# CRACKING THE CODE: OPEN-SOURCE SEED AND INTELLECTUAL PROPERTY RIGHTS

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## I. INTRODUCTION

Plant seeds operate like computer code on many levels. From their genetic makeup to their accessibility, both contain complex systems that create challenges for users to work with and understand their legal rights. Computer code has developed in recent years to help novice coders and programmers build skills in different computer languages.[1] One of these developments has been the advent of open-source code.[2] In contrast to code—which has garnered legal protection by corporations for their exclusive use—open-source code is a well that anyone with a computer may access and benefit from.[3] This model has provided many avenues that were previously unavailable to computer programmers.

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1. *See What is Open Source?*, OPENSOURCE.COM (Jan. 2, 2023, 11:05 PM), https://opensource.com/resources/what-open-source [https://perma.cc/RJ6D-644W].

2. *See id*.

3. *See id*.

Similarly, plant seeds are also facing issues surrounding the intellectual property (IP) rights of certain types of commercial crops.[4] Many farmers find it increasingly difficult to save seed and preserve traditional plant breeding and reproduction methods due to restrictions placed by the seed providers who have patent protection over the genetic makeup of the seed.[5] Companies like Monsanto and Syngenta issue licenses to farmers to use their seed in specific ways.[6] Most commonly, farmers use these licenses for seasonal crops and not for reproduction.[7] This helps the companies maximize profits by creating returning customers.[8] Further, seeds that are only planted once and never reused do not adapt to the localized conditions.[9] This helps companies market ancillary products, such as fertilizers, that can be used no matter the climate.[10]

The lack of seed adaptation has contributed to a decline in biodiversity among common crops.[11] Specifically, agrobiodiversity has significantly changed due to a ripple effect caused by the introduction of patent protection for seeds.[12] However, a radical new system has sprung forth to regain that loss.[13] That method is open-source seed.[14] Similar to a model of open-source computer code, open-source seed replicates the free share of seeds between farmers and growers to promote seed adaptability and reinvigorate agrobiodiversity.[15]

Court cases like *Diamond v. Chakrabarty*, and the more recent decision in *Monsanto v. Bowman*, illustrate how patent protection for genetically modified seeds has evolved to prevent farmers from saving seed and contribute to a lack of localized resistance to changing climate pressures.[16] As a result, a growing

4. Tove Danovich, *Gardening is Important, but Seed Saving is Crucial*, CIVIL EATS (April 21, 2020), https://civileats.com/2020/04/21/gardening-is-important-but-seed-saving-is-crucial/ [https://perma.cc/F33G-M37T].

5. *Id.*

6. Warren Richey, *Farmers Cannot Replicate Monsanto Seeds for Second Crop, Supreme Court Rules*, THE CHRISTIAN SCI. MONITOR (May 13, 2013), https://www.csmonitor.com/USA/Justice/2013/0513/Farmers-cannot-replicate-Monsanto-seeds-for-second-crop-Supreme-Court-rules [https://perma.cc/6QKG-3XHV].

7. *Id.*

8. *See* Danovich, *supra* note 4.

9. *Id.*

10. *See generally id.*

11. *Id.*

12. *See generally id.*

13. *See generally The Open Source Seed Initiative*, OPEN SOURCE SEED INITIATIVE (Jan. 2, 2023, 11:09 PM), https://osseeds.org/ [https://perma.cc/WWW9-RNRD].

14. *See id.*

15. *See id.*

16. *See generally* Diamond v. Chakrabarty, 477 U.S. 303 (1980); Monsanto v. Bowman,

movement for open-source seed has taken root in small farms and personal gardens utilizing the time-honored tradition of heirloom seed saving.[17] I propose a concerted effort to reinvigorate biodiversity in commercial farming by informing farmers of their rights within their current contracts and incorporating aspects of the open-source seed movement. The question still remains: why does open-source seed matter? With the rise of global climate change, it is more imperative than ever to transition our food systems to a process that promotes adaptability, self-sufficiency, and regionalization.

This Note will follow a chronological structure to posit the current open-source seed movement within the broader context of seed breeding and the fight for and against IP rights. To do so, it will provide an overview of traditional plant breeding methods contrasted against patent protection. In addition, there will be an explanation of biodiversity, its benefits, and the history of decline, which should provide relevant background into commercial crops' roles in agro-ecosystems. Finally, this note will propose an incorporation of the open-source seed movement through licensing that coexists with current patent protections to remedy the decline in agrobiodiversity.

