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Ecology and Values

"The Story of Golden Rice: Food Bioengineering, Economics, and Global Justice"

Genetic engineering – the third-party selection of desired traits in an organism, such that its descendants carry the desired traits – has been a human practice since the Agricultural Revolution. Genetic engineering allowed communities of hunter-gathering humans to survive on what amounted to crabgrass; season after season of selection transformed stringy grasses into fruitful wheat and barley. Deliberate human engineering made dogs out of wolves and turned weeds into rich corn and rice millennia before science was considered a legitimate way to make a living; for better or worse, genetic engineering made the very concept of 'making a living' possible. Anywhere humans farm, anywhere we keep dogs or graze cows or pick fruit or choose mates, we engage in deliberate genetic selection, with comparatively little thought given to the ethicality of it all. Is that attitude still morally relevant?

Now scientists can alter the destiny of organisms within one generation. Rather than painstakingly selecting genetic traits that suit some human whim and amplifying those traits over time through the careful manipulation of breeding stock, researchers can alter the very gene that controls this trait, turning it off or replacing it altogether. The ability, and the responsibility, of humans to change the course of evolution wisely is a considerable ethical issue. It is of great relevance to the environment, animal rights, food production, the global economy, globalization, and politics.

One issue in this tangled morass of agendas is the ethical and economic value of genetically modified organisms (GMOs) – specifically, plants - used for human and animal food. Staple crops such as corn, soy, and rice can be genetically modified to produce vitamins, deter pests, delay ripening, include extra essential nutrients, survive in more extreme climates, or to simply produce larger yields (ID Foodstuffs 6) (Avery).

Thus, bioengineered staple crops could do much to reduce world hunger, provide better nutrition as well as increased food production, decrease pesticide and water use, reduce environmental pollution, increase shelf and storage life, and improve the economies of many struggling nations. These are all desirable qualities in a food product, and yet there is tremendous and well-founded ethical concern across the planet about the morality, safety and viability of these foods.

Consider the case of golden rice. Agricultural, economic and environmental realities have made rice one of the few reliable, cheap, productive crops to grow in monsoon climates. Thus, rice is a staple food, sometimes the sole diet, of many developing countries. This leads to chronic deficiency of an essential dietary component - vitamin A – among the populations of these countries (ID of Foodstuffs 7).

Vitamin A Deficiency can lead to a compromised immune system, skeletal deformity, eye failure, and, if left untreated, results in permanent blindness (Thakore). An estimated 250,000 to 500,000 children go blind each year from a simple, preventable deficiency, curable with dietary milk, eggs, meat, or green vegetables ("VADD" 1). However, in regions where rice is a staple crop, such as developing Africa and Southeast Asia, these dietary options are not a viable solution.

In order to combat this problem, golden rice has been genetically modified to produce precursors to vitamin A, which can be synthesized within the human body. Genetically engineered golden rice smells and tastes the same as 'natural' milled rice; its only difference is its vitamin content and yellow color. These traits can be interbred, allowing farmers to use traditional techniques to mix golden rice genes with existing rice strains. Independent rice breeding can be tailored by the farmer to produce healthier or higher-yielding plants; this allows farmers a measure of control over their plants, as well as increasing the vitality and genetic diversity of golden rice strains. This is an ethical decision for the engineers of golden rice to make; companies like Monsanto, with their locked-in germ lines and development of genetically unviable 'suicide seeds,' have given genetic engineering a very poor reputation with regards to world food production.

"Our innermost desire," the Golden Rice Humanitarian Project website reads, "[is] a good harvest, rich in quantity and in quality, guided by justice and equity, and made possible by access to appropriate technologies" ("About Golden Rice" 5). The reader could be forgiven for being won over by the wording of this sentiment, but it is a noble one. So what are the philosophical arguments that support the bioengineering of food crops in order to improve the well-being of the human population and the global economy?

Ecological theory indicates that many of the precedents necessary for evaluating the bioengineering argument have already been set; the debate about how to reconcile the best interests of humanity with the nebulous but undeniable rights of nature has been hashed out in some detail.

