Anthropocene Agricultural Law

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FALL 2015 SYMPOSIUM: FARM TO TABLE:
AGRICULTURE LAW IN THE ERA
OF SUSTAINABILITY

ANTHROPOCENE AGRICULTURAL LAW

By: James Ming Chen*

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Other claims to the distinction notwithstanding, agriculture is the oldest profession.1 From its humble origins roughly 10,000 years ago, agriculture has catapulted humanity from Pleistocene competitiveness to Holocene dominance and Anthropocene hegemony.3 Though starvation has stalked humanity through much of its history, modern society has scored a magnificent victory. One parochial example suffices to illustrate the scale of the triumph. The first eight decades of system-

* Justin Smith Morrill Chair in Law, Michigan State University; Of Counsel, Technology Law Group of Washington, D.C. Savannah Priebe supplied information on legal controversies involving foie gras. Daniel D. Barnhizer provided a helpful sounding board for a discussion of Adolf Loos and Bronislaw Malinowski. Jin Jirrie offered insights into peak phosphorus and developed economies’ historical domination of agricultural inputs. Special thanks to Heather Elaine Worland Chen. All biblical references are drawn from the Revised Standard Version.

3. See generally, e.g., Jan Zalasiewicz et al., The New World of the Anthropocene, 44 Envtl. Sci. & Tech. 2228 (2010). The term Anthropocene is derived from ἀνθρώπος and καινός; the ancient Greek words for human and new (or recent).
atic food and drug regulation in the United States coincided with a staggering increase of twenty-six years in life expectancy, an unprecedented actuarial leap forward not likely to be duplicated.\textsuperscript{4}

This Essay takes stock of humanity’s arguably illusory victory over its old Malthusian foe.\textsuperscript{5} Having staved off imminent starvation, wealthy consumers in the United States and other developed nations are now free to focus their legal and political energy on the expressive aspects of food. Such bagatelles come at the price of ignoring deeper threats to the ecological and economic underpinnings of agricultural production. Had we world enough and time, food as ornament would be no crime.\textsuperscript{6}

The onset of the Anthropocene, however, demands more serious attention to older, more venerable sources of concern. Resource exhaustion and evolutionary biology remain poised to deliver crippling blows to the agricultural system that serves as life support for affluent, industrialized society.\textsuperscript{7} As existential threats loom, the continued allure of purely symbolic disputes suggests that agricultural law remains content, quite literally, to bet the farm.

Amid the “Great Acceleration” of population, affluence, and technology since the Second World War,\textsuperscript{8} the concurrent transformation of agriculture seems a distant afterthought. “Economic progress,” on or off the farm, “is characterized by a progressive division of labor and separation of function.”\textsuperscript{9} An economic and social landscape marked by fewer, larger, and more industrialized farms, once decried as a betrayal of conventional agrarian values,\textsuperscript{10} has become the norm in developed countries. It is idle to speak of agriculture, which within living memory was once a “self-contained industry” generating “food, fuel, shelter, draft animals, feed, tools, and implements and even most of [the] clothing” for a “typical farm family,” as having any meaningful

\begin{footnotesize}
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    \item \textsuperscript{4} See Peter Barton Hutt, \textit{Food and Drug Law: A Strong and Continuing Tradition}, 37 \textit{Food Drug Cosmetic} L.J. 123, 125 (1982).
    \item \textsuperscript{5} See generally Thomas Malthus, \textit{An Essay on the Principle of Population} (1798), http://www.esp.org/books/malthus/population/malthus.pdf [https://perma.cc/6U33-HGYH].
    \item \textsuperscript{6} Cf. Andrew Marvell, \textit{To His Coy Mistress} (ca. 1649–60), https://www.poets.org/poetsorg/poem/his-coy-mistress (“Had we but world enough, and time / This coyness, Lady, were no crime”) [https://perma.cc/C2XC-QTU7].
    \item \textsuperscript{8} See generally Kathy A. Hibbard et al., \textit{Decadal Interactions of Humans and the Environment, in Sustainability or Collapse? An Integrated History and Future of People on Earth} 341–75 (Robert Costanza et al., eds., 2006); cf. Elizabeth Kolbert, \textit{Enter the Anthropocene: Age of Man}, 219 Nat’l Geo. 60 (2011) (measuring informally both human prosperity and human ecological impact according to a function of population, affluence, and technology).
    \item \textsuperscript{9} Farmers Reservoir & Irrigation Co. v. McComb, 337 U.S. 755, 761 (1949).
\end{itemize}
\end{footnotesize}
distinction from *agribusiness*, “the sum total of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing, and distribution of farm commodities and items made from them.”


18. See, e.g., Ass’n des Éleveurs de Canards et d’Oies du Québec v. Harris, 729 F.3d 937 (9th Cir. 2013); Ass’n des Éleveurs de Canards et d’Oies du Québec v. Harris, 79 F. Supp. 3d 1136 (C.D. Cal. 2015); Illinois Rest. Ass’n v. City of Chi., 492 F.
battle over Vermont’s law mandating the labeling of food produced through genetic engineering. American food fights routinely involve disagreements over the expressive or symbolic value of food. The metaphysics of food and its consumption overrides its nutritional value and the cold equations underlying the ecology and the economics of food production.

Berkeley’s failed coffee referendum is instructive. The initiative would have required all coffee sold within the city to be brewed from beans certified organic, fair-trade, shade-grown, or some combination of any of those traits. Organic production aspires to a vague hope that avoidance of synthetic pesticides and fertilizers can “foster cycling of resources, promote ecological balance, and conserve biodiversity.” Fair trade certification seeks to reorder the economics of agricultural production. Ideally, the elimination of intermediaries within the supply chain minimizes opportunities for exploitation by agribusiness purchasers and enables coffee producers, who often live in developing countries, to realize greater profits. For its part, shade-grown coffee represents an ecologically sensitive approach to agroforestry, insofar as growing coffee under a biodiverse canopy outperforms coffee monocultures on unshaded plantations along multiple ecological measures.

All three of these aspirations have their virtues and their limitations. Combining them, however, exposes a certain logical incoherence. Fair trade certification’s labor-oriented objectives—essentially...


