GLOBAL COMMISSION on the ECONOMICS OF WATER

Brief: The Economics of Water for Transitioning Food systems

Inspired by the final report of the Global Commission on the Economics of Water – The Economics of Water: *Valuing the Hydrological Cycle as a Global Common Good.*

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The Global Commission's report sets out the shifts required to drive radical changes in how water is valued, managed, and used. The new economics of water begins by recognizing that the water cycle must now be governed as a global common good, that can only be fixed collectively, through concerted action in every country, collaboration across boundaries and cultures, and for benefits that will be felt everywhere.

This policy brief examines the implications of the Global Commission's findings on the economics of water for food systems. It identifies pathways to enhance the management of economics of water for food system as well key enablers to deliver on the food-system related ambitions set out by the Global Commission.

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Key messages

Human activity has pushed the global hydrological cycle beyond safe limits, with severe implications for water and food security.

Approximately 2.9 billion people live in regions with declining or unstable water storage – areas which also account for 55% of global food production. The heavy use of irrigation in agriculture, without proper data-driven resource management, accelerates water depletion and exacerbates competition between sectors. Such risks not only destabilize ecosystems but also wreak havoc on economies, exacerbating food insecurity and hunger, and ultimately threatening human well-being.

Water depletion, climate change, and biodiversity loss are intertwined crises, and agriculture contributes to each individually.

As climate change disrupts water absorption and green water flows, the collapse of freshwater ecosystems, in turn, fuels climate change and biodiversity loss, creating a perverse cycle where each crisis intensifies the other. Agriculture not only accounts for 70% of global freshwater withdrawals, drawing heavily on both blue and green water resources, but it also contributes to over one-third of global anthropogenic greenhouse gas emissions and drives 70% of deforestation in tropical and subtropical regions.

To mitigate the food system risks linked to water security, a new revolution in food systems must be launched.

A revolution focused on improving water productivity by reducing water usage in agriculture, accelerating the shift to regenerative agricultural systems, and shifting diets towards plant-based proteins.

Effectively addressing the economics of water for food systems requires valuation of green water, governance of the hydrological cycle as a global common good, and recognition of the interconnectedness of water flows, ecosystems, and food systems.

Central to this vision is a new approach to water economics that prioritizes environmental sustainability, social equity, and economic efficiency (the “Three Es”), as well as policies that support improved water management in agriculture, provide positive economic incentives, and promote integrated production systems that utilize water effectively for multiple purposes.

Context

The global water cycle is the lifeblood of our planet and underpins all economic activities, from medical goods and services to food production and energy generation. It includes blue water, the water in lakes, rivers, and aquifers that is readily extractable by humans, and green water, the moisture held in soil and plants that evaporates or transpires into the air. Green water produces over half of the rainfall over land and is therefore a key source of freshwater, also known as blue water.

Green and blue water are both essential to planetary and human well-being. Human-related activities have significantly disrupted the hydrological cycle. Without urgent, coordinated efforts to restore its balance, communities and economies worldwide will face increasingly severe consequences.

Food systems, defined by the World Food Programme as the "networks needed to produce and transform food, and ensure it reaches consumers," encompass everything from production to consumption – growing, harvesting, processing, packaging, transporting, selling, eating, and disposing of food. They include both land-based and aquatic or marine sources of food and are shaped by social, economic, and environmental factors [1].

Food systems are deeply interconnected with the hydrological cycle. Agriculture alone accounts for approximately 70% of global freshwater withdrawals, with irrigated farming consuming about 85% of that amount to produce 40% of the world's food [2, 3]. Less visible but equally important, rain-fed agriculture depends on rainfall as well as soil and atmospheric moisture. The production of animal and aquatic foods is also highly reliant on water availability.

Water is fundamental to food security. Today, nearly 40% of the world's croplands face water scarcity, which poses a significant threat to global food supplies [4]. In addition to quantity, water quality is critical for the health of crops, livestock, fisheries, and ultimately, the safety of our food. Polluted water can have a severe impact on soils, ecosystems, and human health. Strengthening the performance and resilience of global food systems in relation to water will therefore be essential to achieving Sustainable Development Goal 6 (clean water and sanitation for all).

