



2018

Kentucky's Agricultural and Ecological Future: Designing Legal and Policy Initiatives for the Commonwealth to Develop Tomorrow's Foodcrops

John W. Head
University of Kansas

Follow this and additional works at: <https://uknowledge.uky.edu/kjeanrl>



Part of the [Agriculture Law Commons](#)

[Right click to open a feedback form in a new tab to let us know how this document benefits you.](#)

Recommended Citation

Head, John W. (2018) "Kentucky's Agricultural and Ecological Future: Designing Legal and Policy Initiatives for the Commonwealth to Develop Tomorrow's Foodcrops," *Kentucky Journal of Equine, Agriculture, & Natural Resources Law*: Vol. 11 : Iss. 1 , Article 3.

Available at: <https://uknowledge.uky.edu/kjeanrl/vol11/iss1/3>

This Essay is brought to you for free and open access by the Law Journals at UKnowledge. It has been accepted for inclusion in *Kentucky Journal of Equine, Agriculture, & Natural Resources Law* by an authorized editor of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

Kentucky's Agricultural and Ecological Future: Designing Legal and Policy Initiatives for the Commonwealth to Develop Tomorrow's Foodcrops

*John W. Head**

OUTLINE

- I. INTRODUCTION: KENTUCKY AGRICULTURE TODAY AND IN 2070
 - A. *The Ecological Setting: Kentucky's Natural Riches*
 - i. *Ecoregions NA0402, NA0404, and NA0409*
 - ii. *Foodcrop and other agricultural production in Kentucky*
 - B. *The Historical Setting: Kentucky's Agricultural Journey*
 - i. *Kentucky as a model of agricultural adaptation and innovation*
 - ii. *Proactive policies: reviving hemp*

- II. MODERN EXTRACTIVE AGRICULTURE AND ITS FAILINGS
 - A. *Fossil Carbon and Agriculture*
 - i. *An addiction to extraction*
 - ii. *Fossil carbon slavery*
 - B. *Ecological, Economic, and Social Unsustainability*
 - i. *The ecological dead end of modern extractive agriculture*
 - ii. *Economic and social unsustainability*

* John W. Head holds the Robert W. Wagstaff Distinguished Professorship at the University of Kansas, where he concentrates on international and comparative law. His recent books include texts on global business law, on international agricultural reform, on Chinese dynastic history, on the Asian Development Bank, and on global legal regimes to protect the world's grasslands. He has also written numerous monographs, articles, and other works relating to international law, some of which have been published in Chinese and Indonesian. Mr. Head has been awarded Fulbright teaching and research fellowships to China, Italy, and Canada, and has also taught in Austria, Hong Kong, Jordan, Mexico, Mongolia, Turkey, and the United Kingdom. Special thanks go to Bridget Brazil and Wesley Williams for their assistance in researching and preparing this article.

III. NATURAL-SYSTEMS AGRICULTURE AND ITS PROSPECTS

- A. *Agroecological Husbandry*
 - i. *The ecosystem as the standard*
 - ii. *Perennial polycultures: are they feasible?*
- B. *Arresting and Reversing Unsustainable Agricultural Practices*
 - i. *Soil and climate change*
 - ii. *Economic issues*
 - iii. *Humans and the ecosystem*

IV. LEGAL AND POLICY STEPS TO BUILD KENTUCKY'S AGROECOLOGICAL FUTURE

- A. *A 50-Year Farm Policy*
 - i. *Pusillanimous precedents: what other states have done*
 - ii. *Progressive policy: what Kentucky should do*
- B. *Today's Innovations for Tomorrow's Agricultural Success*
 - i. *Research and development*
 - ii. *Education and the future*

V. CONCLUDING OBSERVATIONS

SYNOPSIS

Kentucky should take robust initiatives to transform its own agriculture. Given both (1) the Commonwealth's history of agricultural innovation and adaptation and (2) recent agricultural-research successes in developing new foodcrops,¹ Kentucky agriculture holds unprecedented promise for Kentuckians—not just today's generations but tomorrow's as well. Fulfilling this promise requires first acknowledging the dead-end character of some existing "extractive" agricultural practices, particularly those showing an addiction to fossil-carbon inputs, and then

¹ While I recognize that the term "foodcrops" often appears as two words ("food crops," with "food" as the adjective and "crops" as the noun), I see value in using the single-word version, partly in order to distinguish foodcrops from "feedcrops" and "feedgrains" that are used predominantly in feeding livestock. Both of those latter two terms often (although by no means always) appear as single words. Likewise, the single-word version is often used for "foodgrains," which is a somewhat narrower term than "foodcrops" as I use it here.

developing new natural-systems agricultural practices that will prove sustainable and enriching for the Commonwealth's soil and society. Taking these initiatives should involve specific legal and policy steps outlined in this Essay.

I. INTRODUCTION: KENTUCKY AGRICULTURE TODAY AND IN 2070

From both an ecological perspective and a historical perspective, the people of Kentucky are rich. I refer not to per-capita income or to the balances held in personal investment portfolios or retirement accounts, but rather (1) to the natural ecosystems that the people of Kentucky share with each other and with other components of their natural world, and (2) to the Commonwealth's varied and storied agricultural tradition.

In this opening section of my Essay, I wish to highlight a few aspects of these ecological and historical riches in order to set the stage for envisioning Kentucky's agricultural future, especially for the next fifty years or so. Then in sections II and III, respectively, I will explore some negative aspects of our modern form of agriculture and then some prospects for agricultural reform that can help Kentuckians both (1) to preserve and enhance their natural riches and (2) to build on their progressive agricultural history. In section IV, I offer specific legal and policy steps that can facilitate such reforms.

I live in Kansas, not Kentucky, and I am first to acknowledge that I take an outsider's view of Kentucky agriculture. However, I do have deep family roots in Kentucky: three generations of my ancestors lived near the small town of Pleasureville, which lies at the border of Henry County and Shelby County just northwest of Frankfort. My branch of the family migrated in the early nineteenth century to northeast Missouri, and it was there that I grew up on a farm and came to understand something of rural and agricultural life. That northeast Missouri farm remains in our family, and now my wife and I live on another farm in northeast Kansas. Drawing from this rural background, I have for several years participated in a broad effort to improve agricultural practices and policies in a range of ecosystems around the world. In addition to these rural roots, my academic pursuits have provided me with an opportunity to examine and evaluate these issues through the lens of the law, and I see the

Commonwealth of Kentucky at an especially promising crossroad in its agricultural story.

The editors of the *Kentucky Journal of Equine, Agriculture, & Natural Resources Law* have kindly invited me to offer my comments on Kentucky's agricultural prospects. In doing so, I draw some on a book I published recently titled *International Law and Agroecological Husbandry*.² With the kind permission of the *Journal* editors, I have fashioned this article largely in the form of a brief but highly structured Essay; it is relatively light on footnote citations, since interested readers can find citations to numerous sources in my earlier book.

A. *The Ecological Setting: Kentucky's Natural Riches*

i. *Ecoregions NA0402, NA0404, and NA0409*

The territorial boundaries of the Commonwealth of Kentucky encompass portions of three "eco-regions" as defined by the World Wildlife Fund. Figures 1, 2, and 3 show the outlines of Ecoregions #NA0402, #NA0404, and #NA0409 (two maps in each case, drawn from different sources) superimposed on the state borders of Kentucky and some of its neighboring states (including Kansas and Missouri, my home states).³ In each of the three Figures, the image on the *left* provides a close-up of the pertinent ecoregion and shows also the territorial boundaries of nearby ecoregions, whereas the image on the *right* provides a slightly less-

² JOHN W. HEAD, INTERNATIONAL LAW AND AGROECOLOGICAL HUSBANDRY: BUILDING LEGAL FOUNDATIONS FOR A NEW AGRICULTURE (2017) [hereinafter AGROECOLOGICAL HUSBANDRY].

³ The maps in Figures 1, 2, and 3 are sourced (with marginal modifications) from the following webpages, with associated attributions: Figure 1, map on left, David M. Olson & Eric Dinerstein, *The Global 200: Priority Ecoregions for Global Conservation*, ANN. MISSOURI BOT. GARD. 89, 125–26, <http://bioimages.vanderbilt.edu/ecoregions/50402.htm> [<https://perma.cc/YC9S-ZQYL>]; Figure 1, map on right, TAYLOR H. RICKETTS ET AL., TERRESTRIAL ECOREGIONS OF NORTH AMERICA: A CONSERVATION ASSESSMENT, 485 (Island Pres 1st ed. 1999) https://commons.wikimedia.org/wiki/File:Appalachian_mixed_mesophytic_forests_map.svg [<https://perma.cc/7898-XJYZ>]; Figure 2, map on left, Olson & Dinerstein *supra*, at 125–26, <http://bioimages.vanderbilt.edu/ecoregions/50404.htm> [<https://perma.cc/Y4WC-9XWY>]; Figure 2, map on right, RICKETTS *supra*, at 485, https://commons.wikimedia.org/wiki/File:Central_U.S._Hardwood_Forests_map.svg [<https://perma.cc/A387-WM4Z>]; Figure 3, map on left, Olson & Dinerstein *supra*, at 125–26, <http://bioimages.vanderbilt.edu/ecoregions/50409.htm> [<https://perma.cc/2ADW-NS45>]; Figure 3, map on right, RICKETTS *supra*, at 485, https://commons.wikimedia.org/wiki/File:Mississippi_Lowland_Forests_map.svg [<https://perma.cc/UG4R-KEYM>].

detailed outline of the pertinent ecoregion, shown in the overall context of the eastern portion of the United States.

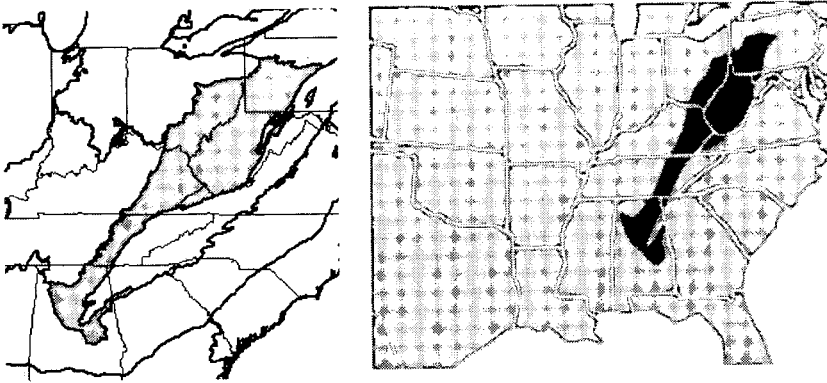


Figure 1. Appalachian Mixed Mesophytic Forests Ecoregion (Ecoregion #NA0402)

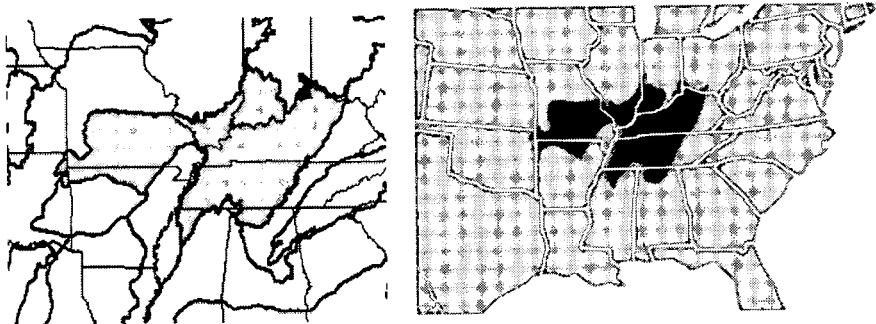


Figure 2. Central U.S. Hardwood Forests Ecoregion (Ecoregion #NA0404)

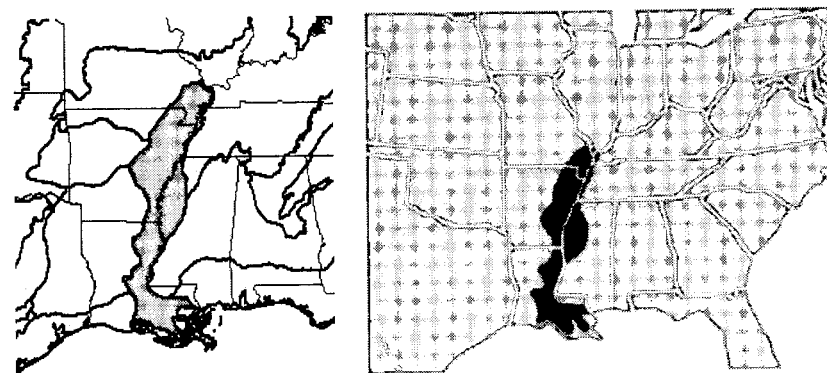


Figure 3. Mississippi Lowland Forests Ecoregion (Ecoregion #NA0409)

The maps in Figures 1, 2, and 3 reflect the work of researchers who, about two decades ago, prepared a system of maps identifying 867 distinct terrestrial ecoregions on the Earth. Each of these ecoregions reflects its own specific combination of climate (temperature, rainfall, wind, and the like), soil types, land cover, species diversification, and other geographical features—with special attention in the case of land cover to what the “natural” landscape would look like without substantial human interference or re-shaping.⁴

As Figure 2 shows, most of central and western Kentucky falls within the Central U.S. Hardwood Forests Ecoregion (#0404). The World Wildlife Fund offers this brief description on its website:

[B]roadleaf deciduous trees dominate the Central U.S. Mixed Hardwood Forests. This region receives less precipitation than the more coastal areas [to the east], however, so drought-resistant oak-hickory forests predominate here. While other forests in the United States and Canada have both oak and hickory, this region was once the only one where both species occurred in abundance over a large area. *Much of the natural habitat in this ecoregion has now been destroyed by development and agriculture.*⁵

The border dividing that ecoregion from the Appalachian Mixed Mesophytic Forests Ecoregion (Ecoregion #0402, shown in Figure 1) corresponds, of course, to the Appalachian mountain range as it runs from northeast to southwest across the eastern portion of the Commonwealth—defined most prominently by the Pottsville Escarpment (also called the Cumberland Escarpment),

⁴ For details about the World Wildlife Fund classification system, which involves not only ecoregions but also biomes and “biogeographical realms,” see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 169–70, 374–79.

⁵ A. Weakley et al., *Central U.S. Hardwood Forests*, WORLD WILDLIFE FUND, <https://www.worldwildlife.org/ecoregions/na0404> [hereinafter *Central U.S. Hardwood Forests*] (emphasis added) [<https://perma.cc/KXH4-C9N8>]. From an environmental perspective, the World Wildlife Fund designates the “status” of this ecoregion as “Critical/Endangered.” *Id.*

which marks the western edge of the Cumberland Plateau. The World Wildlife Fund explains that Ecoregion #0402 “represent[s] relicts of ancient mesic forests that once covered much of the temperate regions of the Northern Hemisphere” and that these forests “acted as a mesic refuge during drier glacial epochs for a wide range of taxa.”⁶

ii. Foodcrop and other agricultural production in Kentucky

I have concentrated above on the “ecoregions” in Kentucky on the assumption that many Kentuckians will not be familiar with those designations, nor with the extent to which the natural habitat and landscapes within those regions (including inside Kentucky’s borders) have been destroyed. This destruction has come largely by conversion to agriculture. What I am proposing in this Essay is that Kentucky agriculture should be changed in order to reverse its negative impacts and to usher in a better agricultural and environmental future for Kentuckians. In order to lay the groundwork for my proposal, let us examine some details of Kentucky agriculture as it stands today.

The Commonwealth’s agricultural production comes mainly from its central and western regions. A well-known physiographic map of Kentucky, reproduced in Figure 4,⁷ designates these regions as the Mississippian Plateau, the Western Coalfield, and the inner and outer bluegrass regions in north-central Kentucky. The production of foodcrops—a generic

⁶ C. Louks, *Appalachian Mixed Mesophytic Forests*, WORLD WILDLIFE FUND, <https://www.worldwildlife.org/ecoregions/na0402> [<https://perma.cc/TH2R-V6TX>]. The World Wildlife Fund designates the “status” of this ecoregion as “Critical/Endangered,” explaining that “[o]ver 95 percent of [the ecoregion’s] habitat, perhaps more, has been converted or degraded at some point in the last 200 years . . . [especially through use] for agriculture, coal mining, logging for charcoal, dams, and road building. *Most of the agricultural lands have subsequently failed and are being abandoned.*” *Id.* (emphasis added).

