Science to Transform Water Systems: Creating Impact from Genes to Basins

CGIAR Water Systems Integration Roadmap 2024–2030

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Message from CGIAR leadership

When CGIAR began a dynamic reformulation of its partnerships, knowledge, assets, and global presence in 2020, under the initiative known as One CGIAR, it did so with a three-part mission: the transformation of *food, land, and water systems* in a climate crisis.

Challenges in food systems, landscapes and water security call for research and innovation to advance transformation in these systems. Water lies at the center of the integrated approaches needed and it is for this reason that CGIAR and the International Water Management Institute (IWMI) together prepared this CGIAR Water Systems Integration Roadmap 2024–2030.

The evidence for why water must surely be better utilized, managed and conserved is all around us. Demands on water resources continue to grow relentlessly. Water pollution is destroying lives and ecosystems. Climate change is pushing water systems deep into unknown states of insecurity, magnifying risks to food security and undermining the Sustainable Development Goals. All of these factors impact food production and the viability of land for agriculture. Poor communities continue to bear the largest burden of water insecurity, and the voices of women, young people and marginalized groups have few channels through which they can express their lived realities. Water insecurity thus threatens the world's commitment to 'leave no one behind.'

Simi Kamal
Chair, IWMI Board of Governors

Mark Smith
Director General, IWMI

Recognizing this, CGIAR is taking an unprecedented step to ensure that its research and innovation lead the way in responding to water challenges. The time has come for CGIAR to seize the untapped potential for integrating water systems science and aligning research and innovation for water security across CGIAR programs and Research Centers. One CGIAR is declaring with one voice that a food-secure future can only exist in a water-secure world.

This ambition is shared by the leadership of CGIAR and IWMI. We have created this CGIAR Water Systems Integration Roadmap 2024–2030 alongside the new IWMI Strategy 2024–2030. The two documents establish a common strategic framework, aligned to the CGIAR 2030 Research and Innovation Strategy, to strengthen the contribution of water systems science to the CGIAR Impact Areas. The IWMI Strategy describes how IWMI applies this framework, while the Integration Roadmap shows how the whole of CGIAR, including IWMI, can work together to transform water systems and enhance water security.

Years into the One CGIAR integrated partnership, we know how much is possible when we unite in research and innovation toward common ends. It is time to turn this transformative potential fully to the water challenges that grip our planet.

Lindiwe Majele Sibanda
Chair, CGIAR Integrated Partnership Board

Ismahane Elouafi
Executive Managing Director, CGIAR

Water security – a complex global challenge

Water security is essential for a safe, just, and sustainable future, but it is getting harder to achieve.

Plentiful for some, water is easily taken for granted, whether for good health or as a resource for agriculture and industry. For others, struggles with scarcity shape their daily lives and prospects for development. For all, water has a destructive power that, if not managed, puts at risk lives and livelihoods. Water flows, cycles and use for one purpose, both locally and over great distances, can put use in jeopardy for others. Water can be mistaken for a simple resource, but water security is a complex problem.

Water security means achieving and sustaining access to an acceptable quantity and quality of water for health, livelihoods, ecosystems, and production, coupled with an acceptable level of water-related risks to people, environments, and economies.

Water is vital for the future of food systems, the energy transition, human health, and the conservation of nature. Strengthening water security will advance equality for women and men, reduce poverty, and facilitate cooperation for peace and security. However, over-exploitation of water resources and pollution triggers water insecurity, and climate change is causing water risks to increase with every increment of warming.

The transformative agenda agreed to in the Sustainable Development Goals (SDGs), the Paris Agreement on Climate Change, and the Global Biodiversity Framework depends on a water-secure future. Solutions for water are key to achieving progress. At the same time, solutions that advance food systems transformation, sustainable development, climate change adaptation and mitigation, and biodiversity conservation are needed to reinforce water security.

The CGIAR 2030 Research and Innovation Strategy put solutions for these systemic global challenges at the center of One CGIAR's science agenda by adopting the mission 'to deliver science and innovation that advance the transformation of food, land, and water systems in a climate crisis.' This builds on CGIAR's multidecade history of research and innovation on agrifood systems. While water-related research and innovation have been part of CGIAR's work throughout its history, water systems science from across the whole of CGIAR has not been brought together before to meet demands for building water security. Given the urgency of water security, and recognition that food security is possible only in a water-secure world, now is the time to take this step.

Five Wicked Water Problems

Water security is complex and multifaceted; it is a 'wicked problem' that cuts across global challenges.

HUNGER

3.2b people
live in regions where agriculture contends with high levels of water stress

Agriculture accounts for
72%
of global freshwater withdrawals, the highest of all sectors

Climate change is projected to put 8 to
80m people
at risk of hunger by 2050

POVERTY AND EXCLUSION

2b people
lacked safely managed services for drinking water and 3.6 billion for sanitation in 2020

In the next decade, climate change will drive
32–132m
more people into extreme poverty

Female extreme poverty is set to rise to
17.1%
under the worst climate change scenario

ECOSYSTEM BREAKDOWN

80%
of wastewater is released untreated into the environment in South Asia and Africa south of the Sahara

Over the last 50 years, water stored in nature dropped by
27,000b m^3

3.4m km^2
of wetlands have been lost worldwide, an area larger than India

CLIMATE BEYOND 2°C

4b people
experience severe water scarcity for at least one month each year

1.65b people
have been impacted by floods since 2000, with future flood risk potentially doubling between 1.5 and 2°C of global warming

Climate change adaptation is effective in reducing risks to a varying extent, but **future projected effectiveness falls sharply beyond 2°C**

DEEP UNCERTAINTY

Past water **data and information is increasingly disconnected** from future water problems

Probabilities for **future water risks are unknown** because of climate change

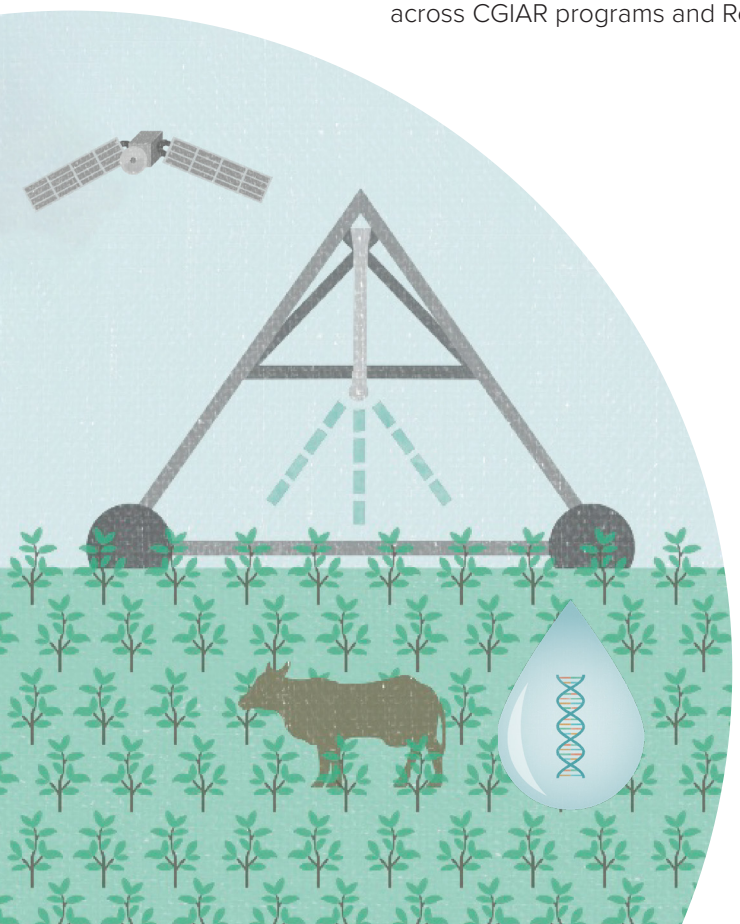
Lock-in to water insecurity is a risk where vulnerabilities are highest

A roadmap to align water systems science in One CGIAR

The CGIAR Water Systems Integration Roadmap 2024–2030 is the first such document for water within CGIAR, and it reflects the status of water as an urgent consideration for nearly every corner of the work we do. The Integration Roadmap was developed alongside the International Water Management Institute (IWMI) Strategy 2024–2030 which describes how IWMI, in collective action partnerships, applies research and innovation to advance the transformation of future water security. Together, the IWMI Strategy and this Integration Roadmap elaborate on how water systems science from across CGIAR can contribute to this ambition.

