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Water and agriculture

An issues note produced for the G20 Presidency of the Kingdom of Saudi Arabia

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by
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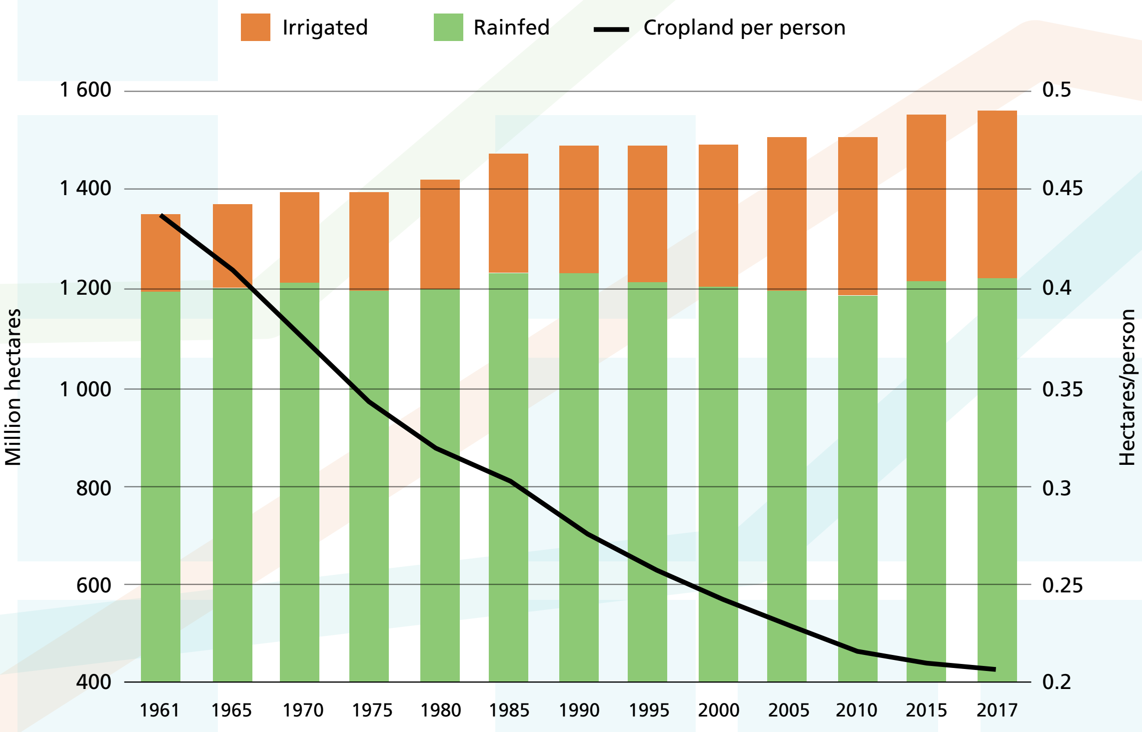
I. Ensuring food and water security: a growing challenge

In the last 30 years, food production has increased by more than 100 percent, and FAO estimates that about 50 percent more food will be needed by 2050 to meet the food requirements of a growing global population with changing dietary patterns (FAO, 2018). Combined with limited natural resources, energy costs and the likely impacts of climate change, the productive use of water is of paramount importance in ensuring food security. Beyond the pressing issue of meeting global food demand, actions will have to balance trade-offs between agricultural productivity growth and natural resources conservation objectives.

Irrigation plays a critical role in transition from subsistence to commercial farming, poverty alleviation and economic growth. Irrigated yields tend to be 30–100 percent higher compared to adjacent rainfed areas; in regions with a pronounced dry season, irrigation allows to extend the growing season into the second, dry season; irrigation also supports the production of more nutrient-dense fruits and vegetables, stabilizes production under climate change; and can serve as a conduit of broader rural access to water resources. Combined with suitable measures such as education, rural markets and infrastructure, irrigation also generates direct benefits other than productivity (increased profitability, reduced risk of crop failure and stabilization of local food production, fairer access to water resources), as well as indirect benefits (employment, additional income, balanced conditions of food and supply markets).

Since 1961, the global area of cultivated land has grown by 210 million hectares (Figure 1). The net increase in cultivated area over the last 50 years is largely attributable to a net increase in irrigated cropping. Irrigated area more than doubled over the period, and since irrigated agriculture is on average more productive than rainfed agriculture (about 40 percent of global agriculture production comes from irrigated land, which is only about 20 percent of all agricultural land), this contributed to lower the number of hectares needed to feed one person from 0.45 to 0.20 hectares per person (FAO, 2011).

Figure 1.
Evolution of land under irrigated and rainfed cropping (1961–2017)



Source: FAOSTAT.

The remaining primary cultivated areas are rainfed, which relies on soil moisture from precipitation although that balance is often difficult to manage due to climatic variability (FAO, 2011 and Sulser *et al.* 2009). Almost all land in sub-Saharan Africa (93 percent), three-quarters of cropland in Latin America, two-thirds of crop land in the Middle East and North Africa, and more than half of cropland in Asia is rainfed (HLPE, 2015). In rainfed systems, better agricultural water management includes a wide range of measures, including rainwater harvesting and soil conservation practices such as mulching, terracing, and tillage, as well as supplementary irrigation, which all can help unlock additional yield potential in rainfed systems (FAO and SIWI, (Forthcoming)).

At the same time, agriculture is facing growing risks from water scarcity, water pollution, and variability in availability. In many regions, agriculture is increasingly affected by droughts, floods, storms, and sea-level rise (OECD, 2017). For example, approximately three-quarters of the key global staple crop areas of maize, rice, soy, and wheat experienced drought-induced yield losses in the period 1983 to 2009, with estimated cumulative production losses of USD 166 billion (Kim, Iizumi and Nishimori. 2019). Between 2005 and 2015 in developing countries, drought caused 30 percent of agricultural loss amounting to over USD 29 billion (FAO, 2018a) . Similarly, the extreme drought event that affected Central and Northern Europe in 2018 resulted in cereal yields declining by up to 50 percent for certain crops. Japan's 2018 heavy rainstorms triggered the deadliest floods since 1982, leading to damage valued at USD 4 billion for the agricultural sector (MAFF, 2018). 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. Extreme weather events will likely increase in frequency and intensity as climate change progresses (IPCC, 2019).

