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CONFERENCE

Forty-third Session

Rome, 1-7 July 2023

The State of Food and Agriculture: Integrated Water Resources Management

Section 1: Overcoming water challenges in agriculture

Section 2: Integrated flood risk management for resilient agrifood systems and rural development

Executive Summary

Water, a foundational component of agrifood systems, is facing increased challenges – water scarcity and drought, floods, and water pollution – that undermine our efforts towards achieving the Sustainable Development Goals.

The first section of this document presents how agriculture is increasingly required to "make its case" for its share of water to ensure food security and nutrition, for mitigating and adapting to floods, and for addressing agriculture-induced water pollution. Today, more than 3 billion people live in agricultural areas with very high or high levels of water shortages or water scarcity. Some 1.81 billion people are directly exposed to floods, which pose a significant risk to lives and livelihoods. The impacts of climate change are expected to worsen this picture with repercussions for agrifood systems, the planet, human health and well-being around the world. The key to all these entangled challenges is integrated water resources management (IWRM) that contributes to inclusive and effective water governance.

The second section of this document presents a rural perspective on the impact of flooding on agriculture and food security and how to address them in a way that delivers multiple long-term benefits for people (food, water and economic security) and nature. A contemporary, more strategic, approach to flood risk and disaster management is presented, which is based on a paradigm of planning that connects the short and long term, seeks to simultaneously manage flood risk to people and the economy whilst promoting the positive (and necessary) role floods play in maintaining productive agriculture (and aquaculture) and ecosystem health.

Suggested action by the Conference

The Conference is invited to:

a) recognize that with severe scarcity, flood risks and water quality deterioration, the water system is at a breaking point, affecting food security, livelihoods and the lives of billions of people;
b) note that policy priorities relating to water depend on the interplay between water resources and various socio-economic drivers and climate change, ensuring access to water resources in an equitable and sustainable manner;
c) acknowledge that transforming agrifood systems to achieve the SDGs sustainably will require integrated water resources management (IWRM) and efficient water use in both irrigated and rainfed agriculture;
d) emphasize that water resources management needs to be integrated at all levels, inclusive of all stakeholders, and coherent across all sectors of agriculture, forestry, fisheries and aquaculture, land and soil, environment, biodiversity, climate change and One Health, among others;
e) stress that growing competition for water and degradation of its quality calls Members for improved governance to ensure sustainable and equitable water allocation, integrated management and efficient use;
f) emphasize that integrated and inclusive water resources management needs to be supported by improved water governance;
g) seize the international momentum to take bold and innovative initiatives regarding surface and groundwater management in agrifood systems to support Members' governance of water;
h) request FAO to further develop programmatic initiatives on flood and disaster risk management and utilization of flooding water, and to fully integrate its work in the areas of water, land and soil, climate change, biodiversity, fisheries and aquaculture, forestry, emergency and resilience towards holistic and innovative solutions; and
i) request FAO to mobilize resources needed to implement programmatic actions on flood and integrated land and water management, including from international financial institutions, resource partners and voluntary contributions by Members.

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I. Introduction

1. Water is the lifeblood of the earth and is central to the entire 2030 Agenda (UN-Water, 2016). Water underpins all the Sustainable Development Goals (SDGs). Addressing the global water crisis – water scarcity, drought, floods and water pollution – is essential for achieving the 2030 Agenda for Sustainable Development, and urgent action, strong political will and enhanced financing are needed to value and manage freshwater in an integrated manner.

2. Our very existence depends on water. Agriculture relies on freshwater from rivers, lakes and aquifers. Rainfed agriculture and part of livestock production depend on the water from limited and variable rainfall patterns. Moreover, freshwater ecosystems sustain livelihoods, food security and nutrition by, *inter alia*, supporting inland fisheries and aquaculture. Supplies of uncontaminated freshwater are needed for safe drinking water, and to ensure hygiene and food safety standards to guarantee human health. In addition, water has numerous other uses and supports other human activities.

3. Global projections indicate that demand for freshwater will increase significantly over the coming decades due to population growth, diversified diets, economic development and urbanization. At the same time, recent assessments, projections and scenarios from the international community paint an alarming picture of the planet's water resources – highlighting overuse, misuse, degradation, pollution and increasing scarcity, drought and flood risks in connection to climate change.

4. Floods are often linked with or trigger other disasters such as landslides. Floods not only impact those directly affected, but can also lead to wider impacts that cascade (and often escalate) through connected infrastructure networks and supply chains (affecting critical services including food supplies, energy and communications), social separation and stress. Once the flood recedes, recovery may take many years as individuals, communities and nations try to rebuild their lives and economies. Hence, the need for a multi-hazard disaster risk reduction approach when addressing flood risks and their cascading impacts.

5. Good agricultural flood risk management, taking into consideration food security, can play a pivotal role in promoting desired societal, environmental and economic outcomes. As such, and in contrast to the often narrowly defined single objective nature of flood control paradigm, strategic flood risk management places an emphasis on reducing risk (to people, economies and the environment) and on building resilience, seeking opportunities to work with natural processes and promote multiple benefits across a range of sectors (e.g. crops and livestock, energy, fisheries, societal wellbeing and environment).

6. Water underpins most of the SDGs, in particular SDG 6: ensure availability and sustainable management of water and sanitation for all. Beyond SDG 6, addressing water shortages (reflected in inadequate rainfall patterns), scarcity (the imbalance between supply and demand for freshwater resources), flood risks and degradation of quality (relative to international standards) is essential for many other goals of the 2030 Agenda for Sustainable Development (2030 Agenda), not least that of achieving SDG2 and SDG1. With only seven years to achieve these objectives, the world can only succeed if we make more sustainable use of our limited water resources, from groundwater, surface freshwater to soil water and atmospheric water.

7. Agriculture is central to this challenge, not only because it is seriously affected by water constraints, but also because it is the world's largest sectoral water user. The way agrifood systems use both surface and groundwater is crucial also to ensuring availability for other economic sectors and for preserving ecosystems.

8. Water management has dominated the discussion, efforts and proposed solutions to water challenges for a long time, without sufficiently considering governance dimensions. In broad terms, water governance refers to the processes, actors and institutions involved in decision-making for the development and management of water resources and for the delivery of water services; encompassing the political, administrative, social and economic domains along with the formal and informal systems and mechanisms involved. At the turn of the century, water governance emerged as a prominent issue, with many ascribing the growing challenges in water resources to a "crisis of

governance". The issues of optimal allocation of water resources across different sectors, increasing productivity of water, water tenure or modalities of control, access, use and management of water by different stakeholders are closely related. It is critical to consider how the issues of control over, competition for, and access to water resources should be dealt with, together with the issues of efficient and effective management. Appropriate governance could facilitate the reduction of inequalities in access to water. Those most at risk are the poorest and most vulnerable groups, such as small-scale farmers, Indigenous Peoples and women. Communities and individuals reliant on water-related ecosystems, such as inland fisher folk, are also at risk. In the worst case, increased competition can lead to conflicts.

9. We need to send a strong message: water shortages, scarcity and degradation of quality just as flood risk must be addressed immediately and boldly if our commitment to achieve the SDGs is to be taken seriously. Growing competition for water – including among sectors, among users and, sometimes, among countries – makes addressing these challenges more difficult. As the world's largest water user, agriculture constitutes a crucial part of the solution. Enhancing water governance can lead to both the long-term sustainability of water resources management and use, and agrifood systems that are more effective, resilient and equitable.

