Contested Agrifood Knowledge Transitions into the Anthropocene

Douglas Constance, Allison Loconto

Contested Agrifood Knowledge Transitions into the Anthropocene: The Case of CGIAR

Douglas H. Constance and Allison M. Loconto

Given that food systems are the major driver of poor health and environmental degradation' in the Anthropocene, 'the need for a global transformation of the food system is urgent. [It will] require a rapid adoption of numerous interventions and unprecedented global collaboration and commitment: nothing less than a Great Food Transformation. (Willett et al., 2019)

Introduction

The industrial agifood system is in the midst of a legitimation crisis regarding its negative ecological, economic, and social externalities (Gardner, 2009; Magdoff et al., 2000; Constance et al., 2018). This crisis has accelerated steadily over the past 20 years and has now reached a tipping point based on the realization that the agrifood system is a major contributor to global climate change. The climate impacts of the Anthropocene make it imperative that we change the way food is produced, distributed, and consumed (Campbell et al., 2017; IPES-Food, 2016; Rockstrom et al., 2017). The problem is well understood, yet the solutions are difficult and contested (Almas and Campbell, 2012; Holt Gimenez and Shattuck, 2011; Scoones, 2016). The challenge is how to feed 10 billion people by the year 2050 without expanding the agricultural land base, and at the same time reduce the negative environmental impacts.

In response to this challenge, two competing agrifood models have emerged as the better path forward: (1) sustainable intensification, and (2) agroecology (Levidow, 2015; 2018). These two transition paths are the outcome of a long history of competing visions regarding the preferred model of the agrifood system: the agrarian ethic and the industrial ethic (Thompson, 2010a). These visions are grounded in different agrifood ontological frames, which manifest as different knowledge systems: food security and food sovereignty (McMichael, 2014). This critical agrifood studies approach reveals the role of agrarian social change and development in the ecological crisis of the Anthropocene (Reisman and Fairbairn, 2020)

The chapter begins with an overview of the historical tension between the "agrarian" and "industrial" visions of US agriculture, followed by a presentation of the current manifestation of these visions, sustainable intensification and agroecology. This section ends with a presentation of the competing ontological frames that ground the proposed transition paths: the food security versus food sovereignty discourses. Next, we present the case of the CGIAR (Consultative Group on International Agricultural Research) to illustrate and contextualize these competing agrifood knowledge systems in the Anthropocene. Data was collected for this case by both authors through extensive document analysis and interviews by the second author during participant observations at FAO – in her role as a Visiting Scientist - between 2013 and 2021. Finally, we analyze the events of this case informed by a sociology of agriculture and food conceptual framework.

Agriculture in the Anthropocene

Industrial agriculture is a leading contributor to climate change in the Anthropocene, accounting for between one-fourth and one-third of GHG emissions (Campbell et al., 2017;

Godfray and Garnett, 2014; Kuyper and Struik, 2014). About 12K years ago the Neolithic Revolution starts the process as early agriculturalists reshaped their environs for food production. The Industrial Revolution institutionalized this process in much of Europe, followed by the spread of national and global capitalism into the developing world and the 'Great Acceleration' after World War II (Hamilton et al., 2015).

Concerns about the sustainability of industrial agriculture and its role in sustainable development were raised by the Brundtland Report in 1987 (Velten et al., 2015). Since then, the term sustainability has come into play as competing interests maneuver to capture the definition (Buttel, 2006; Constance, 2010; Scoones, 2016). The ecological crisis of industrial agriculture was the first to manifest, followed by social and economic crises regarding food production and consumption (Magdoff et al., 2000; Constance et al., 2014). The productivist model based on intensive, specialized monoculture combined with intensive, concentrated livestock production created a metabolic rift – the geographic separation of the nutrient/waste cycle – which contributed to pollution and ecological degradation. This model was coordinated by the nation-State through the USDA and the Land Grant Universities through public research on mechanization, genetics and breeding, and chemical inputs, along with powerful commodity groups linked to agribusiness corporations (Buttel and Newby, 1980; Hightower, 1973). The ensuing treadmill of production rendered US agriculture ecologically, economically, and socially unsustainable (Buttel, 2006). This industrial model was diffused globally as part of development projects through the Green Revolution and organizations such as the Consultative Group on International Agricultural Research (CGIAR) (McMichael, 1996). The food shocks of 2008-2009 accelerated sustainability concerns as calls grew louder for the transition to a new paradigm based on agroecology (IPES-Food, 2016). To complicate the scenario, by the year 2050 the agrifood system needs to feed a

world population of 10 billion people without expanding the agricultural land base, and while reducing negative environmental impacts such as greenhouse gas emissions, chemical contamination, and species extinction (Campbell et al., 2017; Feed the Future, 2015).

In response to this realization, two competing visions and systems emerged as the better path forward to sustainably feed the world: sustainable intensification (SI) and agroecology (Levidow, 2015). These two transitions paths are the outcome of historically competing visions and contested discourses regarding the preferred model of the agrifood system. Modern agriculture in the United States has been characterized by two competing visions grounded in the 'agrarian ethic' and the 'industrial ethic' (Thompson, 2010a). The industrial perspective views agriculture as just another part of industrial society where commodities are produced using positivist science at the lowest cost possible. The trend toward consolidation in farms and firms is just economies of scale at work to increase efficiency and lower costs. Landscapes are viewed in terms of the commodities they can produce and any concerns regarding labor, community, environment, and animal welfare externalities can be addressed through incremental technological changes rather than major departures from the model. From this perspective, sustainable equals produce more with less inputs. This system must be exported to ensure sustainable food production for the world.

The agrarian ethic views agriculture as a virtuous social structure with unique cultural norms that enhance quality of life for rural peoples (Berry, 1978; Thompson, 2010a). Sometimes called alternative and/or multifunctional, agriculture has important social functions beyond its efficient production of commodities, such as providing positive ecological services, protecting the integrity and functioning of the ecosystem, and contributing to healthy rural communities. Agriculture should be embedded in the local community. Farm and

agribusiness consolidation negatively impacts community quality of life (see Lobao and Stofferahn, 2008). This view advocates for agroecology and calls for a transformative departure from the conventional agriculture, which is extractive and unsustainable.

The evolution and prevalence of these two perspectives are linked to the development of the Land Grant University system (Constance, 2014). During the Civil War the US government took several actions to modernize agriculture (Danbom, 1979): the United States Department of Agriculture (USDA) and the Land Grant University system (LGUs) were created; the Homestead Act of 1862 was passed to populate the land with farmers; immigration policies provided industrial workers and prospective farmers; the transcontinental railroad was subsidized; and the Native Americans were subdued. The actions, policies, and programs accelerated the extensification and intensification of modern agriculture across the landscape.

The agrarian ethic tended to be supported by Rural Sociologists and Institutional Agricultural Economists in LGUs and USDA. The industrial ethic was supported more by natural (soil, animal, plant) scientists, neo-classical Agricultural Economists, and urban elites. The agrarian view first aligned with preservationist sentiments that privileged the rural over the urban due to its moral superiority linked to attachment to the land and conservative values. The industrial view aligned with modernist perspectives that saw traditional rural beliefs and institutions as anachronisms of the past that must be modernized to improve rural quality of life. Though the preservationist position tended to dominate into the mid-1900s and occupied substantial academic and pollical space in the LGUs and the USDA, during and after WWII the preservationists were purged as part of the Cold War and the modernists came to power (Danbom, 1979; Gilbert, 2015; McMichael, 1996).

