

Discussion*

Qu Dongyu, Joachim von Braun, Giorgio Parisi,
and Wolfango Plastino

Wolfango Plastino: According to State of Food Security and Nutrition in the World (SOFI) Report 2020, three billion people can't afford healthy diets today; what changes are needed to increase access to healthy diets and to assure at the same time sustainable agri-food systems?

Joachim von Braun: Before answering this question, first let me define healthy diet. It is a diet that is human-health promoting and disease-preventing by providing adequacy of nutrients, without excess, from foods that are nutritious and healthy, and avoiding the introduction of health-harming substances anywhere in the value chain. Healthy diets must also be accessible and affordable and culturally acceptable.

So what changes are needed to increase access to healthy diets and to ensure at the same time a sustainable agri-food system? This is a complex modelling issue. We are addressing it for the Food Systems Summit in cooperation with FAO, because we need to assess synergies and trade-offs. I have four quick points to make. People need to have the purchasing power to buy a healthy diet. The poverty line postulated by the World Bank needs to be higher. 1.90 US dollars a day does not buy a healthy diet. Poorer people need social safety nets to ensure their access. Secondly, the food industry needs to be part of this, and it needs to produce healthy food. Governments need to regulate for safe and healthy food. Consumer information needs to be sound and labelling understandable. Third, there needs to be direct action for children to have access to healthy diets. School lunches and early childhood feeding at health and nutrition centres need to be expanded and better funded to have broader coverage of lower-income children, especially under Covid-19 conditions. And fourth, for sustainable food systems, food prices must

* The text below is the full transcript of the Round Table that followed the *Lectio Magistralis* by H.E. Qu Dongyu, Director General of the Food and Agriculture Organization of the United Nations.

reflect the true cost of healthy food. So-called externalities must be internalized, farming needs the incentives to become climate-neutral and shift to more sustainable land use. Food losses must be cut by means of technologies, and food waste by incentives and behavioural change targetted at consumers.

So your simple question requires a complex answer. We need to follow up on it.

Giorgio Parisi: Producing a healthy diet is not simple. So many different aspects must be considered, aspects which are not only scientific but also socio-economic, because it is one thing to know what should be done, and it is another to have other people do it, and to implement it on the field. Many aspects should be considered, but I would like to stress one, which I believe is very important, and that is biodiversity.

Biodiversity is crucial, because it has many different positive effects. Biodiversity is an insurance against bad harvests. I mean that one food crop may be destroyed by a pest, while another one may survive. Other crops can compensate for the one that is destroyed by adversity. Biodiversity also allows for food diversity, both daily and seasonally. For technical reasons, the diversity of crops allows the soil to regenerate, and micro-organisms can adapt to the great difference of compounds over time, making it more difficult for pests and other organisms to multiply. Agriculture and related land use, of course, accounts for something like 17% or 19% of the total CO₂ emissions, and the transport costs may also be very high for easily degradable goods like fruit and vegetables. I think that while monocultures seem to be economically viable, they must be strongly discouraged.

Qu Dongyu: I fully agree with Professor von Braun and President Parisi, but I just want to highlight Professor von Braun's points. I respect him because, you know, we need a developed economy. If you don't develop a country which is neither big nor rich, you will create a lot of social problems in time. So, we need development and the creation of jobs, decent jobs for the farmers and the people, so they have money to buy their homes. That's the incentive. No matter whether it's food-intensive agriculture or fashion shows, fashion design or industry, or something else, we need to create jobs for development.

Second, we need innovation to improve efficiency, productivity. It doesn't matter whether it's a biotic or an abiotic approach or an engineering approach, because we're talking about biological sectors, biotechnological sectors. And so we need engineering, too. I

visited some Italian factories many years ago. You have very good machines for horticulture, for trimming the garden and so on. All these agricultural sectors are related to technology and innovations. We need innovation to improve jobs and incomes. And last but not least, we need an enabling policy to look at all the issues, like those that President Parisi mentioned, such as how to have farmers and local communities make use of biodiversity and transform biodiversity into food diversity. You can only protect your food, your biodiversity, through food diversities *in situ*. We even have a professional word for this: *in situ*. So you have one village protecting its native flowers, vegetables, fruit. I visited some small villages in Italy many years ago. Each has its special fruit, its special vegetables. And that's your national gene bank, your national germplasm.

