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Jonathan Okeke Chimakonam Ph.D.
University of Calabar, jonathansphilosophy@gmail.com

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TERMINATOR TECHNOLOGY: APPRAISING BIOTECHNOLOGISTS' CLAIM TO FEED THE WORLD

Jonathan Okeke Chimakonam, Ph.D.
Department of Philosophy
University of Calabar
Calabar Nigeria
P.M.B 1115
jonathansphilosophy@gmail.com

Abstract

This paper has shown that the *feed the world* argument as the main justification for the application of biotechnology/genetic engineering to the mainstream of agriculture has collapsed vis-à-vis the "terminator" or the "traitor" technology. Financial gain has also been established as the main motive for the promoters of this technology. In doing this, we have raised health and ethical concerns because it has been shown among others that applying GM on food crop production could have unforeseen health consequences. This we argued out-weighs financial benefits and called for caution and censorship in the application of biotechnology to food crop production.

Keywords: Terminator Technology, Biotechnology, Feed The World Argument, GM Foods, Ethics, Health, and Agribusiness

Introduction

The definition of biotechnology varies, but a simple definition according to Biotechnology Institute is the use of living organisms by humans (Web. n.p). This use could extend to different areas of life and the society example agriculture and food crop production which is the focus of this work. It goes by other names such as genetic engineering. The promoters of genetically engineered crops compare the new technology to the so-called Green Revolution that began in the 1960's. That revolution effectively increased agricultural productivity in many developing nations by providing farmers with new crop varieties, pesticides and fertilizers. Yet, despite those advances, the World Bank Malnutrition statistics (1997) show that more than 800 million people around the world still go hungry each day, and half of them are severely malnourished. Meanwhile the world population continues to grow. The UN in a world population report (2004) has estimated that the global population will cross 8 billion by 2025. This suggests that something urgent and more drastic would have to be done to forestall global food crises.

In addition, a 1997 World Bank report found that the per capita acreage of cultivated land supporting food production dropped by almost 50 percent between 1961 and 1997. The report also suggests that this figure is expected to fall by another 40 percent by the year 2050(worldbank.org/news/resources/report-en). Similarly, a 2007 UN report on water shortage has it that by 2025 some 3 billion people in 52 nations about 40 percent of the projected global population will face chronic water shortage. This obviously makes the impending problem more conspicuous if not more disturbing and the question is; what is the way forward?

Certainly, it is easier to see now that these new challenges require a second green Revolution, promoters say. However, it looks unlikely that pesticides and fertilizers, which have heavy environmental costs, will suffice this time. Instead, the key to this second

revolution will be new plant varieties, genetically engineered to produce their own pesticides and to have higher yields, increased drought tolerance, better nutritional quality, and other valued traits. In this way, a 1999 FAO report has it that "biotechnology, together with other technologies could provide new solutions for some of the old problems hindering sustainable rural development and achievement of food security. But does this unexamined and audacious hope actually reflect reality today; especially when we take time to consider the successes or failures of this technology over the last decade in its nonguaranteed claims? Perhaps our modest assessment should take recourse to an ongoing drama of vigorous promises and campaigns as well as continuously fading hopes.

However, few years into this revolution, a few indices have popped up to suggest that the dream of feeding the world's ever growing population may yet end up as a nightmare. Not only do we rue unrealized promises but possible health risks associated with genetically modified food, fears of creating super weeds from the effects of super herbicides like "round up", possibility of creating superbugs and genetic pollution of environment which altogether can affect food production negatively. And finally, the emergence of "terminator" and "traitor" technologies which have the potential to destroy from one end, what the promoters of this technology claim they build from another end. In this paper, an attempt will be made to appraise the significance of these negating factors especially the terminator technology syndrome vis-à-vis the claims.

A Brief Story of Terminator Technology

On the 3rd of March 1998, the US Department of Agriculture and cotton seed breeder, Delta and Pine Land Company was said to have acquired US patent 5,723,765 for what they call "technology protection system" (TPS). This is a system for genetically engineering a suicide mechanism into seeds of the next generation. It was dubbed the "terminator technology" to the dismay of the patent owners by "Rural Advancement Foundation

International (RAFI). The patented processes will be used by seed companies to prevent farmers from saving seeds to plant the following year. The strategy behind the patent is to kill only the embryos but leaving other essential seed nutrients intact.

The Transgenic Crops update of 1999 shows that this technology could be applied in a number of ways, but in general, it involves three steps:

1. Scientists add terminator genes to a crop.
2. The seed company initiates the terminator process before selling the seeds by adding an inducer.
3. Farmers plant seeds, grow plants and harvest mature, but sterile seeds.