After World War II, and especially during the Cold War, the modernist - now productivist - approach dominated the LGUs. Productivism combined the mechanization of the industrial revolution, selective breeding and hybrid seeds, and chemical pesticides and fertilizers to maximize yield per acre. The resulting food surplus was employed as a weapon to counter the spread of communism. This adoption-diffusion model of agricultural modernization based on technological improvements embraced by modern, innovative farmers was spread to the world through the Green Revolution as 'packages' of agricultural intensification through international agricultural research organizations such as the CGIAR. The US diet based on that model of agriculture was spread through the world through food aid programs (Buttel and Newby, 1980; McMichael, 1996).

In the 1970s the productivist model was criticized as a system whereby the USDA and the LGUs were coopted by agribusiness (Hightower, 1973; Buttel and Newby, 1980). In the 1980s the pendulum swung back toward the preservationists, but this time in the form of critical Rural Sociology approaches that documented the negative environmental, economic, and social impacts of industrial agriculture on rural communities. At the international level the value-neutral modernization/productivist framework was challenged by the value-laden dependista/World Systems framework focusing on neocolonialism, whereby the Global North continued to exploit the Global South through corporate domination (Buttel and Newby, 1980; McMichael, 1996; Wallerstein, 1972). These two perspectives remain today, represented by the tension between positivist and critical positions within the Land Grant System and USDA (Constance, 2014).

The current manifestation of these competing knowledge systems is the tension between sustainable intensification and agroecology as the better path to feed the world in the

Anthropocene. The term ‘sustainable intensification’ (SI) originated in Africa in the 1990s as an agro-ecological program designed to increase food production (intensification) in developing countries without bringing more marginal and/or pristine land into production (extensification), while at the same time reducing negative environmental externalities on the existing cultivated lands (see Pretty, 1997; Levidow, 2015). This first vision was synonymous with the French approach called ‘ecological intensification’ that was being promoted at the same time in West Africa (Tittonell, 2014). Utilizing appropriate technologies informed by indigenous, knowledge-based, agro-ecological methods, SI would increase yields, conserve soil and water, and manage nutrients and pests through local processes of innovation whereby the byproducts of each cycle become the inputs to another. In this context SI is a culturally-sensitive, lower-tech alternative to high-tech Green Revolution approaches that have proven unrealistic and/or problematic for much of the developing world (Patel, 2013; Shiva, 1992).

In 1996 the Food and Agriculture Organization of the United Nations (FAO) sponsored a World Food Summit that called on governments to support a new round of intensification to feed the world, but also to avoid the negative environmental consequences of industrial agriculture ala the Green Revolution (FAO, 1996). The World Bank (2006) defined SI as a combination of production practices such as Integrated Pest Management, Conservation Farming, Low External Input and Sustainable Agriculture, Organic Agriculture, and Precision Agriculture. After the world food crisis in 2007, the United Nations (2008) incorporated SI into the discourse on global food security as an approach to move small-holder peasants past subsistence production by linking them to improved marketing channels and national and international supply chains through a combination of biotech and Conservation Agriculture. Technologies developed in the global North would be part of the ‘tool kit’ transferred to producers in the global South to maximize production per acre while

conserving soil and water resources. The Royal Society of the United Kingdom (2009) echoed the SI agenda to reduce reliance on non-renewable inputs through increased adoption of agroecology and GM techniques to increase yields without adverse environmental impacts and without the cultivation of more land. As evidence of industrial agriculture's contribution to global climate change increased, SI became the model for all of agriculture – the new paradigm to feed the world sustainably (FAO, 2009).

SI became the dominant discourse for national and international organizations, such as the 'Feed the Future' program of the USDA, The Consultative Group on International Agricultural Research (CGIAR), the FAO, the Montpellier Panel and the Sustainable Development Solutions Network, and international donor organizations such as the Gates Foundation (Constance and Moseley, 2018; Tittonell, 2014). Agrifood GMO TNCs embraced the food security discourse from a SI perspective. For example, in 2014 Monsanto's Chief Technology Officer stated that 'sustainable intensification is key to meeting food security needs for our growing planet while also reducing agriculture's impact on the environment' (Monsanto, 2014: 20). Other major GMO firms had similar pronouncements regarding food security and sustainable intensification (Constance and Moseley, 2018).

As the SI agenda gained prominence, it was criticized for being too focused on intensifying production rather than minimizing ecological externalities and social justice disparities (Garnett et al., 2013). Critics maintained the term was not well defined and had 'become a buzzword' that allowed people to put 'a positive spin' on unsustainable solutions (Nink, 2015; Petersen and Sieglinde, 2015). For many agricultural researchers, while SI was necessary in the face of climate change, population growth, and ecological constraints, it was fraught with conceptual and programmatic inconsistencies, which tended to privilege

agricultural intensification over ecological sustainability (Kuyper and Struik, 2014; Petersen and Sieglinde, 2015; Struik et al., 2014). The politics of the possible tended to push SI toward an incremental greening of the dominant system and away from any transformative agenda. Agricultural ethicist Thompson noted, 'The upshot is the debate over agricultural intensification has ideological overtones that one neglects at one's peril' (Thompson, 2010b: 7).

For civil society critics, SI should not be a modest greening of industrial agriculture, but rather should be a radical rethinking of the agrifood system to not only reduce environmental externalities, but also to enhance animal welfare, human nutrition, and sustainable rural development. But its current application is dominated by the Green Revolution focus on high-technology solutions applied to specialized monocultures designed for growing more food on less land with more efficient use of resources (Garnett et al., 2013; Levidow, 2015; Struik et al., 2014; Petersen and Sieglinde, 2015; Rockstrom et al., 2017). As the critique of SI progressed, the agrifood TNCs, agro-exporting states, and the Gates Foundation 'sought to recapture control' of the discourse on and the governance of the global agrifood system through the framework of 'climate smart agriculture' (CSA) grounded in a 'market liberal frame' utilizing technologies and private property rights to address climate change and food security (Newell and Taylor, 2018: 113).

For agroecology proponents, 'business as usual is not an option' (IAASTD, 2008). What is required is a fundamentally different model of agriculture based on diversifying farms and farming landscapes, replacing chemical inputs, optimizing biodiversity and stimulating interactions between different species, as part of holistic strategies to build food security through long-term soil fertility, healthy agro-ecosystems and secure livelihoods, i.e.,

diversified agroecological systems (IPES-Food, 2016). The approach focuses on honoring indigenous cultures and appropriate technologies that support a decentralized agrifood system aligned with concepts of ecological resilience, food sovereignty, fair trade and social justice (Altieri, 2002; Fernandez et al., 2013; IAASTD, 2008; IPES-Food, 2016; Whitman et al., 2010). Agroecology is a science, practice and social movement, which stands in direct contrast to the standardized package of the Green Revolution (Gliessman, 2015; Wezel et al., 2009).

