?
Q3. Key governance or policy changes have you undertaken since 2009 to improve the coherence of policies related to water and agriculture	2.3. Encourage the joint management of water quantity and quality, and pay attention to the hydro morphological characteristics and temporal variability of water bodies, as these affect water quantity, quality, disasters, and water-related ecosystems.	Have new mechanisms that encourage joint management of water quantity and quality been employed (e.g. policy updates, changes to allocation regimes etc.)?
	5.2. Improve policy coherence across climate change adaptation, water management, land management, spatial planning, ecosystem and biodiversity protection and disaster risk reduction.	Have mechanisms that encourage policy coherence between climate change adaptation, water management, land management, spatial planning, ecosystem and biodiversity protection and disaster risk reduction been employed?
	6.3. Encourage policy coherence through effective cross-sectoral co-ordination, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.	Are there new effective mechanisms to coordinate water policies in different sectors?
	6.11. Encourage water governance frameworks that help manage trade-offs across water users, rural and urban areas, and generations.	Does a prioritisation mechanism (e.g., comprehensive cost-benefit assessments) and/or fair representation in decision making exists?
Q4. Main tools (revisions or new tools) used to help guide water policy decision making in agriculture	2.5 Facilitate the development and diffusion of innovative and more efficient ways to manage water, based on technical and non-technical innovations	Have tools to guide water policy been developed and diffused?
	3.5. Improved knowledge of water use and sustainability limits, and improved monitoring of water resources and uses, watershed conditions, ecosystems health and the interconnections between surface and groundwater, to better assess environmental needs and future water availability and make more robust decisions	Have tools for comprehensive water monitoring in agriculture been introduced or improved and can they help make more robust decisions?
	4.1. Allocate adequate human, technical, scientific and financial resources to: • Assess water and effluent quantity and quality. Water quality monitoring should be developed and publicly reported. • Identify sources of pollution (diffuse and point sources), and for the most relevant pollutants, assess the concentrations, total amounts and timing of discharges.	Has new funding, technical or human resource been allocated to develop tools for water monitoring or to help improve standards (policy evaluation or studies)?
	6.5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.	Has there been any new collection of timely, consistent, and comparable information or data to guide or assess water policy in agriculture and have they been shared?

Table A B.2. Matches between general survey questions and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 2/2)

Survey question	Article of the Council Recommendation	Assessment question
Q5. What are the main research and development initiatives in relation to agricultural water (quantity, quality, mitigation and adaptation of water risks) your government has undertaken since 2009?	3.5. Improved knowledge of water use and sustainability limits, and improved monitoring of water resources and uses, watershed conditions, ecosystems health and the interconnections between surface and groundwater, to better assess environmental needs and future water availability and make more robust decisions.	Have new R&D initiatives been undertaken to improve knowledge related to the quantitative management of water in agriculture?
	4.1. Allocate adequate human, technical, scientific and financial resources to: • Assess water and effluent quantity and quality. Water quality monitoring should be developed and publicly reported. • Identify sources of pollution (diffuse and point sources), and for the most relevant pollutants, assess the concentrations, total amounts and timing of discharges. • Set policy objectives and targets to achieve and maintain assigned water quality standards in water bodies, in order to protect designated uses and water-related ecosystems, taking into account water quality requirements for all water uses. • Improve standards for water quality target setting, building on the latest scientific knowledge and the most cost-effective technologies.	Have new R&D funding, technical or human resource been allocated to support agricultural water quality monitoring or to help improve standards (policy evaluation or studies)?
	6.5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy.	Has there been any new R&D initiatives to help collect timely, consistent, and comparable information or data to guide or assess water policy in agriculture and have they been shared?

