



SCIENCE FOR THE FUTURE

CHALLENGES,
RESPONSIBILITIES
AND OPPORTUNITIES

SCIENCE 7 +
SOCIAL SCIENCES
& HUMANITIES 7
2024

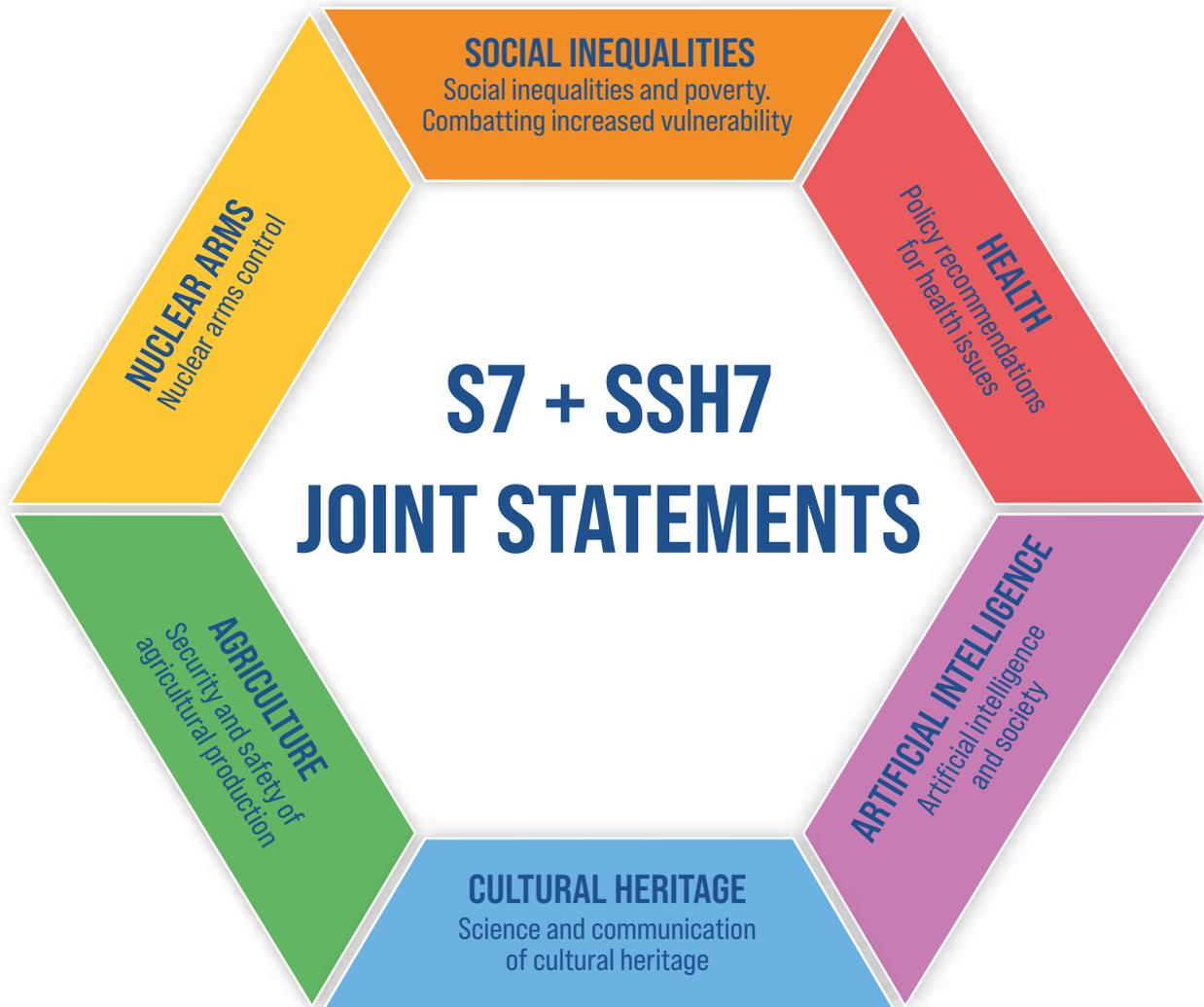


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**SECURITY AND
SAFETY OF
AGRICULTURAL
PRODUCTION**

SECURITY AND SAFETY OF AGRICULTURAL PRODUCTION

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 countries¹ and provide employment to 1.2 billion people whose income supports the life of 3.8 billion world inhabitants². 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 issues³. 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 FAO⁴ and UNCC⁵, provide evidence of the current situation and the need

for action. The IAP reports⁶, 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 soil⁷, but about 33% of global soils are moderately or highly degraded⁴, resulting in production losses, and in a decline of ecosystem services⁴. Without change, by 2050, 90% of all soils, as well as terrestrial ecosystems and food production, will deteriorate⁷. The FAO has set up a Sustainable Soil Management Program to promote sustainable practices and provide guidance on how to translate this into practice⁷. 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 households¹. 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 point¹. 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 ethi-

cal and safety requirements and international agreements. One third of food is produced by smallholder farmers⁸. 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 farmers⁹. 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.
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- 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.
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**ARTIFICIAL
INTELLIGENCE
AND SOCIETY**