In 2015 delegates representing diverse organizations and international movements of small-scale food producers and consumers gathered in Mali for the 'Declaration of the International Forum for Agroecology' to promote agroecology as a key element in the construction of food sovereignty and defend it from co-optation. The cooptation that the declaration refers to was the Global Dialogue on Agroecology organized by FAO between 2014-2018. The meeting in Mali allowed civil society to prepare a strong definition of agroecology, which they introduced at each subsequent meeting of the dialogue: Brasilia, Dakar, Bangkok in 2015; La Paz, Kunming, Budapest in 2016; Rome 2018 (Loconto and Fouillieux, 2019). The Declaration claims that 'agroecology is the answer to how to transform and repair our material reality in a food system and rural world that has been devastated by industrial food production and its so-called Green and Blue Revolutions.'[1] In 2017, as part of a separate process, the UN Committee on World Food Security (CFS) convened the High-Level Panel of Experts on Food Security and Nutrition (HLPE) to produce a report on agroecological approaches and other innovations for sustainable agriculture and food systems to enhance food security and nutrition. The first recommendation of the report states that all stakeholders involved in food systems 'should learn from agroecological and other innovative approaches

[1] Nyeleni Declaration (https://www.foodsovereignty.org/wp-content/uploads/2015/02/Download-declaration-Agroecology-Nyeleni-2015.pdf), accessed 20/08/2022

concrete ways to foster transformation in food systems by improving resource efficiency, strengthening resilience and securing social equity/responsibility' (HLPE 2019: 21). The final report was obstructed by proponents of industrial agriculture until the term 'other innovations' was added to the title and covered in the report, which allowed the inclusion of 'genetic engineering and 'greening' technologies as some of the other innovations (Anderson and Maughan, 2021).

In 2018, at the end of the Global Dialogue, the FAO defined agroecology as 'an integrated approach which simultaneously applies ecological and social concepts and principles to the design and management of food and agricultural systems' (2018: 1). To support political decision making and accelerate progress toward sustainable agrifood systems, it approved the 10 Elements of Agroecology as an analytical framework to support the design of differentiated paths for food system transformation. The 10 Elements framework takes into consideration the differing contexts at a range of levels on a number of scales and specifically designed to be a consensus frame that avoided strong terms like principles or criteria (Loconto and Fouillieux, 2019).

Food Security and Food Sovereignty: The Ontological Tension

The ontological tension between the food security and the food sovereignty visions aligns with these competing agrifood transition pathways in the Anthropocene (Constance and Moseley, 2018). The food security discourse begins in the 1940s when the FAO was created to establish global food security. Although the FAO embraced the scientific modernization of world agriculture (extensification and intensification), it also included the UN's Universal Declaration of Human Rights, which held that food was an essential right of life rather than a

commodity. The Cold War subverted FAO multilateralism as the United States employed bilateral food aid to counter the spread of communism. The FAO vision of food as a right was formally replaced in 1986 when the World Bank redefined food security as the ability to buy food. Part of this change included moving the locus of international agricultural research out of the FAO and into the CGIAR (ETC Group, 2009). In 1994 the WTO institutionalized the global free trade regime and this market vision of food security, whereby countries grow and trade agrifood products based on comparative advantage and people buy these foods instead of grow them. As part of this Corporate Food Regine (McMichael, 2005), the WTO's 2008 Agreement on Agriculture furthered this vision by defining the 'new agriculture' as system of global entrepreneurial farmers employing sustainable intensification practices linked to agrifood TNCs in flexible arrangements governed by sustainability standards (Ingram et al., 2010; McMichael, 2014).

In contrast, the food sovereignty movement posits a counter frame to food security approaches. Created by La Via Campesina, a global, broad-based, peasant-centered, social movement committed to social justice and human rights, this view from the global South challenges the Corporate Food Regime through protests where it denies the validity of the WTO-sanctioned food security framework based on free trade, corporate intellectual property rights, and land grabs (McMichael, 2014). Their protest inside the FAO building at the 1996 World Food Summit set a precedent for subsequent food protests by civil society and led, with the help of institutional entrepreneurs inside the FAO, to the reform of the World Committee for Food Security in 2009 (Loconto and Fouillieux, 2019; McKeon, 2014). Instead, Via Campesina builds coalitions to create agrifood self-sufficiency through land reform, indigenous knowledge and agro-ecological principles (Desmarias, 2007; Rosset, 2008; Wittman et al., 2010; Fairbairn, 2012). This perspective proposes to heal the global

metabolic rift of industrial agriculture through repossession and regionalization of agrifood systems.

The food security and food sovereignty discourses are grounded in opposing ontological assumptions (Desmarais, 2007; McMichael, 2014). Food security embraces a land commodification ontology that assumes that the problem of food supply can be solved through ecological modernization and sustainable intensification, a high-tech repackaging and greening of the modernist adoption and diffusion approaches of the productivist paradigm. This bio-capitalist Second Green Revolution links entrepreneurial global farmers practicing sustainable intensification to agrifood TNC constructed global value chains governed by the WTO free-trade regime. Friedmann (2005) calls this system of green consumers linked to green companies the Corporate Environmental Food Regime.

In contrast, the land sovereignty ontology views land through a multifunctional lens rather than the commodity lens. Food sovereignty embraces a triple-bottom line, full-cost accounting approach that internalizes the environmental externalities and embraces a rights-based rather than market-centered framework, where rights are defined in collective terms rather than the liberal conception of individual rights (McMichael, 2014). This ontology requires a repossession of the land in the face of the continuing enclosures based on accumulation through dispossession (Moore, 2017). The intellectual property rights/copy right framework advanced by the WTO is countered by the copy-left, creative commons and open-source framework of La Via Campesina. Domestic agrifood production is the better path to food security rather than global commodity chains (de Schutter, 2008). Moderate and smaller scale agro-ecological farming is more resilient to climate shocks. The battle between

La Via Campesina and the GMO seed TNCs over seed sovereignty is a crucial example of the ontological fracture (Kloppenburg, 2010).

The food security and food sovereignty frames proceed from non-reconcilable ontological differences (McMichael, 2014). The food security discourse separates the social and physical sciences and casts traditional agriculturalists as primitive laggards whereas the food sovereignty frame values interdisciplinary approaches, honors indigenous knowledge, and pursues social justice (Rivera-Ferre, 2012). The food security approach lacks a social justice and human rights component, which is a central feature of the food sovereignty perspective (Guthman, 2008; Fairbairn, 2012).

The food security path is based on neo-productivist, high-tech solutions using all available tools and technologies, including intellectual property and GMOs (Almas and Campbell, 2012; Marsden, 2013; McMichael, 2014). The food sovereignty path is based on agroecology and a social justice framework. The food security path is patterned on consequentialist philosophy grounded in utilitarian assumptions about agrifood science and rurality. The greater good for the most people outweighs the negative impacts on the few. The agroecology path employs a rights-based rhetoric grounded in de-ontological assumptions to support its social justice agenda. The food security path includes incremental, 'green' reforms to the existing system, while the food sovereignty path pushes for transformative change to the system (Thompson, 2010b; Holt-Gimenez and Shattuck, 2011). Where the current system promises to sustainably intensify, the agroecologists prefer to intensify the sustainable. The agroecologists warn that sustainable intensification is an oxymoron at least (Eckard, 2015), and more probably a 'wolf in sheep's clothing' (FOE, 2012). The neo-productivists promise their green solution can feed the world, while the low-tech agroecology approach cannot.

While food sovereignty advocates argue for a transition path informed by deep agroecology, conventional agriculture proponents have countered with food security discourses focusing on ecological modernization, sustainable intensification, and climate smart agriculture (Levidow, 2015).

The Case of CGIAR

The CGIAR (previously known as the Consultative Group on International Agricultural Research) celebrated its 50th. anniversary in 2021. Created in 1971, the original CGIARs were the culmination of experiments with numerous organizational models of international agricultural research and development reaching back to the early twentieth century. The CGIARs became 'the model' for foreign assistance in agriculture as part of the Green Revolution (Byerlee and Lynam, 2020). Today, the CGIAR is the governance structure for a system of 15 international agricultural research centers (IARCs), focusing on research in support of development and food security in the tropics and subtropics. Six of these IARCs existed prior to the formalization of the CGIAR in 1971 as previous efforts carried out by the Ford and Rockefeller Foundations (FF and RF), the FAO, the US National Academy of Sciences (NAS), the Pan-American Union (now the Organization of American States) and remnants of colonial research institutes of the British and French (mostly) in Africa.

