GMO: FRIEND OR FOE? AN ANALYSIS OF THE GMO DEBATE WITH SPECIAL FOCUS ON INDIA

by

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THESIS ABSTRACT

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Approximately thirty years after their inception, the use of genetically modified organisms, or GMOs, remains contentious. Often, proponents of their use contend that the potential of GMOs to mitigate poverty and hunger in the "developing world" outweighs concerns in the "developed world" about their potential risks. This line of argument simultaneously decontextualizes poverty in the "developing world" from its multi-faceted roots in favor of a simple technological fix and precludes the possibility of anti-GMO sentiment that originates within the "developing world" itself. Focusing on India, I first shed light on the history of applying such simple technological fixes to the problem of hunger and then utilize textual analysis to explore varying perspectives on GMOs in order to make a case for why debates focusing on an objective "goodness" or "badness" of GMOs miss the point.

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I would like to dedicate this work to my Grandma Dee, who has asked me every week for the past year how my thesis is coming along and whether I'm nearly done yet.

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CHAPTER I.

A BRIEF INTRODUCTION TO THE ARGUMENTS OF THE GMO DEBATE

The 2016 documentary *Food Evolution* opens with a debate held by a Hawaiian county government council over whether to permit the production of genetically modified organisms, or GMOs, on the island. The debate ends with the majority of council members voting to ban GMOs, based largely on both their own beliefs and the impassioned speeches presented by concerned locals and at least one prominent non-local. Throughout its hour and thirty-two minute run, *Food Evolution*, which challenges the public's fears over GMOs, paints a largely empathetic image of the anti-GMO voices heard, acknowledging that they are coming from a place of wanting "safe, abundant, nutritious food for all" (Hamilton & Sheehan, 2016). At the same time, narrator and astrophysicist Neil Degrasse Tyson poses the question, "What if, while trying to do the right thing, the council got it wrong [by opposing GMOs]?" This question leads to the main thesis of *Food Evolution*, which is that no credible scientific evidence has been found for GMOs being dangerous to either human health or the environment, and fears over GMOs are based on something other than scientific fact and often spurred on by fearmongers such as attorney and executive director of the Center for Food Safety Andrew Kimbrell, for example. The documentary suggests that GMOs are being needlessly pilloried to the detriment of humanity, since those in need would not reap the benefits provided by GMOs (Hamilton & Sheehan, 2016). Later on, the documentary triumphantly returns to the same Hawaiian island to showcase the reversal of the GMO ban in the light of the success of rainbow papaya in resisting a virus that has decimated its non-GMO counterparts.

In addition to claims of unreasoned public hysteria over GMOs, the documentary alleges that misinformation about the purported hazards of GMOs originates in the "rich world" of the global North and spreads to the "poor world" of the global South, where such misinformation is particularly damaging, given the potential of GMOs to alleviate poverty through higher yields, resistance to diseases or pests, heightened nutritional value, or any number of other traits that might prove especially useful to poorer farmers. Illustrating this point, *Food Evolution* cuts from shots of a speech in which Kimbrell proudly lists the various types of genetically modified crops that have been prevented from going into production with wrenching shots of a young Ugandan child watching the diseased banana crops of his mother's subsistence farm burn. Then, the documentary cuts again to a more successful South African farmer who directly addresses his American audience, stating, "Americans, beware. Please, be informed that whenever you say 'no' to GM technology, you are suppressing Africa. South Africa and the rest of the continent is being left behind" (Hamilton & Sheehan, 2016). Thus, while *Food Evolution* makes an appeal in support of GMOs to reason and scientific analysis, it also presents a moral argument for their acceptance, i.e. that people in wealthy countries should not hinder the production of GMOs because they are needed in less wealthy countries.

In this way, *Food Evolution* embodies two common threads of argument made by those in the pro-GMO community, namely that the debate over whether or not GMOs should be allowed to be propagated can largely be solved by the scientific community determining whether or not they are hazardous, and that GMOs are necessary to feed the developing world, particularly in the face of global climate change (Hamilton & Sheehan, 2016). It is these two assertions that I seek to challenge here. I argue that focusing on the

objective "goodness" or "badness" of GMOs ignores the vital question of *how* they are being used, the situatedness of technology and the role played by social structures, governmental policies, and power dynamics in determining whether a community either benefits from or is harmed by (or perhaps in certain instances even experiences no appreciable change from) the use of a given technology. Therefore, I argue that the GMO debate is largely a proxy for, and thus a distraction from, ideological debates over differing agricultural models and, more broadly, differing views on social development itself, in which the pro-GMO side generally assumes the inherent and objective desirability of both[1]. Furthermore, as I will illustrate, the moral argument that GMOS are necessary to feed the developing world, and that their utilization should therefore not be prevented, detrimentally decontextualizes poverty in the developing world from its historical roots and ignores the multifaceted nature of the issue of widespread hunger in favor of a simple technological fix. Framing the debate in such terms also sets up biotechnology as a sort of "cure all" for whatever food-related problems the developing world may face, particularly since GMOs are often described according to their potential iterations, rather than their current usage.

Most GMOs produced today are developed to either be herbicide resistant, such as "Roundup Ready Soy" or to produce their own insecticides in the form of Bt, a naturally occurring bacterium in soils which is toxic to certain types of insects (Shiva,

[1] Consider, for example, the categories of "developed" versus "developing" countries. These categories implicitly suggest that "development" follows a linear course, with "developing" countries seeking to reach the end goal of becoming "developed", which may or may not actually be the case. Furthermore, it is no coincidence that those countries now thought of as "developed" are largely ones that formerly held colonial control over those now considered "developing". However, while problematic, I will continue to use these terms, both because they are repeated used throughout the works I cite and because they do connote important distinctions between two parts of the world, which are also often referred to as the "global North" and "global South".

2016). Proponents argue that GMOs will help small-scale farmers be more productive (and that Bt technology lowers pesticide usage and therefore exposure, thus benefitting farmer health), improving their livelihoods while also increasing a country's export capabilities. Detractors argue for a return to more traditional agricultural methods and stewardship of the land, often privileging local production and consumption over participation in the global market. As they are currently produced, GMOs fit within the paradigm of modern industrial agriculture ushered in by Norman Borlaug's Green Revolution of the 1960's. This paradigm focuses on increasing yields of mono-crops through the use of chemical inputs (e.g. fertilizers and pesticides) and "improved" varieties of seeds. Thus, the GMO debate may also be viewed as a stand-in for broader debates over the current path of development.

India provides an ideal representative case study for analysis, given its position as a country largely transformed by the Green Revolution and where the "second Green Revolution", as the influx of biotechnology is often called, is still hotly debated. Although it has a thriving information technology sector and increasing national wealth, India is still thought of as a developing country, and it is one in which the majority of the population remains rural and largely marginal farmers or landless agricultural laborers. Furthermore, according to FAO estimates, as of 2015 approximately 16% of the Indian population was undernourished, 48% of women between the ages of 15 and 49 were anemic, and 44% of children under the age of 5 were underweight (FAO, 2015). Secondly, India has a long history of recurring famines and impoverished circumstances that have largely been attributed to India's ever-growing population size. Both of these

factors would seem to make India an ideal place to utilize biotechnology[2] in order to increase nutrition rates.

Yet the utilization of biotechnology has been a sustained subject of controversy in India. Currently, Bt cotton is the only form of GMO that can legally be grown in India, although it is worth noting that approximately 90% of the cotton grown there is Bt, which suggests a high level of popularity among growers ("Production dips", 2013). While pressure has been put on the legislature in the last several years to legalize genetically modified mustard (used in making edible oils) and Bt *brinjal*, or eggplant (Damodaran and Sinha, 2016), in the last year there have also been widespread calls among farmers to end the use of any GMOs in the wake of devastating whitefly outbreaks, which are not susceptible to Bt technology (Vasudeva, 2015). Lastly, in the last few years, Indian has been described as being on the verge of an "agrarian crisis", and there have been several farmer protests, some of which have turned violent, and highly publicized (and continuous) farmer suicides (Mohani, 2017). Many people, from scientific experts to journalists, argue that the only way to solve this agrarian crisis is through the use of GMOs.

Such arguments are made in regards to developing countries throughout the world. Robert Paarlberg (2008), adjunct professor of Public Policy at Harvard Kennedy school and former member of the Biotechnology Advisory Council to Monsanto's CEO, adamantly believes that the developing world, but particularly the African continent,

[2] Much like how a square fits the geometric definition of a rectangle, but a rectangle does not fit that of a square, "GMO" connotes a form of biotechnology, but the term "biotechnology" does not always mean "GMO". However, since this work does not focus on more than one form of biotechnology, I will use the terms interchangeably.

needs biotechnology in order to alleviate poverty and adequately feed its population. He claims that such necessary progress is being stymied by "an imperialism of rich tastes" coming from the global North. He purports that Europeans have largely rejected GMOs due to "unrelated" public food safety scandals such as the 1996 case of bovine spongiform encephalopathy, or "mad cow disease" impacting human health despite initial reassurance from regulators that the meat of contaminated animals was perfectly safe for human consumption (Paarlberg, 2008 p. 16). Paarlberg (2008) laments that the EU gave regulatory approval for the import and consumption of genetically modified crops during the same year as the mad cow scandal, arguing that GMOs were essentially unjustly scapegoated due to public mistrust of regulatory authorities. Paarlberg (2008) further argues that the ensuing backlash against GMOs in Britain and throughout Europe prompted a similar backlash in the developing world. Citing an article from the *Journal of Agrobiotechnology Management*, Paarlberg (2008) points out the fact that a large percentage of nations in the global South that share colonial ties to Europe also share the precautionary approach taken by Europe in regards to GMOs. Similarly, Herring and Paarlberg (2016) have noted that countries with economic ties to the United States have adopted the US' more laissez faire approach to restrictions on GMOs.

Paarlberg (2008) thus makes the case that poor people of the developing world are suffering unnecessarily because those in the developed world are thwarting the implementation of GMO technology based on unfounded fears, and that these fears are being spread to the developing world. As Paarlberg (2008) would have it, developing nations only resist biotechnology because the developed world does so. While there is certainly a case to be made against the dependence of developing nations on trade with

former colonial powers such as those in Europe and imperial powers such as the United States and the ways in which this dependence might influence policy among developing nations, there is an element of infantilization in the way scientists discuss the fears of the lay public in regards to GMOs. In this instance, it also borders the thin line between acknowledging the influence of the global North on the rest of the world and portraying members of the global North as subjects/actors and members of the global South as objects/the-acted-upon.

