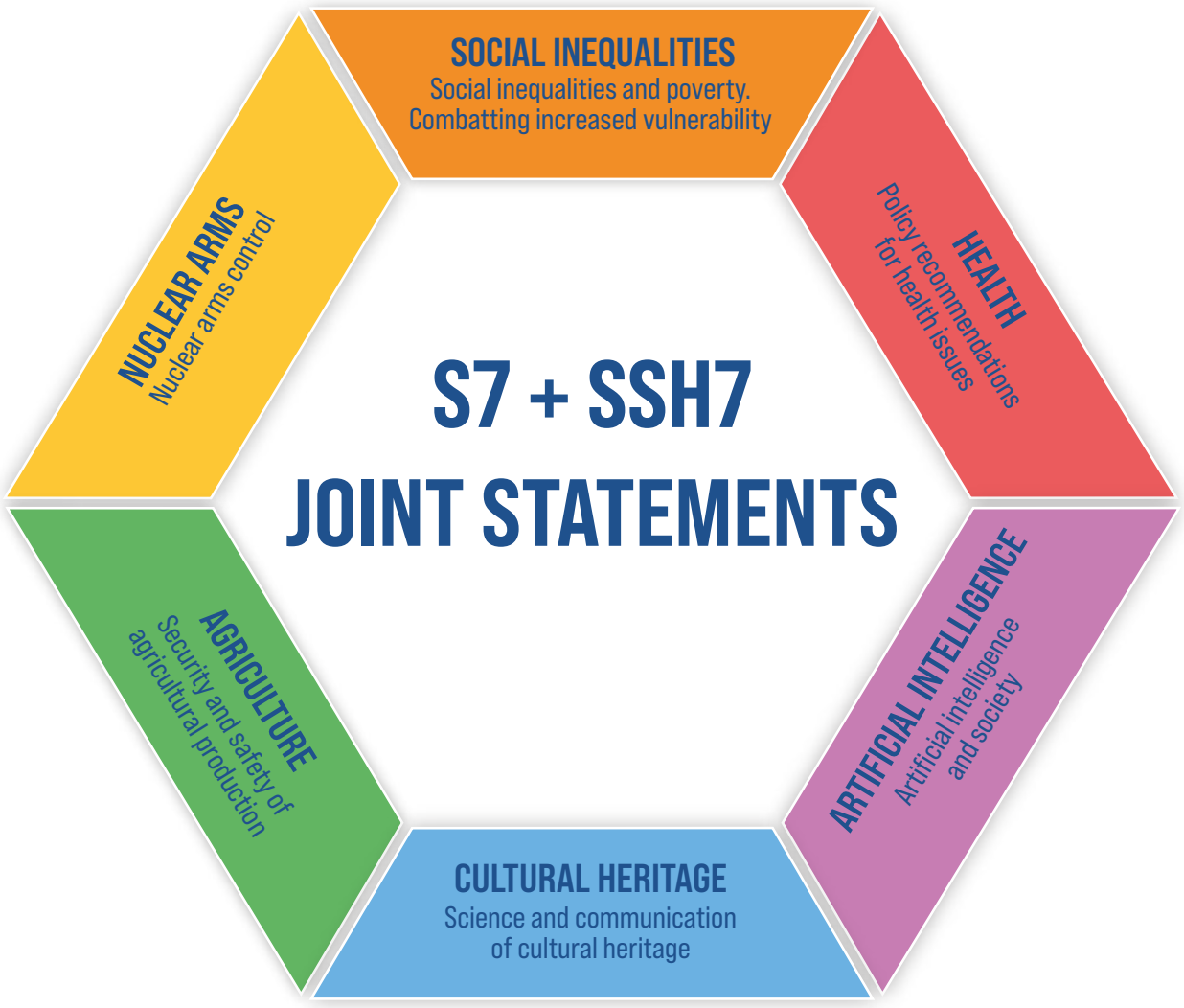
SCIENCE FOR THE FUTURE

CHALLENGES, RESPONSIBILITIES AND OPPORTUNITIES

SCIENCE 7 + SOCIAL SCIENCES & HUMANITIES 7 2024



SECURITY AND SAFETY OF AGRICULTURAL PRODUCTION

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Agriculture is fundamental to our food system. Its supply chains, involving transport, processing, packaging, storage, and retail, generate around 30% to 50% of GDP in many countries[1] and provide employment to 1.2 billion people whose income supports the life of 3.8 billion world inhabitants[2]. Agriculture is also, however, responsible for environmental degradation in terms of greenhouse gas emissions, pollution of natural resources, such as soil and water, and degradation of ecosystems and biodiversity. The UN Global Agenda for Sustainable Development seeks to end hunger, achieve food security, improve nutrition, and promote sustainable agriculture. Agriculture is central to achieving this challenge whilst the global population grows to ten billion by 2050, food habits change towards more sophisticated crop and animal produce, while facing climate and non-climate issues[3]. A drastic change is urgently needed. Future food security requires efficient agricultural systems that increase production, improve the sustainability of natural resources, and increase their resiliency, adapting to rapid changes and extreme conditions, while reducing the consumption of animal-based food.

Numerous reports, prepared by international organisations, such as FAO[4] and UNCC[5], provide evidence of the current situation and the need for action. The IAP reports[6], presented in 2018 at the Rosario S20 meeting, underline the differences among continents and countries, but they converge on the need to increase food production and safety through the introduction of innovative approaches, tailored to local conditions and community values. This will require innovation and political commitment.

Human resources

Human capacity drives the processes of change. In understanding traditional as well as technology-driven agriculture, researchers, and technicians can interact with farmers and learn from their knowledge, facilitating the shift to a model of knowledge-intensive management that integrates traditional and emerging technology options. This method would increase production and its safety, as well as the preservation of ecosystem services. The change requires social, biological, and physical scientists to work with those with local knowledge to overcome the challenges ahead. Preparation of these human resources represents a major policy challenge.

The S7 academies recommend suitable university and agro-technology courses that reflect these new challenges appropriately, equipping those participating with the skills and abilities to face these challenges.

Soil resources

Soil is the single most bio-diverse habitat on Earth, a complex ecosystem regulating several unique functions, essential for the yield and health of crop plants and raising animals, as well as for human and planetary health. As a storehouse of carbon, soils help to regulate gas emissions, contributing to actions that counteract climate change. Approximately 95% of global food is, directly or indirectly, produced in soil[7], but about 33% of global soils are moderately or highly degraded[4], resulting in production losses, and in a decline of ecosystem services[4]. Without change, by 2050, 90% of all soils, as well as terrestrial ecosystems and food production, will deteriorate[7]. The FAO has set up a Sustainable Soil Management Program to promote sustainable practices and provide guidance on how to translate this into practice[7]. However, a better knowledge of the balance of nutrients within the soil is needed, as is the expected maximum productivity of agricultural systems when soils are managed sustainably.