## II. TRADITIONAL PLANT BREEDING (FREE TRADE) V. INTRODUCTION OF IPRS

"Most classical plant breeders will tell you that their work is inherently collaborative—the more people involved, the better."[18] Throughout history there have been three waves of structural change involving plant breeding.[19] Originally, pre-1930s, plant breeding involved free trade of seed and ideas with research being conducted at the individual level.[20] In *Diamond*, the court noted "two factors were thought to remove plants from patent protection."[21] The first factor considered "was the belief that plants, even those artificially bred, were products of nature for purposes of the patent law."[22] Secondly, plants were not thought of as

657 F.3d 1341 (Fed. Cir. 2011).

17. *See The Open Source Seed Initiative, supra* note 13; *see also Open-Source: Protecting Freedom*, OPEN SOURCE SEEDS (Jan. 2, 2023, 11:13 PM), https://www.opensourceseeds.org/en [https://perma.cc/DZ6Y-WCTG].

18. Lisa M. Hamilton, *Linux for Lettuce*, VQR ONLINE (Jan. 2, 2023, 11:14 PM), https://www.vqronline.org/reporting-articles/2014/05/linux-lettuce [https://perma.cc/X5W8-6E4E].

19. PIET SCHENKELAARS ET AL., DRIVERS OF CONSOLIDATION IN THE SEED INDUSTRY AND ITS CONSEQUENCES FOR INNOVATION 62 (2011), https://www.lisconsult.nl/files/docs/consolidation_seed_industry.pdf [https://perma.cc/XC73-GH6X].

20. *Id.*

21. Diamond, 447 U.S. at 311.

22. *Id.*

compliant with the "written description" requirement of patent law.[23] The emergence of new commercial seed firms spawned the first major structural change.[24] These firms continued to adapt public individual research which led to major growth in commercial crops such as maize.[25]

The second wave of structural change occurred during the 1970s as a result of the introduction of IP rights.[26] Specifically, "[t]he [Plant Variety Protection Act (PVPA)] extend[ed] patent–like protection to novel varieties of sexually reproduced plants—plants grown from seed—that parallels the protection afforded asexually reproduced plant varieties."[27] The patent-like protection promised to increase returns from investments in plant breeding research and development.[28] Such an increase led to an influx of mergers and acquisitions between pharmaceutical and agrochemical companies looking to capitalize on the increased protections.[29] Consolidation was not limited to the United States, however, as European conglomerates doing business in the United States also looked to gain market position amidst the changing legal landscape.[30]

The third, and most recent, structural change to plant breeding occurred in the 1980s when genetic modification and other new technologies motivated consolidated multinational companies to propose more coordinated efforts.[31] These motivations drove out market competition and led to a handful of companies dominating the commercial introduction of genetic modification, also known as biotech seed, and other new technologies.[32] Today, this shift is further reflected in seed breeding as this practice "has moved from public universities to private laboratories and four companies control more than 60 percent of global seed sales."[33]

As a result of these three structural changes, plant breeding saw initial improvement and advancement.[34] With the introduction of new varieties, crop

23. *Id*. at 312.

24. SCHENKELAARS ET AL., *supra* note 19, at 62.

25. *Id*. at 16.

26. *Id*. at 62.

27. Ann Wooster, *Construction and Application of Plant Variety Protection Act (7 U.S.C.A. §§ 2321 et seq.)*, 167 A.L.R. Fed. 343, at § 2[a] (2001).

28. SCHENKELAARS ET AL., *supra* note 19, at 16.

29. *Id*.

30. *Id*. at 62.

31. *Id*.

32. *See id*. at 62–63.

33. Danovich, *supra* note 4, at 4.

34. *See* JOHANNES KOTSCHI ET AL., ENABLING DIVERSITY: WAYS TO FINANCE ORGANIC PLANT BREEDING, AGRECOL ASS'N FOR AGRIC. & ECOLOGY 3 (2021),

yields could be increased.[35] In some cases, genetic modification led to disease resistance that had previously resulted in total crop failure.[36] The new method of plant breeding that emerged from increased patent-like protection contributed to an intensification of agriculture far beyond that of mineral fertilizers and chemical plant protection.[37]

However, privatization, the result of the sum of all three major structural plant breeding changes, contributed greatly to the disappearance of economically less important or locally important crops.[38] This led to major reduction of biological diversity among commercial crops.[39] The driving force in privatization of plant breeding was, and still is, profit.[40] Large multinational chemical companies, along with their significant capital resources, could promise increased returns from investments in plant breeding research and development over medium-sized regional seed companies.[41] The rising costs of research and development that occurred with the emergence of new varieties of plants were cited by regional companies as a major driver of most merger and acquisitions with multinational companies.[42] Combined with added costs of having to adopt patent rights for new varieties, small companies and universities had to seek expansion in order to achieve relevant return on their investment.[43] As a result, "three international chemical companies control more than 60% of the global commercial seed market."[44]

Companies derive profit from privatized plant breeding through an IP rights-based royalties model.[45] Essentially, to be most profitable, plant varieties need to be grown and distributed at a large scale. Most companies, even large multinational chemical companies, cannot produce the amount necessary to maximize their profits.[46] Therefore, companies with patent protection will authorize outside companies to use the seeds in a limited capacity, through licenses, and

https://opensourceseeds.org/sites/default/files/bilder/GOSSI/PDFs/Enabling%20diversity_Agrecol_2021.pdf [http://perma.cc/B7PN-MY67].

