COLUMBIA CLIMATE SCHOOL
Climate, Earth, and Society

Ensuring Food Systems Nurture Humanity and the Planet

Columbia Climate School's
Food for Humanity Initiative Strategy
2025 – 2030

Arranged by
The Food for Humanity Initiative

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Overview

Food systems are the lifeline between climate change, environmental sustainability, optimal diets, and nutrition outcomes. Yet food systems face increasing fragility in the larger context of massive world order disruption and reconfiguration. The range of challenges experienced by countries—none of which have a monopoly on food systems successes or failures—points to the complexities of food systems. We need to understand and apply political will and science to address the current challenges of today's world and realize a resilient, equitable global food system.

Our Vision

Food for Humanity Initiative

The Food for Humanity Initiative (F4Hi) at the Columbia Climate School envisions a just transformation of food systems that supports the adaptive capacity to climate variability and change, promotes environmental sustainability, provides reliable livelihoods, ensures access to healthy diets, and optimizes better health and nutrition for everyone. We are a multidisciplinary collaborative network that brings together people and projects on food systems research, teaching, policy, and programming from across Columbia University. Our work touches on the complexities of food systems, with activities around health, agriculture, the environment, equity, and justice.

Our vision is supported by research, impact, and education goals. Specifically, we aim to:

- **Analyze food systems transitions**: Investigate and analyze how food systems can transition toward equitable, sustainable pathways and assess trade-offs between human health, climate, ecosystems, poverty, and labor conditions.
- **Co-design solution pathway**s: Co-design and co-develop solution pathways for policymakers, communities, and other key partners toward environmentally sustainable, equitable, and nutritious food systems at local to global scales, prioritizing the most vulnerable and marginalized to ensure they can adapt to the impact a changing climate will have on ecosystems.
- **Guide education and leadership**: Educate students, professionals, and the public about the complexities of the global food system and prepare the next generation of food systems leaders and change agents.

Collaboration is the cornerstone of our approach. Situated within the Columbia Climate School, we aim to tackle the complexities of food systems challenges from an interdisciplinary perspective, with climate as a cross-cutting theme. We reach across Columbia University's schools, departments, and centers to bring together a diverse set of experts, practitioners, researchers, and students. Sitting in New York City, we engage directly in the global processes of food governance and international policymaking.

Drawing from our multidisciplinary expertise as well as our unique niche and comparative advantage, we work across a set of cross-cutting areas toward food systems transformation. These areas are:

- **Food systems and climate data network**: The state of food systems measurements needs to be advanced to capture the complexities of interactions. This can be done by integrating climate information, using artificial intelligence (AI), models, satellite imagery, and more.

- **Protein futures**: The consequences of a shift to alternative proteins, as well as the necessary evidence, frameworks, policies, and regulations required for this shift, are largely unknown. Finding consensus on these political, cultural, and ethical issues is essential.

- **Sustainable city food systems**: These activities will help restore local food systems where it makes economic and political sense. They will also support outcomes that improve food access, equity, and local nutritional outcomes while strengthening regional food systems.

- **Harnessing opportunity crops for climate and nutrition resilience**: We will work to understand better whether and how opportunity crops can ensure climate and nutrition resilience among empowered communities.

Who We Are

The **F4Hi** is a collaborative consortium of faculty, staff, and students across Columbia University engaging in food systems-related activities. Collectively, we research, educate, and inform policy and practice in partnership with the communities in which we engage and partner locally, nationally, and internationally. The F4Hi strives to be an example of how to collaborate across disciplines, schools, and career levels, and we plan to sustain engagement as well as elevate and expand the critical importance of food systems within Columbia University.

The Columbia Climate School hosts this collective endeavor. It will continue to support and curate cutting-edge research, impactful policy, and innovative education for those who connect and collaborate with the F4Hi.

The Global Challenge

Over the last one hundred years, food systems have made significant achievements to produce more food and provide calories to the world's population. Much of this was done through scientific endeavors and political commitment, demonstrating that policy and science can enormously impact food systems. However, in the twenty-first century, food systems face newfound, complex challenges as well as perpetual consequences and unintended (or intended) trade-offs for how we have managed our food systems. We need to apply innovative political will and science once again to address the current challenges of today's world.