⁷ The map in Figure 4 dates from several decades ago and was described in a 2001 United States Geological Survey publication as having been “adapted from a map originally prepared (around 1932) by A.K. Lobeek [*sic: should read Lobeck*] and reproduced by McFarlan (1943, p. 3). The map shows the extent of Kentucky’s physiographic regions, the distribution of prominent topographic features that border the regions, and the general trend of major rivers.” Wayne L. Newell, *Contributions to the Geology of Kentucky: Physiography in THE GEOLOGY OF KENTUCKY – A TEXT TO ACCOMPANY THE GEOLOGIC MAP OF KENTUCKY*, USGS (Robert C. McDowell ed., 1986), <https://pubs.usgs.gov/pp/p1151h/physiography.html> [<https://perma.cc/MF2Q-PRBH>].

term that I use to encompass corn, soybeans, wheat, and similar seed-producing grain and legume crops—occurs mainly to the west; equine operations take place mainly in the north-central areas.

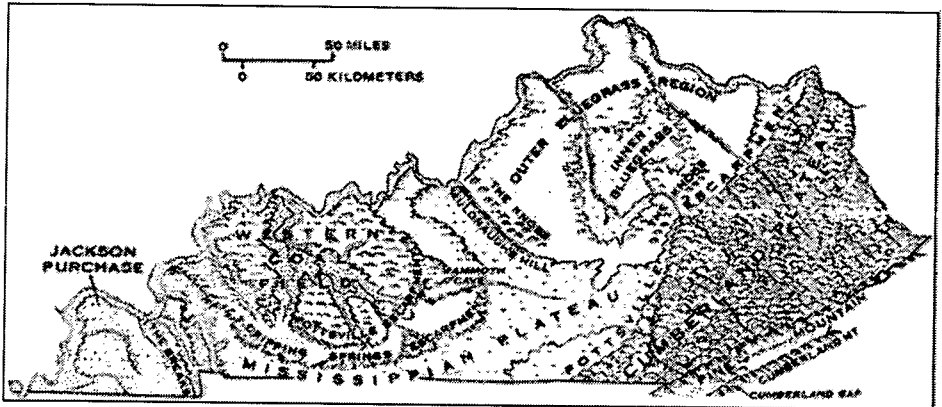


Figure 4. Physiographic map of Kentucky⁸

My particular interest here focuses mainly on foodcrops, especially grains and legumes. This is where dramatic research-based innovations are occurring that I find especially promising for Kentucky, as well as for other portions of the United States where grains and legumes are grown. After all, grains and legumes comprise well over half of the total global human caloric intake.⁹

Kentucky makes impressive contributions to the country's—and to the world's—foodgrain production. The Commonwealth devotes nearly two million acres of its territory to soybean production, well over a million acres to corn production,

⁸ See Newell, *supra* note 7. This image is a work of a United States Geological Survey employee, taken or made as part of that person's official duties. As a work of the United States Government, the image is in the public domain in the United States.

⁹ AGROECOLOGICAL HUSBANDRY, *supra* note 2, at xi, 3; See also *Staple Foods: What Do People Eat?*, FAO, <http://www.fao.org/docrep/u8480e/u8480e07.htm> [<https://perma.cc/Y89L-GU2W>] (noting that just fifteen crop plants supply 90 percent of the world's food energy intake, with three of those—rice, corn, and wheat—making up two-thirds of this).

and nearly half a million acres to wheat production.¹⁰ Naturally, these commitments of land and labor to foodcrop production fit within a larger fabric of Kentucky agriculture more generally. Consider the following key facts about that larger fabric of Kentucky agriculture:¹¹

- Kentucky has about 77,000 farms, occupying a total farm acreage of nearly ten million acres (out of a total landmass area of about 25.4 million acres).¹² Based on sales in the open market, the total value of Kentucky's agricultural products amounts to just over \$5 billion—divided almost evenly between crop production and livestock production.¹³
- The top five counties in agricultural sales are all found in the western half of Kentucky. In 2012 these were led by Graves County (accounting for nearly seven percent of state agriculture receipts), followed by Christian County, Todd County, McLean County, and Daviess County (each accounting for just under four percent).¹⁴
- In recent years, broiler chickens have been the Commonwealth's top agricultural commodity, accounting for more than \$1 billion of the total farm receipts—roughly one-fifth of the total farm receipts for

¹⁰ See *2018 State Agriculture Overview – Kentucky*, U.S. DEP'T OF AGRIC., https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=KENTUCKY [<https://perma.cc/EXD3-4EJZ>] [hereinafter *2018 Overview*].

¹¹ See *2016–2017 Kentucky Agricultural Economic Situation and Outlook*, UNIV. OF KY. COLL. OF AGRIC., FOOD AND ENV'T, <http://www.uky.edu/Ag/AgEcon/pubs/extoutlook161758.pdf> [<https://perma.cc/79T5-4297>] (offering a recent synopsis of agricultural activity in Kentucky).

¹² *2018 Overview*, *supra* note 10; See National Association of State Foresters, *Land Acreage – Total by State*, STATEMASTER.COM, http://www.statemaster.com/graph/geo_lan_acr_tot-geography-land-acreage-total [<https://perma.cc/NH9G-246G>] (citing land-acreage statistics of U.S. states).

¹³ *2018 Overview*, *supra* note 10.

¹⁴ *State Fact Sheets: Kentucky*, U.S. DEP'T OF AGRIC. ECON. RES. SERV. (last updated Mar. 6, 2019), <https://data.ers.usda.gov/reports.aspx?StateFIPS=21&StateName=Kentucky&ID=17854> [<https://perma.cc/RPG3-C9GQ>] [hereinafter *State Fact Sheets*].

Kentucky.¹⁵ The poultry industry in Kentucky accounts for approximately 7,000 employees and pays out nearly \$320 million in wages.¹⁶

- Other livestock operations feature cattle and horses. Cattle constituted the Commonwealth's fourth-highest agricultural commodity in 2017, accounting for \$740 million of Kentucky's roughly \$5 billion worth of farm receipts.¹⁷ Kentucky ranks eighth in the nation for beef-cattle inventory and has the most cattle of any state east of the Mississippi River.¹⁸ Moreover, Kentucky is the number one state in horse sales, with a 2012 United States Department of Agriculture (USDA) report valuing horse sales at nearly \$179 million.¹⁹ The 2012 Kentucky Equine Survey estimated that total equine-related income—which took into account maintenance, breeding, and other sources of income—amounted to \$1.1 billion in 2011.²⁰ Beyond that, of course, Kentucky's reputation and profile benefit greatly from its status as horse capital of the world—a status reflected in the fact that this Essay is being published in a Kentucky-based journal devoted substantially to equine law.
- In recent years, soybeans have been Kentucky's third-highest agricultural commodity, constituting the Commonwealth's highest crop commodity and agricultural export.²¹ Soybean receipts in 2017 amounted to \$825 million, which comprises nearly fifteen percent of the Commonwealth's total farm

¹⁵ *Id.*

¹⁶ *Kentucky Agriculture Facts*, KY. FARM BUREAU 10 (2015), <https://cdn.kyfb.com/KYFB/assets/File/Federation/Kentucky%20Ag/CommodityBooklet2015.pdf> [<https://perma.cc/BEG9-BQZW>] [hereinafter *Kentucky Agricultural Facts*].

¹⁷ *State Fact Sheets*, *supra* note 14.

¹⁸ *Kentucky Agriculture Facts*, *supra* note 16, at 13.

¹⁹ *2018 Overview*, *supra* note 10.

²⁰ *2012 Kentucky Equine Survey*, UNIV. OF KY. COLL. OF AGRIC., FOOD AND ENV'T 5 (Sept. 6, 2013), https://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1000&context=equine_reports [<https://perma.cc/4U6E-WNBN>].

²¹ *State Fact Sheets*, *supra* note 14.

receipts.²² Soybean exports amounted to approximately \$480 million, making Kentucky the fifteenth-highest soybean exporting state in the United States.²³ Nearly two million acres were planted in soybeans, which in 2017 yielded fifty-three bushels per acre.²⁴ Soybean production is heavily subsidized, involving \$40.5 million in subsidies to Kentucky farmers in 2017.²⁵

- Kentucky's second-highest crop commodity is corn,²⁶ constituting the fifth-highest agricultural commodity overall in 2017.²⁷ Farm receipts for corn in that year amounted to approximately \$720 million, with \$140 million in exports. More than a million and a quarter acres were planted in corn, and roughly two-thirds of the harvest was devoted to grain (the remainder to silage).²⁸ Yields in 2018 broke the Commonwealth's record with 175 bushels per acre for grain and 215 million total bushels.²⁹
- Kentucky corn is used primarily for animal feed and for use in producing fuel ethanol and products of Kentucky's bourbon and spirits industry.³⁰ Like soybean production, corn production is heavily subsidized; it attracts over one-third of total agricultural subsidies received in the Commonwealth.³¹

²² *Id.*

²³ *Id.*

²⁴ *Id.*

²⁵ *Kentucky Farm Subsidy Information*, ENVTL WORKING GRP., <https://farm.ewg.org/region.php?fips=21000> [<https://perma.cc/L8YA-3M4D>] [hereinafter *Subsidy Information*].

²⁶ *Kentucky Agriculture Facts*, *supra* note 16, at 18.

²⁷ *State Fact Sheets*, *supra* note 14.

²⁸ *Id.*

²⁹ *Kentucky Corn Facts*, KY. CORN GROWERS ASS'N, <https://www.kycorn.org/ky-corn-facts/> [<https://perma.cc/5WWA-FGD4>].

³⁰ *Id.*

³¹ *Subsidy Information*, *supra* note 25.

- Unlike my home state of Kansas, Kentucky does not dominate the market in wheat.³² Still, the Commonwealth's wheat harvests, concentrated in the southwestern corner of its territory, are impressive, so that Kentucky ranks in the top one-third of all U.S. states in wheat production.³³ Specifically, in 2016 Kentucky ranked fifteenth nationally in winter wheat, fifteenth in soybeans, and fourteenth in corn for grain.³⁴ A total of 450,000 acres were planted in wheat in 2018.³⁵ The crop yielded sixty-six bushels per acre.³⁶ Like corn and soybeans, wheat production is heavily subsidized, and over the past two decades a total of \$380 million in wheat subsidies has been paid to Kentucky farmers.³⁷
- While it is not a foodcrop, tobacco plays an important role in Kentucky agriculture. Tobacco was the Commonwealth's third highest agricultural export in 2017, with more than \$253 million in exports.³⁸ Kentucky is the top producer of burley and fire-cured tobacco production and the second highest producer of total tobacco nationally.³⁹ Farmers harvested 68,100 acres of tobacco in 2017, with a total yield of more than 134 million pounds.⁴⁰ Kentucky tobacco production—which occurs throughout the central part of the Commonwealth—was heavily subsidized in the past, but not in the last five years or so.⁴¹ The future of

³² See *Kentucky Agriculture Facts*, *supra* note 16, at 24; see also *State Fact Sheets*, *supra* note 14. (referencing the fact that wheat is not one of the top five exports in Kentucky).

³³ *A Quick Guide: Agricultural Facts – Kentucky Agriculture 2017*, U.S. DEP'T OF AGRIC. NASS, https://www.nass.usda.gov/Statistics_by_State/Kentucky/Publications/Pamphlets/KYataGlance2016.pdf [<https://perma.cc/UV4H-DFZR>] [hereinafter *Quick Guide*].

³⁴ *Id.*

³⁵ *2018 Overview*, *supra* note 10.

³⁶ *Id.*

³⁷ *Subsidy Information*, *supra* note 25.

³⁸ *State Fact Sheets*, *supra* note 14.

³⁹ *Kentucky Agriculture Facts*, *supra* note 16, at 20.

⁴⁰ *2018 Overview*, *supra* note 10.

⁴¹ *Tobacco Subsidies in Kentucky Totaled \$506 Million from 1995-2017*, ENVTL. WORKING GRP., <https://farm.ewg.org/progdetail.php?fips=21000&progcode=tobacco> [<https://perma.cc/6DT2-TCP2>] [hereinafter *Tobacco Subsidies*].

tobacco in Kentucky is uncertain. While the Commonwealth remains a major producer of the crop, production has been decreasing both for burley tobacco and for fire-cured tobacco.⁴² Health concerns surrounding tobacco use, and a dwindling of contracting between tobacco companies and growers, resulted in predictions that 2018 would see a record low of tobacco planted.⁴³ Many farmers have looked to other crops such as corn, soybeans, or wheat, but have been hesitant to make the full transition due to differences in profits.⁴⁴ Some farmers view hemp—to which I give special attention below in subsection I.B(ii)—as a viable alternative to tobacco production.⁴⁵

- In recent years, hay has been Kentucky's seventh highest agricultural commodity, bringing in more than \$215 million to the Commonwealth in 2015 and representing 3.7 percent of its total agricultural receipts.⁴⁶ In 2016, Kentucky was the seventh-highest producing state for hay, generating over 5.5 million tons of hay.⁴⁷

Through this dizzying flurry of facts, two key themes emerge. First, agriculture plays a central role in Kentucky's current economic realities and prospects. Second, the Commonwealth's agricultural landscape merges both crops and livestock, particularly because of its heavy emphasis on poultry and on horses.

For purposes of this Essay, though, I wish to concentrate mainly on foodcrops—that is, on grains and legumes. Specifically, I pose this question: how might Kentucky write a new chapter in

⁴² *Higher Kentucky Soybean Crop Forecasted, Corn Lower*, U.S. DEP'T OF AGRIC. NAAS (Aug. 10, 2018), https://www.nass.usda.gov/Statistics_by_State/Kentucky/Publications/Current_News_Release/2018/PRAUG18_KY.pdf [<https://perma.cc/PE4A-ZLFF>] [hereinafter *Higher Soybean Crop*].

⁴³ Don Sergeant, *Once King of Kentucky Farms, Burley Tobacco is About to Hit a New Low*, LEXINGTON HERALD-LEADER (April 6, 2018, 12:08 PM), <https://www.kentucky.com/news/business/article208124454.html> [<https://perma.cc/P582-6TW8>].

⁴⁴ *Id.*

⁴⁵ *Id.*

⁴⁶ *Quick Guide*, *supra* note 33.

⁴⁷ *Id.*

its agricultural history by bringing dramatic reforms to the means by which it produces principal seed crops? To consider this question, I briefly examine the Commonwealth's agricultural history. Studying how agriculture has developed in Kentucky up to today can inform an attempt to shape a strong future for Kentucky's agriculture, especially in the face of dramatic economic, ecological, and social changes.

B. The Historical Setting: Kentucky's Agricultural Journey

i. Kentucky as a model of agricultural adaptation and innovation

We might view Kentucky's agricultural history thus far as comprising four main chapters. The first chapter features the farming carried out for many generations by Native Americans. Little detailed information survives from that pre-European period, but agricultural production is thought to have involved squash, sunflower, goosefoot, and maygrass as cultivated plants for food (and tobacco for smoking at important events) during the Woodland period (1000 BCE – 1000 CE) and then corn and beans by the Late Prehistoric period (1000 CE – 1700 CE).⁴⁸

A second chapter in Kentucky's agricultural history begins with European encounter, invasion, and settlement.⁴⁹ In the 1750s and 1760s, early explorers and frontiersmen (such as Daniel Boone) gave accounts of rich land that attracted settlers coming through the Cumberland Gap or down the Ohio River. Subsistence farming was gradually supplemented with commercial farming following Kentucky's admission to the Union in 1792; by that time tobacco was becoming Kentucky's primary cash crop. Kentucky also became a leading producer of the world's hemp supply, used for making rope and fiber products. Corn production also

⁴⁸ See LOWELL H. HARRISON & JAMES C. KLOTTER, A NEW HISTORY OF KENTUCKY 7–8 (Univ. Press of Ky. 1997), [<https://perma.cc/4P58-EPP9>]; see also DOROTHY LAMMLEIN ET. AL., EDS., HISTORY & FAMILIES · OLDHAM COUNTY, KENTUCKY: THE FIRST CENTURY 1824-1924 7–8 (Turner Publishing Co. 1996), [<https://perma.cc/E762-U9CK>].

