

GRASSLANDS, AGRICULTURE, AND INTERNATIONAL LAW: A SURVEY OF PROPOSED REFORMS

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I. INTRODUCTION: A PERSONAL PERSPECTIVE ON PRAIRIES

I was raised on a farm in the northeast corner of Missouri, in the heartland of the United States. The farm lay in two tracts – one on the east edge and one on the west edge of a farm-based community of about three thousand people – and it formed part of a large patchwork of farms carved out of native woodland and grassland that rose up from the Mississippi River valley and extended west along the glacial plain of north Missouri. My parents and my brother and I called the west part of our farm “the Prairie”. It was flat land used for a combination of row cropping and livestock grazing.

As a child, I saw “the Prairie” as a rather dull place, mainly because it had no trees except a few standing in fencerows dividing fields. Consequently, I scarcely thought about “the Prairie”, especially after I left home for the state university and then on to pursue graduate studies overseas. My interests took me into law, particularly international law. I embarked on a career that found me living in Manila, Washington, London, Beijing, and other cities. The path led into an academic appointment, and it is from that perspective that, for the past quarter-century, I have continued to explore topics in the areas of

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international and comparative law.

To my great good fortune, though, the academic appointment I have held throughout this part of my career has been in Lawrence, Kansas, which sits near the edge of the vast Great Plains of North America. When University of Kansas basketball fans “wave the wheat” in support of their team, they recreate in human form the same patterns of undulating grass moving with the breezes and winds that caress what remains of the great grasslands that formerly graced much of Oklahoma, Kansas, Nebraska, and states and provinces further north.

Thus I have found myself back in touch with this continent’s great grassland region, a small portion of which I had known as a boy in the form of “the Prairie” on our family farm. This has influenced the trajectory of my recent research. Having worked for most of my career with issues of international economic development, I now see that sustainable global economic improvement, or even survival, depends crucially on environmental consciousness and husbandry. We must protect our natural world from ecological degradation if we are to have any hope of avoiding economic degradation in coming years, as human populations increase in size and appetite. This perspective now complements my own personal connection to grasslands – that is, seeing prairies as personal places both today and from my childhood – and it fuels my interest in preserving those grasslands, not just in the Great Plains of North America but elsewhere in the world as well.

I am pleased, therefore, that the *Kansas Journal of Law & Public Policy* has organized this symposium titled “Grasslands: Balancing Preservation and Agriculture in the World’s Most Imperiled Ecosystem,” and I appreciate the opportunity to contribute to the record of the symposium’s proceedings. In this article, I offer a brief survey that highlights (i) the character and locations of the world’s grasslands, (ii) their current state of miserable degradation, (iii) why this situation should prompt us to take robust corrective action, and (iv) the paltry legal regimes, both at the national level and at the global level, that are currently in place to restore and protect grasslands – along with (v) my own cluster of proposals for addressing these problems. Central to those proposals is a reform of agriculture, a project that must be global in scope and that will require fundamental legal changes at the international level.

The survey I offer in this short article draws heavily on research I have reported on in two of my recent books: *Global Legal Regimes to Protect the World’s Grasslands*¹ and *International Law and Agroecological Husbandry*.² With the kind permission of the editors of the *Kansas Journal of Law and Public Policy*, I have fashioned this article largely in the form of a brief but highly structured essay – light on footnote citations (interested readers can of course

1. JOHN W. HEAD, *GLOBAL LEGAL REGIMES TO PROTECT THE WORLD’S GRASSLANDS* (2012) [hereinafter *GRASSLANDS*].

2. JOHN W. HEAD, *INTERNATIONAL LAW AND AGROECOLOGICAL HUSBANDRY: BUILDING LEGAL FOUNDATIONS FOR A NEW AGRICULTURE* (2016) [hereinafter *AGROECOLOGICAL HUSBANDRY*].

find citations to countless sources in those two earlier books) and heavy on bullet-points and policy considerations.

II. DEGRADED GRASSLANDS

As I have pursued my interest in grasslands, I have found that my earlier impressions were almost entirely false. Contrary to my view that “the Prairie” of my childhood was a rather dull place, I have now gained an appreciation for the extraordinary complexity, durability, diversity, and subtlety of grassland ecosystems. The world’s grasslands – also referred to in various circumstances as prairies, savannas, shrublands, veldts, pampas, and steppes – constitute a part of the Earth’s natural ecology (and therefore of our human environment) that is of enormous importance in keeping the entire natural system in balance. To our discredit as a species, however, we have brought profound damage to the world’s grasslands. In the following paragraphs I will summarize where the grasslands are located and how they have been degraded, and then I will explain why we should care about that degradation.

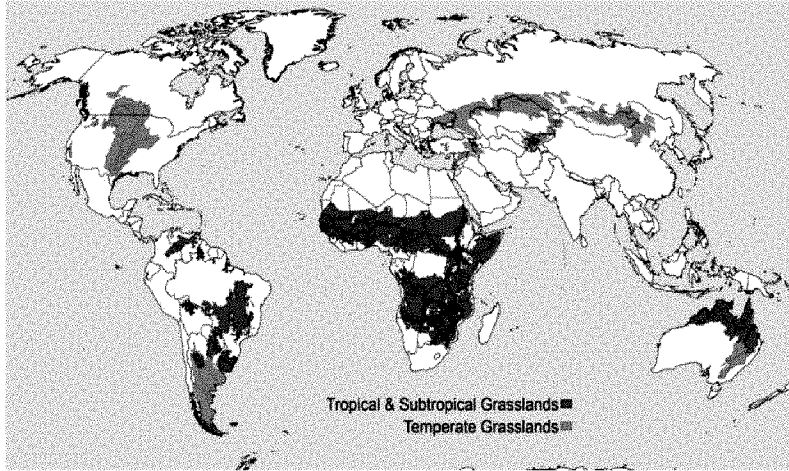
A. *Where are the world’s grasslands?*

Grassland ecoregions exist both in tropical and in temperate zones of the Earth.³ The *tropical* (including subtropical) grasslands abound in Africa, where they form a broad belt stretching nearly across the African continent, not only in the middle of the continent (that is, just south of the Sahara) but also further south, below the equatorial forests. Other sizeable areas of tropical grasslands lie in Australia and in South America, especially Brazil. Map #1 shows in dark shading the world’s tropical grassland areas according to the widely-used classification system developed under the auspices of the World Wildlife Fund (“WWF”).⁴

3. The following discussion of tropical and temperate grasslands draws heavily from Chapter 1 of GRASSLANDS, *supra* note 1.

4. Both Map #1 and Map #2 were prepared largely by Kate Gleeson, an alumna of KU Law School, using maps and databases available in the map collection held by the University of Kansas library system. These databases include information developed by the WWF, which has defined a total of 867 terrestrial ecoregions worldwide. See *Terrestrial Ecoregions Database* at <http://www.worldwildlife.org/science/ecoregions/item1267.html>, along with other sources cited in Chapter 1 of GRASSLANDS, *supra* note 1.

