Chapter 16

Agricultural Resilience: The Many Roles of Lawyers

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Introduction

The fundamental concept of resilience is the ability to recover from or adapt to adverse situations. Resilience of the agroecosystem involves not only the commercial and marketing aspects central to business, such as competition, tax structures, subsidy structures, insurance, and legal questions of externality imposition, but also physical issues regarding soils, water supply, microclimates (e.g., "aspect"—the direction a slope in a field faces can impact crop yield), drainage, and water quality of inputs and outputs. The natural resource supply chain of agribusiness is outside of the control of the farmers and ranchers; recognized as an essential component to support life, it is also a critical demand of society. As primary users of soil, water, and air, farmers and ranchers are ideally situated to manage these resources. However, the natural resource base is becoming increasingly regulated by outside interests. Thus, farmers and ranchers must operate through integration of their agricultural systems across the spectrum from commercial business entities through the natural environment. This creates a unique and complex entity with challenging legal requirements and ramifications. The goal of this chapter is to delineate the challenges of achieving resilience in the agroecosystem and show the many opportunities and obligations for lawyers to make significant contributions to their clients and the community at multiple scales.

This chapter focuses on the fundamental components of the agroecosystem. Outside influences are multitudinous and relate to the agroecosystem in complex ways. To focus this chapter, we will restrict the discussion to agroecosystem functionalities, but with the recognition of the very interwoven nature of these systems. This is not to disregard the complexity of relevant regulatory processes and policy; the Farm Bill alone is a huge topic (see National Coalition for Sustainable Agriculture for analysis of the most recent one).[1]

The second goal is to provide recommended sources to enable quick access. It is important to recognize very significant modifications that are difficult to monitor: the extent of concentration of holdings, subsidy-receipt, and share of commodity production. Capitalization and industrialization of U.S. agriculture is so extensive that in the major commodities only the riskiest parts of a supply chain may be independent. This rapidly shifting business structure requires creativity to design successful entities that can address the myriad requirements of the consumer and government regulators, while supporting the operational goals and morals of the farmer/operator and accommodating natural laws. It is also important to recognize that, in our current system of finance, most agricultural credit is short-term and often limited to individual crop cycles; much of the lending is yearly, increasing the requirement for short-term profits and decreasing the ability to transition to more sustainable farming systems.[2]

1. National Coalition for Sustainable Agriculture, Melissa Charney, 2018, various publications. Washington, D.C., National Sustainable Agriculture Coalition. https://sustainableagriculture.net/publications/.

2. P.C., to Wiener, 1997–2002; P.C. to Sassenrath in studies of farming systems, 1996–2010 Sassenrath, G.F., J.M. Halloran, D. Archer, R.L. Raper, J. Hendrickson, P. Vadas, J. Hanson. 2010. Drivers impacting the adoption of sustainable agricultural management practices and production systems of the Northeast and Southeast United States. J. Sustainable Agriculture. 3(6):680–702. DOI: 10.1080/10440046.2010.493412.

The Agroecosystem

Resilience in agriculture can be characterized by the three S's—survival, stewardship, and succession. In many workshops and meetings with farmers in a variety of settings, these goals were clearly and consistently expressed.[3]

If a farm fails to capture sufficient economic resources to remain in business, it is neither sustainable nor resilient. Survival is increasingly difficult with pressure from markets, land conversion, and water competition. There are a wide variety of sources on the economics of small and medium scale farms.[4] Enterprise budgets are developed based on data collected from individual farming operations. Farm-scale economics can be estimated from the expected value of the combination of outputs using a specified set of inputs, labor costs, and so on, and these may be aggregated from enterprise budgets. Up-scaling to multiple farms for regional management, such as an irrigation ditch group, may increase economically sustainable solutions. On a farm, crop, pasture, and livestock operations are considered. On a group of farms, rotations of crops, cover crops, and fallow and a larger range of choices in livestock management and movement may be considered, ideally capturing economies of scale, additional management expertise, and novelties such as rotation of implements along with crops. However, regional integration requires a synthesis across multiple enterprises that is not obvious.

Farmers desire to be staunch proponents of stewardship and are intimately aware of the need for wise management of that natural resource base on which they rely. A principal obstacle to long-term stewardship is the need for short-term survival. The threats to agriculture from land conversion alone are very serious.[5]

3. Personal experiences of J. Wiener, 2002–2016.

4. *See e.g.*, AgManager, KSU, 2019. https://www.agmanager.info/.

5. American Farmland Trust and Conservation Science Partners, 2018, Farms Under Threat: The State of America's Farmland. Washington D.C., American Farmland Trust. https://www.farmlandinfo.org/farms-under-threat-state-americas-farmland.

Succession, or transfer of the agroecosystem to the next generation or apprentices, is a key driving force for many farm decisions.[6] Farmers see farming as a way of life, a commitment to family and heritage.[7] Succession impacts management choices and their sustainability.

An Example of Resilience: Rain

"The single raindrop never feels responsible for the flood."[8]

Raindrops have enough energy to separate individual soil particles and concurrently collect chemicals—pesticides, herbicides, fertilizers, and so on. These soil particles and chemicals then move across and out of the field with the rain. The energy of the single raindrop, joined with other raindrops, has substantial energy. In waterways, the moving water potentially erodes streambanks, roadways, levees, and culverts. The damage can be substantial.[9] If the soil cannot hold the excess water the risks are much worse, including water table depletion and flood damage on the surface from increased flash floods. Flooding can also destroy infrastructure creating additional financial burdens.