⁴⁹ Much of the content in this paragraph and the next draw heavily from *General Kentucky State History*, THE US50, <http://www.theus50.com/kentucky/history.php> [<https://perma.cc/DK6C-TTUJ>]; see also *Timeline of Kentucky Coal*, KY. COAL EDUCATION, <http://www.coaleducation.org/coalhistory/timeline.htm> [<https://perma.cc/SR8H-WQMK>].

expanded, partly because of its use in making bourbon whisky, as developed in the late eighteenth century.

A third chapter in Kentucky's agricultural history dates from the mid-1800s and features a broadening of the means of land-use in the Commonwealth to encompass three key products: tobacco (as before), plus the newer additions of horses and coal. With the development of burley tobacco following the Civil War, and then the growing popularity of cigarettes (instead of plug tobacco) following World War I, Kentucky solidified its position as a tobacco powerhouse. In roughly the same time-frame, the raising of thoroughbred horses gained in popularity and economic significance, spurred on by the first racing of the Kentucky Derby in 1875. But another use of land—coal production—also took hold in a substantial way: from modest beginnings in the 1820s, by 1879 the coalfields of western Kentucky were producing a million tons of coal a year. In 1900, the first commercial coal mine opened in the eastern coalfields of Kentucky as railroad lines penetrated previously isolated areas.

A fourth chapter, the current one in Kentucky's agricultural history, presents the two central features that I summarized above in subsection I.A(ii): (1) livestock production—mainly poultry, horses, and cattle—accounts for roughly half of the Commonwealth's agricultural production and receipts; (2) the other half comes from crops—especially soybeans, corn, wheat, and tobacco. The first three of those (soybeans, corn, wheat) have benefited from dramatic increases in yield as a result of the so-called Green Revolution of the 1940s and 1950s, as well as from the heavy subsidization I referred to above in subsection I.A(ii). The last of these (tobacco) has suffered sharp declines in popularity and production because of health issues. For different reasons, hemp became suppressed in its production (I explore this below in subsection I.B(ii)).

The developments that I have organized above into "chapters" in Kentucky's agricultural history reveal the ability of Kentuckians to adapt and to innovate. At various moments in the development of agriculture in the Commonwealth, Kentuckians have responded to innovations—in burley tobacco, for instance, and in grain-crop productivity. Agricultural activity has adapted to these innovations, as well as to other external forces, such as those suppressing tobacco as a mainstay of production in

Kentucky. In short, the Commonwealth might justifiably be considered a model of agricultural adaptation and innovation.

ii. Proactive policies: reviving hemp

Let me offer a specific illustration of Kentucky's ability to adapt and innovate in the agricultural sector of its economic and social life. It is an illustration probably familiar to many Kentuckians, so I can be brief in my account.⁵⁰

The first hemp crop was reportedly raised near Danville in 1775, and the favorable growing conditions led Kentucky to become the greatest producer of U.S. hemp in the nineteenth century. However, hemp production declined after World War I due to market forces such as the rise of tobacco as a more popular Kentucky cash crop and the availability of hemp from foreign sources. The emergence of cheap synthetic fiber following World War II pushed Kentucky hemp production further down.

Then came the so-called "War on Drugs." President Richard Nixon favored, and the U.S. Congress enacted, the Controlled Substances Act of 1970, which virtually banned the production of industrial hemp. That legislation was used to prohibit both industrial hemp and marijuana, despite the fact that industrial hemp has a much lower yield of tetrahydrocannabinol (THC), the psychoactive ingredient found in marijuana. This prohibition lasted for years, so that until quite recently all cannabis varieties, including industrial hemp, were treated as Schedule I controlled substances under the Controlled Substances Act.⁵¹

Efforts to change this stance gained traction in the 1990s. Kentucky's governor Brereton Jones convened a commission in 1994 to investigate legislative pathways to grow hemp legally

⁵⁰ Further details can be found in various works, including JAMES F. HOPKINS, A HISTORY OF THE HEMP INDUSTRY IN KENTUCKY (Univ. of Ky. Press 1951); Ernest Small & David Marcus, *Hemp: A New Crop with New Uses for North America*, in ASS'N FOR THE ADVANCEMENT OF INDUS. CROPS, TRENDS IN NEW CROPS AND NEW USES 284 (Jules Janick & Anna Whipkey eds., 2002); and Lawrence Prescott, *Industrial Hemp Bills Gain Ground in U.S. House & Senate*, MARIJUANA HEMP STOCKS (Dec. 13, 2018), <http://marijuanahemp-stocks.com/industrial-hemp-bills-gain-ground-in-u-s-house-senate/> [https://perma.cc/4UC5-MZWZ].

⁵¹ See Prescott, *supra* note 50.

again. Two decades later, Senate Majority Leader Mitch McConnell succeeded in inserting a provision in the Agricultural Act of 2014 (2014 Farm Bill) permitting research into hemp production.⁵² In 2016, Commonwealth legislation⁵³ provided further support for reestablishing a Kentucky hemp production industry, and the Kentucky Department of Agriculture later established the Kentucky Industrial Hemp Research Pilot Program.⁵⁴

Most recently, the Agricultural Improvement Act of 2018 (2018 Farm Bill) brought substantial reform at the federal level by (1) shifting power to the states to regulate hemp, so long as there is a “state plan” in place to monitor and regulate production of the crop, and (2) removing from the list of controlled substances all industrial hemp (defined as *cannabis sativa*) and all of its extracts so long as they have no more than 0.3 percent THC concentration.⁵⁵ Moreover, the 2018 Farm Bill:

- amends (in § 7129) the existing legislation to allow the Secretary of Agriculture to award grants for conducting research on the development of industrial hemp and of new and emerging commercial products derived from hemp;

⁵² See Agricultural Act of 2014 § 7606, 7 U.S.C. § 5940 (2019).

⁵³ See KY. REV. STAT. ANN. §§ 260.850-260.869 (West 2018); see also *Industrial Hemp Advisory Board*, KENTUCKY GOV., <http://app.sos.ky.gov/openboards/Detail.aspx?BCID=405> [<https://perma.cc/GW4H-HHFY>] (explaining that the Industrial Hemp Advisory Board was established “for the purpose of providing advice and expertise as may be needed by a university or the department [of Agriculture] with respect to plans, policies, and procedures applicable to the administration of its respective industrial hemp research pilot programs.”).

⁵⁴ See *Kentucky Industrial Hemp Research Pilot Program*, KY. DEPT OF AGRIC., <http://www.kyagr.com/marketing/hemp-pilot.html> [<https://perma.cc/8SHN-8JGN>]; see also *Kentucky Hemp Pilot Program*, KY. HEMPSTERS, <https://www.kyhempsters.com/kentuckyhempilotprogram> [<https://perma.cc/RF4H-3WAB>].

⁵⁵ See *2018 Farm Bill and What it Means for Hemp in Kentucky*, KY. DEPT OF AGRIC. [hereinafter *2018 Farm Bill*], http://www.kyagr.com/marketing/program_id/70/documents/HEMP_OV_2018FarmBillHempinKY.pdf [<https://perma.cc/J3WH-LZ38>]. The “state plan” requirement (set out in § 10113) involves demonstrating to the U.S. Department of Agriculture that state authorities have procedures in place to record where hemp is produced in the state, to ensure that such hemp meets the less-than-0.3-percent-THC requirement, to dispose of materials with a THC concentration over 0.3 percent THC, and to handle violations of pertinent rules set out in the 2018 Farm Bill and the state plan itself. *Id.*

- specifies (in § 7501) that hemp is eligible for funding under the Critical Agricultural Materials Act;
- requires (in § 7605) that the Secretary of Agriculture conduct a study on the hemp research pilot program that includes a review of the economic viability of the domestic production and sale of industrial hemp and hemp products; and
- includes (in Title XI) hemp production under crop insurance amendments.

Just how will these legal reforms affect Kentucky and its farmers? This remains to be seen, but the potential economic, ecological, and social consequences are sweeping. With its deep history of hemp production, the Commonwealth seems exceptionally well positioned to reap impressive economic returns from developing it as a “new” crop (either for oilseed or for fiber).⁵⁶ From an ecological perspective, hemp offers important features: one observer asserts that “[h]emp is a farmer's friend because compared with cotton, corn, and soybeans, it requires little water, isn't picky when it comes to poor soil[,] . . . grows tightly spaced, thus crowding out weeds, and boasts a deep, soil-aerating root system.”⁵⁷ And from a social perspective, perhaps the expanded

⁵⁶ For a 2015 National Public Radio report on Kentucky farmers switching from tobacco to hemp, see Christopher Booker, *Why Kentucky Farmers Are Quitting Tobacco and Turning to an Unlikely New Crop*, PBS NEWSHOUR (Oct. 17, 2015), <https://www.pbs.org/newshour/show/kentucky-agriculture-banking-hemp> [<https://perma.cc/3NET-CHY2>]; see also Bourree Lam, *From Growing Tobacco to Growing Hemp*, THE ATLANTIC (Oct. 27, 2016), <https://www.theatlantic.com/business/archive/2016/10/hemp-farmer/505604/> [<https://perma.cc/77HC-AYV2>].

⁵⁷ Andre Bourque, *How Hemp and The Farm Bill May Change Life As You Know It*, FORBES (Dec. 17, 2018, 9:39 AM), <https://www.forbes.com/sites/andrebourque/2018/12/17/how-hemp-and-the-farm-bill-may-change-life-as-you-know-it/#2eec055f694c> [<https://perma.cc/QWG4-86UV>]. Another observer makes similar remarks on hemp's ecological impact: “Hemp is more effective at sequestering carbon than trees, it regenerates the soil through nitrogen fixation, does not require pesticides/herbicides, uses 1/3 water of cotton [and] . . . could be a life line to humanity as we face climate disasters.” Dan Mitchell, *Why Legalized Hemp Will Not Be a Miracle Crop*, MODERN FARMER

economic opportunities will, as one hemp proponent suggests, drive some disenfranchised farmers back to the land.⁵⁸ In short, with the legalization of low-THC hemp, Kentucky seems poised to open a new chapter in its agricultural history.⁵⁹

Such a new chapter in Kentucky agriculture, if it comes, would surely be part of a larger transformation of the Commonwealth's economic, ecological, and social landscape. Intense pressure has built in recent years for such a transformation, particularly now that climate change has emerged as an existential global challenge. For a range of reasons, coal production in Kentucky has declined dramatically over the past two decades; Kentucky government figures show a drop from roughly thirty-five million tons per quarter in 2000 to about ten million tons per quarter last year.⁶⁰

Indeed, while some Kentuckians might wish otherwise, coal cannot—and will not—continue serving for much longer as a primary fuel source. Nor will oil and gas, which also feature quite prominently in Kentucky's economy.⁶¹ Resistance to the prospect

(Oct. 17, 2013), <https://modernfarmer.com/2013/10/legal-industrial-hemp-wont-matter/> [<https://perma.cc/6RVJ-5LNN>].

⁵⁸ Bourque, *supra* note 57 (referencing Bruce Perlowin, the chief executive officer of Hemp, Inc.).

⁵⁹ Kentucky is not alone in promoting hemp. One recent report notes that at least thirty-eight states “are currently allowing some form” of hemp production and that some are exploring its potential as an alternative to more traditional foodcrops. Walker Orenstein, *Hemp is being Touted as the Midwest's Next Big Cash Crop. What Would that Mean for the Environment?*, MINNPOST (Oct. 21, 2018), <https://www.minnpost.com/environment/2018/10/hemp-is-being-touted-as-the-midwests-next-big-cash-crop-what-would-that-mean-for-the-environment/> [<https://perma.cc/B9T9-L3PC>]. For a “fact sheet” on the growing of industrial hemp in Montana, see *Industrial Hemp Production 101*, MONTANA FARMERS UNION, <https://montanafarmersunion.com/wp-content/uploads/2018/03/iHemp-Fact-Sheet.pdf> [<https://perma.cc/ZSM7-46PT>]. For a similar “fact sheet” issued by the government of Manitoba, see *Industrial Hemp Production and Management*, GOV'T OF MANITOBA, <https://www.gov.mb.ca/agriculture/crops/production/hemp-production.html> [<https://perma.cc/P49H-7GHP>].

⁶⁰ *Kentucky Quarterly Coal Report July to September 2018*, KY. ENERGY AND ENV'T CABINET, <https://eec.ky.gov/Energy/News-Publications/Quarterly%20Coal%20Reports/2018-Q3.pdf> [<https://perma.cc/78S5-B5X2>].

⁶¹ See Ryan Watts, *Small, but Mighty: Oil and Gas Industry has Impact on Ky. Economy*, LEXINGTON HERALD-LEADER (Sep 12, 2017, 2:43 PM), <https://www.kentucky.com/opinion/open/article172870786.html> [<https://perma.cc/76PR-MXSA>]. The article notes that although Texas, Oklahoma, and Pennsylvania are the states that come to mind when discussing fossil-fuel extraction, Kentucky actually “falls within the Top 20 for oil and natural gas production. Over half of Kentucky's counties produce oil and/or natural gas”

of a “post-carbon world” remains strong in many parts of the United States.⁶² My own home state of Kansas certainly is one of them. Still, I have absolutely no doubt that humanity will be forced to abandon most fossil-carbon forms of energy production within a matter of years if we wish to avoid what the World Bank has warned of regarding a “four-degree world.”⁶³ Even if we prove incompetent as a species to control and reduce our consumption, we will be forcibly weaned off of nearly all fossil-carbon energy within a matter of decades.

Here I will take a brief personal detour. The reason I know about my own family roots in Kentucky is that my paternal grandfather’s sister Idress Head Alvord, born in 1871, was a professional genealogist. When I think of her, I am embarrassed that she described herself as an “unreconstructed Rebel.” If (as I suspect) this means she would have endorsed slaveholding (Missouri, like Kentucky, was a “border state” during the Civil War), then she probably denied evidence of what today seems beyond any question for enlightened people: all human beings share the same fundamental dignity and should be treated accordingly. I wonder what my Aunt Idress would think of my opinion of her. In like fashion, I wonder what people in my grandchildren’s generation will think of persons alive today who deny evidence of what now seems beyond any question for enlightened people: human action, especially over the past two centuries of ever accelerating fossil-carbon extraction and combustion, has created a global climate crisis that cries out for fundamental change in our behavior as a species. For today’s adults to fall short in fostering such change is shameful; for today’s adults to actively deny the problem is bewildering, or worse.

(especially in the eastern and western corners of the state) and in 2016 “oil and natural gas operators extracted around \$400 million worth of products from nearly 30,000 wells. In fact, these same wells annually produce approximately 3 million barrels of oil and billions of cubic feet of natural gas, which is integrated back into global supplies.” *Id.*

⁶² See Steven Mufson & Tom Hamburger, *A Battle Is Looming Over Renewable Energy, and Fossil Fuel Interests Are Losing*, WASH. POST (Apr. 25, 2014), https://www.washingtonpost.com/business/economy/a-battle-is-looming-over-renewable-energy-and-fossil-fuel-interests-are-losing/2014/04/25/24ed78e2-cb23-11e3-a75e-463587891b57_story.html?utm_term=.9b3b7b1302cb [<https://perma.cc/4GF2-A98N>].

⁶³ See The World Bank, *Turn Down the Heat: Why a 4°C Warmer World Must be Avoided*, at 71, WORLD BANK GROUP (WBG) DOC. 74455 (Nov. 2012), <http://documents.worldbank.org/curated/en/865571468149107611/pdf/NonAsciiFileName0.pdf> [<https://perma.cc/7GMQ-9R9R>].