These risks are intensified by the growing demand for and competition over water across the energy, industry or domestic use sectors as well as important environmental water uses (OECD, 2012). At the global level, water use has grown to more than twice the rate of population increase in the 20th century, making it challenging to provide sufficient water of adequate quality in many regions. Demographic pressures, the rate of economic development, urbanization and pollution are all putting unprecedented pressure on water resources, particularly in semi-arid and arid regions. At the same time, the global demand for water by non-agricultural sectors is projected to increase significantly, affecting the availability of irrigation water, including in highly productive agricultural regions (OECD, 2012a, Cooley *et al.* 2016 and Rosegrant *et al.* 2009).

Agriculture production also contributes to exacerbating these risks while impacting freshwater for other users and water-related ecosystems. First, agriculture remains the largest user of withdrawn freshwater resources globally; accounting for about 70 percent of global freshwater withdrawals and around 90 percent of consumptive use, with important differences across countries and regions depending on climatic conditions, availability of groundwater, and the role of agriculture in national economies (OECD, 2010, FAO, 2011, Scheierling and Tréguer. 2018 and Rosegrant *et al.* 2009). As a result of the high consumptive use share of withdrawn water and the large quantities of water used in irrigation, irrigated agriculture can have large consequences for downstream water users sharing the same water resources. At the same time, cheaper, individual well drilling and groundwater extraction technologies have contributed to the rapidly growing use of groundwater for irrigation globally, accounting for more than 40 percent of total irrigation water use (Siebert *et al.* 2010), sometimes resulting in declining groundwater tables, contributing to environmental degradation and putting in question the sustainability of groundwater-irrigated food production (OECD, 2015). Studies reviewing water risk and water security projections identified the northeast region of the People's Republic of China's, India's northwest area and the southwest part of the United States of America as future water risk hotspots for agriculture, largely because these regions face a combination of limited precipitation and the rapid depletion of groundwater by agriculture (OECD, 2017). Groundwater depletion by agriculture is also projected to be a major bottleneck when considering the challenges of the water energy and food nexus (OECD, 2017a). While most water is used in agricultural production, water use and water pollution are also substantial throughout the food value chain, including in postharvest processing and food preparation (HLPE, 2015).

Second, agricultural activities are also a major source of water pollution. Agricultural nutrient run-off, pesticides, soil sediments and livestock effluents, all contribute to the pollution of waterways and groundwater (OECD, 2012a and FAO and IWMI, 2018). Agricultural runoff damages water quality and contributes to eutrophication and acidification of lake and coastal waters, thereby impacting biodiversity, fisheries resources, and the quality of drinking and bathing water (European Commission, 2018 and FAO & IWMI. 2017). While the impacts from agricultural water pollution are largest in Asia, agricultural water pollution growth is most rapid in Sub-Saharan Africa, albeit from low levels (Xie and Ringler, 2017). The overall costs of water pollution caused by agriculture both in terms of treatment for consumption and in terms of damage to ecosystems are likely to exceed billions of euros annually (Gruère, 2016 and OECD, 2017b). For instance, in France, the impacts of agricultural nitrate emissions and pesticides on water resources amount to an estimated annual cost of EUR 610 million and EUR 1070 million, respectively (Marcus and Simon, 2015). The eutrophication process in freshwater bodies induced by agriculture alone is estimated to have reduced aquatic biodiversity by about one-third globally[1].

[1] See for example European Commission (2017), Opening Speech by Commissioner Phil Hogan at International Green Week - GFFA High Level Panel on Food Security and Water Management, European Commission, Brussels. http://ec.europa.eu/commission/commissioners/2014–2019/hogan/announcements/opening-speechcommissioner-phil-hogan-international-green-week-gffa-high-level-panel-food-security_en.

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II. Evidence of progress towards the sustainable use of water in agriculture since the 2017 G20 Agricultural Ministerial

Agriculture ministers from G20 countries have acknowledged these challenges and indicated their willingness to improve the sustainability of agricultural water use and to better address water-related risks to agriculture and food security. In January 2017, under the Presidency of the Federal Republic of Germany, G20 Agriculture Ministers adopted a declaration and an action plan entitled "Towards food and water security: Fostering sustainability, advancing innovation" aiming at improving the sustainability of agricultural water use and management and at enhancing agriculture's resilience to water risks (Box 1)[2]. As part of the G20 Agriculture Deputy discussion, a series of actions was also requested to be undertaken by G20 members and International Organisations.

The Action Plan emphasises two key crosscutting areas where progress is necessary to improve the sustainability of water use in agriculture: (i) better knowledge of agricultural water use and water-related risks; and (ii) improved governance and management of water use in agriculture. During the past three years, International Organisations have made several efforts to support these objectives. The following subsections review the results of these efforts and identify remaining gaps and issues for which further actions may be needed by G20 countries.

2 "Towards food and water security: Fostering sustainability, advancing innovation", G20 Agriculture Ministers' Action Plan 2017, Berlin. http://www.bmel.de/SharedDocs/Downloads/EN/Agriculture/GlobalFoodSituation/G20_Action_Plan2017_EN.pdf?__blob=publicationFile . "Towards food and water security: Fostering sustainability, advancing innovation", G20 Agriculture Ministers' Declaration 2017, Berlin.http://www.bmel.de/SharedDocs/Downloads/EN/Agriculture/GlobalFoodSituation/G20_Declaration2017_EN.pdf. The G20 meeting dovetailed with the 9th Global Forum on Food and Agriculture (GFFA), during which 83 agriculture ministers adopted the Communiqué "Agriculture and Water – Key to Feeding the World" outlining their intention to enhance farmers' water access, improve water quality, reduce water scarcity, and manage surplus water. See GFFA (2017), Agriculture and water- Key to feeding the world, GFFA Communiqué 9th Berlin Agriculture Ministers´ Conference 2017, Berlin, http://www.gffa-berlin.de/wpcontent/uploads/2017/01/GFFA-Kommunique_2017_EN.pdf

Box 1. The 2017 G20 Agriculture Ministerial Action Plan

The action plan "Towards food and water security: Fostering sustainability, advancing innovations", was adopted by agriculture ministers of the G20 countries, as well as representative from five observing countries - the Netherlands, Norway, Singapore, Spain, and Viet Nam - on 22 January 2017 in Berlin.