The Integration Roadmap introduces a common strategic framework, shared with the IWMI Strategy, for water systems science in CGIAR. With a common framework, it becomes possible to align water-related research and innovation across CGIAR programs and Research Centers for the first time. The Integration Roadmap sets out how CGIAR can then apply integrated capabilities to transforming water systems. CGIAR can, in unparalleled ways, align genetic innovation, agricultural research, landscape approaches, and basin management – integrating from genes to basins – in support of water security.

To chart the road ahead, this Integration Roadmap sets out a process for strengthening coordination and collaboration in CGIAR and building a long-term, joint commitment with our partners and funders to integrate research-for-development for water systems. With integration, the contribution of water systems science to the One CGIAR Impact Areas will grow, strengthening the delivery of the CGIAR 2030 Research and Innovation Strategy. The Integration Roadmap will therefore guide us together toward reframing success for One CGIAR in ways that fulfill the mission of transforming water systems, alongside food systems and landscapes, for the benefit of all.

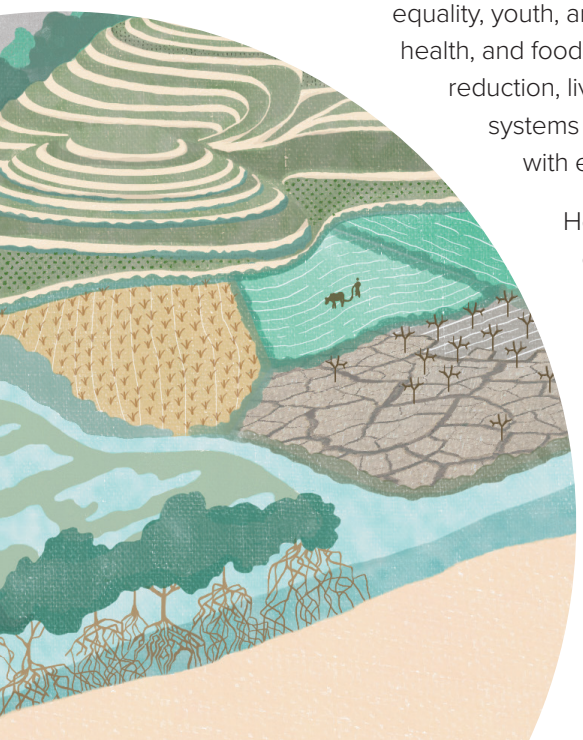


“With a common framework, it becomes possible to align water-related research and innovation across CGIAR programs and Research Centers for the first time.”

Demand for water systems research and innovation

All of CGIAR has a role to play in meeting rising strategic challenges for water security.

Water systems science has historically had a home at IWMI, which has led research-for-development on water security in CGIAR for 40 years, and retains its role in the One CGIAR integrated partnership. Collaborating across CGIAR enhances the scale and impact of IWMI's contributions to future water security. IWMI's research and innovation are aligned with CGIAR's priorities through delivery into the five CGIAR Impact Areas: climate adaptation and mitigation; environmental health and biodiversity; gender equality, youth, and social inclusion; nutrition, health, and food security; and poverty reduction, livelihoods, and jobs. Water systems are deeply interconnected with each of these.



However, in practice, every CGIAR program and Research Center has a role to play in achieving water security. Whenever plant breeders enhance drought resistance or flooding tolerance in new crop varieties, for example, or whenever agronomists innovate changes to farming methods that lower water demand or increase water-use efficiency, this is enormously relevant to water systems. Such has always been the case – but the fundamentals of water systems are changing, and our research is becoming even more crucial.

Strategic challenges for water security

Water systems are complex, shaped by a medley of physical, ecological, social, economic, and political influences. Transforming water systems is therefore a complex undertaking. We can begin to approach it, however, by integrating the task around a few primary strategic challenges.

Water risks. Communities are exposed to drought and flood risks because of inadequate infrastructure, ineffective institutions, and disjointed planning, management, and policies across sectors. Now, because of climate change and increasingly unknown probabilities for extreme weather events, they face deep uncertainty about future water risks.

Worldwide, more than 3.6 billion people lack access to safe sanitation annually, more than 350 cubic kilometers of untreated municipal wastewater are discharged into rivers, lakes, and seas. Water pollution caused by urbanization and agricultural intensification, including the expansion of livestock production and aquaculture, puts public health, biodiversity, and food security at risk.

Inequalities. More than 2 billion people still lack safe access to clean drinking water. Marginalized groups face the highest levels of water insecurity. Women and girls collectively spend 200 million hours daily fetching water, which hinders their educational and economic opportunities. They often lack access to water for productive purposes because they are excluded from decision-making and opportunities to develop skills and access financing. Exclusion makes it hard for young people to achieve their goals. These disparities leave women, youth, and marginalized communities more vulnerable to water risks and climate change. Failure to recognize the multiple ecological, cultural, and spiritual values of water and their associated and diverse knowledge systems further reinforces exclusion and inequality.

Unsustainability. Global demand for all water uses is expected to rise by 20–30 percent by 2050, with agricultural demand for water continuing to increase with the growing demand for food. The number of food-insecure people is also rising, and water productivity in agrifood systems must therefore increase, to produce more food using less water while concurrently meeting water needs for health, energy, cities, and ecosystems. Where future irrigation demand cannot be met within sustainable limits, water will have to be moved out of agriculture.

Investment needs for water infrastructure, to meet future demand, manage risks, and achieve the SDGs, are estimated at $22.6 trillion by 2050. This should blend built and natural infrastructure and multisector solutions, while integrating biodiversity conservation and the needs of women, men and future generations. There is, in addition, considerable potential to reduce water scarcity using circular management, including water reuse and resource recovery from wastewater, as well as desalination and atmospheric water harvesting. But technological, financing, and policy barriers will have to be overcome before widespread application is achieved.

Obstacles to enabling change. One CGIAR's research and innovation is also guided by strategic challenges that impede change on pathways to transforming future water security. A persistent lack of reliable water data and information is a widespread constraint on water management in the global South. Weak governance, caused by fragmented policy and regulatory frameworks, inadequate compliance and enforcement of laws, low capacity, and lack of participation, similarly holds back progress. In addition, barriers to inclusion and to women's participation and equality are more difficult to overcome where there is an inadequate understanding of how to change gender norms or how gender and social differences intersect and shape inequalities in water use and vulnerability to climate change. Shortcomings in scaling innovations and financing for water are also major obstacles to enabling the changes needed for future water security.

"the fundamentals of water systems are changing, and our research is becoming even more crucial."

Water in the global agenda

The challenges to water security show how far off track the world's transformative agenda has gone – and how much more is needed from water policy, investment, and innovation to respond. The UN 2023 Water Conference recognized this: as the first intergovernmental conference on water since 1977, it set an agenda to urgently scale up action accelerating SDG 6 – to ensure availability and sustainable management of water and sanitation for all – and catalyzing solutions for inclusive, sustainable, and climate-resilient development through water. The conference concluded that the global water cycle should be managed as a global common good, and that delays in meeting the human right to safe water and sanitation must end. It called for the recognition of water as an indispensable catalyst for health and well-being and for securing food and nutrition security and energy for all.

The UN 2023 Water Conference also launched the Water Action Agenda, a platform for multistakeholder convergence of implementation, investment, and innovation. More than 800 commitments were made by governments, the private sector, civil society, advocacy groups, international organizations, and the research community.

