universität wien

UNIVERSITÄT LEIPZIG

Master Thesis

Plants, Patents and Power: Reconceptualising the Property Environment in Seeds in the 19th and 20th Centuries

Author: Lindsay Ash

Academic degree aspired
Master of Global Studies

Vienna, 2009

Studienkennzahl: A 067 805
Studienrichtung: Global Studies in a European Perspective

Advisor: a.o. Univ. Prof. Dr. Martina Kaller-Dietrich

Abstract

Over the course of the late 19th to 20th centuries, the property environment in seeds has been radically transformed. The extension of intellectual property (IP) rights over plant varieties, a feature of international law since the 1960s, represents a major shift in the status of the seed as a resource, and has considerable consequences for agriculture, trade, and the livelihoods of agricultural producers around the globe. The spread of intellectual property protections over seeds has displaced another, much older management system, that of the commons. Understanding how this considerable proprietary shift occurred involves examining the way that various theories of property have been used and misused in their application to seeds. It reveals that far from being an inevitable development, the extension of private property to seeds has required a significant stretching of the tenets that underpin private property as an institution. This thesis analyses the development of IP protections in seeds over the 20th century from the perspective of property theory, and argues for a more balanced picture of seed ownership as two competing systems – one common, one private – that have shaped each other over the course of the century. The final chapter examines strategies that have been proposed to overcome the tensions between private and common ownership. These include rights reservation strategies, the deference to national sovereignty and open source biotechnology. Each of these strategies represents an attempt to redress the negative impacts of private property in seeds by engaging with the institution of property in new ways.

* * *

Im Laufe des späten 19. und beginnenden 20. Jahrhunderts fand eine radikale Transformation der Eigentumsverhältnisse an Saatgut statt. Die Erweiterung von geistigen Eigentumsrechten (IP) an Pflanzensorten, eine Einrichtung des internationalen Rechts seit den 1960er Jahren, brachte einen großen Wandel des Status von Saatgut als Rohstoff mit sich, der erhebliche Konsequenzen für die Landwirtschaft, den Handel, und das Leben von Agrarproduzenten auf der ganzen Welt hat. Die Ausweitung des Schutzes von geistigem Eigentum an Saatgut hat ein anderes, viel älteres Managementsystem – das Gemeinwirtschaftliche – ersetzt. Um zu verstehen, wie sich diese erhebliche Verschiebung vollzogen hat, muss geprüft werden, wie verschiedene Eigentumstheorien in ihrer Anwendung auf Saatgut genutzt und missbraucht wurden. Es zeigt sich, dass es sich keineswegs eine unvermeidliche Entwicklung handelt und dass die Anwendung des Privateigentums auf Saatgut eine bemerkenswerte Dehnung jener Grundsätze erforderte, auf welchen das Privateigentum als Institution ruht. Diese Arbeit analysiert die Entwicklung des Schutzes geistigen Eigentums an Saatgut im 20. Jahrhunderts aus der Perspektive der Eigentumstheorie und tritt für ein ausgewogeneres Bild von Saatguteigentum zwischen zwei konkurrierenden Systemen – dem gemeinwirtschaftlichen und dem privatwirtschaftlichen – ein, die einander im Laufe des Jahrhunderts geformt haben. Das abschließende Kapitel untersucht jene Strategien, welche zur Überwindung der Spannungen zwischen privatem und gemeinschaftlichem Eigentum vorgeschlagen worden sind. Dies inkludiert Strategien des Eigentumsvorbehalts, die Respektierung nationalstaatlicher Souveränität und Open Source Biotechnologie. Jede einzelne dieser Strategien repräsentiert einen Versuch, die negativen Auswirkungen des Privateigentums an Saatgut zu beseitigen, indem die Institution des Eigentums in neuer Art aufgegriffen wird.