ARTIFICIAL INTELLIGENCE AND SOCIETY

Artificial Intelligence (AI) is reshaping our world, offering numerous benefits but also raising critical concerns to be addressed through globally coordinated and inclusive governance. In October 2023, the G7 leaders published the Hiroshima Process International Guiding Principles and its accompanying Code of Conduct for public and private organizations developing and using advanced AI systems. With the present joint statement, we express the position of the G7 Science Academies on the technical and societal concerns brought by AI with a list of recommendations to policymakers.

1. Powerful AI systems, posing potential risks to the public if misused, should be appropriately secured against cyber and physical attacks. For sensitive AI applications, data-protection frameworks (e.g., EU's General Data Protection Regulation) commensurate to the level of risk and the use of privacy-enhancing technologies are essential to protect personal data. When interacting with AI systems, users need clear data protection guidance on how and for how long their data will be used, reused, and stored.
2. As AI systems become more capable and present greater risks to human control, formal safety guarantees will be required before

deployment can proceed. It is essential to adhere to strict standards for requirements verification, system validation and testing, and post-deployment monitoring, ideally by independent bodies that also check for hidden biases. Laws should be promoted to enforce the need for documentation, enabling users to understand capabilities, limitations, and appropriate domains of applications. The traceability of the underpinning data on which AI models are built is critical. As AI impacts crucial decisions in areas like medicine, the sciences, law, and finance, transparency and accountability are paramount. Clear avenues of accountability should be created as AI systems are developed and rolled out. Features like explainability, algorithmic recourse, and avenues for redress empower individuals to challenge AI decisions.

3. Trustworthiness in AI systems is vital. As humans spend more time interacting with AI systems and AI-generated content forms an increasingly large percentage of our information ecosystem, the risks to democracy, society, and human understanding become critical. Governments should promote legally enforced standards for AI-generated content. Institutional structures that promote

accuracy and authenticity will become increasingly important. Furthermore, raising the lifelong literacy of populations to understand how to identify and interact with AI-generated content will be key. Technology developers and online media platforms should consider the value of digital content provenance systems as well as the inclusion of domain experts in socio-technical evaluations (e.g., red teaming).

4. Generative AI offers vast potential in content creation and software development but raises questions about the protection of intellectual property rights when AI creates seemingly new content from existing works. The creative industries and scientific research are among the main sectors in which generative AI is having a significant impact. The existing legal framework for copyright, fair use, and IP protection needs an overhaul for the AI age. To address these issues a mix of clear legislation, industry self-regulation, and independent oversight is required.
5. Large-scale AI systems demand expensive computational resources, creating a barrier to entry. Widening global access to high-performance computing and establishing inter-governmental research hubs is vital for AI's equitable future. Expanding AI computational resources raises environmental concerns due to rising energy consumption. Sustainable design in data centres, strategic locations for efficient energy and cooling, together with novel energy-efficient AI techniques are crucial to aligning AI with environmental ethics.
6. Whereas open-sourcing of well-curated

datasets free of copyright issues is generally a public good to be encouraged, large open-source AI models present a complex tradeoff between benefits (e.g., for public-sector researchers and small downstream developers) and risks from misuse that are borne by the public. Decisions on allowing or restricting open-source dissemination of powerful AI systems must be subject to democratic oversight, and safety regulations that apply to proprietary systems must also apply to all instances of open-source systems.

7. The rise of Autonomous Weapons Systems prompts urgent ethical and military concerns. Their autonomy could lower the threshold for conflict, spur an arms race, and risk misuse by rogue regimes or terrorists. While some advocate banning such weapons, others seek stringent regulations in line with International Humanitarian Law, ensuring human oversight. Quick action by society is key to addressing this important challenge. Public transparency and discussions are crucial to navigating these challenges, aiming to uphold human values and international norms, as well as physical security at personal, local, national, and international levels.
8. Aligning AI with human values and ethics is required as AI systems will gain influence. Cross-sector collaboration is crucial for implementing ethical AI, integrating both technical and socio-cultural aspects while also taking cultural diversity into account. Addressing near-term risks, which may negatively impact vulnerable social groups, is critical to maintain trust and encourage

the adoption of beneficial technologies. The economic and social costs of alignment should be transparent and included in the decision-making process regarding when and how AI systems are used.

