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New Models for Science Diplomacy Transcending Boundries: The InterAcademy Partnership Food and Nutrition Security and Agriculture Project

Claudia Canales Holzeis, Robin Fears, Joachim von Braun, and Volker ter Meulen

IAP: The Global Voice of the Science Academies

In 2015, this journal published a perspective[1] on the role of academies of science in providing key diplomacy tools, and introduced the InterAcademy Partnership (IAP)[2] — the global network of science academies. The IAP encompasses over 130 academies of science and medicine working together in four regional networks (Figure 1), and provides a platform that allows member academies to collaborate across disciplines and borders to bring scientific insight to national, regional, and global policy debates. The IAP aims to advance sound policies, improve public health, promote excellence in science education, and help achieve critical development goals. Academies of science and medicine serve key roles as providers of evidence-based policy and advice, and this function is strengthened by a number of features: 1) academies are merit-based institutions with members comprising leading scientists in all disciplines; 2) academies are free from vested political and commercial interests; and 3) their association with regional and global

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networks enables the academies to address pressing global challenges while at the same time retaining an awareness of national needs and priorities.

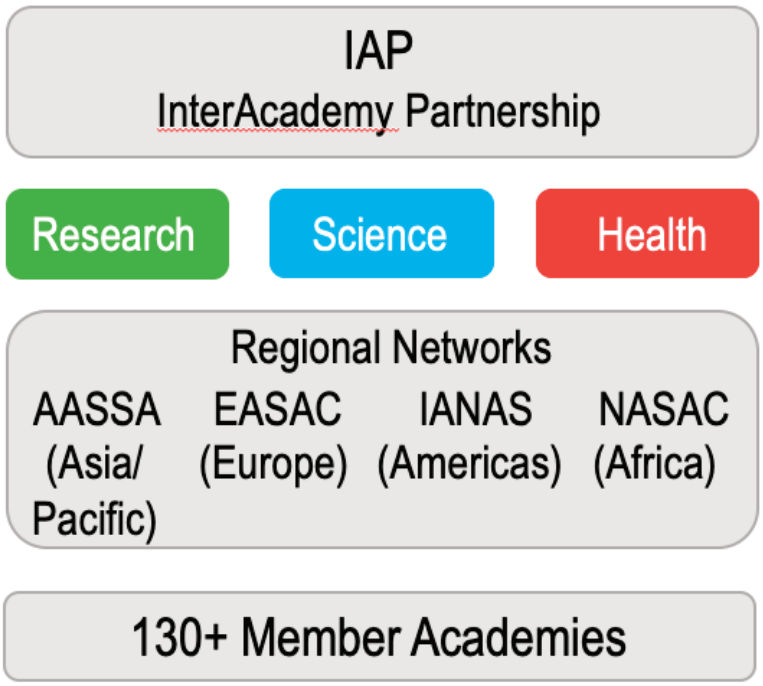

Figure 1. The structure of IAP. The three pillars of the InterAcademy Partnership include the three original IAP academy networks: IAP for Science (formerly the global network of science academies, IAP); IAP for Health (formerly the InterAcademy Medical Panel, IAMP); and IAP for Research (formerly the InterAcademy Council, IAC). 130 member academies constitute the intellectual core of the partnership, working together in regional networks in Africa, the Americas, the Asia/Pacific region, and Europe.<No data from link>Figure 1. The structure of IAP. The three pillars of the InterAcademy Partnership include the three original IAP academy networks: IAP for Science (formerly the global network of science academies, IAP); IAP for Health (formerly the InterAcademy Medical Panel, IAMP); and IAP for Research (formerly the InterAcademy Council, IAC). 130 member academies constitute the intellectual core of the partnership, working together in regional networks in Africa, the Americas, the Asia/Pacific region, and Europe.

Academies of science and medicine and their regional and global networks play an important role in national and international policy by contributing to the sharing and implementing of good practice in clarifying controversial issues, developing and communicating the evidence base, and informing the choice of policy options. Critical factors for success in such activities come from the independence of contributions, reliance on excellence in science and scientists in all disciplines, sound peer review, established contacts with policymaking bodies, and the power to convene actors across multiple sectors.