Table of Contents

Abbreviations

ABS – Access and Benefit Sharing

AIPPI – International Association for the Protection of Intellectual Property

ASSINSEL – International Association of Plant Breeders

BiOS – Biological Open Source

CBD – Convention on Biological Diversity

CGIAR – Consultative Group on International Agricultural Research

CIMMYT – International Wheat and Maize Research Institute

FAO – Food and Agriculture Organisation

GATT – General Agreement on Tariffs and Trade

HYV – High Yielding Variety

IARCs – International Agricultural Research Centres

IBPGR – International Board of Plant Genetic Resources

INBio – National Biodiversity Institute, Costa Rica

IP(Rs) – Intellectual Property (Rights)

IUPGR – International Undertaking on Plant Genetic Resources

ITPGRFA – International Treaty on Plant Genetic Resources for Food and Agriculture

PBRs – Plant Breeders' Rights

PGR – Plant Genetic Resources

PGRFA – Plant Genetic Resources for Food and Agriculture

PVP – Plant Variety Protection

PVPA – Plant Variety Protection Act

TRIPS – Trade Related Aspects of Intellectual Property Rights

UPOV – Union Internationale pour la Protection des Obtentions Végétales

WIPO – World Intellectual Property Organisation

WTO – World Trade Organisation

1.1 Introduction

For millennia, farmers have traded, selected and conditioned the seeds they use, selecting plants with desirable traits for replanting, and in doing so have fashioned the one hundred and fifty plant species from which we draw our sustenance.[1] Plant breeding, the "deliberate identification and selection by a human agent of specific qualities or traits in an organism,"[2] has a history as long as agriculture itself. So-called traditional methods of plant breeding, which emerged at different times in different parts of the world, are the means through which the world's most important crops were domesticated.[3] Traditional plant breeding is, however, constrained by the rules of nature. For most of agrarian history farmers, as breeders, could only work within the confines of sexual compatibility of plant varieties, and could not predict with any certainty the outcomes of their selection. Since the late 19th century, a number of scientific techniques have broken down these barriers, providing breeders with a new, more precise set of tools for engineering seeds. As the sophistication of biotechnology, or techniques that use living organisms to modify products, plants or animals,[4] has grown, so too has the ability of plant breeders to target and enhance specific traits in seeds, and thereby dramatically improve their yields.

Scientific developments in seed breeding have, since the mid 20th century, been consolidated and protected by laws of intellectual property. The extension of IPR to varieties of plants recognises the effort and scientific endeavour that goes into developing a new variety of plant and the entitlement of breeders to receive benefit from their labours. Just as advances in the science of plant breeding have been concentrated in certain areas, so too have intellectual property laws developed unevenly, with more stringent regulation in those areas of higher research concentration – typically agriculturally dominant industrialised nations of the global North. Most industrialised countries now extend some form of legal protection to scientific breeders, whether it is plant breeders' rights or patent protection. The result of uneven protections is that an extremely lucrative variety of seed in one part of the world

1 H. Garrison Wilkes, "Plant Genetic Resources over Ten Thousand Years: From a Handful of Seed to the Crop-Specific Mega-Genebanks" in *Seeds and Sovereignty: The Use and Control of Plant Genetic Resources,* ed. Jack Kloppenburg (Durham, North Carolina: Duke University Press, 1988), 26.

2 Denis J. Murphy, *People, Plants and Genes: The Story of Crops and Humanity.* (Oxford: Oxford University Press, 2007), 234.

3 Murphy, *People, Plants and Genes,* 56.

4 Graham Dutfield, *Intellectual Property Rights and the Life Science Industries: A Twentieth Century History.* (Burlington: Ashgate Publishing, 2003), 135.

may be unable to be capitalised upon in another. A push to harmonise intellectual property regimes in the last two decades, specifically through the 1994 Trade Related Impacts of Intellectual Property Rights (TRIPS) Agreement, is an indication of the expansion of the privatisation of the seed.