The IARC model was designed as centers of excellence to carry out fundamental multidisciplinary research to generate agricultural technologies (originally germplasm and seeds), which through economies of scale and scope would be diffused via research networks across different countries and ecological regions. IARCs were designed originally to substitute for underdeveloped agricultural research facilities in developing countries through

capacity building, training local scientists, and supporting national university programs in agricultural modernization. They targeted research on specific commodities (rice, wheat, corn, beans, livestock, etc.) designed to be public goods and reduce hunger. Additionally, the governance structure of the IARC model strove to reduce bureaucratic and political interference by operating as autonomous, non-governmental centers with independent and international boards. Finally, the funding structure was designed to be long-term and sourced from richer countries through the official foreign aid (agencies) and philanthropical organizations, which would align with those organizations' humanitarian and *political objectives* (*italics added*; Byerlee and Lynam, 2020: 2).

The Genesis of the IARC Model

The structure and mission of the IARC system can be traced to the Land Grant University (LGU) model developed in the United States in the late 1800s, in collaboration with the United States Department of Agriculture (USDA), and then embraced by the foundations and the FAO after World War II. The three-pronged LGU research, teaching, and cooperative extension model was designed to develop and diffuse agricultural innovations. The USDA maize (corn) improvement program started in the 1920s at the University of Minnesota. The institutional innovation of cooperative research – organized teams at different locations studying the same topic - accelerated the rate of technological innovations of genetically-improved hybrid maize seed. In 1943 the UN held its first conference on food and agriculture; in 1945 the FAO was formed to modernize food and agriculture and feed the world (well, at the time they only meant to feed Europe) (Loconto, 2022). After World War II the US used its scientific forces to address the Malthusian challenge, and to use food as a weapon in the Cold War (see Perkins, 1997). The USDA/FAO coordinated a hybrid maize program to rebuild European agriculture (Byerlee and Lynam, 2020).

The USDA international wheat program started in the 1950s in response to a stem rust epidemic, linking to the RF Mexico Agricultural Program (MAP) led by Norman Borlaug (from the University of Minnesota), and then creating similar research sites in Australia, India, Kenya, South Africa, and Spain. Following the European maize model, it formalized as the FAO Near East Wheat and Barley Association, where it fostered breeding programs in North Africa and Pakistan and then cross-country diffusion of resistant strains. The early organizational and monetary support from foundations, USDA, and FAO set a strong base, which later morphed into the first IARC - CIMMYT (the International Maize and Wheat Improvement Center) (Byerlee and Lyman, 2020).

The international rice improvement program originated in India (International Rice Study Group) after World War II, then was formalized as an IARC in 1948 in the Philippines as the International Rice Commission (IRC). Coordinated by FAO, it followed the cooperative research model of maize in Europe and wheat and barley in the Near East to develop hybrids that transferred the increased fertilizer-induced growth rates of the temperate japonica varieties to the indica varieties of the tropical and sub-tropical regions. The IRC laid the groundwork for the second IARC - IRRI (the International Rice Research Institute) (Byerlee and Lynam, 2020).

Following a different trajectory, after World War I another group of scientists, governments, and industry from the US organized to support regional agricultural research centers for the Latin American tropics. The group included Latin American countries dependent on tropical exports and US corporations looking to source tropical commodities in response to increased competition in US markets by Dutch and British Empire imports from Asia. The Tropical

Plant Research Foundation (TPRF, 1924-1931) operated under the National Academy of Sciences, headquartered in Washington, D.C. It was governed by a mix of private and academic interests from the US, with most of the funding from US food companies. The founding director was a LGU-trained USDA plant pathologist. The global depression in 1930 eliminated the funding stream for the TPRF, but the interest in tropical commodities persisted (Byerlee and Lynam, 2020).

As World War II disrupted US supplies of tropical commodities, in particular rubber, the tropical research center agenda resurfaced, supported by the Pan-American Union and Henry A. Wallace, US Secretary of Agriculture. Headquartered in Costa Rica near a USDA rubber research station, the Inter-American Institute of Agricultural Sciences (IICA) was founded in 1942 with an Iowa State University-trained USDA agronomist as its director. After the war ended, the funding stream changed from the US government back to private US corporations sourcing tropical commodities. In the 1960s the IICA got a new Latin American director from Colombia, changed its name, and switched its focus to Central American research and teaching (Byerlee and Lynam 2020). Over the years, IICA has come to dominate the agricultural development project grants in the region, often in direct competition with FAO and other specialized, international agricultural research centers that are not based in the sub-region.[2]

In the early 1960s another IARC venture was proposed to counter communist insurgency in Latin America. The Kennedy Administration, with support from the RF and NAS, announced the Alliance for Progress, a USAID program to create a series of regional institutes with special attention to Latin America. The NAS-funded feasibility study conducted by the

[2] Interviews with FAO and IICA staff in Costa Rica in February 2019.

University of Minnesota suggested the creation of the Tropical Research Foundation (TRF) to establish research stations in three ecological zones of the tropics, each staffed by twenty US scientists. The TRF was Washington conceived, staffed, and funded, largely due to the LGU scientists' collective view that developing countries could not conduct agricultural research and feed themselves. Alliance for Progress partner countries such as Brazil pushed back against the TRF for not integrating with ongoing efforts in the regions. The TRF proposal was rejected by a NAS-appointed, high-level panel for these reasons. It was replaced in 1967 with CIAT (Centro Internacional de Agricultura Tropical) headquartered in Palmira, Colombia, and mostly funded by the RF. Although the original CIAT mandate was to develop sustainable cropping systems for tropical lowlands, over time it became led by the Brazilian research organization Embrapa, founded in 1973, which had transformed Brazil's tropical savannahs into the soy breadbasket of the world (Byerlee and Lynam, 2020).

The IARCs in Africa followed a different path grounded in the colonial histories of Britain and France. The colonial model consisted of regional research centers supporting export crops for the core country. With independence, the model shifted to small-holder farming systems, especially the challenges associated with shifting cultivation and animal diseases, but insufficient infrastructure and lack of stable funding hampered these efforts. After preliminary initiatives by NAS, USAID, and the foundations in anglophone West Africa, in the 1960s the IITA (International Institute for Tropical Agriculture) was created following the IICA model in Latin America. The RF and FF provided majority funding and a University of Minnesota agricultural scientist was put in charge. Headquartered in Ibadan, Nigeria, IITA cooperated with francophone African scientists on farming systems research, particularly on the issue of declining yields in the shifting cultivation system. IITA is the only one of the four African IARCs that gave serious attention to farming systems research. Longer-term formula

funding from the FF allowed it to do this, as most other IARCs had to focus on crop-oriented research to show quicker results and payoff (Byerlee and Lynam, 2020).

WARDA (West Africa Rice Development Association) was preceded by British and French post-colonial research institutes. In the late 1960s the French network of six stations faced budget problems. West African countries wanted increased domestic rice production to reduce imports and provide an urban wage food. The USAID and newly formed United Nations Development Program (UNDP) were interested in pursuing a regional rice project. UNDP coordinated the creation of WARDA in 1970, led by a French and a Vietnamese economist who specialized in rice and the Green Revolution in Vietnam. The decentralized French model based on strengthening existing institutions conflicted with the US centralized model. Politics over WARDA (centralized or de-centralized) was heated, resulting in a hybrid model that struggled, and then was reorganized as the Africa Rice Center, which retained a hybrid form of an IARC model aligned with existing research centers (Byerlee and Lynam, 2020).