9. Effective stewardship is pivotal for even AI benefits distribution. Increasingly capable AI systems will have a significant impact on labour markets, and a joint approach with governments, industry, educators, and civil society is essential for ensuring the equitable distribution of the benefits. Governments should consider incentives for socially useful AI systems that address unmet needs rather than simply replacing humans in existing roles. Policies should prioritize the development of AI systems that address the most important challenges for the planet, society, and the economy.
10. Cooperation between the public and private sectors enhances responsible AI development. While private entities innovate rapidly, public institutions offer regulatory and ethical frameworks and promote independent long-term research for the benefit of humanity. Exchanging talent merges best practices and goals. This synergy combines innovation with accountability, optimizing AI's societal benefits, and it is best served when society, through regulators and democratic processes, draws the red lines of what is acceptable or not, and developers take the onus to demonstrate that their systems do not cross these red lines.
11. The responsible and safe development and deployment of AI is not solely a scientific and technical matter: it requires a collabo-

orative approach across different academic disciplines, including the humanities and social sciences, to understand and shape the complex socio-technical system within which AI operates and devise appropriate governance arrangements. By blending technical and non-technical views, we can address AI challenges like bias and fairness, ensuring inclusive, robust, transparent, and equitable deployment of AI.

12. Education should clarify AI's capabilities, debunk myths, and weigh its pros and cons. Citizens should be technically literate and aware of AI's social and ethical implications. Public dialogue, facilitated by various stakeholders, allows individuals to shape AI policies actively and align AI with the public interest. The risks and opportunities of integrating powerful AI systems into the educational framework should be carefully balanced.

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**POLICY
RECOMMENDATIONS
FOR HEALTH ISSUES**

POLICY RECOMMENDATIONS FOR HEALTH ISSUES

A common denominator to a number of the policy recommendations in this document is Public Health. There is strong evidence, reinforced by the COVID-19 pandemic, that there is an increasing imbalance between investment in treating disease and investment in maintaining health.

Preparedness and response to pandemics

Statement of the problem

The COVID-19 pandemic revealed weaknesses of health systems and institutional responses, and inadequate international cooperation. Control of an epidemic relies heavily on the pro-social actions of individuals: getting tested, wearing a mask, isolating oneself in the event of infection. This depends largely on public policies, the dissemination of reliable information, access to screening sites, an economic framework (such as paid sick leave) and the commitment of citizens. So far, there has been insufficient engagement with existing associations to set up a process that ensures that the public's voice is included.

Recommendations

Initiatives need to be put in place and coor-

ordinated on a world scale to identify potential novel pathogens and their natural reservoirs in other (wild and domesticated) species. Research should be supported by pathogen biomonitoring and genome sequencing facilities that are equitably distributed throughout the world. This implies the generalization of "one health" approaches. Real-time integration of genomic sequence data with complementary microbiological, clinical and epidemiological data should be strengthened. Inter-operability of information systems and legal aspects of data acquisition and perusal need to be addressed at a transnational level. Wastewater surveillance programs and rapid molecular surveillance of contagious bioaerosols (based on microbial DNA or RNA) should be established and standardized. Research in technologies and platforms that allow rapid development of vaccines, monoclonal antibodies and other tools to rapidly address emerging infections should be prioritized.

There is a need for clinical trial networks to be formed well in advance of the threat, ready to make use of adaptive platform designs and master protocols where possible; clinical trial networks generated very useful information on the (in)effectiveness of drugs and on the effectiveness of vaccines during the COVID-19

pandemic. In COVID-19 we observed the broad impact of the infectious agent on people with predisposing conditions such as mental health, non-communicable diseases, sexually transmitted diseases, and social inequalities. This requires much more attention, in terms of monitoring for broader impacts, fighting poverty and preventing non-communicable and other communicable diseases. Given the reliance on a collective approach requiring governments to engage with civil society and local stakeholders, a critical element of all actions is to enhance public trust and health literacy.

It is vital to strengthen multilateralism for pandemic management in all its essential dimensions - political, cultural, institutional and financial. This commitment to readiness inevitably requires additional financial resources. While infrastructural and professional flexibility may be helpful, there should not be a trade-off between pandemic safety and ordinary service levels.