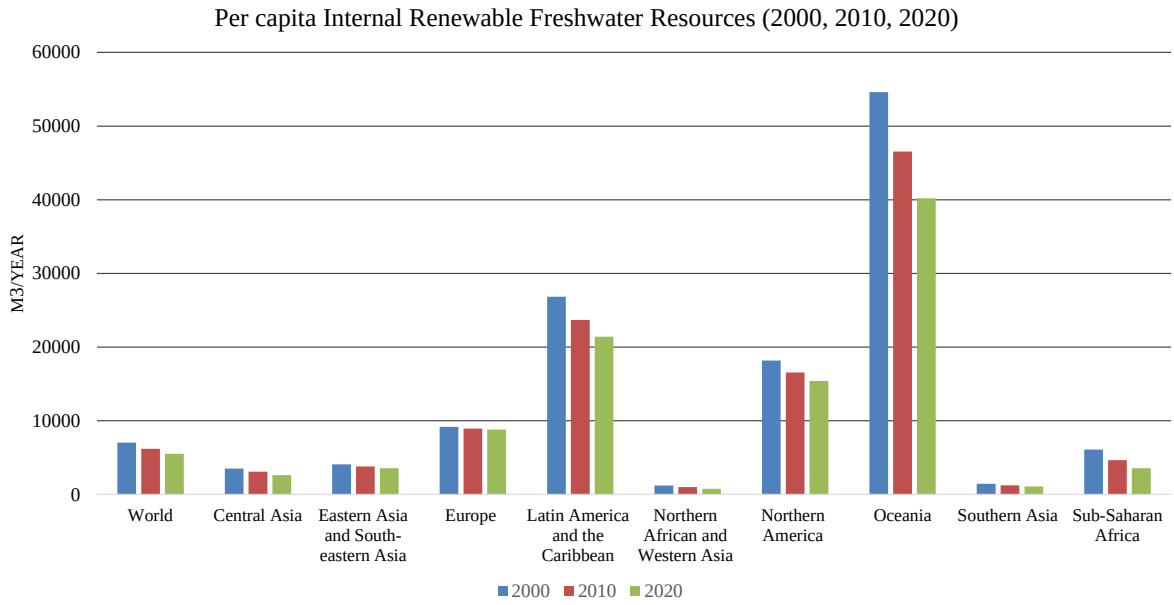
II. SECTION 1. Overcoming water challenges in agriculture

Water system at a breaking point: Overview

Unprecedented pressures on water resources

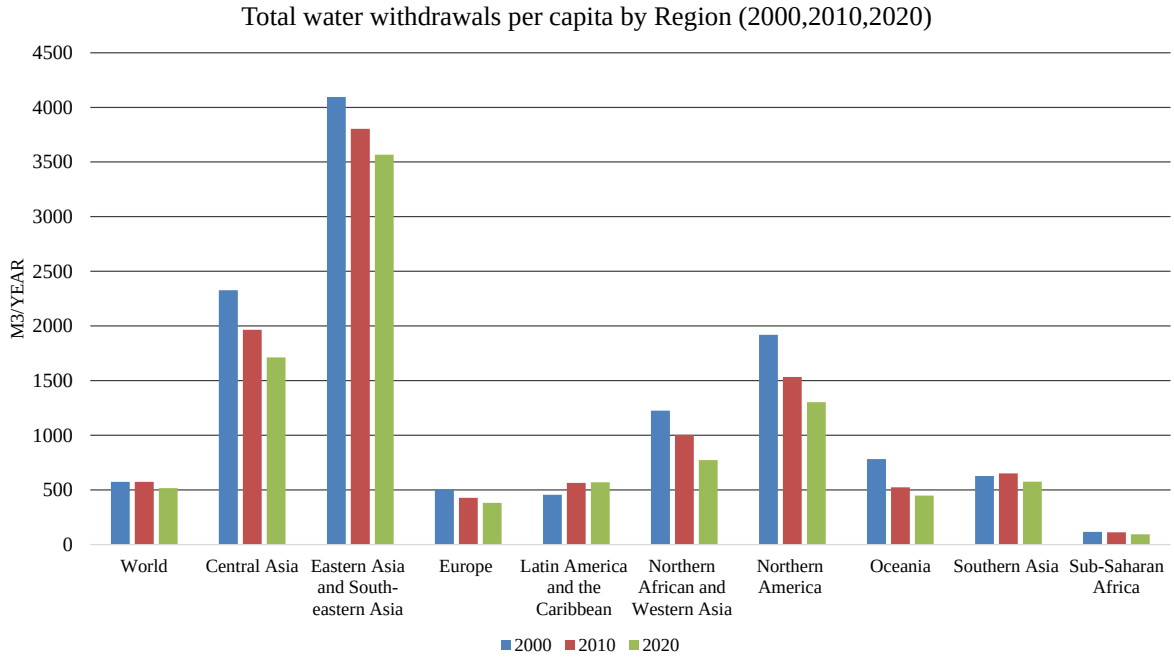
10. Pressures on land and water resources have never been so intense, and their accumulation is pushing the productive capacity of land and water systems to the limit, threatening food security and nutrition. Long-term internal renewable water resources (IRWRs) from rivers and aquifers amount to 44 211 km^3/year, and freshwater withdrawals (all sectors) are close to 4 000 km^3 /year, almost 10 percent of IRWRs. The overall change in the per capita distribution of freshwater resources is consistent with population growth. Between 2000 and 2020, the decline in global per capita IRWRs was about 20 percent (Figure 1). Total water withdrawals per capita declined from 2000 to 2020, except in Central America and the Caribbean, Southern America as well as Sub-Saharan Africa and Southern Asia (Figure 2). These trends are expected to persist as populations grow, partly due to overall increases in water productivity, including agriculture, and partly due to the prevalence of water scarcity induced by extended periods of aridity in areas of high population density. The situation will only grow worse if immediate action is not taken – the reason why The State of Food and Agriculture 2020 report addressed the two main water challenges affecting agriculture and food production: water shortages in rainfed agriculture and water scarcity, affecting irrigated agriculture.

Figure 1: Total annual IRWRs per capita by geographical region, 2000, 2010 and 2020 (m3/capita)



Source: FAO AQUASTAT, available at https://www.fao.org/aquastat/en/

Figure 2: Total water withdrawals per capita by geographical region, 2000, 2010 and 2020 (m3/capita)



Source: FAO AQUASTAT, available at https://www.fao.org/aquastat/en/

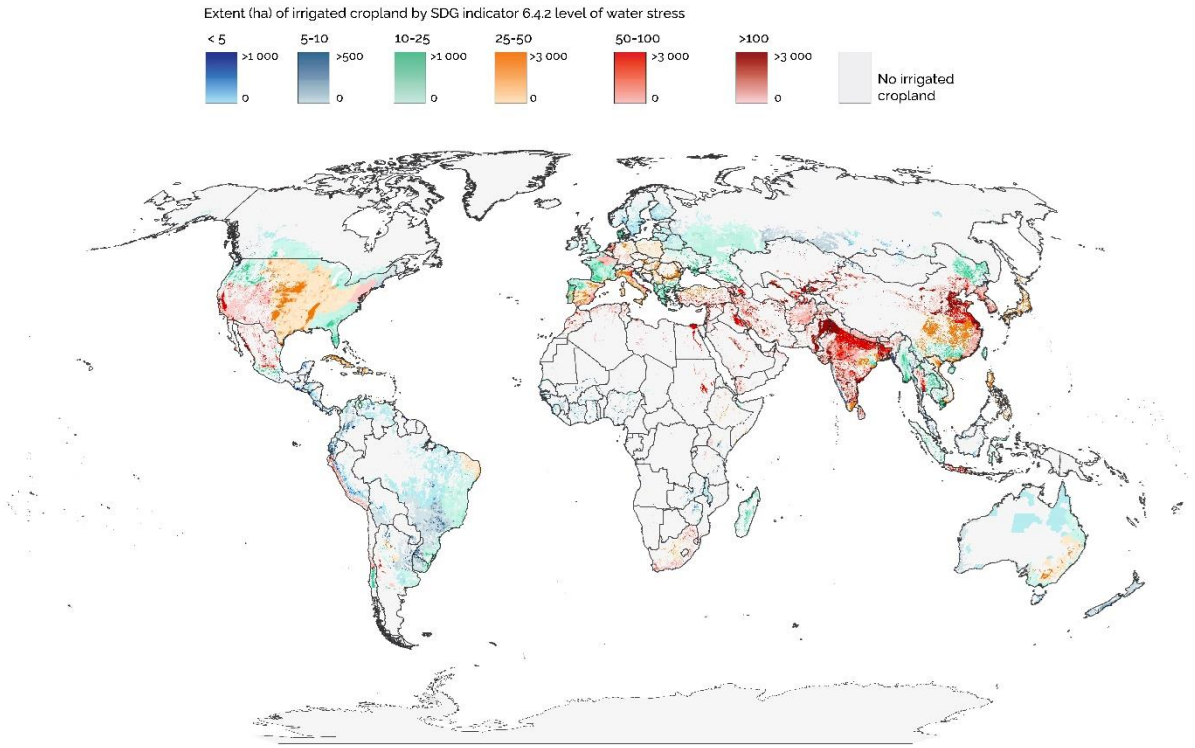
Agriculture contributes to and is affected by water stress

11. More than 3 billion people live in agricultural areas with very high or high levels of water shortages or water scarcity. About 1.2 billion live in areas where there is a high drought frequency in rainfed cropland and pastureland areas or high-water stress in irrigated areas. In Central Asia and in Northern Africa and Western Asia, about one-fifth of the population live in agricultural areas with very high-water shortages or scarcity. In sub-Saharan Africa, only about 5 percent of the population live in areas affected by high or very high water stress. There, most areas are rainfed, suggesting that

water constraints are driven by severe drought or lack of irrigation. While 5 percent might seem negligible, it implies that about 50 million people live in areas where severe drought has catastrophic impacts on cropland and pastureland.