Thirteen actions were listed under four focal areas, as summarised below.

Governance and coherence of water-related polices

a. We will better integrate the sustainable use and management of water in food and agricultural policies.

b. We will improve the coherence of policies related to water and agriculture.

c. We endorse close cooperation at all levels in implementing the water, food security and nutrition goals of the 2030 Agenda.

Water-use efficiency and resilience

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.

e. We aim to improve plant and animal breeding to enhance water-use efficiency and resilience.

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.

g. We commit to actions that reduce food loss and waste, acknowledging that such actions can alleviate pressure on water.

Water quality

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.

i. We will use, conserve and protect soils in ways that prevent erosion, sedimentation and increased salinization, creating a healthy soil ecosystem that supports water infiltration, carbon sequestration, carbon stocks, biomass production, appropriate organic matter levels and soil biodiversity.

Information, innovation and collaboration

j. We call for the improvement of data and information for sustainable water and soil management, giving particular consideration to soil moisture, precipitation and groundwater.

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 Communication Technology (ICT) applications and considering the needs of vulnerable rural populations.

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.

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 […] to enable those employed in the agricultural sector to protect, use and manage water sustainably.

Source: "Towards food and water security: Fostering sustainability, advancing innovation", G20 Agriculture Ministers' Action Plan 2017, Berlin).

2.1. Improved data and knowledge systems

Consumption-based agricultural water accounting system

In water scarce areas or those with high competition over resources, rather than increasing productivity per land area unit, the primary goal should be to sustainably increase production per water unit. The most commonly perceived option is to reduce water losses in the production process, that is, improve irrigation efficiency.[3] For example, this can be achieved by reducing leakage in water conveyance and drainage losses in irrigation application.

But excessive emphasis is often placed on improving irrigation efficiency, with efforts aimed at reducing water 'losses' within irrigation distribution systems. A number of factors limit the scope for and impact of water loss reductions. Only a part of the water between the source and final user is 'lost' from the hydrological cycle. A large part of the water 'lost' returns to the hydrologic system, either through percolation into the aquifers or as return flow into the river systems. Some water is 'lost' through non-beneficial water use, either through evaporation from weeds or soil surfaces, or through drainage into low quality water bodies, salt sinks or to the sea. Increasing the efficient use of water in agriculture include reducing non-beneficial water losses while ensuring that environmental uses are protected, for example, through advanced irrigation technologies combined with caps on irrigation withdrawals (Grafton, *et al.* 2018). However, opportunities for reducing such non-beneficial water losses through designing costly and ineffective demand management strategies are limited and vary according to local conditions (FAO, 2015). Strategies to reduce inefficient water use outside the water domain include reducing postharvest losses, changing diets and improving agricultural trade.

Increase in crop yields (production per unit of land) is the most important source of crop water productivity increase. Yield increases are made possible through a combination of improved water control, improved land management and better agronomic practices. This includes the choice of genetic material, and improved soil fertility management and plant protection. Plant breeding and biotechnology can help enhancing productivity with respect to water by increasing the harvestable parts of the biomass, and by reducing biomass losses through increased resistance to pests and diseases. They can also result in reducing soil evaporation through vigorous early growth for fast ground cover, and in reduced susceptibility to drought.

Thus, a focus on water productivity rather than a sole focus on the technical efficiency of water use alone is an important consideration. To understand the full potential of each of these strategies, careful measurement and monitoring of agricultural and non-agricultural water withdrawals and consumptive uses is urgently needed.

As part of the G20 Action Plan "Towards food water security: Fostering sustainability, advancing innovations", an international conference entitled Genetic diversity – the key for improving drought stress tolerance in crops was organized by Federal Ministry of Food and Agriculture of Germany on 19–20 December 2019 in Berlin. The conference discussed research advances in this area and aimed to open new perspectives from exploring and valorising the functional diversity

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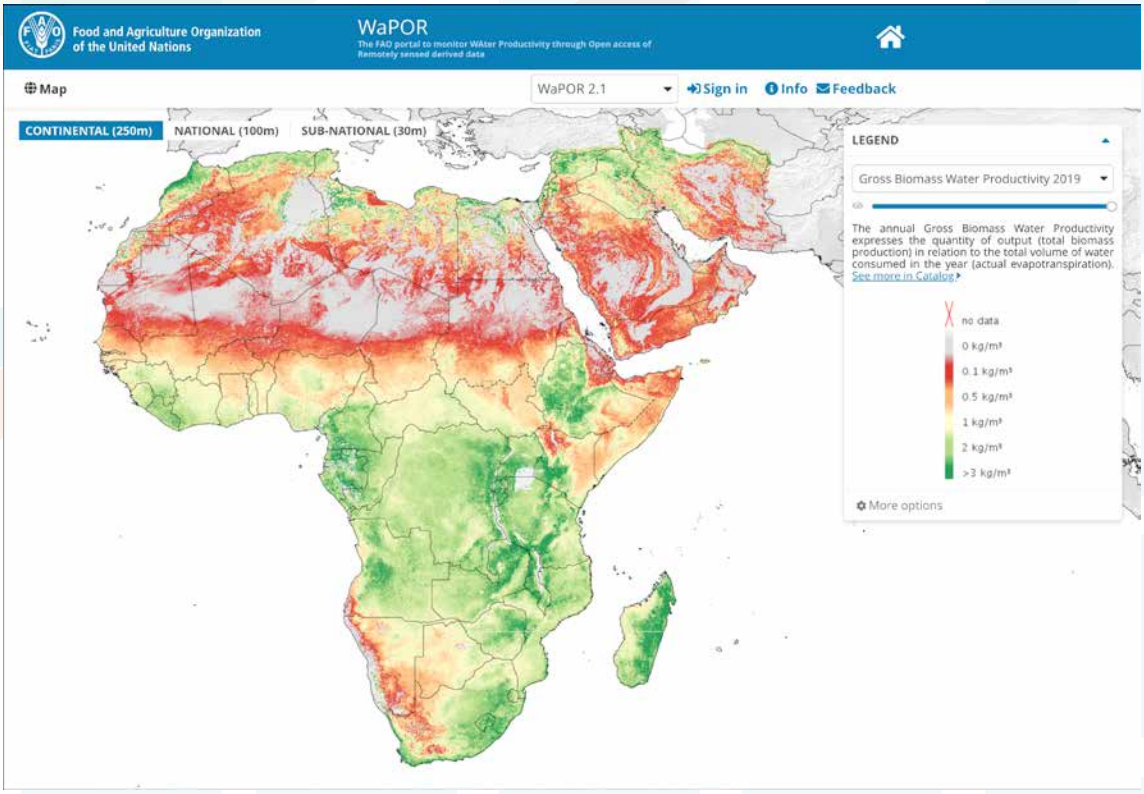
[3] Generally, 'water efficiency' is a dimensionless ratio that can be calculated at any scale and used for different classes of water supply and use such as in an inter-basin transfer system, a town water supply network. In the agricultural sector, it is referred to as irrigation efficiency (IE) and used to assess and monitor system losses that can be classified as non-beneficial water use fractions that may be non-recoverable (e.g. evaporation from a canal) or recoverable (e.g. seepage from unlined canals).