Eventually, the rain collects in downstream lakes and reservoirs, where the chemicals and sediments are well established as contributing to life-threatening algal blooms.[10] The sediments also reduce the holding capacity of reservoirs and water bodies, enhancing downstream flooding, impeding water supplies,

6. Archer, D.W., J. Dawson, U.P. Kreuter, M. Hendrickson, J.M. Halloran. 2008. Social and political influences on agricultural systems. Renewable Food Agricultural Systems. 23(4): 272–84; Bigelow, D., Borchers, A., Hubbs, T. 2016. U.S. farmland ownership, tenure and transfer. Economic Research Service EIB-161. https://www.ers.usda.gov/webdocs/publications/74672/eib-161.pdf?v=0.

7. Sassenrath, G.F., et al. *supra* note 2.

8. Attributed to Douglas Adams.

9. Pierce, F.J., W.E. Larson, R.H. Dowdy, and W.A.P. Graham. Assessing long-term changes due to erosion. J. Soil Water Conserv., 38(1):39–44, 1983; Pimentel, D. Soil erosion: A food and environmental threat. Env. Dev. Sustain., 8:119–37, 2006. doi: 10.1007/s10668-005-1262-8.

10. Anderson, D.M. 1989. Toxic algal blooms and red tides: A global perspective. In Okaichi, Anderson, and Nemoto, Eds. Red Tides: Biology, Environmental Science, and Toxicology. Elsevier Science Publ. Inc. pp. 11–16.

and requiring substantial investments to correct.[11] This is highly adverse for agricultural resilience. Moreover, the movement of water across political boundaries is creating trans-boundary contamination issues that are becoming more relevant in the United States[12] and the rest of the world,[13] and is expected to increase in intensity and negative impact as environmental consequences heighten.

The agricultural system is composed of individual fields, farms, and regions. While farmers and ranchers are very aware of the impact of their management choices, the combined result of choices from multiple, and highly diverse, enterprises are difficult to clearly delineate. Each entity must stay in business individually, with each individual decision difficult to relate to the observed outcomes.

Natural Resources and Agricultural Resilience

Farmers learn early on that the critical component of their production system—the natural resource base—is largely outside of their control. The most costly weather events are tropical cyclones, resulting in more than $945 billion in damages and more than 6,500 deaths (Table 16.1). Much of the damage, and especially the expensive damage, is to property and infrastructure, but agriculture is impacted as well due to loss of crops and livestock.[14] In contrast, damaging heatwaves and droughts focus

11. Kansas Water Office. 2019. John Redmond Dredging. https://kwo.ks.gov/projects/john-redmond-dredging.

12. McKinney, D.C. 2011. Transboundary water challenges: Case studies. Prepared for U.S. Department of State, Foreign Service Institute; and Univ. of Texas at Austin. Available online at: http://www.caee.utexas.edu/prof/mckinney/ce397/readings/transboundarywaterissues.pdf.

13. Li, Z., Liu, M., Zhao, Y., Liang, T., Sha, J., Wang, Y. 2014. Application of Regional Nutrient Management Model in Tunxi Catchment: In Support of the Trans-boundary Ecocompensation in Eastern China. 16 APR 2014. CLEAN—Soil, Air, Water.

14. Billion-dollar weather and climate disasters: Table of Events. National Oceanic and Atmospheric Administration. https://www.ncdc.noaa.gov/billions/events.

the damage on agriculture and the ancillary businesses and industries most severely. Drought is the second most costly natural disaster, resulting in an average adjusted cost of more than $9 billion per event. The drought of 2012 was the most extensive since the 1930s, impacting nearly half of the country and resulting in failed crops. Other natural disasters affect property, infrastructure, and agriculture, depending on where they occur. The frequency and intensity of events, including damaging storm systems, flooding, and wildfires, have been increasing.

Table 16.1 Summary of weather and climate disasters in the U.S. from 1980–2019

Event	Number of Events	Total CPI Adjusted Cost, B$	Deaths
Tropical Cyclone	44	$945.56	6502
Drought	26	$249.66	2993
Severe Storm	113	$248.15	1642
Flooding	32	$146.43	555
Wildfire	17	$84.99	347
Winter Storm	17	$49.38	1048
Freeze	9	$30.41	162

Source: NOAA National Centers for Environmental Information. https://www.ncdc.noaa.gov/billions/summary-stats

Water Quantity

Too Much

Floods and Levees

Since 1980, the United States has experienced 32 major flood events costing an estimated $146 billion and resulting in more than 500 deaths.[15] Recent historic flooding in 2019 in central and southern United States left millions of acres of cropland under water, delayed or prevented planting of additional millions of

15. NOAA National Centers for Environmental Information. https://www.ncdc.noaa.gov/billions/events.

acres, restricted barge traffic due to high water levels (negatively impacting agricultural industries and transfer of crops[16]), and resulted in an estimated cumulative $20 billion in damages.[17] Flooding also damages infrastructure, and the recent historical floods have demonstrated the increasing need for greater attention to aging and inadequate levees. The U.S. Army Corps of Engineers reports more than 100,000 miles of levees in one-fifth of all U.S. counties.[18] Levees that don't fail during floods concentrate the flows leading to higher velocity in the rivers and greater scouring of related infrastructure (i.e., bridge scour). When levees do fail, the flood may deposit undesirable debris and sediments that may be highly polluted from accumulation of sewage and urban run-off. Most levees needed work before the recent flood events occurred.[19]

The "levee effect" is a commonly used term explaining increased investment behind levees, thought to be safe places. The increased investment includes suburbanization, increased agriculture, and public investment, enlarging the risks in the event of levee failure. Repair funds may be sparse, with the exception of some disasters big enough to command congressional attention. The Army Corps of Engineers has resisted damage claims where levees that it built fail.[20] There may be some relief for farms affected, but the levees themselves may be left to obsolete districts. The problem is described by the American Society of Civil

16. https://www.grainnet.com/article/171672/2019-flooding-challenges-grain-transportation.