Antimicrobial Resistance (AMR)

Statement of the problem

Antimicrobial resistance (AMR) is based on a natural biological phenomenon of adaptation whereby microorganisms acquire the ability to survive or grow even in the presence of sufficient concentrations of an antimicrobial agent. The World Health Organization has declared AMR one of the top ten global public health and development threats. In 2019, annual deaths associated with bacterial AMR were 4.95 million, of which 1.27 million were directly attributable to bacterial AMR (Murray et al <https://pubmed.ncbi.nlm.nih.gov/35065702/>). At particular risk of mortality are the most vulnerable individuals, such

as the elderly and children in the early stages of life. In the absence of effective antimicrobial treatments, some of the most important achievements of modern medicine, including major surgeries and new cancer therapies, are also at risk. Furthermore, the Research & Development of new antibiotics has been severely insufficient during the last decades, mostly because innovative products are kept in reserve as last resort options only for the most threatening infections, which limits their profitability.

Recommendations

One effective way to address this emergency is Antimicrobial Stewardship, which includes a set of procedures aimed at preserving the future efficacy of antibiotics by reducing their inappropriate use and therefore limiting selective pressure on the microbial population.

Among other options, the pharmaceutical industry should be incentivized through public funding to develop new antimicrobials, vaccines and diagnostics for the most burdensome syndromes and the most dangerous pathogens. One goal is establishing a market that will encourage the development of new antibiotics - for example through advance purchase agreements. A second goal is how and when to use novel antibiotics, in order to minimize the chances of the early emergence of antimicrobial resistance. Global push incentives that de-risk R&D activities and pull incentives that reward the approval of much-needed products can create sustainable business models that support innovation and facilitate access. Also important is the promotion of research for alternative solutions including vaccines, monoclonal antibodies, phage treatments, treatments using CRISPR-Cas technology and other emerging/evolving methodo-

logies [see also “Infectious Diseases and Antimicrobial Resistance”, S7 2015].

The crisis of the universal health systems

Statement of the problem

Most National Health Systems are in crisis and primary prevention is still largely underfunded. The crisis derives from a range of factors, including aging societies, shortage of personnel (particularly nurses), lack of clear clinical guidelines, lack of an explicit agreement on the amount and quality of healthcare that citizens require, and organizational issues. There are several deeper drivers of the crisis including the “technological imperative”, i.e., the adoption of new technologies available on the market in spite of increasing marginal cost-effectiveness; large variability, even at small area level, in the delivery of healthcare; lack of harmonized information systems, so that little is known on the gap between needs, demand, and healthcare offerings. These aspects imply large health inequalities and shift financial demands from primary prevention to healthcare treatment.

The urgent need to activate and practice medicine inclusive of women has been confirmed by numerous studies in recent decades and by findings showing different susceptibility of men and women to different therapeutic strategies, and unequal access to services. There are persisting gender inequalities in diagnostic and treatment pathways. Clinical trials (specially phase 1 and 2), are still undertaken with men in the majority. There is also strong evidence that children are often under-represented in clinical research.

Recommendations

There is an urgent need to address the underlying social determinants of health, including behavioural and environmental risk factors across the lifespan. Systematic national monitoring systems about healthcare access inequalities are needed.

The health system alone cannot tackle health inequalities and rising levels of comorbidities. Additional support is required for other sectors of public intervention to address these broad problems. Much greater transparency is needed to better define collective priorities, including better integration of the public and the private sectors and a social pact that specifies what citizens are entitled to and within which time frame, to make universalism a reality. There are also opportunities related to technology and the use of AI that can provide productivity improvements and more equitable access to services.

It is high time to promote medical research performed among women and children. Recognition of gender by medicine implies the need for urgent innovation in pharmacology. It is important that pre-clinical and clinical protocols of medical research be equally developed for men and women and that Ethics Committees ensure that protocols respect the right of women to health and access to inclusive healthcare. Children are also an underserved population, particularly in terms of research.

The health impacts of climate and environmental change

Statement of the problem

An overarching global problem that affects he-

alth is climate and environmental change. The health of humans and other species is seriously threatened by the rapidly changing climate. The health impacts are only partially known and include deaths from heat waves, spread of infectious diseases, especially those which are vector-borne, salinization of coastal areas, the deadly (direct and indirect) effects of floods, wildfires, drought and their implications for agricultural productivity and food safety. There are marked social inequalities in these health impacts. Government responses to global warming and wild species extinction have been so far insufficient and inconsistent.