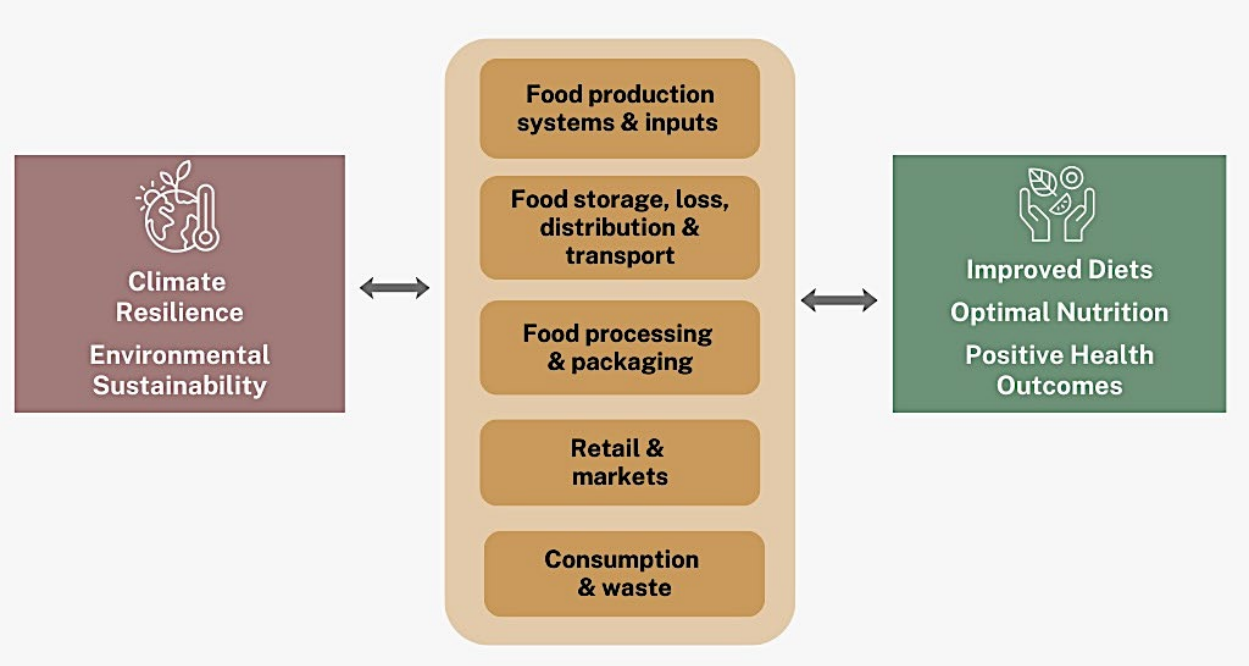
With climate change, the long tail of the COVID-19 pandemic, and ongoing conflicts around the world, food systems and the diets they produce are facing increasing fragility. The world is also facing significant risks as well as potential positive and negative disruptions. The use of AI, the changing world order and the political economy of nations, future pandemics, and sclerotic global cooperation could impact food systems dynamics in varying ways. The role, control, and expansion of corporations, particularly transnational companies, on the environment, climate, and largely adverse agriculture, food and beverage production is a force that is yet to be tamed or effectively governed.

Human-induced climate change also alters weather patterns and increases the risk of extreme events, causing widespread harmful impacts, losses, and damages to both human society and nature. While climate variability and extreme weather events have been a historical constant and more extreme in some places than others, the unpredictability, frequency, and severity of these events have significantly increased, causing threatening and devastating effects on human food security as well as negative nutrition and health outcomes that we are now only beginning to understand. We are also dealing with compounded events—multiple risks and hazards that can be temporally, spatially, and concurrently. They can also be non-linear, interacting, and cascading, influencing many forms of vulnerability, adaptation, and potential migration, and have devastating impacts on food systems.

In a turbulent, hot planet, threats to the resilience and sustainability of food systems could make it even more complicated to nourish a projected population of 9.7 billion by 2050. This is especially the case in some low- and middle-income countries. For example, in nearly all countries in sub-Saharan Africa, over 50 percent of the population cannot afford a healthy diet. Climate change has adverse impacts across food systems, with more frequent and intense extreme weather events that profoundly affect production, storage, and transport, potentially imperiling the global population's ability to access and afford healthy diets. In addition, changes in climate means and extremes in all parts of the world are affecting the suitability and sustainability of many cropping systems as well as adversely impacting the health of many communities.

At the same time, how food is grown, processed, packaged, and transported has deleterious and far-reaching impacts on the environment and finite natural resources, further accelerating climate change, tropical deforestation, and biodiversity loss. The demand growth for certain types of food and diets will contribute further to detrimental human and planetary health impacts. Food insecurity and malnutrition remain stubbornly high, and every country suffers from at least one form of malnutrition – including undernutrition, micronutrient deficiencies, overweight/obesity, and diet-related noncommunicable diseases, with marginalized groups being disproportionately impacted. Food systems are the lifeline between climate change, environmental sustainability, optimal diets, and nutrition outcomes (**Figure 1**).

Figure 1. Food systems are the lifeline between climate and nutrition



No single country in the world has a monopoly on food systems successes or failures. The challenges differ by context and point to the complexities of food systems, particularly in the face of the climate crisis. There are ample gaps that require a concerted effort to realize a resilient, equitable global food system. At the same time, a wealth of food systems policies and solutions are available to ensure environmental sustainability, climate mitigation and adaptation, fair and decent livelihoods, food security, and better nutrition for all, leaving no one behind. However, many of these solutions are under-resourced and have yet to be scaled. In addition, other challenges create barriers to progress, such as political will or the need to design an appropriate solution for a particular context.

Through our efforts across research, policy, and education, the F4Hi at the Columbia Climate School will address these grand global challenges and advance this agenda over the next five years to ensure food equity, healthy ecosystems, and adaptive capacity to climate variability and change.