Table A B.3. Matches between survey questions on water quantity and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 1/3)

Survey question	Article of the Council Recommendation	Assessment question
Q6-1. Quantified national future planning targets for the use of water resources (surface and/or groundwater) in the agriculture sector	3.1. Water demand management policies at national or sub-national levels of government, which: • Reflect short and long term projections and account for uncertainties on current and future water availability and demand;	Are there new quantified targets or projections to inform water demand policies?
Q6-2. Do the targets account for climate change?	3.1. Water demand management policies at national or sub-national levels of government, which: • Reflect short and long term projections and account for uncertainties on current and future water availability and demand;	Do quantified national future planning targets for the use of water resources reflect uncertainties stemming from climate change on current and future water availability and demand?
	5.3. 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.	Do quantified national future planning targets for the use of water resources reflect uncertainties stemming from climate change on current and future water availability and demand?
Q7. What type of water rights regime applies to agricultural water (e.g. use rights, licences, private property rights), and what authority allocates these rights at which level (national, provincial/state, water basin)?	3.3. Water allocation regimes that define a sustainable resource pool	Have agricultural water rights regimes been further defined for surface and groundwater?
	6.1. Clearly allocate and distinguish roles and responsibilities for water policymaking, policy implementation, operational management and regulation, and foster coordination across these responsible authorities.	Have there been updates or clarifications of agriculture water allocation roles and responsibilities?
Q8-2.Are illegal water abstractions for agricultural use a problem in your country? If so, have abstractions been growing or declining	3.3. Water allocation regimes that define a sustainable resource pool and: • Promote compliance and enforcement (i.e. of water entitlements) in national and sub-national contexts.	Have there been improvements in the promotion of compliance and enforcement of the water allocation regime?
	6.7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.	Have enforcement frameworks been strengthened for managing abstraction permits?
Q8-3.Are water abstractions metered, monitored and reported on?	3.3. Water allocation regimes that define a sustainable resource pool and: • Promote compliance and enforcement (i.e. of water entitlements) in national and sub-national contexts.	Have there been improvements in the promotion of compliance and enforcement of the water allocation regime?
Q8-4. Changes in the enforcement mechanisms to ensure compliance with abstraction permits	3.3. Water allocation regimes that define a sustainable resource pool and: • Promote compliance and enforcement (i.e. of water entitlements) in national and sub-national contexts.	Have there been improvements in the promotion of compliance and enforcement of the water allocation regime?
	6.7. Ensure that sound water management regulatory frameworks are effectively implemented and enforced in pursuit of the public interest.	Have enforcement frameworks been strengthened for managing abstraction permits?
Q9. Are water entitlements separated from land entitlements in the agricultural sector?	3.3.Water allocation regimes that define a sustainable resource pool and: • Allocate water and the risk of shortage in a manner that is non-discriminatory and that reflects wider policy objectives (e.g. access to drinking water, ecosystems health, food or energy security), under both average and extreme conditions, including through balancing all interests in basins and considering the cost-effectiveness of measures; • Are dynamic, flexible and adjusted to shifting circumstances at the least social cost;	Have agricultural water rights been separated from land rights to improve the flexibility of the water allocation regime?

Table A B.4. Matches between survey questions on water quantity and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 2/3)

