the Pontifical Academy of Sciences

# Final Statement of the Science and Innovations for a Sustainable Food System

## Workshop of the Scientific Group for the UN Food Systems Summit and the Pontifical Academy of Sciences (PAS)


### Transforming Food Systems

1. To contribute to the preparations for the UN Food Systems Summit 2021 and to the achievement of the Sustainable Development Goals (SDGs) by 2030, the Scientific Group for the UN Food Systems Summit and the Pontifical Academy of Sciences (PAS) Vatican City came together to **review options for science opportunities, evidence-based actions and innovations that can facilitate transformation toward more healthy, more sustainable, more equitable, and more resilient food systems**.

2. Food systems at the global level and in many countries and regions currently fail to end hunger or provide healthy diets, good nutrition, and food safety. Currently 690 million people are chronically malnourished, and two billion people are overweight or obese – these numbers have been high and/or are growing for a number of years now, and with COVID-19 disproportionately impacting poor and food-insecure populations, they are continuing to rise. Many food systems are based on production and distribution systems that are not sustainable. Poverty and inequalities between and within countries are widespread in agriculture and food systems. Climate change and environmental degradation are partly caused by and impact on the food system and people. The fundamental human rights, including the right to food, the right to health, the right to education, the right to decent jobs, and the right to safe water and sanitation are often violated. We view **the Food**

**Systems Summit as the opportunity** to address these problems. The aim of the Food Systems Summit is to help Member States and stakeholders maximize the co-benefits of a food systems approach across the entire 2030 SDG Agenda and address the challenges of climate change and biodiversity loss.

3. We stress that **science, innovation and technologies** play critical roles among the measures to achieve food systems transformations. **All sciences** – natural sciences and social sciences, basic and applied – can and must make significant contributions for the needed food systems transformations and fill related knowledge gaps. We highlight the **role of basic science**, not only technology, for food systems enhancement. For instance, network theory has recently played a central role for creating models to make decisions in dynamic complex systems, incl. biological systems, e.g. for problems such as protein folding and dynamics and in gene networks involved in decision making in bacterial colonies and cancer. These new approaches have been successful with the advent of large quantities of data, new theoretical approaches in statistical mechanics and advances in machine learning. We underscore the value of the **great diversity of food systems** at national and local levels, including food systems of indigenous people, including in forests and other natural environments, and their related knowledge. We reviewed the diverse propositions for science and innovations in world hemispheres provided by academies of sciences and identified entry points to address challenges and trade-offs as well as potential synergies with science and innovations.

4. **Science and scientific advances are not without challenges**. These include concerns that science is not being used, or not being used sufficiently or effectively, to overcome hunger, nutritional deficiencies, unhealthy diets and obesity. There are concerns that scientific advances are bypassing or excluding the needs of poor and vulnerable populations. Another important concern pertains to limitations of narrowly focussed research not capturing externalities, for instance multiple adverse environmental effects of consumption patterns such as excessive meat consumption and food wastage that can lead to high water and land use and to biodiversity loss in different contexts. There are related concerns about trade-offs between affordability and availability of healthy foods. And there are growing concerns about antimicrobial resistance linked to food safety. We considered related current complexities at the workshop, as well as very long-term concerns about humanity in food systems' and biodiversity contexts.

## Agenda for the Food Systems Summit from a Science and Innovation Perspective

5. **Science and innovation are essential** to accelerate the transformation to more desirable food systems. We emphasize the overall food value chains, including for instance the conservation and breeding of seeds and other inputs before farm-based production, the processors, markets, and finally the consumers. Precision and input use efficiency throughout the value chain needs to be enhanced, and policies adopted that will improve the overall systems performance. A better food system is more efficient and sustainable, protecting its most vulnerable members. Thus,

investments in science- and technology-based innovations must be **accompanied by institutional and policy innovations and societal dialogues** to enable full inclusion of poor and marginalized populations, including smallholder communities, in the process of and to benefit from food systems transformation. We focused on important science- and technology-based innovations and policies and institutional innovations to catalyze and support food systems transformation to achieve the Food Systems Summit goals, based on the SDGs and SDG2 in particular.