17. NOAA U.S. Billion-Dollar Weather and Climate Disasters 1980–2020, https://www.ncdc.noaa.gov/billions/events.pdf.

18. Mallea, Amahia, 2019, As Flood Risks Increase Across the U.S., It's Time to Recognize the Limits of Levees. https://www.govtech.com/em/preparedness/As-Flood-Risks-Increase-Across-the-US-Its-Time-to-Recognize-the-Limits-of-Levees.html.

19. The changing hydrology is faster and more intense than was anticipated; for an overview, see US Global Change Research Program 4th National Climate Assessment, and later updates. Washington, D.C., US Global Change Research Program (13 agencies). https://www.globalchange.gov/. Each report has clearly written summaries. Note that the Assessment is now out of date, but see the Special Report, Vol. 1 (2017).

20. See further discussion of this in Chapter 12 of this book.

Engineers,[21] urging $70 billion dollars of additional investment. Levees may have been well-built for conditions now irrelevant, in addition to sustaining continued decay due to water channeling, rodents, and inadequacy of maintenance. States have different policies for rebuilding but the levee effect tends to prevent efforts for removal. Changes in freeze-thaw frequency, flashiness of floods, and very large flows with changing seasonality are also threats to soil health and resilience.[22] Reports and webinars are available.[23] Almukhtar et al. provided a map of the 2019 Midwest flood events.[24] Massive flooding created huge losses in 2018 and worse losses in 2019. Flooded farm fields resulted from excess rain and earlier than normal snow melt, resulting in very destructive impacts on farming soils, prevention of timely field operations, and very large losses of income.[25]

Downstream benefits of levee management include better management of sediments, less pollutants, and achieving "rolling adaptation." A target of 2050, for instance, ignores the reality that hydrology is continuously changing. 2050 will be a point on a curve, so the wise investment is to consider how to achieve adaptability on a sustainable basis. Finally, note that state and local governments can expect a return on investment of $7 saved for every $1 spent on flood mitigation.[26] There is no other known

21. American Society of Civil Engineers, 2017 Infrastructure Report Card; Levees. Reston, VA. https://www.infrastructurereportcard.org/cat-item/levees/.

22. Soil Health Institute, 2019 and back, various important reports on soil health, restoration and links to human health. Morrisville, NC: Soil health Institute. https://soilhealthinstitute.org.

23. Association of State Wetland Managers, Windham ME; https://www.aswm.org/aswm/aswm-webinarscalls; Natural Hazard Mitigation Association https://www.nhma.info/drr; Association of State Floodplain Managers, Madison, WI: https://www.floods.org/.

24. Almukhtar, Sarah, Blacki Migliozzi, John Schwartz and Josh Williams, 2019, The Great Flood of 2019: A Complete Picture of a Slow-Motion Disaster. [September 11, 2019]. New York: The New York Times. https://www.nytimes.com/interactive/2019/09/11/us/midwest-flooding.html

25. *Id.*

26. National Institute of Building Sciences, 2017, Mitigation Saves 2.0. Washington, D.C.: National Institute of Building Sciences. https://www.nibs.org/page/mitigationsaves.

local government investment with that high a return, unless it is education. And, of course, not building, or building to significantly higher standards of design and construction in dangerous places has a huge return.

Too Little

Drought, Fires, and the Wildlife/Urban Interface

Too little water also causes damage, especially to crops and livestock that require water. Additionally, dry conditions contribute to wildfire risk. In 2018, the largest single fire in Kansas history burned more than 500,000 acres. The fires in Oklahoma and Kansas in 2018 would go on to burn more than 800,000 acres, killing cattle and destroying fences and buildings. Losses to cattle operations were estimated at $26M in Oklahoma[27] alone. There is a rapidly growing set of resources on fires, wildland fires, and the wildlife/urban interface.[28]

In the semi-arid West, irrigation by ditches is another resilience problem because of limited feasibility of ditches. "Water does not flow, it is pushed" is a saying based on the requirements for getting water down a ditch. If enough irrigators sell water, the rest may face litigation seeking conversion to different flow measures, piping, and pumping. The earliest water rights are typically associated with high quality land, and those water rights are the most reliable and therefore, the most valuable. In the West, prior appropriation complicates re-allocation. Removing the best water rights from the most productive land is

27. https://www.farmprogress.com/livestock/cattle-operation-losses-wildfires-exceed-26-million.

28. Tecle, A., D. Neary. 2015. Water quality impacts of forest fires. J. Pollut Eff Cont. 3:2. http://dx.doi.org/10.4172/2375-4397.1000140; Pronto, L., J. Karns. 2019. Facing the flames—Looking forward as a global community. Fire Management Today. 77(1):69–71. https://www.fs.fed.us/sites/default/files/fire-management-today/FS%20Fire%20Management%20v77-1v5_508_May_2019.pdf; U.S. Department of Agriculture, Office of the Chief Economist, 2015, Regional Vulnerability Assessments [8 regions]. Washington, D.C., U.S. Department of Agriculture. https://www.climatehubs.usda.gov/archive/content/regional-vulnerability-assessments.html.

economically highly inefficient,[29] and commonly reflects municipal competition for water.