Map #1. General distribution of principal tropical and temperate grasslands

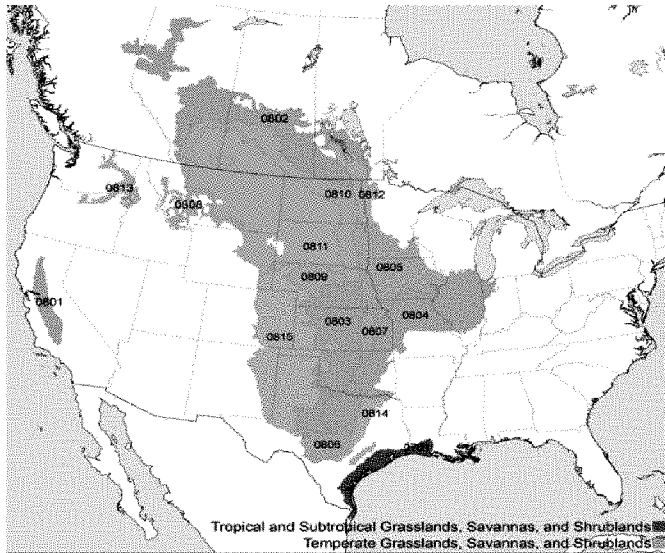


The world's main temperate grasslands include the North American Prairies (Great Plains), the pampas of Argentina, the steppes of west and central Asia and Mongolia, and some savannas and shrublands in Australia. Map #1 shows the world's temperate grassland areas in light shading. As can be seen there, most of the world's temperate grasslands lie within the borders of eight countries: Canada, the USA, Russia, Kazakhstan, Mongolia, and China in the northern hemisphere, as well as Argentina and Australia in the southern hemisphere.

The temperate grasslands found in Canada and the USA appear in Map #2.⁵ These account for roughly 30% of the total area of the world's temperate grasslands – or, more precisely, the world's *former* temperate grassland ecosystems, inasmuch as most of those grasslands have been lost to agricultural conversion (which I will explain in subsection IIB, below). The North American prairies cover vast swaths of the states extending from Texas north to the Dakotas, then continuing into the Canadian provinces of Manitoba, Alberta, and Saskatchewan.

5. As indicated in note 4, *supra*, Map #2 reflects the WWF system of classification.

Map #2. North American Prairies



The four-digit numbers on Map #2 identify the specific temperate grassland ecoregions of North America under the WWF classification system. The five such grassland ecoregions found in the state of Kansas are (roughly from west to east):

- 0815 – Western Short Grasslands ecoregion
- 0803 – Central and Southern Mixed Grasslands ecoregion
- 0807 – Flint Hills Tall Grassland ecoregion
- 0805 – Central Tall Grasslands ecoregion
- 0804 – Central Forest-Grasslands Transition ecoregion

B. How have the world's grasslands been degraded?

The late Swedish zoologist, academic, and author Kai Curry-Lindahl offered these observations about the world's grasslands and what humans have done to them:

It is remarkable how productive grasslands once were. . . . The grassland biome was for millennia a perfectly balanced ecological system which offered optimal conditions for life. . . . Man himself has been intimately related to grasslands ever since he emerged from the forests of Africa about three million years ago. *Despite this long experience modern man has failed to understand the ecology of savannas, steppes, and prairies.* He has devastated few other biotic regions as thoroughly as these – changing the nature of the land

through extermination and the introduction of exotics; overcultivating and overstocking without regard for the capacity of the environment.⁶

Curry-Lindahl's observations are echoed in the literature generated by numerous studies, groups, and campaigns designed to draw attention to the abuse and disappearance of grasslands around the world. One of the groups (headquartered in British Columbia) offers this assessment:

Of all the ecosystems on earth, none has been more dramatically affected by humanity than native grasslands. These lands have been widely altered, because they are attractive places for humans to build settlements, grow crops and graze livestock. Although native grasslands at one time covered 40% of the North American Continent, the vast majority has been transformed into agricultural lands, urban settings, and other settlement uses. In places with significant development and agricultural pressures, virtually all native grasslands have disappeared. For example, 98% of the tallgrass prairie east of the Missouri River is gone, and California has lost 99% of its native grasslands.⁷

One of those figures bears repeating: 98% of the tallgrass prairie east of the Missouri River (this includes the region where I grew up) is gone. Only slightly less arresting figures apply to the disappearance or degradation of mixed grass and short grass prairies in North America, as well as to the disappearance or degradation of other grasslands all around the world. Here are a few examples that I highlighted in my recent book on international law and grasslands⁸:

- Of the 13.8 million acres of native prairie that remains in the eastern Dakotas, 298,000 acres – over 2% – were converted to cropland just during the period 2002-2005. This amounts to a 0.55% annual conversation rate.
- The conversion rate might be much higher in some regions. For example, research conducted in the Missouri Coteau region of the

6. KAI CURRY-LINDAHL, *WILDLIFE OF THE PRAIRIES AND PLAINS* 10 (1981) (emphasis added). Kai Curry-Lindahl (1917-1990) was associated at various times with the University of Stockholm, the University of California at Berkeley, and the University of Guelph, Ontario. He also served as an advisor to several UN agencies engaged in environmental protection and to about 35 African governments from his base in Nairobi.

7. Environmental Law Clinic, University of Victoria Faculty of Law, *GRASSLANDS PROTECTION: A PRIMER FOR LOCAL GOVERNMENTS* (undated) [hereinafter *GRASSLANDS PROTECTION PRIMER*], http://www.rdosmaps.bc.ca/min_bylaws/planning/rgs/ReportsAndStudies/GrasslandsProtection.pdf, and accessible by link from [http://www.rdos.bc.ca/index.php?id=316&no_cache=1&sword_list\[\]=primer](http://www.rdos.bc.ca/index.php?id=316&no_cache=1&sword_list[]=primer). See also other sources cited in *GRASSLANDS*, *supra* note 1, at 39–40.

8. See *GRASSLANDS*, *supra* note 1, at 40–41.

Dakotas has documented annual loss rates as high as 2% in some key areas. To put this into perspective: if that rate were maintained over the long term, half of the remaining native grasslands in those areas would be lost in less than 35 years.

- The digging and drilling for coal, natural gas, and rare earth elements in the Inner Mongolia Autonomous Region of China (which occupies 12% of the PRC's total territory), has resulted in widespread grasslands degradation.

These changes in the world's grasslands can be credited entirely to one overriding cause: human action. More specifically, the two principal ways in which humans have brought about momentous alteration of the world's grasslands include agricultural conversion and inappropriate grazing; other causes are urban development, fire suppression, forest encroachment, and global climate change.⁹ For the limited purposes of this short article, let us focus just on the first of these: agricultural conversion.

For various reasons, grassland soils – especially those of temperate grasslands – are often quite fertile. This fertility, which is particularly pronounced in the North American Prairies, has tempted settlers to plow the grasslands for agricultural purposes. Doing so can in many cases *temporarily* yield large crop production, either for human consumption or for feeding to livestock, but it destroys the grasslands, especially when done year after year.

It has only been fairly recently that the conversion of grasslands to agricultural use began to have a significant impact. Up until roughly two centuries ago, the world's richest prairies and grasslands were largely intact. One reason for this is population: two hundred years ago, in the early 1800s, the world's human population had only barely reached one billion (compared with the planet's current human population of over seven billion). Besides, at that time humans had no way to destroy the very richest of the world's grasslands. Don Worster, an emeritus distinguished professor at Kansas University, explains this reality and how it changed suddenly:

Down to the 19th century the grasslands resisted the farmer's plow. For thousands of years plows had been made of wood, and even when they were given cast-iron edges, they could not penetrate the grasslands. They would break first. Their usable range was limited to exposed soils along the river bottoms or what had once been forest floor.

Not until the nineteenth century did an American inventor named John Deere, followed by other inventors and manufacturers, begin making plows of steel, an alloy of iron and carbon forged with the heat of

9. *Id.* at 41–55.

burning coal. The first steel plow appeared in 1837 near the prairie city of Chicago, Illinois. Such a formidable tool of nearly indestructible steel, pulled in the early days by large yoked teams of oxen or horses, could slice through the toughest sod and expose the deep, fertile soil to the air. Armed with the new plows, farmers could at last, after millennia of avoiding the grasslands, begin to venture out onto them and begin to conquer. They bought John Deere's invention eagerly and [in North America they] began ripping up the midcontinent prairie.