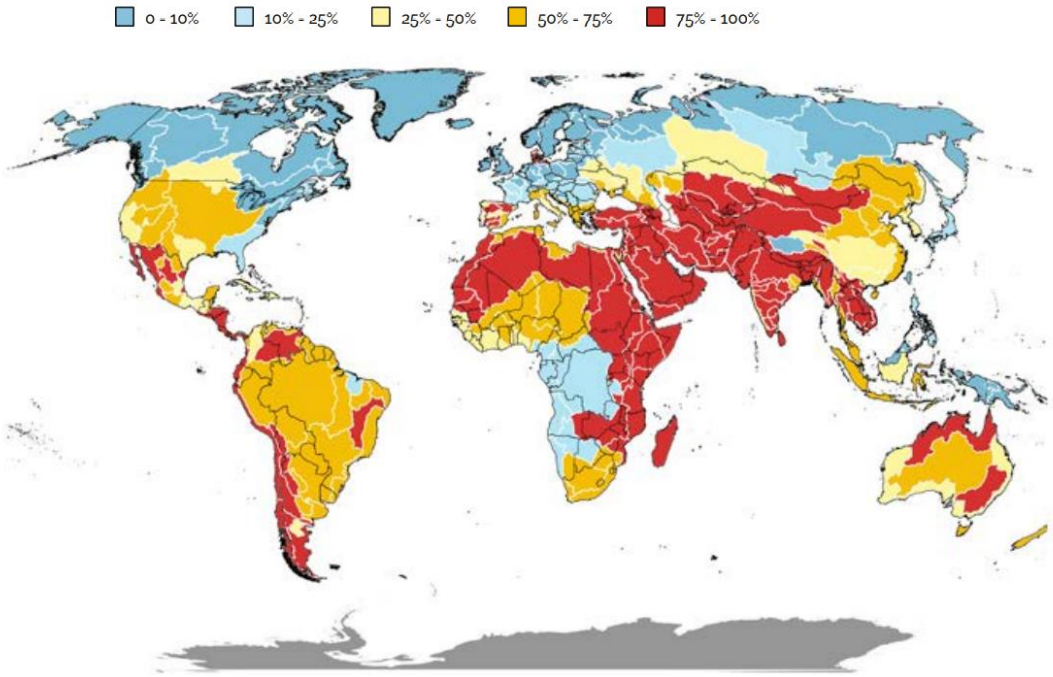
12. Agricultural withdrawals account for a substantial part of total withdrawals in Central Asia, the Middle East, Western Asia and Northern Africa (Figure 3). Rainfall variability and freshwater scarcity is driving renewed interest in irrigation, which accounts for 72 percent of all freshwater withdrawals globally. From a total of 342 million ha of irrigated land worldwide 62 percent is degraded or deteriorated. Water stress is high in all basins with intense irrigated agriculture and densely populated cities that compete for water, particularly where available freshwater resources are sparse due to climatic conditions. Basins affected by high (50%-75%) or very high (75%-100%) water stress are in regions such as North and East Africa, US and Latin America, Central, South and West Asia, and Australia (Figure 4).

Figure 3: SDG Indicator 6.4.2 – Level of water stress on irrigated area, 2015



Source: FAO (2021)

Figure 4: Level of water stress due to the agricultural sector by basin, 2018



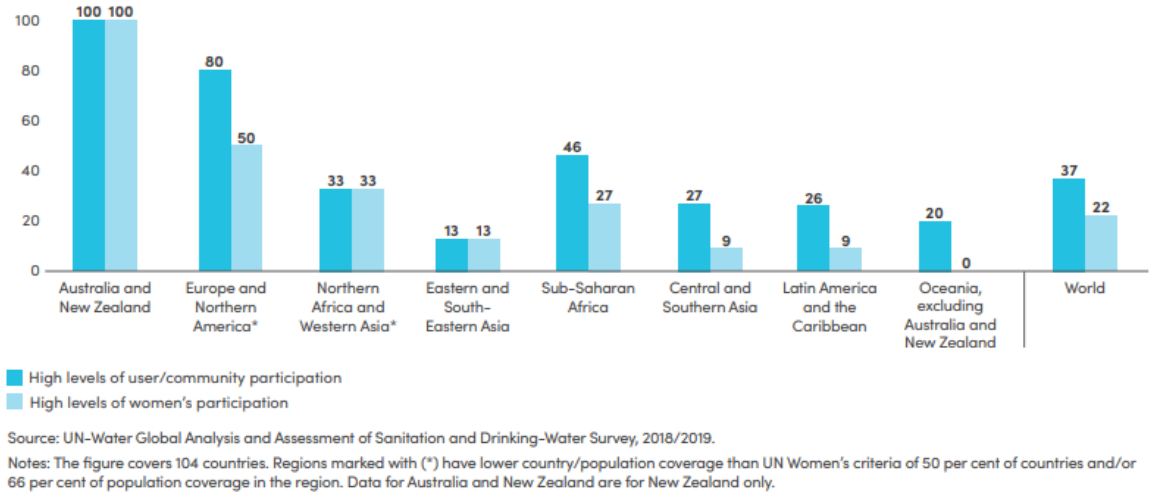
Source: FAO (2021)

13. In terms of agricultural land affected by water shortage or water scarcity, 128 million hectares (or 11 percent) of rainfed cropland and 656 million hectares (14 percent) of pastureland face frequent droughts, while 171 million hectares (more than 60 percent) of irrigated cropland are subject to high or very high water stress.

14. Levels of water stress and drought frequency can vary substantially within countries. Some countries face the dual challenge of severe drought frequency and water stress, all of them in North Africa and Asia. Within rainfed and irrigated agriculture, different production systems may differ both in terms of how they are affected by lack of access to water and in their capacity to address it. Countries with high-input rainfed production (high-income countries in Europe and North America) have a greater capacity to address water challenges. By contrast, in sub-Saharan Africa, where more than 80 percent of cropland is low-input rainfed production and only 3 percent of land is irrigated, farmers have difficulties in accessing irrigation equipment, modern inputs and technologies and lower capacity to address water challenges.

15. The increased pressure on the resource and water stress can thus exacerbate already severe inequalities in access to water. Access to and use of water in agrifood systems is highly gendered and intersects with other forms of social differentiation such as class, age and ethnicity. Globally, women's participation in IWRM and governance (i.e. women formally represented or regularly consulted in these processes) occurs at a high level in only 22 percent of countries (Figure 5).

Figure 5. Participation of women in integrated water resource management, 2018–2019 (percentage of countries)



Source: UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water Survey, 2018/2019.

Notes: The figure covers 104 countries. Regions marked with (*) have lower country/population coverage than UN Women's criteria of 50 per cent of countries and/or 66 per cent of population coverage in the region. Data for Australia and New Zealand are for New Zealand only.

Source: UN Women & United Nations Department of Economic and Social Affairs. 2021.

Groundwater depletion

16. Groundwater provides half of the volume of water withdrawn for domestic use by the global population, including the drinking water for the vast majority of the rural population who do not get their water delivered via public or private supply systems, and around 25 percent of all water withdrawn for irrigation. Groundwater brings major benefits, such as ready local availability, high reliability during droughts, regulating ecosystems and microclimate and generally delivering water of superior quality. Reliance on groundwater will only increase, mainly due to growing water demand by all sectors combined with increasing temporal variability in rainfall patterns. However, this natural resource is often poorly understood, and consequently undervalued, mismanaged and even abused.