IWMI committed in the Water Action Agenda to building and supporting coalitions for collective action on high-ambition missions for research and innovation through the Transformative Futures for Water Security initiative. Before the conference, IWMI co-led a dialogue, together with young leaders and convening partners from the global South, to shape this initiative. The hundreds of contributors aligned demand to generate eight high-ambition missions for science-based collective action on water security.

Water systems science in the One CGIAR integrated partnership responds to the global agenda for water – and its systemic relationships with climate change, biodiversity, and food systems – and multiplies the contributions of research and innovation to the stakeholder-led, collective action missions articulated by the Transformative Futures for Water Security dialogues.

Such an approach can achieve benefits across multiple SDGs. Our aim is to apply research-for-development to accelerate progress on SDG 6 on clean water and sanitation alongside national and regional priorities for water. We also aim for CGIAR water system science to contribute to SDG 2 – to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture – by ensuring that future water security for smallholder farmers and rural communities in the global South is integral to their food and nutrition security, to overcoming hunger, and to fulfilling national and regional priorities for agricultural development.

Transformative Futures for Water Security

The Transformative Futures for Water Security dialogue brought together more than 1,000 representatives from 440 organizations, including national and local governments, youth networks, civil society, the private sector, researchers and knowledge creators, investors and water users across sectors. Regional dialogues were held in Southeast Asia, South Asia, Central Asia, the Middle East and North Africa, East Africa, Southern Africa, West and Central Africa and Latin America before a final conference in South Africa in February 2023. Participants called for mission-driven, collective action on water security to catalyze convergence on policy change, investment, private sector and community action and innovation.

"Water systems science in the CGIAR integrated partnership responds to the global agenda for water – and its systemic relationships with climate change, biodiversity, and food systems"

A new vision for integration of water systems in CGIAR

With one common framework for water systems science, CGIAR will apply capabilities from across its programs and Research Centers to build future water security.

First the first time, we will create a whole-of-CGIAR response to the urgency of water security and reframe our concept of success – because we know a food-secure future is possible only in a water-secure world.

We will contribute through our comparative advantages in research and innovation to the priorities of partners and stakeholders for collective action on future water security.

IWMI will continue to deliver its rigorous, solutions-oriented water management research, built on developing, testing, and scaling science-based solutions for water management in the global South and using knowledge and evidence to strengthen policy and investment for water security. At the same time, integrating IWMI and CGIAR-wide capabilities under a common framework will build powerfully on this role, because all CGIAR Research Centers include relevant and complementary water-related research-for-development in their programs, focused particularly on genetic improvement, agricultural productivity and diversification, and water and food policies.

One CGIAR – from genes to basins

One CGIAR's integrated partnership combines the complementary mandates of CGIAR Research Centers in a more unified and integrated way to tackle the complex challenges of food, land, and water systems in the twenty-first century, and their interrelationships with climate change mitigation and adaptation and with biodiversity conservation. Across the integrated partnership lie untapped synergies for water systems science.

When deployed, these synergies will provide One CGIAR with the capability to integrate water systems science from genes to basins – from crop breeding for resistance to drought and lower water demand, to agronomy and technologies to raise water efficiency and productivity in agrifood systems, to inclusive solutions for integrated development of water, food, and energy systems at basin and regional scales.

One CGIAR has unparalleled potential to deliver research and innovation to advance the transformation of water systems. Now is the time to fully leverage this potential to accelerate future water security.

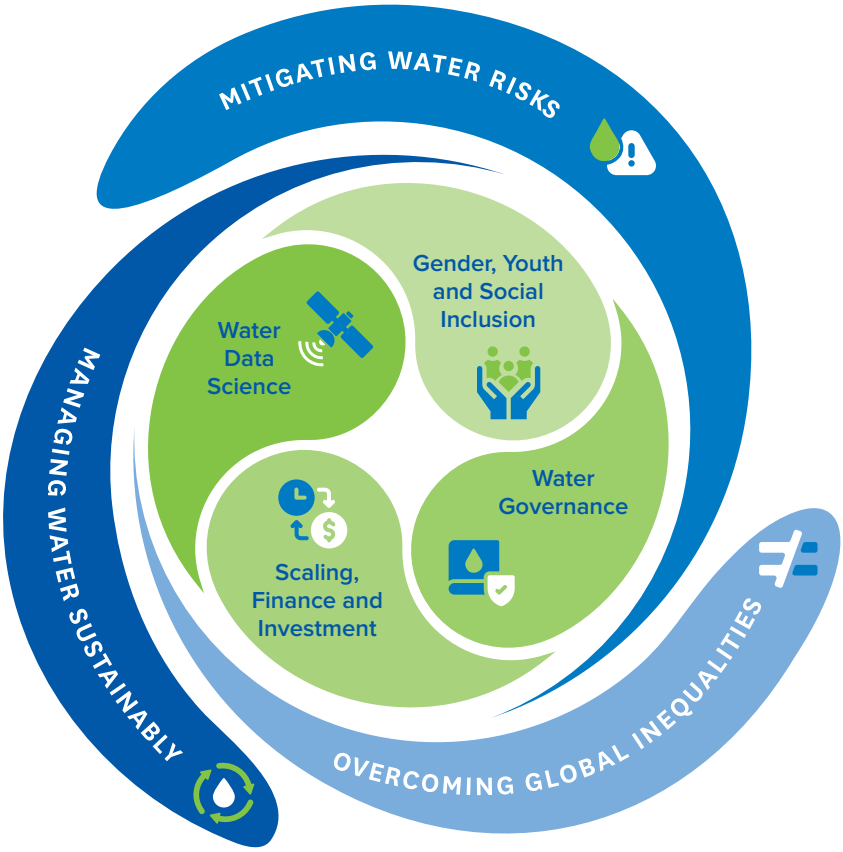
GOVERNANCE, REGULATION, MARKETS AND INCLUSION
WATER DATA AND DIGITAL INNOVATION
WATER-ENERGY-FOOD-ECOSYSTEMS NEXUS
WATER RECYCLING AND REUSE
CLIMATE-SMART ACCELERATORS
SYSTEM INNOVATION
IRRIGATION AND WATER PRODUCTIVITY
AGRONOMY
CROP DIVERSITY
GENETIC IMPROVEMENT

Water systems science in CGIAR

Strategic framework for water systems science in CGIAR

The CGIAR Water Systems Integration Roadmap 2024–2030 contributes to delivering CGIAR's mission through outcomes that advance the transformation of water systems.

The Integration Roadmap centers on three Strategic Focus Areas. These are interdependent; outcomes for each depend on the progress of others. They are further enabled by four Transformational Levers. The Transformational Levers deliver evidence and solutions to enable, scale, and accelerate outcomes across the Strategic Focus Areas. Outcomes of the Transformational Levers contribute to progress in each Strategic Focus Area.



One CGIAR aims to align research and innovation from across CGIAR programs and Research Centers to strengthen transformative innovation systems for future water security. We aim to work through diverse collective action partnerships to address strategic challenges for water security by linking excellence in research to social, economic, and environmental outcomes.

Through partnerships and networks, we can engage local, national, regional, and global stakeholders in systems change for water security. We focus on One CGIAR's comparative advantages and leverage the complementary capacities of partners to achieve joint outcomes. By unlocking collective action – across CGIAR and with partners – we aim to ensure our solutions are adaptive, robust, have lasting impacts, and catalyze transformations for water security.

This strategic framework aligns with the CGIAR 2030 Research and Innovation Strategy and its five Impact Areas. Performance in implementing the Water Systems Integration Roadmap will therefore be tracked using CGIAR's portfolio results dashboards. We will support the development by CGIAR of appropriate indicators for results relative to water systems science and water security and their integration into the CGIAR Performance and Results Management System.

CGIAR water systems science will:

Contribute to mission-driven research and innovation, guided by the...

TRANSFORMATIVE FUTURES STAKEHOLDER MISSIONS

8 high ambition missions for science based action and water security

...and by the...