Our Shared Vision and Values

We envision a positive and just transformation of food systems that supports the adaptive capacity to climate variability and change, reduces greenhouse gas emissions, promotes environmental sustainability, provides reliable livelihoods, and ensures access to healthy diets for better nutrition and health for everyone.

Our vision rests on a notion of resilient food and agricultural systems that optimize nutritional value, climate change adaptation and mitigation, individual and rural community well-being, agricultural yields, and ecological services. We recognize that many food systems workers are vulnerable and disadvantaged. Any vision of resilient food systems must emphasize support to these and other marginalized communities. Finally, given the diversity of challenges, it is important to recognize that approaches to supporting resilient food systems must be heterogeneous and allow for different needs and strategies, even within the same community.

Our vision is supported by a set of research, policy, and education goals about what we want and how we work. Specifically, we aim to:

- Investigate and analyze how food systems can transition toward equitable, sustainable pathways and assess trade-offs between human health, climate, ecosystems, poverty, rural economies, and labor conditions.
- Co-design and co-develop solution pathways for policymakers, communities, and other key partners toward environmentally sustainable, equitable, and nutritious food systems at local to global scales, prioritizing the most vulnerable and marginalized to ensure they can adapt to the impact a changing climate will have on ecosystems.
- Educate students, professionals, and the public about the complexities of the global food system as well as prepare and support careers in the sector and the next generation of food systems leaders and change agents.

We will also underpin this vision with a **core set of values**. These include:

- ***Promoting diversity, equity, inclusion, anti-bias, anti-racism, accessibility, and justice***: We value and support diverse groups of individuals, including people of different races, ethnicities, religions, abilities, genders, and sexual orientations in our collective work. We will prioritize diversity, equity inclusion, anti-bias, anti-racism, accessibility, and justice in implementing projects and partnerships, supporting local ownership and leadership, promoting diversity and inclusiveness in our activities, and amplifying local voices.

- ***Mainstreaming climate justice***: We commit to advancing transformative climate justice in our research, capacity development, and programmatic work by instituting climate and food justice as a cross-cutting theme. This will mean developing new modes of strategic and fair relationships and partnerships with both academic and non-academic partners at multiple scales to expand beyond traditional siloed academic collaborations. This also means cultivating and deepening existing community partnerships and establishing new collaborations to co-produce climate and food justice knowledge. Additionally, we strive to expand international, global research partnerships, particularly among interdisciplinary teams in developed and low- and middle-income countries, and grow intergenerational research, such as early career and graduate training opportunities in food systems and policy.

- ***Prioritizing marginalized and vulnerable populations***: We will prioritize food systems research to benefit those most vulnerable, marginalized, and disadvantaged to the impacts of climate change and extreme climate events, particularly food systems workers. For those who are food insecure and malnourished, that often means women, young children, those impacted by conflicts, migration, and displacement, and those suffering from extreme poverty.

- ***Engaging with local communities and partners to mobilize action on food systems***: We will seek collaborations that connect with local communities impacted by food systems challenges and catalyze the co-development of capacities, approaches, information, and products that address their contextual needs. We will be inclusive of Indigenous solutions that can improve food security and resilience. By co-convening, co-generating, and co-leveraging knowledge and research with partners, we can work toward joint innovation and implementation. This will be complemented by capacity-strengthening efforts, undertaken through the F4Hi, for research and education users to apply results to achieve outcomes and impact.

- ***Ensuring due diligence on funding sources and ethics***: We will perform donor risk assessments and donor due diligence under the guidance of Columbia University and the Columbia Climate School. We will aim to not accept funding from the private sector/industry/companies that have a reputation of historical and present transgressions on the environment, food security, public health spheres, etc., that disproportionately impact marginalized populations, or that support “business as usual” climate strategies with no aims to mitigate.

Our Unique Niche

Situated within the **Columbia Climate School**, the first academic institution in the United States solely devoted to addressing the climate crisis, the F4Hi aims to tackle this complex problem from an interdisciplinary perspective. As one of the flagship Action Collaboratives of the Climate School, the F4Hi will leverage multiple areas of existing expertise: climate, environment, agriculture, health, and nutrition, which comprise some of the most significant sectors of the food system. Viewing climate as a cross-cutting theme also creates a space for cross-fertilization over our diverse network of expertise. The Climate School hosts the F4Hi as a service for the university as a whole, bringing together the food systems expertise from across campus. The Columbia Climate School curates this collaboration, with all schools invited to participate and contribute to defining the scope and direction of our work. We serve as the primary platform within the University to amplify the expertise of our members in the food systems sphere. We have also established strong partnerships with other universities and are poised to work toward forming a university consortium.