35. *Id.*
36. *Id.*
37. *Id.*
38. *See id.*
39. *Id.*
40. *See id.* at 4.
41. *See generally* SCHENKELAARS ET AL., *supra* note 19.
42. *Id.*
43. *Id.* at 40.
44. KOTSCHI ET AL., *supra* note 34, at 4.
45. *Id.*
46. *Id.*

receive payments usually based on a percentage of the net or gross revenue made by the IP.[47]

The profit driven market consolidation presents seeds that are highly homogenous to achieve characteristics such as high yield and uniform maturity.[48] Seed uniformity is required to protect the variety as private and exclusive.[49] The resulting fairly homogenous and high-performing varieties allow companies to maximize profits through large-scale distribution.[50] However, this creates problems for localized plant genetic diversity.[51] A business model centered around mass production and wide applicability to promote standardized and uniform agricultural production contributes heavily to reducing agrobiodiversity.[52] To restore important localized resistance in the face of a rapidly changing climate and increasing rates of human population, this business model must be reversed by a shift to open-source seed.

## III. STATUTORY PROTECTION OF PLANT PATENT RIGHTS AND RESULTING LITIGATION

The United States Constitution provides the grounds for the fundamental idea of patentability of "Writings and Discoveries," with the purpose of enhancing the useful arts.[53] However, since its enactment, debate over what qualifies as patentable subject matter has occurred.[54] Traditionally, naturally occurring phenomena were not considered patentable subject matter.[55] This doctrine was modified with the passage of the Plant Patent Act.[56]

Asexual reproduction of plants to novel varieties was originally offered patent protection through the Townsend-Purnell Plant Patent Act of 1930.[57] This marked the first time living organisms received patent protection.[58] But after 40

47. *See Intellectual Property Royalties – Everything You Need to Know*, ROYALTYRANGE (Apr. 2020), https://www.royaltyrange.com/home/blog/intellectual-property-royalties-everything-you-need-to-know [https://perma.cc/E825-A4UC].

48. KOTSCHI ET AL., *supra* note 34, at 4.

49. *Id.*; *see generally* Plant Variety Protection Act, 7 U.S.C.A. § 2422(2).

50. KOTSCHI ET AL., *supra* note 34, at 4.

51. *Id.*

52. *Id.*

53. U.S. CONST., art. I, § 8, cl. 8.

54. Burke Bindbeutel, *The Beans of Wrath: Genetic Patent Holders Reap Further Protection*, 19 ENVTL. & SUSTAINABILITY L. 426, 429 (2013).

55. *Id.*

56. *Id.* at 430.

57. Wooster, *supra* note 27, at § 2[a]; *see generally* 35 U.S.C. §§ 161–64.

58. Bindbeutel, *supra* note 54, at 430.

years, Congress realized sexually reproduced plants – plants grown from seed – could mirror the true-to-type reproduction that occurred through asexual methods, such as propagation or grafting.[59] So, in 1970, Congress enacted the PVPA which extended to breeders' plant variety protection if they met the following conditions: the variety had to be new, distinct, uniform, and stable.[60] The construction of the conditions regarding variety create many issues for biodiversity, specifically with regard to the variety being uniform and stable.

The issue of what was patentable subject matter under the PVPA was put to rest in the case of *Diamond v. Chakrabarty*.[61] Mr. Chakrabarty had filed a patent for a strain of bacteria he developed that was to be used in cleaning up oil spills.[62] The court limited the issue to whether the bacteria constituted a manufacture or composition of matter within the meaning of 35 U.S.C. § 101 which provides for an invention's patentability.[63] The Court held the bacteria was patentable because it was not a "hitherto unknown natural phenomenon, but to a non-naturally occurring manufacture or composition of matter."[64] Therefore, the court reasoned the relevant distinction for patentability "was not between living and inanimate things, but between products of nature, whether living or not, and human-made inventions."[65] This reasoning had two effects. First, it supported the PVPA by offering direct support of the constitutionality of the legislation.[66] Second, it opened the door to patent holders being able to sue infringers.[67]

The details of what constitutes an infringement of plant variety protection are outlined in 7 U.S.C. § 2541. That section provides, "it shall be an infringement of the rights of the owner of a protected variety to perform without authority."[68] In relevant part, the acts referred to within 7 U.S.C. § 2541 include selling, importing, multiplying, or developing the plant variety.[69]

The Act also provided three exemptions from infringement of plant patent protection. First, patented seeds could be used solely for research purposes by

59. Wooster, *supra* note 27, at § 2[a].
60. *Id*.; *see* 7 U.S.C. § 2402.
61. *See* Diamond v. Chakrabaty, 447 U.S. 303, 321–22 (1980).
62. *Id*. at 305.
63. *Id*. at 307; *see* 35 U.S.C. § 101.
64. Diamond, 447 U.S. at 309.
65. *Id*. at 313.
66. *See* Diamond, 447 U.S. at 315.
67. *See id*. at 322.
68. 7 U.S.C. § 2541(a).
69. *Id*.