20. See Chen, supra note 17, at 5.


the redirection of economic surplus from supply-chain efficiency toward higher returns on agricultural labor—have no connection to shade-grown coffee as a form of permaculture or to organic production’s more diffuse ecological ambitions. “Slave of the wheel of labor, what to him / Are Plato and the swing of Pleiades?”24 The freedom to choose among these three forms of nonconventional coffee cultivation instead performs the expressive function of protesting less virtuous methods for growing or distributing coffee. Drink our elixir, and you are virtuous. Drink any other swill, and you are vile.

A similar sort of internal inconsistency characterizes controversies over milk from cows treated with recombinant bovine somatotropin (“rbST”).25 This bitterly contested subject has devolved into a legal stalemate. Federal appellate courts have banned not only forced disclosures of rbST use,26 but also state-law prohibitions of voluntary labeling by farmers who have elected not to treat their cows with rbST.27 Consistent with its broader policy that food vendors may not label their foods as “GM free” or “biotech free” unless they simultaneously disclose that foods so labeled are neither safer nor nutritionally superior to unlabeled foods,28 the United States Food and Drug Administration requires milk touting its origin in cows not treated with rbST to disclose that “[n]o significant difference has been shown between milk derived from rbST-treated and non-rbST-treated cows.”29 The resulting legal equilibrium is as unhappy as it is stable. Vermont’s comprehensive GMO labeling law, if it survives an ongoing court challenge, would decisively break this logjam in favor of staunch opponents of transgenic food technologies.

Prohibitions on foie gras are arguably even more pointed in their castigation of offending consumers. If you eat foie gras, so the logic goes, you condone the force-feeding of ducks or geese. Again, there is no intrinsic demerit in opposing gavage as a matter of law and business ethics. Because public values neither demand nor enforce a strictly vegan ethos,30 the law tolerates animal slaughter.31

27. See Int’l Dairy Foods Ass’n v. Boggs, 622 F.3d 628 (6th Cir. 2010).
same time, the law recognizes gradations of decency. The general right to kill animals does not necessarily subsume a specific right to engage in an agricultural technique that a democratic majority may find abhorrent.\footnote{Contra Arnett v. Kennedy, 416 U.S. 134, 153–54 (1974) (plurality opinion of Rehnquist, J.) ("[W]here the grant of a substantive interest is inextricably intertwined with [procedural limitations], a litigant . . . must take the bitter with the sweet.").}

The labeling controversies so prevalent in contemporary agricultural law effectively treat conventional coffee, non-organic milk, \textit{foie gras}, and (at an extreme) all foods produced through genetic engineering as food taboos. Such “prohibitions to eat certain foods” have arisen across cultures over the full span of human history.\footnote{JAMES GEORGE FRAZER, THE GOLDEN BOUGH: A STUDY IN MAGIC AND RELIGION 21 (1922).} Food taboos almost invariably arise from belief in “negative magic.”\footnote{See id. at 22.}

These rules of sympathetic magic dictate that contact with disgusting objects constitutes permanent contamination and that visual similarity constitutes qualitative equivalence.\footnote{See Paul Rozin, Linda Millman & Carol Nemerooff, \textit{Operation of the Laws of Sympathetic Magic in Disgust and Other Domains}, 50 J. PERSONALITY \& SOC. PSYCHOL. 703 (1986).} Food that touches a cockroach is repulsive, and so is otherwise wholesome food shaped and colored so that it resembles a cockroach. Lest food taboos prohibiting resort to “many animals and plants, wholesome enough in themselves,” be dismissed as “superstitions of the savage,”\footnote{See FRAZER, supra note 33, at 238.} contemporary behavioral science recognizes the persistence of superstition and magical thinking, even among educated and emotionally stable adults.\footnote{See, e.g., Jane L. Risen & Thomas Gilovich, \textit{Why People Are Reluctant to Tempt Fate}, 95 J. PERSONALITY \& SOC. PSYCHOL. 293 (2008).}

Food taboos—ranging from seasonal limitations such as Lenten avoidance of meat and the Mormon prohibitions on coffee, tea, and alcohol, to comprehensive rules prescribing kosher or halal practices—give meaning to religions commanding hundreds of millions of adherents worldwide.\footnote{Of these religious food traditions, Jewish kosher rules may have received the closest scrutiny in American legal scholarship. See generally, e.g., TIMOTHY D. LYTTON, KOSHER: PRIVATE REGULATION IN THE AGE OF INDUSTRIAL FOOD (2013); Timothy D. Lytton, Jewish Foodways and Religious Self-Governance in America: The Failure of Communal Kashrut Regulation and the Rise of Private Kosher Certification, 104 JEWISH Q. REV. 38 (2014); Shayna M. Sigman, Kosher Without Law: The Role of Nonlegal Sanctions in Overcoming Fraud Within the Kosher Food Industry, 31 FLA. ST. L. REV. 509 (2004).}

To recognize the universality and the power of food taboos, however, need not dictate their enshrinement within secular law. As I argued two decades ago, “I do not accuse American agriculture of being too Marxist.”\footnote{Jim Chen, \textit{The American Ideology}, 48 VAND. L. REV. 809, 822 (1995).} Rather, “American agriculture is not Marxist...
In *The German Ideology*, Karl Marx argued that philosophy, drawn from “the realm of pure thought,” had no meaning absent its “relation . . . to . . . material surroundings,” particularly the physical stuff on which humans subsist. The German Ideology is the fallacy that civilization has any starting point besides the amassing of food, fiber, and fuel.

The work of psychologist Abraham Maslow provides a less politically charged way to express the same point. Maslow defined a hierarchy of needs, from simple physiology to love and social esteem, and arranged as layers of a pyramid. The first of Maslow’s layers comprises basic physiological needs (such as food, hydration, and a stable body temperature), in the sense of freedom from immediate threats to health or safety. At higher levels of the pyramid, Maslow placed love (in the sense of caring for family and offspring) and esteem, which he defined as achievement, reputation, prestige, and social standing. Finally, Maslow placed “self-actualization” at the top of his pyramid of needs. “A musician must make music,” he wrote, “an artist must paint, a poet must write, if he is to be ultimately happy” with himself.

