

FOOD TRANSFORMATION TECHNOLOGY IN PAOLO BACIGALUPI'S *THE WINDUP GIRL* AND WHAT IT MEANS FOR US

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Abstract

This article argues that a stage in history has come where advanced technology, especially that of genetically engineered foods and animals, is quickening the humankind's downfall. Bacigalupi represents this well in *The Windup Girl*, a futuristic novel that looks with great focus at the transformation of food and animals in the twenty-third century. In our own world, climate change is creating urgent food issues. Genetically Modified Organism (GMO) technologies, having been initially introduced to overcome dire food shortages, have turned out to have many negative side effects, both in our own world and in the fictional world of *The Windup Girl*. More problematic are the unknown dangers of food transformation technologies. These technologies are driven by multinational corporations both in the real and fictional worlds, and Bacigalupi suggests that the current trajectories of our food transformation industries and their technologies could lead to the demise of human civilization.

Keywords

food transformation technology; GMO, The Wind-Up Girl, climate change, Paolo Bacigalupi

About the Author

Dr. Young-hyun Lee's current research is within ecocriticism and the environmental humanities. Lee has published and lectured on issues of concern such as the controversies surrounding Genetically Modified Organisms (GMOs) and GM foods, food ethics, and translation studies. Her publications of translated books include *Do You Know the "Comfort Women" of the Imperial Japanese Military?* (2017), and *나의 첫여름* (*My First Summer in Sierra*), which Lee co-translated with Won-Chung Kim in 2008. Lee currently holds a one-year research award from the National Research Foundation of Korea at Kangwon University and teaches translation studies and English prose as a lecturer at Sungkyunkwan University in Seoul.

Paolo Bacigalupi's *The Windup Girl*, a novel named as one of the best fictions of 2009 by *TIME* magazine (Grossman), deals with technology and the challenges it poses for human food sources. The human pursuit of comfort and convenience finds a zenith of expression in the novel. Set in twenty-third century Thailand, the novel presents the results of our own anthropocentric civilization and the view that nature is a mere resource. The effect of our ecophobia¹ is the destruction of the environment and the depletion of resources. In this critical situation, such multinational companies as AgriGen and PurCal in *The Windup Girl* ship their seeds at exorbitant rates, and the Thai Kingdom is persuaded of the "merits" of food transformation technology in ways that mirror what is happening with today's small farmers. The patriotic implications of the "generippers" and their use of technology in the novel are also deeply relevant, as I will discuss below, to contemporary multinational agri-politics. Tragic incidents ensue in *The Windup Girl* from the use of genetically engineered crops, and factory workers die from epidemics, a situation that looks startlingly similar to suicide patterns of contemporary Indian farmers following failures of genetically engineered crops. More problematic are the unknown dangers of food transformation technology by these profit-driven companies, fictional and real. The epilogue of the novel, a dialogue of two genetically engineered people and a "generipper" left in an already inundated city, implies the demise of human civilization that will result from the avarice of food transformation industries and their technologies. Although technology has helped humanity in many ways, we have come to a stage where advanced technology—especially that of genetically engineered foods and animals—is quickening our downfall, as Bacigalupi represents in *The Windup Girl*, which looks with great focus at the transformation of food and animals in the twenty-third century.

The genetic engineering technologies in *The Windup Girl* are ethically problematic. We see this most of all in the scenes with Emiko, a cyborg initially made to gratify men's carnal appetites, but ends up being sold to a club owner after having been forsaken by her Japanese owner for economic reasons. The ethics of food transformation technology today requires attention, since these technologies will exert more enormous influence over all living beings in the future. *The Windup Girl* is a warning. The ethical issues of the fictional future are also ethical issues of the nonfictional present.

In our nonfictional present, the Genetically Modified Organism Exploratory Committee in the US raised ethical issues in the "Executive Summary from the Genetically Modified Organism Exploratory Committee." It explained the ethical aspects of GMO technology because "[the] use of genetically modified organisms is a practice still in its infancy. The long-term effects of this technology are yet to be seen" (Bates). The committee especially emphasized the probable effects of GMOs on "herbicide use and resistance" and "untargeted species" on the environment and

on human health. Bacigalupi taps into these ethical issues by representing the plight of Emiko. The novel focuses on ethically problematic aspects of transformation technologies by representing Emiko as a genetically engineered woman with problems—she gets hot very quickly, is weak, and so on.