We can trace the waves of conquest decade by decade across the [American] continent: beginning with Iowa and Minnesota in the 1840s and [18]50s, then across eastern Kansas and Nebraska by the 1860s, then across the mid-latitude grasslands by the 1870s and 1880s, before drought put a stop to the advancing plows. Then in the first three decades of the twentieth century the great plow-up continued westward, all the way to the Rocky Mountains. The original sea of grass had given way to a sea of wheat and corn.¹⁰

In addition to the direct effect that agricultural conversion has on grasslands – that is, by physically replacing them with fields of crops – some secondary effects also appear. Rivers, creeks, and streams in grassland areas have been channeled and dammed in order to provide water for agricultural irrigation. In addition, many ponds and lakes have been drained to make still more land available for agricultural production. These alterations to bodies of water have in many cases destroyed or degraded the grasslands of which they form an essential part.

The negative impact of converting grasslands to agricultural use takes many forms around the world. The survey of pertinent literature that I offered in my recent book on international law and grasslands includes such illustrations as these¹¹:

- In the Great Plains of North America, many species of grassland birds have seen population declines over the past decades as the intensity of agricultural activities has increased.
- In some parts of Africa, new species introduced for plantation forestry production are rapidly invading grassland ecosystems where they disturb the functioning of these ecosystems and reduce biodiversity.
- In the Cerrado region of South America, conversion of some lands for agriculture has destroyed much of the native vegetation.

10. Donald Worster, *The Grasslands in Time: From the Eocene to the Anthropocene* (Keynote address for conference on Comparing Grasslands in China and North America, Chinese Academy of Social Sciences, Beijing, China, September 2011), at 12-13.

11. See GRASSLANDS, *supra* note 1, at 44-45.

- In Europe, changes in agricultural practices and land use pressures are making grasslands disappear at an alarming rate. According to one report, the area of grasslands in Europe declined by 12.8% from 1990 to 2003.

C. *Why should we care about grasslands degradation?*

What good are grasslands?¹² Some people might answer this question by urging that there is beautiful elegance in ecological balance, and that this constitutes an adequate reason to preserve and protect the grasslands. Indeed, I would be among those people. However, we can easily see a bounty of other, more “practical” values and benefits that grasslands provide. Three of the most prominent of these are soil conservation, species biodiversity, and carbon sequestration.

1. Soil Conservation

The first of these, soil conservation, should be obvious to anyone. Despite being exposed to recurrent droughts and occasional torrential rains, most grasslands in their natural state are not subject to substantial soil erosion. The complex root systems of prairie grasses, often extending much further below ground than the visible plant matter extends above ground, act to hold the soil in place, prevent run-off, and help the plants draw groundwater in even the driest conditions.

To some people with little contact or experience working with soil, the topic of soil conservation might seem uninteresting and pedestrian. And yet the Earth’s soil serves as the highly complex medium in which the energy of the sun is transformed into life.¹³

So significant is soil to the life of our planet that numerous books and articles have been written to highlight the need to conserve it. One such work is William Bryant Logan’s 1995 book, *Dirt: The Ecstatic Skin of the Earth*. David R. Montgomery’s more recent book carries the same main title but a darker

12. Much of the content of the following paragraphs draws from *id.* at 57–63. Readers interested in further details, and in citations to additional sources, may find them there.

13. Kansas University emeritus professor Don Worster has emphasized the complexity of soil by explaining that it comprises much more than just minerals derived from various sorts of rock: There is the humus, the organic residue of roots, carrion, feces, bone, and leaves mixed through the mineral components. On this humus there is an incomprehensibly large number of bacteria working away, decomposing the dead, fixing nitrogen, forming nitrates to feed the living. The soil is fungi, too, and earthworms, moles, burrowing insects – over a thousand different animal species in all, aggregating more biomass below ground than above it. . . .

DONALD WORSTER, *THE WEALTH OF NATURE: ENVIRONMENTAL HISTORY AND THE ECOLOGICAL IMAGINATION* 81-82 (1993).

subtitle – *Dirt: The Erosion of Civilizations*. Montgomery explains how soil degradation has spelled doom for many past civilizations, and he insists that “[s]uch problems are not just ancient history. That soil abuse remains a threat to modern society is clear from the plight of environmental refugees driven from the southern plains’ Dust Bowl in the 1930s, the African Sahel in the 1970s, and across the Amazon basin today.”¹⁴ So serious is this problem, Montgomery asserts, that “[u]nless more immediate disasters do us in, how we address the twin problems of soil degradation and accelerated erosion will eventually determine the fate of modern civilization.”¹⁵

We might usefully regard the Earth’s soil, then, as an extremely thin “skin of life” stretched over a dead rock. If it remains healthy, that “skin of life” can create adequate food, feed, and fiber – and indeed, it can do so in luxuriant abundance – for the benefit of creatures living on it, including humans. Grasslands, perhaps more than any of the other types of land cover, help nurture the health of that “skin of life”, by conserving the soil.

2. Biodiversity

A second answer to the question “what good are grasslands?” is that they help maintain a rich diversity of species on Earth. Some plants found in the grasslands – *Echinacea purpurea* (purple coneflower) comes readily to mind – have medicinal uses. Many of these have been known for generations by indigenous peoples.¹⁶ Other plants of the grasslands provide abundant food sources. As one source says, “[g]rasslands have been the seedbeds for the ancestors of major cereal crops, including wheat, rice, rye, barley, sorghum, and millet. They continue to provide the genetic material necessary to breed cultivated varieties that are resistant to crop diseases.”¹⁷

This notion that grasslands are the “seedbeds for the ancestors of major cereal crops” warrants special attention. In his famous work *The Ascent of Man*, Jacob Bronowski explains the lucky coincidence that constituted the turning-point in the spread of agriculture in the Old World:

Before 8000 BC wheat was not the luxuriant plant it is today; it was merely one of many wild grasses that spread throughout the Middle East. By some genetic accident, the wild wheat crossed with a natural goat grass and formed a fertile hybrid [called Emmer]. . . . The hybrid

14. DAVID R. MONTGOMERY, *DIRT: THE EROSION OF CIVILIZATIONS* 2 (2007) (emphasis added).

15. *Id.*

16. A Kansas University faculty member has undertaken an extensive study of this in the North American context. See generally KELLY KINDSCHER, *MEDICINAL WILD PLANTS OF THE PRAIRIE: AN ETHNOBOTANICAL GUIDE* (1992) (documenting both Native American and European uses of 203 native plant species in treating various ailments).

17. Robin White, Siobhan Murray, and Mark Rohweder, *Pilot Analysis of Global Ecosystems: Grassland Ecosystems* (2000), available on the WRI website at <http://www.wri.org/publication/content/8268>. See also further relevant information on the WRI website at <http://www.wri.org/publication/pilot-analysis-global-ecosystems-grassland-ecosystems>.

was able to spread naturally, because its seeds are attached to the husk in such a way that they scatter in the wind. . . . [But then] there was a second genetic accident Emmer crossed with another natural goat grass and produced a still larger hybrid . . . , which is bread wheat.¹⁸

Bronowski surmises that the same process—that is, the accidental creation of new hybrids out of the lush diversity of grasses—occurred elsewhere in the world as well.¹⁹ In short, the very foundations of agriculture lie in the world's grasslands, and specifically in their genetic diversity.