The extension of private property protections to seeds, to their composite genes and to the processes of manipulating their traits is a marked shift in their ownership and management, with significant consequences for the seed and for the billions of people who depend on it. It is a considerable distortion of many of the principles that underpin private property theory and intellectual property regulation. Not only has it converted a resource that throughout history was shared and swapped without remuneration into a commodity, it has channelled the profits deriving from this commodification to an extremely narrow base of beneficiaries. Disputes have occurred regarding the unbalanced way in which the benefits of genetic advancements have been distributed, and the appropriateness of applying private rights to such an important resource has been questioned.

Most of these conflicts centre around the meaning and application of the concept of ownership. The absence of a clear definition of what it means to own genetic resources, the sudden emergence of property protections which appear counter to the nature of the seed, and a lack of congruity between legal regulations of various countries create significant conflicts of entitlement between corporate actors, states, non-government organisations and farmers. The conflicts of entitlement have escalated, and become truly global since the so-called "seed wars" at the UN's Food and Agriculture Organisation in the 1980s. The debates are intensified due to the nature of the distribution of the world's genetic resources. Battlelines of the conflict over plant genetic resources are often framed as the clash between the "gene-rich, grain-poor" nations of the South, and the "gene-poor, grain-rich" so-called breadbasket economies of the North.[5]

The conflict over seeds is less a geopolitical struggle between North and South, and more of a struggle divergent views about the optimal way to manage the resource. When debates occur over the ownership of seed, they concern not only *who* should be the owners of seeds, but *how* they should own

[5] Pat Roy Mooney, "The Law of the Seed", *Development Dialogue* 1-2 (1983): 11.

them. The absence of a clear system of rules prior to private property in seeds has perpetuated the belief that private propertisation appeared in a vacuum, seizing upon a resource that was unprofitable and disorganised. This is a view that overlooks the centuries of agricultural history in which communities of farmers effectively managed their resources communally. The concept of common property as an effective system of management has been largely discounted by critics who associate it with ineffectiveness and overexploitation of resources.[6]

Far from being an ineffective system of management, the commons need to be reframed as a viable alternative to private capitalist property paradigms based on individual rights of entitlement. The property environment in seeds can best be seen as two systems - one common and one private - that have mutually shaped each other through resistance and cooperation over the course of the 20th century. As a renewable, self-regenerating and replicable resource, the seed is a favourable commodity for management in common. Management in common was, for centuries, the dominant way in which seeds were held. For a large number of farmers, who either by choice or by circumstance, are excluded from the market of propertised seed, common property management of seeds is still a reality.

The recognition of the existence of common property management in seeds has suffered from confusion of terminology. The term commons is used to refer to both contained management systems characterised by communal entitlement to resources and a more global pool of resources which are managed by humankind jointly to ensure their preservation. Perversely, the common heritage principle espoused by the 1983 *International Undertaking on Plant Genetic Resources* (IUPGR) was used to reinforce the private property system by allowing the removal of genetic resources from gene-rich areas without compensation. Despite these definitional limitations, the recognition of common management as a viable and competing system of ownership is an important step towards addressing the unbalanced picture of seed ownership.

The private property system of IPRs in seeds has become so entrenched, its products so widely used and its principles so resolutely affirmed in international law that a return solely to common

6 Garrett Hardin,"The Tragedy of the Commons," *Science* 162 (1968).

management seems untenable. There are three distinct strategies that have been pursued to redress the imbalances between private and common property management in seeds. The first is a rights-reservation strategy, which aims to carve out pockets of rights, or compensation, for farmers within the private property system. The lobbying for farmers' rights is one such strategy. The second is a deference to state sovereignty over natural resources, a principle affirmed in the *Convention on Biological Diversity* (CBD). By placing control of resources in state hands, it is hoped that more equitable arrangements for resource transfer can be achieved. The third is an attempt to drastically resculpture the property landscape, responses such as open source biotechnology. None of these strategies has wholly succeeded in resolving the tensions between common and private ownership.