Although Emiko is engineered not as food but as a kind of a sex slave, she no doubt reminds the readers of one of the sex slaves called “comfort women”² in the Japanese imperialist era. “Men cheer at Emiko’s degradation,” the narrator explains: “To the men: ‘She likes it. All these dirty windups like it.’ More laughter” (Bacigalupi 241). She is constantly subjected to humiliating treatment and regarded as an object of trade.

Another ethical issue that Bacigalupi raises in this novel is that technology makes the characters blind to the enslavement and abuse of genetically engineered animals. Transformed animals, such as “megodonts” (genetically engineered elephantine animals) in the kink-spring factory³ run by Anderson Lake, are forced to work in almost unbearable heat. Similarly, Emiko has to sexually entertain men customers under Kanika’s supervision every night in a club and must endure the humiliation. Emiko, simply put, is to be consumed by men as animals are to be consumed by human beings.⁴ The animals and laborers working for the factory are habitually abused and are forced to endure extremely harsh working conditions:

The roar of manufacturing envelops Anderson as he enters the factory, drowning out the last despairing howl of Yates’ optimism.

Megodonts groan against spindle cranks, their enormous heads hanging low, prehensile trunks scraping the ground as they tread slow circles around power spindles. The genehacked animals comprise the living heart of the factory’s drive system, providing energy for conveyor lines and venting fans and manufacturing machinery. Their harnesses clank rhythmically as they strain forward. Union handlers in red and gold walk beside their charges, calling out to the beasts, switching them occasionally, encouraging the elephant-derived animals to greater labor. (Bacigalupi 9)

Yates⁵ is optimistic about the possibility that technology could lead humanity to “[a] new Expansion! Dirigibles, next-gen kink-springs, fair trade winds” (Bacigalupi 62). “[Those] subjections, the ecophobia, the speciesism, the racism” as indicated, are “the ethical *sine qua non* of the world food economy” in one of the chapters of *The Ecophobia Hypothesis*, where Simon Estok explores “the ways in which contemporary western food production mechanisms rely on very socially and environmentally dangerous ethics” (94). Thus, few would deny that enslavement of genetically engineered women and animals represented by Bacigalupi is one of the most urgent issues to attend to in the near future.

As the kink-spring factory run by Anderson abuses and kills the workers and the megodonts, hi-tech industries such as food transformation production companies show little interest in human or animal welfare and care more about their profit margins. In the situations where the factory workers are dying because of epidemics, Hock Sung, a middle manager for the factory, tries to come up with ways of how he can sneak the bodies out and throw them away secretly. Self-interest is rampant in this novel, and it is such an inability to see the importance of compassion for others that is so potent a warning in this novel. Mai,⁶ for example, also is worried only about herself because she has no other way to support herself with the factory being closed. Mai and Hock Sung know well that Anderson would shut down the factory because the workers are dying. Mai, worried about losing her job, begs Hock Sung: "I don't want to lose the job. . . . Please don't tell the farang. Everyone knows the farang might close the factory. Please. My family needs. . . ." (Bacigalupi 153). Profit and compassion seem incompatible.

Contemporary agribusiness pursuits of unfettered GMO production are clearly important problems today, and the current trajectory of these problems could easily lead to the nightmares pictured in *The Windup Girl*. The novel offers dire warnings for contemporary society. Richard Caplan, an environmental advocate for a US Public Interest Research Group (PIRG), argues why genetically engineered food ingredients or crops should be banned. In "Antibiotic Resistance and Genetically Engineered Plants," he explains how dangerous the methods and unpredictable the results are: "The process of inserting a gene of interest into a plant is," Caplan notes, "crude, haphazard, and random." Among the two methods⁷ of gene insertion which are usually used, "neither [one] is precise, as both methods provide no guarantee where the gene will land in the host organism, or even whether the gene of interest has been inserted into the host organism at all." Such a tendency of disregard for potential dangers worsens when it comes to GMO companies.

