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Making Water Pivotal in the Design of Food Systems*

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Water plays a crucial role in our food systems and food security. However, the essential role of water for a functioning food system and the impacts of food systems on water availability and quality have not yet been adequately recognized. Due to a lack of coordination among water and food systems actors, there are siloed water, food security, and nutrition strategies. This paper presents the case to make water pivotal in designing food systems, laying out action perspectives for different actors to move toward what we call "water-responsible food systems". This paper is based on input from many participants during workshops and existing literature. A food systems approach provides an excellent entry point to link food with water considering climate change and energy. Moreover, collective and cross-cutting actions between actors in food systems are essential to make

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decisive progress, as well as a common language and insight into the trade-offs of the multiple values of water for a clear prioritization of water use and allocation.

Keywords: Water; food systems; action perspectives; responsibilities; silos.

1. Embracing Water as an Organizing Principle in Food Production

With about 70% of our blue freshwater resources being withdrawn for irrigation to produce food, growing water challenges magnify food system vulnerabilities. This is particularly worrisome as climate change, mediated through changes in the timing, quantity, and quality of water, will increasingly affect all facets of food systems (Ringler *et al.* 2022; IPCC 2021). Water scarcity is growing, and global warming has been estimated to reduce renewable water resource availability in many areas and increase water demand. Water withdrawals are expected to increase over time due to population growth, climate change, biofuel crops, and the growing consumption of water-intensive livestock and freshwater aquatic products because of higher incomes and urbanization processes that shift people's diets. This higher water demand has increased competition for water across a range of sectors. In the main food production areas of the world, water withdrawals from rivers, lakes, and aquifers are significantly reducing the freshwater reserves, despite the improvement of more efficient production and processing technologies. Poor water management and misuse also contribute to this reduction in freshwater reserves. There is a growing urgency to ensure that food production uses water based on local availability and that policies cap water use within these limits (Beltran-Peña *et al.* 2020).

In today's hyper-connected global economy, characterized by deep trade links, the world is more prone to shocks (e.g., natural disasters, conflicts, and diseases). To evaluate whether our food systems are resilient, one needs to take a multiple-threat perspective. Our food systems are not only exposed to water scarcity, pollution, and floods but also to changing geopolitical situations, as evidenced recently by the Russian invasion of Ukraine. Invasions and geopolitics can send shockwaves through trade patterns and spike food prices (Hellegers 2022). In times of instability, national water and food security are critical. As almost a quarter of the total water footprint of agriculture is embodied in the international trade of agricultural commodities, it is essential to understand the political economy of global food trade, markets and policies, food and nutrition security (FNS), and water resource sustainability (Konar *et al.* 2016).

Despite the essentiality of water for food systems, the UN Food Systems Summit has not sufficiently considered the role of water in food systems transformation (Ringler *et al.* 2022). There is a disconnect between water actors and food system actors. For instance, only 30% of the countries that designed a national food system transformation pathway mentioned water and only 15% addressed this clearly (Lifeng, personal communication 2023). Food–water–energy systems have endured severe shocks in recent times, putting the planet's resilience to the test (Global Commission on the Economics of Water 2023). It is clear that transformational change is needed to ensure sustainable food production within water planetary boundaries (Matthews *et al.* 2022; Gerten *et al.* 2020). All action areas emanating from the 2021 Food Systems Summit, including restoring degraded and protecting natural ecosystems, making food safer, increasing access to more nutritious food, and strengthening the climate resilience of food systems, depend on better use of water in food systems (FAO 2020, 2021; UN-Water 2021). This requires us to embrace water as an organizing principle in sustainable food systems. We need to overcome water blindness in food system design to achieve water-responsible food production.

This water blindness raises the question: what is each actor's responsibility and corresponding action pathway? Section 2 of this paper dives deeper into this question, using a food systems approach (FSA). Section 3 sets out different action perspectives for actors in food systems, Section 4 outlines the necessary conditions for them to materialize, and Section 5 finishes with concluding remarks.