After independence the importance of cattle in Africa as a protein source increased to combat malnutrition. Africa's colonial history created special barriers to the IARC model, as noted above in the WARDA story. Eventually, in 1973 ILRAD (International Laboratory for Research on Animal Diseases) was sited in East Africa and in 1974 ILCA (International Livestock Centre for Africa) was based in West Africa. The RF was the prime organizer for both centers with USAID and UNDP support in anglophone East Africa and USAID and francophone support in West Africa. Both ventures had to navigate the 'center versus regional' organization form. At the organization meetings, the French representatives argued that these IARCs should complement and strengthen the existing national and regional

efforts. These discussions shifted to the CGIAR after its creation in 1971. After some difficulties with blending the two models, ILRAD was created as an autonomous center based in Nairobi, Kenya, and ILCA, based in Ethiopia with a French director, was approved and designated to function in a complementary role to the existing national and regional centers in West Africa. In 1995 CGIAR merged ILRAD and ILCA into ILRI (International Livestock Research Institute) (Byerlee and Lynam, 2020).

By the late 1960s the logistics and costs of running the four existing IARCs pushed the foundations and USAID to consider a comprehensive plan for the IARCs. Several more IARC centers were coming online. The first two IARCs – CIMMYT and IRRI – were credited with much of the success of the Green Revolution in wheat and rice. The FF, RF, UNDP, aid agencies from the US, Great Britain, Canada, Sweden, Japan and other countries, plus the Asian Development Bank and the Inter-American Development Bank, and other interested parties held a series of conferences at the FF's villa in Bellagio, Italy in the late 1960s. The IARC model had significant traction as 'the model' of agricultural development. At the same time the OECD Development Assistance Committee was supporting multi-donor cooperation. Then, the World Bank, through its president Robert McNamara, entered the negotiations. As a trustee of the FF McNamara supported the Green Revolution and brought that agenda to the World Bank as a Cold War tool to blunt the spread of communism. He wanted to scale up the IARCs with World Bank as majority funder. He proposed five new centers and offered the World Bank's unrestricted grant funding. USAID promised to cover 25 percent of total costs. The IARC model dominated the discussions, championed by the FF as 'a new form of truly international organization' (Byerlee and Lynam 2020:14). But it was still opposed by the French representatives and other attendees who preferred supporting existing research institutes.

In summary, the IARC organizational model, culminating in CGIAR, originated in the US LGU system around hybrid maize. That model was based on LGU centralized control of multiple trials at once to speed up the genome testing and bring better producing cereal varieties to market. LGU agricultural scientists staffed the FF, RF and USDA. After World War II the growing global concerns about eliminating hunger and feeding the world prompted the foundations to expand their investments in the agricultural sciences. The FAO, USAID, and UNDP supported the model, which was replicated famously by the RF and Borlaug in Mexico for wheat and maize (CIMMYT) and then again for rice in Southeast Asia (IRRI). The model was diffused overseas by the foundations, USAID, UNDP, and then the World Bank as part of the development project – the Green Revolution – where it encountered remnants of colonial models of agricultural development. The French model was based on decentralized national and regional centers, instead of the centralized US-based IARC model. The French often pushed back in negotiations over the structure and form of the IARCs and CGIAR. The IARCs – in the form of CGIAR – were seen as critical for progress in developing countries who had neither the resources nor the infrastructure to carry out agricultural development. The IARC model was also seen as a critical tool in the Cold War to counter the success of communism in the developing world.

The Creation of CGIAR

The Consultative Group on International Agricultural Research (CGIAR) was formalized in December 1971 as a network of independently managed IARCs that worked together to create and disseminate improved plant varieties to alleviate hunger and poverty. Sponsorship of the four original centers (CIMMYT, IRRI, IITA, CIAT) was transferred to the CGIAR and its Technical Advisory Committee (TAC), with offices at the World Bank in Washington,

D.C. (Correa, 2009; Ozgediz, 2012). CGIAR was based on four principles: informal, consensus decision making; donor sovereignty; center autonomy with autonomous governing boards; and science based.

The first two decades were the golden years of CGIAR. Stable core funding of unrestricted funds (from the World Bank), TAC control, autonomous boards, and political consensus about its mission and founding principles allowed the TACs to prioritize research agendas (Petit, 2022). By 1975 there were seven new centers, two more policy centers were added by 1980 (IFPRI and ISNAR), and from 1972 to 1980 donors had increased from 17 to 29 and funding from $21M to $141M. The research agenda also changed from strictly genome improvement to include farming systems, natural resource management (NRM), livestock, and institutional constraints on agricultural development (Ozgediz, 2012).

System reviews started in the mid-1970s. The 1981 review prompted the clarified corporate functions of the CGIAR system, enacted rolling 5-year plans for each center, and better specified the roles and duties of trustees on boards. Influenced by the Brandt Report (1980) and Brundtland Report (1987), the CGIAR mission shifted to increasing sustainable food production in developing countries to enhance nutrition and quality of life for low-income people. This new sustainability concern forced more attention to NRM aspects of the centers and added five more centers: water, irrigation, agroforestry, plantain/banana, and forestry research. In the late 1980s the increased need for cross-center coordination regarding NRM and cropping systems combined with new donor preferences to expand the IARC focus beyond agriculture into water and forestry issues began to change the funding structure from the unrestricted model to a restricted project-based model. Donors wanted greater control, accountability, and short-term payoffs for their contributions, which started the trend toward

bilateral projects with specific centers and shifted the decision-making power from the TAC to the donors. Bilateral funding imposed a contract approach to research staff instead of a long-term team approach (Ozgediz, 2012).

By 1991 CGIAR staff numbered 12,000, with 1,300 internationally recruited. Funding needs were $332M, but only $251M was secured. The expected increase in funding did not materialize, as donor monies increasingly went to bilateral contracts with new centers at the expense of older centers, which created turmoil in the system. The two livestock centers were combined to reduce costs (as noted above), other centers were downsized, and two standing donor committees for oversight and finance were created to support funding. The new CGIAR chair secured a one-time $20M donation from the WB, which allowed full funding for 1994. In the 1990s CGIAR membership increased with more developing country members and from the old Eastern Bloc. There was also a new gender initiative (Gender and Diversity Program) and a new policy arena (genetic resources, intellectual property, and biotechnology). The mission statement was adjusted again to 'to contribute, through its research, to promoting sustainable agriculture for food security in developing countries' (Ozgediz, 2012: XIV).

The 1990s also brought new calls for accountability and performance evaluations and shifts to cross-cutting programs to address global issues, but these programs were funded by unrestricted funds, which continued to decrease to about 20 percent of total funding. The changes brought increased transaction costs for each center running multiple bilateral projects and gathering assessment data. As funding shifted away from long-term stability and plant genome research to NRM and bilateral contractual projects, the centers lost many of their career scientists who were the basis of the centers of excellence IARC model. The World

Bank changed its funding system from ‘balancing’ to ‘matching donors’, which further eroded unrestricted funds. The locus of power continued to shift from the TAC to the CGIAR Chair, the CGIAR Center Directors Committee and the donors. As a result, the donors’ pet programs got funded rather than what the TAC thought was most needed scientifically (Ozgediz, 2012).