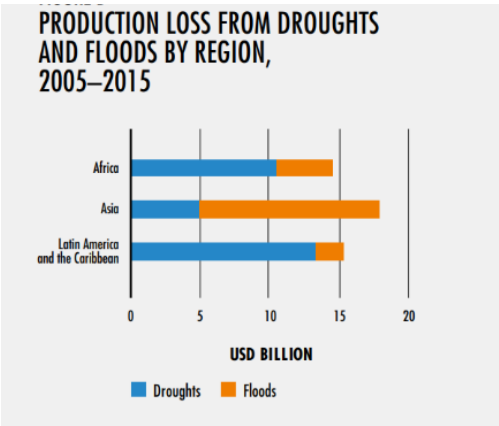
17. Groundwater withdrawal has more than quadrupled in volume over the last 50 years, a trend that is likely to continue. Irrigated areas under stress correlate strongly with intensive groundwater use and depleting aquifers.

18. Another large group of challenges is the rapid growth of pollution pressures on groundwater. There is widespread evidence of deteriorating groundwater quality associated with the leaching of agrochemicals, seepage of urban and industrial effluents, and irresponsible disposal of hazardous waste. Such pollution undermines human well-being and limits the options of groundwater use. Groundwater quality problems tend to be extremely persistent, and often too costly or technically impractical to remediate.

Increasing challenge of floods

19. Climate models predict increasing frequency, intensity and amount of heavy precipitation as a consequence of climate change. More intense rainfall is increasing the risk of landslides, extreme erosion and flash floods. Floods can cause long-term economic hardship for various food system actors owing to loss of livestock and crop production, and damage to food storage facilities, industries or commercial enterprises. This has already happened in the past (Figure 6) and could exacerbate in the future. Floods are frequently associated with water contamination and accelerated soil degradation, and can erode topsoil from prime growing areas, resulting in irreversible habitat damage. They are particularly heavy for the world's poor, the majority of whom live in rural areas and rely on agriculture for their food and income. In some areas, rampant infrastructure development along and around the rivers – not taking into account the natural slope of the land or floodplain exposure to inundation risk – intensify damage caused by floods.

Figure 6: Production loss from droughts and floods by region, 2005-2015



Source: FAO (2020)

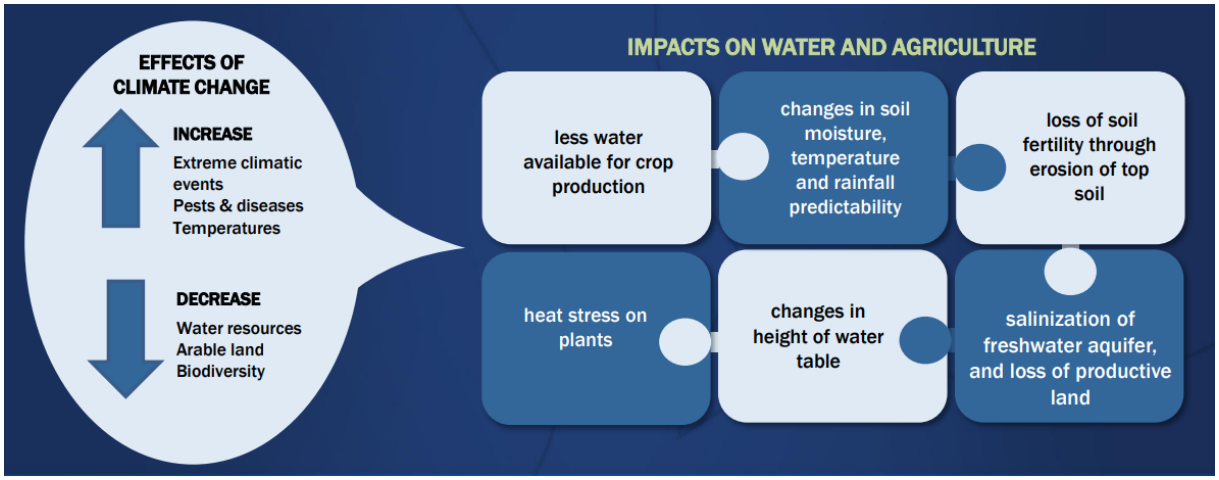
Deteriorating water quality

20. Water pollution is a rising global concern that directly affects health, environment, food security and economic development. Although other anthropogenic activities such as human settlement (urbanization) and industry are major contributors, agriculture has become the dominant source of pollution in many countries. Globally, 80% of wastewater flows back into the ecosystem without being treated or reused (WWAP/UN-Water, 2017), contributing to a major threat to human health and food safety where irrigation is practiced. Of particular concern is pollution caused by emerging chemical contaminants, including pesticides, livestock pharmaceuticals and plastics, and potential antimicrobial resistance for which there is currently little regulation or monitoring.

Climate change will exacerbate water-related challenges

21. Although there is uncertainty as to their location and magnitude, climate change impacts on the water cycle are expected to significantly affect agricultural output and the environmental performance of productive land and water systems (Figure 7). Climate models predict decreases in renewable water resources in some regions (mid-latitude and dry subtropical regions) and increases in others (mainly high latitudes, wet tropics and humid mid-latitude regions). Even where increases are projected, there may be short-term shortages due to changing streamflow caused by greater variability in rainfall. Climate change also affects freshwater ecosystems, fish and other aquatic populations.

Figure 7: Effects of climate change and its impacts on water and agriculture



Source: FAO (2022a)

What innovation and investments are needed for IWRM?

22. Improved water management strategies – where combined with agronomic practices, land and soil restoration and resilient practices to climate change, such as agroecology and other innovative approaches – will be crucial both for addressing water scarcity and transforming agriculture, as well as for reducing risks from floods. These strategies and technologies, just as farmers' incentives to adopt them, are widely influenced by the overall institutional and legal framework – encompassing water tenure, licensing, regulations, incentive measures and the institutional setup – and the overall policy environment, including societal choices, priorities, and relevant sectoral policies.

23. Water management includes a range of options: from entirely rainfed to fully irrigated conditions, to supporting livestock, forestry and fisheries, to interacting with important ecosystems. Political commitment, significant economy-wide and sectoral change, and radical shifts in policies, investments, partnerships, information and support to farmers to overcome constraints for adoption are all needed.

Unlocking the potential of rainfed agriculture through soil water management

24. Rainfed production dominates agriculture, covering about 80 percent of total cropland and producing about 60 percent of food[1]. It can contribute to climate resilience and be part of a strategy for sustainable livelihoods, development and economic growth. Yet to date, policy and governance on water resources management for agriculture has remained focused on irrigation.

25. There are two broad strategies for increasing yields in rainfed agriculture: (i) collecting or harvesting more water and infiltrating it into the root-zone; and (ii) conserving water by increasing plant uptake capacity and/or reducing root-zone evaporation and drainage losses. Some evidence shows that water harvesting and conservation could boost rainfed kilocalorie production[2] by up to 24 percent and, if combined with irrigation expansion, by more than 40 percent. Almost 20 percent of global cropland is suitable for water harvesting and conservation strategies, with hotspots in large parts of East Africa and South-eastern Asia. National governments play a critical role in ensuring that an enabling environment exists to support, promote and regulate the role of the private sector in incremental improvements of rainfed agriculture.

Supporting innovative water management practices

26. Agricultural production systems are major drivers of desirable and undesirable environmental impacts. Without effective governance mechanisms, decentralized water management approaches,

[1] The State of the World's Land and Water Resources for Food and Agriculture – Systems at breaking point (SOLAW 2021).
[2] The State of Food and Agriculture 2020 - Overcoming water challenges in agriculture (SOFA 2020).

such as some water harvesting schemes, can negatively affect water balances in catchments and river basins and, consequently, riverine fisheries. On the other hand, reducing or interrupting periods of flooding can reduce rice-related methane emissions. Nature-based solutions[3], which use natural processes to improve water management and conserve or rehabilitate natural ecosystems and processes, are another case in point. Innovative water management practices need to be gender-responsive and supported by adapted and sustainable governance mechanisms.

27. In situations where water supply is severely constrained, innovation in non-conventional sources of water – such as treated wastewater, desalinated water, fog and/or dew harvesting – is gaining momentum. While these can alleviate water stress and shortage, the existence of the kind of non-conventional source, costs, acceptability, political agendas, socioeconomic conditions and potential users need to be considered, as well as their environmental sustainability.