That genetic diversity appears not only in plants, of course, but also in animals that grassland ecosystems support. Many of them provide habitat for unique animal species. For instance, two of the grassland ecoregions in South America—namely the Low Monte ecoregion and the Patagonian Steppe ecoregion—support 15 and 22 such unique animal species, respectively.²⁰

The species of animals that find their habitat in grasslands—and especially those species that are *unique* to those grasslands—obviously benefit from measures to preserve those grasslands. From that proposition it is but a short step to the proposition that *humans* benefit from the preservation of those grasslands. Indeed, this proposition is central to the Convention on Biological Diversity²¹ and numerous other international legal instruments in which states have formally acknowledged the values of biological diversity in both the plant and animal kingdoms.

3. Carbon Sequestration

A third answer to the question “what good are grasslands?” is that they sequester carbon. Much attention is paid to tropical rain forests as “carbon sinks”—that is, as forms of land cover that can capture and store carbon released into the atmosphere. Grasslands do the same thing. Indeed, the overall potential of carbon sequestration by grasslands compares favorably with the potential for carbon sequestration by rain forests.²² In fact, because grasslands worldwide

18. J. BRONOWSKI, *THE ASCENT OF MAN* 65–68 (1973).

19. *Id.* at 68. Bronowski notes that this coincidental creation of agriculture “surely happened more than once. Almost certainly agriculture was invented again and independently in the New World – or so we believe on the evidence we now have” regarding the development of hybrids of maize. *Id.*

20. See GRASSLANDS, *supra* note 1, at 60.

21. This treaty emerged from the 1992 Rio Conference on the Environment. For the text of the treaty and a survey of its provisions, see the website of its secretariat at <http://www.cbd.int/>.

22. See C. Neely, S. Bunting, and A. Wilkes, eds., *Review of Evidence on Drylands Pastoral Systems and Climate Change: Implications and Opportunities for Mitigation and Adaptation*, FAO Land and Water Discussion Paper [No.] 8 (2009), at 13, http://www.fao.org/uploads/media/LWdisc_paper8_temp.pdf (noting that “[w]hile carbon storage in grasslands is less per unit area than forests, the total amount of carbon that grasslands store is significant because the area of these ecosystems is so extensive”).

have already been so deeply degraded, their potential for carbon sequestration if they were *restored* is remarkably large.²³

III. Deficient protections

Thus far I have tried to establish three main points: (1) that grassland ecoregions appear in a great many places around the world, including both tropical and temperate regions, (2) that most of these grasslands are now deeply degraded, with a principal cause of this degradation being their conversion to agricultural use, and (3) that grassland ecosystems are so important to the world's natural balance that their degradation should move us to take robust corrective action. Have we taken such action? That is the topic I turn to here.

In my recent book on grasslands protection, I examined legal and regulatory regimes that operate in selected countries, and at the international level, to see what attention they give to the issue of restoring and preserving grassland areas. Unfortunately, my overall conclusion was this: whether at the national level or the multilateral level, whether undertaken by government or by non-government organizations, the current regime of initiatives, institutions, and rules designed to protect grassland areas is depressingly weak. Even in those portions of the world that are richly endowed with resources to devote to grasslands preservation and restoration, the protections are indirect, half-hearted, and scattered.²⁴ I offer a few illustrations below—first from the national level and then from the international level.

A. National measures for grasslands protection

Although my research has encompassed several national legal systems, with special attention to Canada, China, Turkey, and the USA, let us consider just the last one of these countries for purposes of this summary.²⁵

A fundamental point of departure in assessing the degree of legal protection for North American grasslands—or, more precisely, the areas that were grasslands for thousands of years, until they were largely destroyed by conversion to agricultural production and grazing—is to consider this fact: nearly all of the land in the ecoregions outlined on Map

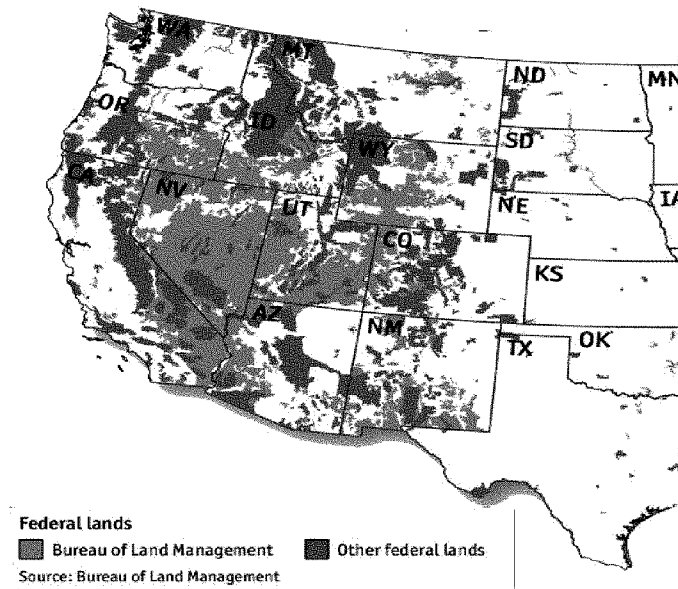
23. *Id.* at 14 (highlighting the vast untapped potential for climate change mitigation and adaptation associated with improved carbon sequestration in pastoral systems and rangelands, and specifically noting that “restoring land health on large areas of degraded land could help compensate for significant amounts of global carbon emissions”). For more information on the subject, see *Fighting Climate Change with Grasslands*, available on the FAO website at <http://www.fao.org/news/story/en/item/38916/icode/>.

24. See GRASSLANDS, *supra* note 1, at 67.

25. My colleague Lijuan Xing, another participant in this *Journal* symposium, is providing a survey of grasslands protection in China.

#2 is (i) privately owned and (ii) used today either for raising crops or for grazing livestock. Granted, vast stretches of the western USA are public lands, with jurisdiction over them being exercised by the Bureau of Land Management (about 245 million acres), the National Forest Service (about 193 million acres), the National Park Service (79 million acres), and the Fish & Wildlife Service (about 96 million acres).²⁶ Practically all of that acreage, however, lies west of the Rocky Mountains, as Map #3 shows.

Map #3. U.S. Public Lands ²⁷



By contrast, the areas once covered by the great North American Prairies lie almost exclusively *east* of the Rocky Mountains (see Map #2, above), and in those areas the primary role of the US government, and of the individual states as well, has been to encourage the development of *agriculture*, not to protect *grasslands*. Fortunately, some government agencies have promulgated regulations and supported innovations that are designed to make agriculture somewhat less destructive. Starting in the 1940s, for instance, what was then called the Soil Conservation Service helped my father as he built terraces and “farmed on the contour” in order to reduce erosion from our fields. Still, the overall trajectory has been one of government support for grasslands

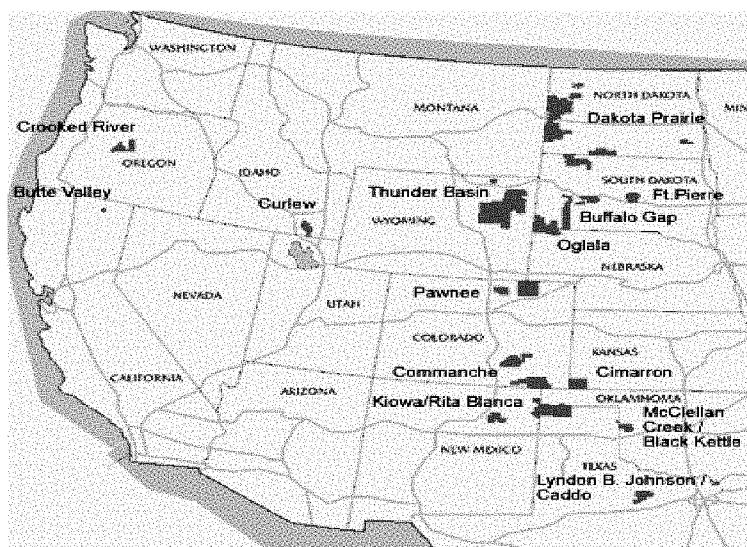
26. See GRASSLANDS, *supra* note 1, at 103–04.