The heading I used for this introductory section of my Essay is "Kentucky agriculture today and in 2070." As a matter of agricultural policy, what should Kentuckians do both (1) to sustain and expand family-farming opportunities and (2) to plan for the post-fossil-carbon world of 2070, roughly fifty years from now—particularly for a post-coal, post-oil-and-gas, post-tobacco Commonwealth? Agricultural research comes immediately to mind. I have explained above how agricultural research might promote a resurgence of hemp production in Kentucky, and specifically the role that recent legal and policy changes are playing in this regard. As a parallel effort, the Commonwealth might direct its energy (including public funding) toward developing agricultural methods and crops that both (1) require little or no fossil-carbon inputs and (2) contribute much less to greenhouse-gas emissions (and therefore to global climate disruption) than our current forms of agriculture do. I turn to this two-pronged point in sections II and III below, and then in section IV I highlight some legal and policy steps that could put Kentucky at the forefront of progressive agricultural reform.

II. MODERN EXTRACTIVE AGRICULTURE AND ITS FAILINGS

Criticisms of modern agriculture have gained momentum in recent years. I have summarized a wide range of those criticisms in my recent writings, including the book mentioned above, *International Law and Agroecological Husbandry*.⁶⁴ In the following paragraphs I highlight some points that have special pertinence to Kentucky, given its historical involvement with coal, oil, and natural gas. I then explain why I regard modern extractive agriculture as an "ecological, economic, and social dead end" that makes agricultural reform essential for Kentucky's future.

A. Fossil Carbon and Agriculture

According to a global report by the Organisation for Economic Co-operation and Development (OECD), fossil fuels

⁶⁴ See generally, AGROECOLOGICAL HUSBANDRY, *supra* note 2.

made up eighty-four percent of the U.S. primary energy supply in 2013.⁶⁵ This is only one way in which our country is dependent on fossil carbon—that is, the deposits of coal, oil, and natural gas laid down millions of years ago. In the following paragraphs, I will highlight how modern agriculture shares in our thorough “addiction” to fossil carbon—or, to express it differently, how modern agriculture has made humans dependent on “carbon slaves.”

ii. An addiction to extraction

Farming might not intuitively be regarded as an “extractive” process. However, in the case of such grain and legume crops as the corn and soybeans (and some wheat and other foodcrops) that farmers grow in Kentucky, agriculture is definitely extractive in character.⁶⁶ For starters, the very fact that these foodcrops are annuals means that tremendous forces of energy must be harnessed every year to plant them and then to suppress other species that we consider weeds because they compete with the crops we plant. This suppression sometimes takes the form of cultivation—tilling of the soil—but more recently, with “no-till” or “low-till” farming, it has involved the application of pesticides.⁶⁷ Either way, fossil carbon is involved, some in the form of coal (especially in supplying the energy to construct the farm implements) and more in the form of oil and gas (not only in powering the implements but also in producing chemical herbicides, insecticides, and fertilizers that are derived from fossil carbon).⁶⁸

What will happen in the transition to a post-carbon world? For one thing, we can expect—and I believe Kentuckians should plan for—a withdrawal of subsidies for fossil-fuel production in the

⁶⁵ Org. for Econ. Co-operation & Dev. [OECD], *Inventory of Estimated Budgetary Support and Tax Expenditures for Fossil Fuels 2013*, OECD, 370 (2012) [hereinafter OECD Subsidy Report], https://read.oecd-ilibrary.org/environment/inventory-of-estimated-budgetary-support-and-tax-expenditures-for-fossil-fuels-2013_9789264187610-en#page1 [<https://perma.cc/LR4G-S98T>].

⁶⁶ See AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 10–15.

⁶⁷ *Id.*

⁶⁸ *Id.*

United States. I have explained these subsidies in my earlier work.⁶⁹ They encompass a vast range of specialized tax advantages, such as (1) allowing oil and gas producers to “expense” (deduct immediately for tax purposes) a share of their drilling costs and equipment purchases, (2) giving coal mining operations favorable tax treatment on royalty income, and (3) exempting some off-road users of gasoline and diesel fuels, including farming, fishing, forestry, and mining sectors, from federal excise taxes on fuel—as well as government funding for certain fossil-energy research.⁷⁰

ii. Fossil-carbon slavery

What significance do these fossil-carbon subsidies have for agriculture? The types of seed crops grown in Kentucky (and in Kansas and Missouri and most of the other grain-and-legume producing regions in the United States) all rely heavily on fossil carbon and therefore on the fossil-carbon subsidies that I have alluded to above.

In order to emphasize just how dependent modern agriculture is on fossil carbon, my research colleague Dr. Tim Crews of The Land Institute has offered an analysis of “fossil fuel slaves” that we use to grow crops. His analysis draws on a comparison with traditional farming techniques that do not depend on fossil carbon:

In the traditional Mexican farming systems I studied, the fossil fuel share of caloric energy used to grow corn was close to zero. The energy to prepare and plant and weed and harvest the fields came [instead] from the corn and alfalfa that captured energy from sunlight in photosynthesis and went to feed the farmers and their draft animals. David Pimentel of Cornell University estimates that traditional Mexican corn-bean-

⁶⁹ See *id.* at 254–58, drawing from OECD Subsidy Report, *supra* note 65. This OECD report provides details on the many different tax structures that the thirty-four member countries of the OECD have adopted, and it gives estimates on fossil fuel subsidies and preferential tax treatment in those countries.

⁷⁰ *Id.*

squash farms like these yielded about 10 calories of food for every calorie of food metabolized by the farmer. [This is typical of such traditional settings:] Most indigenous or traditional agricultures without fossil fuels had ratios between 10 and 40 calories of food out per calorie of food consumed in farming. This ratio defined the amount of energy available to do everything *outside* farming – create art, play music, worship, fight wars, build things like the Great Wall of China

The fossil fuel share of caloric energy [that is] used to grow corn in the US [today, by contrast,] is 99.96%. We are truly *Homo petrolius*. In agriculture, . . . we have figured out how to use fossil energy to address virtually every ecological limiting factor . . . such as insect damage, weed competition, temperature, and nutrients, and too much or little water. . . .

So in a sense, *modern agriculture relies on the carbon bonds of fossil fuel slaves*. I mean the equivalent work of a human that is accomplished by harnessing the energy of fossil fuels. Some may object to this use of the term *slave*, as it excludes important aspects of what we need to communicate about slavery, such as human exploitation and suffering. But I use it here because I worry about how interchangeable the two energy sources have been in the past, and could be in the future if we are not mindful. The adoption of fossil fuel slaves began in earnest with James Watt's steam engine patent in 1781. One hundred years later, Andrew Nikiforuk writes in "The Energy of Slaves," the output of the world's coal-fired steam engines, primarily for transportation and manufacturing, totaled 150 million horsepower. These machines collectively exerted the work of more than 3 billion humans working long shifts. The world's population at that time was 1.5 billion. So in 1880 there were

at least 2 fossil fuel slaves per human, although not evenly distributed.

Now, if we take the amount of commercial energy consumed in the US today and divide it by the population, and compare this with how much energy a human expends doing physical work, *the sobering conclusion is that on average each of us has 80 fossil fuel slaves working the equivalent of 10 hours a day, 365 days a year.* That is 25 billion human slave equivalents, 3½ times the world population, just to maintain the lifestyle of US citizens. This conversion is not perfect, because some of the commercial energy we rely on does not come from fossil fuels. But the majority does. . . . [Therefore,] this conversion gives us a sense of how deep our dependence goes. . . . [This is also what makes it seem reasonable for us, without thinking twice, to hop] in something that weighs 4,000 pounds, using fossil energy to move it 2 miles to buy a 12-ounce package of cheese, and then driving back.⁷¹

In short, modern extractive agriculture, like modern society as a whole, relies heavily on what Tim Crews calls “fossil fuel slaves.”⁷² Upon the withdrawal of subsidies for fossil carbon mentioned above in subsection I.A(ii)—and then upon the shift away from the use of fossil carbon altogether—farmers in Kentucky, Kansas, Iowa, Missouri, Illinois, and elsewhere will need to change our form of seed crop production (remember, I am a farmowner as well).

B. Ecological, Economic, and Social Unsustainability

The news gets worse. Not only do I regard it as inevitable that concerns over climate disruption will force a shift away from

⁷¹ Tim Crews, *Will Becoming Local Here Get Us There?*, 108 LAND REP. 4, 9–10 (Spring 2014), <https://landinstitute.org/wp-content/uploads/2016/09/Land-Report-108.pdf> [<https://perma.cc/QY84-ZZNE>].

⁷² *Id.* at 9.

fossil-carbon inputs to agriculture; in addition, a cluster of other factors also will force fundamental changes in agriculture. Some of these factors likewise involve climate disruption, but some do not.

i. The ecological dead end of modern extractive agriculture

Even if Kentucky seed crop farmers could somehow wean their production methods off of fossil carbon, the very fact that such seed crops are annual crops grown in monocultures makes this form of agriculture a dead end. Consider the following ways in which our current foodcrop-farming methods are ecologically unsustainable:

- Modern extractive agriculture creates substantial habitat loss and degradation. This is true worldwide, in all cropland settings. North America provides a potent illustration: at one time virtually all of the acres (nearly a billion) currently used for farming in the United States were relatively undisturbed habitat. Now the opposite is true. Kentucky is an example: much of the habitat in the Central U.S. Hardwood Forests Ecoregion described above in subsection I.A(i) “has now been destroyed by development and agriculture.”⁷³
- Modern extractive agriculture creates massive soil erosion, even with “low-till” or “no-till” farming techniques. For instance, although topsoil can be replenished at a rate of less than one inch in 200 years, current rates of soil erosion in the United States (even with aggressive soil-conservation efforts in some locations) run twelve times higher than soil formation rates. Moreover, soil loss problems in many regions elsewhere in the world are much worse, so that by one estimate, seventy-five billion tons of soil are washed away by erosion worldwide each year.
- In addition to soil erosion, modern extractive

⁷³ *Central U.S. Hardwood Forests*, *supra* note 5.

agriculture also results in serious soil degradation—that is, in its fertility, its resilience, its organic matter, and other aspects of its quality. Particularly troubling in this regard is the initiative of the past half-century to use massive amounts of outside synthetic chemical inputs that kill or injure countless microbes, worms, insects, and other participants essential to the soil's architecture of life.

- Moreover, modern extractive agriculture creates enormous dead zones and other forms of aquatic poisoning and contamination because nitrate, phosphorus, and other substances emitted from agricultural operations are transported downstream. Kentucky also provides an illustration of this point: many of its streams and rivers are too polluted for human use,⁷⁴ and algal blooms have appeared in numerous Kentucky lakes.⁷⁵ Similarly, emissions of ammonia are transported downwind in the air, inducing species destruction and stress from acid rain. As a consequence, both terrestrial and aquatic ecosystems (including of course wildlife relying on them) have been degraded.
- The damage to habitats highlighted above—including both terrestrial habitat and that of waterways and oceans—is creating an unprecedented reduction in biodiversity, which puts at risk the “ecosystem services” that such biodiversity provides, and ultimately presents food-security risks as well.
- Special concerns arise in the case of pesticides used in modern extractive agriculture. Aside from the risk they

⁷⁴ *Water Runoff Pollution Threatens Kentucky Economy*, AM. SUSTAINABLE BUS. COUNCIL, http://asbcouncil.org/sites/default/files/asbc-runoff-kentucky-f_0.pdf [<https://perma.cc/JV9A-4X9L>] (noting that in 2012 the EPA found that over 7,000 miles of rivers and streams were “impaired,” in part from runoff pollution from fertilizers and pesticides used in farming).

⁷⁵ Will Willis, *From Toledo to the Gulf, Water Pollution Threats Increasing*, KY. WATERWAYS ALL. (Aug. 5, 2014), <https://kwalliance.org/toledo-gulf-water-pollution-threats-increasing/> [<https://perma.cc/NY4F-8DBP>].

might pose to human health, the massive use of chemicals in agriculture (especially in the United States and other developed economies) can contribute to the destruction of beneficial species, increases in pest resistance, reduction in pollination, crop losses, and ground and surface water contamination.

- Modern extractive agriculture causes even greater damage—and substantially adds to an existential planetary threat—by its direct and indirect contribution to global climate change. Anthropogenic climate change started in a significant way with the advent of agriculture thousands of years ago, and the rise of fossil-carbon “addiction” of the sort I explained above has dramatically hastened such disruption—and much of this is attributable still today to agriculture. Overall, roughly thirteen percent of worldwide greenhouse gas emissions come directly from agricultural activities, including livestock operations, and most of these emissions are of nitrous oxide and methane, which are both more potent than carbon dioxide is in their impact on global climate change.

ii. Economic and social unsustainability

In the preceding paragraphs, I have focused attention mostly on the environmental “dead end” of modern extractive agriculture. As I have explained elsewhere, modern extractive agriculture seems economically unsustainable as well. At the level of individual farms and farmers, our current system depends on massive public financial support, in the form both of direct agricultural subsidies and of indirect (fossil-carbon) subsidies. At the global level, our Green-Revolution-based techniques have not succeeded in adequately feeding a growing global human population.⁷⁶

⁷⁶ For my analysis of the economic unsustainability of modern extractive agriculture, see Chapter 1 in *AGROECOLOGICAL HUSBANDRY*, *supra* note 2, at 397–99 (as summarized in the pertinent segments of the “bare-bones legal and policy brief” appearing near the end of that book).

Perhaps as important in the long term, though, are the social (or societal) consequences—not just the ecological and economic consequences—of our current method of foodcrop production. For this I acknowledge the highly influential works of Kentucky's own Wendell Berry. In his 1977 book *The Unsettling of America*, Berry explained how commodification of farm products and the “fence row to fence row” mantra of agribusiness in the United States pushed most farmers off of their land, and how consolidated business interests tend to enrich themselves at the expense of both the soil and the remaining rural communities.⁷⁷ These realities have persisted, of course, to this day, in Kentucky as much as in other states.⁷⁸

Wendell Berry's views accord with those of several other writers: Wes Jackson, Aldo Leopold, Frederick Kirschenmann, and Don Worster come immediately to mind.⁷⁹ I would summarize these views by highlighting several ways in which modern extractive agriculture runs “against the grain” of human development up through about the end of the eighteenth century:⁸⁰ it disregards the “law of return” (that is, the manner in which natural systems feature a recycling of nutrients and “waste,” thereby creating an efficiently operating closed loop of life processes); it abandons the close knowledge of nature that bioregionalism implies;⁸¹ it aids the development of a consumption

⁷⁷ See generally WENDELL BERRY, *THE UNSETTLING OF AMERICA: CULTURE & AGRICULTURE* 137 (3rd ed. 1996) (urging, for instance, that farming should be anchored in biology rather than in economics).

⁷⁸ In Kentucky, for instance, farm consolidation is extensive: nearly forty-four percent of all farmland falls within very large farms—those encompassing 500 acres or more—and nearly thirty percent falls within operations encompassing 1,000 acres or more; small farms (less than fifty acres each) account for only five percent of Kentucky farmland. See *Quick Guide*, *supra* note 33.

⁷⁹ See, e.g., WES JACKSON, *NEW ROOTS FOR AGRICULTURE* 6 (1980); FREDERICK L. KIRSCHENMANN, *CULTIVATING AN ECOLOGICAL CONSCIENCE: ESSAYS FROM A FARMER PHILOSOPHER* 23 (Constance L. Falk ed., 2010); ALDO LEOPOLD, *A SAND COUNTY ALMANAC VIII–IX* (1949); DONALD WORSTER, *THE WEALTH OF NATURE: ENVIRONMENTAL HISTORY AND THE ECOLOGICAL IMAGINATION* 81–82 (Oxford Univ. Press 1993).

⁸⁰ For a summary of these points, and references to further discussions of them, see *AGROECOLOGICAL HUSBANDRY*, *supra* note 2, at 401–02.

⁸¹ The concept of bioregionalism refers to the obvious reality that different ecoregions (around the world but sometimes also separated only by a few miles) have different characteristics, require different and specialized agricultural approaches, and give rise to social and cultural differences that modern extractive agriculture disregards. See *AGROECOLOGICAL HUSBANDRY*, *supra* note 2, at 401 (as summarized in the pertinent segments of the “bare-bones legal and policy brief” appearing near the end of that book).

ethic; it changes our relationship to land by commodifying it; it has a similar effect on our relationship to community and to shared resources and destinies. Agriculture has been changed in all of these ways in the past two centuries, bringing what many observers consider deeply negative social consequences.