Key challenges and implications

Challenges

Food systems are running out of freshwater: Human activity has pushed the global hydrological cycle beyond safe limits, with severe implications for water and food security. Approximately 2.9 billion people live in regions with declining or unstable water storage, which also accounts for 55% of global food production. The heavy use of irrigation in agriculture, without proper data-driven resource management, is accelerating water depletion and exacerbating competition between sectors. Without a restored hydrological resilience, food systems and the environmental and economic stability they rely on face grave risk.

The water crisis, climate change, and biodiversity loss are intertwined crises: Climate change impacts, such as more frequent droughts, floods, and ecosystem degradation, further erode soil health, reducing both water absorption and green water flows. As freshwater ecosystems collapse, they in turn accelerate climate change and biodiversity loss, creating a vicious cycle in which each crisis reinforces the other. Agriculture contributes directly to all three crises: it consumes most of the world's blue and green water resources, generates over one-third of global anthropogenic greenhouse gas emissions, and drives 70% of deforestation in tropical and subtropical regions [5].

Green water, necessary to food production, is undervalued: Current efforts to manage freshwater resources often overlook the interconnection between green and blue water flows and stocks. Existing approaches primarily focus on blue water, neglecting green water's vital role in supporting rainfall, carbon sequestration, and healthy ecosystems – all of which are essential for sustaining agricultural productivity.

A study on rainfed cocoa farming in Côte d'Ivoire and Ghana (1981-2022) illustrates the critical importance of green water for agricultural productivity [6]. The study found that increased water stress – driven by more frequent droughts and declining rainfall – led to cocoa yield reductions of up to 37%, primarily due to decreased soil moisture, a key component of green water stocks. Shifts in the spatial distribution of water-stressed areas over the period of study further underscore the dynamic relationship between green and blue water systems. More specifically, these shifts highlight how reduced blue water flows (such as rainfall or river discharge) directly affect green water availability in the root zone, which in turn limits plant growth and agricultural output.

Agriculture disrupts moisture recycling: Agriculture is a major driver of land-use change, with significant impacts on regional precipitation patterns. One key process affected is Terrestrial Moisture Recycling (TMR), the cycle by which water from evapotranspiration over croplands, forests, and water bodies returns to land as precipitation. TMR is estimated to account for 40–60% of all rainfall over land, and many rainfed agricultural regions rely heavily on this internally recycled moisture [7]. As a result, disruptions to these flows pose serious risks to agricultural productivity.

Agricultural trade contributes to water depletion: Trade and water depletion are closely linked, as the export of water-intensive foods is often unrelated to the availability and renewal of water resources. When water prices and, consequently, commodity prices do not accurately reflect the actual value and scarcity of water, trade can further exacerbate water depletion [8, 9]. In California, for example, it takes about 12 litres of water to grow a single almond. With 80% of the state's almonds exported, this places significant pressure on groundwater resources and contributes to over-extraction. Similarly, cotton production in Uzbekistan has been associated with the depletion of the Aral Sea.

Food value chains harm water quality: Pollutants from every stage of the food value chain can contaminate waterways, degrading ecosystems and posing long-term risks to human health. At the upstream end, agriculture often relies on chemical inputs – such as fertilizers, pesticides, and herbicides – which can run off into nearby water bodies, causing nutrient pollution, algal blooms, and groundwater contamination. Livestock farming and aquaculture add to the problem through manure and antibiotics that further diminish water quality. Downstream, food processing facilities may discharge wastewater containing chemicals and organic waste, contributing to cumulative pollution across the system.

Water in agriculture is mismanaged due to perverse economic incentives: The widespread under-pricing of water drives overuse across sectors, especially in agriculture, where it encourages the cultivation of water-intensive crops in already water-stressed regions. Agricultural subsidies, estimated at over USD 630 billion annually, further exacerbate the issue by distorting decisions around water use, crop selection, inputs, and land management. Together, these pricing and policy failures reduce agricultural efficiency and contribute to serious environmental impacts, including groundwater depletion, altered green water flows, deforestation, water pollution, and declining water availability.

Modern-day diets are not water-friendly: Modern diets, particularly in middle- and high-income countries, are composed of large amounts of water-intensive foods, such as meat, dairy, and processed products. Such dietary habits contribute to aquifer depletion and wider ecosystem degradation. The problem is compounded by a supply-driven food system, where production focuses on maximizing yield and profit rather than on sustainability or actual consumer needs. At the same time, subsidies often encourage overproduction of water-intensive commodities and processed food. As lower-income economies grow and incomes rise, demand for meat and dairy products is also expected to increase, further intensifying these challenges.