Water Quality

The Des Moines Water Works Case, Eutrophication, Hypoxia, and Increasing Drainage—Ag v. Ag, Shifting Costs and Possibility of Backlash

The *Des Moines Waterworks* case[30] responded to dramatically decreased water quality from tile drainage use on-farm. Tile drainage is used to drain crop fields through near-surface perforated pipes that exit into riparian zones, transferring agrichemicals and sediment into waterways that provide important ecosystem services, including denitrification, shading of creeks, and habitat values. The water degradation dramatically increased water treatment costs for the city. The case against the drainage districts was supported by 63 percent of Iowa residents.[31] However, the case was dismissed because of a very old state law that gave immunity to drainage districts in order to promote them. It was not thrown out for economic efficiency failures, lack of

29. Howe & Wiener, 2016, University of Denver Water Law Review (*infra* note 56).

30. https://u.osu.edu/ohioagmanager/2017/02/22/the-des-moines-water-works-lawsuit-whats-happened-whats-next/.

31. Eller, Donelle, Des Moines Register business writer, archived for public access to her work at https://muckrack.com/donnelle-eller/articles, including reporting on nitrates in Iowa Water, tariffs, levee problems, threats to agriculture, flooding and many other topics; she is often reprinted in other newspapers; it is a fine tour of agricultural resilience issues. But note: the muckrack archive is very large and most of the reporting on the Des Moines waterworks case is three years back, so getting there takes a lot of time. Apparently one may become a member of muckrack and then have access to better sorting. Purchasing access to the *Des Moines Register* may trade some money for a lot of time, but the access to 2014 and 2015 may be limited. Subscription is offered at $0.99 cents per month. See: https://www.desmoinesregister.com/story/money/agriculture/2015/01/18/water-pollution-lawsuit/21929897/ for one article.

extensive co-benefits, aquatic damage or lack of reductions in the hypoxic zones, forecast the biggest ever in 2018.[32]

Grand Lake Watershed

The Grand Lake Watershed (GLW) includes portions of four states that drain into northeast Oklahoma. Extensive agricultural and mining operations have severely impaired the water quality,[33] creating trans-boundary negative environmental impacts. The location of the GLW is representative of the typical interstate and trans-boundary contamination cases becoming more relevant in the United States[34] and the rest of the world.[35] These will increase in intensity and negative impact with environmental and demographic changes. Kansas and Oklahoma have developed watershed restoration and protection strategy (WRAPS) plans[36] that identify critical areas and outline preliminary plans for remediation. The watershed management plan seeks identification and quantification of all pollution sources, using sophisticated computer models.[37]

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32. Warziniack, T. 2014. A General Equilibrium Model of Ecosystem Services in a River Basin. Journal of the American Water Resources Association 50 (3) 683–95. https://doi.org/10.1111/jawr.12211.

33. Manders, G.C. & J.S. Abers, 2014. Tri-State Mining District Legacy in Northeastern Oklahoma. Emporia State Research Studies. 49(2):29–51. https://www.academia.edu/23234584/Tri-State_Mining_District_legacy_in_northeastern_Oklahoma.

34. McKinney, D.C. 2011. Transboundary water challenges: Case studies. Prepared for US Department of State, Foreign Service Institute; and University of Texas at Austin. Available online at: http://www.caee.utexas.edu/prof/mckinney/ce397/readings/transboundarywaterissues.pdf.

35. Li, Z., Liu, M., Zhao, Y., Liang, T., Sha, J., Wang, Y. 2014. Application of Regional Nutrient Management Model in Tunxi Catchment: In Support of the Trans-boundary Ecocompensation in Eastern China. 16 APR 2014. CLEAN—Soil, Air, Water.

36. Middle Neosho Watershed Restoration and Protection Strategy, Final Draft Plan. 2011, http://www.kswraps.org/files/attachments/middleneosho_plansummary.pdf.

37. Grand Lake O' the Cherokees Watershed Alliance Foundation. 2008. Grand Lake Watershed Plan: For improving water quality throughout the Grand Lake Watershed. Draft.http://www.ok.gov/conservation/documents/Grand_Lake_%20WBP_DRAFT.pdf.

Agricultural resources and water management in these complex geographical and political settings require novel approaches that address economic, land management, environmental, and social issues, accounting for the views of landowners, state, and federal environmental agencies, people living in the area, and academia. Unique cross-boundary plans have been implemented to address the water-quality impairments.[38] These Regional Conservation Partnership programs (RCPP) provide funding for one state to implement conservation practices in their neighboring state. There is a need for legal and other assistance at several stages within these cooperative partnerships and within policy considerations.

Ownership and Identification of Responsibilities and Risks

Our understanding of ownership has changed at least in part with changing understanding of ecosystem services and social justice.[39] The challenge then becomes: Who is responsible? How can we begin to develop and implement realistic solutions without clearly understanding ownership, and responsibility? Much like absentee landowners who induce short-term preferences.[40]

Farmers are often blamed for inappropriate management, sometimes resulting in resisting innovations. However, the blame goes much further than agriculture. Hardening of surfaces in urban areas from construction decreases infiltration and

38. Middle and Lower Neosho River Basin RCPP Project. https://www.ok.gov/conservation/documents/2016.02.2_NRBasinRCPPfactsht.pdf.

