STATEMENT September 2021

WATER GOVERNANCE FOR RESILIENT FOOD SYSTEMS FOR FUTURE CLIMATES

“The language of water is the language of climate change

United Nations Framework Convention on Climate Change (UNFCCC), Copenhagen, 2009

Call To Action

To mark the 2021 United Nations Food Systems Summit, we, as a group of 31 globally diverse practitioners and researchers, sound a clarion call for water resilience to be brought to the forefront of building resilient and sustainable food systems that can provision communities, economies and ecosystems into a rapidly changing world.

THE CHALLENGE

Throughout history, water governance has been a make or break issue for governments. In the future, effective governance that can enable transparent, clear-sighted trade-offs of a shifting water cycle will make or break governments and broader social stability, equity, and poverty alleviation.

The UN Food Systems Summit has underplayed the centrality of water and its inherent and growing risks in food systems.

The IPCC AR6 report should be viewed as a call for urgent action on water resilience to ready food systems for unpredictable water futures. Disruption of the water system is and will continue to create cascading risks across food systems.

While resilient food systems and sustainable healthy diets for all call for much larger water use, water resources are limited and needed for other vital functions. Their use in food systems needs to be brought within the limits of sustainability.

Food systems need to pro-actively work toward a socially and environmentally just space that considers water and food needs of people, the ecosystems that provision our food system, and broader energy and equity concerns.

Achieving transformation to water resilient food systems will require a compact between national and local government, communities and the private sector, and governance that empowers women, youth and communities in decision making.

CRITICAL FOCUS AREAS FOR WATER RESILIENT FOOD SYSTEMS

We propose the following six features that together provide a foundation for reducing future water risks to food systems and the basis for water resilient food systems:

- **Treating the food system as a system – adopting interconnected systems thinking that embraces the complexity of how we produce, distribute, and add value to food:** New and innovative platforms and partnerships across the agricultural, environment, energy and land-use sectors are required for interconnected water and food systems thinking. As water and food systems are constantly co-evolving, there is a need for continual assessment of decisions and adaptation that can be achieved through interconnected systems thinking.
- **Adopting multi-level inclusive governance and supporting inclusive participation:** Localized governance and participatory approaches enable better adaptability and rapid and inclusive responses to local threats to water security that could rapidly escalate across agricultural supply chains. The emergence of different governance institutions necessitates effective platforms for negotiation that build capacity for cooperation across the system as well as supporting robust conflict resolution mechanisms.
- **Enabling continual innovation, new knowledge and learning:** A range of innovations are required in knowledge and technology, incentive systems, and financial instruments to facilitate behaviour change. To make use of new knowledge, there is a need for continual learning, capacity building and associated feedback mechanisms that allow for improvements, learning, flexibility and course adjustment.
- **Incorporating diversity and redundancy – living resilience:** Embracing diversity and socio-ecological complexity in agricultural production techniques for more flexible, better adaptive capacity and systemic resilience provides a range of options to respond and adapt to changing circumstances, over both the short-term and long-term.
- **Ensuring system preparedness:** Focus on preparedness and capacity building, transparency in data availability, accountability in data collection and management. In a changing world where future shocks and stresses cannot be perfectly predicted, resilience can be built by focusing more on preparedness and increasing the range of adaptive capacities that are available.
- **Plan for the long term:** Water resilient food systems must proactively plan for and adapt to system changes over both short and long timescales built on a strong evidence base. Hard and soft infrastructure and governance systems should be designed to meet tests to resilience over a long time-horizon rather than focusing on present day stresses.