The theoretical approach of anthropocentrism would heartily favor the development of bioengineered food crops. This theory describes a human-centered universe in which it is absolutely morally defensible to use natural resources in any way that humans see fit (Armstrong). The anthropocentric frame of reference would show that it is a human right – perhaps a responsibility – to edit a plant's genes so that it better reflects what humans would like to see in it. No thought should be wasted on the moral considerability of the intact rice genome, or the impact that golden rice might have on the natural environment, because what is truly important is that humans are getting fed.

Writing to reconcile anthropocentrism with traditional environmentalism, James Sterba argues the *principle of human preservation* when he states that "Actions that are necessary for meeting one's basic needs or the basic needs of other human beings are permissible even when they require aggressing against the basic needs of animals and plants" (Sterba 227). This argument favors human choice over other rights, but Sterba replies that this continues the nonanthropocentric tradition of viewing all species as equals; he notes that all species favor their own kind, to one degree or another. He then goes on to temper this by stating that this aggression is unfounded when applied to non-basic needs and luxury items.

Sterba's reasoning implies that genetically modifying a plant to make it a better food organism could be justified. The case of golden rice indicates that vitamin A is one of the most basic of human needs. If genetically modifying the rice plant is, indeed, aggressing against it, then it is still morally justifiable from a nonanthropocentric point of view.

The ethicality of engineering golden rice is even supportable from some of the tenets of its detractors. Many animal rights activists, like the Animal Liberation Front and PETA,

argue that it is the moral responsibility of all humans to make the conscious choice to become vegetarians or vegans. Advances in crop enrichment would make global vegetarianism a more probable reality, providing essential minerals and nutrients while requiring little farmland.

Deep ecologists, like Daniel Quinn, do not believe that bioengineering food to provide better nutrition is an ethical solution to world hunger. Quinn states that increased food production is only possible through 'totalitarian agriculture,' in which human will is oppressively imposed on natural environment. Also, increased food production leads to increased human production, resulting in population booms that are harmful for the environment. Quinn's recommendation for resolving the disparity between large populations of starving humans and small amounts of food is to let Nature take its course. The humans will starve to death, until there is only a small, stable population that can survive only on sustainably produced food. Improving food production in impoverished, famine-struck areas would be foolish, Quinn states. It would be equally ridiculous to donate surplus food to these areas through famine relief. If these starving people receive food, their population will increase, creating more hungry mouths, and they will be even worse off then before.

Thus, deep ecologists would have at least two reasons to oppose the bioengineering of golden rice. Firstly, tampering with the rice's genes is the very epitome of totalitarian agriculture. In his best-selling novel "The Story of B," Quinn uses the terms 'Takers' and 'Leavers' to characterize farming humans vs. hunter-gatherer humans; farmers are portrayed as 'taking' from the land and giving nothing back, while 'leavers' use only what they need. Quinn points to the mindset of 'Taker culture' as the culprit in

humanity's exploitation of natural resources. Farmers control the destiny of plants; this leads them to lack respect for the plants; eventually, this leads to a lack of respect for the Earth, with pollution, overpopulation, poverty, and unhappiness becoming the obvious evolutionary progressions. The genetic modification of golden rice to suit human needs would be patently exploitative. Quinn and his fellows would argue that bioengineering would lead to increased disrespect for natural resources.

Secondly, deep ecologists would reason that the increased food production and nutritional value of golden rice would be detrimental to the environment. The above-mentioned quarter-million malnourished children at risk of death every year are an indication that their environment cannot support them. Their malnutrition is simply proving the point that there are too many humans for the Earth to support. It would be counterproductive and unethical to continue to feed them at all, let alone to introduce nutritional factors that would lengthen their life-spans. This argument is certainly logical, but its ethicality is subject to questioning.

Deep ecology movements such as the Animal Liberation Front call genetic engineering an "unsacred liason invented by chemical engineering companies" that involves "combining genes … against the laws of natural selection" ("Genetic Trespassing" 2) in an article on their website, appropriately entitled "Genetic Trespassing and Environmental Ethics". Citing Quinn, the article continues "Genetic engineering aims at unnaturally increased food production to fuel the already excessive human population explosion that is burdening the planet and its resources", echoing the deep-ecology sentiment that human populations should be curbed naturally through hunger and resulting die-offs ("Genetic Trespassing" 12). This reflects the theoretical struggle to find

a balance between human good and environmental harm that resonates through modern ecological theory.

