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Richard Moore*

NASTY WEATHER AND UGLY PRODUCE: CLIMATE CHANGE, AGRICULTURAL ADAPTATION, AND FOOD WASTE

Food systems worldwide are threatened by climate change, as reflected, for example, in the diminished yields of fruits and vegetables and reduced production of global fisheries. This article discusses the threats of climate change on agricultural production and the need for agricultural adaptation. It posits that food insecurity must be considered in terms of climate change and its likely effects on food production. The article argues that agricultural mitigation and adaptation measures should be pursued and communicated through the mechanisms of the Paris Agreement. In the United States, reducing food waste effectuated by the regulation on the culling of unattractive but edible produce represents a modest, yet necessary mitigation and adaptation opportunity.

INTRODUCTION

Climate change threatens to do great harm to global food systems by reducing crop yields, harming fisheries production, reducing available water resources, and increasing extreme weather events.¹ Proposed solutions vary significantly, from greater local control of agriculture and improved diversity of crops² to the revision of legal barriers which prevent the transfer of agricultural technology.³ The Paris Agreement recently recognized the “fundamental priority of safeguarding food security” in the global response to climate change.⁴ However, some have argued that the agreement does not sufficiently incentivize “climate

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1. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014 SYNTHESIS REPORT FOR POLICYMAKERS 13, 15 (2014) [hereinafter 2014 SYNTHESIS REPORT].

2. Carmen G. Gonzalez, *Climate Change, Food Security, and Agrobiodiversity: Toward a Just, Resilient, and Sustainable Food System*, 22 FORDHAM ENVTL. L. REV. 493 (2011).

3. Robert C. Bird & Daniel R. Cahoy, *Human Rights, Technology, and Food: Coordinating Access and Innovation for 2050 and Beyond*, 52 AM. BUS. L. J. 435 (2015).

4. Paris Agreement to the United Nations Framework Convention on Climate Change, PmbL., Dec. 12, 2015, T.I.A.S. No. 16-1104 (entered into force Nov. 4, 2016) [hereinafter Paris Agreement].

smart” agriculture.⁵ Needed climate friendly agricultural policies would increase agricultural productivity equitably and sustainably, building agricultural resilience to climate change while also reducing agricultural greenhouse gas emissions.⁶

The United States entered its acceptance to the Paris Agreement on September 3, 2016⁷ but, without ratification by Congress, the constitutionality of the acceptance remains complicated.⁸ Considering candidate Trump’s statements fiercely criticizing the agreement during the campaign⁹ together with the administration’s position of willingness to reconsider after the election,¹⁰ it seemed the position of the new Presidential administration on the agreement was similarly uncertain. But, in early June 2017, President Trump announced an intention to withdraw from the agreement.¹¹ However, it is clear that the ability of the United States to withdraw from the Paris Agreement is limited and cannot formally occur until after the next presidential election.¹² But politics aside, it remains necessary that the U.S. adapt its agriculture to a warming climate while keeping the “fundamental priority of safeguarding food security” in mind.

This article examines some of the steps that the U.S. can take to safeguard food security, nationally and internationally. Part I lays out the realities of climate change and the international response to it. Part II defines and discusses food insecurity, globally and in the U.S. Part III discusses the threat climate change poses to food systems. Part IV discusses the importance of agricultural adaptation and mitigation, including steps the U.S. has taken and should take. Part V describes the issue of food waste in the U.S. and proposes a regulatory solution to reduce the amount of food wasted due to cosmetic criteria.

5. Jonathan Verschuuren, *The Paris Agreement on Climate Change: Agriculture and Food Security*, 7 EUR. J. RISK REG. 54 (2016).

6. *Climate Smart Agriculture*, CLIMATE CHANGE, AGRIC. & FOOD SECURITY, <https://ccafs.cgiar.org/climate-smart-agriculture-0#.WLT3KvL45ZN> [<https://perma.cc/Z8J7-CMNS>]. For a more detailed discussion of climate smart agriculture see FOOD & AGRIC. ORG. OF THE U.N., “CLIMATE SMART” AGRICULTURE: POLICIES, PRACTICES, AND FINANCING FOR FOOD SECURITY, ADAPTATION, AND MITIGATION 1–16 (2010), http://www.fao.org/fileadmin/user_upload/newsroom/docs/the-hague-conference-fao-paper.pdf [<https://perma.cc/D29Q-78WK>].

7. *Paris Agreement Status of Ratification*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/paris_agreement/items/9444.php [<https://perma.cc/MTJ6-MZBL>].

8. See, e.g., Daniel Bodansky & Peter Spiro, *Executive Agreements*+, 49 VAND. J. TRANSNAT’L L. 885 (2016).

9. *Trump Campaign Statement on Paris Climate Accord*, TRUMP PENCE CAMPAIGN (Oct. 5, 2016), <https://www.donaldjtrump.com/press-releases/trump-campaign-statement-on-paris-climate-accord> [<https://perma.cc/H58R-ZZVT>].

10. As President-elect, Trump stated he would “take a look” at the Paris Agreement. *Donald Trump’s New York Times Interview: Full Transcript*, N.Y. TIMES (Nov. 23, 2016), https://www.nytimes.com/2016/11/23/us/politics/trump-new-york-times-interview-transcript.html?_r=0; see also Coral Davenport, *Policy Advisers Urge Trump to Keep U.S. in Paris Accord*, N.Y. TIMES (Apr. 18, 2017), https://www.nytimes.com/2017/04/18/us/politics/trump-advisers-paris-climate-accord.html?_r=0 (“Mr. Trump plans to make a final decision on the fate of the Paris agreement before a meeting of the Group of 7 leading economies at the end of May, according to Sean Spicer, the White House press secretary”).

11. Michael D. Shear, *Trump Will Withdraw U.S. From Paris Climate Agreement*, N.Y. TIMES (Jun. 1, 2017), <https://www.nytimes.com/2017/06/01/climate/trump-paris-climate-agreement.html>.

12. Harold Hongju Koh, *Triptych’s End: A Better Framework to Evaluate 21st Century International Lawmaking*, 126 YALE L. J. F. 338, 356–57 (2017).

I. CLIMATE CHANGE AND THE CONFERENCE OF PARTIES

Global warming has been a major concern for decades and there is strong scientific consensus that further warming will have broad and long-lasting effects. According to the Intergovernmental Panel on Climate Change (IPCC) “[a]nthropogenic greenhouse gas emissions have increased . . . and are *extremely likely* to have been the dominant cause of the observed warming since the mid-20th century.”¹³ Baseline climate modeling scenarios¹⁴ predict a temperature increase of around 4 degrees Celsius (C) above pre-industrial levels.¹⁵ Extreme weather events, such as “heat waves, droughts, floods, cyclones, and wildfires” are very likely to increase in both frequency and intensity.¹⁶ Rising sea levels are very likely and the acidification of oceans is moderately likely.¹⁷ Even if greenhouse gas (GHG) emissions are eliminated or reduced, these negative effects will likely continue.¹⁸

Although there was some awareness of the possibility of climate change as early as the late nineteenth century, real scientific concern about the severity and effects of climate change first arose in the 1980s.¹⁹ The United Nations (UN) first addressed climate change in 1988, when the General Assembly declared climate change a “common concern of mankind”²⁰ and established the IPCC, the “leading international body for the assessment of climate change.”²¹ In 1992, The Earth Summit in Rio de Janeiro produced the United Nations Framework Convention on Climate Change (UNFCCC) and the Conference of Parties (COP) system which continues today.²²

The most recent Conference of the Parties, COP21, took place in Paris from November 30 to December 11, 2015,²³ resulting in the adoption of the Paris Agreement. The agreement, which “aims to strengthen the global response to the threat of climate change,” sets a specific target of halting “the increase in the global average temperature to well below 2 degrees C above pre-industrial levels” with an aspirational goal of “limit[ing] the temperature increase to 1.5 degrees C above pre-industrial levels.”²⁴ In order to reach this target, the agreement incorporates

13. 2014 SYNTHESIS REPORT, *supra* note 1, at 4.

14. “Scenarios without additional efforts to constrain emissions.” *Id.* at 8.

15. *Id.* at 9.

16. *Id.* at 8, 10.

17. *Id.* at 10.

18. *Id.* at 16.

19. FARHANA YAMIN & JOANNA DEPLEDGE, THE INTERNATIONAL CLIMATE CHANGE REGIME: A GUIDE TO RULES, INSTITUTIONS AND PROCEDURES 21 (2004).

20. *Id.* at 22.

21. *Organization*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, <http://www.ipcc.ch/organization/organization.shtml> [<https://perma.cc/AR9F-DQ3U>].

22. YAMIN & DEPLEDGE, *supra* note 19, at 23–29; United Nations Framework Convention on Climate Change, May 9, 1992, S. Treaty Doc No. 102-38, 1771 U.N.T.S. 107 [hereinafter UNFCCC].

23. *Paris Climate Change Conference*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/meetings/paris_nov_2015/meeting/8926.php [<https://perma.cc/698B-6JBV>].

24. Paris Agreement, *supra* note 4, at art. 2(1)(a).

measures of mitigation²⁵ and adaptation,²⁶ including provisions for capacity building, loss reduction, international financing, and technology transfer.²⁷

One of the primary mechanisms for achieving the goals of the agreement is the requirement that parties create and submit an “intended nationally determined contribution” (INDC), which communicates that party’s mitigation objectives and planned measures.²⁸ The UN additionally encouraged parties to communicate adaptation measures in either their INDC or a separate adaptation plan.²⁹ INDCs are intended to reflect each party’s “highest possible ambition” in pursuing those measures.³⁰ In order to promote “clarity, transparency, and understanding,” parties are required to share information about their INDCs and submit new INDCs every five years, “with a view to enhancing its level of ambition.”³¹

Among the multiple goals and recognitions of the agreement, food security and hunger are explicitly mentioned twice. The first mention is in the preamble, which states that the parties to the agreement recognize “the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change.”³² The second is in Article 2(1)(b) which declares the fundamental goal of “[i]ncreasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production.”³³ This language echoes one of the core objectives of the UNFCCC, to achieve GHG emissions stabilization while also promoting sustainable development, all without threatening food production.³⁴ The Paris Agreement’s provisions on food security have met a mixed response. Some

25. “Mitigation” is defined by the IPCC as: “An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.” *Glossary E-O*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, https://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-e-o.html [<https://perma.cc/WHH5-EAZ7>].