of genetic resources via breeding for drought stress tolerance to strengthening international collaboration.[4]

Managing overall demand through a focus on water productivity rather than concentrating on reducing water losses within irrigation systems is an important consideration which requires careful monitoring of a number of parameters including water use in agriculture, biomass production and evapotranspiration. Advanced modelling capabilities in combination with remote sensing and earth observation technologies are systematically strengthened to support policy decisions in water.

As a result of recent advances in remote sensing, biomass production and evapotranspiration are increasingly being monitored using advanced models in combination with earth observation data. FAO's portal to monitor Water Productivity through Open-access of Remotely sensed derived data (WaPOR), was developed to assist countries in monitoring agricultural water productivity, identifying water productivity gaps, proposing solutions to reduce these gaps and contributing to a sustainable increase of agricultural production. At the same time, it takes into account water use in ecosystems and the equitable use of water resources, which should lead eventually to an overall reduction of water stress. The WaPOR system is being used to monitor in a spatially disaggregated way progress toward SDG 6, in particular target 6.4 "By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity", through its indicators on water efficiency and water stress (Figure 2).

Figure 2.
Illustration of mapping with the WaPOR system



Source: FAO WaPOR.

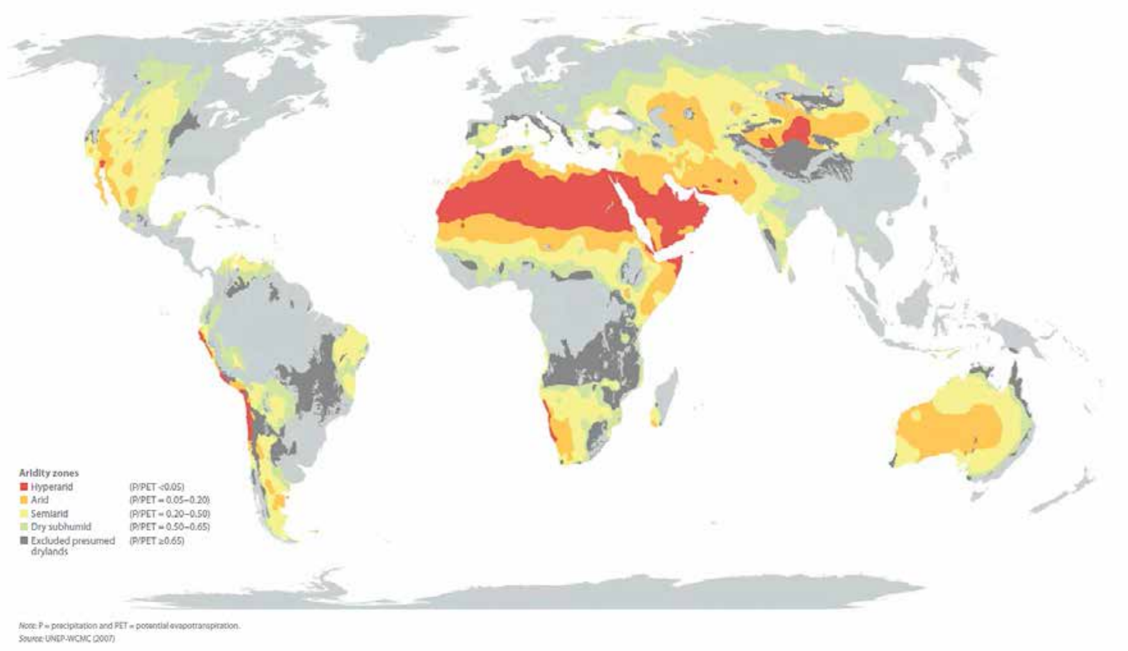
[4] This event builds on a first G20 workshop on "Harnessing genetic resources for improving drought stress tolerance in crops" held in Berlin in fall 2017.

Anticipating and monitoring droughts

Drought affects many regions around the world, including parts of the western and Midwestern United States, Central America, northeastern Brazil, the sub-Saharan African belt, the Horn of Africa, Southern and Central Africa, Madagascar, Southern Spain and Portugal, Central Asia, Northwest India, Northeast China, Southeast Asia, Indonesia, and Southern Australia (Dilley *et al*. 2005).

