9. The ‘new normal’: food, climate change and intellectual property

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The global food system is broken. Worldwide, 868 million are undernourished.¹ The Asia-Pacific region ranks highest in terms of the number of people that are hungry and sub-Saharan Africa leads on a percentage basis.² In Niger, for example, one in two children suffers from malnutrition and one in six dies before the age of five.³ In July 2011, the United Nations declared Somalia’s food crisis a famine, triggered by the country’s worst drought in 60 years, killing tens of thousands of Somalis from malnutrition-related causes and forcing mass exodus to neighbouring Kenya. Aid agencies estimate that 3.7 million people in Somalia and millions more in neighbouring Djibouti, Ethiopia and Kenya are close to starvation.⁴

Secretary-General Ban Ki Moon, at a meeting of the UN Security Council in 2011, stated that climate change will result in a world where ‘mega-crisis may well become the new normal’.⁵ Josette Sheeran, Executive Director of the UN World Food Programme, has called the triple threat of climate change, rising food prices and population growth a ‘perfect storm’.⁶ On the 2011 famine in East Africa, the head of the US Agency for International Development (USAID), Rajiv Shah, stated: ‘There’s no question that hotter and drier growing conditions in sub-Saharan Africa have reduced the resiliency of these communities ... Absolutely the change in climate has contributed to this problem, without question.’⁷

Even assuming success in limiting global warming to 2 degrees, the target that parties to the UN Framework Convention on Climate Change (UNFCCC) have resigned themselves to, climate change stands to make a bad situation worse. Recent research suggests that the price of key staples for world food supply will increase 70 to 90 percent by 2030, relative to 2010 prices, *before* the effects of climate change.⁸ Taking climate change into account, prices for these staples are expected to roughly double again, rising 120 to 180 percent.⁹ Perversely, the countries that have

historically contributed the least to anthropogenic climate change are the most vulnerable to its effect on food supply.

The proprietary ownership of key inputs, industrial processes developed and controlled by multinational oligopolies, dwindling natural resources and the communities most vulnerable warrant the immediate attention of the international community. Addressing the future of the global food systems implicates intellectual property, human rights, environmental and competition laws, residing more squarely in their intersection than any other climate change-related topic.

This chapter explores how these isolated regimes currently affect global food supply. After introducing the impacts of climate change on global food production, this chapter introduces the right to food. Thirdly, to provide context, technologies directly relevant to the right to food are discussed. The fourth section of the chapter discusses international fora and agreements addressing elements of the intersection of food and intellectual property, competition concerns, the implications of IP and competition for the right to food. The chapter concludes with recommendations for future efforts.

9.1 GLOBAL FOOD SUPPLY AND CLIMATE CHANGE

Current scientific predictions indicate that climate change will reduce food production, availability, and accessibility in vulnerable regions across the globe.¹⁰ Although developed countries are principally responsible for carbon emissions that have led to climate change, the primary effects of climate change will be felt in the developing world.¹¹ While precise geographical impacts remain uncertain, agricultural yields are predicted to improve slightly in temperate zones such as North America and Europe, but fall significantly in tropical and semi-arid zones, including Africa, the Indian subcontinent, the Pacific Islands and tropical regions of Latin America.¹² Rising global temperatures are expected to augment the severity and frequency of droughts and extreme weather events such as floods, both of which can have devastating effects on crops and livestock.¹³ In addition, toxic chemicals once sequestered in melting Arctic ice can enter the food chain, bio-accumulate and bio-magnify, increasing human exposure to a cocktail of carcinogens, mutagens and other hazardous chemicals.

9.1.1 Water Shortages

By disrupting precipitation patterns, climate change will cause droughts of increased frequency, length and intensity across tropical regions. Most climate models predict an overall decrease in precipitation in the northern and southern sub-tropics over the next hundred years.¹⁴ For example, warming in the Indian Ocean is expected to reduce precipitation in parts of Africa, Asia and the Americas.¹⁵ In addition, receding glaciers will cause water resources in some areas to decline by as much as 30 percent in the next four decades, while also contributing to floods in the short term.¹⁶

Short- and long-term water shortages can lead to a loss in soil moisture retention, causing overall declines in crop yields and livestock production.¹⁷ Further, changes in the timing, location and amount of precipitation are likely to disrupt agricultural production, particularly in areas dependent on rain-fed crops.¹⁸ For example, yields for rain-fed crops in drought-prone areas of Africa could decline by as much as 50 percent by 2020.¹⁹ Overall, increases in water scarcity will render some lands unsuitable for both crops and livestock, and thus contribute to instability of the global food supply.²⁰

9.1.2 Crop Devastation

Climate change will also increase the annual occurrence of extreme weather events such as high winds, heavy rains, storm surges, wildfires and flash floods.²¹ Extreme events are likely to increase across Southern and Eastern Asia, Eastern Australia, Northern Europe, in mountainous areas affected by melting glaciers, and in low-lying coastal areas.²²

Extreme weather events, including heavy rains, storm surges and flash floods, can damage standing crops and livestock, cause a loss of stored crops, and destroy agricultural infrastructure, such as roads, machinery and storage facilities.²³ Thus, an increase in such events will likely contribute to a decreased capacity, yield and supply in affected areas. Moreover, greater variation in weather patterns is predicted to change the frequency and extent of pest infestations and crop diseases, which can lead to increased uncertainty in the quantity and safety of food supplies.²⁴