Funding problems persisted prompting another system review in 1998, which suggested that the CGIAR establish as a legal corporation with a central board, executive committee, and full time CEO. The suggestions met with strong resistance from within CGIAR, as had previous recommendations for centralization. The European donors again suggested a regional structure by reorganizing the centers into four regional programs linked to national and regional actors on time-fixed projects. Climate change and nutritional health came under the purview of CIGIAR, further complicating missions and funding (Ozgediz, 2012).

In CGIAR’s 4th decade it continued to struggle with how to organize the CGIAR system to meet higher order needs and still retain the positive attributes of the IARC model. In the end the ‘one model fits all’ approach did not work well for much of what needed to be done – climate change, poverty, and nutrition. Finding stable funding to do the research to deliver the public goods continued to be the challenge (Ozgediz, 2012). CGIAR’s research financing shifted from funding centers to funding Challenge Programs (CPs) to better coordinate CGIAR with other research actors and mobilize additional funding. Other changes included transforming the TAC into a Science Council, establishing a CGIAR system office, adopt the Charter of the CGIAR system, and establish regular performance assessments. The Donor group reached 62 members by 2002 and they liked the performance measurement system, but Centers disliked it for the increased transaction costs, especially as restricted funding

continued to rise. With this new model, staff positions were no longer secured funding, but were completely tied to resource mobilization by the researcher to pay their salaries, very much in the image of the American-Dutch model of competitively funded research.[3]

The Centers perceived the CP system, with no restriction on who could submit proposals, as a threat. To mollify the Centers, the first pilot CPs funded were submitted by the Centers: *Water and Food* – grow more food with less water; *Harvest Plus* – reduce micronutrient deficiency to breed staples with micronutrients (e.g., Golden Rice); and *Generation* – molecular biology (GMOs) to create a new generation of plants to meet farmer needs. The next CP, submitted by the Forum for Agricultural Research in Africa was *Livelihoods and Natural Resource Management in Sub-Saharan Africa: Securing the Future of Africa's Children*. 'The final CP approved by the CGIAR, after a few years of freeze, was on a much-anticipated subject: climate change', *Climate Change, Agriculture, and Food Security*[4] (Ozgediz, 2012: xvii).

The CGIAR approved more changes at the 2008 meeting, again adjusting its mission to: reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership, and leadership (Ozgedez, 2012: XVIII). The major outcome of these changes was the separation of 'doers' and 'funders'. The Centers (doers) created a new organization – the Consortium of International Agricultural Research Centers - with a board and an executive office located in Montpellier, France that established global programs called CGIAR Research Programs

[3] Interview with staff member of the Alliance Bioversity-CIAT in October 2020. This Alliance was forged during the most recent series of mergers within CGIAR in 2019 that is focused on reorienting the entire CGIAR system around 'food systems'.

[4] CGIAR Research Program on Climate Change, Agriculture and Food Security - CGIAR (https://www.cgiar.org/research/program-platform/climate-change-agriculture-and-food-security/), accessed 03/09/2022

(CRPs) through the Strategy and Results Framework (SRF). The counterpart (funders) was the CGIAR Trust Fund with the Fund Council performing executive duties. The SRF provided the roadmap for achieving a new vision and strategic outcomes through the CRPs and requested funding for each CRP from the Fund. Final approval for these changes occurred in 2009 when the Bill and Melinda Gates Foundation joined the CGIAR; the foundation had been a major donor to Centers. At this meeting the donors requested and secured a third tier of funding: (1) pooled contributions (unrestricted); (2) restricted – donor to pet project CRP to Center through CGIAR; (3) center direct – donor money passes CGIAR, goes directly to the center, which is 'essentially a by-pass mechanism to channel donor funds to individual Centers' (Ozgedez, 2012: XX). These changes brought an end to the original CGIAR system as a network of consulting international agricultural research centers; the Consultative Group would no longer exist, but the CGIAR name would still be used. The 2009 major restructuring transformed the loose coalition of centers with separate research agendas and donors to 'a coherent, business-like whole' (CGIAR, 2016a).

The new CGIAR became operational in January of 2010 with the CGIAR Trust Fund established at the World Bank, followed by the inaugural meetings of the Consortium and Fund Council. During the transition two CRPs were approved for funding: the Global Rice Science Partnership and the Climate Change, Agriculture, and Food Security ($100M and $65M annually, respectively). By the end of 2011 24 donors had contributed $332M to the CGIAR Fund. In 2012 the Fund Council approved 15 CRPs for funding, each led by a CGIAR Center. The new CGIAR focused on three new principles: separation of doers and funders; harmonization of research funding and implementation; and managing for results (Ozgediz, 2012).

In 2016 the CGIAR adopted another governance structure, called the CGIAR System Framework, which provides a System Council and CGIAR System Organization (CGIAR, 2016b). In December the CGIAR's 2011-2016 research portfolio of CRPs came to an end and the System Council approved the 2017-2022 Portfolio of Research Programs and Platforms. 'CGIAR remains the world's leading partnership on sustainable crop and animal agriculture, forestry and fisheries, with annual System revenue of $919 million' (CGIAR, 2016b:3). Window 1 (no restrictions) and 2 (funders to specific CRPs) funding was $220M (down 15 percent from 2015). Window 3 (funders to specific Centers) funding was $323M (up 10 percent from 2015); and bilateral project funding was $346M (down 11 percent from 2015). Center funding was $30M, up from $28M in 2015. At the end of 2016 CGIAR's 15 Centers and the CGIAR System Organization employed 10,270 staff in 96 countries.

In summary, the success of the Green Revolution, especially the increase in Mexican wheat and Asian rice, is attributed to the IARC model and the CGIAR as the exemplar (Renkow and Byerlee, 2010). While the original Centers focused on single-crop genome research to increase productivity and reduce poverty, later Centers researched farming systems, natural resource management, and agricultural policies. Because crop productivity is easier to quantify, some centers were more successful than others at generating positive measurable impacts. As a result, through a series of governance reforms the donors and CGIAR central administration put increasing pressure on the CGIAR research managers and Centers to demonstrate that the money was well spent, eventuating in a shift in power from the TAC to the donors. Reforms in 2015/2016 addressed the continuing disconnect between donor demands and scientific achievability, between 'delivery and uptake of new knowledge' and 'production of international public goods.' The CGIAR struggled to be both a research and

development mechanism and failed because you cannot draw a cause-effect line straight from agricultural research today to development tomorrow (Leeuwis et al., 2018).

The long-term view of the SRF conceptual frame operationalized through CRPs and the short-term model of bilateral contracts attached to yearly budget cycles created unrealistic quantitative promises of development impacts by researchers – to secure funding – that could be accomplished (or measured in the short term), which then led to a poor review, and more calls for reforms and accountability. Long term strategic research did not fit with short term development success and the yearly budget cycles. The result was that the new CGIAR model is geared toward quick wins instead of the kind of work needed for long-term transformations to combat poverty, enhance global food security and address climate change. Being responsive to donors, national partners, and place-based contexts distracts from the CGIAR original mandate to produce international public goods (Leeuwis et al., 2018).

The IARC model proved not as useful for NRM activities, such as farming systems, soil erosion, water conservation, nutrient depletion, land degradation and climate change, which are site/region specific. The newer IARCs do have a broader focus on sustainable intensification of farming systems, but as mentioned above, NRM and farming systems are harder to quantify, find the payoff, and see the wide-spread impacts and benefits of the donor's investment for that research. After the 1992 Earth Summit and Brundtland and Brandt reports the CGIAR refocused toward a sustainability agenda, which took it outside its normal agricultural research boundaries into natural resource management and farming systems. For example, IITA developed techniques to sustainably intensify shifting bush/fallow agriculture but needed a 'new type of farmer' to adopt these techniques and integrate them into his/her farming operations. CGIAR is searching for organization models

to do both, especially as such ‘a model has become essential to a global agenda focused on mitigation and adaptation to climate change, zero deforestation, sustainable use of freshwater resources, and other aspect of the SDGs’ (Byerlee and Lynam, 2020: 15).