Food as ornament may be summarized as the Maslowian fulfillment of Marxist philosophy. Having feasted on our daily pumpernickel, we may freely indulge exercises in German philosophy. As befits life in the affluent, information-driven, and increasingly secular societies of the industrialized world, food multitasks. It is no longer enough that food nourishes. Food that is organic, shade-grown, cruelty-free, and subject to fair trade protocols establishes the consumer’s membership in the proper social circles. For those committed to food as a way of life, ensuring its rigorous compliance with an ethical set of production protocols is a form of self-actualization. Food as secular sacrament holds special appeal for “natural Luddites,” the “Western intellectuals who have” effectively rejected “the industrial revolution.” In many and various ways, our forebears strove for the infinite through religious traditions, but these days many of us seek spiritual fulfillment

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40. *Id.*
44. See *id.* at 372–76 (physiological needs, based on “homeostasis” and “appetites”); *id.* at 376–80 (safety).
45. See *id.* at 380–81 (love); *id.* at 381–82 (esteem).
46. *Id.* at 382–84.
47. *Id.* at 382.
48. C.P. Snow, *The Two Cultures: And a Second Look* 22 (2d ed. 1964); see also *Cultural Divides, Forty Years On*, 398 *Nature* 91, 91 (1999) (observing that *The Two Cultures* “still resonates” in a world “where cultural antipathies are very much alive and kicking”).
through food.\textsuperscript{49} Honoring some form of food-based ethic enables many members of contemporary society to achieve communion with like-minded others around a shared sacrament.

Standing by sharp contrast and in firm opposition to food as ornament and as sacrament is a work of Austrian philosophy bisecting the historical arc from Marx to Maslow. In 1908, architect Adolf Loos gave a lecture called \textit{Ornament und Verbrechen}, or \textit{Ornament and Crime} in English translation.\textsuperscript{50} \textit{Ornament und Verbrechen} would prove to be one of the twentieth century’s most influential works of artistic criticism. Indeed, it may be regarded as the manifesto of Modernism in architecture and the visual arts. In this Essay, I hope to extend Loos’s esthetic philosophy, as expressed in \textit{Ornament und Verbrechen}, to agricultural law and policy. Call it \textit{Crime and Sacrament}.

\textit{Ornament und Verbrechen} opened by invoking the greatest intellectual achievement of the preceding century, Charles Darwin’s theory of evolution and its popularization in the German-speaking world by Ernst Haeckel.\textsuperscript{51} “The human embryo in the womb passes through all the evolutionary stages of the animal kingdom,” Loos declared.\textsuperscript{52} This opening gambit united artistic criticism with Haeckel’s mantra, ontogeny recapitulates phylogeny, the idea that any individual organism’s life cycle replays the entire evolutionary history of its species.\textsuperscript{53} Loos then equated the “evolution of culture . . . with the removal of ornament from utilitarian objects.”\textsuperscript{54} With specific reference to food, Loos observed:

Ornament does not heighten my joy in life or the joy in life of any cultivated person. If I want to eat a piece of gingerbread I choose one that is quite smooth and not a piece representing a heart or a

\textsuperscript{49} Cf. Hebrews 1:1–2 (“In many and various ways God spoke of old to our fathers by the prophets; . . . but in these last days he has spoken to us by a Son, whom he appointed the heir of all things, through whom also he created the world.”).

\textsuperscript{50} See JANET STEWART, FASHIONING VIENNA: ADOLF LOOS’S CULTURAL CRITICISM 173 (2000).


\textsuperscript{54} Loos, \textit{supra} note 52, at 20.
baby or a rider . . . . The show dishes of past centuries, which display all kinds of ornaments to make the peacocks, pheasants and lobsters look more tasty, have exactly the opposite effect . . . .

In a modern society where utilitarian necessity has overridden all decorative impulses, “ornament on things that have evolved away from the need to be ornamented represents wasted labour and ruined material.” On earth if not in hell, “the form of an object lasts” only “as long as the object lasts physically.” Consequently, the production of ornament (as opposed to strictly utilitarian objects) commits “a crime . . . through the fact that ornament inflicts serious injury on people’s health, on the national budget and hence on cultural evolution.” Drawing its “greatness” from its inability to “produce[e] a new ornament,” our contemporary age has “fought [its] way through to freedom from ornament.” That freedom has given rise to “spiritual strength.” The free borrowing of “the ornaments of earlier or alien cultures” liberates an advanced society to “concentrate[ ] [its] own inventiveness on other things.”

Especially in its own artistic domain, Ornament und Verbrechen remains controversial. Modernism as critique is so corrosive that it consumes itself, for any movement driven by change and crisis fulfills its own prophecy through self-destruction. “Thinking through the transitory concept of modernity can lead to the end of modernity thus precipitating the advent of postmodernism.” As a result, “the many virtues of modern design—such as functional, modern, useful, and lawful” coexist with their “opposites in modern life: dysfunctional, primitive, useless, and criminal.”

Loos’s modernist aesthetic nevertheless embodies an almost mathematical ambition to attain “a beauty cold and austere, . . . without [any] appeal to any part of our weaker nature, without the gorgeous trappings of painting or music, yet sublimely pure, and capable of a stern perfection such as only the greatest art can show.” The closest
legal parallel to *Ornament und Verbrechen* may come from Bronislaw Malinowski, whose studied custom and criminal justice in primitive societies at the same time James George Frazer documented universal mythology in *The Golden Bough*. The function of law, said Malinowski, “is to curb certain natural propensities, to hem in and control human instincts and to impose a non-spontaneous, compulsory behavior.” Much more recently, Kenji Yoshino has likewise subordinated the inherent “falsity, irrationality, and seductiveness” of literature and poetry to the strictly civic “functions of the state.” Any reconciliation of poetry with civic governance demands that this “polluted discourse” demonstrate “affirmatively . . . that it can fulfill state functions.”