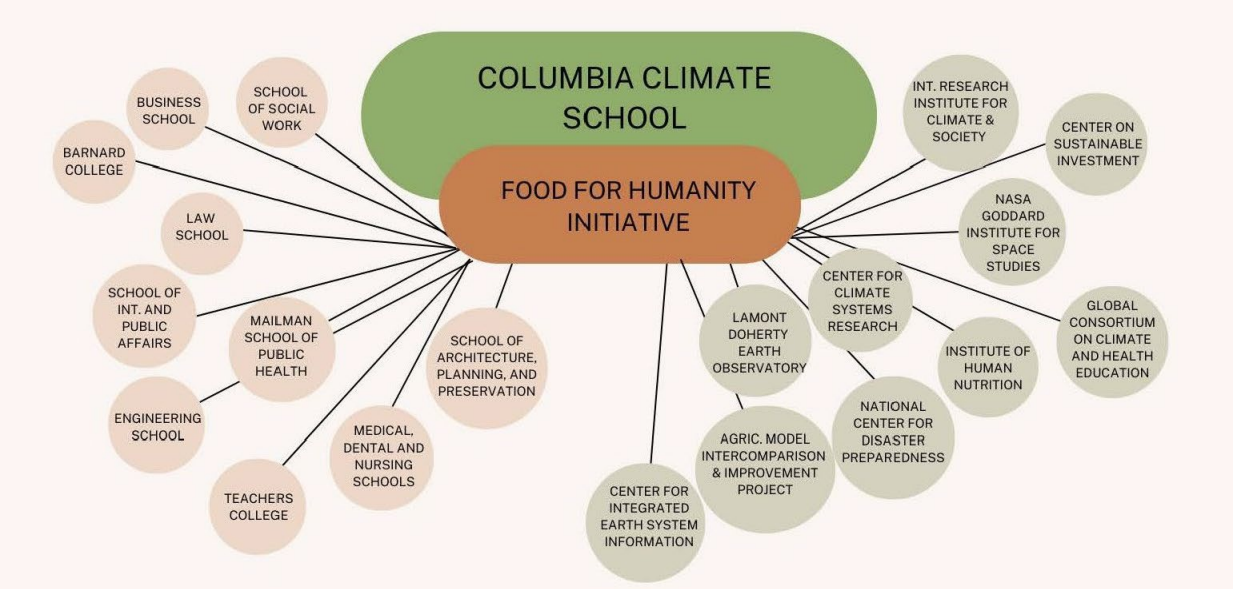
The F4Hi is a **collaborative network** for everyone at Columbia University working on food-related research, teaching, policy, and programming. The F4Hi network—composed of instructional and research faculty, staff, and students—encompasses a range of expertise and talent that allows for collective action toward solving large-scale, interconnected food systems challenges. While many involved in the F4Hi have their own research interests, the power of synthesis and collaboration allows for impactful contributions to address the challenges related to food systems and climate change. Many of our affiliated experts are involved in multi-partner programs and initiatives, bringing these broader communities into the F4Hi.

Collaboration is the cornerstone of our approach. We leverage multidisciplinary resources across Columbia University's schools, departments, and centers to **bring together a diverse set of experts, practitioners, and researchers**. Our Initiative draws on strengths from the Columbia Climate School, the Lamont Doherty Earth Observatory, the Mailman School of Public Health, the School of International and Public Affairs (SIPA), the Engineering School, Teachers College, the Law School, the Business School, NASA Goddard Institute for Space Studies (GISS, home of the Agricultural Model Intercomparison and Improvement Project (AgMIP)), and other centers and institutions at the university (**Figure 2**). We look beyond only agriculture to the many complex pieces of the food system, providing extraordinary opportunities for collaboration.

New York City, our home, has a unique role in global policy, with the strong presence of the United Nations and business and finance providing our researchers the opportunity to engage directly in the political process of food governance and international development. It is also a diverse urban landscape, allowing us to address many of the complexities that challenge food systems in the context of a changing climate—impacts of weather shocks, access to healthy diets across many communities, including migrants and marginalized populations, and the intricacies of food systems connections between rural and urban environments. New York City offers us an opportunity not only as a living laboratory for research and other opportunities to engage in these cross-cutting issues but also because the city prioritizes food policy. In addition, we can build on and further develop the deep and diverse connections with local communities among our network that allow for enriching education and research experiences.

Because of our positioning within one of the country's top universities, **our students** help provide a dynamic and innovative engine for our activities. Columbia University has some of the best and brightest young people from around the world, who come to campus to learn and engage. We rely on students' geographical and intellectual diversity across campus, drawing from the many different schools within Columbia University. Students engage with the F4Hi in many ways—in the classroom, through student projects, and as participants and volunteers at our events. We have a responsibility to promote a symbiotic relationship in which we, in turn, make opportunities available to them.

Figure 2. Columbia University's Food and Climate Ecosystem



Legend: the circles on the left are schools at Columbia University; the circles on the right are centers/institutions at Columbia University

Our **engagement extends to both policy and practice**. Our core team, along with our network of experts, contributes to several global initiatives that support climate-resilient food systems, such as the EAT-Lancet Commission, the Intergovernmental Panel on Climate Change (IPCC), the World Food Programme (WFP), the Food and Agriculture Organization (FAO), the World Bank, the United Nations Development Programme (UNDP), regional development banks, the CGIAR Centers and Programs, the Food Systems Countdown Initiative, and the Food Systems Dashboard. We actively participate in global policy fora, such as the Conference of Parties (COP), the United Nations Food Systems processes, and the Scaling Up Nutrition (SUN) Movement. We are also committed to strengthening and expanding our collaborations beyond the University, partnering with organizations at the local level, including the Mayor's Office of Food Policy, and nationally to reach national-level decision-making processes and local communities touched by issues of food systems inefficiencies.