26. “Adaptation” is defined by the IPCC as: “Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.” *Glossary A-D*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, https://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-a-d.html [<https://perma.cc/E6FU-NSQZ>].

27. Paris Agreement, *supra* note 4.

28. *Id.* at art. 4(2).

29. *Intended Nationally Determined Contributions*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/focus/indc_portal/items/8766.php [<https://perma.cc/R6LM-MPKJ>].

30. Paris Agreement, *supra* note 4, at art. 4(3).

31. *Id.* at arts. 4(8), (9), (11).

32. *Id.* at pmb1.

33. *Id.* at art. 2(1)(b).

34. “The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to *ensure that food production is not threatened* and to enable economic development to proceed in a sustainable manner.” UNFCCC, *supra* note 22, at art. 2 (emphasis added).

have praised a perceived focus on food security while others have criticized a perceived lack of commitment to food security, the lack of an explicit right to food, and a lack of focus on agriculture—particularly on the distinction between small-holder agriculture and agribusiness.³⁵

Although there are those who feel that the Paris Agreement does not command enough action on food security, the agreement nevertheless contains explicit language recognizing the importance of the issue in the context of climate change. This language is, at the very least, a step in the right direction in light of current food insecurity, in both the developing and developed world, and the threats that climate change poses to global food production. With the Paris Agreement having entered into force on November 4, 2016,³⁶ parties to the agreement should consider food insecurity and the threats of climate change when developing and implementing their INDCs and other national climate change mitigation or adaptation plans.

II. FOOD INSECURITY: GLOBALLY AND IN THE UNITED STATES

Food insecurity is an issue which disproportionately affects the Global South, but developed countries, including the United States, are not free from issues of food insecurity and must also consider the food insecure in their own nations as they confront climate change. According to the definition from the Food and Agriculture Organization of the United Nations (FAO), “[f]ood security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”³⁷ Despite a decrease of 216 million undernourished people since the early 1990s, there remain 795 million people globally who are undernourished, the majority of whom live in Southern Asia, East Asia, and Sub-Saharan Africa.³⁸

35. See, e.g., *Breakthrough Climate Agreement Recognizes Food Security as a Priority*, FOOD & AGRIC. ORG. OF THE U.N. (Dec. 12, 2015), <http://www.fao.org/news/story/en/item/358257/icode/> [<https://perma.cc/YV2U-QD6J>]; *Paris Climate Agreement Unlocks Opportunities for Food and Farming*, CLIMATE CHANGE, AGRIC. & FOOD SECURITY (Dec. 14, 2015), <https://ccafs.cgiar.org/research-highlight/paris-climate-agreement-unlocks-opportunities-food-and-farming#.VvnsEvkrKhc> [<https://perma.cc/FC8V-ASJS>]; but see, e.g., Hilal Elver, *Climate Change and the Right to Food*, AL JAZEERA (Dec. 23, 2015), <http://www.aljazeera.com/indepth/opinion/2015/12/climate-change-food-151222125711435.html> [<https://perma.cc/794T-NMJE>]; Ahmed Hassan, *Paris Climate Change Agreement Falls Short on Food Security and Fossil Fuels*, SOMALIA NEWSROOM (Jan. 1, 2016), <http://somalianewsroom.com/paris-climate-change-agreement-falls-short-on-food-security-and-fossil-fuels> [<https://perma.cc/TJU5-BUYC>]; Vidya Venkat, *Draft Paris Agreement Disappoints Civil Society*, THE HINDU (Dec. 11, 2015), <http://www.thehindu.com/sci-tech/energy-and-environment/draftparisagreement-disappoints-civil-society/article7976311.ece> [<https://perma.cc/ZTS8-VM8F>].

36. *Paris Agreement Status of Ratification*, *supra* note 7.

37. FOOD & AGRIC. ORG. OF THE U.N., AN INTRODUCTION TO THE BASIC CONCEPTS OF FOOD SECURITY 1 (2008), <http://www.fao.org/docrep/013/a1936e/a1936e00.pdf> [<https://perma.cc/6CYM-J7P3>].

38. FOOD & AGRIC. ORG. OF THE U.N., THE STATE OF FOOD INSECURITY IN THE WORLD 8, 10 (2015), <http://www.fao.org/3/a4ef2d16-70a7-460a-a9ac-2a65a533269a/i4646e.pdf> [<https://perma.cc/VQD9-AUXB>].

To be sure, food insecurity is not as prevalent in the United States as in many parts of the world,³⁹ but it is not unknown in the country. The United States Department of Agriculture (USDA) defines a household as “food secure” if “all household members [have] access at all times to enough food for an active, healthy, life.”⁴⁰ According to the USDA, in 2014, 14 percent of U.S. households “were food insecure at some time during the year.”⁴¹ For households with children, that percentage increases to 19.2 percent, while 9.4 percent of households with children are in a situation in which both adults and children are food insecure.⁴² Additionally, 5.6 percent of households (6.9 million households) not only faced food insecurity but “very low food security” in 2014.⁴³ Both food insecurity and very low food security are usually “recurrent, but not chronic” problems in the United States, with low rates of daily food insecurity⁴⁴ and higher rates of food insecurity when measured by month.⁴⁵ The percentage of households facing both food insecurity and very low food security increased significantly in 2008 and, although down slightly, has not returned to the lower levels of the mid-1990s.⁴⁶ Although a nationwide problem, the effects of food insecurity are not equally distributed among states and regions⁴⁷ or between racial groups.⁴⁸

Inadequate food production is not the primary cause of food insecurity. Estimates place current food production at a level high enough to supply sufficient calories to a global population of between 12 and 14 billion.⁴⁹ Of the global food insecure, approximately 70 percent “are themselves small farmers or agricultural

39. The FAO designates the US as having “very low” hunger. “Very low” is defined as less than five percent of the population being undernourished. *FAO Hunger Food Map*, FOOD & AGRIC. ORG. OF THE U.N., <http://www.fao.org/hunger/en/> [<https://perma.cc/VHY3-H77C>].

40. ALISHA COLEMAN-JENSEN ET AL., U.S. DEP’T OF AGRIC., HOUSEHOLD FOOD SECURITY IN THE UNITED STATES IN 2014, at 4, 8 (2015).

41. *Id.* at 8.

42. *Id.*

43. “The defining characteristic of ‘very low food security’ is that, at times during the year, the food intake of household members was reduced and their normal eating patterns were disrupted because the household lacked money and other resources for food.” *Id.* at 5, 8.

44. For instance, daily prevalence of very low food insecurity in December 2014 was “0.7 to 1.1 percent of all households” or “13 to 20 percent of the annual prevalence.” *Id.* at 11. However, the USDA recognizes that “[t]he omission of homeless families and individuals from these daily statistics biases the statistics downward, and the bias may be substantial relative to the estimates, especially for the most severe conditions.” *Id.* at 11.

45. “On average, households that were food insecure at some time during the year were food insecure in 7 months during the year” and “[s]imilarly, households with very low food security at some time during the year experienced the associated conditions, on average, in 7 months during the year.” *Id.* at 11.

46. *Id.* at 12.

47. As an example, “estimated prevalence rates of very low food security ranged from 2.9 percent in North Dakota to 8.1 percent in Arkansas.” *Id.* at 18. Although not extreme, regional rates of food insecurity vary from 15.1% in the South, 13.3% in the Northeast, 13.8% in the Midwest, and 13.1% in the West. *Id.* at 15.

48. The racial disparity in food security is significant, with Black, non-Hispanic households at 26.1% food insecure and Hispanic households at 22.4% food insecure, as compared to White, non-Hispanic households at 10.5%. *Id.* at 13.

49. U.N. CONFERENCE ON TRADE AND DEV., TRADE AND ENVIRONMENT REVIEW 2013: WAKE UP BEFORE IT IS TOO LATE iii (2013) [hereinafter WAKE UP BEFORE IT IS TOO LATE].

laborers,” making food insecurity and hunger “not phenomena of insufficient physical supply, but results of prevailing poverty, and above all problems of access to food.”⁵⁰ Studies have shown that financial speculation on commodities and the production of ethanol are two of the most significant negative effects on global food prices,⁵¹ leading to calls to better regulate financial markets and reduce reliance on ethanol.⁵² Indeed, the spikes in food prices resulting from financial speculation have been linked to global unrest, including worldwide riots in 2008 and the Arab Spring in 2010.⁵³

While food insecurity, both globally and in the United States, is not caused by insufficient food production, the threat that climate change poses to food production will still likely affect the food insecure. Poverty and inequitable distribution of food, the underlying causes of food insecurity,⁵⁴ will continue to exist in an ever warming world and the negative effects of rising temperatures on global food production will only exacerbate the effects of these economic and social conditions. When rising temperatures cause crop yields to drop, it is likely the already food insecure who will feel the negative effects the most.

III. THE EFFECTS OF CLIMATE ON FOOD PRODUCTION

Further increases in global temperatures will have negative impacts on the global production of food, from agriculture to fisheries, which will increase the burdens on the food insecure. The IPCC recognizes that “[g]lobal temperature increases of [roughly 4 degrees C] or more above late [20th] century levels, combined with increasing food demand, would pose large risks to food security globally.”⁵⁵ The negative effects of climate change on global crop yields are projected to increase over the coming century, with relatively minor yield changes over the next decade and extreme yield changes by the end of the century.⁵⁶

An independent report found a likely value of five percent decrease in crop yields per degree C increase in temperature, with a plausible range of three to eight percent decrease per degree C.⁵⁷ Crop yields are predicted to decrease primarily as a function of faster crop development and shorter crop duration; impacts to rates of photosynthesis and respiration; reduced water-use efficiency; and direct damage to crops from extreme heat.⁵⁸ Some of the more critical commentary on COP21 argues that the agreement will likely not meet its target of

50. *Id.*

51. Marco Lagi et al., *Accurate Market Price Formation Model with Both Supply-Demand and Trend-Following for Global Food Prices Providing Policy Recommendations*, 112 PROC. OF THE NAT'L ACAD. OF SCI. E6119 (2015).