Implications

The social costs of food system vulnerabilities are borne disproportionately by the most vulnerable communities, both locally and globally. If governments, businesses, and civil society do not act to mitigate the stresses that food systems place on water resources, the cost of inaction will be severe. Food production will be significantly impacted, with disproportionate yield declines in middle- to lower-income countries. While areas facing little socioeconomic vulnerability may not feel the impacts of yield declines as strongly, lower-income areas may face much greater instability if prices rise due to food supply disruptions.

Over half (55%) of the world's food is produced in regions where water storage is declining, reducing the availability of groundwater, soil moisture, and surface water for both rainfed and irrigated agriculture. This is especially concerning for irrigated areas, which produce approximately 40% of the global agricultural value and are vital to food security. Some of the world's most productive and critical agricultural regions, including India, China, and the Mediterranean, already face crop losses with risks that irrigation cannot be maintained. If current trends continue, severe declines in water storage could make irrigation impossible in some areas, resulting in a 23% drop in global cereal production [10]. Moreover, failure to adequately address the relationship between land cover and rainfall generation, a crucial aspect of the global hydrological cycle on which agriculture depends, risks further jeopardizing the sustainability of food systems.

Such risks will not only destabilize ecosystems but also wreak havoc on global economies, exacerbating food insecurity and hunger – ultimately threatening human well-being.

AMBITION: Launch a new revolution in food systems

The Green Revolution, which began in the 1940s and 50s, significantly boosted wheat and rice yields, thereby preventing famines and improving rural incomes. Its heavy dependence on water, pesticides, and nitrogen-based fertilizers, however, is unsustainable.

To mitigate the challenges and associated risks linked to food and water, we must launch a new revolution in food systems, following three main goals.

- **Goal 1: Improve water productivity by reducing water usage in agriculture by a third, while increasing crop yields.**

To address growing food demands and protect water resources, innovations that improve water productivity – including micro-irrigation, fertigation, rainwater harvesting, and climate-resilient seed variants – should be paired with incentives and policies that curb excessive agricultural water use. This approach can help maximize crop yield per drop, maintain soil moisture, support a balanced hydrological cycle, and ensure social equity with sufficient water availability for all users. For example, a study on solar-powered irrigation in Punjab, Pakistan, found that feed-in tariffs for solar-irrigation pumps reduced reliance on fossil fuels, conserved groundwater, and improved farmer livelihoods [11].

Improving water-use efficiency alone, however, is unlikely to reduce overall agricultural water consumption if the water saved is redirected toward expanding irrigation, increasing crop intensity, or shifting to more water-demanding crops. To be effective, efficiency measures must be accompanied by robust water accounting, regulatory frameworks, and behavioural incentives at both field and basin levels to cap or reduce total water withdrawals.

- **Goal 2: Accelerate the shift to regenerative agricultural systems from 15% of global cropland to 50% by 2050.**

Maintaining soil health is crucial for enhancing water infiltration and storage, as well as improving crop resilience to drought. Regenerative agriculture supports soil health through low-tech methods such as cover cropping, intercropping, mulching, agroforestry, and restoring natural habitats. These practices enhance soil water retention, sequester carbon, and are adaptable across a range of crops and regions. They also require lower input costs while increasing yields, thereby improving the livelihoods of smallholders. For instance, studies on intercropping soybean with wheat found a significant improvement in profitability, with a return on investment of 15-25% over ten years [12]. Another study in Ethiopia found that soil and water conservation practices improved food security, with an increase in both household dietary diversity (HDD) and overall food consumption [13].

The goal is to scale regenerative agricultural practices to 50% of global cropland by 2050 – up from just 15% as of 2019. Achieving this target requires collaboration with agroindustry coalitions to drive supply chain-wide change and to build demand for regenerative agricultural products among farmers and off-takers. Additionally, reviving and preserving traditional agricultural practices that utilize regenerative techniques is essential.

- **Goal 3: Aim to achieve a 30% share of plant-based proteins in diets by 2050, especially in higher-income countries with high red meat and dairy consumption.**

Since agriculture is a significant contributor to water use, greenhouse gas emissions, and habitat loss, it is crucial to shift diets and reduce collective consumption and dependence on animal-based food products. This is particularly important in high-income countries with high red meat and dairy consumption. However, it is essential not to apply this goal uniformly to lower-income countries, where animal-sourced foods remain vital for protein and micronutrient supplies, especially for young children and pregnant women.