In his treatise on modern food ethics, Philosophy professor at Michigan State University Paul Thompson (2015) grapples with this same question of whether it is appropriate for the public in the developed world to oppose biotechnology if it has the potential to aid disadvantaged peoples in the developing world. He terms this argument the "Borlaug hypothesis", which he defines thusly: "even if you don't see any value in applications of cutting-edge technology for food production and processing for yourself, you should still lend moral support to any technology that has the potential to help the poor" (Thompson, 2015, p. 200). Thompson (2015) then weighs whether the Borlaug hypothesis stands up to the main arguments made against the use of biotechnology, which he has separated into five basic categories of concern. These categories include: the precautionary principle, social justice, (un)naturalness, personal autonomy, and virtue ethics. Thompson (2015) ultimately argues that the Borlaug hypothesis does not stand up to the final category alone, which encompasses aretaic concerns regarding the virtue of the companies and scientists that produce GMOs, as these groups have been remiss in terms of transparency, adequately communicating with the public, and in some instances

exhibiting indifference to how the technology is being implemented in regards to social justice.

While his ultimate conclusion is compelling, I would argue that Thompson (2015) measures social justice and aretaic concerns according to different standards, thereby undermining his conclusion. Although he acknowledges the importance of social justice concerns levied against biotechnology and its producers, including the technology treadmill, dependency theory, and biopiracy, he claims that, because these concerns could be applied to any new agricultural technology, they do not in themselves constitute a reason to forego biotechnology. Rather, he argues, they provide parameters within which researchers should operate; he therefore opts to refer to these concerns as "side constraints" to the question of whether or not biotechnology should be utilized (Thompson, 2015). Thus, although he places aretaic concerns within the actual contemporary context of how GMOs are being produced in order to determine whether Borlaug's hypothesis holds against them, he does not do the same with social justice concerns. Furthermore, he does a disservice to such concerns by referring to them as "side constraints". After all, to those fighting for social justice, and more importantly, to those affected by injustice, they are anything but a "side constraint". It is therefore part of the goal of this work to ameliorate this oversight.

As I have illustrated thus far, pro-GMO scientists and thinkers contend that GMOs are necessary to feed the developing world and that their widespread use is being prevented by anti-GMO activists in the developed world without consideration of how their activism is ultimately harming those people who would stand to benefit most from biotechnology, i.e. the people of the developing world. While this is indeed a compelling

moral argument in favor of the implementation of GMOs, it ignores the possible reasons that people from the developing world might themselves be leery of biotechnology that go beyond being told by outside voices that they're dangerous. Furthermore, whether or not intended as such, this argument sets up biotechnology as a simple technological fix to the problem of hunger without considering its multifaceted nature and how a given technology's usefulness is determined by the context in which it is applied.

Therefore, in focusing my analysis on India, it is my goal here to provide a greater understanding of how a country's culture, history, and other factors play a role in a technology such as biotechnology's acceptance and usefulness within that country. I further seek to elucidate the ways in which opposition to biotechnology in the developing world exists beyond a parroting of the opposition expressed in the developed world. Because my argument centers on the necessity of multiple and context-specific perspectives, I will conduct a textual analysis of the writing of two prominent voices within the Indian agricultural field, Vandana Shiva and M.S. Swaminathan. These two authors present differing viewpoints on the role biotechnology should play in Indian agriculture. Textual analysis involves interpreting specific texts and thereby allows for a greater understanding of the sense-making practices of the writers and the cultures within which they write (Frey, Botan, & Kreps, 2000). While it is beyond the scope of this work to fully attempt to understand and articulate the different sense-making practices of these two writers, it is my goal to illustrate the ways in which they approach the role of biotechnology in India and Indian development practices and how these approaches are grounded in particular worldviews that largely differ in important ways from those of proponents of biotechnology in the United States.

Chapter Overview

Following the introduction, my argument is divided into three chapters. The first of these chapters provides a historical lens through which to understand India's agricultural development up to the present. I argue that India's frequent famines in the last two centuries were in fact largely the product of British colonial governance, rather than simply resulting from overpopulation, as they have traditionally been understood. I further argue that this inaccurate understanding of agricultural shortages and famine has, in turn, paved the way for technological fixes to the twin problems of food shortage and malnutrition, because they are broadly viewed as a straightforward mismatch between production and consumption. I also elucidate the political agenda that has underlaid the supposedly humanitarian assistance and intervention in Indian agriculture on the part of the United States thus far. In the subsequent two chapters, I conduct a textual analysis of the works of two prominent figures in the Indian agricultural scene, Vandana Shiva and Mankombu Sambasivan Swaminathan (hereafter referred to as "M.S. Swaminathan") respectively.

As one of the most prominent voices for the global anti-GMO movement, Vandana Shiva is an ideal subject for my work. I focus my analysis on her 2016 book *Who* Really *Feeds the World?* In this chapter, I argue that her perspective provides vital context for how GMOs- as they are currently produced- should be understood, giving reason for why a "developing" country such as India might resist the use of biotechnology for reasons that originated separately from concerns within the "developed" world over their use. According to Shiva (2016), GMOs are an inextricable part of the industrial food paradigm from which they have arisen, and the corporate

monopoly over them and the food system more broadly, serves as a form of neocolonial control.

The final chapter will focus on M.S. Swaminathan's *From Green to Evergreen Revolution*, which anthologizes articles he has written for *The Hindu* in the last twenty years on the problems facing Indian agriculture and possible solutions to those issues. As the "Indian father of the Green Revolution", Swaminathan provides a vital perspective from which to view the GMO debate and the role of biotechnology in India. I argue that his writing further illustrates the necessity of placing technology, including biotechnology, into its social context in order to determine whether it will actually be useful. While he is pro-GMO, Swaminathan consistently emphasizes the necessity of initiating broad-based policy and social reforms in order to improve both agricultural productivity and the material circumstances of Indian farmers, with biotechnology serving as a tool to enhance the effectiveness of the reforms.

In the final chapter, I summarize the arguments made in these chapters to illustrate why debating the objective "goodness" or "badness" of GMOs does not actually answer the question of whether or how they should be utilized. I conclude by returning to the moral argument that anti-GMO voices in the "developed" world should stifle their critique in light of the alleged potential of GMOs to feed those in the "developing" world.

CHAPTER II.

AGRICULTURE, AFFLUENCE, AND HUNGER IN COLONIAL AND POST-COLONIAL INDIA

With its ancient culture, predominating polytheistic religion, and sensory vibrancy, India has captured the Western imaginary for centuries. As is the case with many other non-European nations, though, this Western fascination has largely centered on the "Otherness" of Indian culture, in which Westerners have understood India in relation to its fundamental difference from European cultures. As Rudyard Kipling (1898) stated, "East is East and West is West, and never the twain shall meet." Anthropologist Mary Douglas (1972), too, described India as a "mirror image" of Europe-its complete and total opposite. Yet, this fascination seems to have also always been tempered by fear. Immanuel Kant, for example, referred to Indians' "dominating taste for the grotesque", "their religion (one of) grotesqueries, idols of monstrous form" (Malhotra and Ahuja, 2012). This combination of fascination and fear, which very much continues to exist in the present day, is rooted in what post-colonial writer Edward Said (1978) terms "Orientalism". Said (1978) defines Orientalism along several interdependent lines. In academic terms, it is any study, be it anthropological, sociological, historical, or otherwise, of the "the Orient", which encompasses the Middle East, North Africa, and Asia, by members of "the Occident", which mainly refers to Europe but which might loosely be described as "the West". More importantly, though, he defines it as a type of discourse, a way of speaking about the Orient/East as being the ontological and epistemological opposite to the Occident/West (Said, 1978). Finally, through Orientalism as an academic discipline and form of discourse, it also serves as a

means for the West to claim knowledge over the "Orient" and thus authority over it (Said, 1978). Said (1978) argues that Orientalism, particularly as it relates to India, fell largely under the purview of Britain and France in the nineteenth century, with the United States playing a greater role after World War II.

Orientalist thought pervaded colonial India, which was under official British rule from 1858-1947 and unofficial British control for a century prior through the East India Trading Company. Viewing India through the lens of Orientalism influenced how the British understood the many famines that occurred in India throughout their reign, and, in turn, the British administrative response to those famines. Namely, famine was blamed on sheer overpopulation caused by highly prolific Indians who lacked self-discipline (Caldwell, 1998). Similar beliefs were also held within the United States in the post-colonial era after World War II, with many prominent thinkers and scientists predicting imminent global famine because of overpopulation, predominately in developing countries outside the West (Paddock & Paddock, 1967; Ehrlich, 1968). Such famine was ultimately avoided thanks in large part to the Green Revolution, which vastly increased the supply of crops such as wheat and later rice and soy. In this way, the Green Revolution provided a solution to the problem of hunger in India, but one that did not stray from the colonial understanding of Indian famine as one of supply not meeting demand, in which the fault for this disparity lay with the Indian people. As I will illustrate, however, this diagnosis did not account for the ways in which colonial rule directly contributed to India's impoverishment and inadequate agricultural production levels well into the twentieth century. Such oversight is vital to consider given current

calls for increased use of biotechnology to solve world hunger, which many refer to as a "second Green Revolution".

In order to understand these calls for a "second Green Revolution", it is important to understand the context leading up to and including the initial Green Revolution in India, which occurred approximately twenty years after India gained independence from Britain. Prior to British control, the Bengal region was one of the wealthiest in the world, although this quickly changed under the East India Company (Mukerjee, 2010). During the formal colonial period, India provided so much wealth through trade goods such as spices, jewels, and textiles and a readily available labor (and soldier) pool that it was dubbed "The Jewel of the British Empire" (Empire-Learning Zone, 2012). India thus provided many of the raw materials necessary in the British Industrial Revolution, as well as a market for the much more expensive finished goods produced in Britain with these materials (Empire-Learning Zone, 2012). In this way, India played a direct role in the creation of British wealth. However, this rise in British fortune saw its equal and opposite effect on the Indian population. During this era, India experienced some of the worst recorded famines in human history, including the Bengal famine of 1943 that spurred the nationalist independence movement and arguably prompted the end of the British Empire. It has been estimated that between the eighteenth and twentieth centuries famines caused around 60 million deaths (Srinivasan, 2017).

Rather than linking their own governmental policies to these famines, British administrators of the time took a Malthusian view of these famines, and thus, how their government should respond to famine in India (unsurprisingly, given that Malthus taught Political Economy at the East India Company's College at Hertford, where many future

administrators were schooled) (Caldwell, 1998). From this viewpoint, famines were a natural means of bringing overpopulation back into equilibrium. Because, in their view, British rule had seemingly ended the other positive checks on population, including warfare and infanticide, famine became all but inevitable (Caldwell, 1998). These famines disproportionately affected the poorest parts of the population, who in more plentiful years also saw the highest birth rates. Therefore, the British believed that providing large quantities of aid to these populations would be self-defeating, as sparing contemporary populations from famine meant that they would continue to replicate, meaning there must then (supposedly) be even greater famine in future (Caldwell, 1998). Furthermore, taking anything from the better-off portions of society, whether through taxation or supply rationing, would only imperil the financial security of those populations, thereby also increasing the severity of future famines. Thus, it was ultimately in the best interest of all to let the market decide how to allocate resources (Caldwell, 1998).