The technology's success has been said to depend on a cleverly controlled sequence of interactions among the spliced – in genes. The last engineered gene comes into play very late in seed development when a special switch under the control of the inducer (a chemicalized process) turns on the gene causing it to produce toxin. The toxin kills the embryo that is part of each mature seed. This technology has three genes with their on/off switches. Before selling to farmers, a seed company treats the seeds with a chemical inducer to initiate the terminator gene interactions. Although, the patent covers a number of ways the genes might interact, below is a description of one way the technology could work.

Terminator genes in the absence of the inducer	Terminator genes in the presence of the inducer
Gene 1: Repressor	
A repressor gene produces repressor protein	The same repressor protein is produce
Gene II: Recombinase	

A recombinase gene is controlled by a promoter. Between the promoter and the recombinase gene, scientists place a DNA fragment which is a binding site for the repressor from Gene 1.

In the absence of the inducer the repressor binds to the binding site and the plant cannot produce the recombinase protein and enzyme that snips out pieces of DNA	The inducer interferes with the repressor attachment to binding site – thus allowing Gene II to produce recombinase

GENE III: TOXIN

A gene for a toxin lethal to embryos (Toxin Gene) is controlled by a late promoter (LP) that is active only during the late stages of seed development when the embryo is developing. Between the late promoter and the toxin gene, scientists place a piece of DNA called a blocker, which interferes with the ability of the promoter to turn on the gene.

Without the inducer, there is no recombinase to snip out the blocker. With the blocker in place no toxin is produced. Thus, by withholding the inducer, seed companies can produce generations of viable seeds.	Recombinase from Gene II snips out the blocker and allows the late promoter to turn on production of the toxin gene late in the seed.
	LP – Blocker – Toxin Gene
	↓ ↓
	↓ Blocker (cut out by recombinase)
	LP – Toxin Gene
	↓
	↓
	Toxin is produced and kills the embryo before the mature seeds are harvested

Source: - http://filebox.vt.edu/cals/cses/changedor/terminator.html

However, the engineering of foreign DNAs into a crop or an organism is done artificially. This requires attaching the gene to a virus or just physically inserting the extra DNA into the nucleus of the intended host with a very small syringe or with very small particles fired from a gene gun (Johnston, 352: Steinbrecher, 9). Other methods exploit natural forms of gene transfer, such as the ability of agrobacterium to transfer genetic material to plants (Lee, 325: Wiess, Encarta yearbook, Microsoft.com) or the ability of lent viruses to transfer genes to animal cells (Park, 159). On the whole terminator technology represents the biotechnologist's disgust for mankind and great love for wealth. This renders his claim to feed the world not only illogical but immoral. This is because it is difficult to

reconcile the conscience of the biotechnologist who yearns to feed the world and the one who created the terminator technology; either one of the conjuncts truly holds and we might as well assume the latter given the circumstances.

Appraising the Claims vis-à-vis Terminator Technology

There are claims from 1994 when the first light was seen on the horizon that biotechnology or genetic engineering could be applied in the mainstream of agriculture. Crops could be engineered for traits that improve production values, including higher yield and quality. They could be engineered to fight off pests, diseases and even become draught resistant. Nutritional genes could be added to crops to increase levels of healthy fats, oils, key vitamins and other nutrients. One prominent example is the golden rice engineered to contain three extra genes that allow the rice to make beta carotene, which the body converts to vitamin A. According to Holcberg (Web. n.p) as well as WHO 2009 report on nutrition vitamin A deficiency for instance affects 250 million children globally and is the world's leading cause of blindness not to mention other diseases. Hence, it is argued by promoters that biotechnology is mankind's lifeline out of impending food and health crises. However, one is meant to wonder whether the problem is actually as big as it has been made to appear or whether some technology capitalists are at some selfish game of creating a lifetime stream of huge income. This is because; given the huge financial stakes involved; it is understandable that all the strings are being pulled in this battle to control food production. This is what David Shenk calls "Biocapitalism" (Web. n.p). These Biocapitalists do everything they can think of to promote this technology including recruiting writers, ethicists, PR companies to mention just a few. In a document which was leaked to the press in August 1997, Burston Marsteller a PR Company according to David Shenk advised the biotech companies "that they cannot hope to win the arguments over the risks posed by genetically modified food, including environmental dangers (Web. n.p). The biotech companies were

advised to focus on "symbols", not logic. These symbols would elicit hope, curiosity, and sense of caring and so on. We can therefore see that there is more to this super seed game than met the eyes. On this ground, one is cleared to wonder whether the biotechnologist is a hero or a villain; and whether the technology itself is actually a lifeline or a knotted noose especially with terminator technology acting as farmers' task master.

