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The Effects of Climate Change on Food Security

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"A famine is more than a food shortage—it is an environmental disaster, a total disruption of the systems and institutions that produce and distribute food"

-Jack Hollander 2003

Abstract

Global hunger has become one of the most pressing issues our planet faces. The need to research the causes of this food shortage are more urgent than ever, and if we fail to act, the situation will only grow direr. Climate change and food shortage are both highly intricate, but their common ground is the area that is of greatest importance. Climate change has proven too much for global food production systems to bear, and as a result, climate-stressed regions are now experiencing food insecurity as well. Climate change has shaken the three pillars of food security—availability, access, and utilization—and it will be an enormous undertaking to shore them up. As diverse as the three components of food security are; they are all interdependent. Solutions to this crisis will require a well-rounded approach. Drawing conclusions from literary research and engaged experiential research with The Apeiron Institute of Providence, Rhode Island, this thesis discusses the most important ways that climate affects food security, and proposes the most needed and feasible solutions that should be pursued in the near future.

Introduction

Homo sapiens have existed for roughly 200,000 years. It took until 10,000 B.C. for our species to number above 3 million. When Jesus Christ was born, there were about 300 million of us. In 1800, the human population finally passed the 1 billion mark. Now there are approximately 2 million new humans every week, and we will total 7 billion within the next few years. Viruses would envy our ability to procreate with such explosive force. Our population growth requires an enormous amount of resources. Humans consume 40% of all calories available to land animals, and 45% of our planet's fresh water (Penn 2003). Despite these stratospheric nutritional requirements, feeding humanity has only recently become a challenge. Factors such as population growth and failed food distribution systems consistently threaten to bring mass hunger, yet humans have always found a way to survive. For millennia, our planet could produce as much food as we asked of it. More people mean more farmers to cultivate more land. Agriculture has always been able to outpace population growth, and even today as we continue to reproduce geometrically, technology has facilitated unprecedented crop yields. Many people in the developed world assume that it is overpopulation or social injustice that force one sixth of our world to go hungry every day, but it is the advent of climate change in the past few decades that has finally tilted the scales in favor of world hunger. Climate change is the straw that will break humanity's back. In a global survey conducted in 2004 by the Council of Scientific and Industrial Research, houses around the world experiencing food shortages were asked what factor has most impacted their food security. They were asked to choose between 33 possible factors. Overpopulation didn't make the top 10. High food prices took third place, with 5% of households listing it as the reason their food security is jeopardized. Poverty came in second with 7%. But the clear winner was climate/environment, with a full 12% of responders listing it as the primary reason they go hungry (Gregory 2005).

Climate change is primarily fueled by the addition of greenhouse gasses into our atmosphere through the combustion of fossil fuels. In its simplest manifestation, this means more CO_2 and warmer temperatures. One would assume that these would actually help plants grow. Increased CO_2 in the air and soil would help plants photosynthesize. Warmer temperatures would extend growing seasons. And plants have been shown to use water more efficiently under increased carbon dioxide concentrations. But this only considers increased CO_2 and does nothing to account for the many facets that accompany climate change. The reality is that climate change doesn't have any simple manifestations. The way our climate works is unpredictable and dynamic. For example, we could expect that at high latitudes (such as Canada, the UK, and Russia) crop yield will see respectable increases with moderate global warming, perhaps as high as 10%. This assumes that extreme climate events do not become commonplace. However, warming more than 1 or 2 degrees Celsius will result in sharp declines in harvest. In stark contrast to the potential prosperity of high latitudes, the tropical regions will see crop yields collapse with even the mildest of climate changes. Crop losses in the tropical region are already estimated at around 5%, and will likely soar to 30% by the middle of the century (Slingo 2005).

> "The most serious disruptions of agriculture will result from drying of the central parts of northern continents, regions that now constitute the world's principal bread baskets. Potentially compensating yield increases in areas that might become more climatically suited to agriculture might not be realized because of other inadequacies. For example, the Canadian shield, to which Iowa's present climate may eventually 'migrate' has thin, nutrient-poor, acidic soil" (Ehrlich 1993, pg.19).