39. Ruhl, J.B., Salzman, J. 2007. The law and policy beginnings of ecosystem services. Journal of Land Use. 22:157–72; Sassenrath, G.F., Heilman, P., Luschei, E., Bennett, G., Fitzgerald, G., Klesius, P., Tracy, W., Williford, J.R. 2008. Technology, complexity and change in agricultural production systems. Renewable Agriculture and Food Systems. 23(4):285–95; Armstrong, C. 2017. Natural resource ownership. For Hugh LaFollette (ed.) International Encyclopedia of Ethics, Forthcoming. Available at SSRN: https://ssrn.com/abstract=3045687.

40. See notes 2 and 5, *supra*. Bigelow, D., Borchers, A., Hubbs, T. 2016. U.S. farmland ownership, tenure and transfer. Economic Research Service EIB-161. https://www.ers.usda.gov/webdocs/publications/74672/eib-161.pdf?v=0

increases runoff. Use of chemicals for personal lawn and garden care, in contrast to use in agricultural production operations, is unregulated. Improper functionality of municipal waste treatment plants creates substantial environmental contamination. A common contaminant of water quality is artificial sweeteners.[41] These compounds have profound impacts on water quality, ecological function, and ecosystem sustainability of aquatic systems; are not adequately removed by waste water treatment plants; and yet arise nearly exclusively from urban contamination. Improper or absent recycling in municipalities contributes additional contamination.

Solutions—What Can Lawyers Do?

The most significant solutions come from participants sitting on the same side of the table. A common perspective fosters creative solutions, and greater willingness to implement and maintain change. Farmers and ranchers need someone on their side. Landowners have the presumed right to do as they please with their property. However, the ancient wisdom is that one may not use one's land to harm others.[42] Externalizing costs is not efficient, desirable, or moral. The impacts to the larger environment are also concerns of non-landowners, who may be poorly informed. How do we reconcile these disparate viewpoints?

Lawyers can contribute to agroecosystem resilience by addressing the three common goals of producers: survival, stewardship, and succession. Lawyers can help with agricultural survival through equitable long-term arrangements. For example, expanding the marketing diversity of production flows to large

41. Mawhinney, D.B., R.B. Young, B.J. Vanderford, T. Borch, S.A. Snyder. 2011. Artificial sweetener sucralose in U.S. drinking water systems. Environmental Science & Technology. 45:8716–22. dx.doi.org/10.1021/es202404c.

42. Mitigating Misery: Land Use and Protection of Property Rights Before the Next Big Flood. Authors: Edward A. Thomas Esq. and Sam Riley Medlock JD. Vermont Journal of Environmental Law, Vol. 9, 2008; Government Liability for Flood Hazards. by Jon Kusler, Esq., PhD. Order at: https://www.aswm.org/watersheds/floods-and-natural-hazards/9780-government-liability-for-flood-hazards.

consumers, such as school districts, rather than relying exclusively on commodity markets could decrease the risk of production. Survival can also be improved through collaboration across enterprises, enabling groups of farms to collaborate and to integrate enterprises for even flows. Greater entrepreneurial and geographic diversification of the agroecosystem will reduce risks.

Better stewardship, such as improved management of the water cycle, reduces the damage from excessive events, though it can never completely remove the potential for catastrophic risks. Lawyers can assist here through clearer definition of ownership and responsibilities, as in the *Des Moines Water Works* case and the Grand Lake Watershed. Improved conservation production methods on-farm can improve the water cycle.[43] Reduced or no-till production practices improve soil, increase infiltration of water, reduce run-off, and improve the water holding capacity, reducing negative impacts from extreme water events, both flood and drought.[44] However, unless suitable compensation is made, farmers incur all of the costs with limited benefits. While improvements on-farm are well-known, the impacts from urban and developed areas are also critical to environmental resilience.

Lawyers can assist with succession through significant improvements in modernization of farms, and rural entities (e.g., ditches) as businesses, and helping with ownership (e.g., of closed corporations) to avoid succession problems. Lawyers can also reduce costs by providing templates for planning and for documents that could be economically customized, as well as working to educate and to call for repeal of sprawl-producing

43. Ogilvie, C.M., W. Deen, R.C. Martin. 2019. Service crop management to maximize crop water supply and improve agroecosystem resilience: A review. J. Soil and Water Conservation. 74(4):389–404. doi:10.2489/jswc.74.4.389.

44. Lipiec, L., J. Kuś, A. Słowińska-Jurkiewicz, A. Nosalewicz. 2006. Soil porosity and water infiltration as influenced by tillage methods. Soil and Tillage Research. 89(2): 210–20; Daigh, A.L.M., J. DeJong-Hughes. 2017. Fluffy soil syndrome: When tilled soil does not settle. J. Soil & Water Conservation 72(1):10A–14A. doi:10.2489/jswc.72.1.10A; Haruna, S.I., N.V. Nkongolo, S.H. Anderson, F. Eivazi, S. Zaibon. 2018. In situ infiltration as influenced by cover crop and tillage management. J. Soil & Water Conservation 73(2):164–72. doi:10.2489/jswc.73.2.164.

efforts to increase sales taxes and the property tax base, which do not need rate changes.

Once we define the boundaries of the problems, we can identify the risks and responsibilities and proceed to establish collaborations across boundaries.[45] We also need to determine what is a reasonable compensation for good management,[46] and find the political will to provide disincentives for bad management. One incentive might be the stabilization from long-term contracts, enabling transition toward sustainability.