The 2030 CGIAR goals highlight: health (malnutrition and food safety); reduced Greenhouse Gas (GHG); sustain NRM; poverty and hunger, which are all indivisible. ‘We need to find ways of generating healthy diets that are affordable, desirable, environmentally sustainable, and poverty reducing in their generation’ (Lawrence, 2020: 1). To do this, the CGIAR needs new alliances with upstream and downstream political economy of food choices researchers. CGIAR is good at doing the science, but not as good on why science-based policies are not enacted. CGIAR ‘needs to understand the terrain between food and fork much better than is does now’ (Lawrence, 2020: 2).

CGIAR and Sustainable Intensification

As noted above, the 2010 changes to the CGIAR included a CRP on Climate Change, Agriculture, and Food Security funded at $65M annually over several years (Ozgediz, 2012). Recommendation #3 of the Final Report of the CGIAR Commission on Sustainable Agriculture and Climate Change was to ‘Sustainably intensify agricultural production while reducing greenhouse gas emissions and other negative environmental impacts of agriculture’ (Beddington et al., 2012: 33). The report noted that ‘sustainable intensification is potentially the most promising means of simultaneously increasing food production while achieving land-based mitigation…’ (Beddington et al., 2012: 33).

The first project was SIMELSA - the Sustainable Intensification of Maize-Legume Cropping Systems for Food Security in Eastern and Southern Africa (2010 – 2018) (Siamachira, 2018).

Coordinated by the International Maize and Wheat Improvement Center (CIMMYT), its main goal was to aid smallholder farmers to reach their resources' full potential through the development of Conservation Agriculture-based sustainable intensification options and thereby increase their farm-level food security, productivity and incomes in the context of reduced climate risk and change.[5]

The second project was Africa RISING - Africa Research in Sustainable Intensification for the Next Generation - supported by USAID as part of its Feed the Future Initiative with a focus on cereal-based, crop-livestock, and maize-legume-livestock farming systems.[6] Coordinated by IITA and ILRI, Africa RISING's aim was to reduce smallholder farmers' hunger and poverty through sustainable intensification farming systems that improve food, nutrition, and income security, particularly for women and children, and conserve or enhance the natural resource base. The goal was that by 2021 at least 300,000 smallholder farm households would have had access to Africa RISING technologies.

The third project was the USAID-funded Feed the Future Innovation Lab for collaborative research on sustainable intensification.[7] It was coordinated by CIAT from 2014 through 2019 with a focus on sustainable intensification, food safety, gender integration, and dietary diversity in Tanzania, United Republic of Burkina Faso, Ethiopia, Senegal, Bangladesh, Cambodia. The overall aims were to sustainably increase the production of nutritious food and encourage dietary diversity of smallholder and women farmer and, to increase food production through improved crop-production technologies while minimizing environmental impact.

[5] SIMLESA (https://simlesa.cimmyt.org/what-we-do/), accessed 03/09/2022
[6] Africa Rising (https://africa-rising.net/), accessed 03/09/2022
[7] Feed the Future Innovation Lab for Sustainable Intensification (https://blogs.k-state.edu/siil/), accessed 03/09/2022

The final project was LivestockPlus - The Sustainable Intensification of Forage-based Agricultural Systems to Improve Livelihoods and Ecosystem Services in the Tropics (Arango et al., 2013). It was coordinated by CIAT from 2014-2020 with a regional emphasis on Colombia and Brazil with the aim to improve mixed-crop-forage-livestock-tree systems by achieving social, economic, and environmental security through sustainable intensification on improved forages. The overall goal was to reduce the ecological footprint of livestock production and generate a diversity of ecosystem services, such as improved soil quality and reduced erosion, sedimentation, and greenhouse gas (GHG) emissions., through three interrelated intensification systems: genetic intensification – the development and use of superior grass and legume cultivars for increased livestock productivity; ecological intensification – the development and application of improved farm and natural resource management practices; and socio-economic intensification– the improvement of local and national institutions and policies, which enable refinements of technologies and support their enduring use.

The French Position: Agroecology

An important part of the recent changes in the CGIAR system is the geo and techno-politics revealed through tensions between national and international research (Hainzelin, 2022; Petit, 2022), as well as the most recent conflicts over the agroecological transition (see Barbier et al., this volume).

The move of the new global center to Montpellier in 2009 was part of an effort to legitimate both the CGIAR system as an international organization and the power of France as an international leader in agricultural research (Hainzelin, 2022). By moving to Montpellier, the

headquarters of the CGIAR system is now physically located in the same campus as one of the four branches of International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM), an intergovernmental organization created in 1961 to focus on agriculture in the Mediterranean region. This campus is also the site for Agropolis Foundation, which was created in 2007 by the three specialized national agricultural research institutes in France: National Research Institute for Agriculture, Food and Environment (INRAE), the Center for International Cooperation in Agricultural Research for Development (CIRAD), Research Institute for Development (IRD) and the Agricultural Engineering School of Montpellier (Montpellier SupAgro).

The foundation was created to consolidate and increase collaboration within the immense French scientific community working on agriculture, food, the environment and development within the country and so to create a single interlocutor for international negotiations with the Rome-Based Agencies (FAO-IFAD-WFP) as part of France's political ambitions in the agrifood sector (Loconto and Fouillieux, 2019). One of the key ambitions is to promote the agroecology paradigm not only within France, but also in international agricultural research, which has meet with serious resistance, particularly in Africa (Hainzelin, 2022; Petit, 2022). This ambition also cost France the directorship of FAO as the French candidate was perceived by the United States and China (and the numerous African countries who voted for the Chinese candidate) as being too weak in supporting the productivist agenda.[8] Nonetheless, the proposed research mandate is clear – interdisciplinary research that will support the agroecological transition is the future of international agricultural research (Caquet et al., 2019; Soussana, 2021).

[8] Review of the official statements of the member states during the vote in 2019, interviews with observers of the vote at FAO and an interview with a member of the French candidate's campaign.

In 2021 Agropolis International produced it's 26th dossier entitled '*Agrological transformation for sustainable food systems: Insight on France-CGIAR research'* devoted to research and partnerships in agroecology in support of the CGIAR 2030 Research and Innovation Strategy and the nascent 'One CGIAR' (Atta-Krah et al., 2021). The dossier is the collective work of Agropolis International, CIRAD, INRAE, CGIAR, and IRD. Following a year long process of a series of scientific workshops organized among the four organizations, the dossier includes contributions from five hundred French and CGIAR agroecology scientists and experts from one hundred national and international universities and research organizations to demonstrate that agroecology is now a key focus of the scientific community in the critical work on transformative food systems approaches to address climate change and food security for all. The objective of the dossier is to link the different dimensions of the CGIAR 2030 elements 'in a holistic and transformative approach to food systems, *beyond the usual focus of CGIAR research teams on agricultural production'* (italics added; Atta-Krah et al., 2021: 8).