Food transformation technologies regard living entities as properties or commodities, and this can bring about catastrophic and fatal consequences. While it is true that we have a long history of selective breeding, genetic modification is a very different matter. The motive for making genetically engineered animals might sound innocent and benevolent, but the results are irrevocable, as Bacigalupi shows:

Hock Seng has heard that cheshires were supposedly created by a calorie executive—some PurCal or AgriGen man, most likely. . . when the little princess turned as old as Lewis Carroll's Alice. The child guests took their new pets home where they mated with natural felines, and within twenty years, the devil cats were on every continent and *Felis domesticus* was gone from the face of the world, replaced by a genetic string that bred true ninety-eight percent of the time. (27)

Genetic engineering, however, is far from innocent, and the possibilities of violent effects are very real. Indian environmental activist and anti-globalization author Vandana Shiva points out in *Biopiracy: The Plunder of Nature and Knowledge* some of the possible violence which genetically engineering technologies could have: “first, life-forms are treated as if they are mere machines, thus denying their self-organizing capacity. Second, by allowing the patenting of future generations of plants and animals, the self-reproducing capacity of living organisms is denied” (55). The intellectual properties and patents the GMO companies claim, whether businesses call them “biotechnological inventions,” “gene constructs,” or “products of the mind,” are a flat denial of the self-organizing capacity of living organisms. Carsten T. Charlesworth, et al., in a scientific article entitled “Identification of Pre-Existing Adaptive Immunity to Cas9 Proteins in Humans,” confirms the danger of GMO technologies, using data demonstrating that the immune systems of genetically modified animals (including clones) are severely compromised. Shiva, although not a scientist, understands how violent and unpredictable genetic modification can be. Jurassic Park technology is dangerous. Bringing back species is uncharted territory. Films make it look appealing. Even respected authors such as Diane Ackerman explains joyfully that extinct species may “haunt the earth again” because of our genetic manipulations (162). The Svalbard Global Seed Vault is all about using such technologies to bring back extinct sources of food.

The restoration of extinct plants and animals advertised as a prodigious achievement in *The Windup Girl* is a dangerous transformation of life. The ideas trumpeted by GMO companies are totally opposite to their actual practices in the novel. There are generippers hacking into designs for TotalNutrient Wheat and SoyPRO, and it is all about money and profit. It resembles Monsanto today and their Roundup Ready Soybean advertisements. One of the representative justifications most GM companies set forth for introducing genetically engineered crops in agriculture is “increasing yields.” The reality, however, is that “genetic engineering is actually leading to a “yield drag.” On the basis of 8,200 university-based soybean trials in 1998, it was found that the top Roundup Ready soybean varieties had 4.6 bushels per acre, or yields 6.7 percent lower than the top conventional varieties” (Shiva, *Stolen Harvest* 113). There are countless examples of farmers who ended up ruining their farms after investing in the genetically engineered seeds, believing the false promises of increased agricultural production. We have good cause to distrust food transformation technologies.

This distrust is well represented in *The Windup Girl*. When Anderson, indicating fruit in a market, asks the merchant whether or not it is safe, the woman shows him Environment Ministry certificates to prove that the genetically engineered fruit is the latest variation and is first-rate. Far from trusting the science, Anderson views the new fruit with skepticism and thinks that the merchant must have bribed

officials for certificates: “rather than going through the full inspection process that would have guaranteed immunity to eighth generation blister rust. . . The cynical part of him supposes that it hardly matters. The intricate stamps that glitter in the sun are more talismanic than functional, something to make people feel secure in a dangerous world” (Bacigalupi 5). Anderson knows that these certificates would do nothing if an epidemic broke out again because “it will be a new variation, and all the old tests will be useless, and then people will pray to their Phra Seub amulets and King Rama XII images and make offerings at the City Pillar Shrine” (5). We see here a desperate situation in which people rely on superstition once an epidemic occurs. Shiva warns against the kinds of risks the novel represents:

Converting . . . “weeds” into “superweeds” that carry the gene for herbicide-resistance would provoke high crop losses and increasing use of herbicides. . . . In many cases, the weeds that plague cultivated crops are relatives of the crops themselves. Wild beets have been a major problem in European sugar-beet cultivation since the 1970s. Given the gene exchange between weedy beets and cultivated beets, herbicide-resistant sugar beets could only be a temporary solution.

Superweeds could lead to “bioinvasions,” displacing local diversity and taking over entire ecosystems. (*Stolen Harvest* 105)

As more and more damage from invasive species occurs around the world, the threat to biodiversity from GM tampering is increasingly clear.