Although in the short-run, a select few will benefit from climate change, when all is considered, everyone loses. Tropical regions and global breadbaskets will unquestionably see yields fall, and no increases in productivity elsewhere in the world can counterbalance that (Penn 2003).

A population's vulnerability to food insecurity includes the likelihood of exposure to food stresses (i.e.: crop failure, massive unemployment, disease epidemic) as well as that population's ability to cope with those stresses. True security includes some sort of food buffer to guard against famine. Fortunately in our globalized world, there are organizations and governments that can quickly move food to areas where it is most needed. Despite this, many countries choose to maintain their own food production. A well-rounded buffer against famine includes both the means to import food, and some degree of production and reserves within the country. For example, in India, there is an enormous amount of food produced, but the population lacks the means to buy any imported food if there is some sort of disaster. A city like Hong Kong has more than enough money to buy food, but produces none of its own. “Vulnerability and poverty are often interrelated because both the likelihood of exposure to stresses is greater among the poor, and because a large portion of their resources are spent either purchasing or producing food, thereby reducing their capacity to cope with perturbations” (Gregory 2005, pg. 2142). Obviously India is more vulnerable to food insecurity than Hong Kong because of its widespread poverty, but both places lack a full defense against hunger (Ehrlich 1993). When considering food security, it is clear that no factor plays as important a role in promulgating hunger as climate change does. And when considering the ways humanity can cope with food insecurity, no solution will see success if it does not put adaptations to climate change at its forefront, and the knowledge of the three components of food security at its core. In the research for this thesis, the primary questions are: how does climate change impact food security? And what solutions are most appropriate given the relationship between food security and climate change?

Methodology

In trying to answer the questions generated from my literature review, it was apparent that the vast majority of my research would be through previously published work, supplemented with conclusions and connections I drew between my understanding of climate change and my understanding of food security. However, as is indicated by its definition; community engagement is a critical part of the Community Engaged Thesis. The way I wanted to take advantage of this aspect of my research is to see how groups in Rhode Island achieve food security.

Naturally, food security in Rhode Island is incredibly different from food security elsewhere in the world. In Rhode Island, the vast majority of people have incredibly stable food security. But that doesn't mean that there isn't room for improvement. To research this topic, I worked with The Apeiron Institute in South Providence. Directed by State Representative Art Handy, Apeiron is a group that tries to bring sustainability to Rhode Island. This includes things like urban farming, small business sustainability training, and educational programs for the people of Rhode Island. They believe that RI has the unique advantage of being small and progressive enough to test models for change that could one day be applicable on a much larger scale.

The part of their work that I felt came closest to my research goals was Apeiron's urban farming program. Although relatively small, the program was exemplary in its consideration for all three components of food security. It was through my analysis of Apeiron's program that I came to the realization that only three-pronged efforts towards staving off hunger will succeed. Apeiron teaches people how to best utilize the minimal growing space in Providence's urban environment; this creates availability. For families that rely on social programs like WIC and Food Stamps, Apeiron provides information about how to use these services and best take advantage of them; thus creating access. Art Handy and Apeiron also helped champion a program in Providence, whereby families can use their food stamps at local farmers markets. The food found at farmers markets is nutritionally preferable to the produce found in grocery stores; improving utilization. Additionally, the sense of community gained from participating in such local markets is indispensible.

Although I gained the majority of my factual evidence for my thesis in literature, the framework and inspiration for my thesis was derived from what I learned at Apeiron. Perhaps Apeiron's theory that Rhode Island can serve as a model is not as farfetched as it seems. If a non-profit organization in the smallest state in the U.S. can find some success in their war against food insecurity, then surely the combined efforts of the global community can do the same.