9.1.3 Release of Toxic Chemicals

Persistent Organic Pollutants (POPs) are industrial and agricultural chemicals that have been linked to cancer, immune deficiencies and infertility.²⁵ These chemicals bio-accumulate and bio-magnify in animals,

to result in the highest concentration at the top of the food chain. Evidence now shows that rising temperatures will release POPs from environmental reservoirs such as soil, water and ice.²⁶

The release of POPs from environmental reservoirs will increase the contamination of aquatic and land-based food sources with POPs.²⁷ In addition to the obvious health-related concerns for communities that rely on increasingly contaminated wildlife, the increased mortality accompanying POPs exposure may lead to a decrease in food availability and the loss of traditional sources of food.²⁸ This effect of climate change disproportionately threatens the diets of coastal communities, in particular Arctic communities. Levels of POPs are particularly high in Arctic regions due to long-range environmental transport of POPs to the north through air and water. The high concentration of POPs among the Inuit²⁹ has been linked to serious immune and endocrine weakness.³⁰

9.1.4 Soil Erosion

Extreme weather, such as intense rainfall and high winds, as well as changes in temperature, solar radiation and atmospheric carbon dioxide concentrations, are expected to contribute to soil erosion and lead to lower yields of affected crops.³¹

9.1.5 Biodiversity Loss

Agricultural biodiversity involves the management and conservation of genetic biodiversity of plants, animals and microorganisms within an agricultural ecosystem. Maintaining agricultural biodiversity contributes to natural pest control, pollination, nutrient cycling, crop resilience and yield efficiency.³² Significantly, the maintenance of biodiversity helps ensure that ecosystem services will continue under changing climate circumstances. Unfortunately, biodiversity is threatened by the increased incidence of droughts, floods, wildfires, disease, and pests, that will result from climate change.³³

9.1.6 Fisheries

The projected increase in oceanic temperature, corresponding decrease in ocean oxygen levels, and increasing frequency of extreme weather events are expected to exacerbate existing stresses on marine fish stocks.³⁴ These stresses will be compounded by the increasing acidification of oceans due to the dissolution of atmospheric carbon dioxide. Acidification leads to the degradation of coral reefs, which provide food and

shelter for approximately one-quarter of marine fish species.³⁵ It can also hinder the development of crustaceans and small fish, which constitute the base of many marine food chains.³⁶ Further, increases in freshwater temperatures, along with overall decreases in water availability, river flows and the size of lakes are predicted to impact the productivity of aquatic ecosystems and freshwater fisheries.³⁷ Although this chapter does not focus on fisheries, it is a critical element of global food security and the realization of the right to food.

9.2 RIGHT TO FOOD AND CLIMATE CHANGE

Climate change implicates a host of human rights, the linkages of which are well recognized and articulated.³⁸ Rising sea levels and the increasing frequency or severity of storms implicate the rights to life, health, adequate housing, to self-determination and development. Rising surface temperatures and projected increases in vector-borne diseases implicate the rights to health, food and life. Changes in precipitation patterns and the melting of glaciers implicate the right to water. Measures for the mitigation of climate change, in particular the use of forests as carbon sinks, could perversely affect the rights of local and indigenous communities. The rights of women and children are particularly vulnerable to the consequences of climate change in many countries.

In addition to these rights, the predicted effects of climate change have significant implications for the right to food. The introductory section detailed many of the projected effects of climate change, namely, the loss of crops and livestock due to water shortages, increased salinity of growing conditions, changes in plant and animal pests and diseases, as well as the further decline of fisheries due to ocean acidification. Regardless of whether one speaks in terms of food security,³⁹ food sovereignty⁴⁰ or the right to food, these effects of climate change all threaten to undermine our potential to ensure that everyone in the world has enough nutritious food, and to increase our environmental footprint in a vicious cycle as we try to increase production in the short term.

The right to food is well-established under international law.⁴¹ Three main objectives of the global food system are elements of the right to food; specifically, food must be available, accessible and adequate. Availability refers to the supply of food on the market relative to the needs of all populations.⁴² Accessibility has both a physical and an economic component: (1) food should be physically accessible to all people, including children, older persons or persons with disabilities, and (2) food must be affordable without compromising other basic needs

such as education fees, medical care or housing.⁴³ Adequacy means that food must satisfy dietary needs, be safe for human consumption, free of adverse substances and culturally acceptable.⁴⁴ These three elements of the right to food – availability, accessibility and adequacy – are reoccurring concerns with respect to the technologies, intellectual property laws and competition issues implicated by the right to food.

In 2004, governments adopted a set of Voluntary Guidelines⁴⁵ to support the right to adequate food in the context of national food security, in order to achieve the goals of the Plan of Action of the World Food Summit.⁴⁶ Among the Voluntary Guidelines is the recognition that ‘developed and developing countries should act in partnership to ... achieve the progressive realization of the right to adequate food in the context of national food security through technical cooperation, including institutional capacity building, and transfer of technology’.⁴⁷ The following section details the technologies and knowhow relevant to the realization of the right to food.

9.3 TECHNOLOGIES DIRECTLY RELEVANT TO THE RIGHT TO FOOD

This section focuses on climate change-related technologies that have an effect on global food supplies and production. The first four sections discuss approaches for increasing the availability and adequacy of global food supplies. The final section discusses the negative consequences of certain biofuels on the availability and accessibility of food.

9.3.1 Agroecology

Agroecology is the science of applying ecological concepts to the design, development and management of sustainable agricultural systems.⁴⁸ Agroecological practices can build resilience in communities predicted to experience the brunt of climate change’s impacts on the right to food.⁴⁹ The concept provides a framework with which to analyse food production systems as a whole, including their complex set of inputs and outputs and the interconnectedness of the constituent parts.