So you can let your farmers grow, making food for other consumers for generations to come. Otherwise you're only talking about biodiversity protection. That's not very relevant to our daily life; it's only relevant to the experts. It's not good enough. So I think of these three aspects – enabling policy by putting the durables first, decent jobs in bio-agriculture, and the food industry and so on – and I think of the digital also. In China, we have 60 million new digital jobs created in e-commerce. So you lose jobs from the department store, from supermarkets, but at the same time you create new jobs in e-commerce. Direct service. These are real transformations through innovation. And that is the final point: innovation. Innovation in all things, not only technology, but business models, policy and so on.

Wolfgang Plastino: *How do we use science and innovation to transform agri-food systems to achieve the 2030 Agenda for Sustainable Development Goal 2: Zero Hunger?*

Qu Dongyu: First, zero hunger: what does zero hunger mean? For different regions, for different peoples, there are different interpretations. I would say that the staple food in Africa is cassava. In Asia, South Asia, it's rice. In the South Pacific islands, it is taro, and in the Caribbean region it is a legume, or pulses. So we have the first thing to focus on: first, there are major commodities of the zero-hunger staple food. Second, we have to look at how to improve the nutritiousness of food. In Italy, you like to eat different vegetables than those that we like to eat. You like to eat eggplant, but not many countries like to eat eggplant. So you have to focus on your specific commodities. Third, to end global hunger, you have to establish a good supply chain, because in the culture of

perishable products, you need both the culture and the supply chain running. So you need to invest in the infrastructure surrounding agriculture. And fourth, you need innovation again, because, as I've said, innovation is needed in each commodity, each sector, each sub-sector. You need a different specific innovation for each of these. Otherwise, you can't feed the populace.

Joachim von Braun: Science in all key components of the food system is needed. The primary production system in the market and processing system, in consumption and nutrition, and addressing the income and resiliency issues related to climate stress. And science is needed that embraces the system as a whole – system science.

Current investment in public science for the food system is not sufficient to achieve the 2030 Agenda for hunger and nutrition. The ratio of science investment per capita in high-income countries versus low-income countries is about one hundred to one. That is one of the biggest inequalities on Earth. And we need more sharing of science – more investments and more sharing of relevant science between North and South. Investment in agricultural research for innovations is one of the highest pay-offs in terms of sustainable hunger reduction. When we scientists call for more investment in science, and more science, and so on, policy makers don't immediately believe that there is need for this. So we need to prove it. Research shows that with investment costs per person of 30-40 US dollars, about three hundred million people can be brought out of hunger productively and sustainably, if well targeted.

We need in addition better science and policy interface. Climate policy and climate science were helped forward by the international Intergovernmental Panel on Climate Change, the IPCC. We need something like that for food also, an IP on food. Maybe FAO can host it.

Giorgio Parisi: I fully agree with Director Qu and Professor von Braun. I think that science has a great responsibility here. Of course, it's not only science. We have to organize things on a global level. I think that there should be some global investment made by the rich countries in such a way that the investments of rich countries go to third-world countries, to the poorest countries, in order to help them. The total budget of FAO is something less than one billion dollars, which is not a lot if we consider the incredible kinds of problems our world is facing. It is clear that multilateralism and collaboration of countries are required to provide the possibility of having science, and innovation coming from

science, go and work in the field – to work *in situ* as Director Qu was saying. And science of course can only say to politicians what should be done; their answer on all levels, or their decision to adopt specific suggested courses, depends very much on their prior political commitments. The Green Revolution that Director Qu has spoken of before, of the fifties and the sixties, piloted new varieties of wheat, rice and maize. There were various successes in Mexico, in many Asian countries, as in India, the Philippines and China, where politicians committed to their widespread adoption, but there were fewer in Africa.

And there is another point that is quite important, one where science could be very relevant, and that is protection from pests, from all kinds of pests. For example, we know that a long time ago, I mean thirty years ago, science was quite useful in blocking the case of the cassava mealybug, which could potentially have destroyed agriculture almost completely in many African countries. The very important introduction of a parasitoid, *Apoanagyrus lopezi*, enabled control of the pest, and avoided widespread famine across sub-Saharan Africa, practically saving the lives of twenty million people. It is clear that this was a very successful intervention, but science should be very careful in monitoring this type of new parasite that could destroy agriculture, also because in some cases it could be extremely difficult to find a way to biologically control new parasites.