Experimenting with New Models for Science Diplomacy Across Boundaries: The Focus on Food and Nutrition Security and Agriculture (FNSA)

In 2015, the IAP initiated a project with the objective of establishing a new model for transboundary science diplomacy that draws on resources provided by

the IAP and its member academies. The IAP selected food and nutrition security and agriculture (FNSA) as the focus, since it represents one of the world's most pressing challenges. That is, all countries experience to a greater or lesser extent the triple burden of malnutrition: undernutrition, micronutrient deficiency, and over-consumption of calories leading to overweight and obesity. Achieving food and nutrition security is a United Nations Sustainable Development Goal (SDG 2, "Zero Hunger"), and this goal is implicit in most other SDGs.[3] However, the Food and Agriculture Organization of the United Nations (UN FAO) recently warned.[4] that the number of undernourished people in the world is increasing, reversing progress in international food security. Conflict, climate variability, and extreme weather events contribute to this trend. The number of obese people is also on the rise, with serious public health implications. Many countries are experiencing simultaneous undernutrition and obesity, since excess weight gain can also be a consequence of poverty. Malnutrition is now a factor in one of five preventable deaths globally.[5] Food insecurity transcends public health boundaries and contributes to all forms of malnutrition.

The FNSA project also is important in the context of another legally binding international accord, the Paris Agreement, on mitigating climate change.[6] The UN Intergovernmental Panel on Climate Change (IPCC) recently warned that the Earth is already experiencing the consequences of 1°C of global warming, in the form of increasing extreme weather events, rising sea levels,[7] and the melting of the Arctic sea ice. To avoid the worst consequences of climate change, global warming must be limited to 1.5°C instead of 2°C above pre-industrial levels. Reaching this target requires rapid and far-reaching transitions in all human activities so that greenhouse gas (GHG) emissions8 fall by about 45% from 2010 levels by 2030, and reach "net zero" around 2050. Agriculture contributes approximately 20% of global GHG emissions , and could increase emissions 50-90% by 2050 in the absence of technological changes and dedicated emission mitigation measures.[9] At the same time, food production is affected deeply by changing climatic conditions; extreme climate events already account for 40% of the variability in global wheat production, and climate change could eventually overwhelm all of the gains in U.S. agricultural productivity that have been realized since 1981.[10]

Therefore, a very pertinent question is how the SDGs with food security and nutrition and climate change objectives might be attained simultaneously, in the context of predicted global population increases, urbanization, and changing lifestyles, including an increase in the consumption of livestock products. Science has an important role to play by contributing insights into synergies and trade-offs with respect to conflicting objectives, and by advising on how divergent interests might be reconciled. There is an urgent need to build more capacity for research and innovation in technical fields that address these questions, and to mobilize

those resources in advising policymakers and other key stakeholders. For this reason, the primary objectives of the IAP FNSA project were to identify the key challenges and opportunities for using the science already available to deliver healthy and sustainable diets, and to identify the main knowledge gaps to guide the formulation of an effective global research agenda. Action is required at multiple geographical levels, from the local level targeting specific regions or demographic sectors particularly vulnerable to food insecurity, to the regional and international. The IAP is particularly well placed to address these recommendations for multiple scales.

Due to the multiple interlinkages among food, nutrition, and agriculture; climate change mitigation; and natural resources and biodiversity preservation, the IAP FNSA project incorporated a food systems perspective that considered food production, processing, marketing, consumption (including food safety), and waste, as well as broader societal implications and the impact on the environment (Figure 2). Food waste, an important misuse of resources is estimated to affect 30% of food production globally, although more primary data-based studies are needed for accurate quantification.[11]