6. **Bio-Science innovations** to develop new technologies and tools hold great promise: applying advanced breeding to orphan crops, genetic engineering, genome editing, microbiome research for soil, plant, animal and human health, plant nutrition, animal production and health, alternative protein and essential micronutrient sources (including vegetable protein sources and improved micronutrient retention and bioavailability), cell factories, re-carbonization of the terrestrial biosphere, and restoring soil health and functionality, improving resource efficiency of cropping systems. Individually and in combination these have great potential to meet a number of food system challenges. It will be important to adapt these technologies to local conditions, make them accessible and affordable to farmers especially small holders. Some of these innovations benefit from co-design between researchers and users. Open information sharing is needed to ensure that users are aware of the opportunities, costs and benefits of new technology and use better the scientific evidence already available.

7. Advances in **digital innovations and engineering** – e.g. artificial intelligence, big data analysis, remote sensing, wifi connectivity, robotics, digitization, mechanization, sub-surface drip fertigation with conservation agriculture, precision agriculture, smart farming, vertical farming, indoor farming, digitized food processing – hold much promise to make food systems more sustainable, reduce food waste and losses and improve hygiene. Attention to employment effects and a sharper focus on the poorest is called for, as well as attention to ethical considerations. Yet, many of these opportunities will only materialize for the poor when rural areas are getting access to internet and low cost telephony. Currently rural women in particular are implicitly excluded from these opportunities in many contexts.

8. **Social sciences and policy research,** incl. economics and legal studies, provide critical inputs for positive food systems innovations and transformations, and help adjust innovations to contexts. Social science and policy research is central for designing social safety nets and insurance mechanisms for resilience. Innovations come for instance from behavioral socio-economics research, collective actions research, socio-economic lab-based and field experiments, landscape research, participatory approaches; employing micro- and macro data and remote sensing with artificial intelligence; innovative modelling of whole systems, combining food systems with climate / energy / water systems, and with ecology and health and nutrition modelling. To assess current and potential policy framework conditions that are conducive for food system design and their functioning in different contexts is supported by research into political and governance systems, including fiscal and finance systems, and governance at global, national and at decentralized

levels, and opportunities for rights-based approaches.

9. **Climate change is the defining issue of our time**. Agriculture, including forestry, and related land use change are part of the problem but must also be part of the solution. Agriculture and related land use change are the single largest driver of multiple environmental pressures, and large contributors to greenhouse gas emissions and air pollution. Boosting nature-positive production calls for complex measures that transform farm input use, agronomy, plant production and livestock systems; enable protection and use of biodiversity through biophysical and ecological practices; facilitate protecting the agriculture- and forest-related genetic base; and develop science- and technology-based innovations for food systems related environments, i.e. for cleaner and greener energy. Moving quickly toward climate-neutral, climate-positive and climate-resilient food systems should employ carbon pricing and technologies and have a sustainable circular bioeconomy as its concrete vision.

10. The sustainable food system must be based on **sustainable land, water and forest uses and protection of ecosystems**. One-third of global land area is degraded. Increasing the area of cultivated land or moving cultivation onto new land is not an option, but locally adapted sustainable intensification of existing agricultural systems is needed. Most fertile land is already cultivated. **Soil** degradation is being exacerbated by climate change along with land misuse and soil mismanagement. **Water** is becoming an increasingly scarce and polluted resource and ecosystems services are being undermined. Science-based innovations are needed to keep – and where needed regenerate – productive and healthy soils, land and water. **Forests** and tree-based agricultural systems today contribute directly and indirectly to the livelihoods of an estimated one billion people globally. Innovations in agroforestry with trees and bushes can contribute to large-scale productive land use combined with ecological and climate positive ecosystems services. Wild foods (e.g. berries and fruits) are important for food security and nutrition both for smallholder farmers and indigenous peoples. Food systems concepts need to integrate the forest systems. Science-based innovations for **sustainable "blue foods"** that protect and harness oceans and coastal areas can play a growing role in ending malnutrition and in building healthy, nature-positive and resilient food systems. Innovations must support the nutritional diversity of "blue foods", reduce waste, address environmental change and management failures, and capitalize on opportunities to sequester carbon in the marine environment. The knowledge and innovation potentials of small-scale actors in the "blue foods" systems need to be recognized and supported.