27. This map is drawn from Beth Burritt, *Should a Handful of Peer-Reviewed Articles Dictate Land Management Policy*, (posted Dec. 2, 2015), <https://publiclandgrazing.org/category/policy/>, which itself draws from a 2012 Congressional Research Office publication, Ross W. Gorte, et al., *Federal Land Ownership: Overview and Data* (2012), <http://cns7prod.s3.amazonaws.com/documents/FEDERAL%20OWNERSHIP%20OF%20LAND-CRS-2012.pdf>, at 6.

destruction—through their conversion to agricultural use, that is—instead of grasslands protection.²⁸

One significant exception stands out. Under the Bankhead-Jones Farm Tenant Act of 1937,³³ the US Department of Agriculture (“USDA”) was authorized to “develop a program of land conservation and land utilization [that was aimed] . . . to correct maladjustments in land use . . .”³⁴ As a consequence, millions of acres of land—mainly purchased by the federal government under Dust-Bowl-era legislation of the mid-1930s—were made the subject of reinvigoration efforts and were transferred to various government agencies or retained by the USDA.³⁵ From those, a total of 3.8 million acres were designated “national grasslands” in 1960.³⁶

Map #4. U.S. National Grasslands



28. One of the principal forms of government support for environmental protection in US agriculture has been the Conservation Reserve Program (“CRP”), which emerged from the Dust Bowl days and assumed its most recent formulation in the so-called “farm bill” of 2014. For details on the CRP, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 147, 249–50. For an account of the overall “get big or get out” philosophy of US agricultural policy for the past several decades, featuring incentives for more and more conversion of native ecosystems to agricultural production, see *id.* at 288.

33. 7 U.S.C. §1000 *et seq.*

34. 7 U.S.C. §1010.

35. For information about the role of several US regulatory agencies exercising various forms of authority over public lands, including some grassland areas see GRASSLANDS, *supra* note 1, at 97–108. The agencies include the four agencies noted above – the Bureau of Land Management (part of the US Department of Interior), the National Forest Service (also part of the US Department of the Interior), the Fish & Wildlife Service (also part of the US Department of the Interior), and the National Forest Service (part of the USDA) – as well as the Environmental Protection Agency.

36. See GRASSLANDS, *supra* note 1, at 98.

Those 3.8 million acres comprise 20 designated national grasslands that fall under the authority of the USDA's Forest Service. This initiative would seem to suggest that US law does in fact act to protect grasslands. However, Map #4 shows just how miniscule are the areas set aside for this form of protection.

Moreover, the degree of protection afforded by the designation of an area as a national grassland is paltry. For instance, the Bankhead-Jones Act calls on the Secretary of Agriculture "to develop a program of land conservation and land utilization" that will focus not only on controlling soil erosion and protecting wildlife but also on "developing energy resources."³⁷

I can offer an illustration of what that can mean in practice. A few years ago my wife and I drove through the second-largest of the national grasslands – Thunder Basin National Grassland, located in northeastern Wyoming (see Map #4). To our surprise, the principal feature there is not gloriously quiet, open Wyoming prairies offering an abundant home to prairie dogs and other wildlife but rather North America's largest open-pit coal mine.³⁸

Granted, the designation of these national grasslands—along with the setting aside of other small areas for protection, such as the Tallgrass Prairie National Preserve in the Flint Hills area of Kansas³⁹—does signal a desire to make some efforts at grasslands protection. Still, they are insignificant in the overall picture. Indeed, the website for the Tallgrass Prairie National Preserve highlights the thoroughness of the process that has eliminated tallgrass prairies in North America:

Tallgrass prairie once covered 170 million acres of North America. Within a generation the vast majority was developed and plowed under. Today less than 4% remains, mostly here in the Kansas Flint Hills. The preserve protects a nationally significant remnant of the once vast tallgrass prairie and its cultural resources. Here the tallgrass prairie takes its last stand.⁴⁰

37. 7 U.S.C. §1010.

38. For more details on the Thunder Basin National Grassland, and an account of the intense frictions that have surrounded efforts to protect prairie dog populations there, see GRASSLANDS, *supra* note 1, at 109–10.

39. For details on this preserve, see <https://www.nps.gov/tapr/index.htm>. Another protected area, but also not part of the national grasslands system, is located in Illinois: the Midewin National Prairie. For details, see <https://www.fs.usda.gov/midewin> (last visited May 9, 2017).

40. NATIONAL PARK SERVICE, *Last Stand of the Tallgrass Prairie*, <https://www.nps.gov/tapr/index.htm> (last visited May 9, 2017).

I believe the same can be said of the US national grasslands program more generally: it represents a “last stand” in the effort to resist the momentum of destruction that has characterized the grassland ecosystems that once defined the Great Plains of North America. Like the indigenous peoples that inhabited this region for millennia, those ecosystems have been almost entirely eradicated; those that remain have been afforded only faint protections in small reserves.

B. International measures for grasslands protection

Unfortunately, the same weakness in grasslands protection that my research found in the USA also appears internationally. In exploring various avenues by which action can be taken at the global level—these include the operations of international organizations, the creation of treaties, and the development of customary international law—I found precious little effective resistance to grasslands degradation worldwide. In the following paragraphs I offer a very abbreviated summary of what I reported regarding this topic in my recent book on grasslands.⁴¹

Several international organizations have environmental-protection mandates. Some of the more prominent of these organizations, and their efforts towards grasslands protection, included the following:

- The United Nations Environment Programme (“UNEP”), which emerged shortly after the Stockholm Conference of 1972, helped conclude the 1979 Convention on the Conservation of Migratory Species of Wild Animals, which has now been ratified by over 150 countries.⁴² That treaty focuses on the conservation of migratory species and their habitats, as do some other agreements that UNEP helped negotiate among some countries in South America.⁴³
- The United Nations Development Programme (“UNDP”) gives considerable attention to biodiversity management, as for instance in supporting the initiatives of the Nairobi-based Drylands Development Centre. Some of that Centre’s programs target grasslands improvement

41. See GRASSLANDS, *supra* note 1, at 136–66.

42. For information about the Convention and its parties, see the pertinent page on the website of the Convention on Migratory Species, http://www.cms.int/species/Grassland_birds/grassland_birds_text.htm (last visited May 9, 2017).