However, the case of the 1943 Bengal famine, which claimed approximately 3 million lives, illustrates the fact that famine is not wholly determined by the disparity between production capacity and consumption needs. British imperial policies, and Prime Minister Winston Churchill in particular, were largely responsible for the severity of the Bengal famine. Firstly, since the nineteenth century, much of Indian agriculture had been devoted to producing export goods such as opium (which the British used to subjugate China), tea (which eventually became a staple in Indian households but was originally produced for Britain), jute, and indigo, among others (Mukerjee, 2010). Many of these crops were grown using slave-like indentured servant labor, meaning that large tracts of

land were not being used to provide foodstuffs to local populations, and the wealth created by these products were also not reaching local populations (it is worth noting, too, that wealthier Indian landholders were complicit in this process).

Of course, there are also often environmental elements, be they pests, blights, or natural disasters that play into the creation of famine by affecting the production side. Such conditions were certainly at play in Bengal, which, like much of India, is reliant on monsoon rains. In 1943, flooding, a cyclone along the Bengali coast, and a rice crop disease combined to create scarcity in the region (Mukerjee, 2010). Then this scarcity became a famine through the Churchill administration's military accounting, which favored the British population and military efforts over the needs of Bengalis. Churchill declined to send any form of food aid, although some government aid was provided to urban populations, particularly British business people and their employees (Mukerjee, 2010). On the contrary, food and other supplies were actually *confiscated* from the Bengali region in order to keep them out of the hands of Japanese forces, should they decide to invade (which they did not). British ships that might have carried aid to India were instead held in reserve for sending to Italy (in case it should come under Allied control). Although Canada and Australia wished to send aid, their available merchant ships were operating in the Atlantic Ocean, bringing food supplies to Britain itself, which already possessed a stockpile (Mukerjee, 2010). The rest of India, though, was not experiencing food shortages, and tens of thousands of tons of rice were being exported to Britain (Mukerjee, 2010). However, like the nineteenth century administrators before him, and true to Malthusian principles, Churchill placed blame for the famine on the Indian people themselves, stating that they "bred like rabbits", which made sending them

aid useless (Mukerjee, 2010). Thus, nothing was done by the British to alleviate the suffering of the starving rural populations of Bengal, and the economic and emotional toll of the famine carried into the next decade.

As mentioned previously, the severity of this famine and the apparent unconcern of the British government helped spur the drive for Indian independence, which was achieved in 1947. Pakistan was also partitioned from India at this time, thanks in large part to cultural cleavages wrought by the British in their divide-and-conquer method of rule that had long spurred antagonism between Muslims and Hindus (Mukerjee, 2010). Immediately, and in contrast to Gandhi's advocacy supporting the superiority of localized village life, Indian Prime Minister Nehru's government launched a program of rapid industrialization and modernization in order to "catch up" to the wealth and standards of the more industrialized nations, a Herculean task given the fact that the wealth of the more industrialized nations was largely achieved through exploitative colonial forces such as those described above (Cullather, 2010). In order to support industry growth, agricultural production needed to expand as well. So, new land was brought under cultivation, irrigation projects were embarked upon, agricultural universities were established, and land reforms were (somewhat unsuccessfully) attempted in order to break up and redistribute large shareholdings. This time period saw rapid economic growth. But growth was greatly tempered by low initial income (since the vast majority of the population were subsistence farmers), continuing population growth, and failed monsoons in the 1960's (Cullather, 2010). Hence, despite all efforts, India seemed poised to face another desperate food shortage.

For contemporary Western observers, it seemed clear, once again, that India's expanding population was to blame for this shortage. South African writer Ronald Segal (1965) takes a slightly more holistic and largely sympathetic view than his contemporaries, acknowledging the exploitative nature of industrialism and the ways India might simultaneously be exploited by other nations even as it exploits its own rural poor (although he describes the vast numbers of the rural poor as "economic parasites"). Yet, he argues that "independence itself struck a serious blow to the already weak Indian economy with the establishment of Pakistan," whereas, as we have seen, colonization was responsible for much of India's impoverishment in the first place (Segal, 1965, p. 191). Although it must be stated that India did indeed lose important tracts of agricultural land, as well as research institutes, to partition (Perkins, 1997). Other writers saw India's situation as symptomatic of overpopulation, which they considered to be a global problem. American biologist Paul Ehrlich (1968) begins his seminal work *The Population Bomb*, in which he asserts the imminence of mass devastation and human misery as a direct consequence of global overpopulation straining the finite resources of the world, thusly:

> I have understood the population explosion intellectually for a long time. I came to understand it emotionally one stinking hot night in Delhi a couple of years ago…As we crawled through the city, we entered a crowded slum area. The temperature was well over 100, and the air was a haze of dust and smoke. The streets seemed alive with people. People eating, people washing, people sleeping. People visiting, arguing, and screaming. People thrusting their hands through the taxi window, begging. People defecating and urinating. People clinging to buses.

> People herding animals. People, people, people, people. As we moved slowly through the mob, hand horn squawking, the dust, noise, heat, and cooking fires gave the scene a hellish aspect…We were just some overprivileged tourists, unaccustomed to the sights and sounds of India. Perhaps, but since that night I've known the feel of overpopulation (p. 17).

As illustrated in the above quote, although Ehrlich considers overpopulation and undernutrition to be a worldwide phenomenon (mostly affected developing countries but that would soon encompass all nations), he views India as particularly emblematic of the situation. Moreover, his writing recalls the Orientalist depictions of India alluded to previously, painting a portrait of India as a grotesque, "stinking hot" and "hellish" (Ehrlich, 1968, p. 17). Even as he reminds readers of the basic humanity of the impoverished and starving embodied by the term "overpopulation", stating for example: "what we must never forget as we contemplate our unprecedented problems-that in all the mess of expanding population, faltering food production, and environmental deterioration are enmeshed miserable, hungry, desperate human beings", he portrays them in equal (if not greater) measure as pestilential, pitiable in their own right but collectively a danger to the global community (Ehrlich, 1968, p. 44).

Ehrlich (1968) estimates in *The Population Bomb* that famine conditions would be reached throughout the world by the 1970's and 1980's. Although he acknowledges the possibility of increasing agricultural production through the increased use of fertilizers in order to avert the food shortages he predicts, he considers those stop-gap measures that would ultimately be outpaced by continued population growth, while also having deleterious effects on the environment (Ehrlich, 1968). As noted previously, fears

of overpopulation have existed for centuries. However, the perils of consumption needs outstripping production capacity became all the more salient in the turbulent political climate of the 1960's, a time in which the us-versus-them existential fears of the Cold War rested uncomfortably with the growing environmental consciousness and ethos of a "Spaceship Earth" (Deese, 2009). This tension is visible in Ehrlich's writing, which oscillates between sympathy for the plight of the starving masses in the developing world, and concern for how their plight will ultimately affect citizens of the United States.

Ehrlich (1968) offers a limited role for the United States to provide food aid, which was in fact done, mostly through providing loans so that India could buy American wheat. However, he provides this as a temporary fix, stating: "We [have] also, in the opinion of some, hindered India's own agricultural development. Perhaps we gave too many Indians the impression that we have an unlimited capacity to ship them food. Unhappily, we do not" (Ehrlich, 1968, p. 38). Thus, the only solution in his view is to take immediate and dramatic action to curtail population growth, particularly in developing nations such as India, which would mitigate (but by no means eradicate) starvation and shortage throughout the world. Of course, the United States should, in Ehrlich's view, take the lead in both halting its own population growth and ensuring that action be taken in other nations as well due to its own high consumption levels, as well as its prominence in international affairs (Ehrlich, 1968).

Ehrlich was far from alone in this assessment. In fact, his work was heavily influenced by the book *Famine-1975! America's Decision: Who Will Survive?*, published a year before *The Population Bomb*. In *Famine-1975!*, authors William and Paul Paddock

(1967) similarly predict impending global food crises brought about by overpopulation and propose immediate, drastic action be taken to mitigate their impacts. They, too, view the US as playing a pivotal role in finding the solution to this problem, as illustrated by their book's subtitle. They argue that it is mainly the US that might be relied upon to provide some of the necessary amounts of wheat to the rest of the world (wheat being a "bulk food" item already widely in production in the US and thus an ideal candidate for export)(Paddock & Paddock, 1967). However, given the US' limited capacity to increase its own agricultural production, they advocate for the development of a "triage system" so that the US might decide which countries to sponsor with food aid and which must be declared a part of the "can't-be-saved" group (Paddock & Paddock, 1967, p. 207). Those deemed to be beyond help would thus not receive aid, as it would be akin to "throw[ing] sand in the ocean" (Paddock & Paddock, 1967, p. 207).

Because of the pivotal role the Paddocks see the United States playing in not only ensuring that as much of the globe as possible gets through the crisis without "sinking into chaos", but also in creating a "'better' life (both spiritual and material)" through "the support of American capital goods which today nearly equal all those possessed by the rest of mankind", they believe it justified that American interests be given consideration when determining which nations should receive aid (Paddock & Paddock, 1967, p. 210). Among other strategies for determining which nations to award American aid, they advise that American officials "ignore the prospect that if food is withheld from a country it will 'go communist'", since "a nation in the chaos of famine poses no threat of disaster to us" (Paddock & Paddock, 1967, p. 210, 211). Instead, they suggest that priority be given to those nations that have raw materials "required by the American and the world

economy" as well as those that have "military value" to the United States (in addition to belonging to at least the "walking wounded" triage category) (Paddock & Paddock, 1967, p. 212). While perhaps par for the course of political strategizing, this prioritizing of countries that provide benefits to the US certainly has neocolonial undertones. Like Ehrlich, Paddock and Paddock (1967) viewed India as particularly emblematic of the problems facing the rest of the developing world (and, if left unchecked, the developed world). They describe India as: "the bellwether that shows the path which the others, like sheep going to the slaughter, are following…The future of mankind is now being ground out in India. If no solution [is found], all the world will live as India does now" (Paddock & Paddock, 1967, p. 56-57).

