Towards solving the food puzzle

For a food secure future, transformative changes in the world's food systems are needed in order to deliver sufficient nutritious food at affordable prices to the consumer, with less pressure on natural resources. In the process, agriculture will have to continue to support the livelihood of hundreds of millions of families. The research programme Global Food Security: Scarcity and Transition has been contributing to this challenge by helping to increase the understanding of processes underlying food insecurity and by providing tools and knowledge that are being used to underpin policy and action on agricultural development and food and nutrition security.

Putting the pieces together

Broadly speaking, two major areas of effort to improve food and nutrition security have been identified: (1) improving livelihood opportunities by breaking the vicious circle of living in poverty, the lack of command over the food resources that prevent hunger and malnutrition and support health, and the inability to escape a vulnerable subsistence; (2) achieving a sustainable growth path for the world's food systems, by accelerating agricultural productivity growth and by mitigating expected instability on global and local food markets (emanating from, for example, climate change, policy, or conflict).

The recurring food price hikes in recent years, persistent hunger and malnutrition, continued depletion of natural resources and stagnating levels of productivity growth in agriculture have become a global priority. A common effort is therefore required to develop a sustainable and resilient agriculture for food systems that provide affordable nutritious food for all.

Towards a prioritised research and knowledge agenda

The solutions for food insecurity, hunger and malnutrition are embedded in long-term strategies aimed at improving livelihoods and health, strengthening the management of natural resources via growth and innovation, while at the same time addressing specific concerns such as security, equity, gender and cultural diversity. Informing policy- and decision-makers at all levels in the supply chain and governing institutions on plausible options and directions for innovation and investment in the coming years is imperative in order to support beneficial directions for change. During the course of the research programme, several stakeholder consultations were organised around these priorities, the results of which are now being used in the definition of a future research and knowledge agenda for Wageningen UR.

Views on knowledge contributions

Stakeholders have voiced their appeal for coherent visions on the pathways and options that sustain people's access to healthy food with high nutritional value and the sustainability of agricultural production. A key issue to understand is if and how a diverse agricultural production system contributes to a healthy diet, and how specialization and diversification create synergy or trade-off through their impact on gender balance in food consumption, resilience to withstand crises and other mechanisms that drive food and nutrition security. Although the coherent view is not complete, several elements that will contribute to

reaching this more integrated view are apparent. Some suggestions for elaborating on the research agenda relate to:

- *Fisheries:* There is limited insight into the tension between the diversity of local production systems in relation to innovation, supply chain development, consolidation and power. The role of fisheries and biomass from oceans deserves more attention in the integrated food-energy-water issues.
- *Agricultural practices:* Clarity is needed regarding the uncertainties and trade-offs related to agricultural practices – not only in regions where management practices are characterised by low skills and incomplete information (particularly in low-income countries), but also in regions and countries transitioning to high output agriculture, for example, areas undergoing urbanisation and middle-income countries. Safeguarding food safety and the prevention of food losses requires solutions across the entire supply chain.
- *Food insecurity in fragile states:* Some of the hotspots of food insecurity have weak institutional environments and are afflicted by conflict – there is a need to assess solutions to food insecurity in these fragile states.
- *Managing risk and instability in the food system:* The integration of agricultural markets is key to connect supply surpluses and deficits, yet it also advances the potential transboundary impact of shocks in the global food system. Information and communication technologies such as mobile phones and data networks and technology in changing the optimal practices and managing or preventing risk and instability can play a vital role here.
- *Meeting the increasing demand for fresh and nutritious food:* The increasing demand for high-quality and safe food by more affluent consumers in low- and middle-income countries is creating dramatic change in the organization of food processing and retail. Upgrading of agricultural value chains for crops, livestock, fish could benefit welfare and stability in the long run provided that enabling policies and checks and balances are in place.

Working towards solutions

Key knowledge challenges emerging from the domain of food and nutrition security lie in the integration of perspectives on sustainable consumption (access) and production (supply) within the framework of resilient food systems. There is a long record of separate interventions motivated by considerations of either agriculture/food, or nutrition/health. Although advances have been made in this type of research, working in silos has failed to produce the integrated, cross-cutting perspectives and solutions that are needed to overcome the challenges at hand. The integration is needed across three mutually related outcomes:

Sustainable agricultural development pathways

Production systems for crops, livestock, forestry and fisheries face major constraints for efficiently increasing (land, water and labour) productivity in settings of scarce natural resources, and large climatic variability and diverse institutional arrangements. The options for sustainable intensification of resource use should be considered along with conservation needs and the need to reverse degradation of the ecosystem – which calls for an integrated, yet differentiated analysis. Thresholds for improving input efficiency and output productivity within the context of fragile and vulnerable regions need to consider principles of adaptation, resilience and flexibility. Reducing yield gaps and crop losses and raising productivity and environmental protection in livestock farming therefore require simultaneous interventions at the level of biophysical constraints (input availability), knowledge (input use, skills levels, young farmers) and economic incentives (credit and assured land rights that favour adoption). With respect to the intensification and/or integration of mixed cropping and agroforestry systems and the transformation of transhumant animal systems and design of innovative terrestrial and acquatic systems special attention needs to be paid to spillovers and internal synergies, as well as risk management (and sometimes reputation) motives.
In marginal areas already under environmental or other stresses, or in high input systems, extensification towards more appropriate and sustainable production systems may be the solution. Finding the right balance between societal and environmental realities is key in the development of production systems.