Wolfgang Plastino: *Do we have to choose between agro-ecology and biotechnology?*

Giorgio Parisi: Well, no. I don't think we have to choose. I think that agro-ecology and biotechnology are complementary to one another. I would say that the main aim of agro-ecology is to reduce the use of synthetic chemicals, which in the long run have harmful consequences for human health, and even more importantly, we should make agricultural production sustainable, and chemical use may sometimes take us in the wrong direction. Biotechnology allows us to take fundamental steps in the same direction as agro-ecology, and there are many ways in which biotechnologies may help.

I will give only one example. Soil, which is of course the basis of any crop, is quite a complex system containing many organic and inorganic components, which coexist in close interaction with the living biomass. Of course, the system is complex because the number of different species, the number of different substances and so on, is so high that their interactions are not so easily understood, in the same way that we don't understand what happens

in our guts, where we have a hundred thousand different microbiota. Now, there are many bacteria that promote cell growth, and among these bacteria, the role of rhizobacteria is fundamental – for example, Rhizobia, which are very important because they can establish a symbiosis with leguminous plants for nitrogen fixation in the soil. It is clear that nitrogen fixation is crucial, because this is the basis of all agriculture, and all types of crop rotation. It is clear that if we succeed in certain interventions in the composition of soil micro-organisms in such a way that we can improve nitrogen fixation and other types of beneficial processes, this kind of scientific intervention, which could be done in such a way that it could be easily used, could have a dramatic effect on the productivity, and also on the sustainability, of agriculture. What is important is what happens in the long run; we should not only succeed in eradicating hunger in 2030, but we should also find a way of maintaining a world free of hunger; the sustainability of agriculture is crucial here. Now, these kinds of interventions on bacteria and other kinds of interventions of the same type are absolutely compatible with the agro-ecological vision, so I do not see any kind of contradiction between these two ideas.

Qu Dongyu: I fully agree with President Parisi, but I want to make two short comments. You know, every technology, every approach, has a main purpose, a main function. So first, I want to be clear: there is no contradiction between agro-ecology and biotechnology. They should play complementary roles. I agree with President Parisi.

Second, what kind of agro-ecological tradition are we talking about? In China, in Roman times, two thousand, three thousand years ago, in Egypt, they already had agro-ecology. But that's a low-level tradition. Now we need more innovation in agro-ecology. Innovation should come in all ideas, not only the technological stuff, but also management, and also in our marketing approach. And then we have to look out for bad technology, also. We need to minimize negative fossil fuel impact before these technologies come to the field. So there's no contradiction here.

But how can we put all of this together to make one plus one larger than two? Or even two times two makes four, or three times three makes nine. It's simple. Different countries have different priorities. Some countries may put more priority on agriculture, some maybe put more on agro-ecology or other technologies. So let's be flexible, and differentiate the priorities and the choices of the member countries, because they are in different development stages in their economies and agri-food systems.

Joachim von Braun: I want to follow up on President Parisi's point regarding soils. I very much agree that this is critical. Land and soil degradation is a big global problem. In our research, my institute together with our partners estimate that three hundred billion dollars is the annual cost of land and soil degradation. And most of this cost is lost in ecosystems functions, in water and biodiversity and so on, and also a large part is lost in production. The cost of inaction, of our accepting this high cost, is much higher than the cost of action. There are solutions, and agro-ecological approaches are part of the solutions. All agricultural systems must consider ecology; that was also highlighted by Ambassador Marrapodi. However, we must start by improving from where the systems are, that is from the realities of farming in the highly diverse farming systems around the world, and identify best-fit approaches, not idealizing approaches across the board.

Many agro-ecology approaches exist alongside many biotechnology approaches; so best fit is what we need to look for. With the exception of low-input low-output, farming will waste land resources, and we need to watch that. For instance, most smaller farmers in Africa would benefit from improved seed breeding. That breeding should be done much more locally and can be enhanced by bioscience. So the two approaches belong together.