Drylands are particularly sensitive to droughts and their related impacts (see Figure 3). These are vulnerable marginal ecosystems from both a climatic and socioeconomic point of view. Dryland populations are frequently among the world's poorest people, who live with a higher risk of food insecurity, land degradation and desertification as a result of rainfall variability (FAO, 2008). Occupying around 45 percent of the world's land surface, drylands are home to over two billion people or about 34 percent of the global population. Ninety percent of the world's drylands populations live in developing countries, including in major cities such as Cairo, Mexico City and New Delhi (UNCCD, 2012).

Figure 3.
Impacts of droughts



Source: FAO (http://www.fao.org/fileadmin/user_upload/newsroom/docs/full-map.png).

Despite their extreme vulnerability and water scarcity, drylands are home to 50 percent of the world's livestock and 44 percent of all cultivated land (UNCCD, 2012). In these drylands, around one billion people rely on rainfed or irrigated farming or pastoralism for their daily survival. Droughts are usually combined with other stressors, such as overexploitation of resources, deforestation and environmental degradation, which contribute to desertification and to a decline in agricultural productivity in drylands (FAO, 2008). In these regions irrigation can strengthen the resilience of farmers to climate shocks however, if not well conceived, it may induce maladaptation and result in water-intensive crops that increase drought vulnerability (Damania *et al.*, 2017).

Table 1.
Cost of natural disasters to the agriculture of the developing world, 2005–2015

Natural disaster	Cost (USD billion)
Drought	29
Floods	19
Earthquakes/landslides/ associated movements	10.5
Other meteorological disasters, such as extreme temperatures and storms	26.5
Biological disasters, such as diseases and infestations	9.5
Wildfires	1

Source: FAO (2015).

Approximately 22 percent of the damage and losses caused by natural disasters between 2003 and 2013 were in the agriculture sector. However, if droughts alone are considered, over 80 percent of the damage and losses were in agriculture, in particular livestock and crop production. In sub-Saharan Africa, over 363 million people were affected by droughts between 1980 and 2014 (FAO, 2015a.). Another study shows that most of the natural disaster-related costs incurred from 2005 to 2015 were due to drought impacts, amounting to USD 29 billion in agricultural losses to developing countries (see Table 1). Droughts are the main cause of severe food shortages and affect all dimensions of food security, including availability, stability, access and use, triggering malnutrition and famine in vulnerable drought-prone countries (FA), 2011).

Droughts is a "slow-onset", phenomenon, which means that much can be done to mitigate their impact on the livelihoods of people at risk. Knowing when to declare a drought is vital to save lives and reduce damages, which is why Drought monitoring and Early Warning Systems (EWS) are essential both to inform on and reduce the effects of drought and to respond efficiently to drought events.

Innovative tools that facilitate the monitoring of drought and early action move away from a reactive towards a proactive drought management. FAO's Agriculture Stress Index System (ASIS), for example, allows the monitoring of vegetation indices across global crop areas during the growth season and can detect hotspots all over the world where crops may be affected by drought.[5] ASIS assists countries to strengthen their agricultural drought monitoring and early warning systems. It brings together in a single index the three dimensions that characterize a drought event: intensity, temporal and spatial. Once the tool is calibrated with field information (current land use maps, sowing dates, length of the crop cycle and crop coefficients), it offers more precise results regarding the water stress periods for different crops.

Combining ASIS with the Global Information and Early Warning System on Food and Agriculture (GIEWS) allows a continuous monitoring of food supply and demand and other key indicators for assessing the overall food security situation in all countries of the world. With

[5] See http://www.fao.org/resilience/news-events/detail/en/c/296089/ and https://www.youtube.com/watch?v=QlW6qowJlU8&feature=youtu.be

valuable insight on water availability and vegetation health, GIEWS issues regular analytical and objective reports on prevailing conditions and provides early warnings of impending food crises at country or regional level.[6]

2.2. Progress in agriculture and water policy and governance in G20 countries

As part of a broader effort to track policy progress on agriculture and water, the OECD Secretariat developed a survey to analyse policy changes in G20 countries, with reference to the 2017 G20 Agricultural Ministerial Action Plan. Acknowledging that the Action Plan was adopted only three years ago, a time span that may be insufficient to implement significant policy changes, the survey requested information on policy changes made since 2009.

The survey covered the four areas and twelve items of the Action Plan (Box 1),[7] while additional complementary information on the evolution of irrigation-related agriculture support and most distortive support categories was extracted from the OECD Producer Support Estimates database (OECD, 2019). As of December 2019, responses had been received from twelve G20 economies, and therefore the results provide a partial overview of policy developments in the G20 in the last decade in the areas which the G20 Agriculture Ministers identified as requiring actions on water and agriculture. [8]

Responses to the survey indicate that the twelve G20 members undertook a wide number of policy changes in the areas defined by the Action Plan. Taken together, the information suggests that the responding G20 members adjusted their policies to align with the 2017 Action Plan by a rate of 61 percent. Similar rates of policy changes were found in the areas of water quantity, water risks and cross-cutting water policy issues (with rates of changes ranging from 58 percent to 63 percent), while more frequent changes were observed in the area of water quality (67 percent). Responding members that are relatively more water scarce reported a larger number of policy changes on water quantity management than did relatively more water abundant members.

The results of the analysis were used to derive indices aiming to measure the alignment of policy changes with the 2017 G20 Action Plan. First, the direction of changes was assessed by analysing whether the reported policy changes represented a shift leaning towards or against the Action Plan recommendation. Second, the amplitude of the policy change was assessed qualitatively by determining whether the policy change was limited, partial, or extensive. Cases with undetermined change or unsure directions were labelled as such. The derived indices of alignments were set to range from O (not aligned) to 1 (very well aligned) and computed for each member and policy area.[9]

[6] The Agricultural Stress Index System (ASIS) wins 2016 Geospatial World Excellence Award. Since October 2018, GIEWS Earth Observation website has been updated with the outputs of ASIS 2. See http://www.fao.org/giews/earthobservation/

[7] Item c) of the Action Plan was not included as it was an endorsement rather than an action.