Full Statement

Significant progress has been made globally in the production of food to meet growing demand. This is evidenced by per capita food availability increasing since the middle of the last century despite a more than doubling of the global population[1] with a concomitant decline in hunger and malnutrition at the global level. An important benefit of our ability to feed a growing population, driven by political and consumer agendas, has been significant downward pressure on food prices, but at the cost of detrimental environmental, economic, and social impacts.[2] However, an increasing number of countries are facing growing levels of acute food insecurity due to climate shocks and conflict, reversing years of development gains.[3] [4] This has been further exacerbated by the Covid-19 pandemic.[5] [6]

Notwithstanding the current impacts of the pandemic, food and land-use systems are in crisis.[7] At least four interlinked dimensions of systemic change are contributing to emerging food and nutrition insecurity, namely, (1) the climate crisis and an increasingly erratic water cycle, which is destabilizing agricultural and food systems as increased frequency and severity of extreme events, floods and droughts take hold[8]; (2) an environmental crisis unfolding through exploitive resource-use expansion, exacerbated by loss of biodiversity and ecosystem services that impart vulnerability to food systems[9] [10] [11] [12]; (3) a health crisis driven by poor nutrition choices and lack of access to affordable and healthy food[13]; and (4) a rural livelihoods crisis in many countries associated with gender inequality and an aging agrarian population with limited recruitment by youth that have aspirations beyond the farm gate.[14] Moreover, while trade has been an enabler[15] of food and nutrition security—and plays a growing role in national food security of low-and middle-income countries, particularly in Africa, trade has, at times, worsened inequity and access to food.[16] [17]

Whilst climate is a key driver of the challenges facing food systems, it is the Anthropocene condition and its many facets that needs to be acknowledged. We have built large urban conurbations in drought prone regions where populations continue to grow bringing

1 Gordon, L.J. et al. 2017
2 Kurth, T. et al. 2020
3 Queiroz, C. et al. 2021.
4 FAO, IFAD, UNICEF, WFP and WHO. 2021
5 World Bank Group 2021
6 World Food Program 2021
7 FABLE 2019
8 IPCC, 2021
9 The food system includes the related resources, the inputs, production, transport, processing and manufacturing industries, retailing, and consumption of food as well as its impacts on environment, health, and society. It encapsulates the five tracks articulated within the UNFSS namely: Access to Safe and Nutritious Food for All; Shifting to Sustainable Consumption Patterns; Boosting Nature-Positive Production at Sufficient Scale; Advancing Equitable Livelihoods and Value Distribution; and Building Resilience to Vulnerabilities, Shocks and Stresses. UNFSS 2020.
10 Queiroz, C. et al. 2021
11 Béné, C. et al. 2019
12 IPCC 2021
13 Willett, W. et al. 2019
14 Zou, B. et al. 2019
15 OECD, 2021
16 Benton, T. G. and Bailey, R. 2019
17 FABLE 2019

greater stresses to limited water resources; we grow cotton and paddy rice in areas where it makes no sense considering the water footprint of these crops. These are examples of our inability to place water at the forefront in our decision-making process.

A core element of the UN Food Systems Summit is to raise awareness that achieving the Sustainable Development Goals (SDGs) demands reforms in our food systems. These must address systemic changes driving food and nutritional security and the need to build resilience into food systems to ensure the provision of healthy and affordable diets for all while recognizing that the SDGs have deep connections, synergies, and – without care – potential conflicts.

Water is too often left out of the discourse around resilient and sustainable food systems. Equality in access to water and its availability is taken as a given in its supply[18]; in the production and processing of food; in the consumption of food; and in equitably meeting demands from humans and nature.[19] The reality is water has the power to break climate-brittle food systems. We grow water-intensive crops in increasingly drought prone regions. Water management, under significant uncertainty, will increasingly lead to failures through for example droughts and floods, or water contamination contributing to unsafe drinking water and malnutrition and associated disease. In short, water itself is a critical source of resilience across natural and social systems.[20]

Disruption of the water system by climate change is creating risks across the food system – from inputs to food systems, to production and processing, to food consumption. The impacts on food systems will be far reaching from the loss of land in the mega-delta food bowls of south, east and west Asia due to salt water intrusion[21]; changed flow regimes of major river systems from the Andes to the Himalayas[22 23]; shifts in precipitation patterns and snowpack/ glacier melt impacting irrigated agriculture in Central Asia[24]; to abandonment of rainfed agriculture in regions of Africa due to rainfall unpredictability and desertification.[25] Yet these shocks and stresses and, often the solutions, are found in water.[26]