CGIAR MISSION

To deliver science and innovation that advance the transformation of food, land and water system in a climate crisis

It will achieve positive and measurable benefits across the...

CGIAR IMPACT AREAS

- Climate Adaptation and Mitigation
- Enviromental Health and Biodiversity
- Nutrition, Health and Food Security
- Poverty Reduction, Livelihoods and Jobs
- Gender Equality, Youth and Social inclusion

...by advancing future water security through outcomes for the...

WATER SYSTEMS STRATEGIC FOCUS AREAS

- Alleviating Water Risks
- Managing Water Sustainability
- Reducing Global Inequalities

...strengthened by enabling innovation, scaling and acceleration using...

WATER SYSTEMS TRANSFORMATIONAL LEVERS

- Water Data Science
- Scaling, Finance and Investment
- Gender, Youth and Social Inclusion
- Water Governance

...delivered through the...

CGIAR WATER SYSTEMS PORTFOLIO

CGIAR transdisciplinary capabilities from genes to basins

...and leveraging synergies within the...

ONE CGIAR INTEGRATED PARTNERSHIP

CGIAR Research Centers

Science Programs and Accelerators

...and in collective action with...

PARTNERS

Strategic Focus Area: Mitigating Water Risks

Farmers, communities, policymakers, the private sector, planners and investors seek new data, knowledge, capabilities, and strategies for managing future water risks. They need answers to the question: *How can we manage future water risks?*

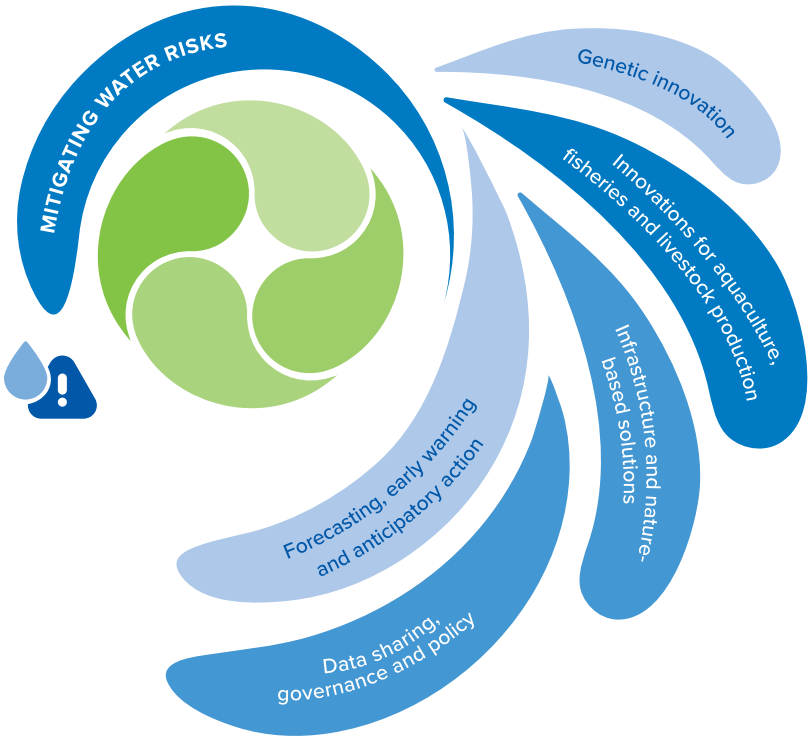
MITIGATING WATER RISKS

KEY QUESTIONS

- How can water risks be reduced in food systems from production to consumption?
- What will make water management more effective for climate change adaptation and mitigation?
- How will future risks of floods, drought, and compound events be managed to build climate resilience?
- How can water pollution be controlled to lower water risks to human health and biodiversity?

OUTCOME

Water risks are reduced, and climate action integrates strategies to anticipate and respond with agility to current and future changes in water risks.



Water risks in food systems. One CGIAR research and innovation will deliver new synergies between water security and transformation in food systems. Our water risk management solutions will integrate genetic innovation, on-farm management of green and blue water, and control of water pollution by crop production, livestock, and aquaculture. Crop breeding for drought resistance and tolerance to flooding and salinity will provide farmers with critical tools for resilience. We will further strengthen water risk management for farmers by scaling bundled solutions for flood and drought that combine index-based insurance, advisory services, seed and agronomic technologies, and climate smart agriculture.

We will also integrate water risk assessment and management with innovations for aquaculture, inland fisheries, and livestock production. One CGIAR will assess how changing dynamics for water risks affect nutrition security and poverty reduction. We will apply our evidence to strengthen coherence among policies on water quality, food safety, and human health, and to integrate water risks and water supply, sanitation, and hygiene in nutrition and health programs and policies.

Climate change adaptation and mitigation. One CGIAR will continue to develop, test, and scale water management for low-emission, climate-adaptive development pathways. New developments in climate smart agriculture, including crop breeding for lower water demand and crop diversification, will strengthen robustness to future water risks and flexibility in farming systems. Our research will evaluate new cropping systems, integrate water management for resilient agrifood systems, and build water resilience into the diversification of agricultural landscapes for climate adaptation and mitigation. Our research will increase carbon sequestration through well-managed soil and landscape systems, and One CGIAR will test and scale water management for methane emissions reduction in rice production.

We will advance the renewable energy transition in water management through technologies such

as solar-powered irrigation, and assess the implications for water policy and management of transition to energy technologies such as hydropower, solar, and green hydrogen. We will use data on energy intensity for water abstraction, storage, supply, use, and recycling to guide emissions reduction. We will use data and evidence to inform climate financing for water security, implementation of Nationally Determined Contributions, and policy coherence across sectors.

Reducing drought, flood, and compound systemic water risks. One CGIAR will enhance drought and flood forecasting and early warning systems to help decision-makers at farm to regional scales make more timely decisions. We will identify the underlying causes of vulnerability and facilitate data-driven anticipatory action across institutional and sector silos. We will apply water risk assessment tools and solutions to address the needs of communities, humanitarian organizations, and local and national governments. We will further assess the interconnectivity among climate-related water risks, institutional capacities, fragility, and conflict as a basis for strengthening anticipatory action. Our research will help humanitarian organizations plan, design, coordinate, and implement water interventions in emergency and post-conflict situations.

Working through partners, we will co-design strategies for water resilience that focus on governance, inclusion, data sharing and exchange, capacities, and infrastructure, including nature-based solutions. CGIAR foresight analysis will assess the implications of future water risks for nutrition, poverty, economic performance, and trade. We will work with governments, basin organizations, and financial institutions to re-tool planning, investment, and policies for deep uncertainty in future water risks.

Reducing water pollution. To protect water supplies and reduce risks to human health and ecosystems caused by water pollution and waste, One CGIAR will apply proven solutions to scale business models and strengthen policy for recycling, safe wastewater reuse and off-grid sanitation. Through deeper collaborations across Research Centers and the One CGIAR integrated partnership, we will develop and test solutions for water pollution in rural communities – caused by crop, livestock, and aquaculture production – to improve food safety and reduce water-borne disease. We will develop and apply modeling capabilities to reduce the spread of aquatic contaminants, including antimicrobial resistance, and develop new applications to reduce microplastic contamination.