In a society full of distrust in technologies, such as the one represented in *The Windup Girl*, people come to realize that advanced technologies cannot protect them from either evil or injury. The merchants’ behavior and remarks reveal this in the novel, and this should serve as a warning to us today. GMO corporations are more concerned these days about shutting off fears over their products than producing safe food, according to the following news report on how much biotech companies spend on “ads ... keyed to show that biotech foods cut the use of chemical pesticides, provide more nutritious food and can help end world hunger by lowering costs. The campaign includes slick educational materials that are being distributed to dietitians, nutritionists, cooperative extension agents and key opinion leaders” (Goodman). In *The Windup Girl*, faith in this kind of sponsored data has clearly run out, and the fruit merchants have more faith in amulets or prayer rather than in what purports to be scientific data. Measures for prevention of infectious diseases often simply do not work, and distrust quickly becomes endemic in the novel.

As Anderson’s transactions show, GMO companies in the novel maintain and expand their power and positions through secret connections and closed-door arrangements with politicians and government ministers, arrangements that are

nothing short of corruption. This is not far from what happens in real life. William Engdahl makes it clear in *Seeds of Destruction: The Hidden Agenda of Genetic Manipulation* how multinational GMO companies pursue their goals in collusion with government officials: “[the] complicity of essential US Government agencies, legally and nominally responsible for ensuring public health and safety of the general population, was a decisive part of the GMO revolution” (226). *The New York Times* ran an article on January 25, 2001 about how Monsanto took control over its own regulatory industry, through the Environmental Protection Agency (EPA), the Department of Agriculture, and the Food and Drug Administration (FDA). The article quoted Dr. Henry Miller, who had a leading role in biotechnology issues at the FDA from 1979 to 1994: “In this area, the U.S. government agencies have done exactly what big agribusiness has asked them to do and told them to do” (Eichenwald). In *The Windup Girl*, while foreign companies “[speak] so casually about changing pollution credit systems, of removing quarantine inspections, of streamlining everything that has kept the Kingdom alive as other countries have collapsed” (49), the incorruptible Environment Minister Jaidee alone tries to break the chain of corruption in the city.

The Windup Girl offers disturbing examples of how politicians and multinational GMO industries collude and ignore underprivileged species and classes when they enact regulations and laws in support of intellectual property rights. The international laws and measures supporting globalization are both speciesist and classist, benefitting a handful of multinational corporations, classes, and nations. For this reason, environmental justice and food justice are more crucial than ever. Shiva, as an active advocate of food sovereignty and anti-globalization, has argued about the unjustness of intellectual property rights and patents over living organisms. These laws and regulations have reorganized relationships, not only between the human species and other species, but also within the human community. Arguing that “[instead] of the culture of the seed’s reciprocity, mutuality, permanence, and exhaustless fertility, corporations are redefining the culture of the seed to be about piracy, predation, the termination of fertility, and the engineering of sterility,” Shiva makes it plain how dangerous the laws and measures are that protect the powerful corporations (*Stolen Harvest* 90).

Food transformation technologies are increasingly based on intellectual property rights and patents and show a collusion between the multinational GMO companies and high government officials. These technologies allow for the plundering of resources from small-scale farmers and the Global South. *The Windup Girl* is set in an era when human civilization has depleted natural resources, and most people suffer from fuel shortages. The powerful and the wealthy still do not care about people’s hardships. Bacigalupi describes Dog Fucker’s⁸ response to Hock Seng’s astonishment at a gas-guzzling car that has come to pick him up:

“What’s the matter? You’ve never seen a car before?” Hock Seng stifles an urge to slap the man for his arrogance and stupidity. . . . “Is it coal diesel?” Hock Seng asks. He can’t help whispering. Dog Fucker grins. “The boss does so much for the carbon load. . .” He shrugs. “This is a small extravagance.” “But the cost. . .” (126)

Hock Seng finds it “an extraordinary waste,” and he interprets it “a testament to the Dung Lord’s monopolies” (126).