Findings

This paper has already used the term 'food security' a few times. The term seems really self-explanatory, but food security is a lot more complicated than one would expect. To define food security, we first need to decide what a food system is. A food system is the relationship between the biological, geographical, physical, and human environments that account for the production, processing, distribution, preparation, and consumption of food. Thus, according to the Food and Agriculture Organization, food security is when "food systems function in such a way that all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (Gregory 2005). As is indicated by its definition, food security has a multiple facets. Food security is divided up into three parts: availability, access, and utilization. Availability refers to the capacity of agricultural systems to produce enough food for the population. Access is whether or not a group can obtain the food that is produced. Employment, market prices, and food preferences all play a role in access. And finally, utilization is a group's ability to use the food they have. It encompasses things like food quality, nutritional value, and the health of the people consuming the food (Schmidhuber 2007).

Availability

In the analysis of climate change's impact on food security, the most obvious correlations between the two lie under the area of availability. Because availability encompasses things like the amount, location, and timing of the food produced, it is the most obviously related to environmental conditions. The minor initial gains in food production due to increased carbon dioxide concentration and longer growing seasons in the temperate zones will quickly be negated by the rapid degradation of growing conditions everywhere else. The first effects of a warming planet will be increased evapotranspiration—the water loss of surface/soil water evaporation, coupled with the water that plants lose to the air every day through their leaves. Although global precipitation may increase by nearly 7%, the rain will fall primarily at higher latitudes and coastal regions. Evapotranspiration will increase by as much as 10% in the inland plains, where the vast majority of earth's grains are produced (Verdin 2005). The vulnerability of the mid-continental plains is exactly why they are so ideal for grain production. In the large, flat swaths of land that define the centers of North America and Asia, rain is at precisely the right amount. It is enough to allow grasses like wheat, barley, and oats to thrive, but too little for any larger shrubs or trees to grow. Although farmers could theoretically irrigate their crops, the water costs of doing so would be devastating.

As the surface of our planet warms, sea levels around the globe will rise. Within the next century, sea levels will rise as much as 3 feet. One foot can be attributed to the fact that as the oceans warm, they will physically expand. The second foot is because the precipitation that once fell in the form of snow and was sequestered in mountains will fall as rain and flow quickly to the ocean. The third foot is due to glacial melting and calving in Antarctica and Greenland

(Pearce 2008). This rise in sea level will consume about 271 million acres of arable land in the developing world.

It is important to remember that a loss of arable land does not only mean a loss of areas in which crops can be grown, but also a loss of cattle grazing land. Poor farmers rely heavily on animals for labor and protein. The inability to support a population of livestock would make it harder to farm what land remained, and cut out the primary sources of protein from their diet. Although some areas in Siberia and Scandinavia will see an increase in suitable cropland, it is unlikely that these areas will be farmed in any meaningful way, as farming isn't a major industry in either place, and both regions are relatively inaccessible. In contrast, the areas that would lose enormous amounts of cropland are the densely-populated regions Southeast Asia and coastal Africa. Although neither region produces a sizeable portion of global food supplies, the small subsistence farms in both regions support the most vulnerable populations on earth (Smil 2000).

Additionally, as global sea levels rise, the saline water table will rise proportionately. This would make the majority of coastal aquifers useless. While inland aquifers and deeper aquifers would probably remain unharmed, the shallow ones which are most accessible for poor farmers would be completely void. Crops and livestock that were already made vulnerable by decreased precipitation would become further endangered by the fact that irrigation is longer an option (Ehrlich 1993).

Climate change will also likely cause enormous stress on the growth cycle of plants. All crops rely on a carefully timed cycle of growth and reproduction. Even tampering slightly with the cycles that dictate food production would cause population-wide crop failures. One way in which this will occur is through the shortening of the granule growing period. Although the period when crops can grow will generally be lengthened under moderate global warming, the stage when the actual grain is produced will be stressed. This period—known as the ‘filling stage’—is shortened if peak temperatures are higher, so grains may never fully develop (Mooneyham 1975).