anyone.[70] Second, the saving of seed by farmers was permitted for the purpose of future plantings.[71] Third, the public interest in planting protected seeds could be authorized to combat monopolistic plant-breeder control.[72]

Importantly, the seed saving exemption for farmers drastically impacted the patent-holder's rights and profitability.[73] Because sexual organisms can self-replicate, when farmers engage in the practice of replanting those seeds, the patent-holder no longer reaps the benefits of their intellectual proprietorship in either the exercise of the invention or the monetary compensation for their use.[74] To prevent loss, in a move that had potential for widespread crop reduction, Monsanto, a well-known seed and chemical company, patented a seed that lacked genetic capacity to produce seeds, colloquially called the "terminator seed."[75] While the seed was retained for research purposes by the company, the seed saving exemption was overturned in its wake.[76]

The removal of the seed saving exemption under 7 U.S.C. § 2543 allowed for the full monetization of plant patents which largely benefitted seed and chemical conglomerates.[77] Unsurprisingly, it also gave rise to a slew of infringement litigation.[78] Monsanto issued a type of license called a "Technology Agreement" prohibiting the replanting of their patented seeds.[79] Such a prohibition has been upheld as enforceable and applied against many unsuspecting soybean farmers.[80] The strengthening of patent protection through statutes and resulting affirming litigation marked the near elimination of seed saving practices.

70. § 2544.

71. § 2543.

72. § 2404.

73. Bindbeutel, *supra* note 54, at 426.

74. *Id.* at 431–32.

75. *See generally* Control of Plant Gene Expression, U.S. Patent No. 5723765 (filed June 7, 1995).

76. *See* J.E.M. Ag Supply Inc. v. Pioneer Hi-Bred Intern., Inc., 534 U.S. 124, 143, 145–46 (2001).

77. Jim Chen, *Parable of the Seeds: Interpreting the Plant Variety Protection Act in Furtherance of Innovation*, 81 NOTRE DAME L. REV. 105, 125–26 (2005).

78. *See*, *e.g.*, Monsanto Co. v. Swann, 308 F.Supp.2d 937 (E.D. Mo. 2003); Monsanto Co. v. Bowman, 657 F.3d 1341 (2001); Monsanto Co. v. Scruggs, 459 F.3d 1328 (Fed. Cir. 2006).

79. *See* Monsanto Co. v. McFarling, 302 F.3d 1291, 1293 (Fed. Cir. 2002); Monsanto Technology/Stewardship Agreement (Limited Use License) (2011).

80. *See* Monsanto, 302 F.3d at 1299–1300.

## IV. BIODIVERSITY IN COMMERCIAL FARMING

Biodiversity is the concept referring to the variety of living species within an ecosystem.[81] Biodiversity loss is a decrease in biodiversity within a species, an ecosystem, a given geographic area, or the Earth as a whole.[82] "Agricultural biodiversity includes those components of biological diversity relevant to food and agriculture as well as the components of biological diversity that constitute the agro-ecosystem."[83] It is present at numerous levels, "from the different ecosystems in which people raise crops and livestock, through the different varieties and breeds of the species, to the genetic variability within each variety or breed."[84] Agricultural biodiversity gives humans food and raw materials for goods.[85] In addition to these benefits, "genetic diversity of agricultural biodiversity provides species with the ability to adapt to changing environments and to evolve by increasing their adaptation to frost, high temperature, drought, and waterlogging as well as their resistances to diseases, insects and parasites."[86] This makes agrobiodiversity essential to sustain the basic needs of humans.[87]

Humans have a direct link to a need for agrobiodiversity through our continued battle for food security.[88] Agrobiodiversity can serve as a safety net to the most vulnerable of our society by providing income opportunity to poor rural families.[89] Further, genetic diversity is the basis for crop improvement.[90] Through traditional methods of plant breeding, generations of farmers have increased harvests substantially.[91]

81. *Biodiversity*, NAT'L GEOGRAPHIC SOC'Y (Jan. 23, 2023, 12:06 PM), https://www.nationalgeographic.org/encyclopedia/biodiversity/ [https://perma.cc/ME28-DUVR].

82. John P. Rafferty, *Biodiversity Loss*, ENCYCLOPEDIA BRITANNICA (Jan. 2, 2023, 11:17 PM), https://www.britannica.com/science/biodiversity-loss [https://perma.cc/3ZV8-5SBT].

83. Emile A. Frison et al., *Agricultural Biodiversity is Essential for a Sustainable Improvement in Food and Nutrition Security*, 3(1) SUSTAINABILITY 238, 239 (2011).

84. *Id*.