Though behavioural changes take time and are difficult, research and development (R&D) and innovation in product offerings, as well as behavioural nudges, can help change consumption patterns without eliminating consumers' sense of individual choice. Incentivizing consumption patterns will also require that plant-based and alternative proteins be priced similarly to or cheaper than animal products, which today, on average cost about twice as much as conventional animal proteins [14].

Recommendations and pathways for action

Effective management of the economics of water for food systems requires recognition of the deep interconnectedness of water flows, ecosystems, and food systems, as well as governance of water as a global common good. Central to this vision is a new water economics that equally prioritizes environmental sustainability, social equity, and economic efficiency (the "Three Es"). Historically viewed in tension, these goals must now be advanced together through appropriate water pricing, absolute resource limits, and incentives for sustainable food and land management. This approach demands coherent policy packages that address trade-offs and externalities, establishing bold targets and ambitious reforms to ensure water's value is recognized and sustained.

Below are pathways for action to achieve the outlined ambitions:

1. **Strengthen Water Resource Management in Agriculture and Regulate Excessive Use Across Sectors**: Improving water management in agriculture is essential for sustainable food systems. Policies should regulate water withdrawals and returns to ecosystems, ensuring a basin-wide approach wherein farming supports upstream efficiency and downstream water availability. Regulations must be coupled with incentives and enforcement so gains in water efficiency don't simply lead to expanded irrigation or shifts to more water-intensive crops. Anchored on science and water data, governments can accelerate transformation by embedding conditions into contracts that direct water-intensive agricultural investments towards less-stressed regions, promote reinvestment in water-related R&D, and support watershed conservation.

Addressing barriers faced by smallholder and women farmers, such as lack of secure land rights, financial constraints, and limited access to technology, is critical for adoption of sustainable water practices. Legal and financial reforms that strengthen tenure and credit access will empower producers to improve soil health and water storage.

Policy frameworks must value both blue and green water and recognize the role of forests and soil moisture in supporting rainfed agriculture and resilience to drought. Coherent water management requires engagement across sectors and stakeholders – guaranteeing that advances in agricultural technology, irrigation, and alternative proteins support water sustainability, food security, and equity. These integrated approaches are necessary to ensure that agricultural water use supports resilient food systems, economic development, and long-term environmental health.

2. **Foster a New Water Economics for Food Systems**: Pricing, Subsidies, and Trade: To safeguard the sustainability of our food systems, governments and practitioners must adopt a new approach to water economics that utilizes accurate pricing, smart subsidies, and trade policy to incentivize responsible water use. The true value of water should inform land use and habitat protection decisions, especially as they relate to agriculture. Correctly pricing water, especially in water-intensive farming, will discourage waste and promote investment in water-saving technologies. Redirecting harmful subsidies towards more sustainable practices, such as micro-irrigation or payments for water savings (see Box 1), can support both environmental goals and farmer livelihoods.

Box 1: From perverse subsidies to incentives for sustainable water use: The case of Indian agriculture

In India, large energy subsidies have unintentionally driven excessive groundwater extraction for agriculture. In recent years, several states have piloted new policies and incentive mechanisms to curb the overuse of water. In Gujarat, for example, the Surya Kisan Yojana (SKY) promotes solar-powered irrigation by offering buy-back tariffs for surplus solar energy generated by farmers, creating an economic incentive to adopt more sustainable water and energy practices.

Additionally, in Punjab, the Pani Bachao and Paisa Kamao programs reward farmers financially for conserving water and reducing electricity use, helping to ease pressure on groundwater resources. Meanwhile, the Mera Pani Meri Virasat scheme in Haryana and Punjab provides financial incentives for crop diversification, encouraging a shift away from water-intensive crops such as rice and wheat.

Together, these initiatives highlight the potential of subsidy repurposing to transform water management in India's complex water–food–energy nexus, aligning economic efficiency and equity with sustainable resource use.

Agricultural trade policy must also factor in water scarcity. While unchecked trade can exacerbate water stress, it can also relieve pressure if water-rich regions export water-intensive goods to water-scarce ones. Enhanced transparency and repurposing of subsidies, along with reforms in agricultural trade, will be critical to aligning prosperity, equity, and environmental sustainability in the world's food and water systems.