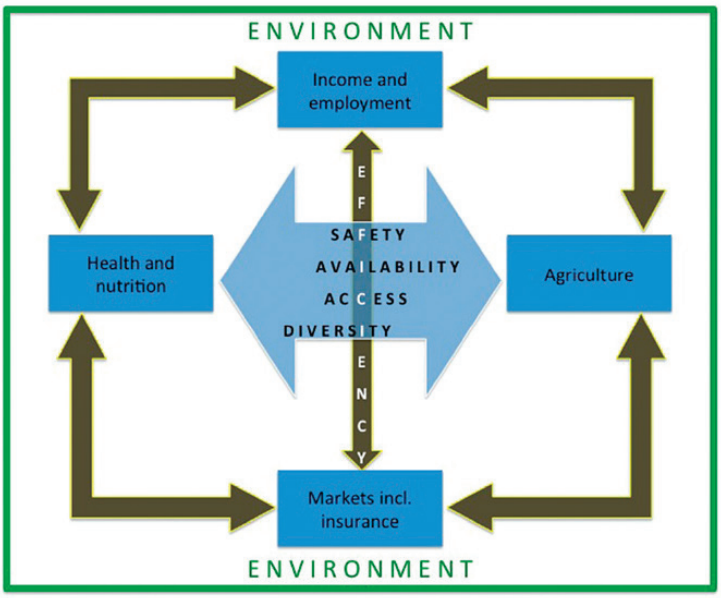

Figure 2. A conceptual framework for research on food, nutrition, and agriculture within the food systems context.[12]

From national to regional to global: a common template for the Regional FNSA Reports

The IAP initiated the FNSA project in June 2016 by establishing four regional academy network working groups (WGs) – in Africa, Asia, the Americas and Europe – consisting of experts in all relevant disciplines, with appropriate

experience across the region, thereby drawing on broad representation of excellence in science. The IAP tasked each WG to independently produce a Regional FNSA Report, which would first provide a mechanism to engage with policymakers and other stakeholders at the national and regional levels, and subsequently serve collectively as resources for the development of a fifth report, the Global FNSA Report. The IAP designed the global output to reflect on differences and similarities between the regions, and focus on science and policy issues that need to be addressed internationally. For this reason, the WGs developed a common template of ten guiding priority questions for the regional assessments, a list that was not intended to be overly prescriptive, but to ensure that the Regional FNSA Reports did not diverge so much as to hinder collective analysis, synthesis, and reflection.

The ten-point template included conducting an assessment of the national and regional situations with respect to FNSA, outlining major scientific challenges and opportunities, and identifying key knowledge gaps. In addition, each WG agreed to consider the public health, nutritional, and environmental issues associated with FNSA, including competition for natural resources (such as land, water, and energy) with other public and private uses and the preservation of biodiversity. Finally, the IAP asked each WG to address the impact of national and regional regulatory frameworks and other public policies on FNSA, and discuss the main implications of their findings and recommendations at the interregional and global levels.

In drafting recommendations, the WGs consulted additional sources of evidence at the national and regional levels according to agreed-upon regional priorities, and took note of other important food, nutrition, and agriculture assessment initiatives. Science and policy community engagement at the national and regional levels accompanied the preparation of the Regional FNSA Reports. The IAP held two plenary meetings in Germany in 2017 and 2018, which brought together all four WGs, together with representatives from key policymaking bodies.

The Regional FNSA Reports

The IAP published all four Regional FNSA Reports in early 2018,[13] after they underwent independent peer review and endorsement by the IAP networks. While this article does not give a detailed description of the Regional Reports' main findings and recommendations, it is fruitful to outline some themes emerging from an analysis of FNSA within and across national borders.

The Regional FNSA Reports all agreed on the need to establish good baseline data to determine the current FNSA status at the national and regional levels to generate robust information resources to guide policy. Since sustainable food consumption patterns are integral to attaining food and nutrition security, cross-disciplinary research that includes economics and social sciences as well as the natural sciences is required. The Reports also recommend that data collection be standardized to allow for comparative analysis and to monitor progress towards developing sustainable and nutritious food systems.

A specific focus is needed on geographic areas[14] and sectors of the population that are at greater risk of food and nutrition insecurity, since variation is sometimes greater within a given country than between countries. For example, the Association of Academies and Societies of Sciences in Asia (AASSA) described the FNSA landscape in Cambodia, where, despite a period of recent growth, the incidence of poverty remains high and also deeply variable across the country. Levels of poverty range from 6.5% in some territories to 51% in other (mostly rural) areas . The ability of the country to address these regional disparities is constrained by a lack of coordination between various tiers of government, as well as between development agencies and non-governmental organizations. The situation in Cambodia is by no means unique. The European Academics Science Advisory Council (EASAC) reported the need to focus specifically on vulnerable groups, such as mothers and children, the elderly, patients, and migrants, all of whom are more at risk of malnutrition than the population as a whole. Policies and programmes must be effectively delivered to where they are most needed, and that they are suitably integrated to prevent the fragmentation and duplication of efforts.