Our Collective Goals and Activities

The F4Hi is a long-term effort to provide novel, multidisciplinary research that informs policy and practice, educates the next generation of food systems leaders, builds resilient food systems, and supports food security for the most vulnerable populations. Our work touches on the complexities of the food system, with activities around health, agriculture, the environment, equity, and justice. Cross-cutting activities in research, policy engagement, and education and training support our three goals. We will also rally around four cross-cutting flagship areas—food systems and climate data network, protein futures, opportunity crops, and sustainable city food systems (**Figure 3**).

Figure 3. F4Hi goals and flagship areas

Goal 1: Analyze food systems transitions

Investigate and analyze how food systems can transition toward equitable, sustainable pathways and assess trade-offs between human health, climate, ecosystems, poverty, rural economies, and labor conditions.

We will provide the scientific underpinnings for progress toward food systems that deliver healthy diets that can nourish people now and help maintain their health into the future, while supporting vibrant rural economies. Our work will also investigate adaptation approaches to better equip food systems against stress and climatic uncertainty. We will articulate and highlight inequities in food systems regarding disparities in access to and quality of food (particularly for women and other marginalized and disadvantaged populations) and the management of diet-related health problems, as well as inequities generated in the production system, and what can be done to address those inequities.

We will identify spaces for collaborative research, including unexplored territory—such as areas of food systems research that have not been extensively studied yet; interdisciplinary opportunities—such as spaces where different disciplines (e.g., climate science, public health, and agriculture) could intersect in novel ways; untapped potential—including areas where the group's combined expertise could lead to significant breakthroughs or innovations; and niche areas—such as specific topics or approaches that other research groups or institutions are not addressing.

Proposed activities supporting Goal 1:

- Establish local food "laboratories" for food systems field research with faculty, scholars, and students.
- Provide evaluation services to community and regional food-related projects looking to understand their work's impact.
- Lead a cross-university research consortium that engages universities with strong food systems schools, degrees, centers, and institutions to identify and develop large-scale research initiatives.
- Host research retreats to brainstorm ideas based on topics or funding mechanisms, leveraging each school’s and individual’s expertise in different types of proposals.

Goal 2: Co-design solution pathways

Co-design and co-develop solution pathways for policymakers, communities, and other partners toward climate-resilient, equitable, and nutritious food systems at local to global scales, prioritizing the most vulnerable and marginalized.

Our work will develop evidence-based solutions to support developing, designing, and delivering climate-resilient food systems policies, management strategies, and investments across interlocking scales in low-, middle-income, and high-income countries and cities. We specialize in climate and food evidence, data systems, and tools to help policymakers make better-informed decisions on where to act and intervene across food systems, what risks come with investments in certain areas, and what investments should be prioritized. We also work to ensure the research and advisory work we do aligns with investment law, practice, and policy.

Our activities will also focus on food sector workers, from farmers and migrant farm workers to meat packers and retail workers, many of whom are marginalized and/or people of color. We will focus on demonstrating, through research and policy influence and working with the necessary policy, political, regulatory, and legal entities, the importance of living wages and safe, fair, and healthy working conditions in a changing climate.

Proposed activities supporting Goal 2:

- Host interactive and dynamic opportunities to support engagement and collaboration, such as an annual global forum on food systems and climate during NYC Climate Week.
- Provide guidance and expertise to governments seeking advice on food systems related topics.
- Establish Hudson Valley farm and urban food partnerships and engage with community organizers focusing on local food justice projects.
- Organize an annual limited series F4Hi podcast, grand round lectures, and seminar series to bring science to the broader Columbia University community and/or the public.

Goal 3: Guide and educate leadership

Educate students, professionals, and the public about the complexities of the food system, as well as prepare and support careers in the sector and the next generation of food system leaders and change agents.

Supporting transformative change in food systems requires a solid foundation in numerous areas, such as nutrition, health, and the environment, as well as climate basics and skills, such as communication, quantitative and qualitative analysis, modeling, and the design of legal and policy frameworks. In addition, education must look beyond the classroom to experiential education, internships, and practicums.

The educational programs at the Columbia Climate School are designed to train a workforce in co-design and co-development pedagogy and to support change agents. These change agents—from the public sector, private sector, civil society, and academic institutions—will develop and implement actions to mitigate and adapt to climate change and other sustainability challenges. The F4Hi will leverage its multidisciplinary expertise and broad networks to support the development of a range of education offerings and specialties.