Agroecology has numerous benefits for increasing the availability and adequacy of food around the world. Pesticide residues can be eliminated through the use of agroecology, increasing the adequacy of food.⁵⁰ Communities using agroecological practices have fared better following extreme weather events.⁵¹ Growing environments have proven to be better equipped for droughts and floods.⁵² Soils have been measured to

contain greater nutrient levels and to be less prone to erosion. The diversity of living species on farms following agroecological techniques provides an important buffer against the extreme weather events, as well as the invasion of pests, weeds and diseases that are expected to increase with climate change.⁵³ In addition, agroecology also provides opportunities for the mitigation of climate change by increasing carbon sinks in soil organic matter and reducing the use of fossil fuel inputs in food production.⁵⁴

9.3.2 Water-related Technologies

The water-related effects of climate change are twofold: water scarcity and water source contamination. To meet the challenge of providing adequate water for food production, technologies can be categorized as: (1) harvesting and storage techniques, such as rain and groundwater harvesting, aquifer recharge and cloud seeding; (2) distribution and management techniques; and (3) water purification techniques for the removal of salts, microbes and chemical contaminants, including wastewater recycling.⁵⁵ For these technologies to be considered effective, they must moderate the water-related health impacts of climate change without causing additional environmental or social harms.

9.3.3 Advance Warning Systems

Extreme weather events are also projected to increase as a result of climate change. In addition to being a life-saving tool, advance warning systems can provide farmers and ranchers with valuable information that can enable measures to protect plants and herds. For example, Rwanda, which relies on farming to generate about 42 percent of its economic output and 90 percent of its employment, plans to establish an early-warning system for extreme weather to help boost farming production and revenue.⁵⁶

9.3.4 Genetic Engineering and Plant Breeding

With the projections for increased drought, soil salinity, pests and disease, adaptation to climate change in many agricultural regions may require stress-tolerant plant varieties. Recognizing a market opportunity, companies have already begun marketing genetically modified plants that are tolerant to a variety of stress factors.⁵⁷ In 2009, scientists discovered precisely how abscisic acid (ABA, a ubiquitous hormone that regulates plant growth, development and responses to environmental stresses)

works at the molecular level.⁵⁸ *Science* named this discovery as one of the top breakthroughs of 2009, and scientists have already proposed adaptation methods using this knowledge, such as the spraying of synthetic chemicals that trigger a hormonal response in plants.⁵⁹

9.3.5 Biofuels

From 2006–2008, a 74 percent increase in food prices was recorded by the World Food Index. The World Bank,⁶⁰ the Special Rapporteur on the Right to Food⁶¹ and the UN World Food Programme⁶² (WFP) all attribute much of the spike in prices to an increasing use of crops for transportation energy and manufacturing purposes. First-generation biofuels, in particular corn, rapeseed and palm oil, have sharply escalated demand-side growth over the past few years.⁶³

According to the US Department of Agriculture, the United States' diverted over 25 percent of its 2009 grain production for blending corn-derived ethanol in gasoline.⁶⁴ Experts state that this amount, 107 million tons, could have fed over 350 million people.⁶⁵ In July 2011, for the first time, more corn was used to produce ethanol for fuel than to feed livestock for food.⁶⁶ Trade restrictions favoring domestic sources of raw material for biofuel production do not maximize the potential environmental benefits of biofuels.⁶⁷ The conversion of farmland and forests for rapeseed and palm oil production to meet national renewable energy policy goals⁶⁸ is further reducing acreage available for food production.⁶⁹ Environmental and human rights advocates in the United States continue to press for ending the practice of using biofuels.⁷⁰

G20 leaders at their summit meeting in November 2010 requested eight international institutions⁷¹ to work with key stakeholders 'to develop options for G20 consideration on how to better mitigate and manage the risks associated with the price volatility of food and other agriculture commodities, without distorting market behaviour, ultimately to protect the most vulnerable'.⁷² One of the resulting recommendations was that G20 governments end national policies that subsidize or mandate biofuel production or consumption.⁷³

9.4 INTELLECTUAL PROPERTY AND FOOD

One of the greatest areas of concern for intellectual property (IP) impediments to climate change-related technologies is in the context of food. IP issues relevant to access to food include the patentability of isolated genes, the use of genetic resources for plants and animals, plant

variety protection and traditional knowledge. Particularly relevant in the context of IP and the right to food is the requirement that food be economically accessible. Negotiations to reform IP norms for food-related inputs and outputs implicates a small but powerful number of rights holders in developed countries, as well as a number of international fora and agreements.

Among the web of international agreements and institutions that address IP and food are the World Trade Organization (WTO) and its Agreement on Trade-Related Aspects of Intellectual Property Rights ('TRIPS Agreement'); the Convention on Biological Diversity (CBD) and its 2010 Nagoya Protocol; the Food and Agriculture Organization (FAO) and its International Treaty on Plant Genetic Resources for Food and Agriculture ('FAO Treaty'); the World Intellectual Property Organization (WIPO); and the International Union for the Protection of New Varieties of Plants (UPOV). These fora and international agreements are discussed below, followed by competition or antitrust issues that have been raised, and IP and competition concerns with respect to access to food.