Furthermore, the synchronization of seasonal functions such as flowering, fruiting, and breeding—known as phenology—will be disrupted with altered temperatures. “These observed changes in phenology may be a positive sign because species are apparently adapting to climactic changes or they may be a negative sign because they show that climate is, indeed, impacting living systems. Are these the species at risk, or are they the lucky ones?” (Visser 2005). Although Visser might argue that shifts in phenology might actually not be so terrible, there really is no way to predict how massive shifts in phenology will affect entire ecosystems. If one looks at the phenology of interdependent species, the dangers become a lot more obvious. Let’s say that there is a fig tree that flowers for three days in July, and this specific species of tree is only pollinated by migrating butterflies. Let us also say that these migrating butterflies instinctively stop in a region where this fig tree grows to ‘refuel’. If the phenology of the fig tree shifts two days earlier, and the migrating path of the butterflies shifts two days later; the two interdependent species will never overlap. Thus, the fig tree cannot reproduce and the butterflies will die of starvation. In a world where literally all agriculture is dependent on the pollination services that our earth provides for free, slight changes in phenology can be devastating for crops if they affect pollinating species.

In the same way that climate change can disrupt the filling stages and phenology of crops, the occurrences that trigger plant growth may be omitted. The majority of cereal crops require very specific natural conditions while they are in the incubation stage in order to begin growing.

One of these instances is the violently thunderous and rainy monsoons in India and Southeast Asia. Cereal crops in those regions must first experience the intense heat of burning that comes with lightning-induced brushfires, followed by extremely heavy rains that monsoons are famous for. Obviously the brushfires can be simulated, but the intense rains cannot be, and their timing must be perfectly orchestrated with the burning cycles (Ochoa 2005). The grains of the breadbaskets in central North America and Asia rely heavily on a period of vernalization. Vernalization is the period of very low temperatures in the winter, when the soil that the seed is planted in freezes. Increased temperatures around the world would keep temperatures from dropping low enough for vernalization and, thus, plants would fail to flower later in the season. If flowers are not produced; fruit, grain, and vegetables will not be produced either (Parry 2005).

Another way that climate change can affect food availability is through extreme weather. Of all the ways climate change changes food availability, extreme weather is the least predictable, most spontaneous, and most dynamic. Thus, it is arguably the most dangerous. Violent winds can rip crops from the earth. Ocean surges can salinate soil and water supplies. Floods and heavy rains can wash vital topsoil into the ocean (Hollander 2003).

Access

When climate change affects crop productivity, its impacts are felt twofold. Not only do grain supplies fall short, but farmers who depend on the income from crop sales are left without the liquid assets to purchase food and commodities to help them cope with food insecurity.

> "Agriculture is not only a source of food but, equally important, also a source of income. In a world where trade is possible at a reasonably low cost, the crucial issue of food security is not whether food is 'available', but whether the monetary and nonmonetary resources at the disposal of the population are sufficient to allow everyone access to adequate sources of food. National self-sufficiency is neither necessary nor sufficient to guarantee food security at the individual level" (Schmidhuber 2007).

The second component of food security is access. Access refers to the prices of food, preferences, and income to pay for food. This is the social component of food security, and therefore the connections between climate change and access are a little harder to find, but they certainly exist. The way climate tampers with food prices is already evident from what was mentioned in the section about availability. If there is less food because harvests were destroyed by climate interference, market demand will drive prices higher and higher. Food is something that people can't live without, so regardless of how unjust food prices may become, people have no choice but to pay them.