43. See GRASSLANDS, *supra* note 1, at 137. Other grasslands-related UNEP activities include organizing efforts to create action plans aimed at protecting grasslands birds and their habitats, supporting scholarly works on environmental issues (including grasslands), and helping develop national environmental-protection laws. *Id.* at 137–38.

in Mongolia, especially by strengthening the abilities of local nomadic herders to prevent degradation from overgrazing.⁴⁴

- The International Fund for Agricultural Development (“IFAD”) has financed projects in China and elsewhere aimed at improving rangeland management, in part to help resist environmental damage to grassland areas through overgrazing. In general, though, IFAD’s operations focus not on *protection* of grasslands but rather on the *utilization* of resources (grasslands included) in ways that will “enable poor rural people to overcome poverty”.⁴⁵
- The World Bank, emphasizing the linkages between global climate change and the conditions of the world’s grasslands, has financed numerous projects that include grasslands conservation as a key element. In China, India, and various African and Latin American countries, World Bank financing has supported grazing reform, natural regeneration of native species, and carbon sequestration through sustainable agricultural land management. The Argentine Grasslands Project supports efforts to reverse the devastating effects that agricultural cropping (especially soybeans) has had on the Pampas, one of the largest of the world’s temperate grassland areas (appearing prominently in Map #1, above).⁴⁶

In addition to the initiatives taken by these international institutions, grasslands protection has occasionally gained attention in the context of treaty-making efforts. These efforts are reflected, for instance, in the following⁴⁷:

- The Convention to Combat Desertification (which entered into force in 1996) and the Convention on Biological Diversity (which emerged from the 1992 Rio Conference on the Environment) both have specific provisions calling for action to address problems with direct implications for grasslands around the world.
- Several other treaties are less directly relevant to grasslands protection but might nevertheless be regarded as supplementary in character. These include two treaties that entered into force in 1975: the Convention on Wetlands of International Importance Especially as Waterfowl Habitat and the Convention on International Trade in Endangered Species of Wild Fauna and Flora.
- Several treaties more limited in their scope – either in terms of their subject-matter or in terms of their territorial reach – also have a bearing, either directly or indirectly, on grasslands protection. One of these dates to the 1940s: the Convention on Nature Protection and

44. See GRASSLANDS, *supra* note 1, at 138–39 and sources cited there.

45. See *id.* at 141–143 and sources cited there.

46. For details on these and related World Bank initiatives relating to grasslands, see *id.* at 143–148 and sources cited there.

47. For a description of these and related treaties, see GRASSLANDS, *supra* note 1, at 235. Most of these treaties can be found online, and most of them also appear in BURNS H. WESTON, INTERNATIONAL LAW AND WORLD ORDER: BASIC DOCUMENTS (looseleaf).

Wildlife Preservation in the Western Hemisphere records an agreement among various countries in the Americas to establish national parks and reserves and to adopt laws and regulations to protect flora and fauna within their territories.

In addition to concluding treaties, countries establish binding rules in international law by engaging in practices consistently over time. Whether any such rules of customary international law⁴⁸ have emerged that bear on grasslands protection is open to some debate. Some observers assert that there is in customary international law a right to a healthy environment (“RTHE”). If so, it might be plausible to infer that countries have an obligation to take certain actions (or refrain from other actions) that bear on the health and sustainability of grassland areas. My research strongly suggests, however, that customary international law does not currently include any RTHE.⁴⁹ Moreover, even if it does, a question would still remain as to what specific obligations, if any, apply in respect of a country’s treatment of grassland areas.

Taken as a whole, my survey of international rules, initiatives, and institutions results in a grim conclusion: Although some important steps have been taken, both institutionally and normatively, to strengthen environmental protection generally, extremely few of those steps give any significant attention to the world’s grasslands. Those that do are laudable but relatively narrow in their application. In sum, neither the legal landscape nor the institutional landscape at the global level features any impressive broadly-based protections or initiatives concerning grasslands.

IV. Agricultural reform

If, as I have posited above, three things are true – (1) that grasslands around the world have been destroyed or deeply degraded by converting them to agricultural use, and especially to grow grain crops, (2) that this loss of grasslands poses serious dangers for the habitability of our planet, and (3) that legal and institutional efforts to address this degradation have thus far been unavailing in addressing these problems—then perhaps a fourth thing is also true: *perhaps more revolutionary change is required, especially in agriculture itself*. I turn therefore to this question: can agriculture, especially grain production of the sort humanity has engaged in for the last several thousand years, be fundamentally changed in ways that would *not* involve a destruction of grasslands?

48. As set forth in any elementary book about international law, customary international law consists of those rules that emerge not from the formal written consent of states – as in the form of a treaty – but rather from informal implied consent of states as evidenced by their actual behavior toward each other. For details, see GRASSLANDS, *supra* note 1, at 156.

49. For my reasoning on this point, see GRASSLANDS, *supra* note 1, at 156–65.

At first glance, the answer would seem to be “obviously not: a plot of land can be a grassland or it can be a grain field, but it cannot be both.” Recent scientific research suggests, though, that this obvious answer is in fact wrong. Prospects look good for developing a new form of agriculture that mimics the natural ecosystem of a grassland, so that in certain key respects a plot of land can be *both* a grassland and a grain field. In this Part, I draw on my most recently published book on agroecological husbandry⁵⁰ to explain how this might be true.

In presenting this explanation, let me offer three propositions, which start by shifting the perspective temporarily away from grasslands and focusing instead on agriculture more generally:

- Proposition #1. The form of extractive agriculture that humans have developed over about ten thousand years presents a cluster of problems, especially in its most modern form. These problems are ecological, economic, and social in character, and they are so substantial as to conclude that *modern extractive agriculture has failed*.
- Proposition #2. *A fundamentally different form of food production and rural life – agroecological husbandry – is now becoming possible*, and it is highly preferable to modern extractive agriculture, particularly in terms of producing grains and legumes that account for the largest portion of human caloric intake.
- Proposition #3. Because agroecological husbandry centers on making grain and legume production mimic the ecosystem of a natural prairie or grassland, *the benefits that grassland ecosystems offer – especially soil conservation, biodiversity, and carbon sequestration – can be restored* by undertaking a new agricultural revolution.

A. *Failings of modern agriculture*

Many observers have developed the details of Proposition #1 above. Some have emphasized ecological (environmental) factors, and indeed it is those ecological factors that explain the term “extractive agriculture” appearing in Proposition #1. After all, the form of agriculture developed in the Fertile Crescent several thousand years ago featured the *annual* planting of seeds in designated plots of land. This process was “extractive” to the degree that the

50. See generally AGROECOLOGICAL HUSBANDRY, *supra* note 2. As explained below, “agroecological husbandry” has as its main elements both (1) a rejection of the notion that soil is to be tilled (either literally by plowing or figuratively by using powerful synthetic herbicides and pesticides) in order to produce food and (2) an embrace of the notion that food production should, to the extent possible, mimic the processes and cycles of natural ecosystems – particularly those grassland ecosystems whose fertility yields the bulk of human food. For details, see *id.* at 135–48; see also GRASSLANDS, *supra* note 1, at 209–15.

integrity of the soil that the farmers used for such cultivated agriculture was compromised by (1) erosion or (2) fatigue (extracting the soil's nutrients without replacing them). Of course, erosion could be reduced by various prudent farming practices, and fatigue of the soil could be counterbalanced in part by using manure from livestock. Yet substantial erosion and fatigue still inevitably occurred.

The degree to which this traditional form of agriculture was "extractive" in character gradually *increased* with the development of more effective means of tilling the soil. The most remarkable, and the most destructive, of these was the steel plow that appeared in the 1830s, especially when farmers could pull their plows with tractors powered by internal combustion engines following the discovery of oil by Colonel Edwin Drake in Titusville, Pennsylvania in 1859—a discovery that started humanity's feverish rush, now about a century and a half old, to extract petroleum and other fossil fuels from the Earth.

The 20th century brought the addition of a third form of extraction for agricultural purposes. Since just after World War II, great quantities of ammonia – a combination of hydrogen and nitrogen – have been used to create synthetic nitrogen fertilizers to boost crop yields. Indeed, roughly four-fifths of all ammonia produced around the world is devoted to use as agricultural fertilizer. In overall terms, nitrogen fertilizer now constitutes the largest single energy input into industrial agriculture. Production of the ammonia requires an intense energy source. In the USA, the source is mainly natural gas, which is of course another form of fossil carbon that is extracted from beneath the surface of the Earth. Hence, as modern agricultural production has come to rely more and more on ammonia for nitrogen fertilizer, the extraction of natural gas has risen accordingly. More recently yet, reliance on fossil-carbon deposits has increased further in order to produce various pesticides and herbicides.