Obviously, this prediction has not come to pass (although Ehrlich would simply add a "yet"). In fact, while much of India's population remains woefully undernourished, with India's undernourished population constituting 20% of the total global undernourished population, India has not seen famine conditions since 1943. This is due in large part to the Green Revolution, which, funded predominately by the Rockefeller Foundation, introduced modern industrial agriculture to India and much of the rest of the world (Perkins, 1997). High yield varieties of wheat, which necessitated the use of fertilizers, were developed through the combined efforts of several scientists, including American agronomist Dr. Norman Borlaug and Indian geneticist M.S. Swaminathan. Increased irrigation allowed for biannual crops, as farmers were no longer solely reliant on monsoon conditions (Perkins, 1997). These methods were met with enthusiasm by Indian farmers and were largely publicly funded, both of which factored greatly into the success of their implementation.

The Green Revolution was predicated upon the assumption that India's food needs were a simple matter of supply not meeting demand. As policy in India, this assumption finds its roots in a report by a team of American experts, organized by the Ford Foundation and headed by Sherman Johnson of the USDA, titled *India's Food Crisis and Steps to Meet It* (Perkins, 1997). This report was "a milestone that shifted India's agrarian strategy from one based on social reform (albeit implemented with fatal internal contradictions) to one based on new technology, to be adopted by the growers and landowners most prepared to adopt the new practices" (Perkins, 1997, p. 181). This report specifically framed India's needs in terms of rapidly increasing production in order to keep up with population increases. Initially, the Indian response to this report was less than enthusiastic, but factors including a series of severe drought, Nehru's passing, and the dramatic yield increases made possible by Borlaug's seed varieties, opened the door to the Green Revolution in India (Perkins, 1997).

In this way, the Green Revolution became an example of the ability of technology to solve seemingly unsolvable problems, including the Malthusian dilemma. However, while the benefits of the Green Revolution cannot be denied, they should be qualified. Firstly, as Cullather (2010) notes "the green revolution epicenters—Pakistan, India, Sri Lanka, Bangladesh, Mexico, the Philippines, and Indonesia—are all among the most undernourished nations, each with higher rates of adult and childhood malnutrition and deficiency diseases … than most Sub-Saharan countries," bringing claims about the success of the Green Revolution into question. The Green Revolution allowed India to vastly increase its agricultural output of grains, turning the country into a net exporter of wheat (and later rice), for example, rather than one that must rely on expensive imports

and foreign food aid. However, wheat is not nearly as nutritious as many other grains, and its production in monocultures meant that other common nutritious Indian plants, such as amaranth greens, came to be seen as weeds (Shiva, 2016). Therefore, while increasing the efficient production of wheat vastly increased the amount of calories produced in India, it did not necessarily impact local nutrition levels, particularly because, as previously stated, much of that wheat is exported. Similarly, it did little to address distribution, which is arguably as important a factor in the creation of food security as the production of food itself.

The Green Revolution also necessitated the heavy use of fertilizers and pesticides, which have had wide-ranging deleterious effects on both an ecological and human-health level (particularly since many small-scale farmers apply both to their fields without any sort of protective-wear) (Pepper, 2008). Furthermore, farmers must purchase these inputs, which often requires taking out predatory loans, becoming especially problematic when harvests fail (Shiva, 2016). Additionally, while this increased output potentially created wealth for certain farmers, Green Revolution technology's applications were limited to regions that already had irrigation systems in place- predominately Punjab, but also Haryana and Uttar Pradesh (Swaminathan, 2016). Even this wealth, though, is questionable, in the Indian context at least, because as the *Times of India* estimated, farmers in Uttar Pradesh actually earned 11 rupees less per quintal with dwarf wheat when accounting for the cost of fertilizers, pesticides, seeds, and rent (Cullather, 2010).

There is also a question of motive in the US' staunch advocacy for Green Revolution technology throughout the world. Peter Singer (1972), writing after the start of the Green Revolution in India, cites the suffering taking place in Bengal in order to

argue that affluent nations, and individuals, should contribute what they can to alleviate the suffering of others, so long as they do not lose anything of equal moral value in doing so. Undoubtedly, humanitarian concerns for the well-being of starving peoples played a role in the US' drive to export Green Revolution technology (especially for Norman Borlaug himself), and the needs of Indian people at the time were certainly dire. But, as economist and author John Perkins (1997) argues, a far greater role seems to have been played by the US' desire to limit the spread of Communism (since populations on the brink might be more easily swayed by the allure of egalitarianism). Perkins (1997) even notes that, as far back as 1949, the US State Department and the Indian embassy were in talks over "bartering wheat for manganese, a strategic mineral for the American armed forces" (p. 174). Especially given the US' disastrous foray into Vietnam, there was ample incentive to keep Communism out of India (Cullather, 2010). In fact, the term "Green Revolution" itself was meant to connote that "there has been a major breakthrough…that this has been achieved by peaceful and 'democratic' means; and that a 'red revolution' has been unnecessary or has been averted" (T.J. Byres, quoted in Cullather, 2010, p. 233). Thus, The Green Revolution itself set a precedent for the US to use science as a tool of foreign policy.

In recent years, a number of factors, such as India's position in the information technology sector, its quickly growing economy, and its large, youthful labor force, have combined to make India a "potential world superpower" with an increasingly affluent middle class (Sanghoee, 2015). Perhaps because of this, American fears over India seem to have shifted significantly from the 1960's-era fears over whether Americans can afford to provide India aid toward a fear of what India's increases in both population and

economic activity might mean for the United States. Some of these fears concern how India's increasing power on the world stage through the information technology field might put the US at a disadvantage (Higher Education, 2016). Others center on India's rising middle class, their increased consumption patterns, and the attendant effects on global climate change (Mazumdaru, 2017). Interestingly, while concern over India's population growth specifically appears to have died down somewhat (except where connected to rising affluence in India), concerns over global population growth are often described in news outlets in terms of how many "Indias" will be added to the global population by a certain date, e.g. "a projected 1 billion increase in global population- which is like adding another India or China" (McTigue Pierce, 2013). Thus, India remains intrinsically tied to Western population fears.

Despite India's substantial economic growth, however, wealth is unequally distributed. In fact, according to the "Global Wealth Report 2016" compiled by Credit Suisse Research Institute, India ranks second in the world in terms of wealth inequality, with the top 1% of the population owning 58.4% of the country's wealth (Kersley and Koutsoukis, 2016). Although measuring poverty levels is difficult and often controversial, India's 2011 census showed that approximately 30% of the population still lives in poverty (Katyal, 2015). Approximately 70% of the population is rural and engaged in small-scale agriculture, with the majority of farmers eking out a living on less than 2 hectares of land (Katyal, 2015). Furthermore, the prevalence of farmer suicides in India has been a well-documented issue since at least the 1990's, with multiple sources- from lack of available credit to poor harvests to overwhelming debt to the "failure" of Bt cotton- being cited as the cause (Swaminathan, 2016; Shiva, 2016). This dire state of

affairs, coupled with concerns over how global climate change will impact agricultural production, particularly in the vast swathes of Indian agricultural land reliant on monsoons, have led to calls for a "second Green Revolution", which for many would take the form of vastly increased utilization of biotechnology (obviously not the same people who attribute farmer suicides to Bt technology).

Prime Minister Narendra Modi is a staunch advocate for biotechnology. In 2015, the Indian government launched the "National Biotechnology Development Strategy 2015-2020" program with the goal of turning India into a biotechnology hub, of which agri-biotechnology would comprise one part (Government Unveils, 2015). In the meantime, as recently as 2017, Indian farmers protested against low sale prices and high loan debts. Farmers in the state of Mahrashtra, for example, began a strike curtailing transport of vegetables and milk to Mumbai in a bid to demand billions of dollars in debt relief and better prices for their goods (Jadhav, 2017). Additionally, a farmers' protest in Madhya Pradesh turned violent, with police killing at least five farmers (Priya Mitra and Santoshi, 2017). The protests in Mahrashtra were eventually halted because the state government announced loan waivers and increased prices for milk (Khapre, 2017). However, such short-term loan waivers are largely stop-gap measures.

As I have illustrated, there is a long history of Orientalist thought in regards to India and Indian hunger, both in Britain and later the United States. During the colonial period, British experts assigned blame for inadequate rations to Indian fecundity. Rather than seeing their own role in creating shortages by diverting agriculture to cash crops for British use, for example, the British actually viewed their interference in India as benevolent, by supposedly ending warfare and infanticide. In actuality, British policy

drove India to the brink and eventually toward independence. The United States took up the British mantle of simplifying India's dire agricultural needs to a mismatch of supply and demand, for which the Indian people were largely to blame. Although the United States did offer aid, including through Green Revolution technology, this aid was predicated upon the idea that the United States would ultimately reap benefits, whether through trade agreements or simply by staving off the rise of Communism.

This fraught history is important to bear in mind when considering the question of whether biotechnology should be disseminated throughout the world, especially in those developing countries that have been argued to "need" GMOs in order to survive. After all, many such countries share histories of colonial exploitation that have impacted their agricultural production which, as with India, are not considered when assessing current agricultural needs. Such oversight presents the possibility of leaving the true drivers of hunger unaddressed in favor of providing new technologies. Furthermore, such countries have prima facie reason to be suspect of the United States' role in forwarding such technologies, given its history of political maneuvering disguised as providing humanitarian aid.

CHAPTER III.

VANDANA SHIVA: VOICING AN ANTI-COLONIAL PERSPECTIVE ON GMOs

For many, feminist environmental activist, founder of the Navdanya movement, which seeks to conserve native seeds and promote small-scale organic agriculture, and prolific anti-globalization writer Vandana Shiva is *the* public face of the global anti GMO movement. She is also perhaps as polarizing a figure as the GMO debate itself. Journalist Bill Moyers, for example, referred to her in a 2004 interview as a "'rock star' in the global battle over genetically modified seeds" (Entine, 2014). *The New Yorker* writer Michael Specter (2014), on the other hand, paints her as a well-intentioned (and highly privileged) activist but ultimately a zealot, likening her to an "end-of-days mystic". Paul Thompson offers, rather tongue-in-cheek, that "no one is better at the thirty-second soundbite on behalf of the poor" (2015, p. 231). To proponents of biotechnology, Shiva is mainly a charismatic fearmonger who overstates her scientific credentials, having once studied to become a physicist (About Dr. Vandana Shiva, n.d.).