Food preference seems somewhat trivial in light of all the other parts of food security that climate change affects. One would just assume that if climate change makes one type of food less accessible, people could just choose another food source. We assume that people grow and cultivate the foods they prefer, but the vast majority of earth's populations have developed specific food preferences to suit their environment, not the other way around. As the world becomes more globalized, many countries are finding their populations more urbanized. Urban populations have access to things like supermarkets, shipping ports, and mass media. These have, on the whole, shifted global dietary preferences to a more 'western' style. This diet is defined by an enormous amount of meat and animal proteins. It requires around 15 pounds of grain to produce one pound of beef. The drops in grain production that climate change will cause will be felt exponentially more at higher levels of the food chain. As grain begins to run short, people will not have enough grain to sustain much livestock. The enormous grain-fed beef demand in growing countries like China is stressing an already climate-pressured global granary (Slingo 2005). In the United States, the vast majority of our protein is animal-based and we do not have alternate sources of protein built into our diet. This protein-heavy diet is integral to U.S.

culture. What rice and beans are to South America, meat is to North America. A Untied States that feeds on plant protein is unimaginable. It isn't far-fetched to say that Americans would likely face protein deficiency before converting their dietary preferences away from meat and dairy. In Sub-Saharan Africa, for example, sorghum is far better suited to the now frequent heat waves and droughts than maize is. But because people generally prefer the taste and usefulness of maize, they continue to plant the crop, even as it repeatedly fails to produce a sizeable harvest. Preferences make a population stubborn and unwilling to alter diets. As preferred crops become more difficult to grow, they will become more expensive, and food will not only be scarce, but also costly.

Fortunately, there are institutions in place to provide food for those who cannot provide for themselves. Groups like The World Food Program, America's Second Harvest, and local food banks can alleviate short term food crises, but the food they provide does not cater to regional preferences or solve the overarching problem (World Meteorological Organization 1996). If people do not have resources, their options for adaptation are extremely limited. Through the elimination of income, climate change turns food insecurity into a vicious cycle.

Utilization

The third facet of food security is utilization. In the context of food security, utilization refers to a population's capacity to take advantage of the food that is available. This means utilization addresses things like a food's nutritional quality and the health of the person eating the food. The chemical and biological composition of food is highly dependent on environmental conditions. In grains, the protein and gluten levels vary based on temperature. As temperatures increase, gluten levels become highly unpredictable. If gluten levels are not relatively consistent, the process of making refined foods becomes incredibly difficult. Given that the majority of the world finds most of their calories in some form of risen bread, the inability to make bread would be a difficult obstacle to work around. Meat is prohibitively expensive for many people, so if their crop-based proteins were to diminish, protein deficiency would abound (Slater & Levin 1981). Extreme weather has also an enormous impact on the spread of pests. As median temperatures rise, so do crop-destroyers like locusts, fungi, and toxic bacteria. Many species of insect that eat plants are triggered to hatch once temperatures reach a certain point. Ideally, these temperatures are not reached until the plant is mature enough to withstand some degree of assault. But if temperatures get warmer earlier, insects will spawn while plants are still in the early developmental stages, and ill-equipped to handle. This results in the death or underdevelopment of huge swaths of farmland (Conkin 2007).

Crops are not the only food source that becomes less easy to utilize because of climate change. Coastal marine species that live in shallow water are incredibly susceptible to slight changes in temperature. Relative to the depth of the water, coastal areas have a high surface area ratio. This means that increases in air temperature are felt much faster and much stronger in coastal areas than in the open ocean. The shallow areas close to shore are where the world's poorest fishermen catch all their food. The vast majority of the world gets their only animal protein in the form of seafood, but that food supply is being tainted because of climate change. "Warmer seas may contribute to increased cases of human shellfish and reef-fish poisoning in tropical regions, and a poleward expansion of the diseases" (Schmidhuber 2007).