I am not suggesting, by the way, that traditional rural life, farming systems, and food production have been unequivocally happy, healthy, peaceful, abundant, and satisfying in earlier eras—far from it. Many aspects of rural and farm life in past generations and millennia have been hard, harsh, and even horrible, especially by standards that most people would wish to apply in the twenty-first century. Of course, the very same thing could be said of urban life as well in many places and at many times before the modern era, and still today for millions of people worldwide. The concern I have emphasized in the foregoing paragraphs is that the yield-enhancing advances that modern extractive agriculture has brought—and that the Green Revolution accelerated and intensified so dramatically—have come at the expense of some values, ethics, and efficiencies that were developed and proven effective over several millennia of human agricultural experience. We should not abandon those values. Fortunately, recent innovations demonstrate that we do not need to do so.

III. NATURAL-SYSTEMS AGRICULTURE AND ITS PROSPECTS

In sections I and II above, I surveyed some key elements of Kentucky agriculture and emphasized the “dead-end” character of the form of agriculture used to produce grains and legumes (corn, wheat, soybeans) in Kentucky—and in much of the rest of the world as well. The following paragraphs take a different direction. I will explain in summary fashion the growing success that researchers are having in developing major foodcrops that can establish a new form of agriculture—one that replaces annual plants grown in monocultures with perennial plants grown in polycultures.

A. Agroecological Husbandry

As explained above, the form of agriculture that dominates our global food supply and much of our global landmass relies

either on tilling the ground as a literal matter (plowing, cultivating) or on tilling the ground in a figurative manner, by a chemical means of disturbing (even sterilizing) the soil. One way of explaining the meaning of “agroecological husbandry”—the term I introduced in my 2017 book *International Law and Agroecological Husbandry*—from a simple etymological perspective is that it retains the reference to *ager* (from Greek, meaning “field” or “land”) but removes the reference to *cultūra* or *colere* (from the Latin, meaning “to cultivate”).⁸² The term “agroecological husbandry” therefore introduces the notion of ecology and highlights the importance of the ecosystem to a “natural-systems” agriculture.

In the following paragraphs, I wish to elaborate briefly on these points, and particularly to emphasize how agroecology takes the ecosystem as the standard for creating a sustainable system of food production. Then I will explain why I use the notion of “husbandry” to emphasize how agroecological husbandry rejects modern extractive agriculture’s single-minded emphasis on production.

i. The ecosystem as the standard

Tilling the soil—whether in a literal way or a figurative way through chemicals—is a necessary component of conventional agriculture because such agriculture focuses almost exclusively on annual crops, not perennial crops. Annuals thrive on disturbance—that is, on a temporary disruption (and removal if possible) of competing plant life. By contrast, perennials thrive on (and help maintain) continuity and non-disturbance.

I highlight this pair of associations—disturbance in the case of annuals and non-disturbance in the case of perennials—because it illustrates a key distinction between agroecological husbandry and conventional agriculture. Agroecological husbandry takes natural ecosystems as the model or standard on which to base a new approach to the process of growing food in soil. The specific type of natural ecosystem that I have in mind is that of the native grasslands that formerly covered vast areas of the

⁸² For a discussion of these terms, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 136–38.

world and that have, over thousands of years, been converted to agricultural use. Before European settlement, the landscapes of Kentucky—in Ecoregions #NA0402, #NA0404, and #NA0409, as explained above in subsection I.A—featured rich broadleaf forests. However, the Central U.S. Hardwood Forests ecoregion (#NA0402), which covers roughly three-quarters of Kentucky’s territory (see Figure 2) “becomes more savanna-like in its northern reaches . . . [where] the forest forms a mosaic with prairie.”⁸³ It is this prairie or grassland type of ecosystem—not just in Kentucky, of course, but in various places around the world—that displays special features that we can examine in order to understand why grain agriculture started in grassland ecosystems.⁸⁴

As I explained in a 2012 book on grasslands, the flora in those areas consist primarily of perennials, not annuals.⁸⁵ For instance, what gives the Great Plains of North America their distinctive character—at least in those rare segments of them that have not come under the plow or been damaged by livestock grazing—is the abundant presence of big bluestem, little bluestem, Indian grass, grama grass, buffalo grass, switch grass, and other species. All of these are perennials, as are the many legumes that typically proliferate in some grasslands and help provide the grasses with much-needed nitrogen.⁸⁶ By contrast, the form of corn, wheat, rye, oats, barley, rice, and other grains that dominate today’s agricultural production are annuals. They must be planted anew each year, and the soil must be made to accommodate them (and to eliminate their competitors) by disturbance of the soil—either by literal tilling or by the application of various forms of biocides to poison or prevent other life forms in the soil.

⁸³ See *Central U.S. Hardwood Forests*, *supra* note 5.

⁸⁴ For a discussion of the earliest beginnings of grain agriculture, featuring developments around the city of Jarmo (in present-day Iraq) several thousand years ago, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 6–10.

⁸⁵ See JOHN W. HEAD, GLOBAL LEGAL REGIMES TO PROTECT THE WORLD’S GRASSLANDS 31 (Carolina Acad. Press 2012) [hereinafter GRASSLANDS] (drawing from a Canadian survey of grasslands to explain that “[g]rasslands are usually dominated by perennial grasses over the annual and biennial types”).

⁸⁶ In the case of the native grasslands of the American Great Plains, for instance, a wide variety of leguminous plants provide, through nitrogen-fixing bacteria in their rhizomes, a significant portion of the nitrogen that serves as natural fertilizer for the grasses. Soybeans can also provide nitrogen in the same way. For further details, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 138.

If we were, then, to envision a technique of growing grains and other foodcrops in a way that would mimic the natural order, resilience, and ecological economy of grasslands, that technique would focus attention on perennials, not annuals. It would also focus on a broad mixture of plants living in a diverse community. Grassland ecology is, after all, the epitome of diversity and polyculture. By contrast, modern extractive agriculture is the epitome of monoculture. Even the customary practice of crop rotation—following corn with soybeans, for example, in order to take advantage of the nitrogen-fixing function that soybeans carry out, thus helping the fertility of the soil—has largely been abandoned in U.S. agricultural production in favor of a single monocrop, usually corn, on the same field year after year.

Therefore, a technique for growing food that departs drastically from modern extractive agriculture and that instead takes the ecology of grasslands as its model would involve perennial plants grown in polycultures, as opposed to annual plants grown in monocultures. These elements lie at the center of agroecological husbandry.

Let me explain briefly why I use the word “husbandry” instead of “production.” The emphasis of conventional agriculture, built as it is on the tradition of using annual grains grown in monocultures, has revolved almost entirely around increasing yields in order to meet rising demand, emerging mainly from the explosion of global human populations. “Production agriculture” is a term often used to capture this emphasis on ever-increasing yields.

The term I offer instead of “production” is “husbandry.” The latter term derives from “husband,” which according to the American Heritage Dictionary traces its roots back to the Old Norse term *hūsbondi*, itself composed of the roots *hūs* (“house”) plus *bōndi* or *būandi*, the present participle of *būa*, (“to dwell”). Hence, a husband in this narrow etymological sense—and irrespective of a person’s gender, of course—is “a householder.” The term “husbandry,” in turn, therefore carries the narrow denotation of “management of a household” (whether by a man or, as is most common in most of the world, a woman). And yet “husbandry” carries a broader connotation as well, to encompass such notions

as conservation, frugality, economy, and the prudent or judicious use and nurturing of resources.⁸⁷

I mean “husbandry” in that latter sense—to refer to the understanding, conserving, and nurturing of the long-term viability of an ecosystem for its own sake because of its own value. That value can include benefits that inure to humans, of course, but the benefit accruing to humans would not naturally—and should not—be the main reason for husbandry. In this respect, the concept of husbandry shares some important characteristics with the concept of an equitable trust, especially as that concept has developed in English law. As I have explained in another context, the concept of the trust, tracing its roots back to Roman law, involves an equitable obligation that legally binds a person (the trustee) who has legal title and control over certain property (the trust property) to manage that property not for his or her own direct benefit but rather for the benefit of a specified group of persons named as the beneficiaries of the trust.⁸⁸

I hasten to add that the first part of the term “agroecological husbandry” is by no means my own creation. That is, even though I think the term “agroecological husbandry” originates with me, the term “agroecological”—or its noun form “agroecology”—dates back several decades, and it reflects a rich heritage of alternative views regarding agriculture, ecology, and humanity.

ii. Perennial polycultures: are they feasible?

I have asserted above that agroecological husbandry would aim to replace annual monocultures with perennial polycultures in order to produce the grains and legumes that constitute the largest component of global human caloric intake. But is it possible to get

⁸⁷ For further etymological and historical details regarding the term “husbandry”—with use as a noun dating back to about 1300 CE (signifying “management of a household”) and as a verb from the early fifteenth century to mean “manage thriftily”—see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 140. As noted there, its synonyms include conservation, frugality, economy, parsimony, “the control or judicious use of resources,” and the “science and practice of producing crops and livestock from the natural resources of the earth.” The term “animal husbandry” is still widely used to convey this latter meaning in respect of livestock. *Id.*

⁸⁸ See generally John W. Head, *Sketching a Global Agroecology Eutopia: The Land Institute in Directional Context*, in FOOD UTOPIAS – REIMAGINING CITIZENSHIP, ETHICS AND COMMUNITY 162–63 (Paul V. Stock et al. eds., 2015) [hereinafter *Sketching*] (referencing the concept of the trust, and its relation to the concept of “husbandry”).

food for humans out of perennial polycultures? The short answer is “yes.” Numerous successes have recently emerged from the work done thus far by agricultural researchers—mostly at The Land Institute headquartered in central Kansas but also at its affiliated field stations in various other locations around the world—in developing both perenniality and polyculturism in foodcrops.

A prime example of this success appears in the form of Kernza®. This is a perennial wheatgrass—that is, it just gets planted once, not every year—which produces commercially viable yields of grain that can be used for the same purposes as regular (annual) wheat. There are Kernza® cookies. There is Kernza® bread. There is Kernza® beer. The grain is still under development (in order to improve its features for yield, pest resistance, seed retention, and so forth), but it has already proven itself as the first radically new form of foodcrop developed in the past several thousand years. It has gradually gained in commercial retail use. Patagonia Provisions was the first company to develop a commercial retail product (Long Root Ale) made from Kernza® for the mainstream marketplace. A Minnesota brewing company has begun producing a Kernza® beer. Moreover, a number of restaurants in Minnesota, California, and Ohio serve bread and other products made with Kernza®, and one Minnesota company produces Kernza® pasta.⁸⁹

Other progress in developing perennial foodcrop polycultures includes the following:

- Research into perennial sorghum has shown promising results and was given a boost recently by the

⁸⁹ *Kernza® Grain: Toward a Perennial Future*, THE LAND INST. (2019) [hereinafter *Kernza®*], <https://landinstitute.org/our-work/perennial-crops/kernza/> [https://perma.cc/X7QK-CWF3]. Reflecting both the momentum and the confidence created by these successes with Kernza®, The Land Institute offers several projections: to expand Kernza® grain supplies from small niche markets to commercially-viable large-scale production, starting gradually from 2019; within ten years, to create Kernza® crops with seed size that is 50 percent of annual bread wheat seed size; in the longer term, to develop a semi-dwarf variety of Kernza® and improve its bread baking quality; ultimately, to develop a Kernza® variety with yields similar to those of annual wheat and therefore see Kernza® widely grown throughout the northern United States and in several other countries around the world. *Id.* For further details on development of perennial intermediate wheatgrass, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 208–10.

development of diploid versions of hybrids. The hybrids draw from perennial johnsongrass (*sorghum halepense*), which has a forty-chromosome tetraploid, and annual grain sorghum, which has a twenty-chromosome diploid structure.⁹⁰

- Progress on perennial rice has now reached an advanced stage; it has been tested in research plots on farms in China and now is in pilot production there. Moreover, the perennial rice “is already on par with annual rice—not just in yield, but also in taste—and tropical Yunnan [province] allows two crops a year.”⁹¹
- Progress and modest successes also have been achieved in developing perennial versions of silphium,⁹² wheat,⁹³ and legumes.⁹⁴

⁹⁰ *A Leap for Sorghum*, LAND REP., Spring 2018, at 1, 16 <https://landinstitute.org/wp-content/uploads/2018/06/LR-120.pdf> [<https://perma.cc/9ARK-FKA2>]; cf. *Perennial Sorghum*, THE LAND INST. (2019) [hereinafter *Perennial Sorghum*], <https://landinstitute.org/our-work/perennial-crops/perennial-sorghum/> [<https://perma.cc/MV8K-UATE>] (exploring the 2016 study which showed that during the first seven years of a sorghum perennialization program, yields increased by about 27 percent). See AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 216–18 (discussing further details on the development of perennial sorghum).

⁹¹ *Perennial Rice Moves to Farms*, LAND REP., Spring 2018, at 1, 16–17 <https://landinstitute.org/wp-content/uploads/2018/06/LR-120.pdf> [<https://perma.cc/9ARK-FKA2>]; see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 213–15 (discussing further details on the development of perennial rice).

⁹² *Perennial Oilseeds (Silphium)*, THE LAND INST. (2019), <https://landinstitute.org/our-work/perennial-crops/perennial-oilseeds/> [<https://perma.cc/T2HZ-2WEC>]; see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 218–24 (discussing further details on the development of perennial silphium and also discussing sunflowers).

⁹³ *Perennial Wheat*, THE LAND INST. (2019), <https://landinstitute.org/our-work/perennial-crops/perennial-wheat/> [<https://perma.cc/5EWP-967A>] (stating that although “[e]lite line of perennial wheat yield gran about 50-70% that of annual wheat cultivars,” researchers at The Land Institute “expect it could take another 10-20 years to develop an economically viable perennial wheat variety.”); see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 210–13 (discussing further details on the development of perennial wheat).

⁹⁴ *Perennial Legumes*, THE LAND INST. (2019), <https://landinstitute.org/our-work/perennial-crops/legumes/> [<https://perma.cc/222W-TMKH>] (emphasizing that the development of perennial legumes would be as elements in polyculture cropping to take advantage of their nitrogen-fixing capacity).

Signaling the growing acceptance of the scientific viability of perennial grains, the Food and Agriculture Organization of the United Nations (“FAO”) conducted an international workshop in 2013.⁹⁵ A central theme emerged from the proceedings of that workshop: despite the demands and challenges presented, researchers have made substantial progress to date on the development of perennial grains (and legumes) to be grown in polycultures. Accordingly, the 2013 FAO workshop, and published proceedings emerging from it, gave a firm endorsement of perennial crops as a necessary part of agricultural development. Moreover, the related but distinct project of finding how such new perennials can be grown in polycultures (mixtures of species) rather than monocultures is gathering promising momentum.

Research efforts aimed at developing perennial foodcrops and the mixtures of species that would make them most productive are not confined, of course, to The Land Institute. For instance, researchers at the Missouri Botanical Garden and Saint Louis University are conducting a global inventory of perennial grain, legume, and oilseed species.⁹⁶ The aim of the inventory is to systematically “review and evaluate wild, perennial, herbaceous species” for domestication—that is, for use in developing perennial foodcrops.⁹⁷ Likewise, researchers from various universities and institutions are also involved in this effort to shift from modern extractive agriculture to natural-systems practices involving perennials grown in polycultures.⁹⁸

⁹⁵ See generally *Perennial Crops for Food Security: Proceedings of the FAO Expert Workshop*, FAO (2014), <http://www.fao.org/3/a-i3495e.pdf> [<https://perma.cc/TRB9-322C>].

⁹⁶ See C. Ciotir et al., *Global Inventory and Systematic Evaluation of Perennial Grain, Legume, and Oilseed Species for Pre-breeding and Domestication*, PERENNIAL AGRICULTURE PROJECT (2019), <http://www.tropicos.org/Project/PPAPG> [<https://perma.cc/8Q7S-4EPN>].