85. Gurdev S. Khush, *The Importance of Biodiversity to Food and Agricultural Systems Across the Globe*, WORLD FOOD PRIZE FOUND.: THE BORLAUG BLOG (Oct. 16, 2017, 3:11 PM), https://www.worldfoodprize.org/index.cfm/88533/18098/the_importance_of_ biodiversity_to_food_and_agricultural_systems_across_the_globe#:~:text=Agricultural%20biodiversity%20includes%20all%20components,ornamental%20plants%20of%20aesthetic%20value [https://perma.cc/MP4J-RG4L].

86. *Id*.

87. *Id*.

88. *Id*.

89. *Id*.

90. *Id*.

91. *Id*.

There are four main benefits of agrobiodiversity among commercial farming: productivity and stability, pest and disease resistance, adaptability, and regionalization.[92] This section will explore how traditional plant breeding methods promote each benefit.

### *A. Productivity and Stability*

Biodiversity among agricultural systems promotes food security and provides for livelihoods in a sustainable manner.[93] Unlike modern trends of superficial modification, traditional plant breeding requires less inputs and produces more outputs.[94] For instance, farmers who buy or are licensed to use patented seeds must subsequently purchase and use a variety of products including fertilizers, herbicides, and pesticides.[95] Whereas traditional methods require none of these products and over time surpass those seeds in harvesting metrics.[96]

Important to understanding the productivity of maintaining agricultural biodiversity are the economic benefits. In a study conducted by the Institute for Agrobotany, researchers focused on what factors influenced farmers decisions on maintaining diverse cultivation.[97] First, diversity of crop resources is of economic importance because it determines annual yields.[98] Yield growth and yield instability have economic value that relate to efficiency trade-offs in the short term.[99]

Researchers then applied a traditional cost-benefit analysis to argue the environmental economics produce a net positive.[100] Environmental goods, such as seeds, have both use value and non-use value.[101] Use value is further divided into direct use value, which is value derived from consuming the good, and indirect

92. INT'L PLANT GENETIC RES. INST., THE ECONOMICS OF CONSERVING AGRICULTURAL BIODIVERSITY ON-FARM: RESEARCH METHODS DEVELOPED FROM IPGRI'S GLOBAL PROJECT 'STRENGTHENING THE SCIENTIFIC BASIS OF IN SITU CONSERVATION OF AGRICULTURAL BIODIVERSITY' 49 (Melinda Smale et al. eds., 2002), https://www.bioversityinternational.org/fileadmin/_migrated/uploads/tx_news/The_economics_of_conserving_agricultural_biodiversity_on-farm_801.pdf [https://perma.cc/A4UC-G7SX].

93. *Agricultural Biodiversity*, CONVENTION ON BIOLOGICAL DIVERSITY (Oct. 15, 2021), https://www.cbd.int/agro/ [https://perma.cc/T85W-UQGU].

94. INT'L PLANT GENETIC RES. INST., *supra* 92, at 32.

95. *See Agricultural Biodiversity*, *supra* note 93.

96. *See id*.

97. INT'L PLANT GENETIC RES. INST., *supra* 92, at 6.

98. *Id*. at 9.

99. *Id*.

100. *See generally id*. at 29.

101. *Id*. at 25.

use value, which is value received from production effects.[102] The quality and quantity of food produced as well as the cash flow generated for farmers make up the direct use value of agricultural biodiversity.[103] Non-use value is the remaining value not attributed to direct or indirect use.[104] Examples of non-use value include viewing the environmental asset as beneficial to future generations, known as bequest value, or simply that the environmental asset exists, which is known as existence value.[105]

This method of assigning value to agricultural biodiversity assists in aligning efforts to conserve it. While evidence of consumers employing a cost benefit analysis in regard to maintaining agricultural biodiversity is scant, this analysis shows how traditional seed breeding efforts outpace the economic value of patent protection. And while the economic value of biodiversity based practices for agriculture must consider both functions and services to society, ultimately it is the individual farmers who act as agents and decide what practices to employ.[106] Mostly, individual farmers will make these decisions based on their own private needs and interests.[107] Therefore, it is imperative that any new licensing practices or movements toward open-source seed must take into account the financial and physical limitations of individual farmers. Ideally, the open-source seed movement will reduce the overall costs over time. However, farmers must consider all of the costs associated with switching seed providers, as well as seed practices.

### *B. Pest and Disease Resistance*

A main driver of the patented seed population and resulting monetization was its propensity to effectively protect harvests from being destroyed by invasive pests and diseases.[108] However, as will be discussed later, this process of maximizing yield has resulted in the overuse of pesticides which has damaged soil quality that monocultures are unequipped to thrive in.[109] Through the process of integrated pest management (IPM), biodiversity can once again be the focus of the pest resistance discussion.

102. *Id.*

103. *Id.*

104. *Id.* at 26.