Recommendations

A first step of public action needs to be a rapid transition from fossil fuels to non-carbon solutions, including renewables, followed by other evidence-based and equity-sensitive interventions to mitigate climate change and adapt to it. International coordination of actions concerning deforestation, extensive animal breeding (particularly ruminants), wild animal harvesting, sanitation of food markets, and planetary health oriented dietary changes are urgently needed. Serious action against chemical pollution is also essential. Concurrently, the impact on climate change needs to be considered in healthcare services and delivery (e.g. choice of anaesthesia, drones for delivery of medications) as well as in the context of biomedical research.

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**NUCLEAR
ARMS
CONTROL**

NUCLEAR ARMS CONTROL

After a sustained period of declining numbers of nuclear warheads, there is a risk this trend could now reverse.

The decrease in the number of warheads was the combined effect of numerous treaties. Following the 1970 Non-Proliferation Treaty (NPT), the United States and Russia established a set of bilateral arms reduction and verification treaties, which greatly reduced the risk of a nuclear confrontation. These treaties significantly reduced the stocks of nuclear weapons in the USA and Russia and helped increase confidence and stability in international relations.

Recent years have seen an inversion of this trend, associated with increased international tensions which led to the withdrawal from several treaties.

The increase in geopolitical crises and new wars being fought involving countries possessing nuclear weapons threaten regional and global stability. New threats have been made to use tactical nuclear weapons. These are designed to be used on the ground against military targets. However, in addition to their large destructive power, the use of such weapons is associated with severe and widespread effects from radioactive fallout. Most importantly, the use of such weapons could lead to the escalation and the use of strategic nuclear weapons.

Efforts have also been made against the use of

nuclear weapons. On 3 January 2022, the five NPT nuclear-weapon states declared that “A nuclear war cannot be won and must never be fought”. Later that year, G20 leaders declared at the Bali Summit on 16 November 2022, that “The threat of use or use of nuclear weapons is inadmissible”. At the Hiroshima Summit in 2023, G7 leaders declared, for the first time ever, their commitment to achieving a world without nuclear weapons.

In the context of the current global instability, it is imperative to highlight the known consequences of nuclear warfare. There is a strong scientific basis for the following points.

The speed of any war can be rapid. Hundreds of multi-warhead missiles can be launched over a short period of time.

The multifaceted damages resulting from a nuclear conflict have been the object of intensive scrutiny by the scientific community in thousands of technical publications.

1. Survivors of the blasts and fires who are exposed to high radiation doses would face acute radiation sickness and most would die within hours or weeks. Those exposed to lower but still substantial doses would have an increased risk of developing radiation-related diseases in the future;

2. Among the long-term effects on survivors are the increased rates of cancer and other diseases, including cardiovascular diseases and immune dysfunction as shown by epidemiological studies of the Hiroshima and Nagasaki survivors and other exposed populations;
3. A full-scale nuclear war between the nations with the largest arsenals would result in devastation to those nations and would cause harm worldwide. In addition, several recent scientific studies conclude that also nuclear wars between nations with smaller arsenals could have substantial effects beyond the early fatalities, which themselves could range up to hundreds of millions of people;
4. Nuclear explosions and the fires they cause are likely to inject soot into the stratosphere, reducing sunlight and temperatures on Earth. While there is uncertainty about how much soot reaches the stratosphere and how long it remains there, these effects could significantly reduce agricultural output and fish catch following a nuclear war, exacerbating food insecurity globally beyond the direct disruption from the war;
5. Depending on the scale of use of nuclear weapons, there is the potential for the destruction of entire ecosystems and extinction of species, due to the direct impact of explosions and fires and altered climatic conditions. In the worst cases this could be on the scale of a mass extinction.

Historical evidence suggests that the primary way to shift from growth to reduction of nuclear weapons, to reduce the risks of nuclear use, and to reduce the proliferation of nuclear we-

apons is by means of international agreements that limit numbers and types of weapons, establish means of monitoring and verification, establish means of communication and conflict resolution, and verifiably restrict uses of nuclear materials and technologies, all to implement the renewed commitments against the use of nuclear weapons.

Among the roles of the scientific community are to continue to develop and communicate the scientific evidence base that shows the catastrophic effects of nuclear warfare on human populations and on the other species with which we share our planet, to develop means to monitor, detect, and verify agreements, and to support the governments as they seek to fulfil the commitments described above.

The science academies of the G7 countries, in light of the rise in international tensions and wars, call on the G7 leaders to once more reaffirm their commitment to achieving a world without nuclear weapons and to take the necessary steps to help the world to realise this goal safely and securely.