Survey question	Article of the Council Recommendation	Assessment question
Q10-1. What is the proportion of cost recovery, and the type of charges1 applied to surface water allocated to farmers?	8.3. Setting tariffs or charges for water services and all other uses that cover the operation, maintenance and renewal costs of infrastructure and a progressive proportion of capital costs, where possible.	Have surface water charges increased towards full cost (OM, Capital costs, other cost) recovery?
Q10-2. What are the main policy instruments used to recover costs (e.g. O&M, capital, environmental costs) of groundwater allocated to farmers?	8.3. Setting tariffs or charges for water services and all other uses that cover the operation, maintenance and renewal costs of infrastructure and a progressive proportion of capital costs, where possible.	Have new policy instruments been introduced to recover costs for groundwater use in agriculture?
Q11-1. Key policy instruments used to manage water demand in the agricultural sector	3.1. Water demand management policies at national or sub-national levels of government, which: • Reflect short and long term projections and account for uncertainties on current and future water availability and demand; and • Are based on water management plans that build upon an understanding of the ecologically sustainable limits of the system, account for all the social, economic and environmental functions of water while preserving water resources. Where needed, water supply can be augmented in sustainable ways, e.g. through modular, scalable approaches to green and grey infrastructure, or the use of reclaimed water.	Have new policy instruments (e.g. quota, prices, market instruments) been introduced for managing agricultural water demand?
	8.1. Setting abstraction charges for surface and ground water that reflect water scarcity (i.e. environmental and resource cost) and that cover administrative costs of managing the system.	Has water pricing been introduced or refined to manage water scarcity?
Q11-2. If water pricing is used, is it differentiated by region or season to signal water scarcity and encourage water use efficiency?	2.1. Are adjusted to local conditions.	Has water pricing become differentiated depending on local context?
	3.2. The promotion of water use efficiency to alleviate pressure on all surface and groundwater resources, especially where water is scarce and competition between sectors intensifies, whilst taking into account the need for groundwater recharge and environmental flows. That promotion can include the consideration of economic instruments for water resources management (e.g. water abstraction charges), support for water-efficient technologies or for the use of alternative sources of water (e.g. reclaimed water).	Have water pricing instruments been introduced as a mechanism to promote WUE?
	3.3. Water allocation regimes that define a sustainable resource pool and: • Allocate water and the risk of shortage in a manner that is non-discriminatory and that reflects wider policy objectives (e.g. access to drinking water, ecosystems health, food or energy security), under both average and extreme conditions, including through balancing all interests in basins and considering the cost effectiveness of measures; • Are dynamic, flexible and adjusted to shifting circumstances at the least social cost;	Has water pricing to signal water scarcity become differentiated across seasons?
Q12-1.Have new policy instruments been introduced for promoting WUE (e.g. subsidies, water supply cost recovery, taxes, farm advice, research)?	3.2. The promotion of water use efficiency to alleviate pressure on all surface and groundwater resources, especially where water is scarce and competition between sectors intensifies, whilst taking into account the need for groundwater recharge and environmental flows. That promotion can include the consideration of economic instruments for water resources management (e.g. water abstraction charges), support for water-efficient technologies or for the use of alternative sources of water (e.g. reclaimed water).	Have new policy instruments been introduced for promoting WUE (e.g. subsidies, water supply cost recovery, taxes, farm advice, research)?

Table A B.5. Matches between survey questions on water quantity and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 3/3)

Survey question	Article of the Council Recommendation	Assessment question
Q 12-2. Do the policies used to improve water use efficiency take into account the need for groundwater recharge and environmental flows in water-scarce regions?	3.2. The promotion of water use efficiency to alleviate pressure on all surface and groundwater resources, especially where water is scarce and competition between sectors intensifies, whilst taking into account the need for groundwater recharge and environmental flows. That promotion can include the consideration of economic instruments for water resources management (e.g. water abstraction charges), support for water-efficient technologies or for the use of alternative sources of water (e.g. reclaimed water).	Have agricultural water policies to improve WUE taken greater account of groundwater recharge and environmental flows?
Q13.Are collective instruments (e.g. collective entitlements, collective action mechanisms) used to manage surface or groundwater use?	3.4. Collective management approaches, such as collective entitlements, where applicable, in areas where little information is available on water availability and use, or where the transaction costs of managing individual entitlements are too high (e.g. for groundwater management).	Are new collective instruments employed to manage surface or ground water use in agriculture?
Q14. Evidence on the effectiveness of water demand management policies, both in terms of their environmental effectiveness and economic efficiency	6.5. Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related data and information, and use it to guide, assess and improve water policy	Have there been new evaluations of water demand management policies in agriculture?
	6.12. Promote regular monitoring and evaluation of water policy and governance where appropriate, share the results with the public and make adjustments when needed.	Have there been new evaluations of water demand management policies in agriculture?
Q15-1 What minimum instream (natural flows) or ecological flow standards (for removing, sediment, flushing weeds, etc.) exist for surface water bodies (e.g. rivers, lakes, etc.) to ensure environmental needs are met? If these standards only apply to a share of rivers, please indicate the share.	3.1. Water demand management policies at national or sub-national levels of government, which: • Reflect short and long term projections and account for uncertainties on current and future water availability and demand; and • Are based on water management plans that build upon an understanding of the ecologically sustainable limits of the system, account for all the social, economic and environmental functions of water while preserving water resources. Where needed, water supply can be augmented in sustainable ways, e.g. through modular, scalable approaches to green and grey infrastructure, or the use of reclaimed water.	Have minimum environmental flows or ecological flow standards been introduced or raised?
	4.8. Take measures to protect, restore and promote sustainable use of water-related ecosystems, halt and reverse degradation, and halt biodiversity loss.	Have minimum environmental flows or ecological flow standards been introduced or raised?