Improving water productivity in animal production

28. The water productivity – in physical and nutritional terms – of animal products is commonly lower than that of crop products, and highly dependent on the type of animal product and production systems. For example, livestock may rely on rainfed pastureland for feed – often with no alternative productive use of water – or on irrigated cropland. In mixed production systems, livestock may consume crop residues or feed produced on irrigated land. Various options exist for improving the sector's water productivity, including proper control of grazing, improved animal health and changes to diets and drinking systems. One aspect to consider in livestock production is the need to address pollution caused by animal production. Another area for improvement in productivity is that of integrated fish–irrigation systems. Irrigation can change physical aquatic habitats and nutrient contents and contribute to the decline of fisheries. However, opportunities for fish production to be integrated into irrigation systems exist (e.g. mixed use of land for aquaculture and rice production) and will depend to a large extent on national and regional policies and governance structures.

Investing in irrigation for improved water productivity

29. Rehabilitating and modernizing irrigation can reduce water consumption. Making more productive use of irrigation can help save water by increasing crop yields and/or reducing evapotranspiration. Differences in water productivity (output per unit of water consumed) across countries are explained by farmers' access to modern agricultural inputs, efficient irrigation systems and better soil, and improved water management. The most appropriate system will depend on socioeconomic and climatic conditions, sources and prices of energy, labour availability, depth of groundwater sources and infrastructure costs. The "Evaluation of FAO contribution to Sustainable Development Goal 6" is a valuable resource to further develop these concepts. Irrigation modernization must be preceded by water accounting and governance analysis, along with policy instruments such as water allocation to maintain or reduce basin-wide water use after the introduction of new technologies. Otherwise, greater efficiency may lead to the same withdrawals while reducing return flows downstream. Also, if access to efficient irrigation is uneven between large-scale agribusinesses and marginalized smallholders, the least powerful groups may be left with less water. Furthermore, clear gender inequalities are evident with regard to decision-making about irrigation technology.

Thinking beyond the surface: improving groundwater governance

30. Due to the diversity and complexity of issues and "invisible" nature of groundwater, it is often challenging to adequately incorporate it into the water management process. It is partially because of the open-access nature and direct use of most underground resources, where tenure rights and/or social norms contribute to dictating entitlements. Because groundwater is essentially a local resource, effective governance arrangements need to extend down to the local level, but should also be linked to basin-level, national-level or even transboundary level, as appropriate. Improving

[3] "nature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits". *United Nations Environment Assembly of the United Nations Environment Programme Fifth Session, 2022, Nairobi, Kenya.*

groundwater governance recognizes the value of aquifers and aims at achieving the sustainable provision of freshwater and preventing the degradation of aquifers. In areas where groundwater is over-pumped or depletion is occurring, new regulations for sustainable use of groundwater and their enforcement will have strong social and economic impacts. Because decisions are often taken outside the water sector (e.g. on food, land and urban planning; waste management; health; and chemical substances), there is a need for greater cross-sectoral coordination and collaboration. Data and information are also key.

Protecting inland fisheries and developing aquaculture

31. Inland fisheries contribute to about 20 percent of wild fish catching, and inland aquaculture contributes to 62.5 percent or 51.3 million tonnes of farmed fish of the world in 2018 (FAO, 2020b). Inland fisheries require maintaining environmental flows[4] and sustainable fishing practices. Inland fisheries are constrained by the availability of surface waters, connectivity among them, as well as the water quantity and quality, navigation, dredging and sand mining, etc. Inland aquaculture, mostly in freshwater, requires integrated land use planning and sustainable use of water and other inputs such as feed. A more balanced decision making process for water schemes could take into consideration inland fisheries and aquaculture.

Avoiding and reducing degradation and restoring lands and soils

32. Sustainable land and soil management, reducing degradation and restoring lands and soils, supports sustainable agricultural productivity, water efficiency and productivity, biodiversity, carbon capture as well as reduction of flood risks. Nature-based solutions represent effective, long-term and cost-effective interventions to address water management, ecosystem services and soil restoration and transform the agricultural sector into a beneficiary and a custodian of ecosystems. Recognizing that 1/3 of cropland and pastureland is degraded to a different extent, restoration combined with sustainable soil and water management must be a top priority of affected countries so as to bring them back on track to produce more food, support livelihoods and other ecosystem services[5]. Attention is needed to protect resource rights and the most vulnerable groups.

33. Furthermore, nature-based solutions can complement conventional grey infrastructure to improve flood risk management and create additional social and environmental benefits.

Improved governance for IWRM and agrifood systems transformation

34. Water resources should be managed to sustain agrifood systems that are more productive, resource-use efficient, inclusive, resilient and sustainable. The different roles, responsibilities and attitudes of stakeholders involved in water governance are dispersed across sectors, locations and jurisdictions, but they all need to be clearly understood. One concern is that of affordability and ensuring equitable access to water. Another is that of ensuring environmental flows, ecosystem services and non-consumptive use of freshwater resources, e.g. for inland fisheries. Hence, improving water governance calls for adaptive management at the catchment level to address the needs of all water users according to national contexts, as appropriate.

35. Well-designed allocation regimes contribute to multiple policy objectives: economic efficiency, by allocating resources to higher value uses as well as contributing to innovation and investment in water use efficiency; environmental performance, by securing adequate flows to support ecosystems services; and equity, by sharing the risks of shortage among water users fairly. Combination of governance and management instruments including legislations, water plans, strategies, administrative measures, market approach and other economic incentives can help to understand and address trade-offs across sectors, facilitate cross-sectoral coordination and reconcile economic, social and environmental objectives. A key challenge is to include and safeguard the

[4]. Environmental flows describe the quantity, timing, and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and well-being. https://riversymposium.com/about/brisbane-declaration/

[5] The State of the World's Land and Water Resources for Food and Agriculture – Systems at breaking point (SOLAW 2021).

interests of groups with less power and influence but reliant on ecosystem services (e.g. fisher folk, subsistence farmers, pastoralist groups and women).

Transparent water accounting and auditing, and clear water tenure are key building blocks

36. Better understanding of how much water is available, how it is used where by whom, and whether current patterns are sustainable is the basis for designing equitable water allocation regimes and effective water management. Water accounting – the systematic study of the current status and trends in water supply, demand, accessibility and use – is vital as a resource baseline for policies and interventions aimed at tackling water challenges. However, water accounting should form part of a broader process of water governance[6]. Combining water accounting with water auditing or governance analysis, i.e. placing the findings of water accounting into the broader societal and institutional context – can provide the basis for more realistic, sustainable, effective and equitable water allocation and reallocation, and water management and use[7].

37. Water tenure – the relationship, whether legally or customarily defined, between people, as individuals or groups, and water resources[8] – and its responsible governance are strong building blocks for efficient water use and equitable and sustainable access to water. Gender inequalities in access to land can impact access to water and irrigation technology. The development of community organizations to manage water allocations at local level can contribute to equitable access to water resources and in improving water and food security for rural populations, particularly in areas affected by water scarcity where close to 80 percent of smallholder farms in low- and middle-income countries are located (FAO 2021), and less than a third have access to irrigation. In many cases, access to and use of water is regulated by the community-based customary tenure systems including those practiced by the Indigenous Peoples that should be recognized and respected.

38. A Global Dialogue on Water Tenure for Food Security, Climate Adaptation and Social Inclusion, as supported by the 28th Session of the Committee on Agriculture (COAG28) and recommended by the 171st Session of the Council[9,10], could lead to an agreement on voluntary guidelines defining principles for responsible governance of water tenure through an inclusive and consultative process that includes all relevant stakeholders and actors, in particular the small-scale producers, women and Indigenous Peoples.

There is a need to focus on investment and governance in rainfed areas

39. National plans, such as water resource plans and roadmaps to 2030 Agenda, national food security pathways, need to promote investment options in both rainfed and irrigated agriculture and include water management in rainfed areas that often have impacts at the catchment and river-basin scale. Public support is required by investing in infrastructure and supporting water capturing and conserving technologies to help attenuate the effects of drought while contributing to agricultural development. As in irrigation systems, attention to land and water tenure is also needed in rainfed systems, together with community-based watershed management approaches for addressing water shortages and land degradation, which cannot be tackled at the farm level alone. These approaches need to extend to forest conservation and restoration at the watershed level.