Let us therefore get to work. The wealth of the Great Acceleration, as it happens, may be illusory. If so, the exuberance of food as ornament—as expressed through the profusion of laws facilitating labeling schemes, esthetically motivated production protocols, and consumer choice—confronts the reality of scarcity. What began as a paean to Ernst Haeckel’s edict, “ontogeny recapitulates phylogeny,” collides with the grim, double-edged blade of ecology and economics. Haeckel coined both of those terms, too, in homage to the ancient Greek word ὀίκος. In a world of finite resources, the legal variant of *Ornament und Verbrechen* dictates “a type of co-operation which is based on mutual concessions and sacrifices for a common end.” This Essay now turns to those vital questions of housekeeping.
II. HUMANITY’S TWILIGHT | MENSCHENÄMMERUNG

A specter is haunting humanity, the specter of the Anthropocene. The human footprint on the global environment has become so deep that some scientists have urged the redesignation of our moment in geological time. We have passed, so it has been argued, from the Holocene epoch to the Anthropocene. Although formal recognition of an Anthropocene epoch remains elusive as a matter of stratigraphy, the concept provides a vivid, salient reminder that human activity has had a profound impact on every physical and biological aspect of the planet. One proposal aligns the onset of the Anthropocene with the rise of agriculture:

Defining the onset of the Anthropocene in terms of the initial domestication of plants and animals worldwide 11,000–9000 years ago . . . resolves the serious challenge of satisfying geological standards for establishing a new epoch in a much more compelling manner than . . . alternative starting dates . . . , including the Industrial Revolution . . . .

Shifts in geological time are typically associated with mass extinction events. The Phanerozoic Eon, a span of 542 million years beginning with the emergence of hard-shelled animals, has witnessed at least five catastrophic collapses in biodiversity: the Ordovician-Silurian, the late Devonian, the Permian-Triassic, the Triassic-Jurassic, and

73. Cf. NIEZSCHIE, Twilight of the Idols, supra note 67. Nietzsche’s original title of Twilight of the Idols in German was GÔTZEN-DAMMERUNG, ODER WIE MAN MIT DEM HAMMER PHILOSOPHIRT (1889).

74. Cf. Marx & Engels, Manifesto of the Communist Party, in THE MARX-ENGELS READER, supra note 41, at 331, 335 (“A spectre is haunting Europe—the spectre of Communism.”).


78. Bruce D. Smith & Melinda A. Zeder, The Onset of the Anthropocene, 4 ANTHROPOCENE 8, 13 (2013) (citation omitted).

79. See, e.g., Alexander V. Markov & Andrey V. Korotayev, Phanerozoic Marine Biodiversity Follows a Hyperbolic Trend, 16 PALAEOWORLD 311 (2007); Kenneth G. Miller et al., The Phanerozoic Record of Global Sea-Level Change, 310 SCI. 1293 (2005). The term Phanerozoic is derived from the ancient Greek words φανερός and ζωή, which together mean “visible life.”
the Cretaceous-Paleogene.\textsuperscript{80} Strictly as a quantitative matter, the current rate of biodiversity loss constitutes a sixth great extinction spasm.\textsuperscript{81}

Given the biological thinness of the human larder—barely 100 species account for nine-tenths of plant matter consumed globally—\textsuperscript{82} biodiversity loss weighs heavily on agriculture. Despite some progress in forestalling specific extinctions\textsuperscript{83} and in conserving some swaths of critical habitat,\textsuperscript{84} specific indicators such as vertebrates,\textsuperscript{85} tropical forests,\textsuperscript{86} and coral reefs\textsuperscript{87} indicate severe declines in biodiversity. Anthropogenic climate change drives much of the destruction.\textsuperscript{88}

“But climate change is only the tip of the iceberg.”\textsuperscript{89} As earth rapidly approaches certain limits on its carrying capacity, the Anthropocene epoch compels respect for a “spaceman economy,” or a view of the planet as “a closed system necessitating consideration and careful planning of the consequences of human economic activity.”\textsuperscript{90} Beyond altering “the carbon cycle, humans are . . . significantly altering several other biogeochemical, or element cycles, such as nitrogen, phosphorus and sulphur, that are fundamental to life on the Earth.”\textsuperscript{91}


\textsuperscript{81.} See, e.g., E\textsc{lizabeth} K\textsc{olbert}, \textsc{The Sixth Extinction}: A Natural History (2014); Richard Le\textsc{a}key & Roger Lewin, \textsc{The Sixth Extinction}: Patterns of Life and the Future of Mankind (1995); Stuart H. M. Butchart et al., Global Biodiversity: Indicators of Recent Declines, 328 SCI. 1164 (2010).


\textsuperscript{83.} See Taylor H. Ricketts et al., Pinpointing and Preventing Imminent Extinctions, 102 PROC. NAT'L ACAD. SCI. 18,497 (2005).

\textsuperscript{84.} See Güven Eken et al., Key Biodiversity Areas as Site Conservation Targets, 54 BIOSCIENCE 1110 (2004).

\textsuperscript{85.} See Ben Collen et al., Monitoring Change in Vertebrate Abundance: The Living Planet Index, 23 CONSERVATION BIOLOGY 317 (2009).

\textsuperscript{86.} See Matthew C. Hansen et al., Humid Tropical Forest Clearing from 2000 to 2005 Quantified by Using Multitemporal and Multiresolution Remotely Sensed Data, 105 PROC. NAT'L ACAD. SCI. 9439 (2008).

\textsuperscript{87.} See Blake Armstrong, Maintaining the World's Marine Biodiversity: Using the Endangered Species Act to Stop the Climate Change Induced Loss of Coral Reefs, 18 HASTINGS W.-NW. J. ENVTL. L. & POL'Y 429 (2012).

\textsuperscript{88.} See, e.g., Douglas H. Erwin, Climate as a Driver of Evolutionary Change, 19 CURRENT BIOLOGY R575 (2009); Camille Parmesan, Ecological and Evolutionary Responses to Recent Climate Change, 37 ANN. REV. ECOLOGY EVOLUTION & SYSTEMATICS 637 (2006); Andreas Schmittner et al., Climate Sensitivity Estimated from Temperature Reconstructions of the Last Glacial Maximum, 334 SCI. 1385 (2011).

\textsuperscript{89.} Will Steffen et al., The Anthropocene: Conceptual and Historical Perspectives, 369 PHIL. TRANSACTIONS ROYAL SOC'Y A 842, 843 (2011).