9.4.1 International Agreements and Fora

Since its inception in 1995, the WTO's TRIPS Agreement has been controversial for numerous reasons with developing countries and public interest advocates.⁷⁴ The patenting of plants and isolated genes has been a particularly vocal point of contention, among other issues, including access to medicines. As part of the ongoing Doha Round of negotiations, the declarations of trade ministers in 2001 suggested that the WTO would conduct an expansive review of the relationship between intellectual property rights (IPRs) in plants and competing policy objectives as it considers whether and in what ways to revise the current text of the TRIPS Agreement.⁷⁵

Article 27(3)(b) of the TRIPS Agreement requires that Member States 'provide for the protection of plant varieties either by patents or by an effective *sui generis* system or by any combination thereof'. Issues raised by Article 27(3)(b) in the TRIPS Council include the implications regarding the interests of developing countries; exclusions to patentability; the relationship of the *sui generis* provisions and UPOV; ethical questions about the patenting of life-forms; prior informed consent and benefits sharing; and traditional knowledge and farmers' rights.⁷⁶

Although UPOV is not explicitly mentioned in Article 27(3)(b), it is one such *sui generis* system that has more-often-than-not been adopted by developing countries, in large part due to the requirements of trade or investment agreements with industrialized countries or regions.⁷⁷ UPOV

is the only international institution for plant variety protection. Following the original Convention for the Protection of Plant Varieties in 1961, there have been three Acts, each with progressively fewer public interest flexibilities. However, plant variety protection is still viewed as having more public interest flexibilities, for example, regarding research, than patents. Access to UPOV has been extremely limited for civil society non-governmental organizations (NGOs), as only two of 25 NGO observers are from civil society.

India, Brazil and Thailand are notable exceptions to developing countries that have adopted a UPOV Convention, as they have implemented their own *sui generis* systems. There has been considerable debate in the TRIPS Council over the possible amendment of the TRIPS Agreement to provide for the disclosure of origin of genetic resources in patent applications.⁷⁸ The IP issues surrounding genetic resources have been taken up in other fora as well, such as WIPO, the CBD and the FAO. In WIPO, the Intergovernmental Committee on Genetic Resources, Traditional Knowledge and Folklore is mandated to submit to the 2011 WIPO General Assembly the text of one or more international legal instruments which will ensure the 'effective protection' of genetic resources, traditional knowledge and traditional cultural expressions.⁷⁹

The CBD has four Articles to ensure equitable access, use and distribution of the benefits of biodiversity, specifically genetic resources and traditional knowledge.⁸⁰ These Articles have been a focal point for negotiations for several years. Parties to the CBD established an Ad-Hoc Open-ended Working Group on access and benefit sharing (ABS) to negotiate an international regime on ABS. In the fall of 2010, parties to the CBD concluded a vaguely worded Protocol on ABS, the Nagoya Protocol. The FAO Treaty also speaks to the equitable sharing of benefits arising from the utilization of plant genetic resources for food and agriculture. Interestingly, under the FAO Treaty, parties have also committed to measures that promote the 'development and maintenance of diverse farming systems that enhance the sustainable use of agricultural biological diversity and other natural resources'.⁸¹

Given the number of international agreements implicated, it is not surprising that commentators have noted several areas of potential conflict. For example, there are two potential areas of conflict between the FAO Treaty and TRIPS: Article 12.3(d) FAO Treaty, regarding the exclusion of certain genetic resources from IP protection; and Article 13.2 FAO Treaty, regarding the sharing of benefits. A conflict with Article 12.3(d) TRIPS is especially likely for states, particularly countries that award patents to inventors who have isolated plant genes from nature.⁸² Analysis by the FAO suggests that the sharing of benefits arising

from the use of genetic resources in biotechnology patents could violate the non-discrimination clause of Article 27(1) TRIPS, based upon the WTO Panel's ruling in *Canada – Patent Protection of Pharmaceutical Products* (DS114).⁸³ With respect to conflicts between provisions of the CDB and the TRIPS Agreement, several parties have submitted proposals at the WTO TRIPS Council to harmonize the two agreements.⁸⁴

9.4.2 Antitrust (Competition) Issues

There is a high degree of concentration in the agricultural sector. Four firms – DuPont, Limagrain, Monsanto and Syngenta – control over 50 percent of global seed sales.⁸⁵ Three firms – Archer Daniels Midland, Bunge and Cargill – control 90 percent of global grain trade.⁸⁶ Price fixing, the allocation of customers and other forms of anti-competitive behavior have resulted in some of the largest antitrust fines in US history and criminal charges.⁸⁷ Such conduct wilfully subverts the operation of free markets and can cause serious economic harm. It virtually always results in inflated prices to purchasers or depressed prices to suppliers; indeed, that is the very purpose of such conduct. Farmers have been concerned that further concentration through mergers and acquisitions will limit the number of sellers of seed, chemicals, machinery and other equipment from whom they have to buy, as well as limiting the number of customers for crops and livestock to whom they can sell.⁸⁸ In the context of mergers and proposed mergers, concerns have been expressed by antitrust officials of potential abuse of patented seed technologies.