Obviously, this *feed the world* argument is being peddled by promoters of biotechnology today for their own selfish gains. In reality famine and hunger around the world have more to do with the absence of land reform, social inequality, biases against women in many cultures, lack of access to cheap credit and basic technologies, rather than a lack of agribusiness super seeds. This was recognized in the World Food Summit held in Rome in November 1996 according to WHO report of 1996. People are hungry because they do not have access to food production processes or the money to buy food. Genuine efforts to banish hunger should address those social and economic inequalities which create poverty and not pretend that a 'magic' technology will solve all the problems. It is clear to all that Agribusiness companies will not distribute genetically engineered food free to the hungry poor who have no money to buy them. Thus from the foregoing, it is also clear that the motivation for producing genetically engineered organisms is simply the desire by agribusiness corporations to make more profits and not to feed the hungry world.

Evidently, the development of the terminator gene which, can switch off a plant's ability to reproduce thereby, rendering the next generation seeds sterile points to the spurious nature of the feed the world argument. According to Kissam (Web. n.p) Rural Advancement Foundation International (RAFI) reports that over 85% of farmers worldwide rely on "brown-bagging" (seed collection) and cannot afford the expense of buying seeds every new season. Surely, in an agribusiness world where farmers can no longer collect seeds for replanting, only the worst can be imagined.

Obviously, the "terminator technology" would end up driving the cost of food higher thereby not only making food less available for the world's hungry population but defeating the "feed the world" argument. If farmers cannot collect seeds for replanting; if they have to spend huge sums of money in purchasing new seeds every season then in line with logic of economics, farmers will spend more. And because of these extra expenses the consumers would have to spend even more. How then, can the hope of feeding the world with this "magic" technology be reached?

Furthermore, this terminator technology could be used to create plants whose desirable traits would be switched on only by the application of some specific chemicals. Farmers will have to buy seeds and the chemicals that go with them. But what could be more logical for companies than to put the required chemicals in its own herbicides or pesticide? Astra-Zeneca's patent WO973983 for instance is said to cover a system which creates GE plants that require continuous exposure to a chemical for germination and healthy growth (Primalseeds n.p). GE companies therefore aim to strengthen the link between seeds and chemicals and extort further money from farmers. For the promoters of genetic engineering as an option against hunger, this is ethically untenable. When GE companies produce seed that contains multiple GE traits, farmers in turn, will be required to buy chemicals that will activate each specific trait. (Nature n.p). This could be exorbitant. The technology will be betraying in a high degree the people it claims to save. No wonder RAFI describes this as a "traitor technology" (Rafi n.p). With the emergence of terminator technology there is no gainsaying the fact the technology purportedly on a rescue mission has turned into a traitor with intent at impoverishing those it claimed to care for.

Further Health and Ethical Concerns

Third, the argument whether genetic engineering has failed in its claim to feed the world is as important as the health hazards that may be posed by the consumption of

unscreened genetic materials and the exposure of the environment to genetic pollution. Steinbrecher write that:

> Transgenes transferred into the wider environment cannot be tracked down and simply recalled to the laboratory. A ripple effect on other species will take place, even if it cannot be predicted when such an effect will occur, to what extent, or in which species. (33)

What Steinbrecher tries to highlight is the potentiality for a possible genetic meltdown. Humanity exist in a network by their common biological relationship and interconnection, as a result, any serious health hazard that falls out of this genetic game would translate easily to an epidemic or which is worse, a pandemic. Serious concerns have also been shown in this regard in that most of the foreign DNA components are extracted from disease causing organisms and spliced into our food crops. This use of genetically modified organisms has sparked significant controversy in many areas and the safety of GMO in the food chain has been questioned by some environmental groups, with concerns such as the possibilities that GMOs could introduce new allergens into foods, or contribute to the spread of antibiotic resistance (Bakshi, 211). Although all studies conducted to date have shown no adverse health effects resulting from eating genetically modified foods, (Key, Ma and Drake, 290) environmental groups still discourage consumption on the basis of possible long term effect, claiming that GM foods are unnatural and therefore unsafe (Asia News, 1614). Such concerns now call for safety testing of any new organism produced for human consumption (Konig, Cockburn, Crevel and others, 1047). But Mae Wan Ho a famous geneticist has cautioned that:

> The large-scale release of transgenic organisms is much worse than nuclear weapons or radioactive nuclear wastes, as genes can replicate indefinitely, spread and recombine
>
> (210).