Proposed activities supporting Goal 3:

- Develop and roll out a Food and Climate Certificate for the Columbia Climate School Master of Climate (MS) program.
- Construct collaborative and innovative courses that engage multiple faculty and respond to emerging needs and interests of students, the private sector, and policymakers.
- Design experiential learning opportunities for students.
- Support and share joint postdoctoral fellowships among faculty working in food systems.
- Develop a mechanism to connect students interested in food projects across the university.
- Improve training opportunities for students across a range of international to local institutions engaged in research, development practice, and policy “think and do” tanks.

The Scales and Mechanisms in How We Collaborate

We work at multiple spatial scales to provide evidence, tools, and products.

- At the **global level**, our activities build resilient pathways to reduce food systems stress and shocks through research and policy work on international trade, food access barriers, and better food and climate systems science. For example, the Food Systems Countdown Initiative is an excellent mechanism to bring together experts working on food and climate data to track and monitor food systems performance and accountability.

- At **regional and national levels**, the Initiative's work supports the development of innovative pathways for healthy diets and sustainable food systems through our exploration of topics including alternative proteins, opportunity crops, and research at the intersection of climate services and nutrition. For example, building evidence for and scaling up production of Indigenous minor millet in India has promise for promoting climate and nutrition resilience.

- At the **local level**, research on food systems sustainability in cities and the food-exchange relationship between rural/hinterland areas and cities is a priority. Relevant activities include work on potential structural shocks to hyper-local food distribution and access points as well as the impacts of changing climate trends on food justice issues among marginalized and food-insecure populations living in cities. For example, a partnership between the Stone Barns Center for Food and Agriculture and the F4Hi is investigating the impacts of climate-resilient agroecosystems and food safety net programs in local New York communities.

Cross-Cutting Flagship Areas

This strategy will allow Columbia faculty, researchers, staff, and students to work on a set of cross-cutting areas related to food systems transformation. These thematic areas support and work across our three goals and draw from our multidisciplinary expertise, unique niche, and comparative advantage. They provide opportunities for researchers, students, and practitioners to engage in efforts to support food systems transformation. The thematic areas are further described below with no particular prioritization.

Food systems and climate data network

The disconnects between efforts to improve climate mitigation/adaptation and food security are pervasive. A key enabler of those disconnects is fragmented climate and food data as well as a lack of integration of climate services into food systems decision-making at regional, national, and subnational levels. Different geographies and components within food systems shape the need and potential for different climate actions, thus the need for data and evidence defragmentation. Otherwise, governments, businesses, and development partners are unaware of how their food systems are performing and what areas are challenged or need investment. As such, food systems risks and potential solutions may go unidentified.

Improving access to and understanding of food and climate data and evidence can reveal emerging food systems shocks and potential solutions that can promote sustainability over time. Integrating diverse data could provide a better understanding of the links between farmers and markets and producers and consumers, as well as critical topics such as post-harvest management, healthy diets, and social protection. There is a need to improve and augment food systems data and integrate climate science and information with these data. There is also a need for more granular, real-time, and disaggregated data to ensure that decision-makers understand food systems vulnerabilities and who is disproportionately impacted by shocks. Crowd-sourced data or citizen-science data points can contribute in this regard.

This work will also advance the state of food systems measurement and the evidence of how climate variability and change continually impact food systems. Many types of empirical methods, data, and models are used to understand how long-term climate change and extreme weather events will affect food security, diets, and nutrition outcomes. While bringing together vastly different types of data, variables, statistical methods, and models to understand the relationship between climate and food security, diets, and nutritional outcomes is complex, there is a need to improve the quality, validity, interpretations, and assumptions of associations, causalities, and impacts.

The role of AI and other advanced methods and models is increasingly crucial as these tools are seen as massive disruptors that will continue to impact society. While there are social and ethical concerns of privacy and security, social manipulation, misinformation, discrimination and bias, and job displacement, there are opportunities to change how we understand, measure, and intervene across food systems using these tools. There is a need to develop a new generation of food systems indicators that can capture the complexities of interactions. This will include AI and other methods, but also the integration of diverse datasets, satellite imagery, climate data, health and economic indicators, and more.

This flagship area will develop global guidance and better data tools, metrics, indicators, and models to unpack some of the most complex food systems science issues and ensure decision-makers are aware of how food systems are performing, potential near- and long-term risks, and where to intervene. These advanced and enhanced approaches to data and evidence will also support the investigation of critical questions, such as the impact of mean climate and its variability on food and agriculture. Under this flagship, we will convene a location for activities, provide cross-disciplinary training on data usage, and translate data to ensure they are useful, interpretable, and interoperable for policymakers and other data users who need to make real-time decisions on food systems in the context of climate variability and change.

Protein futures

The consumption and production of livestock is an area that cuts across food and climate challenges. A new generation of alternative proteins is being developed as a more environmentally friendly alternative to traditional animal agriculture, by helping to reduce water, feed, and land resource consumption and greenhouse gas emissions. Such efforts also serve as an essential source of protein and other nutrients critical for a growing population. Through a better shared understanding of the potential political, ethical, and social opportunities, trade-offs, and challenges of these alternatives, they have the potential to revolutionize food systems by addressing pressing issues such as sustainability, food security, and animal welfare.