Strategic Focus Area: Overcoming Global Inequalities

Policymakers, financial institutions, and development and humanitarian agencies want to integrate evidence-based recommendations for social transformation into policy, planning, program design, and implementation. They need answers to the question: *How do we make sure there is water security for all, and no one is left behind?*

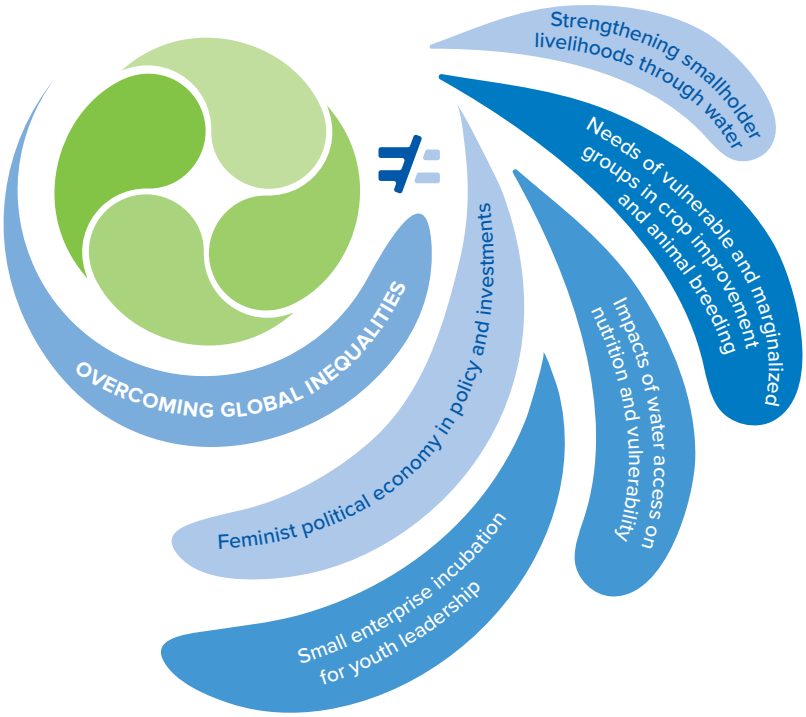
OVERCOMING GLOBAL INEQUALITIES

KEY QUESTIONS

- What are inclusive solutions for water management that advance equality in access and use and in agriculture and food systems?
- What water management solutions reduce poverty for women and poor communities?
- How can the inclusion of diverse water values and knowledge in decision-making reduce inequalities?
- How can youth inclusion and leadership strengthen accountability to future generations in water research and innovation and water policy and management?

OUTCOME

Gender equality and youth and social inclusion are improved to make the benefits of water security more equal, reduce poverty and ensure that water management leaves no one behind.



Inclusion in water management solutions. CGIAR will, for the first time, align research and innovation for water management – from genetics and technology through business models and policy – to drive advances in gender equality and social inclusion, and reduce hunger and poverty for all. Crop improvement for drought and flood tolerance and reduced water demand will integrate the preferences of women, youth, and marginalized groups, and crop and animal breeding will better target vulnerable households using data on water insecurity.

We will use our results to champion water services, technologies, learning, and skills development that remove barriers to women's equality and youth and social inclusion, cater to differences in user preferences and community needs, and encompass both productive and non-productive uses of water. Applications will reduce inequalities in access to water innovations that enhance productivity for agriculture, livestock, and aquaculture and to innovation bundles for water, food, nutrition, and climate security. Our scaling pathways for innovations and water management will adapt and apply business and financial models that promote inclusion and equality supported by impact assessments to gauge trade-offs, risks, and unintended consequences. We will assess the impacts of restricted access to clean water on human health and create frameworks to guide transparent and fair water trading, pricing, and allocation across sectors and users.

Reducing poverty. We will integrate equality and inclusion into research and applications addressing water and food security. CGIAR will generate data on the impacts of water access for women on nutrition security, dietary diversity, and vulnerability to water-related shocks and stresses. We will explore how equal access to water resources, innovations and risk management translates into development gains for women and marginalized groups, and quantify adverse impacts and maladaptation. We will use evidence and innovations to strengthen the income and livelihood benefits from water management for smallholder farmers. We will apply principles of feminist political economy to guide policies, programs, and investments to achieve a more even distribution of benefits. Our research will encompass the protection and recognition of rights in accessing, managing, and using water in food and energy systems.

Use of diverse water values and knowledge. CGIAR is committed to including a wider range of stakeholder interests and choices in water management by integrating diverse values and knowledge systems, including Indigenous knowledge, in negotiation and decision-making. We will build on our experience integrating formal and customary law in hybrid water law and support inclusive basin planning and water allocation to meet diverse user preferences and needs. We will develop and apply evidence to guide the alignment of institutional reforms with the interests of

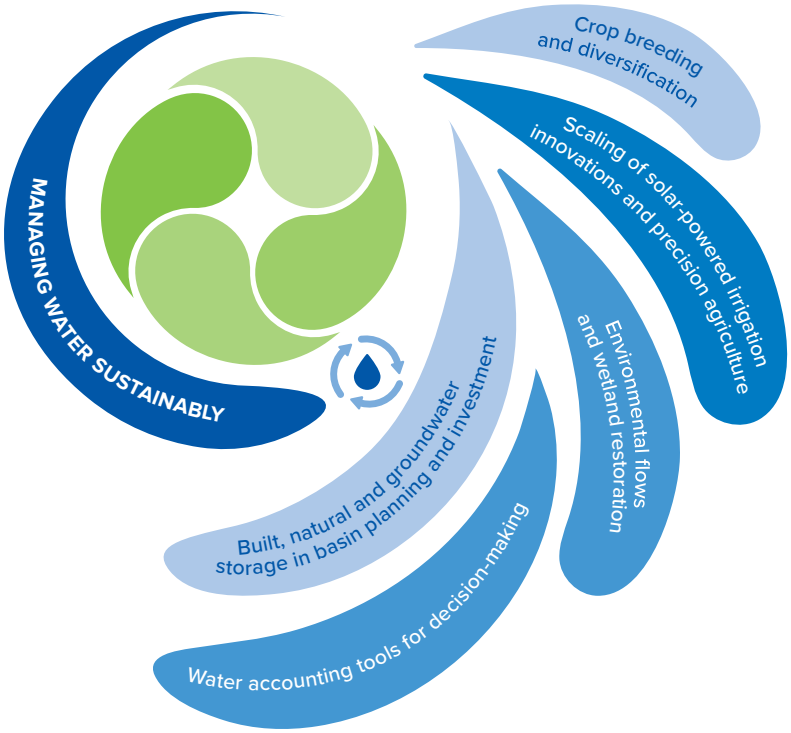
all community members, especially those who have been historically marginalized.

Youth inclusion and leadership on water security. Our innovation accelerators and partnerships for small enterprise incubation will empower youth to be entrepreneurs and leaders in water innovation, businesses, and management. We will develop capacity sharing programs that are flexible and responsive to the needs of disadvantaged groups.

One CGIAR will promote economic prospects for young people by fostering collaboration between the public and private sectors. Furthermore, we aim to empower young people to tackle current water challenges and lay the foundation for future water security. We will use this shift toward youth leadership to promote intergenerational accountability for water.

Strategic Focus Area: Managing Water Sustainably

National and local governments, multilateral financial institutions, development partners, farmers, and the private sector need answers to the question: *Will there be water to meet our development goals?*



MANAGING WATER SUSTAINABLY

KEY QUESTIONS

- What water management solutions in irrigated and rainfed agriculture will improve farmers' livelihoods and food security?
- How can water be moved out of agriculture where future demand is not sustainable?
- How can goals for biodiversity conservation and ecosystem restoration be met through water management?
- How will water infrastructure and allocation meet competing needs among water users and across sectors?

OUTCOME

Sustainable solutions to meet growing and competing demands for freshwater are applied with increasing scale and speed.

Improving food security and farmer livelihoods. One CGIAR will bring together research-for-development across Research Centers to provide sustainable water solutions for food production. Data on future water availability will guide crop breeding and crop diversification to lower water demand in agriculture while raising nutritional value. In combination with crop nutrition, soil health, and integrated management of water, fertilizer, and pesticides, CGIAR technologies and innovation bundles will raise productivity and reduce the water-related yield gap, while lowering water use along the rainfed-to-irrigation continuum.

We will empower small-scale farmers through farmer-led irrigation, renewable energy solutions (e.g., solar irrigation) and multiple-use systems to address productive and non-productive water needs in rural, peri-urban, and urban settings. One CGIAR will test and scale irrigation technologies to raise water-use efficiencies, integrating rainwater harvesting and supplementary irrigation. In large irrigation schemes, we will tackle suboptimal performance by combining institutional incentives, pricing mechanisms, and community-led governance. We will use the evidence and data we generate to advance policy coherence in the water and food sectors to avoid development drivers in agriculture that jeopardize water systems.