The Regional FNSA Reports also describe instances where a cross-national approach is needed to address challenges for FNSA at the regional level. Mountainous areas are particularly impacted, with a complex interaction between socio-economic, environmental (including food production), and cultural factors, resulting in widespread malnutrition. For example, the AASSA discusses the Hindu-Kush Himalayan (HKH) region, defined as the area that extends 3500 km across the high mountain regions of eight countries: Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan. The number of undernourished people in the countries of the HKH region is estimated to be 415 million, accounting for more than half of the global total. An integrated multi-sectoral and multi-dimensional approach sensitive to territorial differences is required to achieve future FNSA in this region. In the Americas, the Interamerican Network of Academies of Science (IANAS) describes the Caribbean islands as the area most vulnerable to malnutrition, as many are heavily dependent on imports and have weak and undiversified economies. The Caribbean is also particularly

exposed to environmental degradation from extreme weather events. More attention by the international research and policymaking communities is needed to develop nutritious and resilient food systems in these island states.

All the regional assessments stress the importance of science and innovation for smallholder farmers, who constitute a large proportion of the world's poor and are the most vulnerable to malnutrition and the impacts of climate change. The regions differ in the relative contribution of small and large farms to agricultural production; small farms generate over 75% of most food commodities in sub-Saharan Africa and Asia, while large farms dominate in the Americas, Australia, and New Zealand, with Europe somewhere in between.[15] The Network of African Science Academics (NASAC) notes the importance of responsible innovation in all components of food systems, which need to address key impediments for FNSA but be within the financial means of smallholders. These include innovations focused on affordable and accessible improved planting materials, sustainable management of agricultural systems (soil quality and water scarcity being key constraints to productivity), and food preservation to decrease waste. For instance, one example of a frugal innovation is a storage bag for grains[16] to reduce pest damage and food contamination by mycotoxins (a widespread and serious public health issue in parts of Africa).[17] Research and innovation also are needed to develop cheaper diagnostic tools for disease identification, such as inexpensive portable tests kits to use in the field, technologies based on renewable energy sources, and improved access to markets.

A better understanding of the heterogeneity of FNSA in different localities would also lead to more knowledgeable debates on controversial topics. For instance, all the regional assessments discussed meat consumption. Industrial meat production and excessive consumption is unsustainable from environmental and public health perspectives, yet animal-based products represent an important source of high-quality nutrients for resource-poor people in developing countries, in particular children, and for many vulnerable groups elsewhere. The International Livestock Research Institute estimates that one billion rural poor people rely on livestock for food security and income, and warn against one-size-fits-all 'livestock less' policies.[18] In developing countries, livestock also is used as farm labor where mechanization is often not available, and represents a form of insurance in times of financial need. Therefore, reducing livestock production in these settings would require parallel interventions and policies to promote rural development, establish basic infrastructure and services, and ensure the availability, accessibility, and affordability of alternative, sustainable, and nutritious diets. Science can contribute by informing the policy decisions pertaining to food systems for improved nutrition, quantifying potential synergies and trade-offs, reducing the environmental footprint of the livestock sector, and exploring novel sources of

dietary protein. It is essential to identify effective policy incentives to curb meat consumption, limit the excessive intake of calories, and promote the demand for healthy and sustainable foods, targeting both consumers and the private sector. The complexity of the Regional FNSA Report analysis highlights the importance of aligning the transformation of food systems to both the SDGs and climate change mitigation targets for the development of effective policies, and the critical need for integrated solutions.

The Global FNSA Report

The recognition that many of today's pressing global challenges must be addressed in collaborative and interconnected ways across nations provided the main motivation to develop the Global FNSA Report.[19] The IAP used the four Regional FNSA Reports and the feedback they received from policymakers, together with more recently published scientific studies and continuing interaction among the regions under the auspices of an expert editorial group. The purpose of the Global FNSA Report is to "advise on interregional matters, local-global connectivities, and issues at the science-policy interface that should be considered by inter-governmental institutions and other bodies with international roles and responsibilities." Science diplomacy and building bridges between communities and nations for closer collaboration in scientific research and policymaking is key to attaining improvements in global FNSA.