Wolfgang Plastino: Is there one game changer solution or should we be thinking on bundling solutions to achieve the needed agri-food systems transformation?

Joachim von Braun: There is no silver bullet to end the problems of the food systems. We have analyzed a whole range of options and concluded that a bundle of about twenty interventions in combination could go a long way towards optimally and sustainably ending hunger by 2030, or bringing it close to or below 3% from the current about 10%. That is not free of charge. At an additional cost per annum of about forty to fifty billion US dollars, we can collectively partnership between the global North and the global South, and, with a lot of actions by public and private players, achieve a world coming close to ending hunger.

For the Food Systems Summit, we are carefully modelling scenarios adapted to local circumstances, and considering options that quickly achieve both improve food and nutrition security, and protect and rebuild the agro-environment. Where should this additional annual investment of forty to fifty billion US dollars to end hunger come from? Through broad-based investment, not a

single game-changer; these resources should not only come from development aid and public investment, but also from creative financing, which needs to be mobilized. Trillions of dollars of funds are looking for investment in the low-interest-rate context currently, while there is a huge need to invest in hungry people, people with potential. This is an economic market failure and an ethical failure that the Food Systems Summit must address.

Giorgio Parisi: I agree with Professor von Braun. I also think that there is not only one game-changing solution. We actually need a bundling solution, because the transformation that we face is a slow but continuous process that requires time, but also perseverance and balance. There can be no single answer, but rather a range of answers to be adapted to different situations in different regions of the world and in different areas within the same country. There are great differences between agrifood systems in both food security, which is extremely important, and nutritional status. There are major differences in nutrition even between population strata within the same country, and eating habits change as per capita income rises. There is no one-size-fits-all solution to achieve a healthy diet and exploit the potential of the environment.

Many factors also need to be considered, such as food prices, the income of farmers, especially small farmers, the distance between production and consumption sites, and the priorities of governmental objectives in the agricultural system (because it is also important what local governments want to do); and one also has to consider finally the availability of products in local supermarkets and markets. So all kinds of economic factors have to be taken into consideration in order to go in this direction, but always recalling that the process is slow and cannot be solved with a silver bullet.

Qu Dongyu: First of all, I agree with my colleagues. But I just wanted to remind our audience that the agri-food system is not as simple as you might imagine. You eat food; every day you eat it. But this food is composed of chemistry, physics, mathematics, biology – you name it – from the soil to the water to the air. So it's not that simple, if you are not an expert in food systems. And agrifood is important not only for the time being, but for generations and generations to come, because this is part of civilization.

That's why I would like to look at the complexity of agri-food systems. We need to look at the level of scientific innovation, we need to look at the economic level, we need to look at the environmental level, we need to look at the educational aspect, we need to look even at the family level, the individual level. It's like a big

player playing a piano. You are each one of the fingers; you can play your specific role. So you may not work in the agri-food system, but you still can play a role, starting with your family, for instance by educating your grandchildren to waste less food, or by building good habits – how to purchase the hard work of farmers, and from producers and traders and so on.

But I have an idea which is a little different from the others'; we can use one stone to hit three birds. That is a government policy-maker's thinking, to use one stone to hit three birds, instead of one bird or two birds. That's the beauty of enabling policies. That's also a big potential internationally, with FAO working for one hundred and ninety four countries. I forgot to mention investing in farming development not only in Germany or China or the United States or Europe; you should go to the field. So we need more agents that understand this within the market, via market-oriented scientists in developing nations. Not only by talking in Rome; we also need to go to Africa, to the Caribbean, Latin America, and other developing nations. So let's work together, let's think together, and, by learning together, walk together and contribute together to a safe, peaceful world.

Wolfgang Plastino: *What do you expect to be the role of digital technologies in the agri-food system transformation by 2030?*

Qu Dongyu: You know, in the history of the Roman times, or ancient Chinese or Asian times, we have faced three or four different stages of civilization, from traditional wild life, to the traditional home life, then you come to industrial life. Now comes digital life. You can see that the pandemic has forced us to be placeless. Placeless life, virtual life, is really green life. Of course we need face-to-face talks in the future. Still, this will be a good adjustment for us: digital culture, no matter if you're a big farmer in Brazil or in North America, or a small one in the Far East, Japan, South Korea, China (some parts of China). As I said, the digital approach will be one stone hitting three birds, or four birds, at the same time. You can force a reversal in over-production processes and supplies, and food loss or waste.