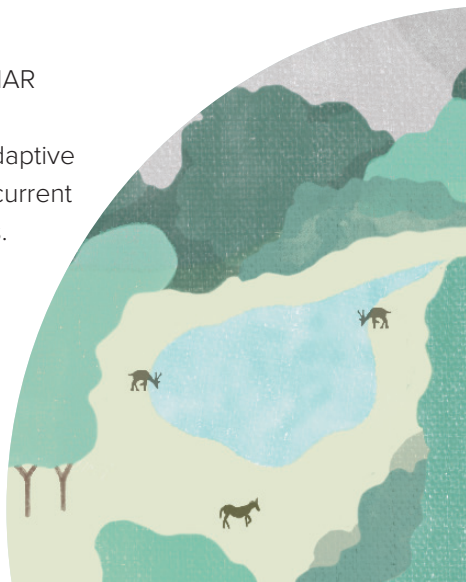
Moving water out of agriculture. One CGIAR research across water systems will address the critical challenge of moving water out of agriculture where future demand cannot be sustained. Because water is essential in agriculture, by aligning innovations – from crop breeding and diversification to technologies, precision agriculture, and water management – with policy and development of non-agricultural revenue streams, CGIAR will enable pathways for saving water in agriculture and reallocation to other sectors and the environment. We will also assess how trade influences drivers for water use in agriculture and search for evidence to help eliminate perverse incentives for excess water use through policy coherence across sectors.

Our research will build on long-term experience of wastewater reuse and recycling for innovation in the circular economy. We will assess the use of desalination in food systems and applications of hydroponics and vertical farming to curb water use in food production. Our focus will be the feasibility and acceptance of circular solutions to create sustainable water systems at watershed scale.

Biodiversity conservation and ecosystem restoration. One CGIAR will further develop and apply knowledge of environmental flows to the management of river systems. We will test and scale solutions for managing and restoring wetlands to deliver ecosystem services for urban water supply and resilience, and for food and nutrition security, including fisheries. We will apply natural capital accounting in crafting incentives for inclusion of ecosystem services in water investments. We will develop financing criteria for nature-based solutions by quantifying performance and trade-offs across objectives. We will apply our evidence to strengthening policy coherence for water and biodiversity.

Water infrastructure and allocation decisions. Through partnerships with advanced research consortia, we will apply cutting-edge analytical tools for designing and operating infrastructure portfolios to balance multisector performance for water, climate, energy, food, and ecosystems. We will develop and apply assessments of trade-offs in the water, energy, food, and ecosystems nexus to support water allocation and integrated planning.

To help reduce the growing water storage gap, we will develop solutions for integrating built, natural, and groundwater storage in basin planning and investment. To reduce groundwater depletion, our research will continue to strengthen sustainable groundwater management and scale solutions for aquifer recharge. One CGIAR will further develop water accounting frameworks and their applications to adaptive management of the water balance for current conditions and future climate scenarios.



TRANSFORMATIONAL LEVERS FOR CHANGE IN WATER SYSTEMS

Water data science. Advances in data science are revolutionizing data analytics just as the urgency of water security is rising. The availability of water data and access to data across the spectrum of water stakeholders is poised to change radically. For these innovations to deliver on their potential to accelerate water security, data analytics and applications of data and information must meet the needs and priorities of the global South.

One CGIAR will leverage water data science to close data and information gaps and develop and apply data analytics that leverage the power of artificial intelligence (AI).

CLOSING DATA AND INFORMATION GAPS

- Increasing data availability using the latest advances in remote sensing, geographic information systems, and the internet of things.
- Improved inclusive digital advisory services for producers to reduce risks and water use in crop and livestock production and aquaculture.
- Using AI to disaggregate data for gender, age, and other social differences.
- Decision support systems based on data cubes such as Digital Earth Africa to integrate climate, weather, water, and socio-economic data.
- Digital dashboards for equal access to data.

DATA ANALYTICS LEVERAGING ARTIFICIAL INTELLIGENCE

- AI tools for near-real-time optimization of decisions at farm-to-basin levels.
- Water accounting for current and future climate scenarios and demand forecasting for food, energy, and ecosystems.
- Social inclusion analytics to target water innovations.
- Foresight methodologies for food systems using water, food, and energy system modeling.
- Digital twins at farm-to-basin levels to support water governance, investment, and integrated planning.
- AI-enabled platforms to compare policy options across food, land, and water systems.

Water governance. Policies, laws, and institutions and an effective regulatory regime are essential to facilitating, scaling, and accelerating the changes needed to manage water risks, implement sustainable solutions, and overcome inequalities in water management. Water governance must link to and align with water management across sectors and scales to advance transformation in water systems.

Improving water governance is a powerful lever for delivering outcomes across the Strategic Focus Areas. We will strengthen One CGIAR's role in enhancing water governance at local, national, and transboundary levels and in improving the coherence of water policies and strategies across sectors and uses.

WATER GOVERNANCE AT LOCAL, NATIONAL, AND TRANSBOUNDARY LEVELS

- Facilitation of stakeholder participation in water governance platforms and reforms.
- Facilitation of institutional alignment for agriculture, water, and landscape management.
- Promotion of cooperative governance models with equality for women, youth, and vulnerable groups.
- Assisting with governance for water quality, irrigation, and groundwater sustainability.
- Support for regional and basin organizations to implement transboundary water management.

COHERENCE OF WATER POLICIES AND STRATEGIES ACROSS SECTORS AND USES

- Aligning agricultural water use and sector policies for water, food, and energy security.
- Climate action integrating adaptive water management, water resilience in food systems, and climate-responsive investment.
- Policy support for upscaling anticipatory action in fragile and conflict-affected areas.
- Demand-driven technical support across sectors on implementation of Nationally Determined Contributions and National Adaptation Plans.

Gender, youth, and social inclusion. Better knowledge of the root causes of exclusion and barriers to change, and how these vary across social groups, is needed to make policies and interventions more effective in promoting gender equality and youth and social inclusion. With clearer evidence and data-driven diagnostics, integrating strategies to reduce inequalities into solutions for resilience, sustainability, and water management that leave no one behind can be more successful.

One CGIAR will leverage research on the root causes of gender inequality and youth and social exclusion and on how to open more space in water management for the voices of women, youth, and people in poor communities.

IDENTIFYING THE ROOT CAUSES OF INEQUALITIES AND EXCLUSION

- Generating data and evidence on the root causes of inequalities and exclusion and how to address them.
- Applying an intersectional lens to build our knowledge of power relations shaping water management.
- Using evidence to challenge and eliminate hierarchies that prevent women's participation in decision-making.
- Assessing how intergenerational differences influence the adoption of water solutions and change.

VOICE AND REPRESENTATION OF WOMEN, YOUTH, AND POOR COMMUNITIES

- Engaging communities in water research to ensure it reflects local realities, values, needs, and preferences.
- Empowering communities using citizen science and inclusive research design.
- Empowering disadvantaged groups to strengthen their agency in water governance.
- Support and facilitation for multistakeholder platforms to integrate marginalized voices.
- Open and inclusive communication channels for research results, data, and policies.

Scaling, finance, and investment. Unavailability of financing for water is a barrier to future water security and there are opportunities to improve the application of evidence to direct financial flows for increased impact and better targeting of inclusive investments. The scaling of water solutions needs pipelines of innovations backed by a strengthened ecosystem for public and private finance, enabling policies, incentives, and partnerships.

CGIAR will strengthen scaling of innovation for water security and enhance the application of evidence from our research in data-driven support tools for investment, strengthening of financing for water, and repurposing of subsidies.