\textsuperscript{90.} Douglas A. Kysar, Sustainability, Distribution, and the Macroeconomic Analysis of Law, 43 B.C. L. REV. 1, 10 (2001) (citing Kenneth E. Boulding, \textsc{The Economics of the Coming Spaceship Earth, in Valuing the Earth}: Economics, Ecology, Ethics 297 (Herman E. Daly & Kenneth N. Townsend eds., 1993)).

\textsuperscript{91.} Steffen et al., supra note 89, at 843.
Put bluntly, sheer exhaustion of basic inputs jeopardizes agriculture as we know it.

Perhaps the best known problem of resource exhaustion involves petroleum, the cheapest, most abundant, and most versatile of earth’s fossil fuels. The “peak oil” concept originated in geologist M. King Hubbert’s prediction that peak production of petroleum would signal its eventual depletion. Subsequent work has elaborated peak oil as a singularly alarming problem for a world still hooked on fossil fuels. If only as a matter of methodology, no other problem of resource depletion has loomed larger in the scientific and economic imagination. Hubbert’s model of peak production underlies the long-term forecasting of the ultimate exhaustion of a depletable resource.

The distributive implications of peak oil bode ill for poorer countries. The supply of petroleum must “keep pace with demand if the large developing countries are to repeat the pathway” paved by today’s wealthiest economies “in their post-World War II economic expansion, when oil was plentiful and inexpensive.” That smooth developmental track, propelled by “plentiful, cheap fossil fuel . . . and large expanses of productive land,” now lies beyond the reach of “the 75-80% of the human population” that seeks “trajectories out of poverty” and has begun “to compete with today’s wealthy countries for increasingly scarce resources.”

Despite the Great Acceleration, “[m]ost of our fellow human beings . . . are underfed and die before their time.” Although “that is the social condition,” the “loneliness” accompanying its wealth tempts the developed world “to sit back, complacent in [its] unique tragedy, and let . . . others go without a meal.” Exacerbating already difficult circumstances, the “new economic giants of Asia [are] moving to se-

95. Steffen et al., supra note 89, at 854.
98. Id. at 6–7.
cure food resources in non-Asian territories,” particularly through a “‘land grab’ in relation to Africa.” As tempting as it may be for rich countries to dismiss their poorer counterparts’ desire for economic development, global equality is likely to pay dividends in political stability and perhaps even improved economic performance around the world.100

“Less well known” than peak oil “is the potential shortage of the mineral phosphorus.”101 Along with nitrogen and potassium, phosphorus is one of three macronutrients in plant fertilizers.102 Global supplies of phosphorus are expected to peak in 2030 and to be exhausted within another thirty to eighty years.103 As global population continues to increase, and especially “as diets change with the rapid development of China, India, and other large developing countries,” phosphorus production will probably peak before demand for this element reaches its apex.104 “Without careful management of phosphorus production and distribution in an equitable and long-term manner,” vulnerable parts of the world face not only “diminishing supplies of petroleum,” as the peak oil problem predicts, but also “a deterioration of food security” traceable to peak phosphorus.105

The Supreme Court of the United States long ago recognized the significance of macronutrients in plant fertilizer. Funk Bros. Seed Co. v. Kalo Inoculant Co.106 denied a patent for a clever but naturally occurring combination of non-mutually inhibiting bacteria for inoculating the rhizomes of leguminous plants and inducing them to fix atmospheric nitrogen in their roots.107


101. Steffen et al., supra note 96, at 739.


104. Steffen et al., supra note 89, at 854.

105. See id.


107. See id. at 131–32.
As Funk Bros. is to peak phosphorus, the 2013 case of *Bowman v. Monsanto Co.*\(^{108}\) presages peak glyphosate.\(^{109}\) *Bowman* is best known for holding that the patent exhaustion doctrine—the principle that “the authorized sale of a patented article” confers “a right to use or resell that article,” but not the right “to make new copies of the patented invention”—does not permit the saving of patented, genetically modified seed.\(^{110}\)

In an agricultural vision befitting the Anthropocene, however, *Bowman* epitomizes the need to consider the evolutionary consequences of legal decisions in light of the “staggering sweep of geological time and the sheer extent of life on earth.”\(^{111}\) Many technologies have accelerated the treadmill on which agriculture runs.\(^{112}\) This treadmill runs in evolutionary as well as economic terms. Just as the Red Queen of Alice’s Wonderland keeps running without seeing new terrain (because the landscape moves with her),\(^{113}\) evolution routinely outpaces human intervention.\(^{114}\) Although the Red Queen also stalks agriculture through resistance to pesticides\(^{115}\) and antibiotics,\(^{116}\) I will illustrate the problem through the example of herbicide resistance.

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\(^{108}\) *Bowman v. Monsanto Co.*, 133 S. Ct. 1761 (2013).


\(^{113}\) See Lewis Carroll, *Through the Looking-Glass and What Alice Found There* 46 (Martin Gardner ed., 1998) (1st ed. 1871) (“Now, here, you see, it takes all the running you can do, to keep in the same place.”).


The transgenic modification of crops has occasioned a decrease in the application of chemical insecticides, coupled with a dramatic increase in the deployment of broad-spectrum herbicides.\(^{117}\) The overwhelming focus in contemporary debates over genetically modified food crops involves putative threats to food safety and human health. Arguments over the economic impact of these crops on farmers (especially organic farmers and others seeking to avoid annual purchases of patented seed) run a close second in passion. But these concerns obscure the potential for ecological and evolutionary damage from the nearly universal adoption of herbicide-resistant crops. As of 2013, 85% of all corn, 82% of all cotton, and 93% of all soybeans planted in the United States had been genetically engineered to resist herbicides.\(^{118}\)

Broad-spectrum herbicides and herbicide-resistant crops are substitutes for demoralizing physical labor. Without herbicides, the farmer must remove weeds by raw force. In the case of cotton, the alternative of chopping is particularly brutal: “In order to produce a good cotton crop, cotton should be chopped in the summertime . . . . [C]hopping or hoeing the weeds out of the rows of growing cotton . . . is a menial, unskilled task which requires no aptitude, no training, and no ability to reason.”\(^{119}\) Or in the words of James Agee: “Chopping is a simple hard and hot job . . . done with an eight- to ten-inch hoeblade. You cut the cotton flush to the ground, with a semi-blow of the blade that aches first the forearms and in time the whole spine.”\(^{120}\)

Glyphosate, the active ingredient in Monsanto’s Roundup herbicide, presents a singularly intense concern. Monocultures consisting of a single glyphosate-resistant variety, such as Roundup Ready soybeans, invite multiple applications, season after season, of glyphosate. The resulting selection pressure gives rise to herbicide-tolerant and herbicide-resistant “superweeds.”\(^{121}\) Almost immediately after Monsanto released its Roundup Ready technology, the first cases of glyphosate resistance in rigid ryegrass (\(Lolium rigidum\)) were documented in Australia.\(^{122}\) Glyphosate-resistant ryegrass has been de-

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120. JAMES AGEE, COTTON TENANTS: THREE FAMILIES 129 (John Summers ed., 2013).