To be sure, Shiva (2016) regularly utilizes incendiary rhetoric to make her points and has made several dubious, or at the very least, hitherto unsubstantiated claims about the dangers of GMOs to human and environmental health, including inking their use to rising autism diagnoses and drawing parallels between their use and slavery. This rhetoric makes it easy for the undiscerning reader to disregard her argument in its entirety without recognizing its merits. While not without problem, her work, as exemplified in her 2016 book *Who* Really *Feeds the World?*, illuminates the myriad ways in which the global food system, the rise of industrial agriculture, and the overwhelmingly Western corporate push to move GM crops into production in the developing world operate in ways that

parallel colonial forces. Furthermore, she deftly illustrates how such pressures further marginalize women in a manner that goes largely unacknowledged in the broader discourse, despite the fact that women form almost half the global agricultural labor force and that agricultural labor is increasingly feminized in the developing world (Shiva, 2016). On these bases, she makes a compelling case for the disavowal of biotechnology in favor of small-scale traditional agriculture operating on ecological principles and for the local market, which she believes to be the key to feeding the world population. However, while illuminating the inadequacy of GM technology in its current iterations to meet the needs of the developing world's farmers, Shiva's critique is hampered by her need to answer the question of whether GMOs are a "good" or "bad" technology. Therefore, Shiva fails to adequately consider a context in which genetic modification might be utilized in more egalitarian ways, for instance by public research institutions using indigenous crops.

Shiva writes from an ecofeminist philosophical perspective. Philosopher Karen Warren (2000) describes ecofeminism as taking place at and responding to "the intersection between three overlapping areas of concern: feminism (and all the issues feminism raises concerning women and other human Others); nature (the natural environment), science (especially scientific ecology), development, and technology; and local or indigenous perspectives" (p. 44). Warren (2000) further argues that any policy or decision-making that does not take place within this intersection "will be 'prima facie' ('all other things being equal') inadequate or unacceptable from the ecofeminist perspective" (p. 44). Shiva (2016) enumerates the ways in which GM technology as it's currently produced fails to take place at this intersection. Fundamental to all of Shiva's

arguments related to biotechnology is the question of "For whom?" and "By whom?", which she unequivocally answers with "Western corporations." Unlike writers such as Thompson (2015), Shiva (2016) refuses to separate questions of whether biotechnology should be utilized from Thompson's "side constraints", such as questions of how they are currently being used, who is making the decisions over their use, and who is benefitting from their use. In so doing, Shiva (2016) also draws attention to the ways in which the power exerted by foreign corporations in the Indian market and agricultural system parallels the past influence of colonial forces and how biotechnology in its current iterations operates as a tool of these forces.

Agrochemical corporations operate from, and therefore make products to fit within, the industrial agricultural system. Therefore, Shiva's critique of biotechnology begins with a critique of this system, which she views as upholding a detrimentally militaristic and reductionist understanding of agro-ecological processes. According to Shiva (2016), justification for the industrial paradigm is rooted in two of Western Modern Science's predominating theories, whose ascendency legitimated modern capitalism and, with it, colonial exploitation. The first of these is a "Newtonian-Cartesian idea of separation: a fragmented world made of fixed, immutable atoms" (Shiva, 2016, p. 4). According to Shiva, this theory allows for a conceptualization of Nature as inert, dead material that can be "used, moved, and substituted without any overarching consequences" (2016, p. 4). This claim is backed by ecofeminist historian Carolyn Merchant (1980/1983), who argues that the scientific revolution contributed to the separation of nature and culture, allowing for the Earth to be viewed as inert and thereby able to be exploited without moral qualm. The second theory is Darwin's theory of

competition as the driving force of evolution (Shiva, 2016). Together, argues Shiva (2016), these theories form a "reductionist, mechanistic paradigm of knowledge that permits limitless exploitation" (p. 7).

In Shiva's (2016) view, this knowledge paradigm paved the way for industrial agriculture in a number of ways that have proven harmful to the environment and, in limiting the long-term viability of agricultural production, farmers. Firstly, the idea that Nature is non-living, which as stated previously, allows for its component parts to be seen as moveable and substitutable, underlies monoculture, a mainstay of industrial agriculture (of course, the ability to isolate, move, and puzzle together discrete pieces of genetic material also underlies the concept of biotechnology [Stone and Glover, 2016]). This is because, if soil life and native biodiversity are non-essential to the wellbeing of a region, they can easily be substituted for a single crop without adverse effect. Furthermore, returning organic matter to the soil in a cyclical process supposedly becomes nonessential, as a given crop's nutritional needs may easily be met by substituting synthetic fertilizers for more naturally occurring ones like compost and manure. However, studies have shown that this is not the case; industrial monoculture farming actually depletes soils over time, reducing their productivity and making them more prone to erosion (Altieri, 1998).

Secondly, rather than operating through a system of cooperation, according to Shiva (2016), Darwin's theory of competition allowed for the creation of a militarized "us-versus-them" ideology of agricultural production, both figuratively and literally. Darwin's theory of competition then legitimates the use of pesticides-including insecticides, herbicides, and fungicides- to annihilate undesired populations because, in a

paradigm of competition, their very presence represents a threat to the viability of agricultural crop life (Shiva, 2016). Shiva (2016) consistently traces a historical arc from warfare to modern industrial agriculture, including the use of GMOs. The history of agro-chemicals is, indeed, rooted in warfare technologies. Among several other examples, the fossil fuel-intensive Haber-Bosch process of nitrogen fixation that allows for the creation of synthetic fertilizers was invented around the time of WWI, allowing Germany to engage in the war for far longer than they would otherwise have been able (Barach, 2016). During the WWII era, several chemical and pharmaceutical companies that now operate in the agricultural sector were involved in the production of noxious gases for use as weaponry. For example, German company IG Farben was implicated in the creation of gases for use in Nazi concentration camps, as well as the use of slave labor from said camps (Andrews, 1999). Due to this violent military history and, more importantly, to the fact that these same companies now operate as agro-chemical companies, Shiva argues that the entire system of industrial agriculture, which relies on the use of pesticides from these companies, is "rooted in war" (Shiva, 2016, p. x). This is dangerous because "when applied to agriculture and the food system, a paradigm rooted in the violence of war and a militarized mindset brings the war to our fields, to our plates, and to our bodies" (Shiva, 2016, p. x). Thus, according to Shiva (2016), industrial agriculture in and of itself is essentially an act of war, validated by Darwinian competition and upheld by corporations operating according to a profit motive.

Shiva (2016) draws a clear connection between modern forces of globalization, which allowed for the ascendancy of corporations in a global market, and historic forces of colonialism, arguing that the "first wave of globalization began in the seventeenth

century" with the "establishment of the East India Company and the signing of the first 'free trade agreement' between the East India Company and the collapsing Mughal Empire" (p. 86). This connection, in and of itself, provides reason for farmers in the developing world to be leery of corporations. Shiva is not alone in making this connection: development sociologist Philip McMichael (2012) traces this same historical progression of colonization to globalization and exploitation of the global South in his book *Development and Social Change: a Global Perspective*.

Shiva (2016) claims that corporations pushed for globalization under the "false" claims that it would both increase food production, since corporations can produce in greater quantities than small-scale producers can, and make food cheaper, thereby increasing its accessibility to the poor (p. 86). Shiva (2016) purports that this first claim regarding the benefits of globalization to food production is false because the higher yields reported by industrial agriculture are due to a difference in definition of "yield". In determining yield, industrial monocultures only measure the production of a single crop without accounting for the high cost of inputs like fertilizers and pesticides (not to mention, the seeds themselves); small-scale polycultures, on the other hand, aggregate the yields of a variety of crops, without having to account for any large input costs, as their inputs largely derive from the farm itself through the use of such methods as seed saving, composting, and utilizing animal manures as fertilizer (Shiva, 2016). The second claim is false, according to Shiva (2016), because the artificially cheap price of industrial food from wealthy nations masks both the high cost of their production inputs and the vast sums of money spent by national governments on farm subsidies. As McMichael (2012) discusses, the International Monetary Fund forced the liberalization of trade among

several nations in the developing world through the imposition of Structural Adjustment programs, which prohibit those same countries from offering similar subsidies to their own farmers. In combination with free trade agreements, this allows corporations to undercut the prices of local goods in other, generally poorer, nations, leading to the destruction of local production and the creation of de facto monopolies, under the guise of "competition" (Shiva, 2016, p. 87). Therefore, in Shiva's view, globalization is simply a neocolonial tool used to facilitate corporate control.

Much of Shiva's critique of biotechnology, and industrial agriculture more broadly, focuses on this corporate power. The global seed market is dominated by the top ten seed producers, who collectively control one-third of the seed market (Shiva, 2016). As it stands now, GM seed production exists solely in the purview of large corporations, with Monsanto, DuPont, and Syngenta being the top three producers of both seeds and the herbicides and pesticides used to protect their growth (Shing Castro, 2015). These companies operate upon a business model that allows them to recoup the monumental costs of research and development through the use of patents, which requires their users to buy new seeds annually. By patenting their seeds, companies help to ensure a market for their product year after year, as the common farm practice of seed saving becomes "patent infringement" (so long as the seeds being saved are from the corporations' plant varieties) (Shiva, 2016). Herein lies a crucial aspect of Shiva's (2016) critique: while she does argue that the patenting of life is fundamentally wrong, she also takes issue with patenting specifically because she views it as a form of piracy, which she terms "biopiracy" (p. 76). This is because the parent material for GMOs and hybrid varieties alike often come from commonly used varieties of crops, which she refers to as farmers'

varieties. These are varieties that have generally been developed and adapted over a period of centuries through the work of indigenous farmers, particularly women. Thus, in Shiva's (2016) view, using these varieties to make new "improved" versions that are then sold back to the farmers essentially amounts to theft. Because these traditional varieties were derived by several farmers working in tandem, with each other and with the processes of Nature, saving and sharing seeds freely, Shiva (2016) argues that seeds represent a biological "commons", which is the right of farmers to continue to utilize and save as they see fit. Therefore, patenting of these seeds represents a new iteration of the undemocratic closure of the commons in the name of capitalism, particularly since "globally, more than 1.4 billion people depend on farm-saved seed as their primary seed source" (Shiva, 2016, p. 68).

Shiva (2016) also identifies what she views to be a stark example of cognitive dissonance in the arguments of corporations regarding patenting and safety concerns about GMOS. Corporations argue that "GMOs are substantially equivalent to non-GMO crops and food" and therefore require no special regulations in their utilization. At the same time, they claim that GMOs are different and novel enough to warrant patenting; thus, "the same GMO is natural when it comes to avoiding responsibility for safety, but it is different from the natural- or unnatural- when it comes to owning it", an argument Shiva (2016) describes (not unproblematically) as "ontological schizophrenia" (p. 69). In addition, GMO-producing corporations such as Monsanto claim that their seeds are designed with desirable traits setting them apart (Unlocking Hidden Potential, n.d.). Of course, if such seeds did not, in fact, possess desirable qualities, no one would buy them. But Shiva (2016) presents the important question of *which* traits are considered desirable

and *by whom*. From her viewpoint, the traits embedded in GMOs (and hybrids) are those best suited to the needs of corporations, rather than to those of farmers or consumers. Arguably the most prominent example of such a trait is the "terminator trait", as it is known by those who oppose its use. "Terminator technology" refers to a technology whose purpose would be to produce a form of GM crop that would produce sterile second generation seeds, rendering seed saving, if not impossible or even illegal, then certainly futile. Fears over this technology reached their zenith in the 1990's, prompting Monsanto to publicly declare in 1999 that it would not utilize such technology in food crops (Myth, 2017). Throughout this same period, and indeed to this day, Vandana Shiva railed against this technology-firstly, for its undemocratic nature (in the same vein as patenting) and secondly, for the risk it poses of spreading sterility to non-targeted open pollinated crops, which Shiva (2000) argued in her book *Stolen Harvest* could result in a crisis of both food production and biodiversity.