⁹⁷ *Id.*

⁹⁸ See, e.g., Brad G. Peter et al., *Nature-Based Agricultural Solutions: Scaling Perennial Grains Across Africa*, 159 *SCIENCE DIRECT* 283 (2017), <https://www.sciencedirect.com/science/article/pii/S0013935117315712> [<https://perma.cc/BFK2-PF4G>] (with authors from Michigan focusing on the use of perennial pigeonpea and sorghum in marginal lands on the African continent); Matthew R. Ryan et al., *Managing for Multifunctionality in Perennial Grain Crops*, 68 *BIO SCIENCE* 294 (April 2018), <https://watermark.silverchair.com/biy014.pdf> [<https://perma.cc/Z5NY-R884>] (with authors from universities in New York, Illinois, Minnesota, Ohio, and Australia). See also Daniel A. Kane et al., *A System-*

B. Arresting and Reversing Unsustainable Agricultural Practices

Why make such a shift? In Section II of this Essay, I summarized key deficiencies and dangers of modern extractive agriculture. I classified them as ecological, economic, and social in character, and I emphasized that modern extractive agriculture is unsustainable in all three respects. Now I offer a synopsis of how agroecological husbandry, and particularly a natural-systems approach to producing grains and legumes, can overcome the deficiencies and dangers of modern extractive agriculture.

ii. Soil and climate change

Perennial foodcrop polycultures, and the system of agroecological husbandry in general, can reverse soil depletion and degradation and can help address the climate crisis we face. The reason for this is that perennial polycultures mimic ecological processes of natural grasslands in many ways. Consider the following:⁹⁹

- Because of their deep roots, perennial polycultures can arrest the soil degradation that traditional agriculture causes through erosion, damage to soil structure, and reduction in soil organic matter.
- Likewise, perennial polycultures can reduce the loss of water compared with annual grain crops, since the

atic Review of Perennial Staple Crops Literature Using Topic Modeling and Bibliometric Analysis, PLOS ONE (2016), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4877017/pdf/pone.0155788.pdf> [<https://perma.cc/4NRA-2NVB>] (reporting that 914 scientific-research articles were published from 1930 to 2016 concerning the results of “research on perennial staple crops, including wheat, rice, rye, sorghum, and pigeon pea”).

⁹⁹ See also *The Advantages of Perennial Agriculture*, MISSION 2015: BIODIVERSITY, http://web.mit.edu/12.000/www/m2015/2015/perennial_agriculture.htm [<https://perma.cc/NJX3-R7DM>]. For further details on some of these points, see *Sketching*, *supra* note 89, at 216–17, 221–22.

much deeper roots of perennials “intercept, retain, and utilize more precipitation” when it falls.¹⁰⁰

- Perennial polycultures can, because of their diversity, better resist attacks by pests and pathogens—an advantage that might become increasingly important to Kentucky farmers as climate change brings “[i]ncreased pressure from diseases, insect pests, and weeds” to their farms.¹⁰¹
- Perennial polycultures can reduce groundwater contamination resulting from nitrate leaching in annual monocultures.
- Perennial polycultures can, more generally, better maintain the health and fertility of a landscape over longer periods of time. This is attributable to several factors. First, perennial roots have years to grow much deeper into the soil and thereby to gain access to nutrients and moisture that annuals cannot reach. Second, the initial canopy development of perennials in early spring is faster than that of annuals (which will have just been planted), so that perennials are able to intercept and use more light early in the season, and thereby to suppress the establishment of weeds. Third, at the other end of the life cycle, annuals are harvested

¹⁰⁰ J. D. Glover et al., *Increased Food and Ecosystem Security via Perennial Grains*, 328 SCI. 1638 (2010) (“Annual grain crops can lose five times as much water . . . as perennial crops.”).

¹⁰¹ See Paul Vincelli et al., *Climate Change: A Brief Summary for Kentucky Extension Agents*, UNIV. OF KY. COLL. OF AGRIC. 2 (Nov. 2011), <http://www2.ca.uky.edu/agcomm/pubs/id/id191/id191.pdf> [<https://perma.cc/79Q4-MF52>] (listing additional expected effects of climate change on Kentucky agriculture in the next 20 to 30 years: reductions in corn yields, increases in soybean yields, increased year-to-year variability in crop performance (including crop failures), and reduced livestock production (especially for ruminants, such as cattle) during summer months (because of higher summertime temperatures)); see also *What Climate Change Means for Kentucky*, EPA, REPORT NO. 430-F-16-019 (Aug. 2016), <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-ky.pdf> [<https://perma.cc/28WP-NQ6X>] (noting that “[d]roughts are likely to be more severe, because periods without rain will be longer and very hot days will be more frequent” in coming decades).

by a form of “clear-cutting” that kills them, rendering them incapable of continued photosynthesis, whereas perennials can continue photosynthesis after harvest. Moreover, microhabitats that may be present in perennial crops for some organisms, such as nitrogen fixers, might be absent or much less robust in annual crops. Indeed, the below-ground soil ecosystem as a whole maintains a more beneficial community of soil organisms when soil disturbance ceases and organic inputs via roots increase.

- Perennial polycultures can dramatically reduce the required amount of agricultural fertilizer and chemical pesticides.¹⁰² These draw heavily (in their production) from fossil carbon. The total global quantity of available fossil carbon is limited—at least on a human-based time-scale—and its extraction and use bring detrimental change to the air and the water through emissions and run-off.
- Perennial polycultures can also dramatically reduce the fossil-carbon fuels needed to power farm equipment—partly because fewer passes over a field are necessary and partly because less equipment is needed. This further reduces the draw on non-renewable fossil-carbon deposits and reduces greenhouse-gas emissions that contribute to climate change.¹⁰³

¹⁰² WES JACKSON, *The Next Synthesis, in NATURE AS MEASURE: THE SELECTED ESSAYS OF WES JACKSON* 179, 218 (2011) (explaining the reduced need for pesticides in perennial polycultures is due to the perennial species’ evolution to outlast pests and ability to create species and chemical diversity from a diverse polyculture featuring many types of perennials—which would require a “tremendous enzyme system on the part of an insect or pathogen to produce an epidemic”).

¹⁰³ See Jerry D. Glover et al., *Harvested Perennial Grasslands Provide Ecological Benchmarks for Agricultural Sustainability*, 137 AGRIC., ECOSYSTEMS AND ENV’T 3–8 (2010). This study estimates that a perennial crop could reduce the fossil-fuel energy required for production by as much as 90 percent compared to conventional no-till annual wheat. Applied to all U.S. grain, this reduction would reduce the annual U.S. carbon dioxide emissions by 162 million tons. This amount is well over 100 times more than the carbon

- Perennial polycultures can sequester carbon,¹⁰⁴ thereby (1) recapturing a significant amount of the carbon released from the soil in the past several decades¹⁰⁵ and (2) contributing to the resilience and stability of the climate.
- In addition to sequestering carbon, perennial polycultures would probably reduce emissions of nitrous oxide, which is thought to be about 300 times more potent, molecule for molecule, than carbon dioxide (the much more prevalent greenhouse gas) in terms of causing climate change. This reduction in nitrous oxide emissions would come from the fact that nitrogen can be provided in polycultures by including legumes, which fix nitrogen, instead of by relying on synthetic nitrogen as is done now with annual monocultures.
- In some settings, perennial polycultures can also reduce emissions of methane, another potent greenhouse gas. This has already been made possible by the

dioxide emissions that drivers of the Toyota Prius in the U.S. could prevent from entering the atmosphere each year, as Tim Crews of The Land Institute has brought to my attention.

¹⁰⁴ See Thomas H. DeLuca & Catherine A. Zabinski, *Prairie Ecosystems and the Carbon Problem*, 9 FRONTIERS IN ECOLOGY AND THE ENV'T 407, 407–09, 411 (2011) (providing an explanation of the carbon-sequestration potential of perennial polycultures that covered much of the American Great Plains until the nineteenth century). For further details and FAO reports showing that the overall potential of carbon sequestration by grasslands compares favorably with the potential for carbon sequestration by rain forests, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 184 (citing John H. Davidson, *North America's Great Carbon Ocean: Protecting Prairie Grasslands Keeps Carbon in the Soil and Slows the Pace of Climate Change*, PRAIRIE FIRE NEWSPAPER (June 2010), <http://www.prairiefirenewspaper.com/2010/06/north-americas-great-carbon-ocean> [<https://perma.cc/77A3-AZN3>]).

¹⁰⁵ One especially well-respected observer has estimated that between 100 and 200 gigatons of carbon have been lost from the land (that is, released into the atmosphere) due to land use change in terrestrial ecosystems since 1850. R.A. Houghton, *Historic Changes in Terrestrial Carbon Storage*, in RECARBONIZATION OF THE BIOSPHERE: ECOSYSTEMS AND THE GLOBAL CARBON CYCLE 59, 59 (Rattan Lal et al. eds., 2012). Most of this, he asserts, came from vegetation conversion of forests to crops but that about a quarter of it (25 to 50 gigatons) came from loss of soil organic matter due to cultivation for agriculture. *Id.* Another observer reports an even higher estimate (about 78 gigatons) of carbon lost from soil organic matter since 1850. R. Lal, *Soil Carbon Sequestration Impacts on Global Climate Change and Food Security*, 304 SCI. 1623, 1623 (2012), <http://science.sciencemag.org/content/304/5677/1623> [<https://perma.cc/LRQ4-KTMV>]. For further details, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 184.

development and use of perennial rice (especially in China as noted above) because that rice relies on its perennial character as an alternative weed control strategy to traditional flooding.

ii. Economic issues

Although the points made above are presented mainly from an ecological standpoint—emphasizing how perennial-polyculture foodcrops can arrest or even reverse damage caused by modern extractive agriculture to the local or global ecosystem—many of the points made above also have important economic components to them. Kentucky farmers will surely agree that the costs involved in farming operations today are high. The costs include the prices of massive farm implements (and their fuel) for planting, maintaining, and harvesting crops, as well as the costs of the seeds themselves and of an array of chemicals (herbicides, insecticides, rodenticides, fungicides, and fertilizers) that may be heavily dependent on oil prices.

One of the goals of researching perennial grains and legumes grown in polycultures is to reduce the costs of many of the above-mentioned inputs. Such a reduction could reverse the trend of recent years in which farmers who actually rely on farm income for their financial prosperity need to achieve economies of scale by farming vast tracts of land, usually including much land that they rent, not own. Looked at from another perspective, a goal of developing and implementing perennial-polyculture farm operations is to allow for a re-entry of small-scale and family farmers who have been largely elbowed out of competition because of the high costs of farming operations.

The prospects for this “re-population” of farming communities (or what used to be farming communities), and for economic improvement generally for all farmers, are remarkable under perennial-polyculture operations. In such operations, there would be no annual purchase or production of new seed for sowing. Also, less mechanical energy would be expended in field operations, thereby reducing fuel costs. The need for irrigation—a

matter that has gained attention in recent years in Kentucky¹⁰⁶—could also be greatly reduced. The need for pesticides, and therefore the cost of purchasing them, would drop as well.

iii. Humans and the ecosphere

Recall that in Section II of this Essay, I not only cataloged ecological and economic disadvantages inherent in modern extractive agriculture; I also emphasized certain social concerns associated with it. For instance, I asserted that modern extractive agriculture “runs against the grain of human development” in several ways. In that connection, I drew special attention to the work of numerous observers (including Kentucky’s own Wendell Berry) in highlighting bioregionalism, the law of return, and the need to reverse the recent trend toward commodification of land and the damage it has brought to rural communities.

Agroecological husbandry is entirely consistent with this line of argument. A natural-systems approach recognizes that each ecosystem will present its own array of climate, soil, and other physical conditions, and that the particular foodcrops to be grown in such an ecosystem—and how to grow them there—will turn crucially on those particular conditions. Likewise, the cyclical character of nature, reflected in the phrase “law of return,” is central to agroecological husbandry. By taking a native grassland ecosystem as its model for designing a foodcrop ecosystem, agroecological husbandry respects and incorporates the law of return. Moreover, a form of food production that both permits and requires a closer human (and human-community) connection to the land will reverse the commodification of land and the damage it has brought to rural communities.

In sum, agroecological husbandry offers grounds for hope that the ills directly associated with modern extractive agriculture can be largely overcome. From an ecological standpoint, an economic standpoint, and a social standpoint, agroecological

¹⁰⁶ See, e.g., Katie Pratt, *Irrigation Study Fulfills a Need for Kentucky Farmers*, UNIV. OF KY. COLL. OF AGRIC., FOOD AND ENV'T (Aug. 20, 2013), <https://news.ca.uky.edu/article/irrigation-study-fulfills-need-kentucky-farmers> [<https://perma.cc/LL5G-72D7>]; Terry Simmons, *Kentucky: Low-pressure Irrigation System Looks Promising for Small Farms*, AG WATCH NETWORK, <https://agwatchnetwork.com/kentucky-low-pressure-irrigation-system-looks-promising-small-farms/> [<https://perma.cc/ZF69-EQMX>].

husbandry promises to be preferable to modern extractive agriculture on these grounds.

IV. LEGAL AND POLICY STEPS TO BUILD KENTUCKY'S AGROECOLOGICAL FUTURE

In the first three sections of this Essay, I emphasized three key themes:

- Kentucky has abundant ecological and agricultural riches, yet the Commonwealth finds itself today at a crossroad involving both opportunities (e.g., a revival of hemp production) and challenges (e.g., the continuing decline of tobacco and the phase-out of fossil-carbon production);
- The principal foodcrops that account for more than a fourth of all of Kentucky's farmland acreage and that contribute importantly to national and international markets—namely corn, soybeans, and wheat—are produced in ways that degrade the quality of Kentucky's ecosystems and impose heavy economic and social costs on its people;
- A natural-systems approach to agriculture—featuring foodcrops that are perennial instead of annual and are grown in ways that mimic native ecosystems—is coming into reach through intensive agricultural research, and this new approach holds great promise to address the ecological, economic, and social costs that modern extractive agriculture imposes on Kentuckians.

In this penultimate section of my Essay, I will summarize how I believe Kentucky can seize the opportunity that this new agricultural research presents.

A. A 50-Year Farm Policy

Recall that farm acreage in the Commonwealth amounts to nearly one-half of the total acreage in Kentucky.¹⁰⁷ We might regard this as providing “headroom” for agricultural improvement: nearly half of the Commonwealth’s overall land mass has been devoted in recent decades to agricultural production of one sort or another, and therefore a new form of agriculture—beyond modern extractive agriculture—holds the potential for massive improvements in farming across much of Kentucky’s territory.

Ecological “headroom” also abounds. I emphasized above the severe ecological degradation that Kentucky’s lands (and waters) have suffered from both agriculture and fossil-carbon extraction. As depicted in Figure 2, the ecoregion covering most of Kentucky is the Central U.S. Mixed Hardwood Forests Ecoregion (#NA0404). According to the World Wildlife Fund, “[m]uch of the natural habitat in [the Central U.S. Mixed Hardwood Forests] ecoregion has . . . been destroyed by development and agriculture,” and both that ecoregion and the smaller Appalachian Mixed Mesophytic Forests Ecoregion (#NA0402, shown above in Figure 1) have received “Critical/Endangered” status.¹⁰⁸ Accordingly, the widespread adoption of a natural-systems form of agriculture in Kentucky holds the promise of massive environmental relief and restoration.

How can Kentucky redeem that promise? That is, as a practical matter, what would the Commonwealth do to take full advantage of the agricultural and ecological “headroom” I have highlighted above? My answer: adopt a long-term agricultural policy for the Commonwealth and make it binding. Unfortunately, there is little precedent for such a thing in the United States. By adopting a firm, progressive, ambitious, and binding 50-year farm policy, Kentucky could set a virtuous “national standard” for action by other states.

¹⁰⁷ *State Fact Sheets*, *supra* note 14. As noted there, total farmland comprises about 13 million acres, and total acreage in Kentucky amounts to about 25.3 million acres.

¹⁰⁸ See *Central U.S. Hardwood Forests*, *supra* note 5; see also *supra* text accompanying note 6.

i. Pusillanimous precedents: what other states have done

My colleague Wesley Williams has helped me search for long-term farm (or agricultural) policies adopted by various U.S. states. We have found only a few. I summarize some of them below for illustration.