In 1998, the US Department of Justice (USDOJ) investigated Monsanto's proposed acquisition of DeKalb Genetics Corporation. Both companies were leaders in corn seed biotechnology and owned patents that gave them control over important technology. The USDOJ expressed strong concerns about how the merger would affect competition for seed and biotechnology innovation. To alleviate concerns, Monsanto spun off to an independent research facility its claims to certain proprietary technologies to introduce new traits into corn seed, such as insect resistance.⁸⁹ Monsanto also entered into binding commitments to license its Holden's corn germplasm to over 150 seed companies that currently buy it from Monsanto, so that they can use it to create their own corn hybrids.⁹⁰

These actions did not, however, alleviate concerns of the abuse of market power by large agricultural firms like Monsanto. In 2010, US Attorney General Eric Holder, Jr announced that we 'will see an historic era of enforcement' if indeed the agricultural industry suffers from a lack of free and fair competition in the marketplace.⁹¹ Similar rhetoric by US

Assistant Attorney General Christine A. Varney has drawn applause from audiences at public hearings.⁹²

9.4.3 IP and Competition Concerns over Access to Food

The IP regime for food and agriculture has significant implications for improving agricultural practices in a changing climate and for accessing food-related technologies, exacerbated by a highly-concentrated industry with established and highly-profitable business practices. In the face of stresses brought on by rising population levels and climate change, IP privileges could help to attract investment in research and development of new plant varieties that would enable adaptation. In addition to the development of new plant varieties, proponents of harmonized and strong IPRs argue that access to new and improved technologies in developing countries is in fact facilitated though strong IP policies and rigorous enforcement.⁹³ Increased crop yields are often cited as evidence of the benefits of strong IP regimes for food production in the Global South.⁹⁴

While some might say that IP is necessary for innovation, IP is never sufficient by itself to catalyze innovation – especially for problems that predominantly face the developing world, as will be the case with the effects of climate change on food production. The World Health Organization (WHO)’s Global Plan of Action for innovative solutions to problems that disproportionately affect developing countries states:

Intellectual property rights are an important incentive in the development of new health care products. However, this incentive alone does not meet the need for the development of new products to fight diseases where the potential paying market is small or uncertain.⁹⁵

Increasing food insecurity is likely to further intensify debates about the patenting of seeds and plant variety protection, fueling calls for compulsory licensing provisions akin to those used to provide access to life-saving medicines in developing countries.⁹⁶ Similar debates have started to ensue in relation to climate-resilient plant and seed varieties. At the UNFCCC, civil society representatives of 20 million farmers in Africa have demanded:

an end to efforts by foreign corporations to patent climate-resilient African plant and seed varieties, and call[ed] for a system of intellectual property rights tailored to the needs of small-holder farmers and that is favorable to technology transfer at all levels including through appropriate plant variety protection.⁹⁷

Critics from all sides – civil society, government and industry – point to ways in which IPRs are being used to prevent the transfer of technology and innovation. Experts charge that Monsanto has used license agreements with smaller seed companies to gain an unfair advantage over competitors and to block cheaper generic versions of its seeds from eventually entering the market.⁹⁸ DuPont, a rival company, also claims Monsanto has unfairly barred it from combining biotech traits in a way that would benefit farmers. Against these backdrops, the US Department of Justice opened an investigation into antitrust and agriculture, which delivered a report in May 2012.⁹⁹

Moreover, the current IP regime favors an industrial style of agriculture, and promotes dependency on synthetic chemicals and monoculture production models.¹⁰⁰ The commercialization of agroecological practices has been challenged by the limited returns on investment for R&D, whereas an IP-centered industrial model can dangle tantalizing supra-competitive returns for many years. The industrial model is ill-suited for traditional models of farming in developing countries, dependent on diverse crop varieties and traditional techniques.

Yield improvements that are often cited for proprietary plants and animals often come at the expense of biological diversity, as herbicides and pesticides are sprayed over genetically altered crops. Moreover, many commercially available plant varieties are dependent on fertilizers and are water-intensive.

The above-market price cost of proprietary plants and seeds may slow the adoption of approved but environmentally unsound technologies. However, the short-term bump in yield that may accompany proprietary plant varieties pressures other farmers to adopt these technologies to compete in the short term. The world's most widely adopted genetic trait, Roundup Ready® herbicide resistance in soybeans, is set to go off patent soon in the United States, with the last applicable patent expected to expire in 2014.¹⁰¹ During a public hearing on increasing scrutiny of the agriculture industry, Assistant Attorney General Christine Varney drew applause from the audience when she said that the USDOJ planned to keep a close eye on the coming shift to generic forms of biotech crop traits, as the patents that companies hold on those traits expire.¹⁰² Monsanto says it will not oppose the entry of generic varieties.¹⁰³ Following the entry of generic traits, it will be interesting to follow price decreases, sales increases and corresponding environmental concerns.

Despite promises of vigilant oversight, concerns remain about the abuse of market power enabled by proprietary technologies and an extremely concentrated industry. In a seed market that Monsanto dominates, the jump in prices has been staggering.¹⁰⁴ US Department of

Agriculture figures show that corn seed prices have risen 135 percent between 2001 and 2010. The price of soybean seed, which is not used for biofuels, has increased 108 percent over the same period. By contrast, the US Consumer Price Index (which does not include food or energy) rose only 20 percent in that period.¹⁰⁵

Monsanto's enforcement of its IPRs has garnered considerable attention around the world. Since the mid-1990s, the multinational has sued 145 individual US farmers for patent infringement in connection with its genetically engineered seed.¹⁰⁶ This number, however, only reflects cases that are in the public record. The Center for Food Security has found evidence that the actual number of cases investigated by Monsanto is closer to 500 per year, which could mean up to 8,000 suits over a similar timeframe.¹⁰⁷ The prospect of multi-year litigation against one of the largest companies in the world would make any farmer think twice. Conversely, farmers using genetically modified seeds could be liable to neighboring farmers who choose to maintain wild-type varieties if genetically modified varieties drift onto their fields.