These various factors justify the use of the term "extractive" in describing today's agriculture. Moreover, the features of the modern extractive agriculture I have summarized above form the foundation for ecological critiques of the entire system. The critiques usually emphasize one or more of the following issues:

- Modern extractive agriculture creates massive *soil erosion*, even with "low-till" or "no-till" farming techniques. For instance, although topsoil in a grassland ecoregion can be replenished at a rate of less than one inch in 200 years, current rates of soil erosion in the USA (even with aggressive soil-conservation efforts in some locations) run 12 times higher than soil formation rates. Soil loss problems in many regions elsewhere in the world are much worse.
- In addition to soil erosion, modern extractive agriculture also results in

serious *soil degradation* – that is, in its fertility, its resilience, its organic matter, and other elements of its quality. Particularly troubling in this regard is the initiative of the past half-century to use massive amounts of synthetic chemical inputs that kill or injure countless microbes, worms, insects, and other participants in the soil’s rich 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. 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* are degraded.
- Modern extractive agriculture creates substantial *habitat loss and degradation* more generally. This has brought an unprecedented reduction in *biodiversity*.
- Modern extractive agriculture adds to an existential planetary threat by its direct and indirect contribution to *global climate change*. Roughly 13% of worldwide greenhouse gas emissions come directly from agricultural activities; much of these are nitrous oxide and methane, which are more potent than carbon dioxide in their climate impact.⁵¹

In addition to these ecological concerns, modern extractive agriculture has come under attack for its economic unsustainability, for the risks it poses to human health, and for doing deep and lasting harm to society by transforming farming and rural life in ways that unwisely discard important social values.⁵²

B. Agroecological husbandry

Proposition #2, as I stated it above, offers welcome relief in the face of these criticisms of modern extractive agriculture. Extensive field research, focusing on plant breeding and ecological studies, indicates that a different approach to grain production can be developed that would avoid the shortcomings of modern extractive agriculture. This new approach, which I refer to as agroecological husbandry,⁵³ starts from the assumption that nature’s economy – and particularly the economy and architecture of the native grasslands that constitute the setting for a great deal of today’s agricultural production – should provide the guidance for a “natural-systems” agriculture that focuses on perennials grown in polycultures, not annuals grown in monocultures.

51. For extensive details on these and other ecological aspects of modern agriculture, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 78–105.

52. See *id.* at 39–76, 105–32.

53. For an explanation of the concept of “husbandry” in this context, and of agroecological husbandry more generally, see GRASSLANDS, *supra* note 1, at 209–15.

The use of perennials grown in polycultures (that is, mixtures of several species of perennial crop plants in the same field) addresses the ecological concerns that have been directed at modern extractive agriculture. For instance, perennial polycultures:

- can dramatically reduce agriculture's contribution to greenhouse-gas emissions that contribute to climate change, by (i) reducing the use of agricultural fertilizer and chemical pesticides, (ii) reducing emissions of nitrous oxide in particular, which is much more potent as a greenhouse gas than carbon dioxide, and (iii) reducing the use of fossil-carbon fuels needed to power farm implements;
- can in fact help mitigate global climate change by sequestering carbon, thus (i) recapturing a significant amount of the carbon that was released from the soil in the past several decades and (ii) contributing to the resilience and stability of the climate;
- can arrest the degradation that traditional agriculture causes to soil through erosion, damage to soil structure, and reduction in soil organic matter;
- can, because of their diversity, better resist attacks by pests and pathogens;
- can reduce groundwater contamination of the sort that results from nitrate leaching in annual monocultures; and
- can better maintain the health and fertility of a landscape more generally over longer periods of time, especially by preserving the microhabitats present in perennial polycultures.⁵⁴

Fortunately, agroecological husbandry – relying on perennial grains grown in polycultures, and featuring the characteristics and benefits summarized above – is not a pipe-dream. It has solid prospects for success. Although it is still outside the typical orbit of research institutions funded by agribusiness interests it has gained wide acceptance in the scientific world as being worthy of further research. To date, substantial progress has been made—especially through the efforts of researchers at The Land Institute, headquartered in Salina, Kansas—in developing perennial varieties of intermediate wheatgrass (including the commercial marketing of a variety called Kernza®), rice (including five lines of perennial rice now used in China), sorghum, *silphium integrifolium*, sunflowers, and some other oilseeds. Researchers are also making progress in understanding the structure of polycultures.⁵⁵

With every step forward in developing perennial polycultures – and therefore in making it possible to replace modern extractive agriculture

54. See AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 182–86.

55. For a detailed status report on the development of perennial grains, and on efforts to design polycultures most conducive to them for grain and legume production, see *id.* at 201–32.

with agroecological husbandry – we take a step toward regaining the benefits that have gradually been lost with the destruction and degradation of the world’s grasslands. Why? Because, as reflected above in Proposition #3, *agroecological husbandry centers on making grain and legume production mimic the ecosystem of a natural prairie or grassland*. Hence the same benefits that grassland ecosystems offer, especially better soil conservation, enhanced biodiversity, and carbon sequestration, are provided by perennial grain and legume production of the sort that is currently under development.

V. International legal and institutional innovation

To say that an agricultural revolution “is currently under development,” as I suggested in the preceding paragraph, is far different from saying that such a revolution will definitely take place. For one thing, a lot of scientific research still has to be successfully conducted. Given the promise it offers, such scientific research should be vigorously supported and funded.

Yet scientific innovation alone will be inadequate. Legal and institutional innovations are also necessary to revolutionize agriculture and to start the process of restoring the world’s grassland ecosystems. These legal and institutional innovations must occur at all levels of the social order, but especially at the international level. Two types of such innovation warrant special attention. A first one involves negotiating new international agreements, formalized in binding treaties, for both grasslands protection and agricultural reform. A second innovation would feature a reorientation of the concept of sovereignty that lies at the center of international law.

A. Treaty initiatives

Although I have explored these types of innovation in other contexts,⁵⁶ let me outline here their main contours. I begin with pertinent treaty provisions.

First, new treaty provisions could be negotiated to record a broad international consensus on the following *international environmental principles*:

- the precautionary principle⁵⁷;

56. For my views on new treaty law relating to grasslands and agriculture, see GRASSLANDS, *supra* note 1, at 236–43 and AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 296–323. For my views on reorienting sovereignty, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 373–96. I am currently writing another book that examines sovereignty reforms more extensively. See John W. Head, A GLOBAL CORPORATE TRUST FOR AGROECOLOGICAL INTEGRITY: MANAGING A NEW AGRICULTURE IN A WORLD OF LEGITIMATE ECO-STATES (forthcoming 2018) [hereinafter GLOBAL CORPORATE TRUST].

57. A commonly-used synopsis of the precautionary principle is that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. For details, see GRASSLANDS, *supra* note 1, at 191–192, 237n19.

- the principle of intergenerational equity⁵⁸;
- the principle of intra-generational equity⁵⁹;
- the “polluter pays” principle⁶⁰; and
- the principle of sustainable development.⁶¹

Second, newly-negotiated treaty provisions could also record acceptance by the participating states of the following grasslands-specific commitments (among others):

- to share detailed information about the condition of grasslands ecoregions within their borders;
- to establish or strengthen government agencies at the national level, and, where applicable, the provincial level, to concentrate responsibility over the restoration and protection of grasslands;
- to establish as wilderness preserves substantial areas of grasslands that will be free from any form of development and where intense restoration measures will be taken as necessary;
- to establish another level of protection for grassland areas that will not be placed entirely “off limits” but will still be exempted from use for food production or other activities (such as grazing, mining, and other extractive uses) that today constitute principal forms of grasslands degradation;
- to adopt legislation and regulations as necessary to prevent various forms of grasslands degradation;
- to establish effective administrative, civil, and criminal penalties for violating rules on grasslands protection and farmland conservation (with suitable alternatives in those countries not recognizing corporate criminal liability);
- to provide annual reports on each country’s performance of its obligations to protect grasslands; and
- for developed-country members, to provide financial support both to the Secretariat and to the developing-country members through a financial mechanism established in the treaty.⁶²

58. Under the principle of intergenerational, the present generation ought to recognize that it is morally obligated to take into account the welfare of future generations when making decisions over such things as the use (or abuse) of natural resources. For details, see GRASSLANDS, *supra* note 1, at 237n20.