Table A B.6. Matches between survey questions on water quality and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 1/2)

Survey question	Article of the Council Recommendation	Assessment question
Q16. Key pollutants of concern coming from the agricultural sector.	4.1. Allocate adequate human, technical, scientific and financial resources to: • Identify sources of pollution (diffuse and point sources), and for the most relevant pollutants, assess the concentrations, total amounts and timing of discharges.	Have key pollutants coming from the agriculture sector been (newly) identified?
Q17-1. Key water quality data collection tools, relevant to the agricultural sector,	3.5. Improved knowledge of water use and sustainability limits, and improved monitoring of water resources and uses, watershed conditions, ecosystems health and the interconnections between surface and groundwater, to better assess environmental needs and future water availability and make more robust decisions.	Have new water quality data collection tools been developed or existing tools increased their monitoring coverage or frequency?
	4.1. Allocate adequate human, technical, scientific and financial resources to: • Assess water and effluent quantity and quality. Water quality monitoring should be developed and publicly reported. • Identify sources of pollution (diffuse and point sources), and for the most relevant pollutants, assess the concentrations, total amounts and timing of discharges.	Have new water quality data collection tools been developed or existing tools increased their monitoring coverage or frequency?
Q17-2.Data collection developments	3.5. Improved knowledge of water use and sustainability limits, and improved monitoring of water resources and uses, watershed conditions, ecosystems health and the interconnections between surface and groundwater, to better assess environmental needs and future water availability and make more robust decisions.	Have new water quality data collection been conducted?
	4.1. Allocate adequate human, technical, scientific and financial resources to: • Assess water and effluent quantity and quality. Water quality monitoring should be developed and publicly reported. • Improve standards for water quality target setting, building on the latest scientific knowledge and the most cost-effective technologies.	Have new water quality data collection been conducted?
Q18-1. Has your country set any quantitative targets, objectives, or plans for the agricultural sector to improve water quality	4.1. Allocate adequate human, technical, scientific and financial resources to: • Set policy objectives and targets to achieve and maintain assigned water quality standards in water bodies, in order to protect designated uses and water-related ecosystems, taking into account water quality requirements for all water uses. • Improve standards for water quality target setting, building on the latest scientific knowledge and the most cost-effective technologies.	Have new or updated water quality objectives and quantitative targets been introduced for the ag sector?
Q 19-1. Does your country uses spatial tools (e.g. topological, geometric, or geographic data analysis) to target policies in agricultural areas where water quality impacts stemming from agriculture are most acute? Q 19-2.Please indicate whether there were any developments since 2009	4.1. Allocate adequate human, technical, scientific and financial resources to: • Improve standards for water quality target setting, building on the latest scientific knowledge and the most cost-effective technologies.	Have new spatial tools to target ag water quality interventions been introduced?
Q20-1. What types of policy instruments are used to improve water quality?	4.3 Take measures to reduce, to the extent necessary, the pollution of all waters and in particular the pollution of surface waters resulting in eutrophication, with particular reference to the problem arising from the transfer of nutrient-loaded waters across frontiers or to the sea. These measures should ensure compliance with the water quality objectives and targets mentioned above.	Are there new policy measures or instruments are employed to reduce pollution or improve water quality?
	4.5. Consider the most cost-effective measures to tackle water quality issues, whilst applying the Polluter Pays Principle as much as possible where it is mentioned in the legal and regulatory framework, and promoting it where absent.	Have new agriculture water quality (or pollution) taxes been introduced?