Undeterred, a group consisting of over 60 family farmers, seed businesses and organic agricultural organizations in Canada and the United States filed a lawsuit against Monsanto in March 2011, challenging the chemical giant's patents on genetically modified seed. The plaintiffs claim they were forced to sue pre-emptively to protect themselves from being accused of patent infringement should they ever become contaminated by Monsanto's genetically modified seed.¹⁰⁸ The pre-emptive suit was driven by past cases like those of a Canadian farmer, who was found guilty and severely fined because Monsanto's proprietary herbicide-resistant canola drifted onto his property.¹⁰⁹ The farmer did not derive any benefit from its presence, neither through selling the genetically modified seed, nor by spraying the herbicide for which it was engineered to be resistant.¹¹⁰ Adding insult to injury, the farmer also lost the improved genetics resulting from his lifelong practice of saving his own seed to produce his own tailor-made variety of canola, as the crop was confiscated.¹¹¹ Trying to soften the blow from a public-relations debacle, Monsanto agreed to pay in the earlier case for the cost of cleaning up the contaminated farm in a 2008 out of court settlement.

Intellectual property was intended in the United States for the 'promotion of the useful arts'.¹¹² In the context of adapting to climate change, innovation is needed to help the vulnerable adapt to the projected changes in food production, particularly in the Global South. Intellectual property has critical consequences for both promoting the innovation necessary for sustainable global food supplies in a changing climate, and for access to resulting innovations. The following section discusses some

options for addressing the tension between the right to access food and ensuring that the innovation necessary for successful adaptation takes place.

9.5 A WAY FORWARD

A rights-based approach would help to ensure the effectiveness of efforts for climate change mitigation and adaptation. This approach emphasizes the urgency of the situation, on both sides of the equation, providing necessary context and values to international negotiations. To the extent that this involves technologies, a rights-based approach could help to ensure that the right technologies are transferred. The following discussion illustrates how a rights-based approach, e.g., the right to food, could play an influential role in discussions over the innovation of and access to climate-related technologies and knowhow.

9.5.1 Financing Mechanisms

As the effects of climate change materialize, developing countries will need substantial technical and financial resources to build climate resilience.¹¹³ With the lack of ambitious and legally-binding greenhouse gas (GHG) emissions targets internationally, demands for adaptation assistance are likely to assume an increasing proportion of financial contributions to address climate change. Developed countries have committed themselves to providing (at least) US\$100 billion by 2020, for both mitigation and adaptation. It is unclear what portion of these funds will derive from pre-existing financial obligations for official development assistance (ODA); the amount of funding that will be provided between 2013 and 2019; and the amount that is allocated to adaptation activities.¹¹⁴ Other sources also exist, but some of these may differ substantially or not exist at all (e.g., the Adaptation Fund) following the end of the Kyoto Protocol's first commitment period.¹¹⁵

Estimates of mitigation funding needs typically average in the trillions of US dollars, with the International Energy Agency (IEA) estimating in a 2011 report that between US\$580 billion–US\$1.46 trillion would be required per year to achieve the 2 degree warming target by 2050.¹¹⁶ Every year that passes with insufficient and ineffective allocations of financial resources for mitigation increases the amount subsequently required for mitigation and adaptation. In 2007, United Nations Development Programme (UNDP) projected adaptation needs of US\$86–109 billion per year in 2015.¹¹⁷ Today, the estimate for adaptation needs is all

but certain to be higher. The magnitude of the financing required all but eliminates the likelihood that only public funding mechanisms will be sufficient to effectively address climate change.

9.5.2 Allocation of Responsibility

The UN Committee on Economic, Social and Cultural Rights (CESCR), in General Comment 12, notes that ‘all members of society ... have responsibilities in the realization of the right to food’. CESCR emphasizes that ‘[t]he private business sector – national and transnational – should pursue its activities within the framework of a code of conduct conducive to respect of the right to adequate food’. On the international obligations of the public sector, CESCR notes in the General Comment that ‘States parties should take steps to respect the enjoyment of the right to food in other countries, to protect that right, to facilitate access to food and to provide the necessary aid when required.’¹¹⁸ The engagement of both the public and private sector is required, as each has a unique role to play in the innovation cycle and transfer of technologies to the developing world.

To close the funding gap, key partners from the private sector must be incentivized to invest their resources in the adoption of cleaner technologies and developing climate resilience in adversely affected regions. Unfortunately, insufficient incentives have been provided to enable private sector interest in engaging in adaptation activities,¹¹⁹ and this is considered from the private sector investor advisory perspective by McGrory in this collection. Even considering the other sources of adaptation funding,¹²⁰ it is highly unlikely that financial resources for adaptation will prove sufficient.

Bearing in mind General Comment 12, both private and public actors have an obligation to ensure that those least responsible for the effects of climate change have adequate resources to ensure access to food. Likewise, these actors also have the obligation to ensure that activities in their own territories (e.g., biofuel production) do not adversely affect the right of vulnerable people to access food.

9.5.3 Prioritizing Where Resources Are Directed

Discussions in the UNFCCC on the future of providing developing countries access to technologies are currently divided into two tracks: finance and technology. Both elements are critical to providing developing countries with technologies and knowhow to build climate-resilient food and agricultural systems. CESCR notes in the General Comment

that 'States parties should, in international agreements whenever relevant, ensure that the right to adequate food is given due attention and consider the development of further international legal instruments to that end.'¹²¹ By giving attention to the right to food and other human rights considerations in disparate discussions, parties to the UNFCCC can help to ensure that these two related elements dovetail to achieve mutually supportive outcomes. This approach draws on a recommendation by the International Law Commission on the use of shared principles in the 'systemic integration' of fragmented negotiations in related legal regimes.