52. Carmen G. Gonzalez, *World Poverty and Food Insecurity*, 3 PENN. ST. J. L. & INT'L AFF. 56 (2015).

53. MARCO LAGI ET AL., NEW ENGLAND COMPLEX SYS. INST., *THE FOOD CRISIS AND POLITICAL INSTABILITY IN NORTH AFRICA AND THE MIDDLE EAST* (2011).

54. *See generally* Gonzalez, *supra* note 52, at 56–60.

55. 2014 SYNTHESIS REPORT, *supra* note 1, at 13.

56. *Id.* at 15 (Figure SPM.9(b)).

57. David B. Lobell & Sharon M. Gourdji, *The Influence of Climate Change on Global Crop Productivity*, 160 PLANT PHYSIOLOGY 1686, 1695 (2012).

58. *Id.* at 1690.

limiting warming to 2 degrees C.⁵⁹ In fact, some commentators claim that the voluntary contributions submitted by the parties to the agreement are likely to still result in temperature increases closer to 3 or 4 degrees C.⁶⁰ If global temperatures increase by 3–4 degrees, a likely 5 percent decrease in crop yield per 1 degree C would translate into a likely decrease in global crop yields of 15–20 percent, with potentially significant variation.⁶¹

Estimates for the effects of climate change on crop yields in the U.S. are less dramatic, but reports have nonetheless concluded there will likely be decreases in total crop yields. One study, using an estimated baseline global temperature increase of about 3 degrees C, applied multiple scientific models to estimate the potential impact of climate change on the agricultural output of specific countries and found that the United States, depending on the model used, could potentially experience a decrease in crop yield of either 16.5 percent or 5.9 percent by the 2080s.⁶² Of note, the study also considers the effects of “carbon fertilization,” which is the concept that increased atmospheric carbon dioxide (CO₂) has a positive effect on photosynthesis and a reduction in the loss of water due to respiration.⁶³ Under certain models, carbon fertilization could actually lead to an increase of about 8 percent increase in total U.S. crop yield by the 2080s.⁶⁴ The extent of the benefits of carbon fertilization, however, are strongly debated in the scientific literature⁶⁵ and, even when accounted for, it is likely that the negative effects of increased global temperatures will outweigh any benefits conferred directly onto plants from increased atmospheric CO₂.⁶⁶

As might be expected, climate change impacts on crop yield are likely to affect the different regions of the U.S. in disparate fashion. The Southwestern and Southeastern United States are likely to be the most negatively affected, with or

59. Tom Bawden, *COP21: Paris Deal Far Too Weak to Prevent Devastating Climate Change, Academics Warn*, THE INDEP. (Jan. 8, 2016) (“As early as the third page of the draft agreement is the acknowledgement that its CO₂ target won’t keep the global temperature rise below [2°C], the level that was once set as the critical safe limit.”); Oliver Milman, *James Hansen, Father of Climate Change Awareness, Calls Paris Talks ‘A Fraud’*, THE GUARDIAN (Dec. 12, 2015) <https://www.theguardian.com/environment/2015/dec/12/james-hansen-climate-change-paris-talks-fraud>.

60. “But actually, when you add up all the commitments that the countries are making in terms of their reductions in emissions, then actually it’s far, far above [2°C], nearer 3 or 4 degrees C temperature rise.” *Top Climate Expert Crisis is Worse Than We Think & Scientists are Self-Censoring to Downplay Risk*, DEMOCRACY NOW (Dec. 8, 2015) (statement of Kevin Anderson).

61. With a plausible range of 3–8 percent decrease in crop yields for every degree C, a rise in global temperatures of 3–4 degrees C could indicate as little as a 9 percent decrease in crop yield or as much as a 32 percent decrease in crop yield globally.

62. WILLIAM R. CLINE, GLOBAL WARMING AND AGRICULTURE: IMPACT ESTIMATES BY COUNTRY 35–37, 77 (2007).

63. *Id.* at 24. These effects are most pronounced for C3 crops such as “rice, wheat, soybeans, fine grains, legumes, and most trees.” *Id.*

64. *Id.* at 70–71.

65. Lobell & Gourdji, *supra* note 57, at 1690; CLINE, *supra* note 62, at 24–25.

66. Lobell & Gourdji, *supra* note 57, at 1693; C.L. WALTHALL ET AL., U.S. DEP’T OF AGRICULTURE, USDA TECH. BULLETIN 1935, CLIMATE CHANGE AND AGRICULTURE IN THE UNITED STATES 1 (2013); 2014 SYNTHESIS REPORT, *supra* note 1, at 6.

without carbon fertilization.⁶⁷ The northern U.S., however, may experience an increase in agricultural productivity, with increased gains if carbon fertilization is taken into account.⁶⁸ The likely effects in California, a state which produces a major percentage of the nation's fruits and vegetables,⁶⁹ depend greatly on the effects of carbon fertilization.⁷⁰ Because the benefits of carbon fertilization are questionable, it is likely that climate change will ultimately have negative effects on the crop yields of the state. Together with the effects of drought on a heavily irrigation reliant state,⁷¹ the total effect on crop yields in California may be substantial. The USDA recommends fruits and vegetables constitute half of a healthy diet⁷² and declines in fruit and vegetable production in California, a major grower of both, could have a noticeable effect on the average U.S. diet.

In addition to the significant effects of climate change on crop yields, rising global temperatures will also likely have adverse or mixed effects on other sources of food production, including fisheries⁷³ and livestock⁷⁴, both globally and

67. The Southwest is likely to experience a 30 percent reduction in agricultural productivity without the effects of carbon fertilization or a 25 percent reduction with those effects accounted for. The Southeast is likely to experience a 30 percent reduction in agricultural productivity without the effects of carbon fertilization or an 18% reduction with those effects accounted for. CLINE, *supra* note 62, at 72, 74–75.

68. In particular, the Northern Rockies and Plains may experience as much as a 28 percent increase in agricultural productivity without the effects of carbon fertilization or a 47 percent increase with those effects accounted for. However, these “gains are probably overstated . . . by using land area rather than output value to aggregate from the standard grid level up to the region. This would tend to give substantial weight to supposed gains from warming in the cold mountainous areas even though their topography constrains agricultural production.” *Id.* at 72, 74–75.

69. Recent reports show that California is responsible for 22 percent of US grown fruit and 47 percent of harvested vegetable acreage, accounting for 60 percent of fresh-market vegetables. *California Drought: Crop Sectors*, U.S. DEP'T OF AGRIC. (last updated Feb. 3, 2017), <https://www.ers.usda.gov/topics/in-the-news/california-drought-farm-and-food-impacts/california-drought-crop-sectors.aspx> [<https://perma.cc/NH87-NMVW>].

70. California and surrounding states are likely to experience a decrease in agricultural production of between 5–15 percent without the effects of carbon fertilization but a potential increase in agricultural production of between 5–15 percent with the effects of carbon fertilization. CLINE, *supra* note 62, at 74–75.

71. See, e.g., *California Drought: Crop Sectors*, *supra* note 69.

72. WALTHAL ET AL., *supra* note 66, at 75.

73. The IPCC has concluded with high confidence that “[d]ue to projected climate change by the mid-21st century and beyond, global marine species redistribution and marine biodiversity reduction in sensitive regions will challenge the sustained provision of fisheries productivity and other ecosystem services.” 2014 SYNTHESIS REPORT, *supra* note 1 at 13. However, other reports have found that there is likely to be a less than 10 percent global change in fisheries production with a mean increase of 3.4 percent. M. Barange et al., *Impacts of Climate Change on Marine Ecosystem Production in Societies Dependent on Fisheries*, 4 NATURE CLIMATE CHANGE 211, 211 (2014). These impacts are likely to be varied with “increased productivity at high latitudes and decreased productivity at low/mid latitudes with considerable regional variation.” *Id.* This regional variance will likely mean that some regions with high dependence on fisheries, such as West Africa, will see increases in potential catch and others, such as South and Southeast Asia, will see potentially significant decreases. *Id.* at 215. The United States, which is described as having a particularly low dependence on fisheries, will likely see a noticeable decrease in potential catch. *Id.*

74. Climate change may affect animal agriculture “in four primary ways: (1) feed-grain production, availability and price; (2) pastures and forage crop production and quality; (3) animal health, growth and reproduction; and (4) disease and pest distributions.” WALTHAL ET AL., *supra* note 66, at 4. Although the

in the U.S. At the same time these changes to the yield of crops, livestock, and fisheries are likely to occur, world population is projected to grow significantly. Current projections put the population, currently 7.3 billion, at 9.7 billion by 2050 and 11 billion by 2100.⁷⁵ The U.S. population, currently 323 million, is projected to increase to 388 million by 2050 and 450 million by 2100.⁷⁶

Decreased crop yields, potentially at alarming levels, coupled with a larger population make for one of the many significant threats posed by climate change. The United States and other nations must think seriously about adapting agricultural systems to a warmer climate, while considering the obligations and opportunities for collaboration the Paris Agreement provides.

IV. AGRICULTURAL ADAPTATION AND THE UNITED STATES' INDC

Practically, every nation will have to adapt its agriculture to the realities of climate change and many should mitigate their agricultural greenhouse gas emissions, making INDCs essential mechanisms by which to lay out and share these adaptation and mitigation strategies. Many of the INDCs which have been submitted include specific provisions regarding mitigation, adaptation, or both in regards to agriculture.⁷⁷ Adaptation is the primary focus of non-Annex 1⁷⁸ countries, particularly those in Asia and Africa.⁷⁹ Many of these same countries and some Annex 1 countries and political/economic unions, most notably the European Union and Canada, also include mitigation measures for agriculture.⁸⁰ Across INDCs which mention agricultural mitigation, the mean estimated reduction in GHG emissions is 15 percent of business as usual by 2030.⁸¹ However, three of the largest agricultural emitters, the U.S., India, and China,⁸² have not included any specific agricultural sector mitigation targets in their INDCs.⁸³ Experts have argued that adaptation and mitigation are often deeply connected in the agricultural

effects of a warmer climate on animal agriculture are complicated and there will likely be certain benefits, such as warmer winters, ultimately in the US “negative effects of hotter weather in summer likely will outweigh benefits of warmer winters.” *Id.* at 88–91.