2. Why a Food Systems Approach

Food security challenges are not only linked to water but also interlinked with biodiversity, energy, and climate. For instance, redirecting food crops, such as maize, to non-food uses (e.g., biofuel) can generate tensions in commodity markets and put an extra strain on food and water security. Furthermore, several adaptation and mitigation measures for food systems are water-intensive, potentially further increasing water insecurity for people and the planet, as shown by Smolenaars *et al.* (2023). Overseeing the impact of such interventions is complex. A FSA, shown below, can help to navigate this complexity. This paper uses such a "systems lens" to view water not as an input or a sector but as an organizing principle to connect sectors, actors, drivers, and outcomes.

Embracing water as an organizing principle helps food system actors (e.g., producers, traders, manufacturers, retailers, consumers, governments, and financial institutions) re-think and act differently when it comes to water use and (re-)allocation. Their choices affect water resource sustainability directly. Water connects actors in global value chains; it also connects the United Nations Sustainable Development Goals (SDGs), particularly: SDG2 (Zero Hunger), SDG6 (Clean Water and Sanitation for all), SDG7 (Affordable and Clean Energy), SDG12 (Responsible Consumption and Production) and SDG13 (Climate Action). Water is integral to food systems and improved food systems are essential to meet SDG6 (UN 2018; Uhlenbrook *et al.* 2022). It is important to design contextual and co-designed solution pathways based on trade-offs and enhancing climate resilience and environmental sustainability. These pathways need to be translated into concrete actions and responsibilities for key actors in the food system.

A FSA provides an excellent entry point to link food with water, taking account of climate change and energy. Van Berkum *et al.* (2018) define a food system approach as "an interdisciplinary framework for research and policy aimed at sustainable solutions for the sufficient supply of healthy food. An FSA analyzes the relationships between the different parts of the food system and the outcomes of activities within the system in socio-economic and environmental terms". It depicts the interactions within the food system as well as with its socio-economic and biophysical environment and the FNS outcomes (Figure 1). This FSA is important as interventions that are not directly related to water, such as trade restrictions, can have a direct impact on local water consumption, which becomes visible with the FSA.

The food system activities are categorized into five components (Figure 1): the value chain, the enabling environment, business services, the food environment, and consumer characteristics. Three types of outcomes are considered: socio-economic outcomes (e.g., livelihoods, employment), FNS outcomes, and environmental outcomes (impacts on natural resources and climate). The

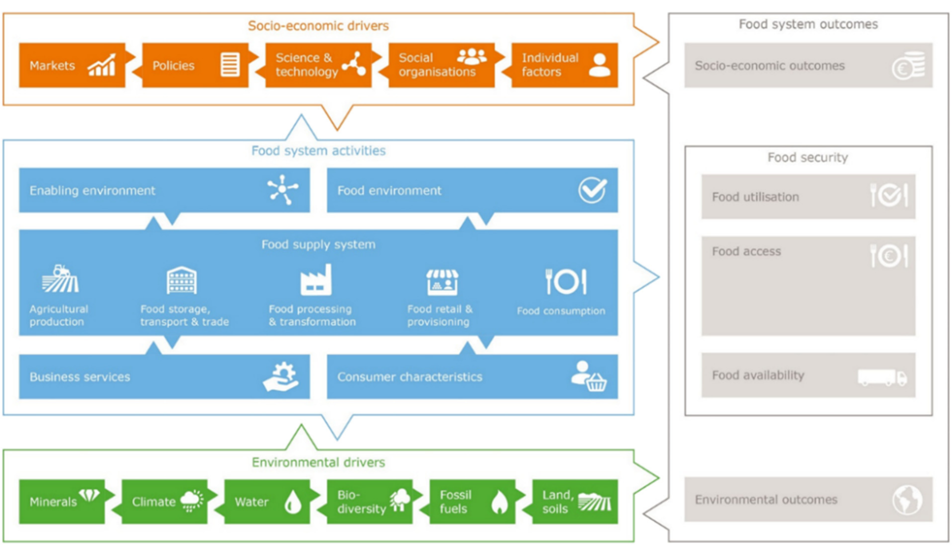

Figure 1. Food System Map

Source: Van Berkum et al. (2018)