The article concludes with a relevant insight into an ecological perspective on genetic engineering. “Can we entrust our food supply and the future of the Earth to those who have no respect or ethical consideration for the living planet, who are motivated mainly by short term profits?” the author asks, poignantly invoking a common us-against-them tenet of argument. “Bioengineering … is spearheaded by scientists whose strange alchemical adventure recognizes no species boundary; not even God can predict the consequences” (“Genetic Trespassing” 21). It is clear that this faction does not support the bioengineering of food crops as an ethical or reasonable method of providing viable nutrition.

A noticeable theme throughout this argument is the supposedly ‘unnatural,’ ‘unsacred,’ and ‘unethical’ nature of genetic engineering. Unfortunately, this approach is not as cloyingly logical as Quinn’s. The article firmly proclaims that cows ‘suddenly wake up’, terrified and unaware, with grossly engorged udders, as a result of genetic engineering, and that chickens will soon be crossed with centipedes to produce horrific creatures with multiple drumstick appendages, when neither of these scenarios are an accurate representation of how genetic engineering works. “Genetic Trespassing” implies that ‘unnatural’ human selection is fundamentally at odds with the pure purposes of Nature. It cites that genetic engineering is fundamentally incompatible with respect for natural processes; it is an abomination unto not only God, but evolution and Mother Earth.

Well, if one must be an abomination, why not go for the trifecta? How many chances does one get to offend a culture’s entire pantheon? Unfortunately, it is too easy – and

cheap – to say things like this, to judge arguments that propound an opinion on a scientific debate based on their misuse of scientific principles. After all, science is just as fallible as philosophy – more so, for it is being constantly disproved, while philosophical tenets linger and affect for centuries. The emotions behind "Genetic Trespassing and Environmental Ethics" are truly valid, reflecting an understandable discomfort within the global public regarding genetic engineering.

Likewise, we cannot dismiss Daniel Quinn for implying that the malnourished children of South Asia should be naturally killed off for the ultimate improvement of the environment containing, incidentally, Daniel Quinn. Although this idea sounds nothing less than sociopathic and racist, coming from a potbellied white fellow with a college degree, a nice condo in Houston, and an English degree that translates into semi-prophetic rambling reminiscent of "The Da Vinci Code" at its most vapid, the idea seems logically sound (Quinn, "Who We Are"). B's character so effortlessly knocks down any opposing argument that it appears that feeding the world is unethical. An exploration of the basis of the claim in greater depth may indicate if this population model is an appropriate basis for an ethical theory.

Quinn does have a valid point in stating that uncontrolled human population growth will lead to a strain on the planet's resources, especially if it takes place in industrializing nations. It might be worthwhile to point out that, despite Quinn's assertions, human population growth does not necessarily correspond to food production or quality. As noted above, countries with cyclical wet/dry climates like India, China and Africa have limited options regarding crop production, and they are among the most malnourished countries in the world. If Quinn and the deep ecologists are correct, countries with great

surpluses of food should contain the fastest-growing populations. Consider the United States and Canada, two countries lush with surpluses of varied, nutritious food, enough for multiple, different meals per day. The population growth rate of the States is 0.91%, while Canada's is 0.88%. India's is 1.38%, Rwanda's is 2.43%, Madagascar's is 3.03%… the list goes on, indicating that countries with limited food production have faster-growing populations than countries with surplus foods ("World Factbook") ("Vitamin A"). This appears to indicate that human population does not increase with food increases. Quinn notes this, using the character of B to ask where these people are coming from, what they are made of, if there is not enough food (Quinn 303). B does not pause to think that, when populations increase while food production decreases or stabilizes, the quantity of food allotted to each member decreases and overall health grows worse. If a human being needs a meal a day to survive, the standard United States daily food intake could be cut by a third per person per day, and the population could increase threefold without a food increase. Populations can increase even as resources decrease, compromising quality of health and standards, but not necessarily growth. When questioned, B replies again that the food has to come from somewhere, declining to answer where, precisely, it comes from – preferring to denigrate the question as 'magical' and unscientific (Quinn 305).

It is possible that Quinn is confusing human population behavior with an anecdotal mouse model; it was long thought that increasing food and space led to an increase in mouse population, just as Quinn cites in "The Story of B." Quinn uses this model to indicate that as long as food production to the starving increases, the human population will increase until food runs out and all systems, including the environment, crash.