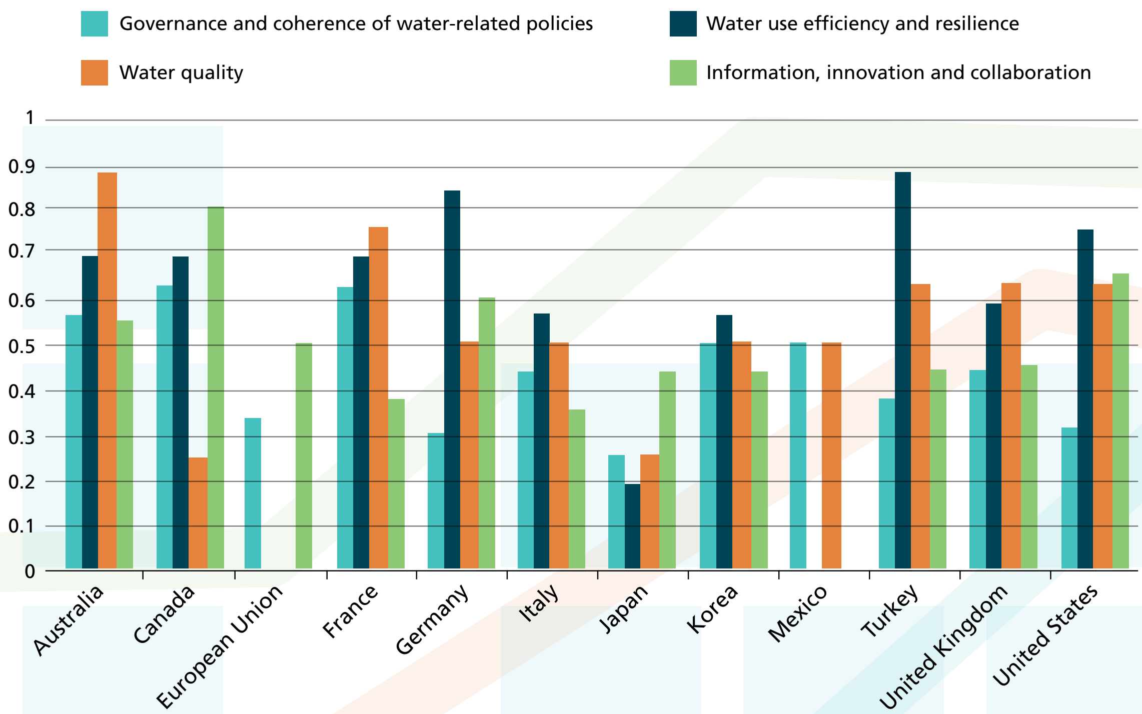
[8] The survey questionnaire was sent to OECD-G20 countries in June 2019 (as part of the broader study) and to non-OECD G20 economies in October 2019. As of December 2019 responses have been received by Australia, Canada, France, Germany, Korea, Italy, Japan, Mexico, Turkey, the United Kingdom, the United States and the European Union.

[9] The derived categorized 1/0 responses for direction and amplitude of changes were 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 policy area. 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 to stay within the 0–1 range.

Results from this exercise suggests that policies in the twelve G20 members are increasingly aligned with the ambition of the 2017 G20 Action Plan (Figure 4). This is true for the four areas distinguished in the 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 4.
Alignment of policy changes by G20 members with the 2017 G20 Action Plan

Scores range from 0 to 1; a higher score indicated a higher alignment



Note: Item 3c. on overall cooperation towards the 2030 agenda has not been investigated. *Refers to EU-wide polices; EU data is missing for the questions on water quality and water use efficiency.

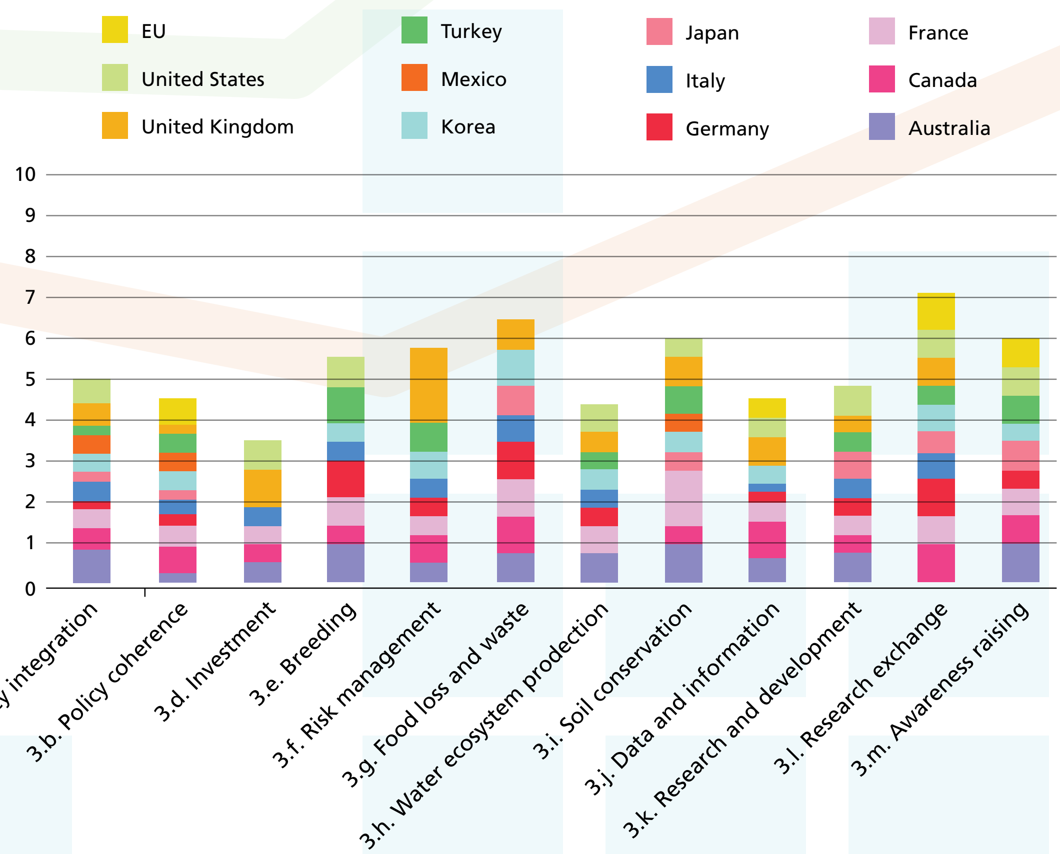
Source: OECD (forthcoming), based on results from the survey.