11. Currently more than 3 billion people cannot afford **healthy diets**, and more than 1.5 billion people cannot even afford a diet that only meets required levels of essential nutrients. Policy innovations are needed to incentivize availability and affordability of nutritious foods that form the basis of healthy diets, to repurpose subsidies toward related supportive investments, to **ensure food prices reflect true costs**. We need economic development in food and other systems to be based on an inclusive measure of wealth that includes natural assets. Non-price instruments, including regulatory-based instruments, can help to deal with externalities associated with pricing

of food. Furthermore, measures that foster behavioral change towards healthy diets, and institutional and technical innovations for increasing income of smallholders should be considered to comprehensively address these complex challenges.

12. Among the most effective ways to sustainably eradicate poverty and inequality is to boost the **capacities, skills and job opportunities** of those contributing to food systems and living in situations of vulnerability. This calls for redistributing resources more equitably, expanding access to natural resources and economic assets, and reducing discrimination. Pro-poor targeted asset building investments and programs, including for non-land assets, offer particular promise. Policy innovations to overcome inefficient and unfair land, credit, trade, and labor arrangements are often essential, but must be evidence-based. Central here is the need for institutional and policy innovations that boost education and skills and facilitate inclusion of and empowerment and rights of **women and youth.**

13. As food systems become more global, dynamic, and complex, they are also becoming more vulnerable to new, challenging, and systemic risks, as evidenced by the ongoing COVID-19 pandemic, in addition to many other ongoing challenges including conflicts. Successful navigation and management of risks and crises call for **policy innovations to de-risk food systems** with novel insurance products and early warning mechanisms, and to design and expand innovative and efficient social protection programs and a variety of nutrition programs including school feeding programs. Rigorous implementation science is needed to strengthen the fit-to-context design and delivery of such programs.

14. The **COVID-19 pandemic** is teaching us that policy responses are often too slow, challenging us to use the evidence base faster and to implement decisions faster. We remain deeply concerned that COVID-19 related food security problems will become much more serious if comprehensive policy responses are not implemented in a more timely and evidence-based manner.

15. Institutional innovations to finance the food systems transformations, including mobilization of **innovative financing and possibly a dedicated fund for hunger reduction**, are needed. To tap the potentials of science, public funding of food systems science and related **research partnerships** need to expand. Nations need to revisit their low levels of spending on food systems-related research and innovation. We are calling for governments to review the level of their science investments in agriculture and food systems and allocate at least **1% of their agricultural GDP to food systems science** and innovation, while also accelerating investment in basic science that is becoming more and more relevant for food systems.

16. Continued and expanded **investments in institutional and human capacity for science and innovation** is needed. The education of the next generations of students – and teachers –should systematically include the multiple ways in which humans generate, distribute, and consume food

in all regions and cultures. We make a plea for investments in improving data, methods, models and tools for all food system components and actors, as well as for building or enhancing (shared) **research infrastructures** related to (research) data, modelling platforms, observation and monitoring networks to support the required advances in research and innovation. More attention needs to be paid to strengthening local research capacities, expanding research collaboration among public and private sector research, and addressing intellectual property rights issues when they hinder innovations that can serve food and nutrition security, and food safety. We call for **international sharing of science** and participation of science in the follow up to the Food Systems Summit as part of implementation agendas. Proposals for international collaboration include supporting low- and middle-income countries to build and sustain capacities to acquire and deploy agricultural technologies through joint education and training programs.

17. **Food systems science and policy** need a stronger framework for constructive and evidence-based interaction for moving ahead, not just for the Food Systems Summit 2021 but for the long term. We call for strengthening the **science and policy interface** at local, national, and international levels with a strong international and independent voice for science-informed and evidence-based food systems policies. Some have proposed strengthening the contribution of science to policy making for transformational food systems with an Intergovernmental Scientific Advisory Panel, which may warrant further review and discussion. Coherent national food systems research policy needs to be better integrated into national development policies. Science and policy have a lot to gain from cooperation but the independence of science must not be compromised in order to address policy and institutional opportunities and failures with evidence-based insights. Science that produces new technologies and insights also needs to constantly **earn the trust of society**. Policies, such as regulation and certification, can help to increase consumer confidence in scientific endeavors, as can improved quality and timeliness of science translation and communication for policymakers and non-technical audiences, along with transparency and declarations of interest in science.