The climate crisis is effectively a *water resilience crisis* – and therefore to meet our aspirations for future food systems, there is a need to transform governance systems relating to food and water to cope with variability, frequency and amplitude of water-related extreme events. The question arises: What are the critical elements for governance of water resilient food systems?[27]

18 Steiner, A. et al. 2020
19 Smith, D.M. et al. 2019
20 Falkenmark, M. et al. 2019.
21 Hooijer, A. and Vernimmen, R. 2021
22 Ragettli, S. et al. 2016
23 Immerzeel, W.W. et al. 2010
24 Barandun, M. et al. 2020
25 Sulieman, H.M. and Buchroirhner, M.F. 2009
26 IPCC, 2021
27 Water resilient food systems, have the capacity to withstand and recover from water related shocks, and respond to long term changes in hydrology and water systems.

Whilst it could be argued that the innate complexity embedded in water – spanning social, economic and environmental domains – makes identifying the constituents of water resilient food systems a tortuous and contestable task, we are of the opinion that it is essential.

The objective must be to prepare for a resilient future that embraces water scarcity, systematic changes in availability and competition. Water use in food systems have to be brought within the limits of sustainability, and food systems need to be ready for a productive future with unpredictable water. Further, change in food systems has to contribute to staying within the planetary boundaries for water resource use[28] and to reclaiming the socially and environmentally just space.

To catalyze a new dialogue on water resilient food systems, we propose the following six attributes that together provide a foundation for good governance to reduce future water risks to food systems. These attributes are grounded in scientific evidence as well as our diverse collective experience and expertise working across the science-policy interface. They should not be seen as exhaustive or a road map to success but rather an opportunity to begin the urgently-needed discussion of how the transformation of food systems sought at the Food Systems Summit will be made water resilient.

Embracing complexity – adopting interconnected systems thinking

The water resilience of food systems is influenced and impacted by the numerous sectors that are dependent on water to create positive interconnected feedbacks across the water cycle.[29] [30] Water and food systems are constantly co-evolving as a result, requiring continual assessment of decisions and adaptation in the sustainable management of food systems.[31] By acknowledging these feedbacks, connections and associated uncertainties, continual adjustments, synergies and trade-offs can be evaluated and actions taken. To achieve interconnected systems thinking, new and innovative platforms and partnerships need to be created that share expertise among practitioners across the agricultural, environment, energy and land-use domains along with other diverse groups that have an interest or stake in water and food systems. Evidence of the effectiveness of such approaches is found in innovation platforms that have emerged to address changes in small-scale irrigation in south and east Africa.[32]

The complexity of water resilience is eloquently encapsulated in the paradox of irrigation efficiency. Simple interventions through policy reform and investments in infrastructure or modernization of irrigation systems have rarely achieved the desired goal of reduced water consumption[33] [34] when scaled up from the farm to basin. By embracing complexity that is inclusive over a range of socio-ecological dimensions and scales, meaningful assessments can be undertaken of how to overcome the efficiency paradox.[35] Similarly,

28 Steffen, W. et al. 2015
29 Sarre, E. 2019
30 Amigo, I. 2020
31 Biggs, R., M. et al. 2012
32 Pittock, J. et al. 2020
33 Grafton, R.Q. et al. 2018
34 McGuire, V.L., 2017
35 Lankford, B. et al. 2020

the adoption of nature-based solutions[36 37 38] and agroecological[39] approaches incorporate the complexity of natural systems in building water resilience into food systems.