Critics dismiss Shiva's concerns about the production of GMOs carrying the "terminator" trait, pointing out that such seeds have *never* been sold; Cornell professor Ronald Herring (2006) even goes so far as to refer to the terminator technology controversy as a "hoax" (p.472). Shiva (2016) claims that this is only due to a global campaign against their use, of which she took part. For their part, Monsanto disavows the "myth" that they have ever "*commercialized* a biotech trait that resulted in sterile-or 'Terminator'- seeds" (emphasis mine)(Myth, 2017). But, there is a marked difference between not commercializing a piece of technology and not creating a piece of technology in the first place, and this careful use of language lends credence to Shiva's assertion that terminator technology is not in use due to public pressure. Herring (2006)

further derides the argument that cross-pollination might occur from a sterilized crop, as Shiva fears. In contrast, Shiva (2000) points to the tremendous adaptive capacity of Nature and the lack of testing on a large scale as reasons in themselves to be leery of the technology. While Herring's point is logical, there is precedent for GM crops behaving contrary to expectations (Charles, 2013).

While terminator technology is perhaps an extreme example, Shiva (2016) suggests that the traits that differentiate patented seeds are still best suited to meet the needs of the corporations. For example, corporate seeds are designed for monocultural production in conjunction with fertilizer and pesticide use, which the same corporations also furnish. Some crops, in order to meet the needs of the global market, are bred for hardiness during long-distance travel or for uniformity to better facilitate processing (Shiva, 2016). Dominic Glover (2010) has also noted in his research the fact that, although proponents of biotechnology might argue that GM seeds are scale-neutral, and thus beneficial to all farmers, the needs of the farmers themselves are extremely scale-dependent. For example, for small-scale farmers making their living from a few acres, a consistent crop is more valuable than the possibility of a high yield one. Yet corporations are able to market their seeds by portraying them as "improved" varieties, thereby negating the quality of farmers' "primitive cultivars", and implying the superiority of the corporate seeds in a move that, while likely not intended as such, connotes a level of Eurocentricity (Shiva, 2016, p. 68). In contrast, Shiva (2016) makes a number of aesthetic appeals to the value of farmers' varieties, arguing that they "have taste, nutrition, and quality" above and beyond corporate versions, pushing back on the idea that corporate seeds are indeed "improved" (p. 68).

In addition to bearing traits best suited to meet corporate needs, rather than those of farmers, Shiva (2016) argues that GMOs, and any patented seeds, create a pattern of violence against farmers. Farmers must often take out loans in order to pay for these "improved" seeds, as well as the fertilizers and pesticides in order required to help ensure their high yields. Because farming can be a precarious job, with any number of factors- from changing global prices to unanticipated weather patterns- affecting one's success, these high costs can become a burden to farmers and even push them into debt, particularly because a monocultural farm does not have the same insurance built into it that a polycultural system has. For example, if a whitefly infestation decimates the cotton crop, the farmer who planted only cotton versus a range of crops will suffer far greater losses (Shiva, 2016). Shiva (2016) draws a direct connection between corporatized seeds, this pattern of indebtedness, and thousands of farmer suicides throughout the world but particularly in India. In fact, she argues that this pattern amounts to nothing short of "genocide", wiping out small-scale farmers across the globe (p. 79). Thus, where some might argue that it is the pattern of indebtedness itself, rather than GMO seeds and their patenting, that has led to farmer suicides, Shiva (2016) portrays the two as being inextricably linked.

The preponderance of corporate seeds also places a particular burden upon Indian women farmers (Shiva, 2016). Ownership of land titles is often a prerequisite for accessing loans and credit programs, and such loans are often the only way farmers can afford to buy the chemical inputs required by hybrid and GM seeds, not to mention the seeds themselves (Oxfam India, 2013).Very rarely do women possess titles to the land they work. Although data is uncertain, estimates suggest that in Kerala, which has the

largest percent of women owners and operators of agricultural land, no more than 14% of agricultural land is operated by women (Oxfam India, 2013). While rural Indian men often engage in other money-making fields and activities beyond farming, rural women are overwhelmingly engaged in agriculture, often as unpaid laborers on family farms or as underpaid laborers on someone else's farm, earning on average 30% less than their male counterparts (Oxfam India, 2013). In essence, women farmers, who form a large part of the agricultural workforce and whose collective labor has been vital in the production of the parent material utilized in making corporate, including hybrid and GM, seed varieties are unable to access these same seeds and are unable to engage in other forms of paid agricultural labor.

For these myriad reasons, Shiva (2016) argues that biotechnology is harmful to both the environment and Indian farmers. However, where Shiva views GMOs through the lens of the corporate control under which they now function and to which she believes them inextricably linked, others value them for their potential to relieve the travails of the poor through traits designed to meet their needs, rather than those of corporations. The most prominent example of such an iteration of biotechnology is the "Golden Rice Project" spearheaded by Ingo Potrykus, which seeks to incorporate beta carotene, a precursor to vitamin A, into rice in order to reduce the high incidence of childhood vitamin A deficiencies in South Asia, particularly in the Philippines (Golden Rice, n.d.). Shiva (2016) views such biofortification projects as a means of masking corporate interests under the guise of humanitarianism, a conceivable proposition given the history outlined in the preceding chapter of Western actors furthering their own goals while claiming it to be humanitarian aid. Shiva (2016) believes that the "liberalization,

privatization, and globalization trends in agriculture have resulted in the creation of an unregulated seed industry"; any regulations that do exist have been, in her view, "either abandoned or modified to accommodate multinational and transnational corporations" at the expense of both farmers and consumers (p. 78). In contrast, proponents of biotechnology such as Potrykus (2012), argue that the corporate control of biotechnology is actually the result of overzealous regulations on the part of government. Potrykus (2012) claims that, in fact, unnecessary regulatory hurdles have made research into biotechnology far too expensive for any sort of public institution to attempt for the sake of the public good- in essence, that regulations have stymied public research, allowing for the creation of a monopoly over biotechnology. According to him, such regulations are what has kept Golden Rice researchers from achieving their intended goals (Potrykus, 2012). These hurdles arguably also prevent more local public researchers from developing biotechnology indigenously.

Whereas, for many such as Paul Thompson (2015), the question of whether GMOs are an appropriate technology in and of themselves is to some degree separate from the question of whether they are being used appropriately, Shiva (2016) argues strongly that GMOs are inherently dangerous because of the industrial agricultural model for which they were created and to which they are, in her view, inextricably linked. Shiva (2016) claims that, rather than industrial agriculture, it is the work of small-scale farmers, and women in particular, operating on agroecological principles and working in harmony with native biodiversity, who can provide the world with appropriate nourishment. Far from being a miracle technology, GMOs thus simply represent another iteration of corporate, and colonial, domination and control. Furthermore, rooted as their history is in

what she terms the “militarized, mechanistic, reductionist, and fragmented paradigm of agriculture”, GMOs are inherently incapable of achieving any end other than destruction (Shiva, 2016, p. xviii). Therefore, Shiva argues that a goal of creating global food security necessitates a disavowal of both industrial agriculture generally and the use of GMOs in particular. Thereby, Shiva’s work illustrates the saliency of colonial history within India and the ways in which contemporary interventions may be viewed through the same lens, particularly in regards to GMOs. However, through her focus on corporations, she precludes the possibility of GM technology ever being utilized outside this framework, even if conceived of and produced indigenously.

CHAPTER IV.

M.S. SWAMINATHAN: A POTENTIAL MIDDLE PATH IN THE DEBATE

Known as the "Indian Father of the Green Revolution" for his role, along with the Green Revolution's other "father" Norman Borlaug, in disseminating modern agricultural techniques throughout India in the 1960's, geneticist M.S. Swaminathan has devoted his expansive career to Indian agricultural development. He has served as director general of the Indian Council of Agricultural Research, principal secretary of the Indian Ministry of Agriculture, and was named one of *Time* magazine's twenty most influential Asian people of the twentieth century, among other distinctions (Founder: Prof M S Swaminathan, n.d.). For the last several decades, he has urged a transition toward what he terms an "Evergreen Revolution" founded on principles of sustainability and equitability, as outlined in his 2016 book *From Green to Evergreen Revolution,* which anthologizes articles spanning from the early 1990's to the mid-2000's he wrote for *The Hindu*, an English-language daily newspaper.

Within this anthology, Swaminathan (2016) identifies many of the same issues with the state of Indian agriculture that Shiva (2016) does, including foreign corporate influence, a lack of attention to the needs of small-scale and particularly women farmers, and environmental degradation. However, where such issues lead Shiva to reject biotechnology for its connection to the industrial agricultural paradigm that upholds these issues, Swaminathan (2016) envisions biotechnology as one of many technological tools that, in conjunction with services and government programs, could actually address them. Swaminathan's myriad proposals for how to improve the state of Indian agriculture are largely reform-based and rely upon a presumptive belief in the goodness of technology,

including biotechnology, the modern economic system, and the ability of corporations to operate toward the public good. While not ignoring India's colonial history, Swaminathan does not fully address its role as progenitor of the modern global economic system and how this connection impacts national and corporate power relations within the system. However, he repeatedly iterates the necessity of localized solutions driven by indigenous actors. In this way, Swaminathan (2016) illustrates what a historically and culturally situated understanding of the role of biotechnology might look like in practice, although he does not do so comprehensively.

Swaminathan's work fits within the equitable development discourse. Dominic Moulden (2013), writing in *Nonprofit Quarterly*, defines equitable development as "development activity with a triple bottom line, taking into account the interests of the business community and local developers, fairness in the treatment of employees, and sustainability in protecting and enhancing resources (human and others) in responding to an array of social and environmental needs" (para.1). Within the context of the GMO debate, the equitable development discourse represents a third "alternative" perspective that has largely been ignored by adherents to both sides of the debate (Bownas, 2016). Swaminathan's work forges this middle ground by largely bypassing the question of whether GMOs are "good" or "bad" (although generally presuming their "goodness") and focusing on the question of how to create a context in which their use provides the most benefits to the Indian population, particularly those who have been largely left out of the broader development discourse, such as rural populations in general, and small-scale, tribal, and women farmers in particular.