75. U.N. DEP'T OF ECON. AND SOC. AFFAIRS POPULATION DIV., WORLD POPULATION PROSPECTS: THE 2015 REVISION 1 (2015), http://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf [<https://perma.cc/XK9R-PSEW>].

76. *Id.* at 22.

77. “Of the 160 Party submissions [analyzed], 103 include agricultural mitigation. And of the 113 Parties that include adaptation in their INDCs, almost all (102) include agriculture among their adaptation priorities.” RICHARDS ET AL., CONSULTATIVE GRP FOR INT'L AGRIC. RESEARCH, HOW COUNTRIES PLAN TO ADDRESS AGRICULTURAL ADAPTATION AND MITIGATION 1 (2015).

78. Annex 1 countries “include the industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) . . . plus countries with economies in transition,” while Non-Annex 1 countries are “mostly developing countries.” *Parties and Observers*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/parties_and_observers/items/2704.php [<https://perma.cc/V8ML-EW5K>].

79. RICHARDS ET AL., *supra* note 77, at 2–3.

80. *Id.* at 3–4.

81. *Id.* at 4.

82. *Agriculture Total*, FOOD & AGRIC. ORG. OF THE U.N. STATISTICS DIVISION, <http://www.fao.org/faostat/en/#data/GT/visualize> (last visited April 27, 2017).

83. RICHARDS ET AL., *supra* note 77, at 3.

context, with efforts in one having significant effects for the other.⁸⁴ This viewpoint is reflected in many INDCs, in which “[f]orty-four Parties, all non-Annex 1, have referred to mitigation and adaptation synergies, mitigation as a co-benefit, or vice versa.”⁸⁵

In contrast, the U.S. does not include either agricultural mitigation or adaptation in its INDC.⁸⁶ According to FAO, the U.S. is one of the top emitters of agricultural greenhouse gases, with an average yearly emission of roughly 350,000 gigagrams from 1990–2014.⁸⁷ The majority of these emissions are related to animal agriculture⁸⁸ with another substantial percentage attributable to synthetic fertilizer.⁸⁹ According to the United States Environmental Protection Agency (EPA), agricultural emissions account for 9 percent of total U.S. greenhouse gas emissions.⁹⁰ As one of the top emitters of agricultural emissions, U.S. efforts are critical for effective global agricultural mitigation. A global reduction of agricultural emissions of 15 percent is estimated to be an important component of slowing warming to 2 degrees C, but without targets from the largest agricultural emitters like the U.S., it is difficult to know if a global reduction of 15 percent is feasible.⁹¹

Given the connection between agricultural mitigation and adaptation, efforts to reduce agricultural emissions in the U.S. will likely yield the co-benefit of adapting U.S. agriculture to a warming climate. By the same token, specific agricultural adaptation measures would likely have important mitigation effects, contributing to global emissions reductions goals. Because the U.S. is not likely to escape the negative effects of climate change on crop yields, fisheries production, and livestock production,⁹² agricultural adaptation in the U.S. is imperative. These negative effects demand that the U.S. consider agricultural adaptation, and its mitigation co-benefits, in its approach to climate change, particularly when considered alongside food insecurity in the country. The nation’s INDC would be an appropriate place to do so.

The lack of agricultural adaptation measures in the nation’s INDC, however, does not mean that the U.S. government has not actively considered and

84. *Id.* at 2 (citing A. Jarvis et al., *An Integrated Adaptation and Mitigation Framework for Developing Agricultural Research: Synergies and Trade-offs*, 47 *EXPERIMENTAL AGRIC.* 185 (2011)).

85. *Id.*

86. *Id.* at 4; U.S., U.S. INTENDED NATIONALLY DETERMINED CONTRIBUTION (2015), <http://www4.unfccc.int/submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf> [<https://perma.cc/QZ48-ECQ2>] [hereinafter US INDC].

87. *Agriculture Total*, *supra* note 82.

88. Enteric fermentation (the digestive process for ruminant livestock) accounts for 36.8 percent and manure (through management, being left on pasture, and soil application) accounts for a combined 28.4 percent of US agricultural greenhouse gas emissions. *United States of America*, FOOD & AGRIC. ORG. OF THE U.N. STATISTICS DIVISION, <http://www.fao.org/faostat/en/#data/GT/visualize> (last visited Apr. 13, 2016) (select United States of America from the dropdown menu).

89. *Id.*

90. *Sources of Greenhouse Gas Emissions*, ENVTL. PROTECTION AGENCY, <https://www3.epa.gov/climatechange/ghgemissions/sources/agriculture.html> [<https://perma.cc/M537-GQBUI>].

91. RICHARDS ET AL., *supra* note 77, at 3.

92. *See supra* text accompanying notes 62–75.

addressed the threat climate change poses to agriculture. In November 2013, President Obama issued an Executive Order “to prepare the Nation for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience.”⁹³ Among several provisions relating to the climate preparedness of state, local, and tribal governments, the order directed federal agencies to continue to develop “Agency Adaptation Plans,” which assess and describe the climate change related impacts to the agency’s statutory mission, describe plans and policies for the agency to address those impacts in the long and short term, and explain how the agency plans to enhance its adaptive capacity through internal and interagency efforts.⁹⁴ The USDA’s Climate Adaptation Plan incorporates the agency’s broad spectrum of activities, with provisions ranging from forestry management in the face of climate change to agricultural adaptation measures.⁹⁵ Of the plan’s five broad goals, two focus directly on food security, both nationally and internationally.⁹⁶ The USDA has also conducted significant research into the likely effects of climate change on U.S. agriculture and the adaptation measures which will be required in the coming decades.⁹⁷ The future of these federal actions is unclear with the new administration, however, due to the President Trump’s inconsistent position on climate change⁹⁸ and previous statements from his nominee for Secretary of Agriculture questioning certain aspects of climate science.⁹⁹

Including agricultural adaptation in the U.S. INDC may also be of relatively limited value because the agricultural system in the U.S. likely has a higher level of adaptive capacity¹⁰⁰ than the agricultural systems of the non-Annex 1 nations which included agricultural adaptation in their INDCs. Agriculture in the U.S. is a \$400 billion industry¹⁰¹ and there are over 900 million acres of farmland in the nation, with roughly a third on farms measuring 1,000–4,999 acres and

93. Exec. Order No. 13,653, 78 Fed. Reg. 66,819, 66,819 (2013).

94. *Id.* at 66,821–22. These plans were originally required by Exec. Order No. 13,514, 74 Fed. Reg. 52,117 (2009) (revoked by Exec. Order No. 15,871, 80 Fed. Reg. 15,871 (2015)).

95. U.S. DEP’T OF AGRIC., CLIMATE ADAPTATION PLAN (2014), http://www.usda.gov/oce/climate_change/adaptation/USDA_Climate_Change_Adaptation_Plan_FULL.pdf [<https://perma.cc/9Y32-R5AB>].

96. “Strategic Goal 3: Help America Promote Agricultural Production and Biotechnology Exports as America Works to Increase Food Security” and “Strategic Goal 4: Ensure that All of America’s Children Have Access to Safe, Nutritious, and Balanced Meals.” *Id.* at 2–4.

97. See WALTHAL ET AL., *supra* note 66.

98. See, e.g., Robinson Meyer, *What Does Trump Think About Climate Change? He Doesn’t Know Either*, ATLANTIC (Nov. 22, 2016), <https://www.theatlantic.com/science/archive/2016/11/what-does-trump-think-about-climate-change-he-doesnt-know-either/508541/> [<https://perma.cc/RBX3-MEWC>].

99. In a 2014 National Review article, Sonny Perdue questioned climate science and the connection between climate change and specific weather events. Sonny Perdue, *The Common Core Blame Game*, NAT’L REV. (May 8, 2014), <http://www.nationalreview.com/article/377495/common-core-blame-game-sonny-perdue> [<https://perma.cc/G8NZ-MV53>].

100. Adaptive capacity is defined by the IPCC as: “The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.” *Glossary A-D*, *supra* note 26.

101. See NAT’L AGRIC. STATISTICS SERV., U.S. DEP’T OF AGRIC., AC-12-A-51, 2012 CENSUS OF AGRICULTURE 7 (2014).

another third on farms 5,000 acres or more in size.¹⁰² In contrast, the average farm size almost everywhere else in the world is significantly smaller and small-scale farmers produce the majority of the world's food.¹⁰³ It is reasonable to expect that larger U.S. farms, with access to more acreage and capital, will have the ability to independently adapt to changing climate conditions.¹⁰⁴ However, there are large numbers of smaller farms in the U.S. without this access to land and capital and, historically, the adaptive capacity of U.S. agriculture "has been driven in large part by public sector investment in agricultural research, development and extension activities."¹⁰⁵ Despite the potential adaptive capacity of private agricultural actors in the U.S., continued governmental efforts to increase the adaptive capacity of the nation's agriculture are required in the face of the unprecedented changes¹⁰⁶ that come with a warming climate.

It is apparent that the U.S. has not failed to consider the effects of climate change on agriculture and the need for agricultural mitigation and adaptation, but the nation's INDC does not reflect these efforts. The U.S. opted to communicate its adaptation plans in a separate document, rather than include them in its INDC.¹⁰⁷ This adaptation plan mentions agriculture twice, once in a list of domestic areas of concern and a second time in the context of international development.¹⁰⁸ It is important to recognize that the U.S. has considered agricultural adaptation and communicated that to the parties of the Paris Agreement. However, by separating the discussion of the nation's mitigation and adaptation efforts, the U.S. misses the opportunity to consider the synergy between the two in the context of agriculture. As one of the top agricultural emitters, it is especially important for the U.S. to approach agricultural mitigation and adaptation together and consider the co-benefits of both.

By discussing the synergies between agricultural adaptation and mitigation in the nation's INDC, the U.S. would promote the cooperative approach of the Paris Agreement. The Paris Agreement contains pervasive language about the importance of cooperation and transparency in the global effort to mitigate and adapt to the effects of climate change, beginning with the preamble which acknowledges that "climate change is a common concern of humankind."¹⁰⁹ Specifically, INDCs are intended to provide "clarity, transparency, and

102. *See id.* at 17.

