TWO DIVERGING PATHWAYS FOR A FOOD SECURE FUTURE

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'Food and agriculture are in the eye of a perfect storm. Over the next quarter century, biodiversity loss, climate shocks, and land degradation will place unprecedented pressures on food and farming systems. Definitions of food security are likely to change and broaden, encompassing dimensions like access to healthy, nutrient-rich soils, and resilience to pandemic disruptions. Discussing soil health, food security, and national security in the same breath could become commonplace, as their interconnectedness becomes clear to all.'

The latest report from the Intergovernmental Panel on Climate Change (IPCC) told us what the news was already telling us: environmental breakdown is upon us. As of 2015, four of the nine planetary boundaries had been transgressed – climate change, biosphere integrity, land system change, and biogeochemical flows. We are already seeing an unprecedented rise in extreme weather conditions, from heat waves, storms, flash floods to ocean acidification. Parts of the Amazon, often referred to as the 'lungs of the Earth', are now emitting more carbon than they absorb largely as a result of agricultural expansion (IPES-Food & ETC Group, 2021). Climate 'tipping points' – irreversible changes to our environments with severe impacts for humanity – are on the horizon.

What does this mean for food security? Over the next quarter century, biodiversity loss, climate shocks, and land degradation will place unprecedented pressures on food and farming systems. Soil is particularly central. Soil health underpins productivity, biodiversity, crop and livestock health, and builds resilience to shocks like floods and droughts. But degraded soils are already affecting 3.2 billion people, with 33 per cent of farmland worldwide being moderately to highly degraded. This equates to a 23 per cent drop in terrestrial productivity worldwide (Loconto, Jimenez & Vandecandelaere, 2018). In 2020, the first global report on soil biodiversity warned that after 12,000 years of harvests only 100 more may remain (FAO, 2021). Soil health becomes of paramount concern when 95 per cent of the food we consume is directly or indirectly produced in the soil (FAO, 2015).

These threats come in a context where food systems – and people's access to food – are already precarious. In a matter of weeks, the COVID-19 pandemic laid bare the underlying risks, fragilities, and inequities of the industrial food system (IPES-Food, 2020). While levels of world hunger and malnutrition had stabilized for 5 years, both increased dramatically over 2020, with 118 million more people facing hunger than in 2019 (FAO, 2021). Combined with armed conflict in countries including Yemen, the Democratic Republic of Congo, or South Sudan, the pandemic has left whole populations on the brink of starvation (UNICEF, 2020). In the US, the 2019 national food insecurity rate had reached its lowest point since it was first measured in the 1990s, but these improvements were turned upside down, with 1 in

7 Americans facing food insecurity in 2020 (Feeding America, 2020).

This may only be the tip of the iceberg. The climate crisis is driving the degradation of ecosystems, migration flows, new economic disparities, and disease spillovers. And when factoring in long, complex, and often opaque supply chains, sudden disruptions – such as COVID-19 or major weather disruptions – are a potential cause for significant economic and social disruptions over the coming quarter century.

In this context, food security will become an ever-greater political priority. As Alfred Henry Lewis famously wrote over 100 years ago, 'there are only nine meals between mankind and anarchy,' alluding to a global history clouded by moments of civil unrest driven by food insecurity. Treating food as a strategic asset – as China, Russia, and the US already do – will surely become the norm. Definitions of food security are also likely to change and broaden, encompassing dimensions like access to healthy, nutrient-rich soils, and resilience to pandemic disruptions. Discussing *soil health*, *food security*, and *national security* in the same breath could become commonplace, as their inter-connectedness becomes clear to all.

But this new reality could lead to a variety of different approaches in the quest to deliver food security. Drawing on the findings of the 'Long Food Movement' project (IPES-Food & ETC Group, 2021), we lay out two contrasting visions of how governments and societies could respond to environmental breakdown, social upheaval, and new food security threats.

Scenario one

The first and perhaps most likely scenario is one in which powerful actors seek to appropriate and control productive resources through vast economic corridors. The need to ensure domestic food supply is already accelerating governments' acquisition of foreign soils (and water) to produce food for their populations. For example, Middle Eastern and North African countries are moving into Sudan (Schwartzstein, 2019). Across Southeast Asia and the African subcontinent, some 20 million hectares of farmland – equivalent to the size of Cambodia or the UK – have been transferred from rural communities to foreign corporations over the past decade (GRAIN, 2019; Goedde, Ooko-Ombaka & Pais, 2019).

Control of these production zones is being rapidly consolidated. Mass infrastructure schemes are being drawn up, based on automation and digitalization, to ensure the efficient handling of goods through global food supply chains. Large parts of Asia and Africa are being reconfigured into major production and distribution zones by China's Belt and Road Initiative. In parallel, Western powers are reinvesting in their own global commodity infrastructures. Already, Cargill and ADM have formed Grainbridge as a joint venture to provide a common technology platform for North American grain farmers (Cargill, 2019). Over the coming decades, governments and flagbearer corporations are likely to continue developing these supply corridors into what they hope will be shock-proof agro-industrial complexes.

Furthermore, agribusinesses will be vying to use new technologies – from rapidly advancing AI to wholesale digitalization – to accelerate the rollout of 'climate-smart' precision production systems. On-farm robots, drones for spraying and surveillance, and self-driving tractors – all tied together in an 'internet of farming things' (Meola, 2021) – are already becoming part of food systems. Agribusiness giants are in fact pitching their digital agriculture platforms as the key to 'regenerative' farming since they can supposedly track (and therefore trade) carbon in the soil.