In designing a mechanism for the transfer of technologies to enable climate-resilient food and agricultural practices, the parties to the UNFCCC must consider the elements of the current food system that are impeding, or may impede access. The premium that patents add to seed varieties is substantial and, given financial limitations, may serve to hinder access to genetically modified seeds that some countries view as necessary.¹²² The Special Rapporteur on the Right to Food detailed the implications of seed policies on the right to food, concluding that the current IP regime was 'suboptimal'.¹²³ His recommendations ranged from avoiding 'TRIPS-plus' requirements in trade agreements, to funding breeding projects on a large diversity of crops and studies of the agricultural system as a whole.¹²⁴

Bearing in mind localized needs for yet undeveloped technologies and knowhow, substantial innovation is still required to enable climate resilience in the developing world. In particular, the development of agroecological practices has numerous benefits, including the unlikelihood that proprietary technologies will hinder access to relevant technologies.¹²⁵ This type of research, unattractive to the private sector, but ripe with positive externalities for communities using its successful innovations, should be of greater priority to public funds contributing in the name of human health and the environment. In addition, the Special Rapporteur suggests limiting the ability of private suppliers to add restrictions on the use or modification of products, which could impede innovation for localized needs.¹²⁶ He also suggests increasing farmers' awareness of, access to and participation in the production of commercial seeds, as well as the scale-up of local seed exchange programs.¹²⁷

Most of these suggested activities are such that adaptation funding could be used for enabling developing countries to develop their own innovation models for environmentally sound agriculture that capitalizes on their own needs, resources and opportunities. The private sector could play a role, but effective safeguards must be present to avoid conflicts of interest and favoritism for industrial agricultural practices. The type of technologies parties consider including in climate-related activities

should look at human rights and environmental impacts, as well as economic factors which serve to increase the cost of preferred activities.

One possible innovation model to consider expanding is the Consultative Group on International Agricultural Research (CGIAR), which is a global research partnership for sustainable agriculture in the developing world. CGIAR's work is carried out by 15 research centers, operating in close collaboration with hundreds of partner organizations, including national and regional research institutes, civil society organizations, academia and the private sector. The funders include developing and industrialized country governments, foundations and international and regional organizations; however, like adaptation funding generally, funds have not been proportional to needs. The annual research budget of just one multinational seed company, Monsanto, is twice the entire annual budget of CGIAR (US\$500 million).¹²⁸

The type of innovation that individual states and the broader international community seek can and should be informed by human right impacts, both positive and negative. Turning back to the example of biofuels, first-generation biofuels continue to attract resources despite their profound implications for human rights and the environment. In the United States, financial flows for biofuels have taken the form of tax breaks and subsidies for relevant actors.¹²⁹ Taxes and subsidies are recognized as a means of incentivizing innovation. In this case, the innovation incentivized has been technologies for the diversion of corn from food stocks to ethanol production. As mentioned before, states are required to 'take steps to respect the enjoyment of the right to food in other countries'.¹³⁰ Political feasibility aside, these tax credits and subsidies should have been diverted to either the development or adoption of more-sustainable technologies. This is an example of how human rights (the right to food) can lend orientation to the redirection of future innovation priorities.

9.6 CONCLUSION

As noted above, the head of USAID, Rajiv Shah, considered, in the context of East African famine, that hotter and drier conditions had reduced the resilience of communities, and that climate change had contributed to this.¹³¹ Plans for development assistance, including the plans of USAID, typically focus on the short-term, environmentally-costly technologies such as genetically modified seeds, synthetic fertilizers and pesticides and the purchase of economically-costly staples.

However, climate change mitigation and adaptation presents an opportunity to further the objectives of sustainable development, to achieve long-term economic and environmental benefits on a global scale. An approach to the transfer of technologies for climate change mitigation or adaptation that is informed by human rights would increase the overall effectiveness of climate change-related efforts for protecting human health and the environment.

NOTES

- * Thanks to Mary Tharin and Alexandra Hill for their research assistance.
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- 2. *Ibid.*
- 3. Oxfam, *Growing a Better Future* (2011) 6, available at www.oxfam.org/sites/www.oxfam.org/files/cr-growing-better-future-170611-en.pdf.
- 4. 'The World This Week', 400(8744) *The Economist*, 30 July 2011, at 6.
- 5. Ban Ki Moon, Address to the UN Security Council, 'Secretary-General's remarks to the Security Council on the impact of climate change on international peace and security', New York, 20 July 2011, available at www.un.org/apps/sg/sgstats.asp?nid=5424.
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- 7. Joshua Hersch, 'East Africa famine threatens regional stability, USAID Chief says', *Huffington Post*, 13 July 2011, available at www.huffingtonpost.com/2011/07/13/famine-in-africa-usaid_n_897644.html.
- 8. Oxfam, n. 3 above, at 12.
- 9. *Ibid.* 7.
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- 15. M. Brown and C. Funk, 'Food security under climate change' (2008) 319(5863) *Science* 580 (DOI: 10.1126/science.1154102).
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- 17. FAO, n. 1 above.
- 18. *Ibid.* 43.
- 19. Union of Concerned Scientists, *Findings of the Fourth Assessment Report: Climate Change Impacts*, IPCC Highlights Series (2007), available at www.ucsusa.org/assets/documents/global_warming/ucs-ipcc-wg2-72pi-2007.
- 20. *Ibid.*
- 21. See FAO, n. 1 above.
- 22. See Parry *et al.*, n. 14 above, at 280.