103. KARLA D. MAASS WOLFENSON, FOOD & AGRIC. ORG. OF THE U.N., COPING WITH THE FOOD AND AGRICULTURE CHALLENGE: SMALLHOLDER'S AGENDA 1 n.3 (2013); *see id.* at 16 fig. 4.

104. For a discussion of the financial support required to allow small-holder farmers to adapt their practices to climate change, *see* FOOD & AGRIC. ORG. OF THE U.N., *supra* note 6, at 17–23.

105. WALTHAL ET AL., *supra* note 66, at 123.

106. For a discussion of the effects of climate change on American agriculture and the politics of climate change, *see* Hiroko Tabuchi, *In America's Heartland, Discussing Climate Change Without Saying 'Climate Change,'* N.Y. TIMES (Jan. 28, 2017), https://www.nytimes.com/2017/01/28/business/energy-environment/navigating-climate-change-in-americas-heartland.html?_r=0.

107. U.S., COMMUNICATION OF U.S. ADAPTATION PLAN (2015), http://unfccc.int/files/focus/adaptation/undertakings_in_adaptation_planning/application/pdf/20150529_usa.pdf [<https://perma.cc/5PEU-7QVC>].

108. *Id.* at 4, 5.

109. Paris Agreement, *supra* note 4, at pmb1.

understanding” of each nation’s plan.¹¹⁰ In regard to adaptation, parties to the agreement “acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach,” as well as “recognize the importance of support for and international cooperation on adaptation efforts.”¹¹¹

Rather than fully communicate sector-specific mitigation targets, the U.S. INDC sets a goal for an economy-wide reduction of greenhouse gas emissions of 26–28 percent below 2005 levels by 2025.¹¹² Alternatively, including specific efforts to mitigate agricultural emissions with a more detailed agricultural adaptation plan in the nation’s INDC would promote the transparency and cooperation considerations of the Paris Agreement. Although every country will face some unique effects to agriculture due to climate change,¹¹³ many of the effects to crops and livestock are similar around the world. Communication between nations, through INDCs, about different adaptation approaches will allow the global approach to agricultural adaptation to be more effective. Communication from one of the top agricultural emitters about ways to combine agricultural mitigation and adaptation would additionally better allow the global community to reach the target of a 15 percent reduction in agricultural emissions without threatening food production and the food insecure.

By including information about the nation’s agricultural adaptation and mitigation plans in the nation’s updated INDC, the U.S. could take step towards protecting the food insecure globally, thus serving the Paris Agreement’s fundamental priority of “safeguarding food security and ending hunger.” In addition to ongoing efforts, the U.S. should consider and include the effects of food waste on food insecurity and steps which can be taken to reduce that waste. As climate change reduces the efficiency of food production, it becomes important to ensure that a greater proportion of the food grown actually reaches the plates of those who need it.

V. REDUCING FOOD WASTE IN THE UNITED STATES

In light of the likelihood of the negative effects of climate change on food production and the significant contribution of agriculture to greenhouse gas emissions, the large amount of food waste in the United States must be addressed. Whether or not they are included in the nation’s INDC, the U.S. should take proactive steps to reduce food waste, including waste that occurs on American farms due to the culling of cosmetically unappealing but edible produce.

110. *Id.* at art. 4(8).

111. *Id.* at art. 7(5)–(6).

112. US INDC, *supra* note 86, at 3. The primary elements of the US INDC are a land sector accounting approach, the use of a market-based approach, and the use of domestic laws, particularly the Clean Air Act. *Id.* at 4–5.

113. *See, e.g.*, CLINE, *supra* note 62.

A. The State of Food Waste in the United States

An estimated 40 percent of all food grown in the United States is wasted, amounting to a total of at least 62 million tons of wasted food every year.¹¹⁴ Most waste occurs at the domestic and retail levels,¹¹⁵ however, a substantial percentage is wasted on farms as well.¹¹⁶ The problem of food waste has increased by roughly 50 percent over the last several decades, from 900 calories per person per day in 1974 to roughly 1,400 calories per person per day in 2003.¹¹⁷ The estimated cost of this waste varies from \$165 billion per year¹¹⁸ to \$218 billion per year.¹¹⁹

The U.S. government has been addressing food waste directly for at least 20 years and has recently increased these efforts. One area of federal government's focus has been on reducing liability for those who donate unsold food, in an effort to increase food donations.¹²⁰ In September 2015, the EPA and USDA "announced the United States' first-ever national food waste reduction goal, calling for a 50-percent reduction by 2030."¹²¹ The goal builds on the EPA's "Food Waste Challenge" launched in 2013, which had over 4,000 participating organizations by the end of 2014.¹²² As part of the program, the USDA has instituted a wide variety of initiatives, from consumer education to the streamlining of donation procedures.¹²³ However, the program has been criticized for not being a robust enough approach to the primary sources of food waste.¹²⁴

Reducing food waste has also gained the attention of public policy groups and academics. Recent criticism has focused on the current regulation of date labeling for food products, confusion over which a UK study found to account for

114. DANA GUNDERS, NAT. RES. DEF. COUNCIL, IP:12-06-B, WASTED: HOW AMERICA IS LOSING UP TO 40 PERCENT OF ITS FOOD FROM FARM TO FORK TO LANDFILL 4 (2012); REFED, A ROADMAP TO REDUCE U.S. FOOD WASTE BY 20 PERCENT 10, 16 (2016). Of the total amount wasted, about 9 million are grain products, 9 million are fruits, 12 million are vegetables, 12 million are dairy products, 7 million are meat, poultry and fish, 8 million are added sugar and sweeteners, and the remaining 6 million are eggs, nuts, and added fats and oils. See JEAN C. BUZBY ET AL., U.S. DEP'T OF AGRIC., EIB-121, THE ESTIMATED AMOUNT, VALUE, AND CALORIES OF POSTHARVEST FOOD LOSSES AT THE RETAIL AND CONSUMER LEVELS IN THE UNITED STATES 12 tbl. 1 (2014).

115. Domestic waste accounts for 43 percent (27 million tons) and retail waste, mostly grocery stores and restaurants, accounts for 40 percent (25 million tons). REFED, *supra* note 114, at 13.

116. 16 percent or 10 million tons. *Id.*

117. Kevin D. Hall et al., *The Progressive Increase of Food Waste in America and Its Environmental Impact*, 4 PLOS ONE, Nov. 2009, e7940 at 1, <http://dx.doi.org/10.1371/journal.pone.0007940>.

118. GUNDERS, *supra* note 114, at 4.

119. REFED, *supra* note 114, at 13.

120. In 1990, Congress attempted to address this area by passing the Model Good Samaritan Food Donation Act. See James Haley, *The Legal Guide to the Bill Emerson Good Samaritan Food Donation Act*, 2013 ARK. L. NOTES 1448.

121. Press Release, U.S. Dep't of Agric., USDA and EPA Join with Private Sector, Charitable Organizations to Set Nation's First Food Waste Reduction Goals (Sept. 16, 2015), <http://www.usda.gov/wps/portal/usda/usdahome?contentid=2015/09/0257.xml> [<https://perma.cc/6ANN-HWJT>].

122. *Id.*

123. *USDA's Activities*, U.S. DEP'T OF AGRIC., http://www.usda.gov/oc/foodwaste/usda_commitments.html [<https://perma.cc/QKL6-C9YS>].

124. Megan Cronin, *Wasted: A Failure of Food Waste Reduction and Pollution Prevention*, GEO. ENVTL. L. REV. ONLINE (Jan. 9, 2016), <https://geir.org/2016/01/08/wasted-a-failure-of-food-waste-reduction-and-pollution-prevention/> [<https://perma.cc/S4TS-SPLS>].

20 percent of consumer food waste.¹²⁵ These critiques call for a standardization of date labels on food products, creating a clear, understandable date labeling system that properly distinguishes between quality-based and safety-based dates.¹²⁶ A 2016 report by ReFED, a collaborative effort between industry, government and nonprofits, outlined a roadmap to achieve a 20 percent reduction in food waste in the United States through 27 solutions in the broad areas of prevention, recovery, and recycling.¹²⁷ Many of the proposed solutions with the largest potential impacts directly involve retail produce sales and consumer behavior, such as standardized date labeling, consumer education campaigns, changes to food packaging, and a variety of efforts to standardize and increase food donation.¹²⁸

However, in the context of the effect of climate change on food production and the benefits of agricultural adaptation in the United States, it is important to ask what steps can be taken to reduce waste at the farm level, where 10 million tons of food per year is wasted.¹²⁹ Reducing food waste on farms, as a preventative measure, is particularly beneficial because food waste prevention “has twice the lifecycle greenhouse gas benefit per ton compared to food recycling” due to reductions in the amount of fertilizer and fuel used to grow the food initially.¹³⁰ In this way, prevention of food waste on the farm is an example of the dual benefits of adaptation and mitigation recognized by academics, within the INDCs of many nations, and by the IPCC itself.¹³¹ Food waste happens on farms for a variety of reasons, both before and after harvest. About 7 percent of planted fields go unharvested in the U.S. every year.¹³² Farmers often grow more crops than there is demand for in order to protect against potential losses from weather or pests, creating “walk-by” fields that are left entirely unharvested.¹³³ Food safety scares and temporary labor shortages can also lead to unharvested fields.¹³⁴

After harvest, the primary cause of food waste is culling, “the removal of products based on quality or appearance criteria, including specifications for size,

125. REFED, *supra* note 114, at 33 (citing the UK study and assuming that US consumer behavior is similar); *see, e.g.*, EMILY BROAD LEIB ET AL., HARVARD FOOD LAW AND POLICY CLINIC & NAT. RES. DEF. COUNCIL, R:13-09-A, THE DATING GAME: HOW CONFUSING FOOD DATE LABELS LEAD TO FOOD WASTE IN AMERICA (2013); *see also* Carmen Shaeffer Kalashian, Comment, *Out of Sight, Out of Mind: Finding a Solution to Food Waste in America*, 23 SAN JOAQUIN AGRIC. L. REV. 103 (2013–2014).

126. *See, e.g.*, LEIB ET AL., *supra* note 125, at 23–27.