SCALING WATER INNOVATIONS FOR WATER SECURITY

- Creating a bankable scaling pipeline that bundles innovations to address risks, sustainability, and gender and social inclusion.
- Fostering multistakeholder engagement to overcome barriers to adoption.
- Creating adaptive scaling pathways to integrate future water risks in crop, livestock, and aquaculture production and ensure equal opportunities along value chains.
- Supporting evidence-based policies to facilitate financing, private sector engagement, and scaling water innovations.

FINANCING FOR WATER, REPURPOSING SUBSIDIES, AND DATA-DRIVEN TOOLS FOR INVESTMENT DECISIONS

- New partnerships with the multilateral, public, and private sectors to apply evidence for investment.
- Impact evaluations to target innovation financing.
- Data-driven tools to address future water risk, sustainability, and inclusion in financing decisions.
- Analytics to support repurposing subsidies.
- Evidence and data for inclusion of water innovations and water resilience in agricultural investment by agribusiness and climate finance

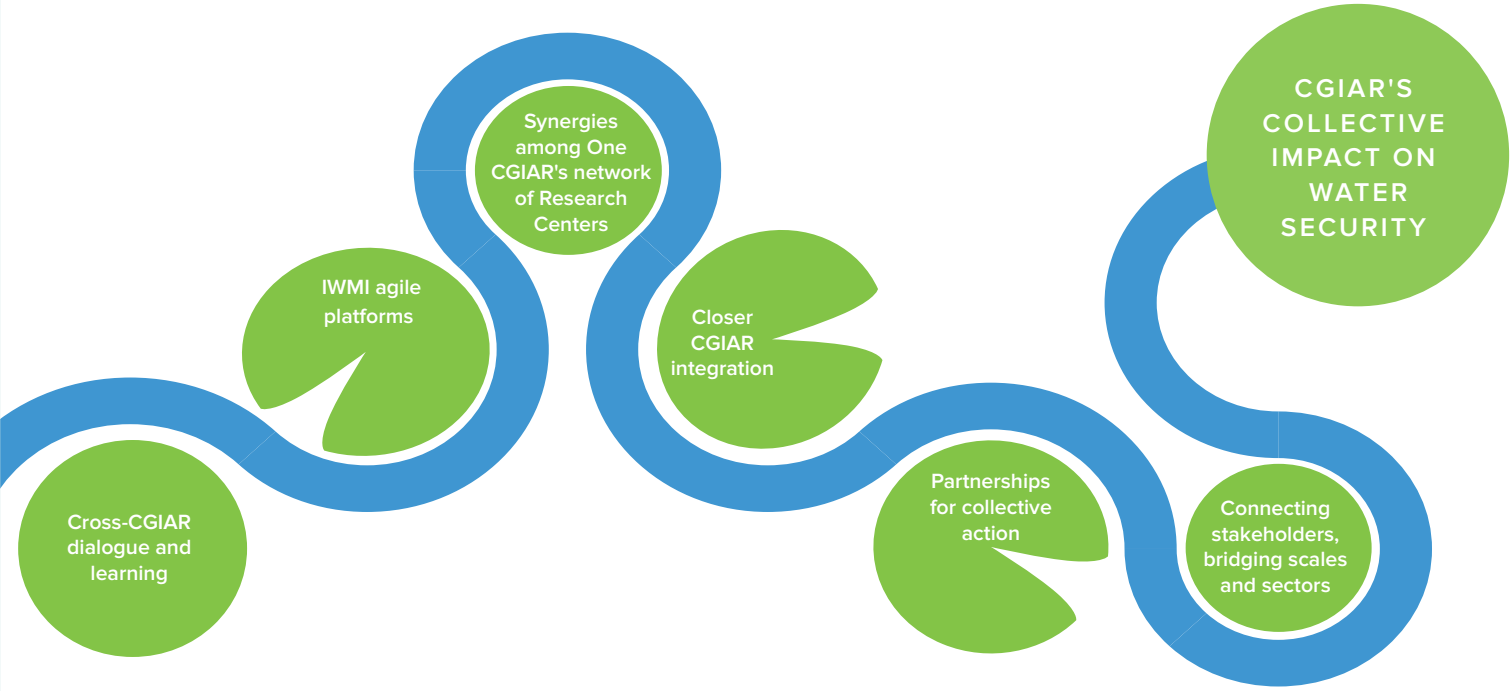
Roadmap for integration of water systems science in CGIAR

CGIAR will apply the Integration Roadmap to co-create and co-deliver projects and programs to catalyze and implement change in water systems and allied food and land systems.

Building closer integration

Implementation of the CGIAR Water Systems Integration Roadmap 2024–2030 will begin by building shared understanding and ownership of the Roadmap through cross-CGIAR dialogue and learning on how to extend and expand the role of water systems science in CGIAR. Clear backing and support from CGIAR's leadership will help to reframe success in CGIAR to include future water security.

The Integration Roadmap and the IWMI Strategy 2024–2030 together will enable One CGIAR to develop the new organizational strengths it needs for implementation of a larger and more complex portfolio of research and innovation to advance transformation in water systems as well as interdependent food and land systems. The Integration Roadmap therefore offers the opportunity for all Research Centers to come together and increase funding for water systems science in CGIAR around its common strategic framework. This will build on the evolving CGIAR portfolio and partnerships with governments, non-governmental organizations, the private sector, farmers, communities, investors, and research and knowledge organizations.



Whole-of-CGIAR delivery

One CGIAR's network of Research Centers and their country and regional offices across Africa, Asia, and Latin America provide a unique platform for co-development and implementation of research-for-development. CGIAR's diverse and multicultural research staff are based across the global South, with many from the countries and regions where they are working. We deliver, therefore, by building on the grounded expertise of our staff, their networks and extensive stakeholder engagement, and long-term, mutually accountable strategic relationships.

While IWMI is the fulcrum for water systems science in the One CGIAR integrated partnership, CGIAR Research Centers bring together a depth of scientific expertise across a multitude of disciplines, with water system science tackled through many different lenses of research. Outcomes in the Strategic Focus Areas and research to develop and apply the Transformational Levers will take contributions from across this wealth of expertise. Our strategic framework is designed explicitly to discourage programmatic and Center silos; Research Centers will continue to collaborate in interdisciplinary research-for-development and leverage the One CGIAR integrated partnership to meet the ambitions of the Water Systems Integration Roadmap.

CGIAR's country and regional coordination mechanisms will also guide the implementation of the Integration Roadmap. The Roadmap will be used to support the strengthening of regional integration in CGIAR and improved CGIAR coherence at the national level by enabling partners and host governments to access and build engagement with water system science across CGIAR using a common strategic framework.

"Partnerships will be at the core of water systems science in One CGIAR, embedded in the design and delivery of our work."

Partnerships for collective action

Through the Water Systems Integration Roadmap, we are committed to deepening collaboration across One CGIAR and carrying it into collective action on water in external partnerships with governments, businesses, development organizations, and investors.

Partnerships will be at the core of water systems science in One CGIAR, embedded in the design and delivery of our work, and using the role of CGIAR and its Research Centers as trusted knowledge partners to build a foundation for dynamic collaboration. This will leverage the water security-focused partnership strategy of IWMI, set out in the IWMI Strategy 2024–2030, and CGIAR's Engagement Framework for Partnerships and Advocacy.

The role that CGIAR plays is determined by our comparative advantages relative to other partners. Our collective action capabilities related to knowledge, research, and innovation complement the contributions to shared objectives of other water systems actors. Partnerships for the transformation of water systems are found across the public and private sectors, in basin and aquifer management organizations, among community-based organizations, and in national research agencies. We connect local, national, regional, and global stakeholders through partnerships and networks, bridging scales and sectors to catalyze and manage change.

Our partnerships will focus on supporting national and regional strategies and priorities. Our knowledge, research, and innovation will contribute through collective action to advancing the CGIAR 2030 Research and Innovation Strategy – for water systems, for food and land systems, and for everyone.

IWMI agile platforms

As a new experiment in integration, IWMI will convene Agile Platforms to bring together interdisciplinary teams around selected

emerging issues and opportunities. Co-led by at least two Program Directors from IWMI, each Agile Platform can draw on expertise from IWMI, One CGIAR, and external partners. They will be responsive, flexible, and time bound, and catalyze and align water systems research, project design, partnerships, and policy engagement for the Strategic Focus Areas and the Transformational Levers.