Not only does the bacterial infection of seafood limit general food supplies; the sicknesses that accompany the bacteria limit people's ability to utilize otherwise healthy food. Utilization is most detrimental to food security not in how it affects the food sources, but in how it limits people’s ability to effectively use the nutrients in their food. The largest killer of children worldwide is simple water-borne illnesses like diarrhea. Research shows strong evidence that with increases in temperature variability, the frequency of diarrhea rises too (Conkin 2007). Extreme weather like excessive rains—which will undoubtedly become more common as climate changes further—leave a lot of stagnant water. This allows mosquitoes to thrive and reproduce quickly. Mosquitoes bear countless diseases, but by far the most dangerous is malaria. By some estimates, malaria has killed almost half of all humans that have ever lived (World Meteorological Organization 1996). Although malaria kills far fewer people than it once did, it continues to jeopardize food security. The monsoons in Southeast Asia also help to spread disease. Monsoons cause ocean surges, mudslides, and torrential winds, all of which inevitable result in a number of deaths. In areas where governments lack the capacity to quickly and efficiently dispose of bodies, water supplies become contaminated, causing disease outbreaks across entire regions (Ehrlich 1993). When a large number of people become sick, the workforce that is able to grow food is not only reduced by the number of patients, but also by the number of people that are necessary to care for the infirm. And while people remain sick, nobody is able to work for the money that would be necessary to buy the food that cannot be grown. In this way, climate-caused illness affects utilization, access, and availability.

Solutions

Climate change has had an enormous impact on food security. Although it may not be the single largest cause of food insecurity, climate change has been the one factor that humans have not been able to cope with. This is probably due to the fact that unlike overpopulation or poverty, climate change affects all three parts of food security. It is an unusual way to think of it, but food security really is like a tripod. It doesn’t matter how much you do to reduce food insecurity on two of the three parts. If you leave any one component of food security unaddressed, no amount of shoring up the other two will see any success. Although a fully-rounded and systemic solution will ultimately be necessary, there are some solutions that I believe have a far more pressing need, and will cause the most beneficial change on a broad scale.

The most correlations between climate change and food insecurity lie under availability. Appropriately, the most solutions for food insecurity in light of climate change lie under availability as well. Foremost, it is important to do more research. Particularly regarding things like changes in weather patterns, shifts in phenology, and temperature increases; current estimates are just that—estimates. More concrete knowledge of how our systems will change is necessary so people can understand how to best prepare for coming decades. The knowledge we would gain from research would dictate how the rest of the solutions to a lack of availability should proceed.

Even though developed countries are reporting some of the largest harvests ever, their means of doing so is incredibly resource intensive. American farms are the most efficient on earth, and although some of this is due to high-quality soil, abundant land, and (at least temporarily) favorable climate, the real secret to the success of American farms lies in their technology. Machinery, computers, processing plants, fertilizers, pesticides, and modern irrigation systems have all fueled the success of the 'modern' farm. Unfortunately, when farmers in the developing world try to mimic the techniques of the developed world, they don't see the same results. In areas where tractors, fertilizers, and advanced irrigation systems aren't available, farms maximize productivity when they are only about 2 acres (Betts 2005). Farmers in the developing world need to revert to techniques that have suited their environment and they resources for hundreds of years, or crop production will only increase in cost and decrease in yield.

In addition to farming crops in a more traditional way, farmers need to choose crops that are more traditionally suitable in their environment. Crops that have not evolved to grow in a specific climate will be much more vulnerable to climate change. Traditional crops may not be as popular or as valuable as some current choices (for example, corn has become a common crop around the world, but the species initially evolved to grow in the Americas), but their success in a changing climate is far likelier if they are in their intended region (Cotter & Tirado 2008). Not only should crops be native, they should also be diverse. A wide variety of crops provides a food source that has a range of resistances and advantages, making the whole food supply substantially less vulnerable to things like pests, fungi, and climate events that will characterize the next few decades.

Once the previous solutions to climate-reduced availability, more food needs to be grown in more places. It seems really obvious, but the truth is that this may be one of the more difficult obstacles to overcome in insuring availability. In our globalized world, it is relatively inexpensive and easy to obtain food from foreign countries. Because of this, most countries abandon food for comparative advantage, and choose to grow none of their own. Climate will change for the entire planet, and if that causes food shortages on a global scale, food-producing nations will become reluctant to export commodities.