Benefits of complexity thinking would include a shift in the mental models and cognitive processes of all actors involved to embrace uncertainty, long-term thinking, feedback loops and understanding of food systems as social-ecological systems, with water a key leverage point for transforming them into resilient systems. Further, embracing complexity provides the foundation for informed decision making that goes beyond sectorial silos.

Polycentric governance, supporting inclusive participation

Adopting polycentric governance fosters resilience across interconnected socio-ecological systems that constitute water and food systems. Such an architecture for governance contributes to strengthening inclusion for women, youth and marginalized people, which is vital for resilience. It recognizes the differences between varied stresses on water and food systems and enables tailoring of policymaking to adapt to local risks.[40] Institutions within polycentric systems have the capacity to act semi-autonomously simultaneously, which enables adaptability and rapid and inclusive responses to local threats to water security that could rapidly escalate across agricultural supply chains.[41] Where different polycentric governance institutions have overlapping interests across these nested systems, there is a need for effective platforms for negotiation that build capacity for cooperation across the system as well as support from robust conflict resolution mechanisms.[42 43] The potential for novel polycentric governance systems at scale has been identified for groundwater usage in sub-Saharan Africa.[44]

Traditional participatory approaches provide concrete examples of polycentric approaches to water management at a local level. The Muang Fai and Subak irrigation systems of northern Thailand and Bali respectively, have been managed through community-based participation and have undergone little change for generations. Similarly, the Qanats of Iran provide an example of a traditional communal management system still in place. These systems encapsulate elements of responsiveness, flexibility and equitable water sharing and distribution mechanisms. Water as a collective good is enshrined in the Mexican and South African constitutions that promotes shared risks and equity.[45 46]

There are, however, lessons to be learnt in promoting polycentric governance structures, all part of a continual learning process that allows for improvements and course adjustment. The development of water user associations (WUAs) as a means

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36 Matthews, J. et al. 2019
37 Malhi, Y. et al. 2020
38 Hallstein, E. and Iseman, T. 2021
39 HLPE. 2019
40 Falkenmark, M. et al. 2019.
41 Carlisle, K. and Gruby, R.L. 2019
42 Ibid.
43 Dore, J. et al. 2010
44 Bruns, B. 2021.
45 Wilder, M.O. et al. 2020
46 South African Constitution 1996.

of democratizing irrigation management is emblematic of a polycentric approach to governance and inclusiveness, with many different examples found in the developed world. Whilst this approach has been promoted in the process of irrigation reform in many developing and emerging economies, its impact has been mixed due to challenges of developing effective and sustainable institutions.[47]

Polycentric governance structures would facilitate the emergence of viable water resource institutions that are transparent, accountable, efficient, responsive, sustainable, adequately resourced and geographically contextualized and move away from current governance arrangements that are often fragmented or weak. Further, since water risks under climate change fall disproportionately on the most vulnerable, such an approach to water resilient food systems would encapsulate a strong lens on equity and local communities. Water resilient food systems would factor in the environmental and ethical costs associated with food systems.

Innovation, knowledge, and learning

Water resilient food systems have embedded within them an ethos of continual innovation and learning along with access to knowledge and the skills and capacity to utilize knowledge in managing dynamically changing risks. They foster systems thinking and knowledge sharing and provide the space for continual learning that is used to inform decision making. The development, promotion and use of climate and water information systems and the implementation of robust monitoring systems, supports and contributes to adaptive management across the entire food system.

To make use of information, water resilient food systems need to incorporate the attributes of continual learning and associated feedback mechanisms that allow for improvements and course adjustment. There is a range of information, knowledge and technological innovations and tools that could be brought to bear in enhancing water resilience into food systems. For example, the concept of 'follow the water' through recent technological advances in real-time monitoring of flows using Earth observation tools[48], provides the critical information required to build robust water accounting systems that can be used in the decision-making process.[49] Demystification of hydrogeology combined with community norms and institutional reforms as a means to manage groundwater as social-ecological commons in Maharashtra, India has been shown to be effective in addressing over exploitation of groundwater resources.[50] In addition, traditional measures that have been used in the past, such as water-use efficiency, will need to be re-thought under climate change, since efficiency is not necessary an indicator of resilience.[51]