environmental drivers mainly interact with agricultural production activities. The socio-economic drivers affect all food system activities and can give rise to multiplier effects or feedback mechanisms. Van Berkum *et al.* (2018) acknowledge that there are important interactions, trade-offs, and synergies between these different activities, drivers, and outcomes that influence the cause-effect relationships. By providing a broad view of the impact of different intervention strategies, it can inform policy choices.

According to Van Berkum *et al.* (2018), the current global FNS challenges are to:

- Increase food availability (supply) to feed a growing population, predominantly by reducing waste, managing demand (including through dietary changes), and building circular food chains.
- Improve food utilization (safe, healthy food) by ensuring varied diets to address malnutrition due to a shortage of micronutrients.
- Improve sustainability (reducing environmental impacts) by producing food within the environmental limits.
- Improve food accessibility (inclusive food systems) by improving the living conditions of farmers and workers and alleviating poverty.

In a business-as-usual scenario, most interventions focus on increasing agricultural productivity to improve FNS. However, Van Berkum *et al.* (2018) argue that interventions should target other parts of the food system to address the challenges mentioned above. Applications of systems thinking are needed to design interventions. In several cases, addressing these challenges could result in increased water and energy needs and use.

Recent geopolitical and market developments in the wake of the Russian invasion of Ukraine suggest that a global food–water–energy system approach is critical for the mitigation of cross-border risks affecting water and food security concomitantly (D'Alessandro *et al.* 2022), especially to avoid the destabilizing effects of national export restrictions and further rises in global market prices and regional food and water insecurity. In countries that have limited coping capacities and are already food insecure or have trade balance deficits, governments may be unable to bear this burden, leading to instability.

Gerten *et al.* (2020) show that transformation toward more sustainable production and consumption patterns could support 10.2 billion people within the planetary boundaries analyzed, but requires spatially redistributed cropland, improved water–nutrient management, food waste reduction, and dietary changes. So, it requires not only an increase in agricultural water productivity but also a reduction in food waste and a change in food consumption.

To avoid outcomes where water systems starve food systems or food systems drain water systems, Ringler *et al.* (2022) propose several solution areas that can help overcome siloed SDG2 and SDG6 development for a more resilient and sustainable food system transformation. The achievement of SDG2 and SDG6 is co-dependent. According to Ringler *et al.* (2023) solutions for jointly improving food systems and water security outcomes include: (1) strengthening efforts to protect water-based ecosystems and their functions; (2) improving agricultural water management for better diets for all; (3) reducing water and food losses beyond the farmgate; (4) coordinating water with nutrition and health interventions; (5) increasing the environmental sustainability of food systems; (6) explicitly addressing social inequities in water–nutrition linkages; and (7) improving data quality and monitoring for water–food system linkages, drawing on innovations in Information and Communications Technology (ICT). Most of these solutions are reflected in the FSA and action perspectives presented below.

3. Opportunities for Collective Stakeholder Action

This section sets out the action perspectives of different actors in the food system to prioritize water availability and quality. These action perspectives are based on input from the participants during various workshops and existing literature.