Unlike the extravagant lifestyle of the upper class, the laborers at AgriGen have a hard time enduring harsh conditions. Though the factory is a subsidiary of a lucrative multinational GMO company, it is a site of sheer adversity. The novel represents the worsening working conditions caused by global warming: “[the worker] wipes sweat off his face. The factory is hotter than a rice pot. With all the megadonts led back to their stables, there is nothing to drive the factory’s lines or charge the fans that circulate air through the building. Wet heat and death stench swaddle them like a blanket” (Bacigalupi 23). Unlike the civilized and comfortable lifestyle of the privileged class, the factory workers have to continuously go through various hardships to overcome hot weather. The multinational GMO companies in the novel claim that whenever they launch a new genetically modified product, it will address hunger or that human beings will be liberated from hard labor or that the product will contribute to the creation of a more affluent and leisurely human society.⁹ Contemporary agribusinesses claim that the gap between the privileged and the underprivileged will lessen and that society will become more democratic and egalitarian.

Such a technologically advanced society as one in *The Windup Girl*, which tends to resolve problems and issues solely through scientific technologies, does not care for what looks small and trivial—including lower classes and other species. In the spatial background of *The Windup Girl*, nature is merely a source of raw material for human civilization. Algae are used as ingredients for producing batteries in Anderson’s kink-spring factory. When some of the workers are ill, Hock Seng is concerned because it could be the precursor of an epidemic, which would mean the closure of the factory. He does not want to believe that an epidemic could happen: “It couldn’t be cibiscosis? Blister rust? No.’ [Hock Seng] shakes his head. . . . [He] flinches away, fighting an urge to wipe his hands on his shirt. . . . Hock Seng’s skin crawls. Two bodies. . . .” (Bacigalupi 154). Even though Hock Seng does not seem to care about the lives of the workers at all, no one can live without the other beings. Life is defined by interdependence. As implied in American novelist Jonathan Safran Foer’s aphoristic remark, “stories about food are stories about us—our history and our values” (9). Greed for short-term profits causes industry to overlook long-term problems.

An ecological point of view is more beneficial in the long run than an industrial point of view. In *The Windup Girl*, “blister rust and genehack weevil [sweep] the globe” (142) in the vulnerable farming conditions produced by over-use and exploitation. Monocropping produces vulnerabilities; diversity produces strength. Shiva explains that “[when] multidimensional, diverse systems are perceived in their entirety, they are found to have high productivity. Their low productivity is a product of an approach that evaluates and assesses within in a one-dimensional framework, which is, in turn, related to an instrumental worldview” (*Biopiracy* 124). In *The Windup Girl*, Bangkok, having tried to survive climate change using advanced technologies of food transformation, is destined to be inundated. In the epilogue, Bacigalupi represents the last days of the capital city of the kingdom:

[Then] the monsoons came and the last attempts at holding back the ocean were abandoned. Rain gushed down, a vast deluge sweeping out dust and debris, sending every bit of the city swirling and rising. People swarmed from their homes with their belongings on their heads. The city slowly filled with water, becoming a vast lake lapping around second-story windows. On the sixth day, her Royal Majesty the Child Queen announces the abandonment of the divine city. (336)

As the fall of the city implies, the abuse of any member of an ecological community may well lead to a domino effect. Seemingly disparate things could turn out to be closely connected. The ecological thought, as Timothy Morton puts it distinctively using his own concept of “strange strangers,” “is interconnectedness in the fullest and deepest sense” (7):

The ecological thought imagines interconnectedness, which I call *the mesh*. Who or what is interconnected with what or with whom? The mesh of interconnected things is vast, perhaps immeasurably so. (15)

Bacigalupi represents what happens when this mesh is jiggled. Human civilization will succumb to the power of nature.

After all the worsening problems caused by GMO technologies, people find themselves stuck in a vicious cycle in the novel. Trade Minister Akkarat (who rose to power after Environment Minister Jaidee Rojjanasukchai’s fall from grace) explains to his replacement, Kanya, that “[the foreigners] are the ones who will be going to the seedbank . . . They only want samples. Genetic diversity for their generipping. The Kingdom will benefit as well” (Bacigalupi 329). Thus, the independent city led by Akkarat collapses. He has been in covert transactions with foreign agents for food transformation companies. These agents speak casually about “changing pollution credit systems, of removing quarantine inspections, of streamlining everything

that has kept the [Thai] Kingdom alive as other countries have collapsed” (49). The new normal are absolutely unprecedented.