Glyphosate resistance has been reported in Palmer amaranth, or pigweed (*Amaranthus palmeri*), hairy fleabane, or buva (*Conyza bonariensis*), horseweed (*Conyza canadensis*), Johnsongrass (*Sorghum halepense*), and goosegrass (*Eleusine indica*). Glyphosate resistance in common lambsquarters (*Chenopodium album*), a weed of special concern to cotton farmers, is particularly dispiriting.

As resistance proliferates in geographic space and across biological taxa, we may soon reach—if we have not already surpassed—peak glyphosate. From this biochemical apogee, we can foresee this herbicide’s decline in effectiveness and its eventual commercial extinction. Pesticides and herbicides, however, “do not go gentle into that good night.”

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and an emasculator of frogs, atrazine remains America’s leading herbicide. In its own time, glyphosate will “rage, rage against the dying of the light.” Whatever its other legal and economic implications, the 2015 expiration of Monsanto’s original Roundup Ready patent will almost certainly expand glyphosate use and the rate at which non-crop plants evolve resistance.

Meanwhile, superweed resistance to glyphosate has spurred the development of crops engineered to tolerate another organophosphorus compound with broad-spectrum herbicidal qualities, glufosinate. Bayer CropScience, a leading rival to Monsanto, has incorporated glufosinate resistance into soybeans, cotton, corn, and canola, and intends to expand production of the herbicide itself. Atrazine yesterday, glyphosate today, glufosinate tomorrow.

Resource exhaustion and a rapidly accelerated evolutionary treadmill pose formidable challenges to Anthropocene agriculture. Although food law fetishists keep framing legal issues surrounding the use of genetically modified organisms in agriculture as matters of consumer rights or awareness, the real issues involve agriculture’s productive capacity—or, even more urgently stated, its destruction.

133. See Tyrone Hayes et al., Atrazine-Induced Hermaphroditism at 0.1 ppb in American Leopard Frogs (Rana pipiens): Laboratory and Field Evidence, 111 ENVTL. HEALTH PERSP. 568, 572, 574–75 (2003); Tyrone B. Hayes et al., Atrazine Induces Complete Femmination and Chemical Castration in Male African Clawed Frogs (Xenopus laevis), 107 Proc. Nat’l Acad. Sci. 4612 (2010); Janet Koprivnikar et al., Contaminant Effects on Host-Parasite Interactions: Atrazine, Frogs, and Trematodes, 26 ENVTL. TOXICOLOGY & CHEMISTRY 2166 (2007); Kaori Mizota & Hiroshi Ueda, Endocrine Disrupting Chemical Atrazine Causes Degranulation through Gq/11 Protein-Coupled Neurosteroid Receptor in Mast Cells, 90 TOXICOLOGICAL SCI. 362 (2005).


135. THOMAS, supra note 132, at 207.


At a minimum, and as an economically tractable starting point, the impact on food prices alone should provide cause for legal concern. The interaction of prices with production, imports, and exports “is a dynamic system with many feedback loops,” spanning such factors as “demand dynamics (including biofuels), slowing production, increasing cost of production, currency valuations, physical product shocks (weather, disease or political instability), aggressive purchase by countries, financial speculation and export restrictions.”

Although price shocks pose a greater challenge to poorer countries, natural ecology and human economy also collide in the richer lands of the Anthropocene. Paradoxically, “human well-being has reached high levels in many countries while our planetary life support system is simultaneously being eroded.”

Existing economic and legal institutions are poorly adapted to manage the challenges of the Anthropocene. The “increasing complexity” accompanying the exponential growth of population, affluence, and technology since the Great Acceleration means that “it is no longer useful to concentrate on environmental challenges and variables individually.” The real challenge facing global governance “lies in the intertwining of multi-scale challenges across sectors,” such as “environment, demographics, pandemics, [and] political unrest.” If left unchecked and allowed to “continue unabated through this century,” these “ultimate drivers of the Anthropocene . . . may well threaten the viability of contemporary civilization and perhaps even the future existence of Homo sapiens.”


143. Steffen et al., supra note 96, at 752; cf. Elizabeth Kolbert, Enter the Anthropocene: Age of Man, 219 NAT’L GEO. 60 (2011) (measuring informally both human prosperity and human ecological impact according to a function of population, affluence, and technology).


145. Steffen et al., supra note 89, at 862.
III. BETTING THE FARM

Nicht Gott sondern Mensch würfelt mit dem Universum: It is not God, but rather humanity, that plays dice with the universe.¹⁴⁶ No less than natural language, risk-taking is a species property of human beings, comparable to “echolocation in bats or stereopsis in monkeys.”¹⁴⁷ Though human choices under risk and uncertainty may “not always [be] rational in the traditional sense,” those choices take an “orderly” rather than “chaotic and intractable” path.¹⁴⁸ Human risk-taking arises from the same material as universal grammar and the atoms of language.¹⁴⁹

The extreme conditions of the Anthropocene epoch, however, put the innate decision-making mechanisms of humans under severe stress. Even in the absence of environmental considerations such as global climate change and impending resource exhaustion, economic history is pockmarked with extreme tail events exceeding traditional forecasts.¹⁵⁰ September 1939, the opening month of World War II, recorded a 9σ departure from the history of correlations between market returns and beta from 1955 through 1968.¹⁵¹ Smaller, less liquid markets reveal even greater shocks. A fifty-year survey of oil prices, from 1960 through 2010, has revealed a 37σ event in 1973.³⁷ σ! It would not have been unreasonable to surmise that “the economic world as we knew it was coming to an end.”¹⁵³ The expected time