The final recommended solution I propose for securing food availability is that agriculture stop digging its own grave. Agriculture is one of the primary sources of environmental degradation worldwide. Deforestation alters evapotranspiration, fertilizers and pesticides pollute landscapes, and farm equipment billows tons of carbon dioxide into the atmosphere every year. Although these things are increasing productivity for a select few farms over the short term, the long run will show that this kind of shameless disregard for the environment will ultimately reduce yields and render farmland useless.

The solutions to a failure in food access are fewer, but they pose a much greater challenge. These solutions require total international cooperation to succeed. This is because access is a social aspect of food security, and in a globalized world, our food society is the entire planet. The global society needs to start by recognizing the fact that there is an enormous disparity between food access in the developing world and food access in the developed world. A large amount of food needs to be sent to the areas where food is scarce. This will result in two things: the hungry will be fed, and the overfed will probably start to use food more efficiently. Using food more efficiently also means a change in preferences. A large portion of grains are diverted to the production of ethanol, beef, and refined sugars (Doyle 2008). By altering diets and grain use in Western nations, it will become much easier to feed the world.

The hard part about achieving sufficient utilization is that people do not see utilization as a food problem, they see it as solely a healthcare problem. Thus, when organizations and governments are trying to mobilize an effort to combat food insecurity, utilization is often overlooked. The most important thing to address in utilization is disease. Pandemics are making utilization impossible in populations where availability and access are already low. In Africa and Southeast Asia, AIDS and malaria run rampant. This is due to a lack of resources and a lack of knowledge. Broad medical initiatives need to be started with the aim of educating populations of the health risks common in their area. Furthermore, resources need to be distributed. These resources don’t even need to be expensive; things as simple as condoms and mosquito nets can reduce infection rates to almost nothing.

The other side of improving utilization is to increase the nutritional quality of food. In regions where land and resources are unavoidably limited, the food that can be produced must be of the highest quality. This can be done through the use of genetically modified crops. There is a common misperception that GM crops are somehow dangerous to humans. Although in regions where growing food is easy it might be a good idea to just stick with what grows naturally, there are regions in the world where the environment is no longer suitable for farming. In Africa, where the land is hot and dry, a new breed of rice called NERICA (New Rice for Africa) has been engineered. Although rice is typically grown in rice paddies that consume enormous amounts of water, NERICA is capable of growing in parched fields. Similarly, a breed of rice called Golden Rice has been developed for Southeast Asia. The rice gets its name from its golden hue—the result of an enormous amount of vitamin A. In Southeast Asia, vitamin A is incredibly hard to come by, and this has taken a toll on maternal and infant health (Doyle 2008). If governments and global aid agencies become more accepting of genetic engineering, the effort and resources invested in crop production will go much farther.

Conclusions

As was seen in the case of Plumpy’nut (See Morgan 2008), simply addressing access does not alleviate the total problem. Neither does simply addressing utilization or availability. Médecins Sans Frontiéres (MSF) were addressing access in the form of Plumpy’nut, and utilization in the form of medical care, but their work in Niger still came under heavy criticism. Much of the criticism was that their approach to solving hunger in Niger was singularly-faceted, and did nothing to resolve hunger on a large scale. This shouldn't imply that I don't think the work that MSF does is not important. In fact, I think that Plumpy'nut is a step in the right direction. Through Plumpy'nut, MSF has added a second component of food security to their assault on hunger. We can't expect one organization to bear the full burden of creating food security. Solutions to climate-induced food insecurity will need to be just as dynamic and complicated as climate change itself. We will need to draw from every nation's coffers and every person's knowledge. Climate change has posed new challenges for feeding the world. The progress that created enormous food security is now working against us through its contributions to global warming. It will require enormous technology, resources, and altruism; but we can fight off global hunger even as we try to reverse climate change. Because when it comes to issues like these, failure really isn't an option.

Resources

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