Climate change is an unprecedented reality in our world today and in the setting of *The Windup Girl*. As American professor of Atmospheric Science David Battisti diagnosed in “Historical Warnings of Future Food Insecurity with Unprecedented Seasonal Heat,” the difficulties that the human species would have to undergo in the future will exponentially increase. These include food security threats due to reduced crop yields, closure of densely populated cities owing to rising sea levels, and suffering and abuse (of underprivileged classes, the Global South, and genetically modified animals). Such a situation has quite a few elements in common with the situation in *The Windup Girl*, which represents various and tremendous environmental problems people face. In *Empire of Food*, Evan Fraser discusses the “three warning signs for imminent, catastrophic ecological collapse—a sort of diagnostic kit for environmental death” (Fraser 217).¹⁰ In neglect of these three causes for alarm, humanity derogates its ecosystem.

As the relation between global warming and food transformation industries implies in this novel, it is time to reconsider the common belief that a scientific and technological solution is the best option to solve current environmental crises such as global warming, rapid increase of endangered species, and deforestation, to name a few. Wendell Berry’s “Two Economies” reminds us of what we have lost due to too much dependence on industrial technologies: “[Industrial economy] makes itself thus exclusive by the simple expedient of valuing only what it can use—that is, only what it can regard as ‘raw material’ to be transformed mechanically into something else. What it cannot use, it characteristically describes as ‘useless,’ ‘worthless,’ ‘random,’ or ‘wild,’ and gives it some such name as ‘chaos,’ ‘disorder,’ or ‘waste’—and thus ruins it or cheapens it in preparation for eventual use” (193). Genetically modified crops are an example of what Berry describes. The companies value only what they can use for their own profit, but what they cannot use they treat as if it were a weed.

Despite the vital role that weeds and insects play in ecosystems, the GMO industry is committed to eliminating them. Yet, the importance of weeds and insects is not to be underestimated. Their biomass alone is compelling, as the website of the Smithsonian Institute shows: “Insects probably have the largest biomass of the terrestrial animals. At any time, it is estimated that there are some 10 quintillion (10,000,000,000,000,000,000) individual insects alive.”¹¹ Furthermore, it is not easy or wise to replace their role with GMO products. Bees, for instance,

. . . are critical pollinators: they pollinate 70 of the around 100 crop species that feed 90% of the world. Honey bees are responsible for \$30 billion a year in crops. That’s only

the start. We may lose all the plants that bees pollinate, all of the animals that eat those plants and so on up the food chain. Which means a world without bees could struggle to sustain the global human population of 7 billion. (Moate)

Bees cannot be replaced, although scientists are currently investigating ways in which drones might be developed to solve the problem of bees disappearing. In *The Windup Girl*, cats have long since disappeared, and they have been replaced with genetically modified animals called “cheshires.”

GM technologies could have an irrevocably serious impact on a society, a country, or the whole human species, and this dangerous technology could drive the destiny of the human species in a way that is irreversible. *The Windup Girl* shows, through its fictional representations of twenty-third century Thai society, where our current trajectory might lead. Today “designer babies” have become a topic of considerable debate. In the article “When Baby Genes Are for Sale, the Rich Will Pay,” Alex Salkever and Vivek Wadhwa explain that

Designer babies are coming in 20 to 30 years. Your children will be able to select, to some degree, their own children's hair color, eye color, and, possibly their intelligence. How can we make sure that everyone benefits from these capabilities, rather than reserving them for those with more cash?

The problem is that such a question sounds highly probable in our own capitalistic society. According to Eduardo Rodriguez, a faculty member at the Interdisciplinary Center for Studies on Bioethics at the University of Chile,

In December 2015, the International Summit on Human Gene Editing, which gather members of national scientific academies of America, Britain and China, discussed the ethics of germline modification. They agreed to proceed further with basic and clinical research under appropriate legal and ethical guidelines, but altering of gametocytes and embryos to generate inheritable changes in humans was claimed irresponsible. . . . [In] February 2016, British scientists were given permission by regulators to genetically modify human embryos by using CRISPR/ Cas9 and related techniques only for research. (3)

The main concern is that it is difficult to predict how this technology will be used. The late Stephen Hawking is also one of those who warned of such concerns. He told the BBC that “The development of full artificial intelligence could spell the end of the human race” (Cellan-Jones). His concern is that humanity might not deal well with the consequences of technologies that produce things that make humans obsolete.