127. REFED, *supra* note 114, at 2, 5–6.

128. *See id.* at 20.

129. *Id.* at 13.

130. *Id.* at 16; *see also* Hall et al. *supra* note 117, at 2 (citations omitted) (“[G]iven that the average farm requires 3kcal of fossil fuel energy to produce 1 kcal of food (before accounting for energy requirements of food processing and transportation, wasted food accounts for ~300 million barrels of oil per year representing ~4 [percent] of the total US oil consumption in 2003.”).

131. *See* RICHARDS ET AL., *supra* note 77, at 3 (citing Andy Jarvis et al., *An Integrated Adaptation and Mitigation Framework for Developing Agricultural Research: Synergies and Trade-offs*, 47 EXPERIMENTAL AGRICULTURE 185 (2011)); 2014 SYNTHESIS REPORT, *supra* note 1, at 29 (“Emissions can be substantially lowered through changes in consumptive patterns, adoption of energy savings measures, dietary changes and reduction in food wastes.”).

132. GUNDERS, *supra* note 114, at 7 (citing Linda Scott Kantor et al., *Estimating and Addressing America’s Food Losses*, USDA FOOD REVIEW, Jan.–Apr. 1997, 2–12).

133. *Id.* at 7.

134. *Id.*

color, weight, blemish level, and Brix (a measure of sugar content).”¹³⁵ The amount of culled produce is likely significant, although exact statistics are difficult to obtain (potentially because culled food never enters the market where data can be and is collected). The ReFED report estimates that positive steps taken to reduce food waste due to cosmetic culling could reduce waste by 266,000 tons of food per year, but does not quantify the total amount of waste due to culling.¹³⁶ In a report concerning the waste of food on farms, the Natural Resources Defense Council recounted these anecdotes from farmers and packinghouse workers:

One large cucumber farmer estimated that fewer than half the vegetables he grows actually leaves his farm and that 75 percent of the cucumbers culled before sale are edible. A large tomato-packing house reported that in mid-season it can fill a dump truck with 22,000 pounds of discarded tomatoes every 40 minutes. And a packer of citrus, stone fruit, and grapes estimated that 20 to 50 percent of the produce he handles is unmarketable but perfectly edible.¹³⁷

Culling also occurs at the packinghouse and retail levels. As an example, in Florida, where approximately 30 percent of the nation’s tomatoes are grown, estimates suggest that at the packinghouse level, 20–40 percent of the tomatoes do not meet grade standards and are not packed.¹³⁸

B. Reducing Waste Due to “Ugly Produce”

Public interest and research groups have called for a reduction in the amount of food waste based on the culling of cosmetically imperfect produce, in other words “ugly produce.” The ReFED report considered the potential impacts of reducing “ugly produce” waste and found that initial steps could divert 266,000 tons of food from being wasted every year, a value of \$277 million.¹³⁹ Recognizing retailers’ branding concerns and farmers’ concerns that sales of ugly produce will cut into the sales of their more aesthetically appealing produce, the report primarily suggests market-driven solutions such as improved marketing, branding, and processing of ugly produce.¹⁴⁰ In a toolkit on reducing global food waste, the FAO takes a more regulatory approach towards reducing the waste of imperfect produce.¹⁴¹ Focusing on compulsory regulations which grade produce and result in the discarding of edible food, the report argues that produce regulations should be based on “safety rather than quality” and that consumers should both be educated

135. *Id.* at 8.

136. REFED, *supra* note 114, at 34.

137. GUNDERS, *supra* note 114, at 8.

138. Steve Sargent, *Reduce Disposal Costs*, GROWING PRODUCE (Aug. 1, 2008), <http://www.growingproduce.com/vegetables/tomatoes/reduce-disposal-costs/> [<https://perma.cc/K9YG-HEQT>].

139. REFED, *supra* note 114, at 34.

140. *Id.*

141. FOOD WASTE FOOTPRINT PROJECT, FOOD & AGRIC. ORG. OF THE U.N., TOOLKIT: REDUCING THE FOOD WASTAGE FOOTPRINT 49 (2013) [hereinafter FAO TOOLKIT].

that ugly does not indicate poor quality and be given the choice to purchase less cosmetically appealing produce.¹⁴²

In the context of climate change, reducing the amount of food wasted simply because of cosmetic defects may become more important as some of the primary causes of ugly produce increase. With a warming climate, insect pests may become a larger problem as their ranges expand, generation times decrease, and general abundance increases.¹⁴³ A warmer climate will likely change the effect of disease on crops in both detrimental and beneficial ways, although generalizations are difficult to make and the effects are likely to vary regionally.¹⁴⁴ Different regional extreme weather events, including extended droughts, heat waves, and extreme precipitation, are also likely to increase due to climate change.¹⁴⁵ Increased insect prevalence, disease incidence, and occurrence of extreme weather events will directly affect total crop yields¹⁴⁶ but may also affect the cosmetics of that food which is harvested. Cosmetic damage caused by insects and disease is included in the USDA Grade Standards for many fruits and vegetables.¹⁴⁷ Particularly high or low temperatures and extreme precipitation can cause a variety of cosmetic growth defects in fruits and vegetables.¹⁴⁸ If climate change does lead to an increase in insect pests, crop disease, and extreme weather events, the incidence of these cosmetic defects will possibly increase, making the issue of culling ugly produce even more important.

Although there are certainly many considerations which lead farmers to cull ugly but edible produce, the presence and implementation of USDA Grade Standards for fresh fruits and vegetables adds a regulatory consideration. The USDA was granted the authority to grade produce through the Agricultural

142. *Id.*

143. WALTHAL ET AL., *supra* note 66, at 44–49.

144. *Id.* at 49–51.

145. *Id.* at 5–6, 111.

146. *See, e.g., id.* at 5, 44–51, 111.

147. *See, e.g.,* AGRIC. MKTG. SERV., U.S. DEP'T OF AGRIC., UNITED STATES STANDARDS FOR GRADES OF FRESH TOMATOES 9 (1991) [hereinafter TOMATO STANDARDS], https://www.ams.usda.gov/sites/default/files/media/Tomato_Standard%5B1%5D.pdf [<https://perma.cc/K69P-BJ4R>] (Insect injury which “detracts from the appearance” of tomatoes is a factor considered in whether tomatoes are considered “damaged.”); AGRIC. MKTG. SERV., U.S. DEP'T OF AGRIC., UNITED STATES STANDARDS FOR GRADES OF APPLES 8–11 (2002) [hereinafter APPLE STANDARDS], https://www.ams.usda.gov/sites/default/files/media/Apple_Grade_Standard%5B1%5D.pdf [<https://perma.cc/6GLE-TBK9>] (healed insect sting marks affecting the cosmetics of an apple may be considered when determining injury, damage, or serious damage).

For more examples, a dropdown menu leading to all of the applicable USDA Grade Standards for vegetables is provided on the USDA website. *Vegetables*, AGRIC. MKTG. SERV., U.S. DEP'T OF AGRIC., <https://www.ams.usda.gov/grades-standards/vegetables> (last visited Apr. 27, 2017). A separate page has a dropdown menu for all applicable USDA Grade Standards for fruit. *Fruits*, AGRIC. MKTG. SERV., U.S. DEP'T OF AGRIC., <https://www.ams.usda.gov/grades-standards/fruits> (last visited Apr. 27, 2017).

148. As an example, high temperatures and abundant rain may cause growth cracks in tomatoes and cold temperatures can lead to catfacing in tomatoes. Michelle Grabowski, *Disorders of Tomatoes*, U. MINN. EXTENSION, <http://www.extension.umn.edu/garden/yard-garden/vegetables/disorders-of-tomato/> [<https://perma.cc/25P5-NFAQ>]. Both of these growth defects are included as criteria in the USDA Grade Standards for tomatoes. TOMATO STANDARDS, *supra* note 147, at 7–9.

Marketing Act of 1946,¹⁴⁹ which was enacted to promote the “welfare, prosperity and health of the Nation” through a “sound, efficient, and privately organized system for distributing and marketing agricultural products.”¹⁵⁰ In addition to research and improvements in the distribution systems for agricultural products, the act specifically provides for the use of market aids, services, and regulation to improve “marketing methods and facilities.”¹⁵¹ In addition to reducing costs, improving dietary and nutritional standards, and widening the market for American agricultural products, these improvements were intended to make “possible for the full production of American farms to be disposed of usefully, economically, profitably, and in an orderly manner.”¹⁵²

The USDA is authorized under the act to “determine the best methods of processing, preparation for market, packaging, handling, transporting, storing, distributing, and marketing agricultural products” as well as to “develop and improve standards of quality, condition, quantity, grade, and packaging, and recommend and demonstrate such standards in order to encourage uniformity and consistency in commercial practices.”¹⁵³ In addition to the grading of livestock,¹⁵⁴ meat,¹⁵⁵ and eggs,¹⁵⁶ the USDA’s authority under the act has been used to create uniform grades for fresh fruits and vegetables.¹⁵⁷ In 1995, many of the grade standards for fresh fruit and vegetables were removed from the Code of Federal Regulations (CFR) but the “standards and all subsequent revisions or new standards [are] made available in a separate publication.”¹⁵⁸ While the grading standards for some produce, such as apples, celery, and pecans, are still located in the CFR,¹⁵⁹ most grading standards can be found on the Agricultural Marketing Service (AMS) website.¹⁶⁰

Use of the USDA Grade Standards is entirely voluntary, but the standards are intended to provide the market “with a uniform language for describing the quality and condition of commodities in the marketplace.”¹⁶¹ In addition to these voluntary standards, certain fruits and vegetables from specific states or regions¹⁶² are subject to industry-initiated, market-stabilizing marketing orders and

149. The Agricultural Marketing Act of 1946, Pub. L. 79-733, 60 Stat. 1082 (codified as amended 7 U.S.C. §§ 1621 – 1638d).

150. 7 U.S.C. § 1621 (2012).

151. *Id.*

152. *Id.*

153. 7 U.S.C. § 1622(a), (c) (2012).

154. 7 C.F.R. § 53.1 *et seq.* (2016).

155. 7 C.F.R. § 54.1 *et seq.* (2016).

156. 7 C.F.R. § 56.1 *et seq.* (2016).