The S7 academies recommend countries to promote investments under the constraints present in different environments, on soil microbial biodiversity, including its monitoring, and on soil rehabilitation programs, as recommended in the 2018 S20 Statement.

Water resources

Water is a basic ingredient of life and underpins crop and livestock production. The projected increases in global temperatures will lead to an intensification of the water cycle and to an increase in the severity of droughts in some regions and will contribute to dramatic floods in others. Water management is likely to become the defining feature of sustainable food production when, by 2050, the world's growing population will use 55% more water in their households[1]. Rain-fed crop production is the dominant system in many countries, but farmers are increasingly turning to groundwater, while about 20% of water catchments have reached a critical point[1]. New water management strategies are needed as well as the development of drought-tolerant crops.

The S7 academies urge governments to support research programs for the management and monitoring of water usage, as well as international programs aimed at developing activities dedicated to water catchment, storage, and recycling techniques. Selection and breeding of crops with more efficient water usage to allow for reduced water consumption is equally an urgent need.

Crop and livestock protection

Meteorological events, pests, and diseases compromise crop cultivation and livestock production. Combating these losses stimulates an increase of the area of cultivated land and the number of animals reared, with consequent increases in the environmental footprint, such as Green House Gas (GHG) emissions, and pressure on land, water, and biodiversity. Farmers attempt to control biological threats by using agrochemicals, including antibiotics, thus generating high environmental costs and, in some cases, exacerbating human vulnerability due to microbial resistance to common antibiotics. Additional risks are associated with microbial agents that can occur in uncooked food, fruits, vegetables and in milk. Chronic toxicity from mycotoxins and other contaminants may lead to chronic diseases, cancers, and impaired growth of children. Climate change is expected

to expand and modify the distribution area of invasive plants/weeds, pests and disease agents, thus exposing crops and livestock to new and unfamiliar problems.
The S7 academies recommend the organization of international programs aimed at generating weather-tolerant, pest and disease resistant crop varieties, animal vaccines, and health-strengthening probiotics. They also urge improving monitoring and surveillance systems and preparing infrastructures and rules to make these resources easily available to farmers, with particular attention to those in emerging countries. Diversification of crop species, including domestication and study of novel food options, offers opportunities to enhance sustainability, resource efficiency and nutritional diversity in global food systems.