3. **Advance multiple water uses and integrated production systems to enable a holistic approach to water management in food systems.** Water in food systems serves many purposes beyond irrigation for crops. It sustains livestock, supports aquaculture, enables food processing and cleaning, and helps maintain the ecosystem services vital for food production. Recognizing and managing water's multiple uses is crucial for the sustainable production of food while protecting resources and livelihoods. Integrated production systems, such as agroforestry or crop-livestock-aquaculture combinations, make efficient use of water by linking these uses within a landscape or farm (see Box 2). By recycling water within the system, farmers can reduce water waste while improving productivity and resilience.

Water reuse is a crucial part in this approach. Treated wastewater from municipal and industrial sectors can be safely reused for irrigation or aquaculture, reducing pressure on freshwater sources. Reusing water within integrated systems recycles nutrients, reduces pollution, and makes food production more climate resilient.

Box 2: Multiple uses of water for efficiency, equity, and environmental sustainability: The case of aquaculture in reservoirs in Northern Ghana

Northern Ghana faces the country's highest rates of food insecurity, mainly due to its reliance on rainfed agriculture, which is especially susceptible to climate change. Recent pilot projects with small reservoirs, however, have revealed the potential of multi-use water strategies to improve resource efficiency, equity, and environmental sustainability. By introducing aquaculture into community reservoirs intended initially for irrigation and domestic purposes, these initiatives have enhanced local nutrition, income, and employment opportunities while essentially preserving existing water uses. Most reservoir activities, including drinking, domestic tasks, and farming, continued uninterrupted, indicating that aquaculture can be integrated with minimal trade-offs. Beyond these technical successes, the pilots highlighted the importance of adopting a business model approach to encourage co-financing from private operators, communities, and local government authorities. They also emphasized the value of collective action and effective partnerships in managing water resources as public goods. Overall, this deliberate and integrated approach to water use demonstrates how vulnerable regions can maximize benefits, foster inclusiveness, and strengthen environmental resilience.

Enablers for action

To achieve the above policy recommendations, the following enablers have been identified to support a shift in food systems:

1. **Harnessing water data:** Effective water management in food systems requires robust, transparent data across the entire hydrological cycle. Current data gaps and fragmentation, particularly regarding green water, hinder science-based decision-making and effective policy implementation. Developing a global water data infrastructure, which includes indicators on blue and green water, as well as water footprints, will empower producers to make informed management decisions and enable consumers to understand the water impacts of their food choices.

   Governments should lead in strengthening data collection from local to national levels, ensuring interoperability and harmonization with international frameworks and indigenous knowledge. Governments should also require that corporates disclose water footprints and that water data be integrated into broader sustainability reporting to further drive transparency, accountability, and responsible water stewardship.

2. **Effective governance and partnerships:** Effective governance and inclusive partnerships are essential enablers for sustainable water management in food systems. Collaborative, multilevel governance – spanning local, regional, and global levels – is needed to ensure food systems are equitable, profitable, and productive. Policymaking must prioritize and empower all stakeholders, especially women, youth, Indigenous Peoples, and rural communities, who are often on the frontlines of water stewardship and food production.

   Locally, scaling up models such as cooperatives and water user associations can improve bargaining power, enable resource pooling, and support the adoption of better water management practices among smallholder farmers. At the regional and global level, fit-for-purpose governance structures should promote collective action, transboundary cooperation, knowledge sharing, and accountability. Ultimately, a unified global water forum can further enhance trust, foster capacity development, and promote the integration of green and blue water governance, ensuring that water is treated as a fundamental principle across sustainable development agendas.

3. **Financing for the food system transition:** Mobilizing private sector financing is vital to accelerating the shift toward sustainable food systems. Governments and public institutions can catalyse investment through blended finance, sharing risks and rewards with private and philanthropic partners to make water-related projects viable and just.

   Innovative risk mitigation tools are also crucial. Crop insurance, cost-sharing programs, and cross-value-chain collaborations can help farmers manage financial risks during the transition to regenerative agriculture. Additionally, alternative financing mechanisms such as Payment for Ecosystem Services (PES) can incentivize the conservation of blue and green water, while recognizing their value as natural capital. Mobilizing these financial instruments will be essential to drive large-scale investments and secure a resilient, water-smart future for food systems.

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Front cover photograph: Irrigated farmlands in the Southern Nations, Nationalities, and People's Region (SNNPR), Ethiopia (photo: Petterik Wiggers/Panos Pictures UK for IWMI).

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