Each Agile Platform will have a specific mandate relative to country priorities or regional and global calls for water systems science and its applications. The Agile Platforms will therefore not be new permanent structures, but rather a way to break down silos and bring researchers together, including from across CGIAR, to strengthen the development of integrated solutions for complex water problems. Outputs will include design of strategic initiatives, policy innovation, knowledge products, or communications campaigns.

Knowledge sharing and communications

One CGIAR must match the urgency of solutions for water security with higher ambition for sharing knowledge and for using knowledge to scale innovations and accelerate change in water systems. We will embed knowledge sharing objectives across our strategic framework and in collective action partnerships by aligning and integrating CGIAR-wide approaches to knowledge and capacity building. The central aim is that data, evidence, and advice are used to accelerate learning and innovation, and elevate the impacts of research. In doing so, we can facilitate the sharing of results and lessons learned from diverse local, national, and regional contexts across global South networks.

The commitment of the Integration Roadmap to sharing knowledge starts with equality and inclusion, and recognition that there are diverse knowledge systems and values at play in managing water. A core principle is therefore that sharing knowledge is a two-way undertaking.

One CGIAR's communications on water systems will complement knowledge sharing and reflect this core principle. One CGIAR and IWMI will enhance coordination and joint implementation of communications to much more effectively leverage knowledge management related to water systems across CGIAR, increase investment in communications on water, and raise the visibility and influence of One CGIAR's water research-for-development. Our target is to have a greater impact in shaping the global agenda for water beyond research, and to be recognized as an indispensable global voice for innovation and science-based policy for transforming future water security.

One CGIAR's collective voice on water

One CGIAR brings evidence and data to the development of science-based policy. Our target for 2030 is for the collective voice of One CGIAR to be active and influential at the interface of the water agenda with the food, climate, and nature agendas, bridging current divides that can cause transformations in food, land, and water systems to be at odds. This will build on catalytic support delivered to partner governments in combination with influence in key global platforms, including the UN Framework Convention on Climate Change, the Global Biodiversity Framework, the Ramsar Convention, future Food System Summits, and the UN Water Conferences in 2026 and 2028. To back this target, One CGIAR will significantly upgrade knowledge sharing, communications, and outreach for water systems science.

CGIAR Centers

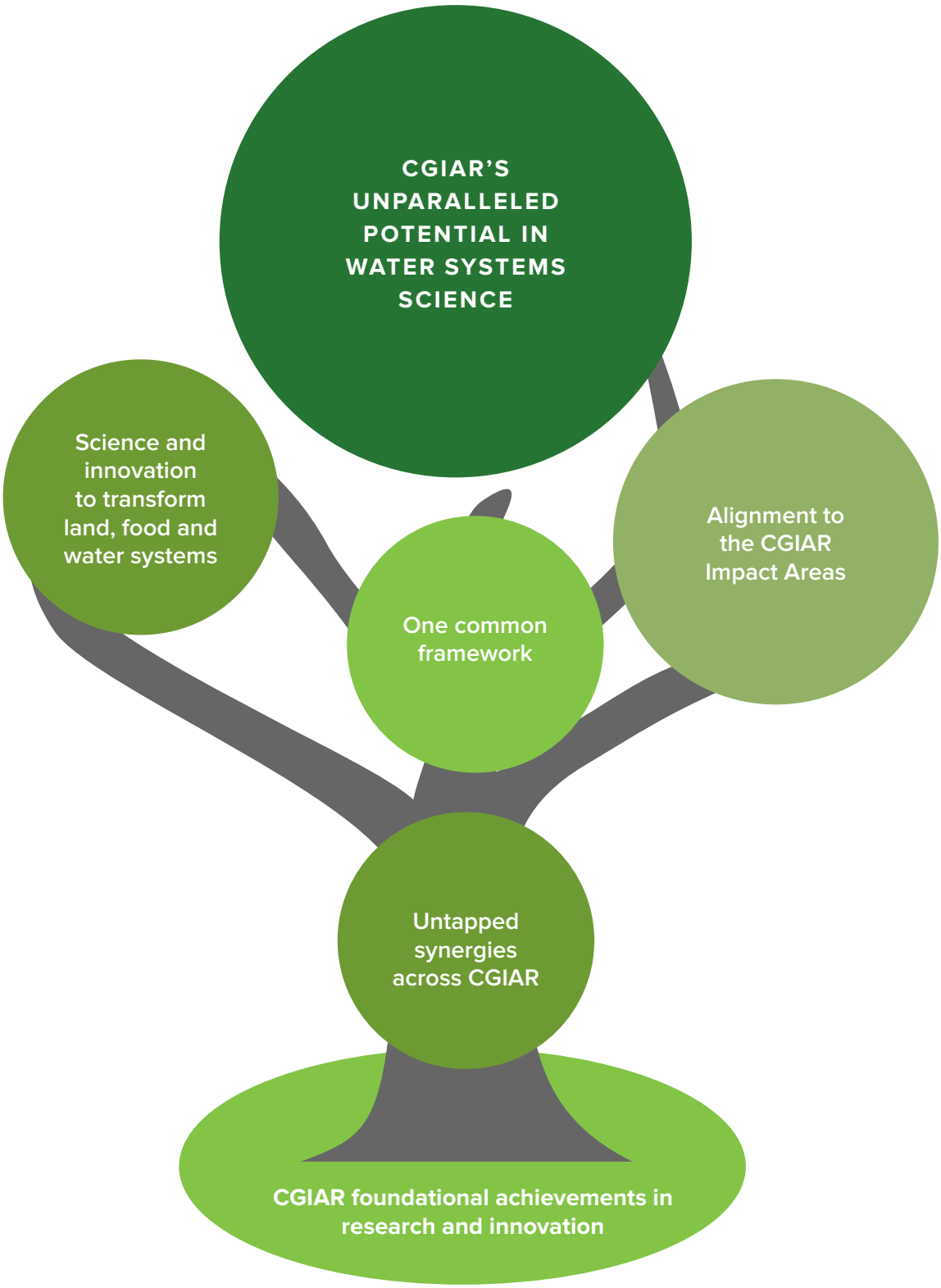

ICARDA
Beirut, Lebanon
ILRI
Addis Ababa, Ethiopia,
Nairobi, Kenya
ICRAF
Nairobi, Kenya
ICRISAT
Hyderabad, India
IWMI
Colombo, Sri Lanka
CIFOR
Bogor, Indonesia
IRRI
Los Baños, Philipines
WorldFish
Penang, Malaysia

One CGIAR's unparalleled potential in water systems science

The One CGIAR integrated partnership has potential to contribute in unparalleled ways to future water security in the global South.

Through the integration of research and innovation in One CGIAR – from genes to basins, and addressing risks, inequalities, and sustainability – the Water Systems Integration Roadmap provides one common framework through which One CGIAR can multiply the scale and speed of transformation in water systems. By finally deploying untapped synergies across One CGIAR, we can leverage impacts from water systems science across food, land, and water systems. The Integration Roadmap will amplify One CGIAR's capability to apply an integrated agenda to the interconnected challenges of sustainable development, climate change, and biodiversity. To deliver on this promise, CGIAR must change.

The Water Systems Integration Roadmap helps One CGIAR to reframe success. With the recognition that CGIAR's vision of a food-secure future is possible only in a water-secure world, success for One CGIAR will be both food security and water security, both food systems transformation and water systems transformation. Building on One CGIAR's foundational achievements in agricultural research and innovation, our future success will embrace water systems science.


CGIAR'S UNPARALLELED POTENTIAL IN WATER SYSTEMS SCIENCE
Science and innovation to transform land, food and water systems
One common framework
Alignment to the CGIAR Impact Areas
Untapped synergies across CGIAR
CGIAR foundational achievements in research and innovation

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