• Producers of food can cope with shocks in various ways. Farmers can build resilience to climate change and water risks (Smith *et al.* 2023) by using climate-smart interventions, such as drought and salinity-resilient seeds, improving the moisture content in the soil, adjusting production to local circumstances and using improved agricultural and water management technologies. They can also adapt to future water regimes and risks with enhanced climate information, preparedness, management innovation, and capacity development (Smith *et al.* 2023). In some areas with economic water scarcity, farmers can convert some rainfed areas to sustainable irrigation, increasing global food production by 6–8%, especially in Sub-Saharan Africa, Eastern Europe, and Central Asia (Rosa 2022). Initiatives and developments, such as those embedded in regenerative agriculture and conservation agriculture, can also be initiated in rainfed areas where more variable rainfall patterns will urge the development of more effective rainfall capture and use systems, such as by creating a higher rainfall absorption capacity in the soil, with which the possibilities to cope with rainfall variations can be enlarged. An integrated approach and context-specific knowledge and incentives are required to do so. It requires a change in thinking to place agriculture as a solution to water systems by enhancing water storage (World Bank 2023; Burke *et al.* 2023), buffering climate shock (floods and droughts), and recycling water use. Reliability of water service to farmers is also important, as this reduces a major risk (Waalewijn *et al.* 2019; World Bank 2023; Burke *et al.* 2023).

• The connectors of the producers to consumers in the value chain are the importers, manufacturers, retailers, and other market intermediaries. A comprehensive value chain strategy that articulates and builds on each value chain partner's unique strengths is needed for water-responsible food systems to emerge. Whilst Europe, the US, and China have been making efforts to develop ESG regulations, which are government standards for Environmental, Social, and Governance-related actions, reporting, or disclosure, their implementation across the value chain for food production remains challenging. Farm-based certification is insufficient to address water challenges in producing countries that are in part linked to international food trade. It is important to make the local implications of water use for global food trade visible and act locally (Weko and Lahn 2024). Mechanisms need to be developed that allow market parties (importers, retailers, and other intermediaries) to take on a much stronger stake in responsible sourcing from a water perspective. These mechanisms need to send financial streams to producers (organizations) in countries of origin to support them in adapting to climate change and be stewards of their land and water (protect and restore) in and outside their farm fences. Here, government regulation that puts in place the right systems and incentives is key. The upcoming European legislation on due diligence sends the right signal in this regard. The two most important directives are Corporate Sustainability Reporting Directive (CSRD) (European Commission 2023) and Corporate Sustainability Due Diligence Directive (CSDDD, Directive 2024/1760) (European Commission 2024). It requires the private sector to perform due diligence on its value chain that includes mapping the effects of business activities on water resources. It also demands responsible water management to be included in responsible business policies. The key here is to operationalize these legal requirements into concrete action globally and not only in Europe.

To this end, the market needs to come together in key sourcing areas and develop pathways that are actionable and scalable — i.e., it needs to develop incentives for value chain-driven collective action. At the outset, this means that actors working on agricultural water stewardship in the same watershed or landscape get to know each other and build relationships and understanding of what each actor is doing. Through time, and with trust, this should translate into joint efforts in the realm of monitoring, investment, and desired outcomes. Fortunately, the thinking and practices around collective action are rapidly evolving: priority watersheds around the world have been identified and best practices have been documented (WWF 2024) as well as case studies to build upon toward the future (SIFAV 2024). Finally, in addition to collective action, market linkages need to be strengthened to become more efficient. This includes investment in physical infrastructure that supports on-farm production (irrigation technology, reservoirs, energy, pre- and post-harvest storage), efficient trading and exchange (telecommunications, covered markets), value addition (agro-processing and packaging facilities), and improved transportation and bulk storage (Warner *et al.* 2008). Consumers need to be aware that food loss and waste are water waste. Kummu *et al.* (2012) find that one-quarter of the produced food supply is lost within the food supply chain and that lost and wasted food crops account for 24% of total freshwater resources used in food crop production.

Halving global food loss and waste could reduce the water footprint of global food production by 12–13% (Jalava *et al.* 2016). Consumers deserve to receive more transparency on water and energy used to produce the food they eat. Stronger incentives are needed for the food system actors to monitor and report on water and energy consumption from farm to fork. The earlier mentioned upcoming European regulation is a step in the right direction in this regard. It is important to consider not only the water intensity of a crop but also the nutrient density. An avocado requires more water to grow than lettuce but also has much more nutrients. Nutritional and health experts should work side by side with water managers at national and farm levels to increase nutrient-dense crops, fruits, and vegetables. The EAT-Lancet Commission (Willett *et al.* 2019) has proposed a global benchmark diet to guide the shift toward healthy and sustainable dietary patterns. Tuninetti *et al.* (2022) found that countries at the highest level of development have an above-optimal consumption of animal products, fats, and sugars but a sub-optimal consumption of legumes, nuts, and fruits. Countries suffering from limited socio-economic progress primarily rely on carbohydrates and starchy roots. Globally, a gradual change toward healthy and sustainable dietary targets can be observed for seafood, milk products, poultry, and vegetable oils. Tuninetti *et al.* (2022) show that if all countries adopted the EAT-Lancet diet, the water footprint would fall by 12% at a global level.