105. *Id.*

106. LOUISE E. JACKSON ET. AL., *Agrobiodiversity*, 1 ENCYC. OF BIODIVERSITY 126, 128 (2013).

107. *Id.*

108. KOTSCHI ET AL., *supra* note 34, at 4.

109. *Pesticides and Soil Health*, CTR. FOR BIOLOGICAL DIVERSITY (Jan. 25, 2023, 1:54 PM), https://www.biologicaldiversity.org/campaigns/pesticides-and-soil-health/ [https://perma.cc/Y293-W3EE].

The basis of IPM is resilience.[110] The basis of resilience is biodiversity.[111] Agricultural biodiversity gives farmers the best opportunity to restore natural resilience, which is both economically and environmentally beneficial.

### *C. Adaptability*

Agricultural biodiversity provides crops with the best chance to adapt to changing environments. Various functions of biodiversity add to the resilience of agroecosystems.[112] "Biodiversity is thought to enhance the capacity to recover from disruption" and "mitigate risks caused by disturbance."[113] Climate change is putting new pressures on the local diversity of crops.[114] Intravarietal diversity, which spawns from saving seed, can promote tolerance of varying weather patterns, rain and drought, heat and frost, changing soil conditions, diseases, insect attacks, and can even produce compensatory growth in the event that one variety suffers.[115] Further, agricultural diversity can promote productivity through its increased adaptability.[116] The resulting crop diversity can enhance nutrient use efficiency.[117] In effect, a return to increased biodiversity through conservation methods will promote resilience.

## V. EFFECT OF IPRS ON BIODIVERSITY/FARMERS RIGHTS

IP rights and the patent protection of seed promotes an industrial model of crop production.[118] The industrial model of production prefers the use of crop varieties that respond to high applications of chemicals.[119] Through both market consolidation that led to a rapid spread of monocultures and massive increases in the use of associated pesticides and herbicides, soil quality declined and losses of unprotected plant varieties were numerous.[120] Not only does such an industrial model produce excessive waste, it is structured around surplus production of

110. Marco Barzman et al., *Eight Principles of Integrated Pest Management*, 35 AGRON. SUSTAIN. DEV. 1199, 1199 (2015).

111. *See id*.

112. JACKSON, *supra* note 106, at 131.

113. *Id*.

114. Patrick Mulvany, *Sustaining Agricultural Biodiversity and Heterogenous Seeds, Woodhead Publishing Series in Food Science*, TECH. AND NUTRITION 285, 293 (2021).

115. *Id*.

116. JACKSON, *supra* note 106, at 130.

117. *Id*.

118. Mulvany, *supra* note 114, at 290, 303.

119. *Id*. at 290.

120. *Id*. at 302–03; *see generally* SCHENKELAARS, *supra* note 19.

commodities instead of ecological sustainability.[121]

Further, farmers currently being exploited by the industrial model are often unaware of their legal rights.[122] In short, farmers enter agreements with companies for patented seeds, and due to the unequal bargaining power, can be unaware of certain contractual obligations.[123] The licenses employed are often disguised as Technology Agreements.[124] These licenses for the patented seeds frequently place restrictions on the ability of farmers to enact environmentally conscious practices such as saving seed.[125] For example, the 2011 technology agreement for Roundup Ready seeds states the grower agrees, "[n]ot to save or clean any crop produced from Seed for planting, not to supply Seed produced from Seed to anyone for planting, not to plant seed for production other than for Monsanto or a Monsanto licensed seed company under a seed production contract."[126] The governing architecture of pressures to prioritize trade and industry interests over environmentally and socially framed farming led to the development of protection for a few companies to the detriment of the masses.[127]

## VI. Open-Source Seed Solution

Since the detrimental effects of patent protection for seeds have emerged, many have searched for legal solutions that creatively circumvent any issues of infringement. One major movement, open-source seed, has been a decidedly opposite approach. The Open Source Seed Initiative (OSSI) was initiated by a University of Wisconsin professor who garnered a team of supporters dedicated to providing fair and open access to plant genetic resources.[128] The initiative is based on the idea that a near monopoly has been created, as only a handful of companies make up most of the world's commercial seed breeding and sales and that patenting is the crucial tool by which major companies wield power over

121. Mulvany, *supra* note 114, at 290.

122. *See* discussion *infra* at Part III.

123. *See generally* Andrew Bloomenthal, *Licensing Agreement: Definition, Example, Types, and Benefits*, INVESTOPEDIA (June 23, 2022), https://www.investopedia.com/terms/l/licensing-agreement.asp [https://perma.cc/UK8B-Z2D3].

124. *See* Monsanto Co. v. McFarling, 302 F.3d 1291, 1293 (Fed. Cir. 2002).

125. *See id.*

126. Monsanto Technology/Stewardship Agreement (Limited Use License) (2011).

127. Mulvany, *supra* note 114, at 306; *see* William Lesser, *The Impacts of Seed Patents*, 9 N. CENTRAL J. OF AGRIC. ECON. 37, 43 (1987).