Recontextualising the expansion of private property rights over seeds and reframing the commons as a viable system of resource management illustrate that the expansion of private property is not simply a displacement of owners, but a displacement of ownership. Solutions that focus on the first half of this issue and ignore the second cannot hope to redress the inequalities that have emerged. Rights reservation strategies can provide some relief to farmers, but a solution that provides compensation or reservation can never be a long term, satisfying solution for producers whose livelihoods have been undermined. Only open source biotechnology has provided a systemic solution, a new form of property that relies on the same open and accommodating culture upon which common property is based, while still encouraging the innovation in seeds upon which our burgeoning population has become dependent.

1.2 Approach

The approach of this thesis is to evaluate the seed from the perspective of the institution of property. It seeks to explain how a resource that was managed for millennia in common has become a subject of private property protections, and how those protections have radically altered the resource itself, creating complex institutional structures around it. The first step is to examine the theory of property, ad how property theory, has, until recent times, put undue emphasis on the institution of private property. Using recent environmental scholarship that repositions the commons as a viable

system of resource management, the paper argues that the commons in seeds have been and are a functioning and efficient system. The third chapter then applies theories of property to the contemporary and historical environment of seeds, explaining how the tenets of common property ownership have been distorted so as to *support* the private property system rather than undermine it. At the end of the 20th century, private property has come to dominate the property landscape in seed, a development which threatens the situation of farmers, particularly in the developing world, to remain autonomous producers. In the final chapter, three solutions that have been proposed to overcome the negative impacts of private property controls will be evaluated. It will be argued that only open source biotechnology creates a solution which engages with the property dimensions of the problem, but as the most comprehensive solution, it is also the most difficult to achieve. A more balanced approach to the history and current situation of seed ownership illustrates the fact that there are large sections of the world that the private property regime has failed to reach, and that private property in seeds is unstable, illogical, and requires constant fortification. It is hoped that through such analysis a more balanced image of seed ownership and management can be created, one that does not see private propertisation as inevitable.

2. History and Context of Seed Ownership and Management

2.1 Concepts

For the purpose of this study, the seed refers to cereal crops of importance to human nutrition, the so-called plant genetic resources for food and agriculture (PGRFA). It does not refer to the seeds of ornamental plants or non-edible crops. Though the rose is the world's most patented plant, rights of ownership over it do not affect the livelihood of producers in the developing world, nor food security. As Halewood and Nnadozie note,

> PGRFA differ from other plant genetic resources … because human intervention has played a critical role in the domestication of crops and in the human, gene and environmental interactions that have led, over thousands of years, to the genetic diversity within and across species.[7]

[7] Michael Halewood and Kent Nnadozie, "Giving Priority to the Commons: The International Treaty on Plant Genetic Resources for Food and Agriculture" in *The Future Control of Food: A Guide to International Negotiations and Rules of Intellectual Property, Biodiversity and Food Security,* ed. Geoff Tansey and Tamsin Rajotte (London: Earthscan, 2008), 117-8.

This study examines the impact of proprietary rights over genetically enhanced varieties of seeds, but any examination of the merits or dangers of genetically modified organisms (GMOs) is beyond the scope of this paper.

There is no identifiable transnational group of individuals who can be uniformly identified as 'farmers' and many international documents refrain from defining the group specifically. New methods of food production and new regulations transform the roles of actors within the global food system, as Borowiak notes, "farmers have been reconfigured as consumers, competitors, and potential biopirates of new commercial seed technologies."[8] When this study refers to the possibility for 'farmers' to retain sovereignty over their seeds, it refers primarily to small-holder producers involved in the production of staple crops. Agricultural production has been dramatically altered in leading agricultural producers such as the United States, Canada, Australia and states of Western Europe. These countries are the biggest consumers of propertised seed and agrochemical tie-in products. Farmers of the developing world, whose production methods still stand to be transformed by the spread of propertised seed, are therefore more of a focus of this paper. Clearly, while there are some agricultural producers who have made enormous gains in the restructuring of benefit from the changes in agricultural production to mechanised, large-scale operations, there are many more who stand to lose.