[6] The State of the World's Land and Water Resources for Food and Agriculture – Systems at breaking point (SOLAW 2021). FAO defines governance as "formal and informal rules, organizations, and processes through which public and private actors articulate their interests and make and implement decisions" (FAO 2013. Reviewed Strategic Framework [online]. Rome. http://www.fao.org/3/mg015e/ mg015e.pdf). Paraphrasing this definition, water governance can be defined as referring to formal and informal rules, organizations, and processes through which public and private actors articulate their interests and make and implement decisions related to water resources.

[7] The State of Food and Agriculture 2020. Overcoming water challenges in agriculture (SOFA 2020). Implementing the OECD Principles on Water Governance. 2018

[8] FAO. 2020. Unpacking water tenure for improved food security and sustainable development. Land and Water Discussion Papers. Rome. https://www.fao.org/3/cb1230en/cb1230en.pdf

[9] Report of the 28th Session of the COAG: https://www.fao.org/3/nj925en/nj925en.pdf.

[10] Report of the 171st Session of the Council: https://www.fao.org/3/nl148en/nl148en.pdf.

Strengthening policy coherence both within and across sectors

40. Greater policy coherence across sectors and policy domains is crucial. Often, the impact of policies is uneven across agricultural subsectors, with a tendency to favour irrigated farming. The expansion of irrigation has improved food security and nutrition in many countries, and in some rainfed areas there is still scope for expansion if done sustainably and equitably. However, it has also contributed to the loss of inland fisheries in some countries, excessive groundwater withdrawals and changes in surface water flows and ecosystems, as well as to increasing inequalities. Strengthening policy coherence will require the aligning of incentives. General subsidies should be replaced by targeted ones to spur adoption of new irrigation technology, the provision of environmental services, and measures for maintaining and restoring healthy freshwater and soil systems. Payments for environmental services – payments to farmers or landowners who agree to manage their land or watersheds for environmental protection – can also help ensure the proper valuation of well-functioning ecosystems.

41. Policy coherence calls for strong mechanisms and processes to manage and coordinate policy, budgeting and regulatory development across sectors. Improved inter-sectoral coordination (land, water, agriculture, energy, climate change, biodiversity, environment, finance and planning) can help address overlaps and trade-offs, improve performance, reduce costs and identify areas where lines of authority can be better delineated should a conflict arise, and improve accountability. Measures include capacity strengthening for public institutions, coordination and consultation mechanisms across ministries, appropriate planning and monitoring tools, and upgraded and integrated data and information systems. Improving the design of irrigation investments to include gender, health and nutrition outcomes can make irrigation an integral part of strategies to reduce poverty, hunger and malnutrition.

An integrated approach is key

42. Evidence demonstrates that restoring degraded resources, promoting sustainable intensification and increasing resilience can be achieved through planning and implementing integrated and multi-stakeholder initiatives at scale. This can be done through territorial approaches, watershed or river basin management, integrated landscape management and restoration, agroecology, climate-smart agriculture and the water-energy-food-ecosystem nexus approach supported by long-term strategies, investments and innovative financing and partnerships to sustain initiatives and improve livelihoods. Finding appropriate pathways to make integrated approaches work requires innovative governance responses and enhanced capacities to build on synergies, address trade-offs and manage processes that may involve (re)allocating limited resources, addressing inequalities and changing the way of empowering actors at different levels of decision-making. IWRM acknowledges that water needs managing at system levels, such as river/lake basin, sub-basin or aquifer. To improve water governance and increase water-use efficiency and sustainability, technical, financial and institutional solutions must be in place, followed by effective and coordinated implementation.

43. Simultaneously achieving social, economic and environmental goals requires that relevant sectors understand the root causes of problems and related socioeconomic and political dynamics. Pragmatic governance analysis facilitates understanding of existing institutions, how they have evolved and how the relative power and capacities of different actors influence the policy adoption and implementation. Such analysis will help to define the gaps and develop interventions for improving integration and governance.

Water pricing can contribute to more efficient use of water

44. Pricing of water, often to reflect the provision costs of water (delivery, treatment, etc.), is one of the factors affecting water use efficiency. Water is still seriously undervalued in many places around the world, where it is consequently used inefficiently. In places where water allocations and water tenure are in place, it may be possible to introduce market instruments such as water pricing that will help improve the efficient use of water. However, water pricing should fully consider the potential impacts on farmers and their livelihoods. Water pricing can be more than just a cost recovery mechanism and a means for improving economic efficiency. It should be also aimed to address social

and environmental dimensions, including the impact of water pricing on lower-income groups and on sectors like agriculture where it is a key input.

Water governance needs to be inclusive and effectively engage key actors

45. Inclusive water governance requires deliberate linkages across scales and sectors, and engagement of all stakeholders, in particular small-scale farmers and women[11]. Such engagement brings multiple sources of knowledge, values and information to the table, contributing to building trust, social cohesion and the rule of law. Participatory policy and decision-making also help defuse conflict and reframe issues holistically by identifying trade-offs and synergies across constituencies[12].

46. Platforms for dialogue and consensual approaches can enable effective engagement and negotiation of farmers and civil society, including more vulnerable groups (e.g. women, the poor and Indigenous Peoples), together with the government and the private sector. This will help ensure negotiated trade-offs are equitable and allow transition to sustainable water management.

47. Managing water requires local-level analysis, planning and action, for which community groups play important role. Local organization of water users, such as watershed management organizations, farmers and fishers' associations, and water users' groups, also known as water users associations, are key in improving water governance. The important contribution of water users' associations to water management and governance is their ability to bring together farmers (particularly small-scale farmers) to manage a shared catchment, water source (a river, lake or aquifer) or irrigation system. Through synergies, members can pool their financial, technical, physical and human resources to manage such shared water systems. It is essential to increase women's engagement in water users' associations and farmers' organizations, where they remain under-represented and disadvantaged[13].

III. SECTION 2. Integrated flood risk management for resilient agrifood systems and rural development

48. Flooding is an integral part of the natural rhythm of healthy rivers. Through seasonal floods, materials (e.g. rocks, sediment and nutrients) are transported to the downstream areas, flood plains, river deltas and coastal areas, which form the most fertile lands of the planet for agriculture. Such natural flooding processes are crucial for freshwater biodiversity, in particular the fish species, both purely freshwater fish species and those migrating to the oceans, which provide about 20 percent of global catching.

49. However, flood disaster is one of the most frequent, widespread and catastrophic hazards, with global flood losses of around USD 20 billion in 2021. Behind these economic losses lies a human story, with an estimated 1.8 billion people exposed to significant flood hazards. Between 1998 and 2017, floods affected more than 2 billion people worldwide and many have lost their lives during major floods. Those who rely on agriculture for their livelihoods are often the worst affected, potentially putting their livelihoods, food security and nutrition at serious risk. Between 2008 and 2018, climate-related disasters caused declines in crop and livestock production worth USD 280 billion globally, of which floods are responsible for a total loss of USD 21 billion in least developed countries (LDCs) and Lower-middle-income countries (LMICs), accounting for 19 percent of total agricultural loss[14].

50. As aforementioned, floods are often linked with or trigger other disasters such as landslides and have indirect impacts that cascade (and often escalate) through connected infrastructure networks

[11] The State of Food and Agriculture 2020. Overcoming water challenges in agriculture (SOFA 2020). Implementing the OECD Principles on Water Governance. 2018.
[12] The State of the World's Land and Water Resources for Food and Agriculture – Systems at breaking point (SOLAW 2021).
[13] FAO. 2023. The Status of women in agrifood systems. Rome
[14] FAO. 2021. The impact of disasters and crises on agriculture and food security: 2021. Rome. https://doi.org/10.4060/cb3673en

and supply chains (affecting critical services including food supplies, energy and communications) and social separation and stress.

51. Good agricultural flood risk management takes consideration of food security, places an emphasis on both risk reduction (to people, economies and the environment) and resilience building through working with nature for multiple benefits across a range of sectors (e.g. crops and livestock, energy, fisheries, societal wellbeing and environment) and thus plays a pivotal role in promoting desired societal, environmental and economic outcomes.