128. *The Open Source Seed Initiative*, *supra* note 13; *see* Niels Louwaars, *Open Source Seed, a Revolution or Yet Another Attack on the Breeder's Exemption?*, 9 FRONT. PLANT SCI., Sept. 2019, at 1.

farmers.[129]

The concept of open-source seed closely follows the tenets developed in coding. Participants in the open-source movement allow free redistribution and modifications or derived works.[130] OSSI creates a system in which plant materials are freely available to breeders under the condition that any further use of genetic resources derived from them would be made available under the same open-source policy.[131]

This section will underscore how OSSI and seed licensing differs from open-source in other sectors. It will also discuss how to best integrate open-source seed into the industrial system. Finally, this section will discuss the potential pitfalls and note the various organizations dedicated to helping solve this issue.

### *A. Proposal*

The open-source seed movement must take into consideration three underlying values: economic viability, legal enforcement, and marketability. First, OSSI must assess the costs for individual farmers associated with switching to open-source seed. Currently, farmers may purchase open-source varieties from any OSSI seed company partners.[132] Notwithstanding farmers access to these partners, in certain circumstances, farmers must terminate whatever agreements they are in currently.[133] This will typically involve consulting legal counsel and contacting their current providers. To aid in this process, OSSI should implement services that include references to attorneys and reviews of partner companies.

Next, the movement must consider the legal enforcement of either an open-source license or a pledge. The main difference with open-source seed initiatives in other sectors is that other initiatives mainly use IP rights and the patent and copyright systems in order to increase openness.[134] In most cases, the holder of an IP right has the exclusive right to commercialize the invention.[135] The IP right allows the right holder to legally implement such open-source use.[136] The OSSI decided that would not be feasible for plant genetic resources.[137] Therefore, the

129. *See* Louwaars, *supra* note 128, at 6.
130. *See What is Open Source?*, *supra* note 1.
131. Louwaars, *supra* note 128, at 2.
132. *See The Open Source Seed Initiative*, *supra* note 13.
133. Bloomenthal, *supra* note 123.
134. Louwaars, *supra* note 128, at 2.
135. *Id.*
136. *Id.*
137. *Id.*

OSSI based its open-source model on a non-legally binding pledge.[138] The pledge states,

> You have the freedom to use these OSSI Pledged seeds in any way you choose. In return you pledge not to restrict others' use of these seeds or their derivatives by patents or other means, and include this Pledge with any transfer of these seeds or their derivatives.[139]

This pledge creates a strong moral obligation as well as firmly sends a message against the patenting trend in seed breeding.

### *B. Open-Source Seed Licenses Versus a Pledge*

"An open-source license is a tool constituted by the provisions of contract law, backed by the authority of the state."[140] Because of the state's authority, the OSSI license proved to be too cumbersome to sustain and it was subsequently replaced with the pledge.[141] The pledge on the other hand grants many freedoms while requiring very little.[142] The licensee is obliged to grant the same rights to other licensors that they enjoyed themselves.[143]

Currently, the OSSI pledge is not legally enforceable.[144] However, if the pledge is made in a contract format, it could have implications for the parties to that contract.[145] The general rules of contract will apply to pledges.[146] "Accordingly, the rights and liabilities of the parties are, if possible, to be construed and enforced according to the intention of the parties as determined from the terms of the contract of pledge and the subject matter, the course of dealing to which it relates, and the surrounding circumstances."[147] Therefore, individual farmers, along with legal counsel, must be advised that the law of pledges can be applicable.

The open-source seed movement must also consider the marketability of the pledge. If individual farmers are not aware that an alternative to buying pa-

138. *Id.*

139. *Id.*

140. Jack Kloppenburg, *Re-purposing the Master's Tools: The Open Source Seed Initiative and the Struggle for Seed Sovereignty*, 41 THE J. OF PEASANT STUD. 1225, 1226 (2014).

141. Johannes Kotschi & Bernd Horneburg, *The Open Source Seed Licence: A Novel Approach to Safeguarding Access to Plant Germplasm*, PLOS BIOLOGY, Oct. 23, 2018, at 3.

142. *Id.*

143. *Id.*

144. *See About*, OPEN SOURCE SEED INITIATIVE (Jan. 27, 2023, 1:17 PM), https://osseeds.org/about/ [https://perma.cc/7HC5-3MEM].

145. 72 C.J.S. *Pledges* § 20.

146. *Id.*

147. *Id.*

tented seeds exists, the movement will fail. Therefore, the OSSI should vamp up their informational resources by offering training on how to switch to open-source. This will eliminate myths surrounding the movement as well as inform farmers about the legal rights they may exercise.