While there is variation, alignment scores bear some similarities across members. Scores for water governance and the coherence of water-related policies do not vary much across members, with alignment indices ranging from 0.3 to 0.6, indicating overall progress towards the ambition of the 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 0.4 and 0.5, respectively. 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 Action Plan helps to better understand the type of efforts undertaken by each of the G20 members that provided responses to the survey (Figure 5). Policy changes undertaken by Australia, Canada, and France are aligned with over eleven of the twelve studied articles of the Action Plan. In contrast, Mexico, European Union and Japan's policy changes are aligned with three, four and seven articles of the Action Plan, respectively. Examples of actions undertaken by G20 members for each area of the Action Plan are shown in Table 2 in the Annex.

Figure 5.
Alignment of policy changes with agriculture and water sections of the 2017 G20 Agriculture Ministerial Action Plan

Each score ranges from 0–1, the maximum aggregate score is 12



Notes: Item 3c. On overall cooperation towards the 2030 agenda has not been investigated. *Refers to EU-wide polices. EU Data is missing for the questions on water quality and water use efficiency.

Source: OECD, forthcoming, based on results from the survey.

The aggregate alignment scores in Figure 5 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 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 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 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 G20 Agricultural Ministerial Action Plan. At the same time, significant steps were observed only for some countries in specific areas of the Action Plan, while other recommendations in the Action Plan 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 was obtained from other G20 members.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III. Recommendations for G20 collective action

In January 2017, G20 Agriculture Ministers committed to policy approaches that foster increased agricultural productivity while ensuring that water and water-related ecosystems are protected, managed and used sustainably for improved food water and security. Focussing on water and agriculture was a very important step, previously unseen in the agriculture policy arena. Three years after these discussions, a number of international initiatives and projects have been launched in this area, and a number of G20 members have introduced policies in line with the 2017 G20 Action Plan.

The 2020 G20 Presidency of Saudi Arabia, provides an opportunity to consider areas where deeper engagement or additional effort may be needed, as part of a proposed broader G20 agenda on the improved management of water resources. Within the context of water and agriculture, G20 countries should:

- Reaffirm their commitment to the sustainable use of water in agriculture, which is essential for food security, recognising that the agriculture sector is particularly water dependent, vulnerable to and engendering water risks. Achieving SDG 2 (zero hunger) and SDG 6 (clean water and sanitation) will not be possible without improving the management of water in agriculture, and making the agriculture sector more productive, sustainable and resilient.

- Recognize the importance of consumption-based water resources monitoring as reference when aiming to improve the efficiency of water use in agriculture. Monitoring water consumption as opposed to assessing water abstractions offers better understanding of real and perceived water losses and thus better informs decision making for sustainable water management. In agriculture, satellite remote sensing to asses evapotranspiration gives the best available indication for agriculture water consumption.

- Continue improving the governance and management of water in agriculture, to bolster the resilience of farmers to water risks and reduce the impact of agriculture on water quality. This encompasses continuing to progress towards their specific commitments outlined in the 2017 G20 Agricultural Ministerial Action Plan, as well as engaging with other sectors to improve the overall management of water as proposed in the 2020 G20 Action Plan on Water Management. G20 members should continue to conduct regular stocktaking of efforts on agriculture and water to understand which areas still require improvements and whether other areas may need to be considered in their collective policy agenda to help agriculture face its growing water challenges.

References

Cooley, H., Coheni, M., Phurisambani, R. and Gruèrei, G. 2016. *Water risk hotspots for agriculture: The case of the southwest United States*, OECD Food, Agriculture and Fisheries Papers, No. 96, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlr3bx95v48-en;

Damania R, Desbureaux S, Hyland M, Islam A, Moore S, Rodella A-S, Russ J, Zaveri E. *et al.*, 2017. *Uncharted Waters: The New Economics of Water Scarcity and Variability* (World Bank, Washington, DC). Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/28096/9781464811791.pdf?sequence=21&isAllowed=y.

M. Dilley. R.S. Chen. U. Deichmann. A. Lerner-Lam. 2005. *Natural Disaster Hotspots: A Global Risk Analysis.* World Bank. Available at http://documents.worldbank.org/curated/en/621711468175150317/pdf/344230PAPER0Na101official0use0only1.pdf.

European Commission. 2018. *Climate and environmental challenges facing EU agriculture and rural areas*, Modernising and simplifying the CAP Background Document, European Commission, Brussels, https://ec.europa.eu/agriculture/sites/agriculture/files/consultations/capmodernising/env_background_final_en.pdf ;

FAO. 2008. *Water and cereals in drylands.* Food and Agriculture Organization of the United Nations, Rome and Earthscan, London. http://www.fao.org/3/a-i0372e.pdf.

FAO. 2011. *The state of the world's land and water resources for food and agriculture (SOLAW) - Managing systems at risk.* Food and Agriculture Organization of the United Nations, Rome and Earthscan, London. See http://www.fao.org/resilience/news-events/detail/en/c/296089/

FAO. 2015. *Towards a water and food secure future: critical perspectives for policy-makers.* Food and Agriculture Organization of the United Nations, Rome and World Water Council, Marseille. 61 pp. Available at: http://www.fao.org/nr/water/docs/FAO_WWC_white_paper_web.pdf

FAO. 2015a. *The impact of disasters on agriculture and food security*. Rome. http://www.fao.org/3/a-i5128e.pdf

FAO. 2018. *The future of food and agriculture – Alternative pathways to 2050.* Rome. http://www.fao.org/3/I8429EN/i8429en.pdf

FAO. 2018a. *The impact of natural disasters on crop and livestock production in developing countries.* Rome.