As the planet warms, alternative proteins—which include cultivated, plant-based, and fermentation-derived proteins—are being considered as a solution to the multiple adverse effects of raising and consuming animal-sourced proteins on human and planetary health. Yet the consequences of a shift to alternative proteins and the necessary evidence, frameworks, policies, and regulations required for this shift are mainly unknown. Finding consensus on these political, cultural, and ethical issues will be essential for the widespread acceptance and successful integration of alternative proteins into global food systems.

Alongside the development of alternative proteins, animal protein consumption will likely increase, especially in some low- and middle-income countries where livestock production systems are critical for economies and livelihoods. In addition, research in countries such as the United States can support sustainable livestock production, such as comparing the sustainability of industrial systems vs. pasture-based systems and livestock production in natural grasslands. These are critical issues for a range of geographic areas, including the Catskills region in New York, where many areas are not suitable for row crop production.

In this Flagship, we will convene a transdisciplinary group of experts to explore the complexities of this approach to food systems. Experts will deliberate on the political, social, ethical, equity (distributional), and economic (trade-off) issues that alternative proteins pose and will develop potential solutions to overcome hurdles and undesirable compromises.

Sustainable city food systems

Food insecurity remains stubbornly high, and unhealthy diets are prevalent in many places around the world and are particularly acute in some communities in New York City. Urban agriculture can play an important role in city food systems. While revitalizing a regional food production system for New York City could potentially reduce some vulnerabilities by shortening supply chains and relying on more localized sources, it is important to note that a considerable reliance on non-local sources will still be necessary to ensure a diverse and resilient food supply for New York City. Climate change impacts and extreme weather events can also affect regional production.

This flagship area will provide evidence to build a more sustainable and resilient food system in the New York City region and better connect producers to consumers through multiple hubs. Such research will help restore local food systems where they make economic and political sense and support outcomes that improve food access, equity, and local nutritional outcomes while strengthening regional food systems. Prioritizing the resilience of the food system and better health outcomes for the region is crucial. This also means analyzing and addressing the impacts of changing climate trends on food justice issues among migrant, marginalized, and food-insecure populations living in New York City, such as food access barriers under different shock scenarios and potential consequences of food security programming to improve access. School, urban and rooftop green gardens, migrant food hubs and foodscapes, and rural-urban food causeways will all be potential solutions on the table. Moreover, these activities can provide solutions for the New York City area and be examples for other urban areas grappling with the same challenges. Building links between major urban areas around food systems issues could be a powerful contribution of the F4Hi.

Harnessing opportunity crops for climate and nutrition resilience

Over the past century, humans have driven massive declines in genetic crop diversity and decreased quality in managing agriculture systems and landscapes. Currently, 15 crops grown and consumed meet 90 percent of the world's caloric demands, and only three staple crops—rice, maize, and wheat—account for 50 percent of global food energy intake. While these crops have an invaluable role in reducing stark hunger, this lack of agricultural diversity also has consequences on global biodiversity, the natural environment, dietary diversity, nutrition outcomes, as well as climate adaptation.

As climate uncertainty and extremes adversely affect widely grown crop commodities, several traditional opportunity crops (TOCs) may play an essential role in food security, diverse diets, and climate adaptation and resilience. Such crops may also benefit the livelihoods of many smallholder farmers who historically understand their agronomy and use. However, the traditional knowledge, understanding, and conservation of TOCs need to be revised. There remain critical questions and research gaps on whether TOCs can help smallholder farmers better adapt in the context of a changing climate. Questions concerning the climate resilience of TOCs, their associated management and acceptance by small-scale farmers, and potential market opportunities, remain to be determined. A deeper understanding of agroecological management options for these crops is critical to fully unlock their value within local farming systems.

This flagship research will build on several projects, including the agroecology projects implemented by partners, such as the CGIAR Initiative on Agroecology and the Vision of Adapted Crops and Soils (VACS) project. By utilizing a transdisciplinary research and place-based implementation approach to TOCs, we will work to understand better if and how TOCs can be a vital tool to ensure climate and nutrition resilience among empowered communities as well as the implications of a shift toward traditional crops and challenges to making a long-term transition toward their adoption. This approach will also provide evidence of how traditional and indigenous knowledge and nature-based solutions can help transform food systems.