In 2008, the California Board of Food and Agriculture inaugurated “California Agricultural Vision” as a process intended to result in a strategic plan for the future of the state’s agriculture and food system. The program established three policy priorities to be met by 2030 that would result in a sustainable agri-food system for California. Two more policy priorities were added in 2017 (and the original three were expanded) so the list now reads as follows:

- Better health and well-being—[agricultural policy should aim at] meeting the nutrition and culinary needs of California’s diverse population and consumers across the country and around the world;
- A healthier planet—[agricultural policy should aim at] improving the health of the natural resources upon which California and food production depends;
- Thriving communities—[agriculture policy should help ensure that] food production and processing are drivers of sustainable California economic growth;
- Connections between farmers and the consuming public—[agricultural policy should help ensure that] citizens are agriculture and food literate, understanding and appreciating what it takes to bring food and fiber to market, and the people behind California agriculture;
- A diverse set of agriculture entities are thriving—[the state should follow policies] ensuring agriculture has the land, water, human capital, and access to the resources and legislative support it needs to remain

profitable and competitive in the twenty-first century.¹⁰⁹

This “California Agricultural Vision” aims to “provide a framework for the State Board of Food and Agriculture,” but it evidently carries no binding force, prescribes few specific actions or initiatives, and imposes no schedules or deadlines. It acknowledges that its goals “cannot be done by any one entity on its own” but instead will depend on building relationships among a wide range of stakeholders. In my view, then, California has not done what I suggest Kentucky should do—that is, to “[a]dopt a long-term agricultural policy for the Commonwealth, and make it binding.”

My colleague and I also found no solid long-term plan pushed by Kentucky’s neighboring state of Illinois. Granted, that state does have a Partners for Conservation program focusing on the conservation of natural resources, and in 2009 the Illinois legislature extended the program to 2021. Working within the ambit of the Partners for Conservation program, the Illinois Department of Agriculture provides several grants for sustainable practices, but the only long-term policy in place is one encouraging farmers to participate in sustainable farming today in order to ensure there is a future for Illinois agriculture.¹¹⁰

Although Indiana, another of Kentucky’s neighbors, maintains several programs that look to the future, none of them has a published plan for anything beyond 2020. Its Nutrient Reduction strategy aims “to capture statewide, present and future endeavors in Indiana which positively impact the State’s waters as well as gauge the progress of conservation, water quality improvement, and soil health practice adoption in Indiana.” The state also participates in the Conservation Reserve Enhancement Program, which in cooperation with the federal government allows

¹⁰⁹ See *California Agricultural Vision*, CAL. DEP’T OF FOOD AND AGRIC., (2017) <https://www.cdfa.ca.gov/agvision/> [<https://perma.cc/V79Z-TEYL>].

¹¹⁰ See *Partners for Conservation*, ILL. DEP’T OF NAT. RES., <https://www.dnr.illinois.gov/conservation/pfc/Pages/default.aspx> [<https://perma.cc/P4R7-BQ4Y>]; see also *Sustainable Agriculture*, ILL. DEP’T OF AGRIC, <https://www2.illinois.gov/sites/agr/Resources/Conservation/Pages/default.aspx#h3> [<https://perma.cc/FYX3-GJCK>].

farmers to enter long-term contracts (14-15 years) to transition their fields to native grasses. Finally, the Indiana Conservation Cropping Systems Initiative (“CCSI”) works to improve soils on Indiana farmlands, and has published a strategic plan through 2020.¹¹¹

Although Iowa does not seem to have adopted a long-term agricultural policy or plan, several divisions of the Iowa Department of Agriculture seek to protect Iowa farmland and farm resources for years to come. Programs include the Urban Conservation Program, the Iowa Watershed Protection Program, and the Field Services Bureau, which provides financial assistance for conservation practices and establishes district initiatives to regulate on a local level.¹¹²

My home state of Kansas seems more ambitious in this regard than most states. The Kansas Department of Agriculture has issued a 178-page “Growth Strategy Document” identifying goals and desired outcomes for numerous agriculture sectors. For example, the section on corn prescribes specific action items for “[i]ncreasing demand for ethanol, renewable diesel, DDGS [distiller’s dried grains with solubles] and livestock feeding, with a focus on proactive water policy and efficient transportation infrastructure.” The corresponding entry for sorghum calls for “[e]xpanding research partnerships and strengthening Kansas’ position as the top sorghum-producing state in the nation.” However, the “Growth Strategy Document” gives little attention to

¹¹¹ See *Conservation Cropping Systems Initiative Strategic Plan*, CCSIN.ORG, <https://drive.google.com/file/d/1UP1KZR7xfnjGjWkYsgirE6wUQKXWgAE/view> [<https://perma.cc/P4S5-28N7>]; *Conservation Reserve Enhancement Program*, IND. ST. DEP’T OF AGRIC <https://www.in.gov/isda/2377.htm> [<https://perma.cc/7ZT9-N6BX>]; *Indiana State Nutrient Reduction Strategy*, IND. ST. DEP’T OF AGRIC., <https://www.in.gov/isda/2991.htm> [<https://perma.cc/MEM8-DFZD>].

¹¹² See Field Services Bureau, *District Initiatives*, IOWA DEP’T OF AGRIC. AND LAND STEWARDSHIP, <https://www.iowaagriculture.gov/FieldServices/districtInitiatives.asp> [<https://perma.cc/BSE2-83F6>]; see also Field Services Bureau, *Financial Assistance for Conservation Practices*, IOWA DEP’T OF AGRIC. AND LAND STEWARDSHIP, <https://www.iowaagriculture.gov/fieldServices/financialAssistance.asp> [<https://perma.cc/2M4Z-76M9>]; see also Field Services Bureau, *Urban Conservation Program*, IOWA DEP’T OF AGRIC. AND LAND STEWARDSHIP, <https://www.iowaagriculture.gov/fieldservices/urbanconservation.asp> [<https://perma.cc/99LS-9GFY>]; see also *Iowa Watershed Protection*, IOWA DEP’T OF AGRIC. AND LAND STEWARDSHIP, <https://iowaagriculture.gov/water-resources-bureau/iowa-watershed-protection> [<https://perma.cc/XR8E-5RCG>].

ecological considerations, focusing instead primarily on issues of market expansion, deregulation, financial subsidies, and infrastructure improvement. Moreover, the document prescribes no specific dates or durations for the initiatives it proposes. Overall, it appears more as a compilation of suggestions rather than firm policies that have been adopted by the state.¹¹³ Indeed, the initial page describing the “Growth Strategy Project” explains that the documents emerging from it, including the “Growth Strategy Document,” “are not intended to represent the opinions and priorities of the executive branch” of the state’s government.¹¹⁴

There does not appear to be any long-term strategy or proposal put forth by the Minnesota Department of Agriculture. However, the Minnesota legislature has made it “the policy of the state to preserve agricultural land and conserve its long-term use for the production of food and other agricultural products,” and then provided details of how this policy is to be implemented. These include, among other things, (1) protecting agricultural land “from conversion to other uses”; (2) conserving and enhancing soil resources “to ensure their long-term quality and productivity”; and (3) “fostering of ownership and operation of agricultural land by resident farmers.”¹¹⁵

ii. Progressive policy: what Kentucky should do

In my 2017 book *International Law and Agroecological Husbandry*, I proposed legal and institutional initiatives to facilitate a global agricultural transformation. One portion of that book elaborated on a proposed U.S. Congressional enactment of a “50-Year Farm Bill” as first championed by Wes Jackson and Wendell Berry.¹¹⁶ Such legislation at the federal level should, in my view, be preceded or supplemented by legislation at the state level that would establish binding agricultural policies and reforms devoted to ecological and agricultural sustainability. I offer here some suggestions about such a policy for Kentucky,

¹¹³ See generally KAN. DEPT OF AGRIC., KANSAS AGRICULTURAL GROWTH 48, 130 (2019) <https://agriculture.ks.gov/AgGrowthStrategy/growth-strategy> [<https://perma.cc/UQ85-SMWX>].

¹¹⁴ *Id.*

¹¹⁵ See MINN. STAT. § 17.80 (1982).

¹¹⁶ See AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 265–67.

which could be referred to as the Kentucky 50-Year Agroecology Policy—or, because it would look forward to about the year 2070 (assuming its adoption in about 2020), it could carry the shorthand label of KAP-2070. My suggestions will focus first on overall aims and then on some specific measures.

The overall aim of the Kentucky 50-Year Agroecology Policy, or KAP-2070, would be to reorient and define Kentucky policy on a cluster of agricultural and ecological issues (hence my use of the conglomerate term “agroecology,” which I explained above in subsection III.A). Given the importance of corn, soybeans, and wheat to Kentucky—not only (1) in economic terms but also in terms of (2) the acreage devoted to these foodcrops and (3) the ecological impact of these operations—the Commonwealth’s policies on grain and legume foodcrop production would be central to the KAP-2070. Indeed, because of the benefits Kentucky could realize from promoting the recent innovations I summarized in Section III of this Essay, the KAP-2070 would give special attention to how such grains and legumes might figure in Kentucky’s future.

This special attention to grains and legumes could take several forms. For instance:

- The Commonwealth could immediately establish and fund one or more research institutes to explore (perhaps in collaboration with The Land Institute or one of its affiliates) the ways in which perennial foodcrops, such as Kernza® and perennial sorghum,¹¹⁷ might reach commercially viable productivity in various Kentucky ecosystems.
- To build research capacity for the medium and long term, the Commonwealth could, through the College of Agriculture, Food and Environment at the University of Kentucky as well as the College of Agriculture, Communities, and the Environment at Kentucky State University, fund the training of Ph.D.-level junior

¹¹⁷ See *Kernza*®, *supra* note 89; see also *Perennial Sorghum*, *supra* note 90.

scientists to work in the research institutes referred to above.

- The Commonwealth could provide funding to expand dramatically the ongoing scientific research into foodcrop polycultures. Perennial grains have many advantages over annuals, but ultimately a “mimicking” of the prairie ecological architecture requires the development of mixtures of several species in a single field—different mixtures, of course, in different climatic and soil conditions around Kentucky.
- In order to promote a transition to natural-systems agriculture (away from modern extractive agriculture), the Commonwealth could stiffen agriculture-specific anti-pollution protections to reduce the ecological damage caused by agricultural run-off and pesticide use. This would tend to internalize the negative externalities of modern extractive farming.

In addition to addressing the issue of foodcrop production, of course, the KAP-2070 as I envision it would also address these other Kentucky-specific issues that relate directly or indirectly to agriculture and ecology:

- Reinvigorating hemp production. As I suggested in subsection I.B(ii) of this Essay, the Commonwealth might draw from its deep history of hemp production to undertake an aggressive effort to develop it as a “new” crop (either for oilseed or for fiber). In establishing this as a priority, the KAP-2070 should emphasize not only the economic benefits that Kentucky farmers could gain but also the ecological benefits and the social benefits that hemp promises.¹¹⁸
- Facilitating a “soft landing” for tobacco as a mainstay in Kentucky agriculture. Although I have not addressed above the policy aspects of providing such a “soft

¹¹⁸ See Bourque, *supra* note 57.

landing,” I noted in subsection I.B(i) that tobacco’s decline has occurred in the current “chapter” of Kentucky’s agricultural history. Facilitating a “soft landing” for tobacco might involve transitions to hemp, which was recently re-legalized by means of the 2018 Farm Bill.¹¹⁹ Moreover, as new natural-systems foodcrops come into use, opportunities should abound for former tobacco farms to produce those new crops as well.

- Taking a vigorous and proactive stance prioritizing long-term ecological restoration over short-term economic interests. Taking such a stance would involve a dramatic reorientation of agricultural production: no longer would public monies support the growing of corn, soybeans, and wheat in Kentucky if doing so would sustain a form of agriculture that causes soil degradation, soil erosion, run-off pollution, and fossil-carbon dependence. Instead, public support would be devoted primarily to reversing those consequences of modern extractive agriculture.
- Extending the same ecological prioritization beyond foodcrops to also encompass Kentucky’s other key agricultural activities, particularly poultry, cattle, horses, and equine-related services. Instead of taking a reactive approach, under which such activities can continue so long as the very worst ecological degradation is suppressed, the KAP-2070 would require that these other agricultural sectors operate only insofar as they have a neutral or restorative effect on Kentucky’s ecosystems.¹²⁰

¹¹⁹ See 2018 Farm Bill, *supra* note 55; see also Booker, *supra* note 56; see also Lam, *supra* note 56.

¹²⁰ To this end, the KAP-2070 could reflect the rich literature explaining how horse operations—so key to Kentucky’s agricultural landscape—can be conducted in an ecologically protective and neutral fashion. See Univ. of Ky. Coll. of Agric., *Environmental Best Practices for Horse Farm Owners*, STABLE MANAGEMENT (June 16, 2013), <https://stablemanagement.com/articles/environmental-best-practices-for-horse-farm-owners> [<https://perma.cc/2EMT-P3KK>]; see also Danielle Bolte, *Ecological Benefits of Horses* (July 23, 2014), <https://elcr.org/ecological-benefits-of-horses/> [<https://perma.cc/ADP4-BFZV>].

- Facilitating farm and rural community restoration. A different category of goals established in the KAP-2070 would be economic and social in character. As Jackson and Berry pointed out in the last line of their *New York Times* column on a 50-year farm bill at the federal level, “[w]e need a 50-year farm bill that addresses forthrightly the . . . destruction of rural communities” that modern extractive agriculture has brought to the United States in the past several decades (a destruction that I have seen first-hand where I grew up in northeast Missouri).¹²¹ In like fashion, the Commonwealth’s KAP-2070 would adopt as a legal and policy mandate a rebuilding of rural communities.

In short, a Kentucky 50-Year Agroecology Policy—what I have called the KAP-2070—would aim to facilitate a reorientation of agriculture within the Commonwealth’s territory in ways that would serve the interests of biodiversity, soil health and conservation, water quality, fossil-carbon independence, climate health, and rural restoration.

Much of the foregoing focuses on the substantive aspects of the KAP-2070. As a procedural matter, how might Kentucky undertake the necessary steps to establish and implement such a forward-looking agricultural-reform strategy? For this, consider the Commonwealth’s governmental structure regarding agricultural affairs.

Agricultural policy in Kentucky emerges from several areas and efforts. For instance, the Governor’s Office of Agricultural Policy (“GOAP”) was established in 1998 to provide a direct link between the Governor of the Commonwealth and agriculture.¹²² The Kentucky Agricultural Development Board was created by the

¹²¹ Wes Jackson & Wendell Berry, *A 50-Year Farm Bill*, NY TIMES (Jan. 4, 2009) <https://www.nytimes.com/2009/01/05/opinion/05berry.html> [<https://perma.cc/GA5K-7C22>].

¹²² See *We Are Here to Help You*, GOVERNOR’S OFF. OF AGRIC. POL’Y (GOAP) (2019), <https://agpolicy.ky.gov/Pages/default.aspx> [<https://perma.cc/MLB3-ZQY5>]; see GOAP, ANNUAL REPORT (July 2017-June 2018) [hereinafter ANNUAL REPORT], <https://indd.adobe.com/view/ad24e7a3-3371-4f6b-90bc-08b3e3c9022d> [<https://perma.cc/MHW5-S8CF>].

Commonwealth's 2000 General Assembly to distribute funds for agricultural development¹²³ from the Kentucky Agricultural Development Fund—\$10 million worth in fiscal year 2018.¹²⁴ The Kentucky Agricultural Finance Corporation provides access to below-market financing through several programs, including the Agricultural Infrastructure Loan Program, the Agricultural Processing Loan Program, the Beginning Farmer Loan Program, the Diversification through Entrepreneurship in Agribusiness (DEAL) Loan Program, and the Large Animal Veterinary Loan Program.¹²⁵

The Kentucky Department of Agriculture also naturally plays a role in developing agricultural policy. As noted on its website, the KDA is “a consumer protection and service agency” with offices for (among others) agricultural marketing and consumer and environmental protection.¹²⁶

Agricultural policy emerges not only, of course, from government agencies (and the financial supports and incentives they can provide) but also from research into agricultural innovations. In Kentucky, agricultural research occurs in part on the Kentucky State University Research and Demonstration Farm, a 300-acre facility that, according to a USDA account, “offers students opportunities to conduct research and demonstration projects related to sustainable agriculture, livestock production, horticulture, bioenergy and other land-based studies.”¹²⁷

¹²³ See *Kentucky Agricultural Development Board (KADB)*, GOAP (2019), <https://agpolicy.ky.gov/board/Pages/default.aspx> [<https://perma.cc/MS99-6UN9>]; see also ANNUAL REPORT, *supra* note 122, at 7.