### *C. Combination of Open-Source and IP Rights*

The OSSI recognizes that the current plant breeding industry and farmers are so firmly entrenched in the industrial model based on IP rights that a total shift to open-source is not feasible.[148] Therefore, it is necessary to discuss the ways in which breeders and farmers can transition to open-source while still working within the industrial model. The first challenge facing open-source is the narrative surrounding the "Tragedy of the Commons."[149] This explains that a resource unaccompanied by a right of exclusion is ripe for overuse and depletion.[150] However, as David Bollier writes:

> [T]he commons is frequently confused with an open-access regime, in which a resource is essentially open to everyone without restriction. In an open-access regime, there is no identifiable authority. No one has recognized property rights, and the output of the commons is intended for sale on external markets, not for personal use by members of the commons . . . Without the "social infrastructure" that defines a commons—the cultural institutions, norms, and traditions—the only real social value in open-access regimes is private profit for the most aggressive appropriators.[151]

It is precisely the social practices surrounding the open-source seed movement that prevents the tragedy of the commons from occurring. This is premised from years of traditional plant breeding and agriculture before the introduction of IP rights.[152] Therefore, scholars have called for a limited control model to be instituted which would have community members treat a resource as a commons but have outsiders view the resource as private property.[153]

148. *See generally About*, *supra* note 144.

149. *See generally* Garrett Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243, 1244 (1968).

150. *See id.*

151. DAVID BOLLIER, SILENT THEFT: THE PRIVATE PLUNDER OF OUR COMMON WEALTH 20 (2002).

152. *See generally* CAROL M. ROSE, PROPERTY AND PERSUASION: ESSAYS ON THE HISTORY, THEORY, AND RHETORIC OF OWNERSHIP (Robert W. Gordon & Margaret Jane Radin eds., 1994).

153. *See generally id.*

### *D. Potential Pitfalls*

While open-source seeds provide the best opportunity for an increase in biodiversity, the movement is not without its deficits. Farmers must ask difficult questions when deciding whether to switch to open-source. For instance, farmers must decide which benefit to choose from: the benefit of herbicide resistance or biodiversity. This mirrors a question of short-term effects versus long-term benefits. By using herbicides and patented seeds, farmers may save on initial labor costs to prevent their crops from being ruined by pests or disease. However, a switch to open-source seeds sooner would allow for increased savings on the back end by promoting seed saving practices and not having to purchase herbicides and pesticides in the future.

Further, farmers must gauge the scalability of switching to open-source seed. For large farms, changing or alternating resources takes a considerable amount of planning, time, and access to seed banks. However, only a handful of open-source seed banks currently exist.[154] Even if open-source is a viable option for a farmer or breeder, as discussed earlier, OSSI has not yet successfully employed an open-source license.[155] The best option available is a moral or contractual obligation through a pledge. Therefore, the uncertainty of the availability of open-source seeds could be a strong deterrent.

## VII. CONCLUSION

Open-source seed provides an alternative for growers who are currently restricted in the use of their seeds due to only being licensed to use the seeds for certain purposes. The open-source movement hinges on ethical farming practices and providing a sustainable process which takes on the issue of changing global climate pressures. Through licenses and pledges, the movement attempts to shift current practices of seed adaptation from a consolidated industry and bring it back to the roots of sharing knowledge and culture of the commons.

The consolidation of the seed industry, which was driven by the patentability of seeds, contributed to a lack of seed adaptation because it eliminated the practice of seed saving. Further, the less adaptability seeds have, the more biodiversity among the common crops rapidly declines. Specifically, agrobiodiversity has significantly changed. As a model of open-source computer code, open-source seed replicates the free sharing of seeds between farmers and growers to promote seed adaptability and reinvigorate agrobiodiversity.[156]

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154. *See The Open Source Seed Initiative*, *supra* note 13.
155. *See* Louwaars, *supra* note 128, at 2.
156. *See The Open Source Seed Initiative*, *supra* note 13.

The slew of court cases such as *Diamond v. Chakrabarty*,[157] and the more recent decision *Monsanto v. Bowman*,[158] have demonstrated a pattern of protecting seeds as IP and provide the enforcement mechanism for preventing farmers from saving seed. Through the enforcement of seed licenses and technology agreements, the single use seeds contribute to a lack of localized resistance to changing climate pressures. The growing movement for open-source seed, which was started in small farms and personal gardens, provides a remedy to this situation. Although commercial farms may initially face issues of scalability and up-front costs, the long-term benefits of greater resistance to disease and drought are enticing. By utilizing the time-honored tradition of heirloom seed saving, commercial farms may reintroduce the method of sharing information for the common good.[159] A concerted effort to reinvigorate biodiversity in commercial farming must occur by informing farmers of their rights within their current contracts and incorporating aspects of the open-source seed movement. With the rise of global climate change, it is more imperative than ever to transition our food systems to a process that promotes adaptability, self-sufficiency, and regionalization.

157. *See generally* Diamond v. Chakrabarty, 477 U.S. 303 (1980).

158. *See generally* Monsanto v. Bowman, 657 F.3d 1341 (Fed. Cir. 2011).

159. *See The Open Source Seed Initiative*, *supra* note 13; *see also Open-Source: Protecting Freedom*, *supra* note 17.