Demonstrating Impact and Communicating Our Work

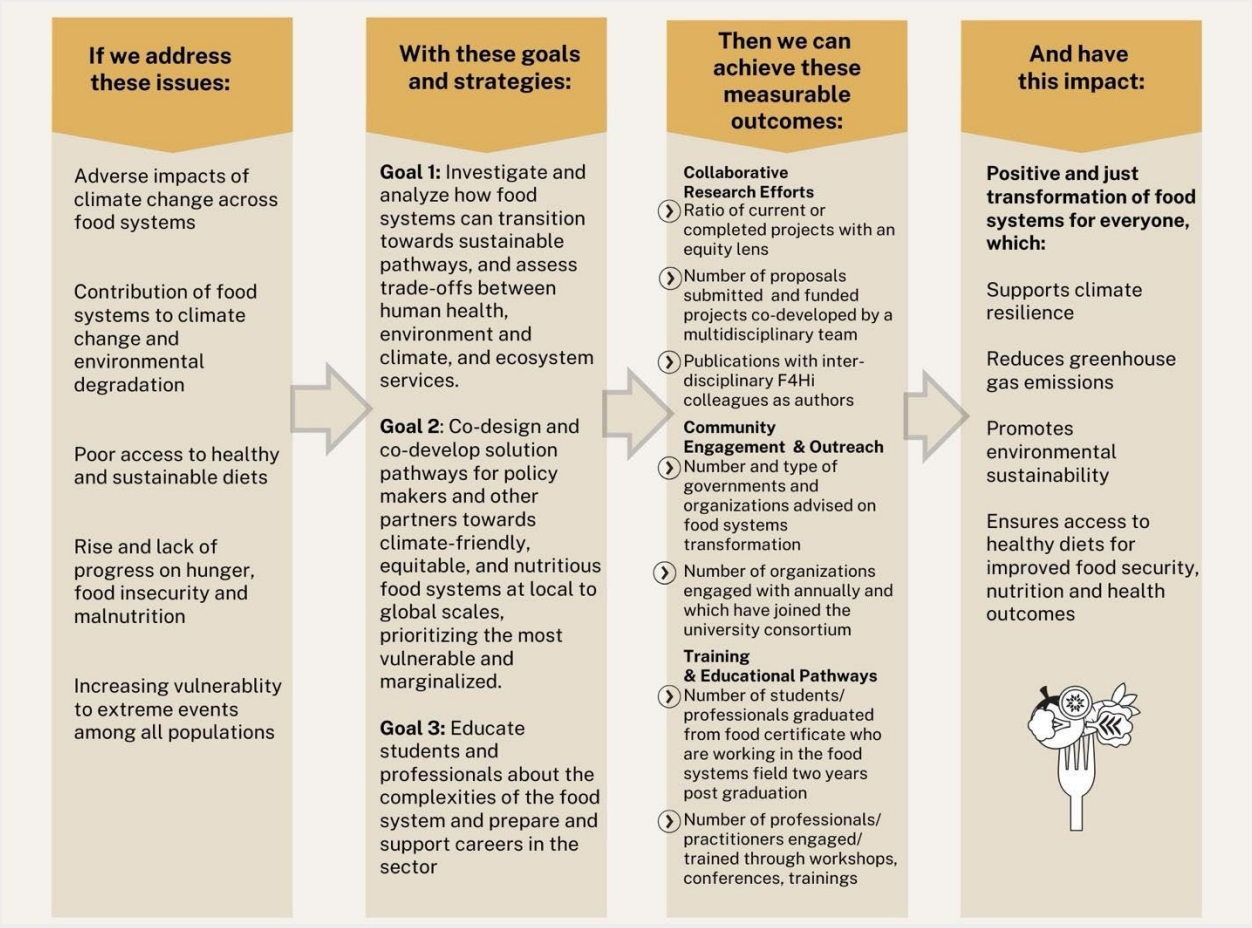
The F4Hi must measure and demonstrate its impact across its goals and activities and through its flagships. To do this, over the course of the first year of this strategy, we will monitor metrics to track our goals and values set out in the strategy and theory of change. We hope that the F4Hi will:

Address the economic, political, and social challenges and trade-offs that food systems face and co-generate—in the context of climate change—novel, multidisciplinary research that informs policy and practice and builds the next generation of food systems leaders so that food systems are resilient and the most vulnerable and marginalized populations are more food secure.

We will track our impact through the theory of change, as shown in **Figure 4**, at the midpoint of the strategy. To ensure our work is communicated, the F4Hi will participate in important news stories, publications, and outputs through our website, social media, the Climate School's media outlets, and the communication outlets of strategic partners. We will also plan events to create more visibility and draw attention to key issues we engage with and contribute to via Climate Weeks, COP climate conferences, Earth Day events, etc. Lastly, we will publish scientific literature and develop a series of short publications about key policy moments. There are various mechanisms for collaboration across the F4Hi:

- **Research collaborations**: Joint proposal development, multidisciplinary approaches, collaboration, publications;
- **Outreach and events**: Annual Climate Week event(s) on food, brown bag seminar series;
- **Educational and learning opportunities**: Field visits, internships, fellowships, capstone projects, courses;
- **Communications**: Podcasts, policy briefs, data tools, media interactions.

Figure 4. F4Hi goals and flagship areas



Conclusion

The F4Hi strategy will develop feasible food systems actions and solutions to address the climate crisis across multiple social and technological dimensions. We will do this by moving beyond traditional academic structures and engaging multidisciplinary teams of experts from within the Columbia Climate School and the broader Columbia University community to effect lasting change in New York City, the United States, and worldwide. In addition, we will engage with external partners to develop knowledge-based, realistic approaches to pressing climate and food systems sustainability challenges at multiple regional scales.