While Swaminathan views development as a generally positive (and possibly inevitable) thing, he argues that rural populations have largely been left out of development considerations in favor of macroeconomic policies that are "by and large oriented towards the needs of big business and industry, who have powerful organization structures to represent them" (Swaminathan, 2016, p. 321). This is, of course, problematic in any nation but especially so in India, where approximately 70% of the population is rural and agricultural, and most of *this* population is marginal, with the average farm holding being under two hectares (it is important to note as well that this population also constitutes 25% of the global farming population) (Swaminathan, 2016). This inattention creates a context where rural populations don't receive adequate support for their livelihoods and eventually must seek work elsewhere, either by joining the ever-growing urban slums in search of work or finding work abroad (Yardley, 2011). Swaminathan (2016) argues that this focus is also problematic for the very simple reason that development in other sectors, including industrial, cannot occur without support from the rural sector, which provides both raw materials and nutrition for the industrial labor force.

Swaminathan's (2016) extensive plans for improving the state of Indian agriculture through an Evergreen Revolution are rooted in his understanding of the impacts of the 1960's Green Revolution in India. Unsurprisingly, given his role in bringing it about, Swaminathan (2016) regards the Green Revolution as being largely beneficial to farmers, as well as a "blessing in terms of saving land and forests", under the logic that increasing productivity on current agricultural lands allows for conservation of lands that might otherwise have been brought into agriculture (p. 28). In contrast to

Shiva (2016), Swaminathan (2016) also views it as being instrumental in fostering Indian sovereignty, since the nation became far less reliant on foreign food imports as a direct result of the Green Revolution technologies.

On the other hand, Swaminathan (2016) also attributes the success of the Green Revolution in large part to circumstances that were already in place at the time, rather than lying with the technology itself. Such prerequisites included "owner cultivation which provide[d] the motivation for the farmer to make adequate investments in the land, consolidation and levelling necessary for efficient water management and soil health maintenance, rural communication which facilitate[d] access to markets, rural electrification to ensure energy for pumping groundwater and for operating post-harvest equipment and a dynamic agricultural research and extension program," as well as the presence of a remunerative market (Swaminathan, 2016, p. 372). However, he is also frank about the shortcomings of the Green Revolution. For instance, Swaminathan (2016) notes that climatic differences meant that benefits were not evenly distributed. For example, much of the Green Revolution involved increasing production of commodity products like wheat and cotton, so its benefits were not felt in rainfed or dry farming areas, where those crops are not as viable (Swaminathan, 2016). He further notes its ecological drawbacks, such as environmental pollution and what he refers to as "land and water mining" (Swaminathan, 2016, p. 28). He presents these shortcomings, though, as an opportunity for growth and improvement in the next Revolution (Swaminathan, 2016).

In so doing, Swaminathan (2016) puts forth the Green Revolution as a template for how to utilize biotechnology as a tool of his Evergreen Revolution, whose purpose he defines as "improv[ing] productivity in perpetuity without associated ecological harm"

(p. 35). He promotes a "symphony approach", a combination of cutting-edge technology, government services, public policies, and farmer involvement (Swaminathan, 2016, p. 18). Swaminathan describes technology in general as "the prime mover of the economic and ecological well-being of farm families" and consistently urges for advancements to be made in both the creation and application of cutting-edge technologies (2016, p. 246). Throughout his writing, he makes repeated use of some variation on the phrase "frontier technologies like biotechnology, information and renewable energy technologies, [and] space applications", immediately placing biotechnology as just one of several important new technologies with potential benefits to India in general and rural populations in particular (Swaminathan, 2016, p. 122, 128, 196, 270, 324). Other beneficial technologies include the expansion of radio and internet communications in order to better inform rural populations of meteorological events so that they might better prepare their crops for impending stresses, for example (Swaminathan, 2016). Importantly, Swaminathan (2016) also stresses the necessity of improving post-harvest technologies (cooling, cleaning, sorting and packaging), without which significant increases in agricultural production would mean very little, since the produce would not be preserved long enough to be distributed. However, he states that, even with all of these things in place, "agriculture may not move forward without proper public policy support in areas such as land reform, pricing of inputs and outputs, marketing arrangements to meet the demands of both home and external markets and investment decisions relating to irrigation, energy supply and rural infrastructure development (Swaminathan, 2016, p. 372). Lastly, while acknowledging the import of traditional wisdom and forms of knowledge, Swaminathan

(2016) cautions those (such as Shiva) who would return to strictly traditional methods of agriculture to recall the prevalence of famines in the pre-independence era.

Swaminathan (2016) seeks to engage the grassroots enthusiasm he discerned during the era of the Green Revolution for his Evergreen Revolution. He puts forth the Indian government as purveyors of this grassroots engagement, as illustrated in his discussion of the implementation of a potential water conservation program: "The programme will be designed so that a small Government Project leads to a mass movement…as happened in the case of national demonstrations in wheat during 1964-65" (Swaminathan, 2016, p. 174). Similarly, Swaminathan makes repeated references to the importance of village life and the implementation of change at the local level which then might be spread nationwide. He states, for example, that it is "only community-centered and decentralized approaches that can help to end poverty and hunger" (Swaminathan, 2016 p. 205). However, as with the Green Revolution, he sees a place for the national government-some might say contradictively- to be fundamental in *initiating* these grassroot movements and change at the local level. For example, he makes repeated reference to the need for initiating-among many other movements- a "bridging the yield gap movement" in order to help farmers maximize their potential yields, to a water literacy and conservation movement so that water may be more readily available and equitably distributed, to a genetic literacy movement, so that people may be well informed about, and therefore not unduly fearful of, biotechnology (Swaminathan, 2016, p. 92). In this way, though, Swaminathan (2016) illustrates the inadequacy of biotechnology or, indeed, any technology by itself, to meet the needs of farmers; rather, technology is best understood as a tool to maximize the benefits of other measures.

Swaminathan (2016) states unequivocally that the sustainable agriculture of the twenty-first century will be based largely on the "appropriate use" of biotechnology, for which international cooperation will be extremely important (p. 61). He specifically advocates for green farming techniques, rather than those of organic agriculture, because organic agriculture precludes the use of GMOs and chemical inputs (which he proposes to utilize in limited quantities) (Swaminathan, 2016). He argues that the potential of biotechnology ultimately depends "upon the imagination and creativity of the researcher and the elegance of the tool employed," but, broadly speaking, he views it as having potential for addressing issues of food security throughout the developing world (Swaminathan, 2016, p. 138). For example, possible applications he cites throughout his book include: the development of vaccines; creating crops with resistance to abiotic stresses such as salinity, high temperatures and moisture stress, and transboundary pests (not unlike the Bt technology currently in use); and potential improvements in both animal stocks and crop yields (Swaminathan, 2016). He also sees biotechnology as playing a key role in integrated natural resources management and precision farming in the following areas: integrated gene management, efficient water management, integrated nutrient supply, soil healthcare, integrated pest management, and efficient post-harvest management, although he does not specify how (Swaminathan, 2016).

In addition to helping meet the needs of marginal farmers, Swaminathan also views genomics, the discipline that has "contributed to powerful new approaches…used in agriculture" and "has helped to promote the biotechnology industry" as an opportunity for broad-based Indian entrepreneurship and self-employment (Swaminathan, 2016, p. 60). He urges the creation of a National Association of Genome Entrepreneurs who could

be supported by venture capital in order to enable entrepreneurs to "convert the rich knowledge available in government institutions in the field of functional genomics into commercially viable products" which they might also utilize in other countries. This would ostensibly operate in the same manner as information technology (Swaminathan, 2016, p. 161), a comparison subtly drawn by his description of biotechnology as creating "biological software for ecological agriculture" (Swaminathan, 2016, p. 117), and less subtly in his reference to making India a "global outsourcing hub in the areas of plant and animal genomics and ICT for the rural poor" (Swaminathan, 2016, p. 44). While Swaminathan (2016) does particularly refer to functional genomics, rather than biotechnology, he also suggests coursework be created by the National Centre for Plant Genome Research, which was established by the Indian Department of Biotechnology, thereby further establishing their interrelation.

In viewing biotechnology as having potentially limitless applications, Swaminathan's perspective does not deviate from those in the pro-GMO discourse. However, Swaminathan (2016) does acknowledge the potential for biotechnology to have adverse impacts, stating simply (albeit vaguely) that some concerns about the impacts of GMOs on human health and the environment are genuine. He does also bring up ethical concerns about their potential applications in human genetic engineering, or even biological warfare. But, again, he relies on the government (in this case, of every nation) to prevent this through the creation of their own institutional regulatory structures, a solution most likely to be viewed as problematic by adherents to both sides of the GMO debate- on the pro side because such institutions would constitute "unnecessary" regulations that would stymie economic innovation, and on the anti side because such

structures are not infallible and might additionally be vulnerable to corporate corruption (Swaminathan, 2016).

While Swaminathan (2016) does not skirt the issue of colonialism, his references to India's colonial history mostly occur obliquely, either through discussions of the struggles immediately following independence or reminders of the many famines that occurred under British rule. Nowhere does he specifically address colonialism as a cause of disproportionate wealth between developed and developing countries, for example. However, he does acknowledge inequalities within the global market, citing for example the fact that most industrialized nations like those in the EU and the United States provide their farmers with heavy subsidies that inherently disadvantage small-scale producers in the developing world. While he argues in one chapter that these nations must be convinced to curb their subsidy programs in order to give Indian farmers a better chance in the market, he acknowledges in a later chapter that industrialized nations will never be willing to do so. Therefore, he argues instead for the formation of an Indian Trade Organization, in the same vein as the World Trade Organization, as a means of protecting Indian agricultural interests in the trade process (Swaminathan, 2016). In this way, he never questions the base premise that participation in the global market is generally beneficial, although it is worth noting that he cautions the Indian government to make sure that potential imports don't negatively impact rural livelihoods, and he warns against the creation of "jobless economic growth" that does not translate into substantive life and livelihood improvements, thereby voicing a need for reform of the economic system (Swaminathan, 2016, p. 116).