Meanwhile, AI is mapping every square kilometre on the planet (including every square centimetre of farmland), for soil, nutrients, moisture, and sunshine, and combining that with massive genomic data sets to suggest AI-designed 'climate-smart' agroecosystems building from DNA upwards

(Oak Ridge National Laboratory, 2019). Algorithms are also being primed to tailor either crop genetic mutations or transient gene-sprays to specific growing environments (Tencent, 2020). There could also be a push to engineer whole ecosystems, from gene drives – a technology that aims to rapidly spread genetically modified traits, transforming entire populations and ecosystems – to the engineering of microbes via alteration of the agricultural and human microbiome (ETC Group, 2018).

Although some governments are worried by the prospect of putting food security at the mercy of foreign-owned data systems, the 'climate-resilient' and 'risk-free' future on offer may ultimately be enough to convince low and middle-income countries to hand over their land, resources, and data. The pandemic has made this future more alluring still: the previously dystopian notion of a fully automated food chain without human workers is also being vaunted as a solution for food safety, hygiene, and resilience to social shocks.

In other words, this is a scenario where the keys of the food system are handed over to biodigital mega-corporations, data platforms, and private equity firms; where farmers and food-workers are disempowered; where resources are deployed in the service of keeping commodities flowing across vast supply corridors; where soil management is decided by algorithms; and where food security is placed at the mercy of increasingly centralized, opaque, and homogenous systems.

The risks of such a scenario are troubling. Already, just 1 per cent of the world's 300 million farms account for 70 per cent of cropland, pastures, and orchards (Watts, 2020). Further erosion of diversity could remove critical firebreaks against climate shocks and disease transmission. These systems will also be increasingly vulnerable to supply chain disruptions. Pressure is already building at major trade 'chokepoints', where large volumes of staple commodities transit daily (e.g. maritime corridors, coastal infrastructure, inland transport infrastructure in crop-exporting areas). Interruptions at these critical junctures could result in supply shortages and price hikes (Wellesley, Walsh & Tucci, 2017). Such consequences would be particularly dire for highly import-dependent nations such as the UK or Japan, regions such as the Middle East, or low-income countries with structural vulnerabilities. In tandem, the local subsistence network and territorial markets on which many countries currently rely are likely to become even more fragile and vulnerable to external shocks and influences.

Scenario two

However, the current cascade of threats could be used instead to set an entirely different course for food systems. Governments could instead look to the growing number of initiatives seeking to build the foundations for new, more sustainable food systems, and shift away from the short-sightedness of business-as-usual solutions that value individual (or national) gain over the wellbeing of all peoples and the planet.

This pathway, the 'Long Food Movement' described by IPES-Food and ETC Group, is rooted in agroecology and food sovereignty. Agroecology relies on natural synergies and diversity – not synthetic chemicals – to build resilience by combining different plants and animals to regenerate soils, fertilize crops, and fight pests. By 'land sharing' rather than destroying fragile ecosystems to make room for more uniform farming landscapes, agroecology allows for the production of diverse, healthy foods while protecting and preserving habitats and natural resources.

Agroecology's capacity to meet the economic, environmental, and social dimensions of sustainability has now been recognized by major international institutions, including the FAO, IPCC, IPBES, and the World Bank and FAO-led global agriculture assessment ('IAASTD'). Accelerating crises and stagnating productivity in industrial production systems could expedite this paradigm

shift. A growing premium will be placed on healthy soils, diverse crop varieties and livestock breeds, vibrant aquatic- and agro-ecosystems, and – with new farmland hard to come by – on management systems capable of regenerating arable land. Moreover, as tools for measuring soil health, carbon sequestration, and biodiversity are fine-tuned, it will be possible to identify which production systems are truly sustainable.

Indigenous peoples, peasants, and other small-scale food producers can also be expected to continue to build resilience through diversity: safeguarding landscapes and nurturing a wide range of crops and their wild relatives via proliferating community gene banks, living collections, and farmer-to-farmer and fisher exchanges across neighbouring ecosystems. The push to re-diversify diets in the face of growing micronutrient deficiencies will be key to reinforcing this transformation.

Farmers, fishers, and food movements will be the driving force behind this agroecological transformation, but it also requires government support to scale up and out. Substantial regional and national support programmes will be needed to ensure that farmers get the seeds they want, organic inputs, and agroecological advisory services. This pathway also relies on soil health, thriving ecosystems, and CO_2 sequestration finally being valued via some form of 'true cost accounting'.

While not wholly immune to disruptions, territorial markets and short supply chains are also often a key component of agroecological systems that can enhance food security and reduce vulnerability to international markets. For net food-importing countries, ensuring dynamic local and regional food chains could become a priority alongside continued international trade flows. However, countries would also have to seek to gradually shift away from trade-oriented agricultural policies that disadvantage small-scale producers or favour unsustainable food systems practices.

Barriers to diversity must also be reconsidered. Intellectual property arrangements governing agricultural genetic resources, such as crop and livestock, must not inhibit the full and free use and exchange of seeds and livestock breeds among farmers and breeders, or their communities. Over the longer term, land reform will also need to be considered to reduce major inequalities in access to land, particularly for the millions of small farmers cultivating less than two hectares across Southern Asia and Sub-Saharan Africa.

In other words, this second scenario is a pathway to sustainability *and* food security – which are ultimately two sides of the coin. This scenario is rooted in revaluing productive resources, not appropriating them. It builds resilience through diversity. It treats food as a strategic asset – but rather than stripping that asset from others, it invests in the people and the resources needed to sustain its value in perpetuity.

Which pathway is chosen will depend on the extent to which we are able to heed warnings. It should not take another global pandemic, or another natural disaster caused by climate change, to recognize the challenges we are facing. It is worth remembering that 'the biggest shocks of recent years (e.g. mass extinctions of species, wildfires) were predictable and predicted – not in date and detail, but in parameters and probability' (IPES-Food & ETC Group, 2021). The opportunity to move forward sustainably starts now.