Define Boundaries—Responsibilities and Risks

By defining boundaries, responsibility and risk can be established. Society is uncertain as to how to take responsibility for our personal contributions without a clear sense of the boundaries. We see only what's within our boundaries and not the larger impact. Scaling up is always limited; research may indicate the impacts of improved practices on fields, but accomplishing benefits at the watershed scale is difficult. Financial structures and compensation for sharing in the benefits of good farming and ranching could be provided to improve adoption of better practices, including local amenities, open space-based increases in

45. Engler, A., P.M. Poortvliet, L. Klerkx. 2019. Toward understanding conservation behavior in agriculture as a dynamic and mutually responsive process between individuals and the social system. JWSC 74(4):74A–80A. doi:10.2489/jswc.74.4.74A

46. Ryan, R.L., D.L. Erickson, R. De Young. 2003. Farmers' motivations for adopting conservation practices along riparian zones in a mid-western agricultural watershed. J. Environmental Planning and Management. 46(1):19–37. doi.org/10.1080/713676702; Prager K., H. Posthumus. 2010. Socio-economic factors influencing farmers' adoption of soil conservation practices in Europe. Human Dimensions of Soil and Water Conservation. Ed. Ted L. Napier. Chapter 12. Nova Science Publ. Inc. ISBN: 978-1-61728-957-6; Prokopy, L.S., K. Floress, J.G. Arbuckle, S.P. Church, F.R. Eanes, Y. Gao, B.M. Gramig, P. Ranjan, A.S. Singh. 2019. Adoption of agricultural conservation practices in the United States: Evidence from 35 years of quantitative literature. JSWC. 74(5):520–34. doi:10.2489/jswc.74.5.520; Kovacs, K.F., J.Y. Lee, C. Henry, L.J. Krutz, R.M. Nayga Jr., F. Tsiboe. 2019. Factors influencing the willingness to pay for on-farm water infrastructure. JSWC. 74(3): 259–68. doi:10.2489/jswc.74.3.259

tax bases, recreational opportunities, water quality benefits, and other local preferences.[47]

Because of the delegation of land use control to local governments and the financing structure for many government functions, there are many issues in ordinances at county and city levels. First, lawyers, perhaps in pro bono committees, can help local governments and agriculture collaborate for mutual benefits. Collaborative development of criteria for hazard mitigation priorities would also be beneficial. Lawyers are experts in organization and equity.

Lawyers can communicate effectively to city councils, county commissioners, and state legislatures about the real fiscal conservatism of hazard mitigation and wise land use management. Analysis is typically of a single project or response in disregard of the increasing frequency of severe events. Lawyers can make money assisting unfortunate policies and projects, but they can also "raise the bar" on recognition of the ethics of supporting bad policy. All of these conditions affect agriculture.

Because of differences across states, the need for legal involvement in mitigation of hazards is significant, as each state may have different criteria for priorities and different means of interaction between applicants for disaster mitigation, response, and recovery, and dealing with the FEMA National Flood Insurance Program, Small Business Administration, and agencies involved in the mapping of hazards.

There is very solid evidence that hazard mitigation is extremely cost-effective. A 2018 report from the National Institute of Building Sciences suggests that for every $1 spent on mitigation, between $4 and $6 are saved.[48] Lawyers can help educate city, county, and state governments on the need to adjust policies to the future rather than the duration of office terms, and on the very high and increasingly frequent costs of failure to mitigate.

47. See Earth Economics, *supra*. http://www.eartheconomics.org.

48. Mitigation Saves 2.0, 2017, National Institute of Building Sciences: https://www.nibs.org/page/mitigationsaves.

Lawyers may also wish to review benefit–cost analysis to explain to local governments that application of short-term policies based on short-term costs of allocation of resources may result in long-term expenses for response and recovery.[49,50] Lawyers will easily grasp the situation of risks and benefits.

Additional work with professional societies will clarify that signing off as a technical expert on bad design and land management is and should be recognized as outdated and dangerously poor activity. Professional standards should enable landscape architects, engineers, and others to refuse to certify poor decisions at high public expense. If a design professional makes decisions that harm the public, there should be, and will be, liability. The standard of care must be raised.

Lawyers can work within the U.S. Constitution, state constitutions, statutes, and regulations to compare what has been traditional in a very different world and what would be a wise decision now. For example, flood plain mapping by FEMA is not what the public understands. Wing et al.[51] performed flood plain mapping with advanced GIS using FEMA definitions; they found 41 million residents in current floodplains while FEMA maps show only 13 million. The future estimations are based on changes in upstream conditions and do not use forecasts of hydrology. As Edelman testified, if we built bridges to the FEMA standard, every other truck would break the bridge.[52] This is very important for investments and applications of techniques such as nonconforming uses to reduce risks and increase safety, utility, and value of investments.

We must inform the public that FEMA flood maps are an insurance rate-setting tool, subject to non-technical influence. This is central to agricultural resilience because fiscally

49. *Id.*

50. Bromley, Daniel, Ed. 1995, The Handbook of Environmental Economics. London: Blackwell.

51. Wing, OEJ, PD Bates, AM Smith, CC Sampson, KA Johnson, J Fargione, P Morefield. 2018. Estimates of Present and Future Flood Risk in Conterminous U.S. *Environ. Res. Lett.* 13: 034023. [This does not include effects of changing weather, but does not consider changes in upstream conditions.]