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**SOCIAL INEQUALITIES
AND POVERTY.
COMBATting
INCREASED
VULNERABILITY**

SOCIAL INEQUALITIES AND POVERTY. COMBATting INCREASED VULNERABILITY

The first of the Sustainable Development Goals approved by the UN General Assembly “to achieve a better and more sustainable future for all” is the eradication of extreme poverty, defined as surviving on less than \$2.15 per person per day at 2017 purchasing power parity, to be achieved by 2030. Since the 1980s, the number and percentage of people in extreme poverty has declined. According to World Bank estimates, in 1990 the incidence of poverty was 37.9 percent; by 2019 it had declined to 8.4 percent. Around 60 percent of the extremely poor live in Sub-Saharan Africa.

This trend reversed abruptly in 2020, when extreme poverty increased in many regions due to the consequences of the Covid-19 pandemic. The number of people in extreme poverty went up by more than 70 million (crossing the 700 million in poverty threshold), and the incidence of poverty worldwide rose to 9.3 percent¹. Many people who have been lifted out of poverty are at risk of falling back into poverty. Some studies report that the long-term effect (until 2030) of the pandemic shock may be an increase in vulnerability to extreme poverty of more than 100 million people². This trend would increase social inequalities both within and between countries, especially where extreme poverty contrasts with increasing wealth of the better off.

In recent years there has been a growing consensus regarding the limits of income poverty measures as a standalone indicator. Poverty is a multidimensional phenomenon because the poor can suffer multiple disadvantages at the same time when they may have poor health or malnutrition, a lack of clean water or electricity, poor quality of work, little schooling, or other disadvantages. The World Bank estimated that in 2019, multidimensional poverty was larger than monetary poverty with a global incidence of 14.5 percent, and in Sub-Saharan Africa 52 percent, with no clear decreasing trend³. Research reveals that many women and people with disabilities tend to be multidimensionally poor compared to people without disabilities.

Food deprivation is also a serious concern, increasing from 720 million severely food insecure people to 900 million in 2022, 11.3 percent of the global population⁴.

There is a clear need for a change of strategy in the fight against poverty, which we urge the governments of the G7 countries to consider. In the wake of the pandemic and its severe socio-economic consequences – as well as the poverty and hunger impact of new conflicts and tensions at the international level on international markets - it is necessary to strengthen more specific policies against poverty in addition to

fostering economic growth. Policies should aim at boosting social protection and preventing dramatic increases in extreme poverty in response to health, food and climate crises, unexpected economic downturns and conflicts (on health issues see also the document on health). These strategies require policymakers to consider other dimensions of poverty not necessarily related to income, such as adequate education and access to essential infrastructure and services (water, food, health, electricity, energy, mobility, accessibility). The lack of these crucial goods and services, regardless of income, has exacerbated disparities between high-income and low-income countries and within countries, with major consequences for social cohesion and overall stability.

Another priority for the change in strategy is the design and implementation of policies to enhance human capabilities and resilience. Much of the development assistance and policy for low-income countries has relied on financial measures (debt reduction or cancellation, financial aid and credit). The experience of the past decades shows that these measures have not been as successful as expected when not combined with the measures recommended below and have also raised concerns regarding accountability.

It is therefore important to engage in an open and critical dialogue – one of respect and reciprocity – to identify policies aimed at improving the capabilities and the resilience of populations. These policies can have specific and pre-determined objectives agreed and implemented with input from local populations. Cooperation on an equal footing and policies need to be more attentive to the specific institutional contexts and to the institutional infrastructure that con-

ditions their success.

The following recommendations are suggested to reduce poverty in countries and for population groups in greatest need:

1. Policies to improve capacity should be pursued and strengthened to increase the resilience of those people and populations who live in conditions of extreme poverty or are particularly vulnerable to future adverse shocks. It is important to ensure access to robust, accessible, sustained infrastructure and services for well-being (e.g. water, food, health, energy, mobility, and accessibility). Policies in this regard must provide for coordinated access to infrastructure and services for all;
2. It is important to ensure, through agricultural and food policies, food support programs for people in poverty that ensure conditions for adequate nutrition for all, but especially for children (see also the document on agriculture);
3. Education plays a crucial role. Generalized access to basic education must be ensured. Collaboration and partnership could be fostered between higher education and research institutions in G7 countries and local institutions, especially in those countries with high rates of extreme poverty and inadequate access to education at all levels;
4. The role of women and other often disadvantaged groups is also crucial to combat extreme poverty. Gender inequality and ableism must be strongly addressed by removing physical, legal, and cultural obstacles to the participation of women, the disabled and other groups. Policies must be developed

and implemented in ways that take account of, and are sensitive to, gender issues and women's empowerment. This should include tackling gender-based violence, which both impacts women in poverty and makes women more vulnerable to poverty;