And then there is food diversity. If you come to Beijing, I don't know how to make the typical Italian spaghetti or pizza. But I can order it. If you arrive at 6:00 pm, I'll order it for half an hour later. So that's sharing cost, sharing economy, from farm production to consumption. And it also ritualizes all the small components of the process. That's what I wanted to make clear.

Every small-hold farmers in Italy can directly sell your olive oil to the market in the Far East, in Japan or in China, and there you can benefit. Through the traditional wholesaler-retailer systems, there is a lot of food and environmental waste, and also less efficiency, and farmers don't benefit from that. But it's different if you have a direct e-commerce, C2C, C2B, you name it. And also you really improve quality, because you don't need the long-term go-between. Everything is synced. We unleash potentials for the economy, for the shared economy in the world – especially for agricultural commodities.

Joachim von Braun: Director General Qu Dongyu already addressed an excellent set of issues in his lecture. The future of digital technologies in the agri-food system looks bright, but we're not there yet. Inequalities are large. Rural people and farmers need digital access. This becomes very obvious under the current Covid-19 situation. We had a conference in the Pontificate Academy of Science a couple of years ago with a distinguished Italian policy-maker, Romano Prodi, on connectivity as a human right. A human right. Some people were wondering what we were up to. Today it has become clear, thanks to Covid-19, that if rural areas don't have connectivity, their human rights are being violated.

But we don't only need connectivity, we also need the capability to use digital access, and the content needs to be useful. Digital technologies will be great for monitoring fields and animals, and the market platforms just mentioned by Qu Dongyu. Field robots can facilitate crop diversity in fields and help overcome monocultures and mechanically assist in weed control. These are things that will happen in the future; they're currently in an advanced experimental stage. The food processing industry in emerging economies, too, will become more automated, because that leads to safer food production. But that will impact labour markets. We need to consider the labour market effects of digitalization, and invest more, a lot more, in training the youth.

In conclusion, in the future, digital innovations and artificial intelligence will increasingly interact with bioscience, so the digital and the bio will come together. That can revolutionize farming on the fields and indoor farming in megacities, say for vegetables, and it will facilitate a more sustainable food system in a circular sustainable bio-economy.

Giorgio Parisi: I fully agree with the previous two distinguished speakers. One must be careful, because the introduction of digital technology is in some sense an on-going revolution, and if we do

not pay enough attention, we risk seeing only the tip of this revolution. In this sector, there is a danger that the technology will be ahead of planning, because there are things that happen that we do not control. There are a very high number of possible innovations in the agricultural system. Some of them which might be extremely interesting include the feeding of each animal according to the quantity and quality of the meat produced, of its daily weight gain; irrigation with different quantities of agro-pharmaceuticals for different areas in the cultivated fields; and semi-automatic tractor driving.

But another aspect which is very important is food quality, food safety, and this is essentially to trace products along the food supply chain, documenting where they come from, how they were grown and treated after harvesting. However, the massive use of digital technology can be achieved only if it can be used in a user-friendly way by farmers. Of course, this requires the ability to understand technology and use technology, and this might be not very easy at all in many different regions.

Also, there are some cultural and economic aspects that have to be considered; for example, special attention must be paid to small farmers who, with a few exceptions, may not have the technical and financial capacities to invest in digital technologies. It is imperative that the diffusion of these technologies does not merely strengthen large estates, depriving small farmers and small producers of economic value. The measures that one has to take, also in this case, may vary considerably from country to country.

However, I would suggest that cooperative solutions are likely to be needed, where small farmers join forces to use advanced technologies, together with technicians who can help them control this new technology. Now, the local governments need to intervene energetically to finance this initiative, even if necessary on a non-repayable basis. Public authorities need to be sensitized; the public governmental authorities need to act as a catalyser for the use of digital technologies. In this problem, as in the others, it is clear we need a whole panoply of initiatives, that go from the scientific side to the development of user-friendly interface to transfer this knowledge from one country to another; and we need to adopt this new technology locally in such a way that it goes to benefit everybody, not a small minority. And that is a very complex system, and we need everyone's help to go in the right direction.