Table A B.7. Matches between survey questions on water quality and sections of the Council Recommendation on Water and corresponding alignment assessment questions (Part 2/2)

Survey question	Article of the Council Recommendation	Assessment question
Q20-1. What types of policy instruments are used to improve water quality?	4.6. Combine regulatory, voluntary and economic instruments to provide continuing incentives for polluters to reduce and control pollution of water resources	Have a combination of instruments or new instruments complementary with existing ones been introduced to manage water quality?
	8.2. Setting water pollution charges for surface and groundwater use and pollution or charges for wastewater discharge at a sufficient level to have a significant incentive effect to prevent and control pollution.	Have new water pollution charges been introduced to control of pollution?
Q20-2. Types of enforcement measures used to manage agricultural water quality	4.3 Take measures to reduce, to the extent necessary, the pollution of all waters and in particular the pollution of surface waters resulting in eutrophication, with particular reference to the problem arising from the transfer of nutrient-loaded waters across frontiers or to the sea. These measures should ensure compliance with the water quality objectives and targets mentioned above.	Are there new enforcement measures to reduce water pollution from agriculture?
	4.7. Set up mechanisms to monitor and enforce compliance with regulatory provisions. Enforcement should be targeted, making use of all available data sources. It should build on clear, transparent and proportionate enforcement rules, procedures, penalties, incentives and tools to achieve regulatory objectives cost-effectively	Are there new spatially targeted enforcement measures to reduce water pollution from agriculture?
Q21, Policy instruments do you use to support the conservation of wetlands and other aquatic ecosystem services in, and around agricultural lands	4.8. Take measures to protect, restore and promote sustainable use of water-related ecosystems, halt and reverse degradation, and halt biodiversity loss.	What new measures have been introduced to protect, restore and promote the sustainable use of wetlands and other aquatic ecosystems services in and around agricultural land?
	4.9. Take the following measures to address sector-specific issues: • Pay particular attention to achieving sustainable management and conservation of fishing resources and other aquatic life in freshwater and related coastal areas at the local, national and international levels, and ensure co-ordination of all relevant authorities, to the extent possible.	What new measures have been introduced to protect, restore and promote the sustainable use of wetlands and other aquatic ecosystems services in and around agricultural land?

Table A B.8. Matches between survey questions on water risks and sections of the Council Recommendation on Water and corresponding alignment assessment questions

Survey question	Article of the Council Recommendation	Assessment question
Q22. What is the main focus of major government funded research projects aiming to assess the impacts to, and adaptation of agriculture to future changes in water availability, due to climate change?	5.1. Prepare for water-related disasters by investing in: •Risk prevention and mitigation through a mix of structural protection measures […] and non-structural measures to prevent and reduce risks, and, where needed, the provision of incentives and tools to foster private self-protective and resilience building measures	Has the government engaged in preparation for climate related water risks and disasters by investing in new research projects to assess risk reduction options in agriculture?
Q23. Extent to which climate change (CC) is factored into water resource management policy consideration	5.3. 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.	Are water related risks factored into agriculture and water resource use policies?
Q24-2. Key policy instruments for drought adaptation and mitigation in agriculture	5.1. Prepare for water-related disasters by investing in: • Social policies and financial mechanisms to mitigate the welfare impacts of losses and ensure a quick recovery and reconstruction that reduce future vulnerability.	Are there new support payments or other financial mechanisms for extreme drought adaptation and mitigation?
Q24-3, Lower and upper limits for drought relief support	6.6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.	Have new lower or upper limits been introduced for drought relief support in ag (for efficiency and transparency)?
Q25-2. Key policy instruments for flood adaptation and mitigation in agriculture	5.1. Prepare for water-related disasters by investing in: • Emergency response capabilities for both known hazards and threats as well as novel, unforeseen and complex events. • Social policies and financial mechanisms to mitigate the welfare impacts of losses and ensure a quick recovery and reconstruction that reduce future vulnerability.	Are there new policy instruments for responding to flood disasters in agriculture (e.g., emergency response capabilities, financial mechanisms etc.)?
Q25-3. Does your government define lower and upper limits for flood relief support?	6.6. Ensure that governance arrangements help mobilise water finance and allocate financial resources in an efficient, transparent and timely manner.	Have new lower or upper limits been introduced for flood disaster relief support in ag (for efficiency and transparency)?