Value chains and markets support dietary transitions

Undernutrition in energy terms remains widespread in settings of conflict and (chronic) crisis. Micronutrient deficiencies are much broader phenomena, which occur alongside overconsumption. Climate change contributes to health risk and livelihood vulnerability in remote areas. In the newly urbanizing and rapidly growing metropolitan settings, access to safe and nutritious food and healthy diets is needed to prevent huge concentrations of health risk.

The bulk of the world's food never reaches a formal market place. Food prices and their fluctuations

around a trend are to a large extent determined on local markets. Nonetheless, the ways of organizing food value chains and markets has a huge (potential) impact on the access to nutritious food and the stability of nutrient intake. Deeper insight is needed, therefore, in the options for intervention within supply chains and markets for more favourable FNS outcomes, and how these complement safety nets to safeguard the livelihoods of the vulnerable members of society.

Particular attention should be paid to gender differences in income-generating activities and in supply chain transactions that perpetuate nutrition deficiencies at the intergenerational level. Access to food that is of acceptable quality and safe is also related to prevailing health, education, water and sanitation regimes and on/off-farm business cases for agricultural intensification and labour opportunities at the small and larger scale.

Upgrading of agricultural value chains (crops, livestock, fish) has the potential to strengthen livelihoods and contributes to an expanding supply base that could accompany dietary transitions through concerted efforts of agents in the chain, including retail and corporations, policy-makers and regulators. Upgrading entails strengthened food trading systems (including storage, transport and reduced post-harvest losses and waste e.g. through agrologistics, producer organizations) and better integrated markets for farm inputs, financial services and risk management practices (insurance) and outputs. The scope for more integrated local and regional markets to permit a more equitable distribution of food and reduces risks of food inequality – provided that safety nets are in place – remains elusive. Adequate incentives for addressing these challenges also include governance regimes that enhance trust and increase reliability of food supply.

Stable and resilient food systems as international public goods

Food and nutrition security has a public good character, considering its fundamental role in economic development and (geographic and system-wide) transboundary effects that may arise from the collapse of food and commodity supply, particularly in (post)conflict regions. To support resilient food systems insights on the role of agricultural policies for reducing emerging risks (early crop failure warning; animal diseases including threats to humans, food scares), strengthening local governance and interregional trade, and enhancing trust and loyalty between supply chain stakeholders are required.

In several post-conflict areas, food production systems and the enabling environment need to be developed from practical non-existence. Climate change has the potential to drive the emergence of new sources of socio-political, environmental and economic risk in the food system and the trade relations with developed countries, where early detection of compromised food safety, animal or plant health is necessary for maintaining trust. The quality and safety control in sourcing regions needs strengthening even where public institutions alone face difficulties to monitor and enforce.

Public policy responses to the challenges differ widely across regions, and are struggling with coherence across domains such as agriculture, fishery, health and security. Ongoing market integration and ever more stringent food safety and quality standards - further reinforced through bilateral and multilateral trade agreements (e.g. the Transatlantic Trade and Investment Partnership, the Economic Partnership Agreements) - ask for more institutional coordination even if the current system of rules brings little push towards more sustainability and equity. The private sector, alarmed by looming difficulties in commodity sourcing and triggered by expanding global consumer markets, drives long-term agendas for transformation (particularly on sustainability) that require checks and balance through alignment with civil society, government and science.

Partnerships for solving the food puzzle and realising change

Wageningen UR's contribution to the Zero Hunger Challenge (proposed by the United Nations Secretary-General Ban-Ki-moon) will be achieved by engaging with stakeholders and decision-makers at different scales in a variety of spheres. Strategic partnerships for food and nutrition security research are in place with a range of actors including the government, private sector, civil society and knowledge partners in the Triple helix in the Netherlands and the low and middle income countries (particularly in partner countries of the Dutch food security strategy). Partnerships with industry include foreign branches of Dutch companies in emerging or developing countries, but also partnerships with local industries have been established. Some of the flagship programmes include industrial partnerships (through IDH Sustainable Trade Initiative, the Seas of Change community of practice, Global Agricultural Information Network and bilaterally), the Consultative Group for International Agricultural Research, the Bill and Melinda Gates foundation (which, for example, funds a programme on global yield gap analysis), the Ministry of Economic Affairs

(programme funding and public-private partnerships) and the European Commission (e.g. FOODSECURE, EAU4FOOD, SAFEFOOD). The research programmes at Wageningen UR are more and more collaborative in nature with other countries, for example, through the European facilities (Horizon 2020, ERA nets and Joint programming initiatives) and global initiatives such as the Agricultural model intercomparison network (AgMIP); the alliance for Climate Smart Agriculture, the Global Research Alliance on Agricultural Greenhouse Gases, the Livestock Dialogue, Exploration of the Oceans, Seas of Change and the Network of Excellence Postharvest Losses.

The extensive network that Wageningen UR has, especially its strong links to governments, industries, civil society and practitioners and its central role in the knowledge system around agriculture and food, makes it well placed to translate knowledge into practice. Whether it is through action-oriented partnership programs or cooperation for scientific excellence, Wageningen UR commits to contribute towards solving the food puzzle and eliminate hunger.

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