¹⁴⁶. “Gott würfelt nicht,” or “God does not play dice with the universe,” a saying attributed to Albert Einstein, arises from a December 4, 1926, letter to Max Born: “Die Quantenmechanik ist sehr achtunggebietend. Aber eine innere Stimme sagt mir, daß das noch nicht der wahre Jakob ist. Die Theorie liefert viel, aber dem Geheimnis des Alten bringt sie uns kaum näher. Jedenfalls bin ich überzeugt, daß der nicht würfelt.” MAX BORN, PHYSIK IM WANDEL MEINER ZEIT 244 (3d ed. 1983); ALBERT EINSTEIN, HEDWIG UND MAX BORN: BRIEFWECHSEL 1916–1955, at 97 (Bertrand Russell preface, Werner Heisenberg intro., 1972). In my English translation: “Quantum mechanics is certainly impressive. But an inner voice tells me that it’s not yet the real McCoy. The theory says a lot, but it barely gets us closer to the secrets of God. Anyway, I am convinced that He does not play dice.”


¹⁵¹. See Juan Salazar & Annick Lambert, Fama and MacBeth Revisited: A Critique, 1 AESTIMATIO 48, 64 (2010).

¹⁵². See Nordhaus, supra note 150, at 243.

¹⁵³. Id.
between 25σ events—roughly $1.309 \times 10^{136}$ years—spans “more millennia than the universe has number of particles.”

Loss scenarios of a magnitude befitting the Anthropocene epoch force us to contemplate appropriate responses to “infinite disutility.” The presence of fat tails, especially when they are fat enough to push probability distributions toward the intractable extreme of infinite variance, thrusts us into “ignorance about both the exact form of the distribution (e.g., normal, Pareto, or exponential) and the exact parameters of the distribution.”

Probabilities and losses sufficiently grandiose to portend the end of civilization, possibly even the survival of humans as a species, have given rise to a “dismal theorem”: The “catastrophe-insurance aspect of such a fat-tailed unlimited-exposure situation, which can never be fully learned away, can dominate the social-discounting aspect, the pure-risk aspect, and the consumption-smoothing aspect.” In plainer language, the dismal theorem posits that “under limited conditions concerning the structure of uncertainty and societal preferences, the expected loss from certain risks . . . is infinite and that standard economic analysis cannot be applied.”

What role does ornamentation, or any other form of personal expression, retain within a decision-making framework befitting the fog of ignorance and extreme outcomes that define the Anthropocene? A plausible answer emerges from a contemporary reassessment of the most expressive pinnacle of Abraham Maslow’s hierarchy of needs. In elevating the self, Maslow erroneously disconnected “the desire to fulfill one’s own unique potential” from the biological foundations of human motivation. Self-actualization fails on strictly sociological grounds, since “any self-inflating tendencies that were not calibrated
to others' respect could have maladaptive consequences for success in social groups.”162

What the social psychologist calls self-actualization may prove to be nothing more impressive than overconfidence or, given a sufficiently large departure from social acceptance, unfiltered narcissism.163 Contemporary psychological sources informing have therefore “remov[ed] self-actualization” from a revised version of Maslow’s pyramid, as a concession to the reality that the “privileged position” once accorded to self-actualization “cannot be compelled [or] justified by the functional logic of human evolutionary biology.”164 Even Maslow himself, in later elaborations of his own theory, felt compelled to add altruism, spirituality, and a sense of something outside or larger than the self to the top layer of his pyramid of needs and motivations.165

As we saw with even the briefest of glances at contemporary thought in design and architecture, Adolf Loos’s strict separation of utilitarian and ornamental elements has proved too doctrinaire. Likewise, some vitality remains in Abraham Maslow’s notion of self-actualization. Even amid the impending calamity of the advancing Anthropocene epoch, a desire for some shot at greatness remains intact. Appropriately enough, agricultural economics opens a back door by which personal ambition and self-expression may reassert themselves within the risk-taking calculus of existential struggle.

During the formative stages of modern behavioral economics, agricultural economists leapfrogged the rest of the “axiomatically minded” profession in acknowledging both “risk and risk aversion” and in connecting “behavior . . . to need by a simple rule called the safety-first principle.”166 Agricultural economics thereby became one of the first branches of economics to embrace Arthur Roy’s safety-first criterion, a financial optimization rule that minimizes the

162. Id. at 298; see also Robert Kurzban & C. Athena Aktipis, Moodularity and the Social Mind: Are Psychologists Too Self-ish?, 11 PERSONALITY & SOC. PSYCHOL. REV. 131–49 (2007).


164. Kenrick et al., supra note 161, at 298.


probability that an investor would realize actual returns below some minimally acceptable baseline. Under the influence of Roy’s safety-first criterion, behaviorally mediated investment portfolios depart considerably from the recommendations of the neoclassical capital asset pricing model. By and large, human investors bowing to their innate heuristics and cognitive biases assemble portfolios that combine large, relatively safe positions (often in fixed-income instruments) with a few highly speculative investments with immense upside potential.

This “bonds and bullets” approach to risk-taking may be a human universal. It certainly is prevalent across economic and cultural boundaries. Affluent investors in developed economies are not alone in blending defensive, risk averse strategies with all-or-nothing bets. Similar behavior has been observed among subsistence farmers, for whom risk is such a stark “fact of [the] physical and social environments” that “one’s livelihood can be literally threatened from all sides (by floods, by pests, by invading armies).” The portfolio optimization problem in subsistence agriculture is one of allocating extremely scarce resources between two assets with radically different risk profiles. “Food crops provide food for the table and have low variance of return, but their expected return is also low.” In other words, food crops provide the closest thing to a guarantee of survival, but at a level of abject poverty. “Cash crops,” by contrast, “are more variable but have higher expected return.” Saving seed corn while simultaneously shooting for the moon appears to be the innate, modal financial strategy of humankind.

The myriad solutions to this problem “all boil down to a simple rule: first take care of subsistence needs (food for the larder and seed for the coming season) and then plant cash crops.” Subsistence farmers’ portfolio strategy consists of planting low-return food crops “to the point where . . . subsistence needs are met,” but remaining probabilities

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170. Lopes, supra note 166, at 287.