Table A B.9. Matches between additional PSE questions and sections of the Council Recommendation on Water and corresponding alignment assessment questions

Survey question	Article of the Council Recommendation	Assessment question
PSE 1. Most distorting transfers PSE database	4.9. Take the following measures to address sector-specific issues: • Foster coherence between water and sectoral policies, e.g. industry, energy, nature, drinking water, health care and agriculture. For the latter, identify and reduce to the greatest extent possible any harmful incentive	Have agricultural price distorting measures and subsidies been reduced?
	8.5. Phasing out price-distorting policy measures and general subsidies that affect water availability, quality and demand, to the extent possible, taking into account broader public policies and priorities.	Have agricultural price distorting measures and subsidies affecting water been reduced?
PSE 2 Irrigation PSE transfers	8.5. Phasing out price-distorting policy measures and general subsidies that affect water availability, quality and demand, to the extent possible, taking into account broader public policies and priorities.	Have transfers for irrigation to agriculture producers declined?

Annex C. Evaluation grids to assess the alignment of policy changes with the 2017 G20 Agriculture Ministerial Action Plan

Table A C.1. Matches between survey questions and sections of the G20 Agriculture Ministerial Action Plan and corresponding alignment assessment questions (Part 1/2)

Survey question	Article of the Council Recommendation	Assessment question
Q3-G1. Key governance or policy change to improve the coherence of agriculture and water policies with land and biodiversity or energy policies	3.b. We will improve the coherence of policies related to water and agriculture. We aim to contribute towards better coordination of roles and responsibilities for water management across government bodies at all levels and to encourage the participation of all relevant actors.[...] We will give due consideration to cross-sectoral approaches to address the synergies and trade-offs between the goals of food production, protection of water, land and biodiversity as well as energy use through enhanced dialogue, collaboration, and policy coherence.	Have governments taken steps to improve the coherence of agriculture and water policies with land and biodiversity or energy objectives?
Q5-G2. Programs to support plant or animal breeding activities to enhance water-use efficiency and resilience	3.e. We aim to improve plant and animal breeding to enhance water-use efficiency and resilience	Have governments adopted programs to support plant or animal breeding activities to enhance WUE and resilience?
Q5-G3. Mechanisms to encourage the sharing of research outcomes, technologies and knowledge with the private sector on sustainable water management	3.l. We encourage the exchange of research outcomes, technologies and knowledge on a voluntary basis between states and between the public and private sectors for the further development of sustainable water management, taking into account the special needs of developing countries	Have governments encouraged the sharing of research outcomes, technologies and knowledge with the private sector on sustainable water management?
Q5-G4. Key measures to raise awareness, and increase and transfer knowledge on water scarcity conditions, and water–efficient production methods, and their locally customisation.	3.m. We encourage measures for awareness-raising, initial and further training and voluntary transfer of knowledge, particularly with regard to water-efficient production methods and technologies and water scarcity conditions, taking into account local, traditional production systems	Have governments taken measures to raise awareness, and increase and transfer knowledge on water scarcity conditions, and water–efficient production methods, and how have they been locally customised?
Q5-G5. Policies to encourage responsible public and private investments and public-private partnership towards sustainable water use.	3.d. We encourage responsible public and private investment to conserve, protect and ensure the sustainable use of water, in particular investment in water management, irrigation systems, water storage, manure management, soil health, land-management practices and agricultural innovation.	Have governments encouraged responsible public and private investments and public-private partnership towards sustainable water use?
Q11-G6. Agricultural policy measures to improve water harvesting, conserve water and soil, better manage groundwater, or improve water allocation	3.a. We will better integrate the sustainable use and management of water in food and agricultural policies. This includes measures to optimise water harvesting, water and soil conservation, ground water management and water allocation systems.	Have governments taken agricultural policy measures to improve water harvesting, conserve water and soil, better manage groundwater, or improve water allocation?
Q12-G7. Farming practices promoted to conserve water, (cover crops, conservation tillage, etc.)	3.a. We will better integrate the sustainable use and management of water in food and agricultural policies. This includes measures to optimise water harvesting, water and soil conservation, ground water management and water allocation systems.	Have governments taken measures to promote water conservation (cover crops, conservation tillage, etc.)?
Q15-G8. New actions to reduce food losses and waste	3.g. We commit to actions that reduce food loss and waste, acknowledging that such actions can alleviate pressure on water. We reaffirm our commitment to the G20 Technical Platform on the Measurement and Reduction of Food Loss and Waste, initiated under the Turkish Presidency, and to associated platforms in facilitating the prevention, reduction and measurement of food loss and waste at local, national and regional level.	Have governments taken measures to reduce food losses and waste?