• It is important that national, regional, and local governments make a clear prioritization of water use and reallocation based on insights into the trade-offs of the multiple values of water. Demand management, for instance by capping water use, is also important (Pérez-Blanco *et al.* 2020). The current food crisis brings to the fore the need to (1) improve the resilience of food and water systems and (2) reassess the socio-economic value of water for agricultural production and open trade, in terms of food security for stability in vulnerable regions. First, national government policy responses to shocks in case of a drought or conflict (e.g., food export restrictions) can magnify food insecurity and associated costs for other countries as well as negatively impact actors along the value chain (Global

Commission on the Economics of Water 2023). Hence, water insecurity at the national level influences not only the production-related actors such as farmers but amplifies within the food system. This amplification needs to be avoided by improving the resilience of food systems, for instance using food stocks. Second, the discrepancy between the low financial value of water for staple crops — which is often taken for granted — and the high socio-economic value of water for food security — for social stability — (Hellegers and van Halsema 2019) indicates the importance of approaching water valuation from a systems perspective (Hellegers 2022). On the cost side, trade in high-value and water-intensive agricultural products does not adequately account for externalities on resources and the environment. It is also important to understand the various policies that may have unintended effects on water systems (Uhlenbrook *et al.* 2022), directly or indirectly, and thus better integrate water in policy impact assessments (Tondel *et al.* 2022). Options to transform agriculture and food systems to better serve the health of people, economies, and the planet (Gautam *et al.* 2022) include repurposing agricultural subsidies. A joint FAO-UNDP-UNEP report (FAO *et al.* 2021) calls for governments to rethink the way agriculture is subsidized and supported. The majority (87%) of $540 billion of support to agricultural producers is either price-distorting or harmful to nature and health. Repurposing this support and environmentally harmful subsidies can help transform food systems and achieve the SDGs (FAO, UNDP and UNEP 2021; Damania *et al.* 2023) and reduce the cost of the negative externalities (Gautam *et al.* 2022). Finally, water can be used as a guiding principle for spatial planning.

• Financial institutions are often approached by development actors as a source of capital for blended finance projects. While there is a pressing need for increased private investment to achieve the SDGs, this debate can sometimes overlook the importance of making the financial system itself more sustainable (Ray, 2023).

Owing to its unrivaled influence over the corporate world, harnessing the power of the financial sector is critical if we are to successfully transition toward more sustainable water and food systems. Aligning trillions of dollars in capital flows with the objective of a food- and water-secure world requires engagement with mainstream financial actors and the government to divert capital away from economic activities that are detrimental to food and water security toward those that are sustainable (WWF, 2023). Driving such changes to capital allocation requires an understanding of — and ultimately a strategy for influencing — the specific financial instruments and incentives to which different financial actors respond and through which they can influence the corporate world.

Examples of how the financial sector can be mobilized on water security issues include:

(1) Incentivizing companies to disclose their impact on water resources and making this information available to investors (CDP 2023);
(2) Encouraging pension funds to use their influence as institutional shareholders in large companies to push for improved corporate water stewardship (Ceres 2023);
(3) Convening financial policymakers such as central banks to address water insecurity as a material risk to financial stability (OECD, 2023).