23. Union of Concerned Scientists, n. 19 above, at 12.
24. *Ibid.*
25. See definition at D. Hunter, J. Salzman and D. Zaelke, *International Environmental Law and Policy* (2nd edn, Thomson Reuters Foundation Press, New York, 2002) 502. POPs include dioxins, PCBs, DDT, brominated flame retardants and others. Twenty-two chemicals or chemical classes are now listed under the Stockholm Convention on Persistent Organic Pollutants, with several other POPs nominated for listing.
26. Report of the UNEP/AMAP Expert Group, *Climate Change and POPs: Predicting the Impacts* (2011) 6.
27. *Ibid.* 6.
28. *Ibid.* 27.
29. The Inuit are a group of culturally similar indigenous peoples inhabiting the Arctic regions of Canada, Denmark (Greenland), Russia and the United States.
30. Hunter *et al.*, n. 25 above, at 1069.
31. M. Nearing, F.F. Pruski and M.R. O'Neal, 'Expected climate change impacts on soil erosion rates: a review' (2004) 59 *J Soil Water Conserv.* 43.
32. FAO, *Agricultural Biodiversity* (2008), available at www.fao.org/docrep/010/i0112e/i0112e00.htm.
33. See FAO, n. 1 above, at 44.
34. FAO, 'Variability and climate change', available at www.fao.org/fishery/topic/13789/en.
35. UN Environment Programme (UNEP), *Environmental Consequences of Ocean Acidification: A Threat to Food Security* (2010), available at www.unep.org/dewa/Portals/67/pdf/Ocean_Acidification.pdf.
36. *Ibid.* (acidification has been shown to cause orientation problems and variable growth rates in clownfish, which can affect their behavior toward predators).
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38. See e.g., UN Human Rights Council, *Report of the 2010 Social Forum, A/HRC/16/62* (4 January 2011); Center for International Environmental Law (CIEL), *Climate Change and Human Rights: Practical Steps Forward* (2009) 10, available at www.ciel.org/Publications/CCandHRE_Feb09.pdf.
39. Food security is a 'situation that exists when all people at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life'; G. Tansey and T. Rajotte, *The Future Control of Food: A Guide to International Negotiations and Rules on Intellectual Property, Biodiversity and Food* (Routledge, London, 2008), see 'Farming, Food and Global Rules' box 1.7.
40. Food sovereignty is based on the human right to food, to self-determination, on indigenous rights to territory, and on the other rights of rural peoples to produce food for local and national markets. Six pillars have been identified, which include a focus on food for people; valuing food providers; localizing food systems; placing controls locally; building knowledge and skills; and working with nature. See Tansey and Rajotte, n. 39 above.
41. See Universal Declaration of Human Rights, Art. 25 (10 December 1948) ('everyone has the right to a standard of living adequate for the health and well-being of himself and his family, including food'); International Covenant on Economic, Social, and Cultural Rights, Art. 11 (3 January 1976) (states parties recognize 'the right of everyone to an adequate standard of living for himself and his family, including adequate food ... [and] the fundamental right of everyone to be free from hunger'); International Covenant on Civil and Political Rights, Art. 6 (16 December 1966) (implying a right to food as part of the right to life); Convention on the Rights of the Child, Arts 24(2)(c) and 27(3) (requiring states to take appropriate

- measures to combat disease and malnutrition through, *inter alia*, the provision of adequate nutritious foods and clean drinking water); Convention on the Elimination of All Forms of Discrimination Against Women, Arts 12(2) and 14(2) (requiring states to ensure adequate nutrition for women during pregnancy and lactation and to take measures to eliminate discrimination against women in rural areas in order to ensure their enjoyment of adequate living conditions); Convention on the Rights of Persons with Disabilities, Arts 25(f) and 28(1); and the Geneva Conventions (right to be free from hunger and right to adequate food are firmly established as rights that must be respected during armed conflict).
42. UN Committee on Economic, Social and Cultural Rights (CESCR), General Comment No. 12, 'The Right to Adequate Food (Article 11 of the Covenant)' (12 May 1999), available at www.unhcr.org/refworld/docid/4538838c11.html. This is also considered by Srinivas in Chapter 6.
 43. UN Committee on Economic, Social and Cultural Rights (CESCR), General Comment No. 12, 'The Right to Adequate Food (Article 11 of the Covenant)' (12 May 1999), available at www.unhcr.org/refworld/docid/4538838c11.html.
 44. *Ibid.*
 45. FAO, Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security (2004), available at www.fao.org/docrep/meeting/009/y9825e/y9825e00.htm.
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 52. *Ibid.*
 53. International Assessment of Agricultural Knowledge, Science and Technology for Development, n. 49 above.
 54. Pesticide Action Network North America, *Agroecology and Sustainable Development* (2009), available at www.panna.org/sites/default/files/AgroecoBriefFINAL_small.pdf.
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 56. M. Murdoch, 'Rwanda plans weather early-warning system to boost farm revenue', *Bloomberg Business Week*, 29 March 2011, available at www.bloomberg.com/news/2011-03-29/rwanda-plans-weather-early-warning-system-to-boost-farm-revenue.html.

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131. Hersh, n. 7 above.