Table A C.2. Matches between survey questions and sections of the G20 Agriculture Ministerial Action Plan and corresponding alignment assessment questions (Part 2/2)

Survey question	Article of the Council Recommendation	Assessment question
Q20-G9. Programs to promote sustainable farming practices – nutrient management, buffer strips, etc. – to preserve water quality,	3.a. We will better integrate the sustainable use and management of water in food and agricultural policies. This includes measures to optimise water harvesting, water and soil conservation, ground water management and water allocation systems.	Have governments initiated programs promoting sustainable farming practices to preserve water quality?
	3.h. We will protect water and water-related ecosystems by encouraging water-friendly, sustainable agricultural practices and technologies that enhance the water quality and resilience of water bodies. We are therefore committed to developing and implementing corresponding strategies at the national level.	Have governments initiated programs promoting sustainable farming practices to preserve water quality?
Q21-G10. Have you initiated programs to promote sustainable farming practices–nutrient management, buffer strips, etc. – to preserve water quality	3.h. We will use, conserve and protect soils in ways that prevent erosion, sedimentation and increased salinisation, creating a healthy soil ecosystem that supports water infiltration, carbon sequestration, carbon stocks, biomass production, appropriate organic matter levels and soil biodiversity	Have governments initiated programs to promote sustainable farming practices to preserve water quality?
Q25-G10.Main agricultural risk management measures have been introduced to increase resilience to adverse weather events and climate change	3.f. We encourage the development of cost-effective agricultural risk management instruments which provide a clear framework for increasing the resilience of farmers to adverse weather events (such as droughts and floods) and climate change, without impeding necessary adaptation	Have governments initiated programs to promote sustainable farming practices to preserve water quality?
Q3. Key governance or policy changes have you undertaken since 2009 to improve the coherence of policies related to water and agriculture.	3.b. We will improve the coherence of policies related to water and agriculture. We aim to contribute towards better coordination of roles and responsibilities for water management across government bodies at all levels and to encourage the participation of all relevant actors	Have governments undertaken changes in policy or governance to improve the coherence of policies related to water and agriculture?
Q4. Changes in the main tools (revisions or new tools) used to help guide water policy decision making in agriculture	3.a. Furthermore, we will better integrate these issues into related sectoral risk assessments and management, recognizing the need to address data gaps in water information.	Have tools to guide water policy been developed and diffused?
Q.5. Main research and development initiatives in relation to agricultural water	3.k. We aim to increase support for research and development on agriculture and water, notably for water-efficient production methods and technologies, sea water desalination, application of brackish water, safe waste water reuse methods and riparian forest and rivershed conservation, taking advantage of the potentials of Information and CommunicationTechnology (ICT) applications and considering the needs of vulnerable rural populations	Have there been R&D initiatives on technologies supporting the sustainable management of water in agriculture?
Additional questions using the PSE database		
PSE 1. Potentially most distorting transfers PSE database	3.b. We will improve the coherence of policies related to water and agriculture. We aim to contribute towards better coordination of roles and responsibilities for water management across government bodies at all levels and to encourage the participation of all relevant actors	Have agricultural price distorting measures and subsidies been reduced?
PSE 2 Irrigation PSE transfers	3.b. We will improve the coherence of policies related to water and agriculture. We aim to contribute towards better coordination of roles and responsibilities for water management across government bodies at all levels and to encourage the participation of all relevant actors	Have transfers for irrigation to agriculture producers declined?