The Global FNSA Report, published by the IAP in November 2018 after independent peer review and the IAP member academies' endorsement, was framed around three main principles: (1) the role of science and technology to safeguard international public goods, defined as those that require collective action and coordination, since they need to be provided on a scale unattainable by individual countries; (2) the need to clarify and address international environmental and institutional risks and their transmission; aobjnd (3) the SDGs, with a focus on how scientific endeavor and innovation (related to scientific, social, and international policy contexts) may contribute to their realization. Global priorities for science and innovation broadly identified in the Global FNSA Report include: sustainable food and nutrition systems, transformation to healthier diets, food production and consumption issues, food-energy-water-health interconnections, and the promotion of effective interaction at science-policy interfaces, including the establishment of international science advisory mechanisms.

What must be addressed globally by the scientific and policy-making communities? Climate change has already been described in this account as a key challenge that no nation by itself can address. In addition, all countries depend on

the trade of commodities to satisfy domestic food demand. Trade can in principle enable a more efficient allocation of resources and the sharing of the burden of supply shocks. However, as recent financial and food price crises have highlighted, greater interconnection among regions also entails an increased risk of system failure, potentially leading to market instability with serious implications for global FNSA. Understanding markets and their instability in an increasingly globalized food system is therefore a pressing scientific research priority. Coherent action also is needed to respond to increased market demand for certain commodities, and to effect appropriate policy responses to limit the impact of high and volatile food prices on the nations and sectors of society most vulnerable to food and nutrition insecurity. A key policy priority is also to determine how fair and rules-based trade systems should be defined and effectively promoted.

All regions face environmental degradation linked to agricultural production, including loss of essential land and water resources and biodiversity; this creates the need for a greater focus on the efficiency of food systems in delivering health and well-being for people and the planet, as well as profits for the food system actors. Climate change and the loss of natural resources are directly linked to the global trade of food commodities; national and regional competition acts to drive many of the costs of food production to the environment. Many countries include only production-based emissions in their GHG inventory, which means that emissions associated with imported goods are allocated to the exporting country, distorting national accounting. For example, the emissions and other environmental pressures associated with the production of the food imported by the European Union (EU) are far greater than the emissions and pressures from the production of the goods it exports to the rest of the world.[20]

The Global FNSA Report also describes how the increasingly interconnected nature of food systems and reliance on food imports to meet demand also has important implications for human health. A shared challenge is the increasing availability of relatively cheap, energy-dense but nutrient-poor foods, which contributes to obesity and micronutrient deficiency and is linked to an alarming rise of non-communicable diseases (NCDs) globally.[21] In addition, food systems across the world are becoming increasingly homogeneous. Humans rely on a handful of crops for the majority of their daily caloric intake, which decreases the resilience of food systems to shocks. This may also heighten the vulnerability of some national food systems to stressors and increases interdependence among countries in terms of food supply.[22] Finally, increased globalization brings challenges related to food safety (including toxins, pathogens, and the adulteration and contamination of foods), the worldwide rise of antibiotic resistance (in some countries, as much as 80% of total use of antimicrobials is in the livestock sector,

and emerging economies are projected to increase their use),[23] and the increased incidence of agricultural pests and diseases.

The analysis by all WGs highlight the fact that addressing FNSA challenges will require a multi-disciplinary and multi-sectoral approach. It will necessitate developing a sound scientific agenda, and improve linkages to policymaking, as well as to science education, training, and outreach. Science diplomacy is critical to promote increased collaboration between countries to share scientific expertise and facilities, facilitate learning between regions, and help build capacity in emerging economies to avoid unnecessary competition and duplication. New transregional research efforts are warranted, accompanied by commitments to transregional engagement between the scientific and policy communities, with respect to the SDGs and climate objectives in particular.

The transformation of food systems, at national, regional, and global levels must also focus on governance and coordination of national and international policies. It is critical for the scientific and policy communities to evaluate the relative impacts of strategic initiatives and policies in different countries and their global implications; understand the critical issues for designing policy options; monitor the return on investment for different actions; and clarify the intersection with other societal priorities, in particular climate change and human health.