52. The need for a strategic approach that better aligns activities at multiple spatial and temporal scales in agricultural policy recommendations in an integrated approach to flood risk management, and that specifically recognizes the needs for agricultural rural communities, includes:

- Incorporating to the economic case also the social returns. – Despite facing substantial exposure and vulnerability, the use of simple monetary measures to justify investment often overlooks the needs of rural agricultural communities. Consequently, prioritisation of investments based on economic benefits skews attention towards urban areas and high-income locations; a bias that means rural communities are left neglected despite the risk to lives, livelihoods and ecosystems they depend on.
- The extensive nature of rural flood risks and impacts requires a well-coordinated system of interventions in contrast to constrained and more controllable floods in urban areas.
- The remoteness of rural agricultural communities – they have less reliable and less/limited access to forecasting and warning; and transport lines and communication can be disrupted during emergency situations.
- Overlaying flood risk and other environmental risks – significant multiple impacts of simultaneous soil erosion and floods; unsustainable land management use/practices.

Paradigm shift on flood risk management: a new conceptual framework for food and agriculture resilience

53. Flood risk management has evolved over the past decades in response to lessons learnt from flood events and advances in science and engineering. Despite these advances, flood damages continue to increase because of climate change and the poor development choices. In recent years the need for a more strategic approach has been recognized. Such an approach recognizes that flooding is a natural process of the global water cycle that does have multiple benefits and that there is seldom a single solution to managing flood challenges and therefore promotes the use of a portfolio of flood risk management measures and instruments.

54. Such a portfolio brings together actions to **manage and reduce exposure to flood hazards** (e.g. using a blend of built and natural infrastructure), to **reduce vulnerability and build coping capacity to flooding** when it occurs (e.g. through anticipatory actions), to **reduce flood impact** on those exposed (e.g. by providing an effective response and aiding recovery), and to **manage flood risks** through better governance (e.g. by implementing flood risk management strategies and plans at local and basin levels).

55. Strategic and integrated framing of flood risk management is important in agricultural rural settings in recognizing the combined performance of the built (e.g. dams and embankments) and natural or green infrastructure (e.g. wetland and upper watershed), the resilient agricultural practices (e.g. growing flood resistant crops), and social interventions (e.g. laws, regulations, policies, strategies, plans, institutions, organizations and individual behaviours).

56. Rural communities including the Indigenous Peoples, have often learnt to live with flooding, recognizing the importance of the functional floodplains and the health of the ecosystems (e.g. soil, land and forest) upon which many rely. Indigenous knowledge, basin scale planning and local actions are all important dimensions to flood risk management. Appropriately aligning planning actions at multiple scales (across time, space and sectoral domains), stakeholder views (including the voices of the most vulnerable), and funding sources and mechanisms underpins the long-term success of managing flood risk (Table 1).

Figure 8. The evolution and development of flood risk management (from Sayers *et al.*, 2017).

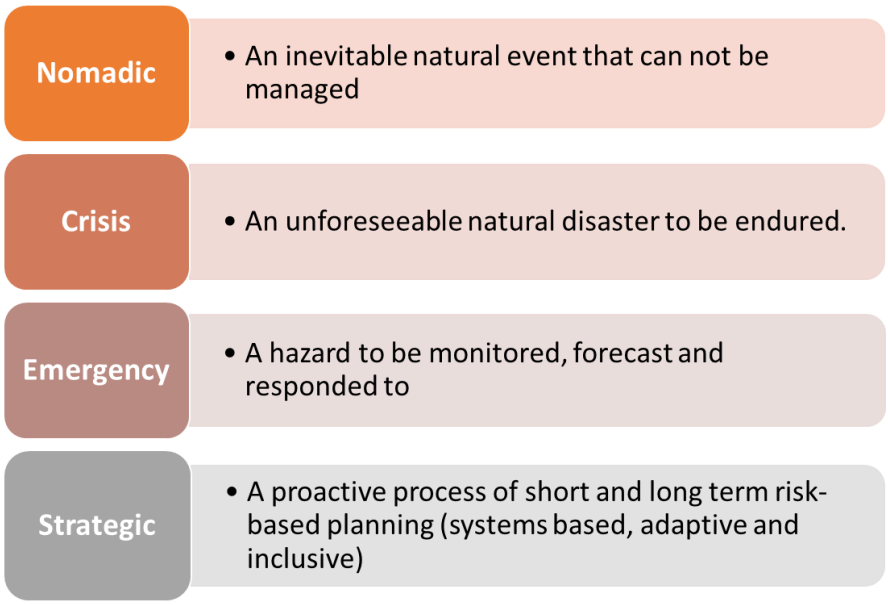


Table 1. Dimensions of integration in flood risk management (adapted from Sayers *et al*., 2023)

Integrated Flood management	**Description**
Basin Planning (Vision).	Including the complete river basin
Inclusive decision process	Including all users, inclusive of farming communities of the upper catchment and on flood affected areas, whether on the river floodplain, or along a coastal fringe, and the environmental systems.
Vertical alignment	Involving all administrative layers and institutional arrangements to encompass the complete range of issues.
Horizontal alignment	Coordination across many divisions of government ministries and agencies, e.g. finance, water, agriculture, environment, land, meteorology, emergency, health, communication, transport, energy, labor and social services.
Multi-sector alignment	Producing synergies and co-benefits for diverse sectors as mentioned above.
Temporal adaptation	Considering both the existing risk (including residual risk) as well as the potential for new (or future) risk in the context of climate change.

Managing flood risk in agriculture and rural areas

57. Compared to flood management in urban areas, rural flood risk and disaster management faces a different context and challenges, including:

a. An appearance of a weak economic case – people and property are, by definition, dispersed in rural areas. Despite facing substantial individual vulnerabilities, the use of conventional approaches to monetize tangible damage can fail to present a strong case for action.
b. Risks are assumed unmanageable – rural floods often cover vast areas, as functional floodplains response to swollen rivers. Such floods cannot be readily (or desirably) controlled with conventionally built defences but rather through a coordinated whole system response (with planning, restoration and targeted multiple functional interventions).
c. A lack of legacy investment support infrastructure:
   - Communications – less reliable and less access to forecasting and warning.
   - Isolation – isolation of rural communities, including disruption of transport links and difficulty of providing emergency services.
d. Interconnected risks with persistent impacts:

- Soil erosion – significant multiple impacts of simultaneous soil erosion and floods.
- Upstream to downstream – downstream impacts of land management practices on floods.

e. Social vulnerability – the need for adaptation and social support in local communities, literacy, etc.

58. There are essentially four broad avenues to managing flood risk and disasters that come together as an integrated portfolio of interventions:

- managing and **reducing flood exposure** through interventions such as improving land use, better spatial planning and a blend of built and natural infrastructure;
- reducing vulnerability and **building coping capacity** to floods through interventions such as best practices of disaster risk reduction, resilient agricultural practices at farm and landscape levels, social protection and insurance, effective response and aiding recovery, anticipatory action;
- **reducing flood impacts** when it occurs through interventions such as effective response and aiding recovery, effective operations of built infrastructures; and
- **managing flood risks** through better governance (e.g. by implementing flood risk management strategies and plans at local and basin levels).

59. There are many options for reducing flood risk and impacts, but it is increasingly recognized that a wide portfolio of measures – from hard to soft infrastructures as well as through better disaster risk governance at all levels – are required to support the delivery of just and inclusive outcomes to people and provide indirect co-benefits through healthy, resilient agriculture and ecosystems.

60. Flood risks and impacts can be reduced if multi-hazard disaster risk reduction (DRR) is fully embedded into development planning and humanitarian actions. Countries/communities must have in place actionable flood risk management strategies (as also part of the Sendai Framework Target E: national/local DRR strategies) at national/basin level, accompanied by an action plan from prevention/risk reduction to response and risk-informed recovery. Furthermore, specific flood risk management interventions must be mainstreamed in sectoral plans/strategies or agricultural DRR strategies and plans.

61. Rural communities are at the forefront in the delivery of flood risk management actions at the local level. Therefore, it is essential that rural communities and actors lead the flood risk and disaster management processes and implementation. In this regard, community-based flood risk management, as an integral part of Community-based disaster risk management (CBDRM), is key to strengthening resilience of people and communities against floods through a portfolio of the aforementioned interventions.