5. Policies to mitigate climate change should not burden more heavily on low-income countries and groups than on high-income ones. Energy transitions should ensure that people in poverty, who often spend a greater proportion of their income and time on energy costs, are not negatively affected, and climate policies should consider the relative capabilities of different nations to respond, and the losses experienced by countries that cannot easily recover from climate impacts;
6. Sub-Saharan Africa overall appears to be the world's most vulnerable area based on many risk factors and dimensions of inequality: environmental, food, health, and education. Policies that support Sub-Saharan Africa are a priority, without neglecting other areas of the world where comparable conditions of inequality occur;
7. We conclude with a recommendation that calls for the urgent strengthening of an integrated action of the G7 states to combat increased poverty and vulnerability, including within the G7. This action could be carried out by using and enhancing the institutional infrastructure already offered by the UN with *The 2030 Agenda for Sustainable Development*, whose primary objective is the elimination of extreme poverty; as also reiterated by the Final Declaration approved

by the *UN Annual Conference on Sustainable Development*, held in September 2023.

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- 1 World Bank (2022), *Poverty and Shared Prosperity 2022: Correcting Course*, Washington D.C.: World Bank Group.
 - 2 Mendez-Ramos F. and Lara J. (2022), *Covid-19 and poverty vulnerability*, Brookings Institution.
 - 3 Diaz-Bonilla, Carolina; Aron, Danielle Victoria; Haddad, Cameron Nadim; Sabatino Gonzalez, Carlos Gerardo; Nguyen, Minh Cong; Wu, Haoyu (2023), *Update to the Multidimensional Poverty Measure - What's New*. Global Poverty Monitoring Technical Note, no. 34. Washington, D.C.: World Bank Group.
 - 4 FAO, IFAD, UNICEF, WFP and WHO. 2023. *The State of Food Security and Nutrition in the World 2023. Urbanization, agrifood systems transformation and healthy diets across the rural-urban continuum*. Rome, FAO.

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Marcia McNutt

**SCIENCE AND
COMMUNICATION OF
CULTURAL HERITAGE.
KNOWLEDGE AND
PUBLIC AWARENESS OF
OUR COLLECTIVE ROOTS**

SCIENCE AND COMMUNICATION OF CULTURAL HERITAGE. KNOWLEDGE AND PUBLIC AWARENESS OF OUR COLLECTIVE ROOTS

1. “Cultural heritage” includes the tangible and intangible products of human culture within nature, as well as the transformative effects of those cultures on the natural world that generate culturally significant landscapes, and it includes information gathered from human remains (viewed as a biological archive of the humans in the past). Cultural heritage is related to our common nature as a species as well as to our diversity as individuals, populations, and communities. It consists of archaeological and bio-archaeological remains, geo-archaeological settings, buildings, monuments, including those underwater today, landscapes, archival materials, books, works of art and artefacts, historical documents, languages and literature, as well as folklore and traditions.
2. Cultural heritage is the foundation of both our collective identity as human beings and the distinct identities shaped by different traditions. It expresses the tangible and intangible memory of societies and is thus at the root of the understanding of our collective past and the human place in nature. The retrieval of this memory substantially contributes to our ability to meet present and future challenges.
3. The contribution of natural sciences, social sciences and humanities, as well as their transdisciplinary involvement, are all crucial to the full and thorough exploration, understanding, preservation and communication of cultural heritage. This is particularly the case for the archaeological and historical heritage, but it also concerns other forms of cultural expression.
4. Scholars and institutions in this field should aim to communicate new knowledge and results achieved through scientific and historical research widely and accurately, avoiding distortions or mere spectacular display of evidence. Public involvement is crucial to enable people to learn and experience directly the tangible and intangible traces left by our ancestors, which are the basis of our cultural and historical roots.
5. Like all scientific knowledge, knowledge of cultural heritage is subject to continuous critical scrutiny according to evolving processes and methods of intellectual inquiry. Rigorous knowledge is invariably a work in progress, with inevitable doubts and uncertainties, which do not weaken but rather enrich knowledge by keeping it transparent, constantly open and growing. Good practice

in the communication of science can stimulate critical thinking and evaluation of evidence, promoting an evolving understanding of our world. This is increasingly important in counteracting pervasive misinformation. Instances of the misuse of cultural heritage and historical sources as an ideological weapon may be found throughout history, showing the enduring threat of unscientific reinterpretation for ideological purposes and underscoring the imperative to address and counteract such distortions with vigilance.