Agropolis dossier #26 builds upon the work of the FAO and the High Level Panel of Experts on Food Security and Nutrition (HLPE) of the UN Committee on World Food Security (CFS) to reflect 'the enormous opportunity ahead' for the 'transdisciplinary research needed to respond to the challenges facing our food, land, and water systems now, in the 21st century' (Atta-Krah et al., 2021: 5). The 'urgency of the agroecological transformation of agriculture and food systems' documented in the dossier is provided in support of the upcoming UN Food Systems Summit to illustrate the 'variety of agroecological transitions pathways' necessary to achieve 'genuinely sustainable food systems' and to avoid the simplification of 'one size fits all' conventional agricultural models that focus on sustainable intensification

but too often neglect 'socioeconomic power asymmetries' and thereby fail to develop 'inclusive cooperative systems' (Atta-Krah et al., 2021: 8).

The current approach that has been set out by France and CGIAR is to gradually strengthen linkages between national and international systems in strategies and funding. However, the current reform towards a One CGIAR was carried out without giving a particular place to the regional forums that make up Global Forum for Agricultural Research (GFAR) unlike the 2010 reform (Moreddu, 2022). GFAR was established by FAO, IFAD, the World Bank and CGIAR in 1996 as a project for resource sharing among national, international, private sector, farmer and civil society research organizations.[9] Housed by FAO, it has also undergone its own series of reforms that have made it more responsive to farmers' needs, more focused on participatory and interdisciplinary research, and more inclusive of broader stakeholders in its forum. However, the main national research centers of the G20 countries do not participate.[10]

Within the OECD countries, which are the main donors of international agricultural research including the CGIAR system and the GFAR members, there is no general coordinating institution. Only the European Union has been successful in consolidating investment in research at a regional level, and increasingly internationally with its new Horizon Europe program that finally allows third-party countries to receiving funding.[11] During this period, specifically in 2012, a new multi-donor fund called the AgroEcology Fund was developed and now includes 15 foundations and awards about USD 1.2 million bi-annually.[12] This is just a drop in the bucket compared to what is mobilized by Gates Foundation annually (USD

[9] GFAR – About Us. (https://www.gfar.net/about-us), accessed 07/09/2022
[10] Partners in GFAR. (https://www.gfar.net/about-us/partners?keys=&field_geographic_scope_value=All&field_countries_target_id=All&field_gfar_constituency_target_id=15205), accessed 07/09/2022.
[11] Horizon Europe. (https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en), accessed 07/09/2022.
[12] AgroEcology Fund. (https://www.agroecologyfund.org/history), accessed 07/09/2022.

6,87 billion in total, USD 398 million for agricultural development in 2021).[13] But both of these private foundations are not typically financing research, but rather simply funding the application of their respective technical packets (Boillat et al., 2022).

A number of national countries have raised questions about the multiplication of international networks and initiatives, requesting a stronger emphasis on collaborative approaches in funding and evaluation of research (Moreddu, 2022). One proposal has been to return the CGIAR system to be housed within FAO, as this organization tries to increase its role in knowledge management and reduce its role in development projects.[14] However, this type of a move would most likely put the recent shift towards agroecology at risk, considering that this topic is only one of the recent initiatives, and is programed to last only 3 years (in line with the dedicated budget line).[15]

Conclusions

The global food and climate crisis we face today is 'not spontaneous but rather the consequence of a long struggle over the governance of global food systems' (Canfield et al., 2021: 2). In this chapter we document the long struggle grounded in the original contrasting ethical positions of agrarianism and industrialism and ending with the current ontological tension between rights-based food sovereignty and market-centered food security proponents, aligned with agroecology and sustainable intensification, respectively. The chapter highlights the role of the Land Grant University system – and the USDA – as a key venue where the

[13] Bill & Melinda Gates Foundation. Annual Report 2021. (https://www.gatesfoundation.org/about/financials/annual-reports/annual-report-2021), accessed 07/09/2022.
[14] Interview with a staff member of FAO legal services in 2020.
[15] Initaitive: transformational Agroecology Across Food, Land and Water Systems. (https://www.cgiar.org/initiative/31-transformational-agroecology-across-food-land-and-water-systems/), accessed 07/09/2022.

competing interests of preservationist versus productivist, world systems versus modernization, and critical versus positivist knowledge systems played out; first in the United States and then in the world as the Green Revolution and the CGIAR.

The original IARC model and CGIAR vision and mission embraced the industrial ethic and modern, productivist system of agriculture. The CGIAR, supported by the foundations, government agencies, and business interests, became 'the model' to diffuse modern agricultural innovations in the developing world to enhance food security and support geopolitical agendas. The 'one size fits all' model was resisted by the French, who advocated for regional research centers focusing on natural resource management and farming systems. CGIAR system reviews starting in the 1970s led to a series of reorganizations and mission drift from a narrow focus on genome technologies for the public good decided by and administered by the TAC scientists to a corporate model and increasing bilateral contracts between donors and research centers. These changes accelerated after 1990 when the World Bank relinquished its role as the major funder and the foundations, in particular the Gates Foundation, filled the void. The foundation model expected short term pay offs for their research dollars, which compromised the kind of long-term research necessary for poverty reduction and system change. By 2010 the consultant group model of collaborating centers had been replaced by the centralized corporate model, but the name 'CGIAR' was kept. In the 2000s climate change became the driving concern and CGIAR developed various programs on sustainable intensification. In 2021 the French pushed back against sustainable intensification and the 'one size fits all' model through the Agropolis dossier, and thereby put agroecology – and farming systems – in the center of the discourse.

The competing agrifood knowledges systems detailed in this chapter continue to play out in the current discourse and negotiations over the Anthropocene (see Chapter 1). The academic and political discourse on the Anthropocene can be divided into two 'knowledge' camps (plus, the climate deniers) (Hamilton et al, 2015). The 'good Anthropocene' camp is represented by Eco-Pragmatism and Eco-Modernization proponents who promise that reflexive modernization technology will solve the crisis and humans will gain control over the earth's systems. The food security model linked to sustainable intensification aligns here. The "bad Anthropocene" camp is represented by Eco-Marxists and Eco-Catastrophists. The Eco-Marxists make global capitalism – the 'Captilocene' (Moore 2016) – the culprit and the Eco-Catastrophists call for preparation for a frugal, 'post-growth society' (Semal 2015). The food sovereignty and agroecology model align here. For philosophers, the Anthropocene – and its 'telluric' Anthropos – calls into question the modernist, Cartesian ontological assumptions of the dualist separation of humans and nature (Hamilton et al., 2015). The ontological crisis of the Anthropocene speaks again to the food sovereignty versus food security tension. While earth scientists scream that the evidence of the human-caused climate change crisis is overwhelming and undeniable, they lament that the politics of unsustainability prevents the needed transformative changes in favor of public policy incrementalism guided by eco-modernization (Hamilton et al, 2015).

The United Nations Food Systems Summit (UNFSS) is the current venue for the contested control of the global food system where the battle between the corporate model of private interest versus the peoples' coalition model of public interest is being play out. Announced on World Food Day in 2019 as part of a UN 'Decade of Action' to deliver on the Sustainable Development Goals, the UNFSS was convened in late 2021 under the auspices of the World Economic Forum (WEF) instead of the UN Committee on World Food Security (CFS).

Representing the interests of multinational corporations, export-oriented countries, and philanthropies, the WEF promotes a 'Great Reset' to 'allay opposition to neoliberal globalization' through a new vision of multistakeholder global governance (Canfield et al., 2021: 2; Schwab, 2021). The food sovereignty counter movement, lead by La Via Campesina and the Civil Society and Indigenous Peoples' Mechanism (CSM), is pushing back against the UNFSS, criticizing it as an organized attempt to subvert democracy and maintain colonial and corporate control of the agrifood system in the Anthropocene (Canfield et al., 2021).

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