It is often said that the conflict over ownership is one of North versus South. The terms global North and global South, though imperfect descriptors, are the ones relied upon in this paper to describe the international socio-political divide in the debate over plant genetic resources. These terms are relied upon extensively in seed sovereignty debates, and though reference to North and South may oversimplify genetic resource ownership it helps to lay the foundations for the debate. In contrast to agricultural nations of the global North, nations of the South have little opportunity to control international agricultural trade, have lower standards of IP protection, lower GDPs, and have a reliance on crops that are lower on the research agendas of corporate plant biotechnology actors.[9] Given that

[8] Craig Borowiak, "Farmers' Rights: Intellectual Property Regimes and the Struggle over Seeds", *Politics and Society* 32 (2004): 522.

[9] W. Falcon and Cary Fowler, "Carving up the Commons – Emergence of a New International Regime for Germplasm Development and Transfer", *Food Policy* 27 (2002): 206.

there are as many horizontal germplasm transfers as vertical, this paper emphasises differences in views of resource management over the geographic location of disputing parties.

2.2 The Seed

The seed can be viewed and valued in a number of different ways. It is, on one hand, a part of nature, a part of man's common heritage, a means to ensure food security, a vital part of life. On the other hand it is an extremely valuable commodity, the centre of an enormous and profitable industry, a means of creating and perpetuating economic dependencies, a tool of leverage in international negotiation, and somewhat perversely, something that can be gifted to those in need. In the struggle of sovereignty over the seed, these qualities often conflict. The seed is one of the most regulated commodities in the world.[10] It is subject to both international and national regulation in the form of intellectual property, of biosafety rules and of certification. It has attracted the attention of international organisations that traditionally have little to do with biological materials, including the WTO and the OECD. Sorting through this regulatory web is a challenge for corporate actors, for public breeders and for farmers alike.

As Mooney notes, as an industrial object, the seed is both the means of production and the product, making it a unique commodity.[11] In order for the seed to be owned, it needs to be removed from its natural state, and imbued with characteristics of value beyond what can be generated naturally. To create a product with market value, its ability to replicate needs to be suppressed, and its ability to yield enhanced. The seeds of the Green Revolution, and later of the biotechnology revolution, have these qualities, and are fundamentally different from the landraces upon which they have been built. They are designed for large scale production and encourage the pursuit of commercially intensive farming and uniformity.[12] As Shiva argues, this type of seed is new because it possesses neither the ability to produce itself nor reproduce itself.[13] It is perfectly able to be bought, sold, owned and traded,

---

[10] Bernard Le Buanec and Patrick Heffer, "The Role of International Seed Associations in International Policy Development", *Journal of New Seeds* 4, no.1 (2002): 78.

[11] Mooney, *Law of the Seed,* 16.

[12] Marc Lappe and Britt Bailey, *Against the Grain: The Genetic Transformation of Global Agriculture.* (London: Earthscan, 1999), 98-99.

[13] Vandana Shiva, *Monocultures of the Mind: Perspectives on Biodiversity and Biotechnology.* (London: Zed Books, 1993), 145.

as any other commodity, and not as a removable, replicable, self-generating part of nature.

The commoditised seed is one that is tailored to generate profit, and is therefore produced according to a different set of priorities. In traditional breeding, variance was a desirable trait in plant species. Genetic diversity formed a sort of insurance for farmers that at least some of their crop would come to maturity.[14] In scientific breeding, and in the commoditised seed, uniformity and yield are the desirable traits. Other traits are less significant, and as a result are often eliminated. This type of seed is the product of a certain type of knowledge, research conducted by individuals inside the confines of a scientific profession. Any development that occurs outside of these confines, within communities, on a collective basis, is not valued, and thus not rewarded, in the same way.