¹²⁴ See ANNUAL REPORT, *supra* note 122, at 9. The most heavily utilized program is the County Agricultural Investment Program. *Id.* at 8.

¹²⁵ See *id.* at 17.

¹²⁶ See generally KY. DEP'T OF AGRIC. (2019), <http://www.kyagr.com/> [<https://perma.cc/UH9J-ERN6>].

¹²⁷ *Alternative Farming Systems Information Center*, NAL USDA <https://www.nal.usda.gov/afsic/edtr/kentucky-state-university-research-and-demonstration-farm> [<https://perma.cc/53ZE-ZKW4>]; see also *Agricultural Research*, KY. ST. UNIV. (2019), <https://kysu.edu/academics/cafsss/agriculture-research/> [<https://perma.cc/85QP-4MCZ>] (noting that the Agricultural Research Station, which encompasses all areas of research within the College, has as its mission “to develop, advance, and disseminate scientific knowledge, improve agricultural productivity, preserve plants and animals, protect the environment, and enhance the health and economic opportunities of the people of the Commonwealth of Kentucky.”).

Agricultural research also occurs at the University of Kentucky College of Agriculture, Food and Environment, particularly at the Kentucky Agricultural Experiment Station and its many affiliated units.¹²⁸

Given the central role of ecology in the Kentucky 50-Year Agroecology Policy that I am proposing, the Kentucky Department for Environmental Protection (DEP) would also play a role in its creation. Notably, the DEP's website offers these observations about Kentucky's natural riches—similar to the observations I made at the beginning of this Essay:

The [DEP] is part of the Energy and Environment Cabinet. The department is home to several agencies that protect and enhance Kentucky's environment including Air Quality, Waste Management, Water Quality, and Enforcement . . . Kentucky's remarkable natural resources have helped shape our economy, culture, and history. Nevertheless, these resources also provide us with the responsibility of good stewardship. Kentucky's residents and businesses must work together to preserve the resource quality and diversity that make Kentucky a great place to live, work, and play . . . [and to] ensure that Kentucky's environment continues to be one of our greatest treasures.¹²⁹

Most or all of these agencies, offices, and entities could productively be involved in an intensive discourse over Kentucky's long-term agroecological future. Ultimately, however, it would be

¹²⁸ See *Research*, UNIV. OF KY. COLL. OF AGRIC., FOOD AND ENV'T, <https://research.ca.uky.edu/> [<https://perma.cc/9GPB-4FXP>].

¹²⁹ See Dep't for Env'tl. Protection (DEP), *Environmental Protection*, KY. ENERGY AND ENV'T CABINET (EEC) (2019), <https://eec.ky.gov/Environmental-Protection/Pages/default.aspx> [<https://perma.cc/E6ZE-BEPL>]. Curiously, the DEP is only one of three departments within the Energy and Environment Cabinet (EEC), whose role is said to be that of "overseers of how we carefully and thoughtfully address the *energy* needs of our citizens." See also *Energy & Environment Cabinet*, EEC (2019), <https://eec.ky.gov/Pages/index.aspx> [<https://perma.cc/J6EH-SQF4>].

the Commonwealth General Assembly that would enact the kind of KAP-2070 that I am suggesting. Primary responsibility for handling the legislation would lie with the Senate Standing Committee on Agriculture and the House Standing Committee on Agriculture. For both of these committees, “matters pertaining to crops” appears as the first item listed under “jurisdiction.”¹³⁰ In order to reflect the ecological aspects central to the legislation that I suggest, both the House and the Senate Standing Committees on Natural Resources and Energy would play important roles as well. For reasons highlighted in the final paragraphs of this Essay, House and Senate committees on Education also would feature importantly in developing a KAP-2070, as would other non-standing committees and subcommittees—and perhaps a special committee formed expressly for this purpose.

B. Today's Innovations for Tomorrow's Agricultural Success

Let me close this section with two specific suggestions for the content of a Kentucky 50-Year Agroecology Policy. One relates to research, the other to education.

i. Research and development

The KAP-2070 should, in my view, provide substantial support for agricultural research. I touched briefly on this in subsection IV.A(ii) of this Essay. As noted there, Kentucky could establish research institutes and fund senior and junior researchers to explore how perennial foodcrop polycultures could most quickly and effectively reach commercially viable production in various Kentucky ecosystems. Kentucky could also support research into hemp production and into the mechanisms best suited for rural restoration in the Commonwealth.

In using the term “support” in the preceding paragraph, I mean urgent, aggressive, public funding for the types of research

¹³⁰ See Legis. Res. Commission, *S. Standing Comm. Agric.*, KY. GEN. ASSEMB., [http://www.lrc.ky.gov/committee/standing/Ag\(S\)/home.htm](http://www.lrc.ky.gov/committee/standing/Ag(S)/home.htm) [https://perma.cc/K9W8-5YAZ]; Legis. Res. Commission, *House Standing Comm. Agric.*, KY. GEN. ASSEMB., [http://www.lrc.ky.gov/committee/standing/Ag%20\(H\)/home.htm](http://www.lrc.ky.gov/committee/standing/Ag%20(H)/home.htm) [https://perma.cc/R3NA-DUUF].

enumerated there. That is, I believe a crucial element of a KAP-2070 would be a robust financial commitment on the part of the Commonwealth—authorized and allocated by its General Assembly and then implemented by the agricultural and environmental agencies I have mentioned above—to a broad-based research program aimed at reorienting Kentucky's agroecology.

Based on preliminary research that my colleague Wesley Williams and I have conducted, very few states allocate specific funding amounts for research aimed at developing novel foodcrops or natural-systems agriculture. Our survey reveals these illustrations:

- In California, the 2018-19 budget devotes \$2.5 million to the California Biodiversity Initiative under the auspices of the Department of Fish and Wildlife. This Initiative aims to “improve understanding of the state's biological richness and preserve, manage and restore ecosystems, [and] protecting the state's biodiversity from climate change.” Of additional note, the California cannabis excise tax, which is forecasted to generate \$630 million in 2018-19 and which remains unappropriated by the legislature, is used in part to fund research related to the legalization of cannabis. The 2018-19 budget also authorizes \$12 million for research into cannabis.¹³¹
- The Illinois 2018-19 budget devotes \$500,000 to the Illinois Environmental Protection Agency for ethanol research and \$1 million to Southern Illinois University for its National Corn-to-Ethanol Research Center. Additionally, the budget provides for \$29.6 million to the University of Illinois' Prairie Research Institute.¹³²

¹³¹ See STATE OF CAL., CAL. STATE BUDGET 2018-19, at 112, 131-32 (2019), <http://www.ebudget.ca.gov/2018-19/pdf/Enacted/BudgetSummary/FullBudget-Summary.pdf> [<https://perma.cc/77TZ-Y2PM>].

¹³² See *Interactive Budget*, OFF. OF MGMT. AND BUDGET (2018), <https://www2.illinois.gov/sites/budget/Pages/default.aspx> [<https://perma.cc/9TBZ-GSWT>].

- The Indiana budget for fiscal year 2018 and fiscal year 2019 appropriates \$17 million for agricultural research and extension through Purdue University.¹³³
- In Iowa, the 2018-19 budget appropriates \$30.5 million for Iowa State University's Agricultural Experiment Station and about \$405,000 to the Iowa State University Leopold Center (focusing on sustainable agricultural practices). It also appropriates \$18.6 million for the Iowa State University Cooperative Extension.¹³⁴
- To provide funding to study low water crops, the Kansas Legislature approved expenditures for research into hemp and sorghum crops in FY 2019 of \$100,000 and \$150,000 respectively.¹³⁵
- The North Carolina 2018-19 budget appropriated \$52.6 million for agricultural research and \$39.2 million for agricultural extension through North Carolina State University.¹³⁶

The KAP-2070 that I envision would include more targeted, far-reaching, and extensive budget allocations—and legislative mandates—than we see in the illustrations I have offered above. Moreover, it would incorporate the philosophy that Frederick Kirschenmann has urged: making agriculture more sustainable requires that we “redesign our food and agriculture system so that

¹³³ See STATE BUDGET AGENCY, STATE OF IND. LIST OF APPROPRIATIONS, at VII-4-5 (2017), https://www.in.gov/sba/files/AP_2017_0_0_0_1_The_Whole_Budget_Report.pdf [<https://perma.cc/7EKL-GLYG>].

¹³⁴ See IOWA DEP'T OF MGMT., IOWA'S BUDGET REP.: FISCAL YEARS 2018-2019, at 16, https://dom.iowa.gov/sites/default/files/documents/2017/01/state_budget_report_fy2018-2019_final.pdf [<https://perma.cc/QMG4-DYWH>].

¹³⁵ See KAN. DIV. OF THE BUDGET, STATE OF KAN. COMPARISON REP., at 35 (2019), https://budget.kansas.gov/wp-content/uploads/FY2019_Comparison_Report.pdf [<https://perma.cc/S7SE-4BTB>].

¹³⁶ See Current Operations Appropriations Act of 2017, Pub. Act 2017-257, 2017 N.C. Sess. Laws 2, <https://www.ncleg.net/Sessions/2017/Bills/Senate/PDF/S257v9.pdf> [<https://perma.cc/C773-ZCBY>].

its functions are more consistent with our best understanding of how the biotic community works.” This requires, he says, that we “refocus our public-research agenda to investigate the synergies and synchronies of the diverse species in each agricultural watershed” and that we “evaluate how they can be employed to increase our agricultural productivity, while simultaneously enhancing the capacity of local ecologies to renew themselves.”¹³⁷

This special emphasis on “enhancing the capacity of local ecologies to renew themselves” should figure prominently in the KAP-2070. Accordingly, the Kentucky government agencies targeted for the funding it provides should include all of the ones I referred to above having involvement both in agricultural matters and in environmental matters.

ii. Education and the future

A second specific suggestion I offer for the content of a Kentucky 50-Year Agroecology Policy concerns enhancing public education regarding agriculture and ecology. I will highlight three particular aspects. First, public schools in Kentucky should provide all students with at least a basic grounding in food production. In neighboring Indiana, a 2017 legislative proposal called for school districts to offer a high-school-level agriculture class.¹³⁸ As emphasized by Frederick Kirschenmann and others, one reason it is difficult for many humans to recognize their dependence on local ecosystems is that they are so disconnected

¹³⁷ KIRSCHENMANN, *supra* note 79, at 186. Frederick Kirschenmann is “one of the most respected critics of the industrial food and farming paradigm,” whose work, along with that of Wendell Berry and Wes Jackson (both cited earlier in this essay), looks “to the wisdom of Aldo Leopold and Sir Albert Howard for inspiration and guidance.” *Id.* at 2. Kirschenmann, an ordained minister with a Ph.D. from the University of Chicago and a distinguished fellow at the Leopold Center for Sustainable Agriculture, helped create the Northern Plains Sustainable Agricultural Society, as well as Farm Verified Organic. *Id.* at 3–4.

¹³⁸ See Rebecca R. Bibbs, *Bill would Require Districts to Offer Agriculture Class to Earn Top Accountability Grade*, THE HERALD BULLETIN (Feb. 8, 2017), https://www.heraldbulletin.com/news/local_news/bill-would-require-districts-to-offer-agriculture-class-to-earn/article_46bc1ca4-45b6-53a3-9a2a-325aeb9de6a3.html [<https://perma.cc/2DFB-KT5G>].

from the natural world; in some societies, most people do not even know the most basic details of their own food production.¹³⁹

Second, public schools should likewise provide students with a basic grounding in Earth sciences—a part of what Wes Jackson and others of The Land Institute are fond of calling “ecosphere studies”¹⁴⁰—so that people would understand the importance, both in their own ecoregion and for the world as a whole, of climate cycles, soil conservation, the “law of return,”¹⁴¹ biodiversity, and the like. Doing so would be consistent with the so-called Earth Charter 2000, which calls for all countries to “[i]ntegrate into formal education and life-long learning the knowledge, values, and skills needed for a sustainable way of life.”¹⁴² It bears emphasis that such an education would go beyond science. It would be part of what Frederick Kirschenmann says should be “a nationwide educational program to foster a national ecological conscience”, and he quotes Aldo Leopold for the observation that “[o]bligations have no meaning without conscience from people to land.”¹⁴³

Third, the KAP-2070’s public education component would provide funding for specialized education and training to the persons most closely involved in farming. Kirschenmann has, for example, called for “a new generation of farmers who are highly skilled in ecology, husbandry, and evolutionary biology, and who seek opportunities to work closely with nature.”¹⁴⁴ In order to train this new generation of farmers, Kirschenmann insists, “[w]e need to introduce more college courses in agroecology and provide internship opportunities for experience-based learning in

¹³⁹ See KIRSCHENMANN, *supra* note 79, at 50.

¹⁴⁰ The Land Institute has sponsored several conferences to explore the meaning and significance of “ecosphere studies,” and to organize educational initiatives that could encourage a world-view in which the ecosphere—as distinct from merely the biosphere (life on Earth) or the ecosystem (confined to a particular territory)—would be the primary frame of reference for policy-making. See also *Ecosphere Studies*, THE LAND INST. (2019), <https://landinstitute.org/our-work/ecosphere-studies/> [<https://perma.cc/5DVP-R7JQ>].

¹⁴¹ See explanatory references to the “law of return” *infra* sections II.B(ii), III.B(iii).

¹⁴² THE EARTH CHARTER: A FRAMEWORK FOR GLOBAL GOVERNANCE 260 (Klaus Bosselmann & J. Ronald Engel eds., 2010) (quoting The Earth Charter 2000’s Principle).

¹⁴³ KIRSCHENMANN, *supra* note 79, at 187.

¹⁴⁴ *Id.* at 222–23.

ecosystems management on real farms.”¹⁴⁵ To this end, perhaps the Kentucky Agricultural Finance Corporation could greatly expand its “Beginning Farmer Loan Program” referred to above in subsection IV.A(ii).¹⁴⁶

V. CONCLUDING OBSERVATIONS

The heading for my introductory section in this Essay was “Kentucky agriculture today and in 2070.” The reason for my reference to this roughly 50-year span should now be obvious: I believe the Commonwealth would be well served by formulating, adopting, and implementing a 50-year agroecological policy that would (1) build on Kentucky’s history of agricultural innovation and adaptation, (2) embrace exciting new research successes in developing new foodcrops, and (3) embark on an ambitious program of public funding to stimulate agricultural research, ecological restoration, and public education—thereby creating a vibrant future for Kentucky’s farmers while restoring the Commonwealth’s natural riches and enhancing its profound beauty.

At first glance, this project—to formulate, adopt, and implement a long-range plan to bring dramatic reform both to agriculture and to environmental policy in Kentucky—might seem impossibly ambitious, even audacious, especially in an age marked by political friction and economic stress. I take the opposite view. In doing so, I focus on three key facts. Fact number one: agricultural change is already coming (again) to Kentucky, in ways I summarized above in Section I. Fact number two: the “dead-end” character of fossil-carbon-based modern extractive agriculture has already become manifest in the ecological, economic, and social failings that I highlighted above in Section II. Fact number three: the momentum toward a new natural-systems agriculture has already grown strong enough to promise a new day for foodcrops of the sort Kentucky farmers produce. Given these realities, now is the time to take the legal and policy steps necessary to secure a bright agroecological future for the Commonwealth.

¹⁴⁵ *Id.*

¹⁴⁶ See ANNUAL REPORT, *supra* note 122, at 18 (discussing that the KAFC approved nearly \$11 million in loans in fiscal year 2018 for the BFLP).