FAO and IWMI. 2017. *Water pollution from agriculture: a global review, Executive Summary*, FAO, Rome, and IWMI, Colombo. http://www.fao.org/3/a-i7754e.pdf

FAO and IWMI. 2018. *More people, more food, worse water? A global review of water pollution from agriculture.* http://www.fao.org/3/a-i7754e.pdf

FAO and SIWI (Forthcoming) *Nutrition-sensitive water productivity – rationale, methodology, farmers and policy.* FAO Land and Water Discussion Papers. Rome.

GFFA. 2017. *Agriculture and water- Key to feeding the world*, GFFA Communiqué 9th Berlin Agriculture Ministers Conference 2017, Berlin, http://www.gffa-berlin.de/wpcontent/uploads/2017/01/GFFA-Kommunique_2017_EN.pdf

R. Q. Grafton, J. Williams, C. J. Perry, F. Molle, C. Ringler, P. Steduto, B. Udall, S. A. Wheeler, Y. Yang, D. Garrick, R. and G. Allen. 2018, The Paradox of Irrigation Efficiency. *Science 361* (6404): 748-750.

Gruère, G. 2016. Agriculture and water: a major conundrum, *Constructif 43*, http://www.constructif.fr/bibliotheque/2016-3/agriculture-et-eau-un-vrai-cassetete.html?item_id=3518&vo=1;

HLPE. 2015. *Water for food security and nutrition.* A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2015.

IPCC. 2019. *Climate Change and Land: Summary for Policymakers*, IPCC, Geneva. https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf.

Kim, W., T. Iizumi and M. Nishimori. 2019. Global Patterns of Crop Production Losses Associated with Droughts from 1983 to 2009" *Journal of Applied Meteorology and Climatology*, Vol. 58/6, pp. 1233-1244, http://dx.doi.org/10.1175/jamc-d-18-0174.1

MAFF. 2019. *Annual Report on Food, Agriculture and Rural Area in Japan FY 2018* (in Japanese).

Marcus, V. and O. Simon. 2015, Les pollutions par les engrais azotés et les produits phytosanitaires : coûts et solutions. - Temis - Ministère de l'Environnement, de l'Énergie et de la Mer, *Études & documents*, No. 136, Commissariat Général au Dévelopment Durable, Paris.

C. Ringler, T. Zhu, S. Gruber, R. Treguer, L. Auguste, L. Addams, N. Cenacchi and T. Sulser. 2016. Role of water security for agricultural and economic development – concepts and global scenarios, in C. Pahl-Wostl, J. Gupta and A. Bhaduri (eds) *Handbook on water security.* (Aldershot, Edward Elgar Publishing Ltd).

Rosegrant, M.W., C. Ringler, and T. Zhu. 2009. Water for agriculture: Maintaining food security under growing scarcity. *Annual Review of Environment and Resources.* 2009. 34:205–223. doi:10.1146/annurev.environ.030308.090351.

Scheierling, S. and D. Tréguer. 2018. *Beyond Crop per Drop: Assessing Agricultural Water Productivity and Efficiency in a Maturing Water Economy*, The World Bank, http://dx.doi.org/10.1596/978-1-4648-1298-9; and

Siebert, S., J. Burke, J. M. Faures, K. Frenken, J. Hoogeveen, P. Döll, and F. T. Portmann. 2010. Groundwater use for irrigation – a global inventory, *Hydrol. Earth Syst. Sci.*, 14(10), 1863–1880, doi:10.5194/hess-14-1863-2010.

T. Sulser, C. Ringler, T. Zhu, S. Msangi, E. Bryan and M. Rosegrant 2009. *Green and blue water accounting in the Limpopo and Nile Basins.* IFPRI Discussion Paper No. 907. Washington D.C.: IFPRI.

OECD. 2010. Sustainable Management of Water Resources in Agriculture, *OECD Studies on Water*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264083578-en. ;

OECD. 2012. *OECD Environmental Outlook to 2050: The Consequences of Inaction*, OECD Publishing, Paris, https://doi.org/10.1787/9789264122246-en.

OECD. 2012a. Water Quality and Agriculture: Meeting the Policy Challenge, *OECD Studies on Water*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264168060-en.

OECD. 2015. *Drying wells, rising stakes: Towards sustainable agricultural groundwater use.* OECD Publishing, Paris, http://dx.doi.org/10.1787/22245081.

OECD. 2017. Water Risk Hotspots for Agriculture, *OECD Studies on Water*, OECD Publishing, Paris. https://dx.doi.org/10.1787/9789264279551-en.

OECD. 2017a. *The Land-Water-Energy Nexus: Biophysical and Economic Consequences*, OECD Publishing, Paris, https://doi.org/10.1787/9789264279360-en.

OECD. 2017b. Diffuse Pollution, Degraded Waters: Emerging Policy Solutions, *OECD Studies on Water*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264269064-en.

OECD. 2019. *Agricultural Policy Monitoring and Evaluation 2019*, OECD Publishing, Paris, https://dx.doi.org/10.1787/39bfe6f3-en

United Nations Convention to Combat Desertification (UNCCD). 2012. *Desertification: a visual synthesis*. Paris. http://catalogue.unccd.int/10_Desertification_EN.pdf.

Xie, H. and C. Ringler. 2017. Agricultural nutrient loadings to the freshwater environment: The role of climate change and socioeconomic change. *Environment Research Letters 12 104008*.

ANNEX

Table 2.
Examples of actions undertaken by G20 members in different areas of the 2017 Action Plan

Article	G20 Member	Example of actions 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 programs, including, for example, support for research that considers managing water on the agricultural landscape and protecting the quality of water that runs off of 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	National project to reduce the edible part of food loss and waste (FLW) which promotes the review of commercial customs that cause FLW and adoption of a new 50% reduction target for the edible part of FLW from food industry by 2030.
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 salinization	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 programs 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 finding through onsite demonstration projects and review of practice standards for best management practices eligible for financial assistance.
3.m. Awareness raising	European Union	Organize 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: OECD, based on responses to the survey.

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