Whilst the ICT revolution and the emergence of Artificial Intelligence will play a significant role in supporting the emergence of water resilient food systems, there is a need to

47 Aarnoudse, E. et al. 2018
48 FAO. 2019
49 Van Opstal, J. et al. 2021
50 Kulkarni H. et al. 2021
51 Garg, K.K. et al. 2021

ensure that indigenous solutions in water management are incorporated into the solutions mix. Rainwater harvesting systems, step wells, Persian wheels, etc. have been shown to be effective solutions for managing water resources. There is a need to revive and mainstream these approaches in the mix of options to be considered.

Innovation is not confined to technology. Advances in incentive-based systems and financial instruments have provided the enabling environment to facilitate behaviour change. Adoption of improved practices and approaches that contribute to water resilient food systems occurs where there is a clear advantage to the individual, these being primarily economic. However, the adoption of practices and approaches that have a public and social good are often more difficult to achieve and less attractive due to a perceived limited immediate benefit (e.g. economic) and in general require incentivization.[52] Innovations in incentive-based approaches that include payment for ecosystem services (PES) and conditional transfer approaches have been key mechanisms in support of improved resource management that have positive impacts on the quantity and quality of water resources generated in the landscape. Examples include Conservation Reserve Program (CRP)[53] in the USA, the Grain-to-Green Program (GTGP) and the Grain-to-Bamboo Program (GTBP) in China[54], the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India[55], the procurement and public distribution of millets in Odisha[56] and the Expanded Public Works Programme (EPWP) in South Africa.[57] There are currently over 550 PES programs globally, steadily increasing in number, with total annual expenditures that could soon reach over US$ 40 billion.[58] Despite their potential, water markets and other incentive-based approaches to water management have struggled to scale up beyond pilot initiatives due to political resistance, financing shortfalls and data deficits. Recent advances in our understanding of incentives for sustainable water use can help to overcome persistent barriers that have hindered past efforts.[59] Emerging research on financial and investment instruments to support environment outcomes[60] holds significant promise to support water resilience in food systems.

Diversity and redundancy

Reaching resilient water systems that support food systems is aided by maintaining diversity and redundancy amongst component parts: from water landscapes through to governance institutions.[61] It provides a range of options to respond and adapt to changing circumstances, over both the short-term and long-term. Within most current food systems, prioritization has promoted leanness and efficiency over system flexibility. Large-scale production technologies have been successful at maximizing output by simplifying and centralizing agricultural input techniques, but have created 'narrow and brittle'

52 Costanza, R. et al. 2014
53 United States Department of Agriculture 2011
54 FAO 2021
55 Kaur, N. et al. 2017
56 Jena, D. and Mishra, S. 2021
57 Porras, I. and Asquith, N. 2018
58 Salzman et al. 2018
59 Garrick, D. et al. 2020
60 Blended Task Force 2020
61 Biggs, R. et al. 2012.

systems at the expense of risks associated with climate change and biodiversity loss.[62] [63] By encouraging and embracing diversity and social-ecological complexity, agricultural production techniques can be made more flexible, incorporating 'broad and nimble adaptive capacity' and building systemic resilience. Evidence from the Mediterranean on nature-based solutions suggests that they have been effective in reducing water demand, improving soil fertility and reduced erosion.[64] It provides the opportunity to conserve ecological diversity and connectivity, promote economic diversity and guard against maladaptive engineering.[65] The lack of progress in reversing the global decline in biodiversity is partly due to a mismatch between how living nature is conceived and valued by the conservation movement on the one hand, and by many different people, including marginalized communities, on the other requiring a pluralistic perspective on biodiversity.[66]