The message Wan Ho and other opponents wish to put across is that measures stronger than mere safety testing is required if research geared towards the application of this technology to food crop production is to be allowed to proceed. This is because genes are not like ordinary bacteria which are hosted in test tubes. The kernel of this argument is that genes are now made to be part of human food chain which for all the intricacies of compatibility is obviously dangerous.

Research has shown that the GE corporations show little or no concern for human life and are overly focused on financial gain (Wan Ho 5). Ethics therefore comes in here, for should money be placed above the value of human life? According to Okeke, "how can we justify a technology that feeds the world with genetically modified food with unknown consequences? Tomato with DNA of say, scorpion; apple with DNA of say, lion and so on What about milk gotten from the Friesian and Holstein cows which probably may not have more than 1per cent resemblance to natural cow and genetically modified with the DNA of dangerous animals like panda" (Okeke, 18). Research has also shown that it is possible for a DNA consumed by an organism to survive in the digestive system and consequently invade other cells. A typical example is that discovered by scientists at Cologne University in 1998 where the DNA that was fed to a mouse survived in the digestive system and subsequently invaded other cells in the mouse's body (Web. n.p). Therefore, what Wan Ho tries to establish is that humanity has been misled into accepting GM foods which among other things could have tremendous health consequences by insincere GM industry operatives whose unwavering goal remains profit making. These capitalists go to any length to convince

ignorant consumers with most times over bloated claims and promises and remand them in the custody of their PR gimmicks by constantly adjusting and justifying their claims.

As this *feed the world* argument collapses, the justification for genetically engineered foods collapses as well. Thus, the continuation of this technology calls for ethical evaluation. What the agribusiness corporations are doing presently is damage control and an attempt to keep the hopeless hope alive in order to keep the tap of financial gain running. Mae Wan Ho has well stated that "it is clear that everyone is in it for the money. The risk can be dismissed by appealing to the benefits and when the benefits are not forthcoming; the promises have to be kept alive" (5).

Indeed, the question is no longer about the wonders of genetic engineering, it is not even the claim that it will feed the starving world, help eliminate diseases and so on, but at what price? It is all too easy to get carried away by the promises and forget the risks. Some activists have argued and correctly too that the risks are great, all the greater as they are unquantifiable and thus far outweigh the benefits, many of which have been shown to be illusory. Others say that Geneticists are experimenting with the substance of life, and the ultimate price could be life itself. It violates the integrity of life itself and our deepest sense of morality to claim what we know to be false or dangerous. Ethics therefore stand against its blind practice in two ways namely; it poses unknown dangers to human health and it is immoral to endanger human lives just to make some money with a huge cover-up plays of lies and deception.

Conclusion

As observed from the outset of this paper, it is the overall claim in the scientific community that genetic engineering, whether it deals with medical applications or with agricultural production, offers some of the greatest opportunities for mankind to make

breakthroughs in areas that will greatly enhance the quality of health and life. However, because of the magnitude of the changes that are being implemented through the new science of genetic engineering, there are *unknowns* which pose risks for humans' health and human environments. The risk benefit analysis clearly does not favor the promoters of this technology. Their claims overtime have turned out to be mere farce and unrealizable. And the use of genetic components of organisms in human food crops is no less hideous as the insertion of human genes into non-human organisms to create new life forms. New ethical questions therefore arise: what percentage of human genes does an organism have to contain before it is considered human? For instance, according to Epstein, "how many human genes would a green pepper have to contain before you would have qualms about eating it? (Web. n.p)." He goes ahead to note that these are not mere speculative questions because the Chinese are now putting human genes into tomatoes and peppers to make them grow faster. So we can now be vegetarians and cannibals at the same time. The fact remains that it is unthinkable if not utterly despicable to acknowledge that all these health risks are generated from an inhumane and insincere quest to make outrageous profit in the agribusiness. Yet this has been established in many research publications with little doubt left to be dispersed. This portrays the *feed the world* argument by the promoters of biotechnology or the GM crops as highly unsubstantiated.

I have argued in this paper that the *feed the world* argument as a justification for this technology has collapsed. And I have exposed "financial gain" as the real motive in the minds of the technologies promoters. This paper however, does not stand in principle against genetic engineering, but recognizes that it is a new and exceptionally intrusive technology with the power to re-fashion the natural order of the world and humanity itself. This alone raises health and ethical concerns and calls for serious censorship in the application of this technology.

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