157. 7 C.F.R. § 51.1 *et seq.* (2016).

158. Proposed revisions to existing standards and new standards still appear in the Federal Register for public comment and the Agricultural Marketing Service continues to use the numbering system from the CFR. 64 Fed. Reg. 35500 (June 30, 1998).

159. *See* 7 C.F.R. §§ 51.300, 51.560, 51.1430 (2016).

160. *Vegetables, supra* note 147; *Fruits, supra* note 147.

161. *Id.*

162. *See Commodities Covered by Marketing Orders*, AGRIC. MKTG. SERV., U.S. DEP’T OF AGRIC., <https://www.ams.usda.gov/rules-regulations/moa/commodities> [<https://perma.cc/EAM5-JSUL>].

agreements which are binding for handlers who sign the agreement.¹⁶³ These agreements tend to incorporate the USDA Grade Standards into their language.¹⁶⁴

Any party interested in having their produce graded may apply to the USDA for inspection and certification.¹⁶⁵ Inspection and certification of fresh fruits and vegetables is based on USDA Grade Standards, state standards, agency specifications, or the buyer-seller contract.¹⁶⁶ If the produce meets the applicable standards, a certificate is “issued for each lot inspected” and, if a contract governs the standards of inspection, “a formal certificate need not be issued, but the fact of such compliance or noncompliance may be indicated.”¹⁶⁷ Although adopting the standards is voluntary, knowing unauthorized use of “any official certificate, memorandum mark, or other identification . . . with respect to inspection, class, grade, quality, size, quantity or condition” subjects the offending party to criminal penalties.¹⁶⁸

The USDA Grade Standards usually break each fruit or vegetable down into two or more grades, with the top grade typically being something like “U.S. No. 1,” “U.S. Fancy,” or “U.S. Extra Fancy.”¹⁶⁹ These grades are typically differentiated by both cosmetic and non-cosmetic criteria. For example, U.S. No. 1 bunched carrots must be “fairly well colored,” “fairly smooth,” and “well formed”;¹⁷⁰ U.S. No. 1 tomatoes must be “well developed,” “fairly well formed,” and “fairly smooth”;¹⁷¹ U.S. Extra Fancy apples must be “fairly well formed,”¹⁷² and U.S. Extra No. 1 celery must be “well developed,” “well formed,” and

163. *Marketing Orders & Agreements*, AGRIC. MKTG. SERV., U.S. DEP’T OF AGRIC., <https://www.ams.usda.gov/rules-regulations/moa> [<https://perma.cc/9BBW-4P5R>].

164. *See, e.g.*, 7 C.F.R. § 966.232 (2016) (incorporating USDA Grade Standards into the requirements of the Florida Tomatoes marketing order); 7 C.F.R. § 906.365 (2016) (incorporating USDA Grade Standards into the requirements of the Texas Citrus marketing order).

165. 7 C.F.R. § 51.5 (2016).

166. 7 C.F.R. § 51.13 (2016).

167. 7 C.F.R. § 51.19 (2016).

168. 7 U.S.C. § 1622(h)(4) (2012). This criminal penalty provision is incorporated by reference into the fruit and vegetable standards. 7 C.F.R. § 51.3 (2015).

169. *See, e.g.*, APPLE STANDARDS, *supra* note 147, at 1; TOMATO STANDARDS, *supra* note 147, at 1. For other examples see *Fruits*, *supra* note 147; *Vegetables*, *supra* note 147.

170. “Fairly well colored means that the carrot has an orange, orange red, or orange scarlet color, but not a pale orange or distinct yellow color;” “Fairly smooth means that the carrot is not rough, ridged, or covered with secondary rootlets to the extent that the appearance is materially affected;” “Well formed means that the carrot is not forked, or misshapen to the extent that the appearance is more than slightly affected.” AGRIC. MKTG. SERV., U.S. DEP’T OF AGRIC., UNITED STATES STANDARDS FOR GRADES OF BUNCHED CARROTS 1, 3–4 (1954) [hereinafter CARROT STANDARDS], https://www.ams.usda.gov/sites/default/files/media/Carrot%2C_Bunched_Standard%5B1%5D.pdf [<https://perma.cc/8AQ7-G6AP>].

171. “Well developed means that the tomato shows normal growth . . . [t]omatoes which are ridged and peaked at the stem end, contain dry tissue, and usually contain open spaces below the level of the stem scar, are not considered well developed;” “fairly well formed means that the tomato is not more than moderately kidney shaped, lop-sided, elongated, angular, or otherwise moderately deformed;” “fairly smooth means that the tomato is not conspicuously ridged or rough.” TOMATO STANDARDS, *supra* note 147, at 1–2, 7.

172. “Fairly well formed means that the apple may be slightly abnormal in shape but not to an extent which detracts materially from its appearance.” APPLE STANDARDS, *supra* note 147, at 2, 7–8.

“compact.”¹⁷³ Most of the premium or highest grades and standards also require that the fruit or vegetable be free from various types of cosmetic damage, often from insects, disease, growth defects such as cracking, mechanical damage, or weather events such as hail.¹⁷⁴ However, grade standards also include non-cosmetic criteria such as lack of decay, lack of soft rot, and freshness.¹⁷⁵ Although cosmetic standards are used throughout the USDA Grade Standards, it is difficult to know how these standards affect culling without knowing how much produce is actually graded or sold according to the standards.

The total amount of fruit, vegetables, and nuts grown in the U.S. annually is difficult to know with certainty, but several figures estimate the most commonly grown produce. USDA estimates for 2010 place total production of the top annual fruit and vegetables crops¹⁷⁶ covered by the National Agricultural Statistics Service (NASS) at just over 89 billion pounds (approximately 44 million tons).¹⁷⁷ Adding the NASS estimates for an additional 12 vegetables¹⁷⁸ raises the total to approximately 47 million tons.¹⁷⁹ Estimates for selected fruits¹⁸⁰ place total production at approximately 28 million tons in 2014.¹⁸¹ Finally, estimates for tree nuts¹⁸² put total utilized production at approximately 2.8 billion pounds (1.4 million tons) in 2014.¹⁸³ These estimates place fruit, vegetable and nut production at

173. “Well developed means that the branches are of good width and thickness in relation to the length of midribs and type of celery and that the heart branches are of reasonable number, length and stockiness,” “well formed means that the branches are fairly straight and not more than slightly curved or twisted,” “compact means that the branches on the stalk are fairly close together throughout most of their length.” AGRIC. MKTG. SERV., U.S. DEP’T OF AGRIC., UNITED STATES STANDARDS FOR GRADES OF CELERY 2, 4 (1959) [hereinafter CELERY STANDARDS], https://www.ams.usda.gov/sites/default/files/media/Celery_Standard%5B1%5D.pdf [<https://perma.cc/3BLD-HQ5U>].

174. See, e.g., APPLE STANDARDS, *supra* note 147, at 8–10; CARROT STANDARDS, *supra* note 170, at 4; CELERY STANDARDS, *supra* note 173, at 5; TOMATO STANDARDS, *supra* note 147, at 8–9.

175. See, e.g., APPLE STANDARDS, *supra* note 147, at 2–3; CARROT STANDARDS, *supra* note 170, at 1; CELERY STANDARDS, *supra* note 173, at 2–3; TOMATO STANDARDS, *supra* note 147, at 1–2.

176. Artichokes, Asparagus, Beans (dry edible), Beans (snap), Broccoli, Cabbage, Cantaloupes, Carrots, Cauliflower, Celery, Sweet Corn, Cucumbers, Garlic, Honeydews, Lettuce, Onions, Bell Peppers, Chile Peppers, Potatoes, Pumpkins, Spinach, Squash, Tomatoes, Strawberries, and Sweet Potatoes. WALTHAL ET AL., *supra* note 66, at 75.

177. See *id.* at 75. Estimates for 2015 are similar, at approximately 43 billion pounds (21.5 million tons) for the most common vegetables not including potatoes, which accounted for approximately half of the 2010 estimates. See NAT’L AGRIC. STATISTICS SERV., U.S. DEP’T OF AGRIC., VEGETABLES: 2015 SUMMARY 9 (2016).

178. Beets, Brussel Sprouts, Collards, Eggplant, Endive, Ginger, Kale, Mustard Greens, Okra, Rhubarb, Turnip Greens, and Watermelon. NAT’L AGRIC. STATISTICS SERVICE, U.S. DEP’T OF AGRIC., STATISTICS BY SUBJECT, http://www.nass.usda.gov/Statistics_by_Subject/index.php?sector=CROPS (last visited Apr. 27, 2017).

179. The estimated production totals from 2001, the most recent year available, can be found through the dropdown menu on the NASS website. *Id.*

180. Apples, Peaches, Pears, Grapes, Cherries, Prunes and Plums, Apricots, Figs, Oranges, Tangerines, Grapefruit, Lemons, Limes, Tangelos, Strawberries, Avocados, Nectarines, Cranberries, Bananas, Kiwifruit, Dates, and Papayas. U.S. DEP’T OF AGRIC., FRUIT AND TREE NUTS YEARBOOK, at tbl.A-5 (2015), <http://usda.mannlib.cornell.edu/usda/ers/89022/2015/FruitandTreeNutYearbook2015.pdf> [<https://perma.cc/7AXN-43NH>].

181. See *id.*

182. Almonds, Hazelnuts, Pecans, Walnuts, Macadamias, and Pistachios. *Id.* at tbl.F-3.

183. See *id.*

roughly 76 million tons per year. According to AMS estimates, “[a]pproximately 46 billion pounds [23 million tons] of fresh fruits and vegetables were inspected by Federal and licensed state inspectors” in 2015.¹⁸⁴ This means that approximately 30 percent of all fruits, vegetables and nuts are inspected according to USDA Grade Standards.