171. Id.

172. Id.

It is tempting to restate this strategy in simple fashion: “farmers gamble on cash crops because they aspire to escape poverty.” Critically, however, subsistence farmers do not view themselves as gambling. Paraphrasing a subsistence farmer’s “preference for subsistence over starvation” as “a preference for \( X \) chance of \( Y \) income over \( X \) . . . totally misrepresents his options.” It is more honest and accurate to visualize food crop and cash crop allocations in subsistence agriculture as the simultaneous satisfaction of the same emotions of fear, hope, and aspiration that motivate wealthier actors. Although “fear of falling below subsistence motivates the allocation to food crops” in what must be considered a truly compelling application of the safety-first criterion, the enduring “aspiration of escaping poverty motivates the allocation of the remainder to cash crops.” Indeed, under sufficiently dire conditions, “it is quite rational” for subsistence farmers “to devote relatively greater acreage to cash crops,” since such a strategy represents their sole “hope to maximize their chances of survival.”179

Similar incentives motivate diamond miners in desperately poor countries such as Sierra Leone. Lacking \textit{ex ante} capital of their own, African artisanal diamond miners “typically work on credit and share [any] profits” from mining “with their creditors.” Because these miners “do not refund any part of the credit that cannot be recovered from their earnings” in the event of a loss from a mine’s failure to recover diamonds, miners engage in a form of “gambling for resurrection” akin to the “excessive risk taking” that characterizes financially distressed firms on the verge of default in developed economies.182

175. Id.
178. Shefrin & Statman, supra note 174, at 137.
The lopsided allure of a huge payoff for the luckiest miners contributes to the “resource curse” that stunts the economic development of some of the world’s countries holding immense amounts of mineral wealth and other natural resources.\textsuperscript{183}

Wealthier investors combine low and high aspirations similar to those of subsistence farmers and diamond miners in the developing world: Affluent people “want to avoid poverty,” to be sure, “but they also want a shot at riches.”\textsuperscript{184} True to Maslowian psychology, such investors build “layered pyramids” that “divide . . . current wealth between a bottom layer, designed to avoid poverty, and a top layer, designed for a shot at riches.”\textsuperscript{185} In the special case of “cautious optimism,” fear predominates asset allocation “except for the upper end of the range.”\textsuperscript{186} By “overweight[ing] the probabilities attached to both the worst and best outcomes,” a cautious optimist produces “a weighting scheme with thicker tails than the underlying distribution.”\textsuperscript{187} In the language and logic of statistical moments, this is kurtosis preference. Thus arises the all-or-nothing structure, or at least the ubiquitous bonds-plus-bullets allocation associated with behavioral portfolio theory. “A cautious optimist,” being “inclined to extremes in the two layers of his portfolio,” chooses “a risk-free bond for his low aspiration account,” and then searches on the basis of “[i]ncreased hope” for “the maximum possible payoffs in [the] high aspiration . . . accounts.”\textsuperscript{188}

To the extent that preparedness for a disaster the size of the Anthropocene “is about assembling the best portfolio of legal rules to deal with catastrophic risks,”\textsuperscript{189} agricultural and behavioral economics both predict that human decision-makers will strive simultaneously for subsistence and a shot at greatness. Survival and strict utilitarianism, to be sure, represent the first order of business. But a desire for ornament and expression also endures. Despite threats to its productive capacity, agriculture in the developed world devotes extraordinary energy to ornamental and sacramental concerns, to the detriment of the global interest in staving off resource exhaustion and evolutionary checkmate. Those who can afford to do so, fetishize food. Those who cannot, starve. This is the iron law of food security in the Anthropocene. Though burdened by a suddenly palpable risk of extinction,

\begin{itemize}
\item \textsuperscript{183} See, e.g., Roy Maconachie & Tony Binns, Beyond the Resource Curse? Diamond Mining, Development and Post-Conflict Reconstruction in Sierra Leone, 32 RESOURCES POL’Y 104 (2007).
\item \textsuperscript{184} Shefrin & Statman, supra note 174, at 141.
\item \textsuperscript{185} Id.
\item \textsuperscript{186} Id. at 145.
\item \textsuperscript{187} Id.
\item \textsuperscript{188} Id.
\item \textsuperscript{189} DISASTER LAW AND POLICY, at xxi (Daniel A. Farber et al., eds., 3d ed. 2015); accord Susan S. Kuo & Benjamin Means, Corporate Social Responsibility After Disaster, 89 WASH. U. L. REV. 973, 975 n.11 (2012).
\end{itemize}
Anthropocene humanity still responds, with all the romance that it can muster, to “the rift of dawn, the reddening of the rose.”

Ontogeny recapitulates phylogeny. If we are foreordained by evolution and natural history to gamble, we should at least take well-informed risks. American journalist Damon Runyon (1880–1946) once advised the risk averse, “[t]he race is not always to the swift nor the battle to the strong, but that’s the way to bet.” For his part, Nikos Dándolos (1883–1966)—better known as Nick the Greek—celebrated the “[r]isk seekers” who “dog the long shots, waiting . . . for ‘that one streak of luck, properly ridden and encouraged,’ to compensate them for all the bad times.”

“Ships at a distance have every man’s wish on board. For some they come in with the tide. For others they sail forever on the horizon, never out of sight . . . .” For “riches” do not fall “to the intelligent, nor favor to [people] of skill; but time and chance happen to them all.”

If humanity does survive the Anthropocene and the ecological crises of its own creation, “the planet itself, the whole planet, would be [our] monument.” Until that moment of glory arrives, some decades or even centuries beyond an age that is as unsustainable as it is gilded, we are well advised to prioritize survival and resource conservation in policies regarding food and agriculture. The prosperity that marks humanity’s rise during the Anthropocene masks an abiding menace of extinction. In humanity’s new and final chapter, we may yet lie “down to die in the midst of [our] victory.”

190. Markham, supra note 24, at 16.
192. Lopes, supra note 166, at 276 (quoting Ted Thackrey, Jr., Gambling Secrets of Nick the Greek 67 (1968)).
196. Id.