The results of these initial engagements suggest a growing awareness of water issues in the financial sector and an increasing understanding that water insecurity is material to financial portfolios (CDP 2023). However, more work in this space is needed, and there are a wide variety of other financial actors such as commercial banks, credit rating agencies, and insurers that are not yet systematically engaged in food and water security issues. There remains significant scope for advocates of food and water security to improve their engagement with the financial sector in pursuit of these aims.

4. How to Materialize Action Perspectives

For the actions perspective presented in Section 3 to materialize, several necessary conditions have been formulated below, such as creating appropriate incentives for actions to move forward.

• **Collective action, roles and responsibilities, integrated policy planning.** Transformational change is needed in the way we tackle water challenges. First and foremost, the public and private sectors need to step up collective action for responsible water use within food systems to respond and further prevent shocks. Global collaboration and coordination are key. Each of the above-mentioned stakeholders needs to take its role and responsibility. Lambooy (2011) has shown that it is quite difficult to determine fixed boundaries as to where public responsibilities end and corporate responsibilities commence concerning corporate impacts on water. First, legislation and policies on how water is managed vary from country to country. Second, different types of industries have different impacts on water. Third, it is often difficult to link changes in the environment directly to the water consumption of one enterprise. Notwithstanding these challenges, it is clear that national and international companies that are extracting water from a given watershed or are tied to it through trade have a far-stretching duty — from a moral and regulatory due diligence point of view — to deeply engage with relevant local actors to protect water, biodiversity, and people's well-being in that landscape.

In the field of policy, more cross-cutting actions are required, e.g., specifically on better governance and more integrated policy planning. Policies do not act in isolation and may involve trade-offs or synergies with other policy measures and objectives. For instance, shifting the global population to a more nutritious and less water-intensive diet in parallel with food loss and waste reduction measures reduces blue water footprints and green water footprints by 23% and 28%, respectively, which is more than the sum of the two strategies implemented independently (Jalava *et al.* 2016). It is therefore important to align water, energy, food, and trade policies. National and regional water scarcity can be mitigated by food trade. However, the impact of shocks (such as extreme weather events and conflict) in one country can be transmitted to others via food export restrictions. Integrated policies are also needed for the circular use and management of treated wastewater, which can reduce the reliance of agricultural production on freshwater resources.

• **A common language, reliable datasets, and sustainable footprints.** A common language is needed on how to determine sustainable water use at the watershed level and introduce targeted measures. At a field level, organizations like WWF are making good progress in this regard, for example in South Africa. More reliable datasets and information systems (including artificial intelligence) can help by improving water accounting and monitoring of water quality. Data and information barriers can be overcome by operationalizing digital solutions for watersheds and aquifers worldwide through better collaboration between the public and private sectors (Smith *et al.* 2023). This in turn can support greater insight into water footprints (Dalin *et al.* 2017) and the sustainability of those footprints in specific local contexts, which can help align policies and design incentives to address issues in hotspots. Dalin *et al.* (2017) show for instance that projections of food demand and water availability suggest that groundwater depletion will continue to increase in the absence of targeted measures. Pakistan's rice exports have for instance more than quadrupled from 1990 to 2010 and resulted in about a quarter of the country's groundwater depletion in 2010. Increasing rice demand abroad has probably played a considerable part in depleting Pakistan's aquifers, and accelerated depletion seems probable given the projected population growth in both Pakistan (by 82% from 2010 to 2050) and its importing partner countries (such as Kenya, Bangladesh, and Iran). On a higher level, sharing and harmonizing data at an inter-sectoral level can support more integrated, long-term policy planning across the food, water, and energy sectors. Finally, accessibility and inclusiveness of data and digital technologies are also key: local and indigenous knowledge should be part of the transmission and utilization and all actors, including for example small-holder farmers, should have good and practical access to relevant data.