The technologies of genetically engineered food and animals in *The Windup Girl* are on a trajectory that our own world is currently following, and although these technologies have helped and are helping humanity, the ways in which technologies transform our food may also be hastening our demise. We see in *The Windup Girl* a nonchalance toward living beings, a trend that does not bode well for life or this planet. GMO technology has long been a profitable multinational business, and it is the greed of the GMO company AgriGen in *The Windup Girl* that produces a genetic food monopoly. Anderson's behavior and actions in the novel mirror what is happening in our reality, in which GMO companies maintain and expand their power and position through secret connections and closed-door arrangements with politicians and government ministers. Such collusive links between the powerful governmental officials and multinational companies go on in the current Trump administration no less than in previous administrations that have fostered the growth of companies such as Monsanto (see Fraser and Rimas). Shiva makes it clear that food is the most essential element of our lives. Our techno-centered civilization—in its effort to exploit the seeds of our food for more short-term profit—is doomed to a sad demise, unless there is a radical shift or stop, and the world of *The Windup Girl* is the logical outcome of the food and technology transformations that we see in our world today.

Notes

1. In the Introduction of the *The Ecophobia Hypothesis*, Simon C. Estok explains that

The ecophobic condition exists on a spectrum and can embody fear, contempt, indifference, or lack of mindfulness (or some combination of these) towards the natural environment. While its genetic origins have functioned, in part, to preserve our species, the ecophobic condition has also greatly serviced growth economies and ideological interests. Often a product of behaviors serviceable in the past but destructive in the present, it is also sometimes a product of the perceived requirements of our seemingly exponential growth. Ecophobia exists globally on both macro and micro levels, and its manifestation is at times directly apparent and obvious but is also often deeply obscured by the clutter of habit and ignorance. (1)

2. "Comfort women" were those women who were forced into sexual slavery by the Imperial Japanese Army before and during World War II.
3. The kink-spring factory is a fictional energy source.
4. American writer and animal rights advocate Carol J. Adams looks into the meaning of meat eating in a patriarchal society by "interweaving of the oppression of women and animals" in *The Sexual Politics of Meat* (13).
5. Yates, as one of AgriGen's personnel, had spent years building the kink-spring factory.
6. Mai is a young girl who depends on Hock Sung to get a living for her family.
7. According to Caplan's explanation on how to insert genes into organisms, "The first involves a 'gene gun' that literally shoots microscopic particles covered with DNA at a high velocity into the target organism. The second method uses a type of bacteria, with the gene of interest attached, to infect a plant and thus insert the gene."
8. Dog Fucker's character is thuggish enough to be called such a term of abuse, though he is a businessman who "works for money [and acts] for money. He and Hock Seng are different parts of the economic organism, but underneath everything, they are brothers. Hock Seng smiles slightly as confidence builds" (Bacigalupi 73).
9. Simon Estok argues that "the reality is that the very system that requires such global distributions—when such distributions in fact, do happen—is the root of deficits in other parts of the world" (95) against the argument of Jennifer Clapp that "[global] food supply chains have also redistributed surpluses of crops from one part of the world to other parts in food deficit, and food safety standards have largely improved" (159).
10. The group of ecologists studied "why ecosystems sometimes collapse under the weight of a pestilence, while at other times the same ecological disturbance

doesn't cause lasting harm" (Fraser and Rimas 217). The list of three warning signs, which they published, is as follows:

The first danger sign is when an ecosystem has too much biomass. A place stuffed to the rafters with leafy greens and wood is likely to catch either fire or the interest of a vicious beetle. Less productive land lacks fuel and bores bugs. So lush ground is more vulnerable than rocks.

The second cause for alarm is connectivity. If the plants jumble together in a promiscuous thicket, flames and beetles can spread quicker.

The third danger is exclusivity. If the thicket is made up of a single breed of fern, a fern-eating bug will gobble the entire growth, not just nibble at a few unlucky individuals. So as biodiversity goes down, vulnerability goes up.

11. See the website of the Smithsonian Institute: "Most authorities agree that there are more insect species that have not been described (named by science) than there are insect species that have been previously named. Conservative estimates suggest that this figure is 2 million, but estimates extend to 30 million" ("Number of Insects").

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