6. Critical public awareness of cultural heritage and accessibility to it are fundamental components of civic culture and civic life: they create a sense of belonging, ownership, and positive awareness of both diverse and collective roots. This process strengthens the link between communities and their histories, contributing to both a thorough understanding of cultural heritage and the conditions for its preservation. Humankind's diverse roots are the result of multiple intersecting histories and traditions. Interpretation and communication of cultural heritage should acknowledge this and thus be instrumental in fostering mutual understanding and respect for cultures that may differ from our own. Reconstructions of cultural heritage should be based on best practices in scientific and historical studies, and avoid disseminating inadequate, flawed or divisive narratives that obscure the multiple overlapping paths followed by artefacts and ideas across time, cultures and places.
7. A major tool in disseminating scientific understanding and interpretations of the wor-

ld's cultural heritage is the careful use of digital platforms, interactive devices, and multimedia installations, which may help in disseminating knowledge and engaging the public in reconstructions and immersive experiences. Narrating crucial phenomena and important dynamics of change in the history of human societies using real data and accessible language, without depriving those phenomena of their complexity, is the best way to make the study of the past relevant to understanding the present and facing the future. Open Access databases created by reliable organizations should also be promoted to disseminate and share the scientific knowledge of cultural heritage.

8. G7 countries should play a leading role in disseminating critical awareness of cultural heritage in schools, museums, and other educational institutions by promoting national and international initiatives both within and outside the G7.

8a. Major efforts should be made to develop an effective infrastructure to enhance the role of museums, heritage sites, parks, archives, and libraries in the protection and dissemination of critical knowledge and enhancement of cultural heritage. Museums as cultural hubs can play an important role in this respect. This development should be accompanied by adequate gender-neutral employment opportunities for younger generations of highly qualified researchers and professionals, who are often not sufficiently valued and properly employed. Adequate funding is recommended both for field investigations, including the preventive archaeological practices especially neces-

sary in heavily urbanised environments, and to enable subsequent thorough studies of the findings and their appropriate publication and dissemination.

8b. We recommend that G7 countries support and promote the dissemination of independent and critical historical and cultural knowledge in educational institutions at all levels, including schools, universities and NGOs. The study of the origins and histories of some crucial phenomena and processes of social change that have taken place over time in human societies and the significance of their material traces as sources of information, understanding and emotional involvement can restore people's awareness of the importance of knowing our own and other's past and the various pathways that have led human societies down to the present, thus making cultural heritage a shared heritage.

9. The G7 countries could play a decisive role in promoting systematic and decisive international collaboration to counter the theft and illegal trafficking of cultural artefacts, which deprive countries of crucial parts of their heritage and identity. In addition, and even more urgently, G7 countries should seek to strengthen international frameworks addressing the intentional destruction of cultural heritage during war or other conflicts driven by ideological, religious, or other motivations, where cultural heritage has often become a deliberate target, and seek to reinforce collaborative efforts and global commitments to preserving cultural heritage during armed conflicts. Access to and enjoyment of cultural heritage is founded

on international human rights norms, which include the right of individuals and communities to know, understand, maintain, and share cultural heritage, as well as to benefit from it. The intentional destruction of cultural heritage is a violation of human rights. The repatriation of cultural property is also a widely discussed and sensitive issue that deserves to be addressed in international contexts beyond the G7 framework.

10. The G7 countries must seek effective means to promote international collaboration between researchers in the natural and human sciences to enhance the understanding of humankind's cultural heritage. Collaboration between scientists, technologists, heritage professionals, local communities, and the general public is essential to strike a balance between innovation and the preservation of cultural heritage, ensuring that innovative technologies will not focus exclusively or primarily on the spectacular representation of vestiges of the past, but will enhance the deep historical significance of cultural heritage, at both a local and global scale. Science and technology are vital in understanding, preserving, and enhancing cultural heritage, and ethical considerations must guide their application. Respecting cultural sensitivities and involving local communities in sharing knowledge about diverse human pasts, making them aware of both what makes them different from one another and what they have in common are fundamental objectives to be pursued.
11. The protection of cultural heritage in the face of both internal and external challenges, such as poverty, conflicts and war, is

an important challenge faced by many nations around the world. Balancing the conservation of cultural heritage and historical landscapes with developmental goals is a problem with no easy solutions. Nevertheless, the G7 countries should take steps to enhance the awareness of heritage along with carefully constructed advisories to reconcile sustainable tourism with the conservation of fragile cultural ecosystems. Steps should also be taken to build skills-training programs for students, local stakeholders and other concerned parties on how best possible results could be achieved through the collaboration of institutions in different nations and the joint dissemination of information.

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