62. Structural interventions include hard engineering constructions, e.g. dams, detention ponds, flood storage areas and embankments, and green/blue measures, such as soil and forest management to increase infiltration of rainfall, managing floodplains and wetlands to store flood water; mangrove restoration, agroforestry.

63. In addition, anticipatory actions ahead of predicted hazards can prevent or reduce acute humanitarian impacts, thus mitigate disaster impacts.

64. Given the current global economic downturn and shrinking financial resources, considering the reverse impacts of large infrastructures on environment and local communities and recognizing the vast rural land areas, the importance of pursuing integrated, “win–win”, “no-regrets” and ecosystem-based solutions to floods risks and disasters are more critical than ever.

65. Recently, governments are increasingly turning to nature to manage flooding, such as widening of natural floodplains, protecting and expanding wetlands and investing in green spaces to reduce run-off. Key tenets of this approach are to work with natural processes to manage floods rather than against them, and put flood water where it is beneficial, such as inland fisheries. Such ecosystem-based solutions can also produce multiple additional benefits, namely, carbon sequestration, water quality improvement, biodiversity enhancement and new jobs in recreation and tourism. Agricultural solutions can address both safeguarding agricultural crops and environmental protection through the

use of "soft path" measures (e.g. land management, wetland storage, and floodplain reconnections, etc.) and "hard path" measures (e.g. bypass channels, controlled storage, etc.), whilst simultaneously delivering effective and efficient flood risk reduction.

66. Agricultural land management can help reduce floods. Most agronomic soil and water conservation practices in Ethiopia increase crop yield and reduce run-off and soil losses. For example, contour ploughing can reduce surface runoff.

67. Innovative solutions of working with floods by farmers do exist in places, such as the Mekong Delta, Vietnam:

- growing freshwater giant prawns to take advantage of the high flooding system;
- building ponds to raise fish, using trash fish caught in the flood season as feeds for cultured fish;
- switching to more profitable cash crops (e.g. sesame) rather than rice;
- adopting multiple cropping systems (e.g. double or triple rice crops) within an embanked system; and
- practising integrated freshwater aquaculture (e.g. integrated rice-fish/crab farming).

68. Many countries are considering schemes to offer farmers and landowners financial incentives for managing land for delivering ecosystem services such as reduced downstream flood risk. In 2018, there were over 550 active programmes around the globe and an estimated USD 36-42 billion in annual transactions. The European Common Agricultural Policy aims to enhance the provision of public goods, such as sustainable soil management. Payments for environmental services related to floods and clean water, are being considered to promote conservationist practices in headwater catchments in many countries, including Brazil.

Guiding recommendations on integrated flood risk management for resilient agrifood systems and rural development

69. The overarching motivation for flood risk management is to support the broader aims of sustainable development. Flooding issues, of course, are always context specific and there are no one-size-fits-all solutions. Building upon the discussions in this document, the following recommendations are proposed for consideration to advance strategic flood management in agriculture and rural areas, which plays a pivotal role in promoting desired societal, environmental and economic outcomes.

70. **Recommendation #1: Accept absolute protection is not possible and plan for exceedance**. There will always be a "bigger" flood and developing early warning systems and triggers for anticipatory action is key. While it cannot substitute building risk prevention and reduction into all aspects of the planning process (from development choices to sustainable agricultural production),this promotes working with communities to raise awareness and encourages investment in forecasting and early warning systems. Central to this is the ability to scale up anticipatory actions while forecast certainty of flood improves.

71. **Recommendation # 2: Assess the resilience of agrifood systems to flood risks.** Recent years have seen a growing importance of "stress testing" to better understand the resilience of particular sectors to climate-related risks. The agricultural sector is fundamental to global security, but currently there is no standardized global assessment or scenario stress tests for global agricultural production and flooding. Understanding agriculture flood risks, how they are distributed and how they may change will be an important step towards developing the best ways to respond. Doing so will require better shared information on agricultural activities and how they may be impacted by floods, which will eventually facilitate and contribute to a global assessment of flood risks to agriculture and rural development.

72. **Recommendation # 3: Work with nature as part of a whole system and portfolio-based response.** Healthy and diverse ecosystems, such as forests, pastures, arable land, floodplain and wetlands, are central to many rural livelihoods. Working with nature processes as part of the rural flood risk management strategy implicitly encourages choices that maintain the natural dynamics from the source to the sea. In turn, it supports healthy freshwater and marine ecosystems and helps

maintain healthy soils; all prerequisites for productive and resilient agriculture. To be successful, working with nature needs to be embedded within a whole system portfolio of measures, from technical solutions on the ground to the policy design at global, national and basin levels.

73. **Recommendation # 4: Understand and communicate present-day risks and how they may change in the future.** An appropriate understanding of the flood hazard, exposure, vulnerabilities and coping capacities, how they are generated, and how these combine into a risk faced is the starting point for any planning process. Turning all kinds of knowledge and information into simplified messages for the rural communities and using the modern communication tools to reach out to them are crucial in managing floods risks and disasters. Further, "it's impossible for a person to step into the same river twice"------ the old Chinese saying reminds us that the river is constantly changing, so are the flood risks.

74. **Recommendation # 5: Agriculture and rural communities need to be closely involved in planning, designing, implementing and monitoring flood risk management actions.** Flooding, and actions taken to manage flood risks and impacts, are not fair *per se*: the inherent natural spatial inequality in the frequency and extent of flooding, plus the legacy of past interventions and the coverage of new ones being the cause. Achieving socially just outcomes is therefore not easy in practice. Promotion of socially just outcomes and an inclusive decision-making process, particularly, inclusive of rural smallholder farmers, women and the Indigenous Peoples when appropriated, play a substantial role in flood risk management and resilience building in many countries. By placing social justice at the heart of the choices made, outcomes for the most socially vulnerable can be maximized.

75. **Recommendation # 6: Connect risk governance mechanisms at all levels and ensure horizontal and vertical integration and alignment to maximize co-benefits and minimize risks.** The Sendai Frameworks Target E - multi-hazard national and local disaster risk reduction strategies and plans requires the development of flood risk management strategies. Flood risk management does not take place in isolation of other Sustainable Development Goals and interacts with many sectors including agriculture, land and water, etc. Horizontal alignment (between sectors, including humanitarian assistance) and vertical alignment (between plans at multiple temporal scales – short to long term – and spatial scales – local to national and even transboundary) are needed to avoid future conflicts and the emergence of unnecessary risks and to identify opportunities; "win-win" outcomes and compromises that deliver wider social, economic and environmental co-benefits. Agricultural land and water management policies, plans and financing must include a flood risk management component. Flood risk governance at the national, river basin and local levels can be strengthened by applying integrated strategies that take comprehensive climate and disaster risk management principles into account. Linking humanitarian assistance with development activities is key for flood management, as it will enable countries and communities to recover from flood related disasters and build long-term resilience.

76. **Recommendation # 7: Increasing finance to scale up resilience interventions in agriculture and rural areas.** Flood risk assessment and early warning in agriculture, ecosystem-based agricultural solutions in flood risk and disaster management, post-disaster recovery and resilience building in agriculture and rural areas should be all integral parts of international and national DRR strategies and financing plans. Due to increasing flood risks, as a result of various factors, including deforestation, land degradation and climate change, there is a need to strengthen risk assessment, early warning systems, proactive preparedness and anticipatory actions and capacities of communities and key institutions, which can help to timely act before a shock occurs and can save lives and livelihoods.

77. **Recommendation # 8: Adapt to the new context and optimize use of flood water as resources for flood-adaptive/resilient economies.** The world is changing rapidly. Constantly changing factors such as climate change, development, land use and other societal changes require an adaptive and innovative planning. Developing and implementing risk reduction and adaptive strategies that respond to an uncertain future rely upon creativity and innovation in selecting responses that do not foreclose future options (or unnecessarily constrain future choice) but still address present day risks, for example, maintaining the functional floodplain and room for the river. It

has been widely noted that, in fact, many countries are facing both water scarcity and flood challenges during the different seasons or years. Following the philosophy of a paradigm shift in flood risk management and working with nature approach, learning from the existing practices by Members, flood water could be smartly stored and used for flood-adaptive/resilient economies, such as hydropower, aquaculture, rice production, water-resilient forest, etc. This could help increase the resilience to both floods and water scarcity/drought and turn flood water into resources for economies, society and the environment.

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