System preparedness

Reaching water resilient food systems will require prioritizing preparedness away from the current reactionary responses.[67] In a changing world where future shocks and stresses cannot be perfectly predicted, resilience can be built by focusing more on preparedness and increasing the range of adaptive capacities[68], rather than trying to orchestrate precise response plans to specific predicted situations. The role of long-term climate forecasting and early warning systems are tools that would allow producers to make tactical decisions[69]; mapping temporal and spatial trends of emerging water scarcity; establishing routine water accounting approaches at a national level; and adapting agricultural water management to water scarcity would assist in preparing for extreme events. Proactive approaches to water management have also been evidenced to be cheaper than responding to eventual shocks.[70] Understanding how risks will cascade across water systems between regions and economies and understanding potential water/agriculture tipping points can assist in highlighting the myriad ways in which actors need to prepare.

In order to support a preparedness agenda there is a need for transparency in data availability, accountability in data management and collection. There are significant gaps in data collection across water systems worldwide and an increasingly important approach that can address this impasse is through citizen science and the citizen-state interface in data collection. Crop water budgeting successes in parts of India are evidence towards addressing this gap.[71]

Long-time horizons

Today, throughout the world we find water infrastructure built thousands of years ago, from the aqueducts of ancient Rome to the irrigation channels of Mesopotamia. They are

62 Petersen-Rockney, M. et al. 2021.
63 Benton, T.H. et al. 2021.
64 Torralba, M. et al., 2016
65 Smith, D.M. et al. 2019.
66 Pascual, U., et al. 2021
67 Bazza, M. et al. 2018.
68 Biggs, R. et al. 2012.
69 Alfieri, L. et al. 2012.
70 Bazza, M. et al. 2018.
71 Ghose, B. et al. 2018.

a defining feature of civilisation. Many investment decisions in water and food systems have long-term consequences. Infrastructure in particular can shape development for decades or centuries, a duration that often extends beyond infrastructure's lifetime because the economic system reorganizes itself around them.[72] Water resilient food systems must proactively plan for and adapt to system changes over both short and long timescales. Climate change is making the water cycle increasingly erratic. It is likely to increase the frequency of extreme weather that will negatively impact agricultural production capacity.[73] One potential impact is multiple breadbasket failures if, for example, the Jetstream stalls over key food producing regions causing prolonged droughts – Earth has already been affected by two consecutive heatwaves across the entire northern hemisphere in 2019 and 2020. Water-resilient food systems should be built on a strong evidence base of the form of long-term stress. Hard and soft infrastructure and governance systems should then be designed to meet tests to resilience over a long time-horizon rather than focusing on present day stresses.

Supporting these constituent components of water resilient food systems will be contingent on policy innovations, institutional innovations, and technological innovations that are connected and need to be pursued in integrated ways.[74] This will require systems innovations, not only single-issue innovations, along with integration into relevant decision maker levels, including policy makers, water managers and, most importantly, farmer/producer levels.

As uncertainty emerges with climate change, our ability to identify the most likely and credible future water regime among a wide range of possibilities recedes. Due to non-stationarity, it is becoming harder to assign probabilities of future events with confidence limits and to then weigh alternative decisions. Instead, the best options for managing water are those that are robust because they show satisfactory performance across a wide range of possible futures.[75] If such robustness can then be complemented by flexibility, the ability to respond to unexpected future events, changes in climatic and hydrological patterns, and residual risk is retained.[76]

Achieving transformation to water resilient food systems will require difficult decisions, negotiation of trade-offs and significant investments across the food system and in the generation of the new knowledge through research and its application. It will require an enabling environment, building a compact between government, communities and the private sector and the political will to stay the course. Further, women, youth and communities – including smallholder farmers – will need to at the centre of decision-making, financial allocations for implementation and governance if transforming food systems is to be water resilient.

72 Hallegatte, S. et al. 2012.
73 Beillouin, D. et al. 2020.
74 von Braun, J. et al. 2021.
75 Matrosov, E.S., et al. 2013
76 Smith, D.M. et al. 2019

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