However, a recent study showed that an increase in food does *not* lead to spiking of mouse populations, rendering the basis of his model questionable at best. "Food quantity and especially food quality are thought to be key factors driving reproductive changes in the house mouse, Mus domesticus, leading to outbreaks of house mouse populations…" a field study reports, concluding "Contrary to our prediction we did not observe food constraint affecting the reproduction of female mice" (Ylonen).

A conclusion to be drawn from these statements is that population growth is not necessarily regulated by food, although food is a limiting factor. Populations are complex systems that depend on several factors to change; an increase in food production in starving or flourishing countries does not predict population.

For every story of Golden Rice, there are two stories of multinationals like Monsanto using the power of genetic engineering to systematically remove the money from the pockets of struggling, impoverished farmers. This frustration resonates with the creepy knowledge that these multinationals have patented genomes and engineered seeds that self-destruct rather than allowing for replanting – with the farmers having no hope of ever holding these corporations accountable. These are crimes that people can never, and *should* never, forget.

However, if we destroyed good ideas simply because they were tainted by corruption, then we would have to do without things we have grown to enjoy, such as the Internet and democracy. Surely it would be a better action to place the burdens of education and decision on the shoulders of the people who are most affected by bioengineering of foods. Perhaps ethical decision-making should not be made by people who would make monetary profit from it – i.e., multinational corporations – because material desire

conflicts with neutral ethicality. Instead, the decision to accept bioengineered foods, such as Golden Rice, should ultimately belong to the people who will eat it.

A Buddhist perspective offers a middle-of-the-road approach to the genetic modification of food that, unlike every other source cited, manages to be empowering and slightly uplifting. “Some geneticists are well intentioned in their desire to use genetic engineering in altruistic ways. For example, in agriculture…. If there are some areas of genetic engineering that can safely benefit humanity while respecting other forms of life, then efforts need to be redoubled …in developing broad ethical guidelines,” says Dr. Ron Epstein. “Clearly the key is educating the public about what is happening. We need to have confidence that ordinary citizens working together can build a foundation of collective wisdom that can show us the way through the incredibly complicated maze of issues surrounding genetic engineering” (Epstein).

This seems to be the most appealing approach of those listed so far. Unlike the deep ecologists, who alienate others with their approach to starving humans in developing countries, Epstein acknowledges the duty that most people feel towards the welfare of other members of their species. This duty can manifest itself in wanting to altruistically engineer products – perhaps like Golden Rice – that will result in little monetary profit, but will enrich and improve the lives of hungry children. If, Epstein suggests, the motives behind bioengineering are intelligent, transparent, and pure, then bioengineering of food crops to benefit humanity would be an ethical action.

Genetic engineering is a process that has shadowed human development since the development of agriculture. It is a natural process, a form of evolution, skewed for human selection; the only thing that has changed is its sophistication. Now, bioengineered food

crops have the potential to reduce human suffering in poor countries with large populations and struggling economies; in particular, Golden Rice could reduce preventable Vitamin A Deficiency and blindness in hundreds of thousands of people. Sterba and anthropocentrists believe that genetically engineering Golden Rice to suit a basic human need is morally acceptable. Quinn and the deep ecologists feel that it is unacceptable to exploit living organisms in this way, and that it is unethical to continue to feed the poor, as that would only lead to population crashes and environmental harm. The latter part is, perhaps, scientifically unusable as an argument, but both sides of the debate have valid points. Finally, taking a cautiously conservative stance, Buddhists recognize the possible grace and inherent fallibility of bioengineering. Buddhists believe in preserving respect for life while reducing material human suffering, especially among the poor and innocent. The Buddhists recommend a thorough understanding of relevant principles and resulting ethical analysis, so the hungry can be fed without disturbing the integrity of the environment or the ethicality of the scientists. This solution seems a reasonable synthesis, as it combines respect for the environment with compassion for the urgency of human malnutrition.

It is, we must admit, rather brilliant of humanity to figure out genetic engineering. It is a dangerous and important power, and it required intelligence and curiosity to develop. Hopefully, these qualities will continue to manifest themselves in finding reasonable, ethical ways to reconcile the bioengineering of food crops with human populations and economies, as well as that all-important natural selector, Nature.[1]

[1] With maybe a bit of abominating just for fun?

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