Technology choices

Innovative technologies, which contribute to improving food security, safety, and sustainability, are continuously being developed. The rapid sharing of these technologies is greatly needed. Some of them are not resource neutral and can increase costs for inputs and outputs. Policies that enable all growers/producers to benefit from the new technologies are essential and should be delivered equitably, regardless of the grower/producer's country and of their technical and social situation. Efforts should be made to integrate extant local knowledge with emerging technologies, so that the sustainability and safety of production and the satisfaction of consumers are enhanced. Full use should be made of frontier areas of science, such as molecular genetics and genomics, relevant biotechnologies, and artificial intelligence, provided that these new advances are aligned to ethical and safety requirements and international agreements. One third of food is produced by smallholder farmers[8]. Incentives are needed to stimulate collective actions in adopting new technologies and modifying traditional practices leading to the improvement of economic and environmental sustainability. Small, local, or regional agro-industries represent an opportunity to ensure safe food availability to the urban population and income and employment for people formerly engaged in agriculture.
The S7 academies invite countries to support projects that address the use of new technologies in agriculture, the establishment of new systems of food production, and the organization of programs and international policies to make technological developments available to all countries and farmers.
The S7 academies favour the adoption of open science models, as recommended by the 2013 G7 countries, with the establishment of the Global Open Data for Agriculture and Nutrition (GODAN). Education and training aimed at improving technological competence, utilization of new technologies and awareness of their risk for the environment and health, must be better supported.

Socioeconomic aspects

The food system has become complex, and food can often be produced, processed, and consumed by moving it to different countries. This trend has contributed to the increase in quantity, quality, and diversity of items available to consumers and has promoted socioeconomic issues that deserve attention. The food market, with its advertisements, information, and labelling, may affect consumers' choices, thus stimulating farmers' decisions on plants to be

cultivated, animals to be reared and technologies and management practices to be adopted. These market asymmetries may privilege staple food crops, while neglecting traditional crops, such as pulses, whose cultivation stimulates soil fertility regeneration and provides a more balanced diet. Introduction of innovations needs to be supported by targeted policies, infrastructures, extension of services, and secure land tenure. Public investment should support private enterprises and stimulate the integration of small producers into value chains, ensure coherence and maximize synergies, taking care that those policies do not promote unsustainable agriculture and food systems and disappearance of small holder farmers[9]. Agriculture is the sector with the highest level of informal employment and will continue to be a major employer in low-income countries. Developing downstream segments of agriculture, particularly in low-income areas, will be important when considering how technological innovation and increases in labour productivity may lead to fewer employment opportunities in crop growing and animal rearing. The seventy-third World Health Assembly in 2020 reaffirmed that food safety is a public health priority. Complex dynamics, as mentioned, have significantly delayed progress towards achieving the World Health goals.

The S7 academies appeal to all countries to promote trade patterns that favour sustainable agriculture and food systems. They also encourage them to reduce reliance on imported basic nutritional food commodities and to facilitate the adoption of the general principles that should be followed by food operators at all stages of the food chain, as indicated by the FAO-WHO Codex Alimentarius.

1 FAO. 2023. World Food and Agriculture – Statistical Yearbook 2023. Rome, FAO.

2 FAO (2023). Estimating global and country-level employment in agrifood systems. FAO Statistics Working Paper Series, No. 23-34. Rome, FAO.

3 FAO 2015a Healthy soils are the basis for healthy food production, Rome, FAO.

4 FAO 2015b Status of the world soil resources, Rome, FAO.

5 UNCCD 2017 The global land outlook.

6 IAP 2018. Opportunities for future research and innovation on food and nutrition security and agriculture: The InterAcademy Partnership's global perspective.

7 FAO - Global soil partnership 2022. The planet survives only thanks to a few cm of health soil that gives 95% of our food, Rome, FAO.

8 FAO. 2019 Farms, family farms, farmland distribution and far labour: what do we know today? FAO agricultural development economics working paper 19-08.

9 IFPRI-WUORLD BANK. 2022. Repurposing Current Policies Could Deliver Multiple Benefits for Farmers, Food Security and Climate.

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