By inspecting nearly a third of all fresh produce, the state and federal inspectors have a more than negligible direct impact on the fresh produce market in the U.S. Although federal and state inspectors do not inspect the majority of fresh fruits and vegetables sold in the U.S., the USDA Grade Standards still shape many of those sales. Even when inspectors are not involved, buyers and sellers may incorporate USDA Grade Standards directly into their sales and shipping contracts.¹⁸⁵ Buyers and sellers often use USDA Grade Standards as a shorthand for quality and inspect the produce themselves according to the standards.¹⁸⁶ A buyer may then request a federal inspection if the product arrives and the buyer believes it does not meet the criteria of the agreed upon standard.¹⁸⁷ Due to the cosmetic criteria in the USDA Grade Standards, a seller shipping an order under a high grade, such as U.S. No. 1, is incentivized to not include cosmetically unappealing but edible produce in the shipment. This use of USDA Grade Standards, including all of the cosmetic criteria, in private contracts has a significant impact on fresh fruit and vegetable sales. Through this incorporation into private contracts and direct inspection by federal inspectors, the USDA Grade Standards have a substantial role in shaping what food makes it to the grocery store shelf and what food does not.

In an agricultural system which culls a significant amount of cosmetically unappealing but edible produce and is facing potentially substantial decreases in total yield due to a changing climate, a government program which incentivizes the waste of edible food should be changed. In addition to its ongoing agricultural adaptation measures, the USDA should consider revising its grade standards for fruits and vegetables to reduce the amount of culled ugly produce. By keeping the safety criteria, such as lack of decay or soft rot, but eliminating the cosmetic criteria, the USDA can take at least a limited step towards adapting U.S. agriculture to a changing climate and fulfilling the obligations of the Paris Agreement.

184. Email from Robert Bridger, Assistant Chief of Staff, Specialty Crop Inspection Division of the Agric. Mktg. Serv., U.S. Dep’t of Agric., to author (Mar. 29, 2016, 2:43 pm MST) (on file with author).

185. As an example, Blue Book Services, a provider on marketing information for the fresh fruit and vegetable industry, has guides for the sale of produce which include information about the U.S. Grade Standards, quality versus condition criteria, good delivery standards, and how these terms might appear on shipping orders. *Commodity References*, BLUE BOOK SERV., <https://www.producebluebook.com/wp-content/uploads/PDFs/Introduction%20&%20Good%20Delivery%20Guidelines.pdf> [https://perma.cc/VNP3-3JF2]. Blue Book Services also provides specific, detailed information about a variety of major crops, including information regarding U.S. grade standards. *Know Your Commodity*, BLUE BOOK SERV., <https://www.producebluebook.com/news/know-your-commodity/> [https://perma.cc/45EB-6K2C].

186. See generally Roberta Cook, *Institutional Aspects of Fresh Fruit and Vegetable Marketing Systems*, U.C. DAVIS (Apr. 1996), <https://are.ucdavis.edu/people/faculty/emeriti/roberta-cook/articles-and-presentations/institutional-aspects-fresh-fruit-and-vegetable-marketing-system/> [https://perma.cc/SA8B-4EQD].

187. *Id.*

Additionally, removing cosmetic criteria from the USDA Grade Standards would better serve one of the primary purposes of the Agricultural Marketing Act of 1946, to make “possible for the full production of American farms to be disposed of usefully, economically, profitably, and in an orderly manner.”¹⁸⁸

The USDA, however, is not the only actor shaping what food is eaten and what food is not and revising the USDA Grade Standards does not guarantee that business or consumer behaviors will change. Businesses will continue to consider the effect of ugly produce on their bottom line and consumers may not accept ugly produce, meaning that removing cosmetic criteria from these standards might not have a significant, or any, effect on the culling of ugly produce. First, revising the grade standards may have limited or no effect on the buying patterns of retail businesses, such as grocery stores and restaurants. Although the grade standards provide a short-hand in the produce market and they are incorporated into sales and shipping contracts,¹⁸⁹ many large retailers have their own specifications for fresh fruits and vegetables.¹⁹⁰ Even if the USDA Grade Standards were revised to eliminate cosmetic criteria, retailers may continue to use cosmetic standards, given the concern that ugly produce would negatively affect their brands and hurt sales of cosmetically appealing, more expensive produce.¹⁹¹

Second, even if retailers began stocking ugly produce, whether the average U.S. consumer would buy that ugly produce is uncertain. Grocery stores stocking ugly produce that simply goes unsold would cause more problems than the current system. The processing, transport, packing, and retail of food contributes as much or more greenhouse gas emissions than the initial agricultural production itself.¹⁹² If ugly produce was processed, transported, packed, and then stocked on grocery store shelves only to be thrown out because consumers would not buy it, this would contribute significant greenhouse gas emissions for no benefit.

Finally, it is worth mentioning that food waste at the retail and domestic levels has different consequences than food waste at the farm level. Food wasted by domestic and retail users comprises the single largest component in landfills,¹⁹³ which are the third largest source of methane emissions in the U.S.¹⁹⁴ In contrast, when food is wasted on farms “nearly all is composted on-site or left to be tilled

188. 7 U.S.C. § 1621 (2012).

189. See *Commodity References*, *supra* note 185.

190. RUTGERS N.J. AGRIC. EXPERIMENT STATION, PERFECTION OF PRODUCE: THE GOOD, THE BAD AND THE UGLY 1 (2010), <http://njfarmfresh.rutgers.edu/documents/WhatsinSeason112310.pdf> [<https://perma.cc/C2J4-7RJR>].

191. REFED, *supra* note 114, at 34.

192. Processing, transport, packing and retail account for 15–20 percent of total greenhouse gas emissions compared to the 11–15 percent of agricultural production. WAKE UP BEFORE IT IS TOO LATE, *supra* note 49, at 20.

193. See U.S. ENVTL. PROTECTION AGENCY, MUNICIPAL SOLID WASTE GENERATION, RECYCLING, AND DISPOSAL IN THE UNITED STATES 5 (2014), https://www.epa.gov/sites/production/files/2015-09/documents/2012_msw_fs.pdf [<https://perma.cc/5RTF-3PF5>] (showing that after recycling and composting, food waste is the largest component of landfills); REFED, *supra* note 114, at 16 (explaining that domestic and retail food waste in addition to on-farm waste comprise “food waste,” but only domestic and retail food waste contribute to landfill waste).

194. *Overview of Greenhouse Gases*, U.S. ENVTL. PROTECTION AGENCY, <https://www.epa.gov/ghg-emissions/overview-greenhouse-gases#methane> [<https://perma.cc/SH7J-66L9>].

into the soil where it enhances soil health similarly to compost.”¹⁹⁵ Ultimately, if encouraging the sale of ugly produce would simply shift the waste from farms to businesses and homes, ugly produce remaining on the farm and being tilled back into the soil is the preferable situation.

There may come a day when businesses and consumers do not reject ugly produce, but encouraging the use of ugly produce will require private efforts. There are already private efforts underway to promote the use of ugly produce, from consumer education campaigns on social media¹⁹⁶ to national media attention, expanding the conversation about the waste of ugly fruit and vegetables.¹⁹⁷ Additionally, some businesses are beginning to focus on buying, selling, or utilizing more ugly produce. Walmart has recently begun a pilot program to sell ugly produce, including weather damaged apples and potatoes.¹⁹⁸ As another example, Bon Appetit, a company that provides food services on campuses and other institutions, has launched an “Imperfectly Delicious Produce” program which works directly with farmers to utilize ugly produce and reduce waste.¹⁹⁹ Restaurants and food service companies as well as processed food manufacturers appear to be ideal places to promote the use of ugly produce. Misshapen tomatoes can be used to make sauce or soup just as well as perfectly round ones and convincing concerned shoppers at the grocery store to buy and eat ugly produce may present more of a challenge than convincing business owners to use ugly produce in prepared and processed foods. Further inquiry is clearly warranted into the opportunities and challenges—legal, practical and economic—of encouraging the use of ugly produce in prepared and processed food.

The culling of ugly produce is a serious problem that, unaddressed, is likely to only get worse with the effects of climate change. As rising temperatures both reduce crop yields and potentially damage more fruits and vegetables in ways that would get them culled today, the issue of cosmetically unappealing but perfectly edible produce will continue to demand attention. A major step the USDA should take in response to this problem is the removal of cosmetic criteria from the USDA Grade Standards. Although fully reducing the waste of ugly produce will depend on the changing habits of businesses and consumers, modifying the influential federal standards may promote the use of ugly produce just as it promotes its waste now.

195. REFED, *supra* note 114, at 12.

196. See, e.g., @UglyFruitAndVeg, TWITTER (Sep. 19, 2015, 4:15 PM), <https://twitter.com/UglyFruitAndVeg/status/645375800649359360> [<https://perma.cc/S2FP-6V25>].

197. See, e.g., Maria Godoy, *Ugly Fruit is Ripe for a Close-Up, as ‘Shark Tank’ Takes on Food Waste*, NAT’L PUB. RADIO (Jan. 8, 2016), <http://www.npr.org/sections/thesalt/2016/01/08/462429929/ugly-fruit-is-ripe-for-a-close-up-as-shark-tank-takes-on-food-waste>.

198. Maria Godoy, *Wal-Mart, America’s Largest Grocer, Is Now Selling Ugly Fruit and Vegetables*, NAT’L PUB. RADIO (Jul. 20, 2016), <http://www.npr.org/sections/thesalt/2016/07/20/486664266/walmart-world-s-largest-grocer-is-now-selling-ugly-fruit-and-veg>.

199. REFED, *supra* note 114, at 30; see also Maria Godoy, *Think Nobody Wants to Buy Ugly Fruits and Veggies? Think Again*, NAT’L PUB. RADIO (Mar. 26, 2015), <http://www.npr.org/sections/thesalt/2015/03/26/395160156/think-nobody-wants-to-buy-ugly-fruits-and-veggies-think-again>.

CONCLUSION

The issues of the effects of climate change on food production and the waste of food in the United States are significantly broader than the culling of ugly produce. However, the culling of ugly produce is a significant problem which may well become worse as the effects of a warming climate increase and intensify. Addressing the ways in which the federal government incentivizes the waste of ugly, but edible, produce is an example of one of the many steps that can, and should, be taken to adapt U.S. agriculture to a changing climate. Recognizing that climate change is a “common concern of all humankind,” the U.S. should include concrete steps such as this, even if not this measure itself, in its submissions under the Paris Agreement in order to promote transparency and cooperation in global efforts. However, regardless of the Paris Agreement, the practical reality is that climate change will affect food systems and the U.S. must take proactive measures to prevent those effects which can be prevented and adapt to those which cannot.