52. Scott Edelman, 2016, Testimony to US Senate Committee on Banking, Housing and Urban Affairs. https://www.banking.senate.gov/imo/media/doc/Edelman%20Testimony%209-13-16.pdf.

conservative land-use includes upstream defense of water supplies and water quality, and downstream defense of public interests in open space, recreational values, amenity values, and defense of local food security and regional food security.[53] Lawyers can help local governments understand that failing such defense is parallel to saving money by not bothering with insurance and maintenance. A rapidly growing number of local governments are using water rates for watershed improvements.[54] Lawyers can consider whether using local current standards of care is actually negligence or worse for the design professionals certifying a development or re-development.

Lawyers can examine statutes for problems such as the Iowa law making drainage districts immune, and consider the conflict between statutory immunity and the U.S. Constitution as described in Chapter 12 of this book as well as the forms of public backlash that may arise and the potential for agriculture versus agriculture conflicts from water supply changes and water quality degradation. Lawyers can also help states and local governments understand that many agricultural policies such as Western Water Law are based in the 19th century and may be obstacles to more efficient outcomes.[55]

Second, small changes in ordinances can make significant impacts to agricultural resilience. For example, after decades of ditch company conflicts over encroachment on the prescriptive rights of way (critical for ditch maintenance) in Colorado, John McKenzie, M. Ag. Economics and JD, asked for help. The local government, Boulder County, agreed and changed an ordinance to forbid development or encroachment within 25 feet of a ditch.[56] This dramatically lessened the problem. Ironically,

53. See Earth Economics (www.eartheconomics.org) for examples of valuation of natural capital and ecosystem services. This is an NGO created to provide defensible valuations.

54. Trust for Public Land, 2018 and previous years, Conservation Vote and work on urban self-defense.

55. Howe, Charles & John D. Wiener, 2016, Reconciling Water Law and Economic Efficiency in Western Water Administration, 19 U. of Denver Water Law Review, 185–212.

56. P.C. John McKenzie, often discussed at Ditch and Reservoir Company Alliance workshops.

newcomers insist that 150-year-old ditches must be creeks because of the mature foliage, which was planted to assist in bank stabilization and shading water.[57] Review and revision of historic and obsolete ordinances could address emerging issues and current understandings of rights and responsibilities.

The Waters of the U.S. repeal of substantial parts of pollution control, including non-point and seepage, is especially dangerous because groundwater contamination can be effectively permanent, and treatment may be very expensive in energy as well as money.[58] Proactive approaches are needed to combine interests and capacities. Water quality will be a much bigger problem if state water quality laws and water rights or permits are not going to apply to federal permits due to attempted repeal of section 401 of the Clean Water Act, which authorizes states to require compliance with water and water quality law. Lawyers can help cross-system collaboration with municipal water providers, but a very large percentage of water use is by agriculture, so it is very vulnerable (the amount varies by state and conditions[59]). The role of tort law may be underestimated.

Integration and Diversification across Scales

Integration requires a synthesis across multiple enterprises and regions that is not obvious. Lawyers can help develop agricultural collaborations across farms and establish easements or other land conservation programs. Regional-scale integration offers potential economic improvements from broadening the geographic reach of agricultural enterprises, increasing the diversity of the agroecosystem and capturing economies of scale.[60]

57. Crifasi, Robert, 2015, A Land Made From Water. Boulder, CO: Universities Press of Colorado.

58. See https://ryankuehler.com to access a leading expert on the Clean Water Act and the issues in Waters of the U.S.; and see Ryan, Mark A., Editor, 2018, The Clean Water Act Handbook, Fourth Edition, American Bar Association, ABA Book Publishing. https://www.americanbar.org/products/inv/book/314761688/.

59. US Geological Survey, National Water Information System: Web Interface, 2019, USGS Water Use Data for the Nation, Reston, VA: US Geological Survey. https://waterdata.usgs.gov/nwis/wu.

60. Hanson, 2008; Archer et al., 2008; Halloran et al., 2010.

Regional integration can be as simple as a rancher grazing his neighbor's crop field after harvest; the harvested field provides low-cost biomass for cattle and the cattle provide low-cost fertilizer for improved soil health. Scaling up from individual farms to regions can enhance diversification and address such issues as geographic concentration of livestock and the conservation issues that ensue.[61] Regional integration of production systems allows development of regional conservation programs, with enhanced potential for substantive impacts. Part of this integration requires a definition of boundaries and responsibilities. In addition to establishing these regionally diverse enterprises, legal assistance will be required to coordinate and manage the conservation programs.

Diversification improves the agroecosystem and agricultural resilience. Broadening the agricultural production system across multiple enterprises, especially enterprises not formally considered agricultural, would allow greater diversification of agribusiness, reducing risk and increasing return on investment. Lawyers can provide the guidelines to establish and maintain these integrated, diversified enterprises.

Lawyers can contribute by helping state and local governments build more effective partnerships with groups like the American Public Health Association. The Bar Associations can assist with creative and equitable financing for better management. Tax increment financing might be appropriate. There is also important equity in matching benefits and costs over time, using bonding or similar techniques.