Policy engagement activities for the IAP FNSA project

The IAP designed the FNSA project to allocate substantial time and resources to engage with policymakers and other stakeholders at the national, regional, and international levels during the development of the Regional Reports and after their publication. The IAP also kept aware of other relevant scientific and policy initiatives by different groups, aiming to add value to existing work rather than duplicate efforts. Whenever possible, the IAP identified policy clients during project formulation and engaged these groups during the preparation of the reports to ensure that the eventual outputs responded as much as possible to existing policy demands. There is significant variation between the regions in the extent to which policymaking is undertaken at the continental level. In the EU, there are established institutions (the European Commission, Parliament, and Council), and in Africa, regional activity is maturing rapidly at the level of the African Union (AU), but there are no equivalent transregional platforms in Asia or the Americas, and national linkages between the science and policy communities vary widely.

The dissemination of the findings and recommendations of the Regional FNSA Reports at the level of individual countries is the responsibility of national

academies, and IAP encourages them to tailor the outputs to respond to local needs and realities (e.g., policy briefs, translations of the reports, etc), and engage national policymakers and other stakeholders, including the general public. The IAP supported the publication of all five reports with a comprehensive global communication strategy comprising a press kit, press conferences, media coverage (written articles and TV and radio broadcasts), and social media sharing. This resulted in the publication of 133 popular media articles and broadcast coverage in 20 different languages. Views were estimated at over 2 million for the written articles and over 10 million for the broadcast. The IAP FNSA project is also capitalizing on existing opportunities to increase the dissemination of the findings and recommendations at regional and global levels. (Table 1 describes selected events that exemplify various project objectives.)

Events	Project Objective
World Science Forum Amman, Jordan, October 2017	Seek feedback on global conclusions
Regional discussion of the European Academics Science Advisory Council (EASAC) on the FNSA Report Brussels, Belgium, April 2018	Interact with policymakers and other stakeholders
EuroScience Open Forum Toulouse, France, July 2018	Seek feedback on regional conclusions
S20 (Science20)[24] Rosario, Argentina, July 2018	Raise awareness in G20; seek feedback on emerging conclusions
Regional discussion of the Network of African Science Academics (NASAC) on the FNSA Report Nairobi, Kenya, September 2018	Interact with policymakers and other stakeholders
World Health Summit Berlin, Germany, October 2018	Focus on nutrition and health
International Union of Food Science and Technology Mumbai, India, October 2018	Focus on food science and technology, nutrition, and health
American Association for the Advancement of Science (AAAS) Annual Meeting Washington, DC, February 2019	Explore trans-boundary issues
International Food Policy Research Institute (IFPRI) Washington, DC, February 2019	Focus on science and technology opportunities at regional and global levels
United Nations Economic Commission for Europe (UNECE) regional forum on SDGs Geneva, Switzerland, March 2019	Focus on climate change: resilience and adaptation

The IAP will trace the impact of the FNSA initiative on policy in the coming years. Changes cannot always be attributed directly to the initiative, because other organizations are contributing to the FNSA conversation. However, a key step for eventual policy impact is to join the IAP voice to those of other relevant bodies while maintaining a distinctive focus on global science and technology, and engage all relevant stakeholders at national, regional, and global levels. The IAP also is engaged in supporting the integration of policies on agriculture, environment, and health, advising on the evidence base required, and drawing attention to key knowledge gaps. A short-term impact of the IAP FNSA project is better coordination among the participating scientific experts and improved capacity for the development of shared research, innovation, and policy agendas for FNSA. The IAP provides a platform for scientists who would not normally work closely on shared scientific challenges and opportunities. For example, the Association of Academies and Societies of Sciences in Asia (AASSA) working group was constituted by experts from China, Iran, Israel, India, Malaysia, New Zealand, South Korea, and Thailand.

We believe that this experiment in international science policy has proven very fruitful. Its strength is derived from addressing key issues related to FNSA at different regional scales, and learning lessons from these national and regional analyses to inform global recommendations with a multi-disciplinary and multi-sectorial focus. Our innovative project design and the sustained commitment of academies worldwide has helped enable new approaches in science diplomacy to promote engagement across the science community and with policymakers and other stakeholders for the collective benefit for human and planetary health. SD

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