59. Intra-generational equity involves consideration of equity within the present generation – so that, for example, people within the present generation have equal rights to benefit from the enjoyment of a clean and healthy environment. For details, see GRASSLANDS, *supra* note 1, at 238n21.

60. One straightforward statement of this principle is that “the person who introduces a pollutant – whether of the air, the sea, or other – should also be responsible for the removal of that pollution”. Eric Engle, *General Principles of Community Environmental Law*, available at <http://lexnet.bravepages.com/Enviro.htm>. For details, see GRASSLANDS, *supra* note 1, at 238n22.

61. This principle requires that development must be capable of being maintained over the long term. For details, see GRASSLANDS, *supra* note 1, at 238n23.

62. These and related commitments are elaborated in GRASSLANDS, *supra* note 1, at 233–39.

Moreover, the new treaty provisions would also record acceptance by the participating states of the following *agricultural-reform-specific commitments* (among others):

- to provide aggressively increased public funding and other support for research into natural-systems agriculture, with special attention to developing perennial grains to be grown in polycultures in various ecological and climate conditions;
- to adopt and implement legislation prohibiting certain agricultural practices (such as nitrate discharge) causing serious and direct ecological damage;
- to reorient agricultural subsidies away supporting from annual-monoculture crops and toward the development and production of perennial-polyculture crops;
- to remove fossil-carbon subsidies; and
- to facilitate land reform, in part to reflect the “public trust” doctrine.⁶³

The new treaty provisions I have briefly enumerated above could be incorporated into one or more existing treaties dealing with environmental issues. Alternatively, and perhaps more effectively, they could be set forth in a new treaty (or pair of treaties) designed to concentrate specialized attention on (i) grasslands protection and (ii) agricultural reform.

B. Pluralistic sovereignty

Let me turn now to the second innovation I mentioned above at the international level – a reorientation of the concept of sovereignty that lies at the center of international law. Designed to meet the political needs of Europe roughly four centuries ago, the “monolithic sovereignty” we have inherited from that period is out of step with modern circumstances and should be replaced with what I have called “pluralistic sovereignty.”⁶⁴

In “pluralistic sovereignty,” authority over certain matters of ecological protection and agricultural reform and production would be exercised not exclusively by nation-states but rather by new non-state legal entities operating within territorial boundaries drawn to reflect scientifically-determined ecological realities, not historically-driven political artificialities. We might refer to these new legal entities as eco-authorities or “eco-states.” Since their territorial jurisdiction would follow ecological contours, they would necessarily

63. For details, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 306–07. For specific information on the applicability of the “public trust” doctrine and related concepts in this context, see *id.* at 308–18.

64. For an extensive discussion of the history of sovereignty, recent departures from “monolithic sovereignty”, proposals for reconceptualizing sovereignty, and the potential applicability of “pluralistic sovereignty” to ecological matters, see *id.* at 353–80.

be transnational in character. Within their orbit of jurisdiction, they would share certain attributes of sovereignty with (political) states.

Fortunately, we can be guided somewhat by historical precedent in undertaking this reorientation of sovereignty. Notwithstanding the seemingly stiff and unyielding character of sovereignty as inherited from earlier times, various forms of blended jurisdiction and authority have already been created and recognized around the world as a legal and practical matter, and some of these are specifically designed to handle environmental issues.⁶⁵ Building on these precedents in order to construct a “pluralistic sovereignty” concept would help achieve the environmental-protection and agricultural-reform aims reflected in the treaty provisions I referred to above—and thereby help overcome the ill effects of grasslands degradation.

Indeed, one historical precedent that can prove particularly useful to us in developing and adopting a “pluralistic sovereignty” concept dates from the close of the Second World War. States took multilateral action then to address global economic and political problems by establishing such institutions as the World Bank, the International Monetary Fund, and the United Nations.⁶⁶ Similar action might be warranted now, especially as a means of coordinating the efforts of the new “eco-authorities” to facilitate ecological protection and agricultural reform at the ecosystem and ecoregion level—including in particular the restoration of grassland ecosystems both through preservation and through a transition to agroecological husbandry.

Naturally, any such new global organization would need to improve dramatically on the existing multilateral institutions. For one thing, reflecting the adoption of the “pluralistic sovereignty” concept summarized above, any new organization should involve participation from a range of entities (not just states) and would need to have voting, managerial, and structural features designed to overcome the series deficiencies widely

65. These instances include (i) the rise of federal systems such as that of the USA, (ii) the rise of international organizations to handle problems common to the international community, thereby placing restrictions on national authorities, and (iii) the special constitutional status enjoyed by Trentino and Südtirol in Italy. *Id.* at 368–71, 381. Additional instances that I am currently studying include the International Joint Commission (“IJC”), responsible for managing boundary waters between the USA and Canada, and the world network of biosphere reserves managed by the UN Educational, Scientific, and Cultural Organization (“UNESCO”). For information on the IJC, see *About the IJC*, on the IJC website at http://www.ijc.org/en_/About_the_IJC. For details on UNESCO’s biosphere reserves, over a dozen of which are transboundary (crossing state borders), see *Ecological Sciences for Sustainable Development*, appearing on the UNESCO website at <http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/>.

66. For a survey of the character and history of these institutions, see JOHN W. HEAD, *THE FUTURE OF THE GLOBAL ECONOMIC ORGANIZATIONS: AN EVALUATION OF CRITICISMS LEVELED AT THE IMF, THE MULTILATERAL DEVELOPMENT BANKS, AND THE WTO* 2–22 (2005).

criticized and acknowledged in the world's existing multilateral institutions.

VI. CONCLUDING OBSERVATIONS: PRACTICALITIES AND REALITIES

At first glance, the array of legal and institutional reforms I have summarized above might seem unduly ambitious in an age that seems to be marked by political gridlock, international conflict, and institutional sclerosis. However, ecological realities—such as those I have touched on above about the ecological unsustainability of our current methods of agriculture and our treatment of the world's grasslands—guarantee that *change will inevitably occur in our behavior*. The issue is how the change will occur and specifically how we can influence its content, pace, and direction.

Moreover, not one of the reforms summarized above is truly unprecedented. Indeed, today's system of agriculture can itself be traced to some specific decisions and innovations made in earlier years that were just as significant and ambitious in their day as the ones now required in ours.⁶⁷ The same can be said of law and institutions at both the national and the international level: the past century alone has seen changes that are just as substantial as the ones required today to build the global legal foundations for a new agriculture.

In my view, then, it is shortsighted—it is unrealistic—to plead that the initiatives outlined here for protecting the world's grasslands and reforming the world's agriculture are *too* ambitious, or that they are excessively inconsistent with existing legal doctrines or entrenched political interests. Indeed, a more potent critique of the proposals I summarize here might be that they are not innovative *enough* to secure fully the changes we need if we are to keep the world from tipping over the precipice of climate change and soil degradation.

67. For observations on the rise of “industrial agriculture” and the advent of the so-called Green Revolution, see AGROECOLOGICAL HUSBANDRY, *supra* note 2, at 287–89.