Additionally, there may be significant opportunities for covenants, which may differ substantially from state to state, as

61. Overview of U.S. Livestock, Poultry, and Aquaculture Production in 2017. https://www.aphis.usda.gov/animal_health/nahms/downloads/Demographics2017.pdf; Environmental Impact of Industrial Farm Animal Production. http://www.pcifapia.org/_images/212-4_EnvImpact_tc_Final.pdf; Helmer, Jodi, 2018, Hurricane-Flooded Hog Farms Could Bring Superbugs to North Carolina Communities. Washington, D.C., Natural Resources Defense Council. https://www.nrdc.org/stories/hurricane-flooded-hog-farms-could-bring-superbugs-north-carolina-communities; NRDC, note 66.

private forms of enforceable conservation. Regarding conservation of farms and farm groups, lawyers can also remind state and local governments of the increased value of real estate near or adjacent to open spaces and farms.

Lawyers can work for equity and efficiency at regional scales. Lawyers can make clear that standing on principle can result in years of lost mutual gains, and lost certainty that would advance collaboration. Economic changes and ironically, perhaps, depletion of state and local government funds from increased frequency of severe events threaten implementation.

Compensation for Responsible Management

Some programs support better management, such as the Conservation Reserve Program and the Environmental Quality Incentives Program.[62] Often, assistance has required a substantial match of funds. Assistance programs may be targeted to the worst managers, and may not respond to the need to support the best managers.[63] Crop insurance is a major risk-management tool, but it may be denied where the goal is to improve resilience by increasing diversification and better management of the flows of wind, water, and the use of vegetation for buffers and cover crops.[64] Lawyers can be allies in individual cases as well as working for systemic change to improve adoption of conservation programs. Lawyers and bankers may also consider re-insurance

62. U.S. Department of Agriculture, 2019, Financial Assistance Programs. Washington, D.C. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/.

63. U.S. Department of Agriculture, 2019, *supra*, note 59 and note 54.

64. National Agroforestry Center, 2019 and back, numerous research and field tests. Lincoln, NE: U.S. Department of Agriculture Forest Service. https://www.fs.usda.gov/nac/ and https://www.fs.usda.gov/treesearch/pubs/55774 on agroforestry for resilience. See also the USDA guide to programs, 2019, About USDA—A Quick Reference Guide. Washington D.C., U.S. Department of Agriculture. https://www.usda.gov/sites/default/files/documents/about-usda-quick-reference-guide.pdf, https://www.usda.gov/sites/default/files/documents/about-usda-quick-reference-guide.pdf.

for private lending. The federal programs need monitoring (e.g., De-regulation Tracker[65]).

Lawyers can contribute by considering ways for these impoverished local districts to better maintain and upgrade levees or adapt to inevitable failure. In any particular state, this may include making the levee district into a benefit corporation or co-operative. Tax increment financing may improve compliance for those achieving adequacy. These must include sharing the costs with all those who benefit. Serious approaches would include basin-scale strategies to move beyond the elderly and inadequate levees,[66] perhaps by increasing use of abatement of nonconforming uses. Additional measures may include development of watersheds above and below urban areas. It is important that "takings" claims may be exaggerated, where land uses and changes worsen impacts on others.[67]

Conclusion

Agricultural resilience is a diverse, complex, and very broad topic of critical importance to society. While traditionally left to agronomists, agriculturalists, animal scientists, and farmers and ranchers, the day-to-day activities of agricultural production can benefit substantially by input and guidance from the

65. Columbia Law School, Sabin Center for Climate Change Law, 2019 and back. New York, NY: Columbia University. https://climate.law.columbia.edu/climate-deregulation-tracker.

66. Watson, Donald & Michelle Adams, 2011, Design for Flooding: Architecture, Landscape and Urban Design for Resilience to Flooding and Climate Change. Hoboken, NJ. John Wiley and Sons.

67. See Chapter 12 of this book as well as Government Liability for Flood Hazards by Jon Kusler, Esq., PhD. Order at: https://www.aswm.org/watersheds/floods-and-natural-hazards/9780-government-liability-for-flood-hazards; Natural Hazard Disaster Risk Reduction as an Element of Resilience: Considerations about Insurance and Litigation by Edward A. Thomas, Esq. (2016) In Linkov, I., & Florin, M.-V. (Eds.), IRGC Resource Guide on Resilience. Available at: https://www.irgc.org/risk-governance/resilience/ and Mitigating Misery: Land Use and Protection of Property Rights Before the Next Big Flood. Authors: Edward A. Thomas Esq. and Sam Riley Medlock JD. Vermont Journal of Environmental Law, Vol. 9, 2008. Located at: http://www.floods.org/PDF/Mitigation/ASFPM_Thomas&Medlock_FINAL.pdf.

legal profession. Identification of risks and benefits, delineation of roles and responsibilities, and development of management guidelines can integrate production activities regionally and entrepreneurially and create dynamic, sustainable, and resilient agroecosystems that are responsive to the farmers' needs for survival, stewardship, and succession, while also addressing growing societal concerns. Lawyers can serve the interests of society by proactively finding ways to help different interests achieve common ground. In Colorado, efforts resulted in basin roundtables with broad representation and eventually a State Water Plan,[68] spurred by the situation in the Colorado River Basin. Similarly, cooperation across state lines has increased implementation of conservation management instead of litigation.[69] It took many years to get there, but the progress is real. This may be a model for others to follow. Lawyers can lead the way by helping to organize and process issues that make it possible for former opponents to sit on the same side of the table.

68. Colorado Water Conservation Board, 2019 and back, Colorado's Water Plan and Technical Updates. Denver, CO, State of Colorado. https://www.colorado.gov/cowaterplan.

69. Middle and Lower Neosho River Basin RCPP Project. https://www.ok.gov/conservation/documents/2016.02.2_NRBasinRCPPfactsht.pdf.