Swaminathan (2016) does, however, put forth the idea that technologies meant to ameliorate Indian agricultural problems must be location-specific and indigenously developed in order to be effective. According to Swaminathan (2016), this is because the needs of food producers in the developed world, whose numbers are rapidly decreasing while the size of the lands they work increase are vastly different from those of the small and marginal farmers in India, whose land holdings are continuously shrinking. Thus, in his view, biotechnology created outside of the developing world will likely not meet the needs of farmers from those regions. As he states, "Research solely directed to the needs of resource-poor small farmers is unlikely to attract the attention of large companies whose priorities are generally determined by the magic of the marketplace" (Swaminathan, 2016, p. 137). He likens these circumstances to large pharmaceutical companies who don't bother researching a vaccine for leprosy because they know that those afflicted with leprosy would never be able to afford it. Swaminathan (2016) thereby acknowledges the limitations of the corporate sector to address India's needs without going so far as to actively criticize it. He does, however, see a place for international cooperation, with "advanced research institutions in industrialized countries and researchers in developing countries, commit[ing] to harnessing science for the public good" (rather than excluding the poor to inventions that will increase food security by adhering to individual property rights) (Swaminathan, 2016, p. 271). Additionally, he expresses the concern that biotechnology might present problems for agriculture in the "Third World" if it were implemented to create synthesized versions of export products such as "sugar, steroids, vanilla and other flavours and gums" (Swaminathan, 2016, p. 140). Of course, Swaminathan (2016) does not suggest that development of such

technologies should somehow be halted, but rather that their applications should be anticipated so that marketing problems (presumably, marketing the natural product in the face of cheaper synthetic substitutes) might be mitigated.

Like Shiva (2016), Swaminathan (2016) is concerned with the impact that patenting might have on rural populations, particularly those whose labor went into the creation of the parent material for patented seeds. He argues that the commercialization of knowledge should not inhibit its sharing for public good in local communities, citing fears that these companies will monopolize the market and become the only source of both these new seeds and the "chemicals needed to control the pests to which the new strains may be susceptible" (Swaminathan, 2016, p. 136). However, Swaminathan's (2016) solution to the issue is more reform-based than revolutionary. He finds the solution to the issue in re-envisioning intellectual property rights to somehow incorporate whole communities (as opposed to solely being available to individuals or corporations). Instead of pushing for the consideration of seeds as part of a biological "commons", as Shiva (2016) proposes, Swaminathan argues that, since "contributions are often made by entire communities and therefore cannot be attributed to individuals…procedures are needed to recognize and reward community contributions to genetic resources conservation and selection (2016, p. 300-301). Although he discusses the need for creating "possible formulas for the sharing of benefits based on different benefit-indicators establishing the relative total amounts and relative contributions corresponding to each country and region", he does not attempt to explain how such formulas might be created or how they would affect contributors at the community-level (Swamanathan, 2016, p. 301).

Yet, Swaminathan (2016) is at pains to acknowledge the labor that tribal and women farmers make to, not only the agricultural system, but conservation of biodiversity, and he therefore seeks ways to acknowledge their work within the context of the modern economic system. Swaminathan (2016) argues that economic incentives are the best way to concomitantly promote conservation and an appreciation of traditional wisdom and local biodiversity. According to him, this might be accomplished by the establishment of "bio-valleys" in areas rich in bio-resources, which he argues might become "to [non-GMO] biotechnology what the Silicon Valley is to information technology" (although he does not adequately describe what form this "non-GMO biotechnology" might take) (Swaminathan, 2016, p. 36). These biovalleys would aim to "promote an era of bio-happiness arising from the conservation and sustainable use of bio-diversity, leading to more jobs and income for the local population" (Swaminathan, p. 180). He also suggests creating an award-based system, with a monetary prize, of recognizing conservation work, such as the already existing "Genome Saviour Award" (Swaminathan, 2016, p. 36). For him, such awards are important because rural and tribal, predominately female, populations are already practicing conservation work at great personal cost, while the broader public is also reaping the benefits of their work (Swaminathan, 2016).

While Swaminathan (2016) does not contradict the claim made by others such as Shiva (2016) that biotechnology might bear some responsibility for decreasing biodiversity, he does actually argue that, at the very least, genetic engineering has enhanced the *economic value* of biodiversity by "render[ing] the transfer of genes across sexual barriers possible" (p. 288). Furthermore, he argues that "food, biotechnological

and pharmaceutical industries have an economic stake in the use of biodiversity" since the diversity of the natural world often provides their source material. Under his logic regarding economic stakes being important for promulgating conservation practices, it would stand to reason then that these industries would practice conservation methods; however, he does not make this argument (305). In this way, he again avoids critique of the corporate sector.

As a prominent voice for the equitable development perspective in the Indian GMO debate, M.S. Swaminathan (2016) argues strongly for the creation of an Evergreen Revolution loosely modeled on the experience of the earlier Green Revolution. The purpose of the Evergreen Revolution would be to sustainably provide adequate nutrition for the Indian population, remunerative work for farmers, and acknowledgement of the contributions of women and tribal communities to agriculture. To that end, he provides myriad suggestions and plans for how agriculture might become simultaneously more productive, beneficial to the farmers themselves, and ecologically benign. Swaminathan (2016) argues strongly for a place for biotechnology within this Revolution but acknowledges that its usefulness as a technology extends only so far as there are adequate government programs in place to support it and local enthusiasm for it. Furthermore, he illustrates the necessity of locally-focused and indigenously created programs and iterations of biotechnology in order to ensure benefits to targeted populations. Although his focus on the Green Revolution and beyond means that he does not fully grapple with India's colonial history and its effect on the current state of Indian agriculture, he still successfully provides a compelling plan for how to situate biotechnology in a culturally and historically significant manner.

CHAPTER V.

CONCLUSION

It has not been my goal here to definitively ascertain whether or not agricultural biotechnology is an appropriate solution to the problem of world hunger. Rather, I have attempted to illustrate the following: first, that the understanding of hunger as a simple supply versus demand equation is an oversimplification that allows for the use of a technological fix (in this case, biotechnology) in order to "solve" a multi-faceted issue; and second, that this oversimplification potentially ignores vital historical and socio-cultural contexts that factor greatly into the successfulness and acceptability of this technology. Therefore, debates in the US and other places that revolve solely around the risk/safety aspects of GMOs in order to ascertain whether they're "good" or "bad" sidestep the important issue of how GMOs are embedded in a particular mode of agriculture whose merits are largely taken for granted in the United States. Thus, the oft-used argument that GMOs are necessary to feed the "developing" world, particularly in the face of global climate change, assumes that hunger is caused in large part by inadequate supply, rather than myriad factors including trade imbalances, inadequate distribution, and education, among others. Furthermore, this argument sets up support for biotechnology as a moral imperative, as no one would argue against wanting people in need to have enough food. However, this perspective also removes a certain level of culpability, because "developed nations" and, indeed, modern industrial agriculture itself, have contributed largely to the creation of the global climate change that now threatens agricultural production in much of the world (and which is used as further proof of the need for biotechnological development).

I have utilized India as a case study through which to better understand the need for contextualization in the GMO debate, both because of its status as a "developing" country with a high population, a large percentage of whom are malnourished, making it a seemingly ideal locus for the utilization of GMOs, and because of its complicated history with the West (predominantly Britain and then the United States). I have illustrated that India's history of famine and hunger has largely been understood in the past along those same terms of supply versus demand, when in reality, they were due in large part to colonial administrative decisions. These famines were then exacerbated by the British's limited understanding of hunger in India at the time as simply a population issue. This understanding predominated after India's independence, during which time the United States took a leading role in both attempting to curtail population growth in the "developing" world and modernizing agriculture through the Green Revolution in order to increase production, relying mainly on cereal monocultures and necessitating the use of both fertilizers and pesticides. While understood by many as a humanitarian, life-saving gesture, this was also done largely to suit the US' political agenda of limiting the spread of communism. More importantly, even as India has become a net exporter of the crops produced through Green Revolution technology (mainly wheat and rice), hunger remains an issue for much of the Indian population. Thus, this history illustrates the limited capacity of a new technology to solve a broad-based issue, and it serves as a reminder to question the narrative of humanitarian intention on the part of the US, a narrative which is often forwarded to promote biotechnology for use in the "developing" world.

I have also analyzed two alternative perspectives on the role GMOs have to play in Indian agriculture, both of which illustrate that there is more to the issue of addressing hunger and the needs of farmers than simply increasing the supply of agricultural products. Vandana Shiva (2016), a staunch anti-GMO advocate, makes a strong case for why GMOs in their current iterations are ill-suited to the needs of Indian farmers, especially women farmers, and may, in fact, be placing a greater burden upon them. In order to make this case, she illustrates the intrinsic ties that GMOs have with industrial agriculture, which she argues has ultimately been detrimental to India because of its reliance on a few varieties of crops grown in monocultures that require chemical inputs. She further illuminates the ways in which corporate control, particularly foreign control, of the seed industry recollects the colonial domination India fought so hard to overcome (a sentiment which likely finds resonance throughout the "developing" world in a way that might not fully be understood by the "developed" world). However, like pro-GMO voices in the "developed world", Shiva's critique is mired by her need to definitely answer the question of biotechnology's "goodness" or "badness". Ultimately, though, Shiva's (2016) perspective reveals why GMOs in their current context and current iterations are ill-suited to meeting the needs of Indian farmers.

Swaminathan (2016), on the other hand, is far more amenable to the use of biotechnology in India. But, by and large, he successfully side-steps the abstract question of whether GMOs are "good" or "bad" by focusing his attention on providing myriad suggestions for how to create a context in which they might be made useful and beneficial to the Indian population. Using the Green Revolution as a template for enacting far-reaching agricultural reform, he recommends the development of rural

infrastructure, particularly post-harvest technologies, the widespread improvement of irrigation and water harvesting capacity, greater reliance on integrated pest management, increased access to credit and non-predatory loans, and government subsidies, among many other suggestions. He also repeatedly expresses the importance of tailoring both technology and reforms to the needs of local populations, as well as the local environment and argues that indigenous researchers are best suited to doing so. Although his focus on the Green Revolution and beyond largely brushes over the extant legacy of colonialism on Indian culture and relations between "developed" and "developing" countries, Swaminathan (2016) nevertheless provides a carefully considered and far-reaching example of how, given the right context, biotechnology could become a suitable and beneficial technology in the "developing" world.

The allure of biotechnology's potential is undeniable. The environmental chaos that is global climate change becomes a little less terrifying when one imagines crops that might be grown in droughts, extreme heat, high salinity, limited space, or any other number of undesirable- but increasingly likely- conditions. However, debates over the "goodness" or "badness" of GMOs, by and large, miss the point. This is because in practice it is important to consider, as Shiva (2016) does, how they currently fit into a particular agricultural paradigm and whether that paradigm is, indeed, beneficial to the small-scale farmers who feed the majority of the world population. As demonstrated in Swaminathan's (2016) work, there is room for them to provide benefits beyond this paradigm, but only insofar as the paradigm is acknowledged and steps are taken to ameliorate its ill effects, which is best done at the local level and with the participation of farmers themselves. Therefore, the moral argument made by pro-GMO voices in the

"developed" world that those in the developed world should stifle their own concerns regarding GMOs because of their potential to help the "developing" world ignore the ways in which this argument also fails to fully consider the needs of those in the "developing" world.

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