• **Recognize the monetary and non-monetary values of water.** The Valuing Water Initiative (2024) calls for the many values of water to be recognized in decision-making about water (re)allocation between uses (e.g., different crops), users (e.g., between households, nature, and food and other industries), and scales (e.g., from local to transboundary level) (Global Commission on the Economics of Water 2023). Water (re)allocation is a policy process based on transparent and accountable setting of policy priorities and social objectives. Water valuation can play a key role in making explicit the trade-offs intrinsic to decision-making and priority setting with respect to water allocation; especially, when it concerns societal needs such as food security and stability, which are not revealed in the marketplace. Special attention needs to be paid to the role of staple crops in trade vis-à-vis the low economic gains per unit of water produced in farm settings. Hence, re-thinking food systems within prevailing water limits in a changing climate requires us to reassess agricultural production areas for commodities and incentivize water-sensitive agriculture across the storage-extraction-use continuum. As such, valuing water — considering the true value of natural capital and ecosystems — may be a key tool in guiding decisions, whereby its value lies not so much in its numerical assessment as in the process it offers to engage stakeholders across different perspectives and interests of water use (Hellegers and van Halsema 2019).

• **Put the right incentive structures in place.** Recognizing the range of values of water in itself does not ensure that decisions taken by stakeholders truly incorporate those values. Relying on the goodwill of actors to take responsibility has proven not to work. It is therefore essential to create appropriate incentive structures. According to WWF (2023) and CDP (2024), there are many opportunities for improvement both in the public and private sectors. In the public domain, WWF (2023) stresses the importance of ending harmful subsidies and creating public policies that promote sustainable water use, particularly in water-intensive sectors like agriculture. Policy and enforcement play an important role in shaping the way agriculture, industries, and municipalities manage water and land use. Subsidies can be much more targeted, thereby increasing their efficiency while taking into account the full spectrum of implications for social, economic, and ecological systems. Harmful subsidies that encourage unsustainable land use, water withdrawals, and pollution need to be urgently phased out and replaced with mechanisms that promote the opposite. This includes farming crops that are appropriate for given levels of water availability or adopting agroecological water management and land-use practices, which also promote the retention of water in the landscape (WWF, 2023). In the private domain, CDP (2024) highlights a broad range of incentives that companies can offer to value chain partners to act on water, including price premiums, bonus schemes, supplier support funds, loan support and interest reduction, recognition (awards), and legal provisions. Public and private incentives can and should come together to drive definitive action on water by all stakeholders.

5. Conclusions

Although water has been recognized as an enabler for transformations of food systems, water is not yet pivotal in the design of our food systems. We can overcome the current water blindness in the food domain and food blindness in the water domain, by connecting actors from both spheres more explicitly when designing food systems. A FSA provides an excellent entry point to link food with water while also considering climate change and energy. This paper proposes to view water not as a sector, input, or adverse outcome, but as a pivotal component in the design of food systems. It calls for more attention to interactions, trade-offs, and synergies in water use between different activities, drivers, and outcomes in food systems. Taking a broad view of the impact of different intervention strategies on water can help inform better policy choices.

This paper has laid out various action perspectives for different actors in the food system. Most interventions currently focus on increasing agricultural productivity, whereas interventions should be broadened to other parts of the food system as well. Better linking international economic, food, energy, and trade policies and water challenges is an important next step.

Collective and cross-cutting actions are important conditions to materialize action pathways. Water needs to become a shared responsibility of all actors in the food system, accompanied by clear action perspectives and corresponding responsibilities and appropriate incentive structures. Joint planning and action by all stakeholders — from civil society, the public sector, and the private sector — is required to increase the resilience of our food systems.

Finally, we need a common definition of how to determine sustainable water use and more reliable data and information systems to underpin it. Better data can provide better insight into the trade-offs of the multiple values of water for a clear prioritization of water use and allocation and could help put currently unsustainable production areas on a path toward sustainability. The idea of food trade to mitigate water scarcity is for instance appealing, but countries have to have strong trade policies in place, such as diversified sources of trade partners, to ensure that they are resilient to geopolitical shocks. The idea of food self-sufficiency on the other hand makes countries vulnerable to weather risks. It is therefore important to reassess the socio-economic value of water for agriculture and food security when assessing trade-offs in water reallocations.

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