In the 20th Century, mechanisation, large scale farming and chemical inputs altered the face of agricultural practice in many parts of the world, perhaps irrevocably. The seed is the centre of this transformation. According to Kenney, "the seed will become the proprietary nexus for plant genetic engineering. The seed is a vehicle for conveying the fruits of molecular biological research to the farmer and thereby realising a profit on the incorporated research."[15] In the middle of a system based on chemical inputs, artificial fertilisers, mechanised production and the elevation of capital over labour is the new seed that is tailored to a specific method of production. Key to addressing the issues of food sovereignty, food production and sustainability is a critical and balanced approach to ownership of the seed, which recognises that is it both shaped by and influential upon a transformed system of agricultural production.

2.3 History of Seed Ownership

Throughout the history of agriculture, humankind has had a specific relationship with the crops harvested, learning the correct environments for particular seeds and tailoring their attributes to production needs through selection. Agricultural improvement was a relatively slow process, in most areas of the world characterised by small-scale, extensive rather than intensive farming.[16] Agricultural

[14] Jack Kloppenburg and Daniel Kleinman, "Seeds of Struggle: Genetic Resources and Geopolitics", *Technology Review* 90 (February/March 1987): 48.
[15] Kenney quoted in Dutfield, *Intellectual Property Laws*, 149.
[16] Murphy, *People, Plants and Genes*, 94.

crops have become as much dependent on this process of selection and harvesting for survival as humans. As crops have developed, this interdependence has grown; now a modern corn variety cannot dispense its seed without the help of a human agent.[17]

One of the striking features of world agriculture is the extreme crop interdependence that characterises the entire globe. No one area of the world secures its population's sustenance from purely local crops. The 'discovery' of the Americas and the Columbian Exchange were the first major steps in creating this interdependence, and were instrumental in the transfers of plant genetic materials across and between continents. The world's most important crops moved from continent to continent, slowly but dramatically improving the ability of states to produce food for growing populations. The 16th century saw the rise of imperial-based plant collection, as well as the birth of a more scientific approach to agriculture. Expeditions in search of exotic crops created a flow of plant resources between New and Old Worlds, and became linked to colonial enterprise. As Mooney writes - "like living pawns in the imperial chess game, coffee, tea, cocoa, rubber, bananas, sugarcane, cotton and spices were shifted back and forth over the surfaces of the globe."[18]

The botanic garden was an important institution facilitating the transfer of genetic materials. The first collections were established by the Dutch through the Dutch East India Company in the 1600s. The British, emulating the efforts of the Dutch, set up the Kew Botanical Gardens in 1759, which became the base for collecting and dispersing crops to and from the colonies.[19] These gardens were strategically important for the structures of international agriculture they created. As Juma notes "[a] single coffee tree which reached the Amsterdam Botanical Gardens in 1706 was later the basis for most of the coffee grown in South America."[20] Ethical opposition to the practice of collecting and dispersing plant samples took longer to develop. According to Brockway, at the time, these collections were generally thought to be in the interest of humanity, and no concept of loss to the country of

---

17 Jack Doyle, *Altered Harvest: Agriculture, Genetics, and the Fate of the World's Food Supply.* (New York: Viking, 1985), 177.

18 Mooney, *Law of the Seed,* 85.

19 Lucile Brockway, *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens.* (New Haven, Connecticut: Yale University Press), 2002.

20 Calestous Juma, *The Gene Hunters: Biotechnology and the Scramble for Seeds.* (London: Zed Books, 1989), 43.

origin was seriously considered.[21]

Plant resources from the gardens provided the foundation for plant variety research in Europe. Several countries developed strong public sector breeding programs, normally supported by university research. Colonial powers devoted research to developing their own crops as well as tropical agriculture to contribute to their colonies.[22] Private breeding was a prominent part of colonial strategy and remains a strong pursuit in many Western European nations including France, Germany and Sweden.

In the United States, patterns of agricultural development and plant breeding were less well-established than in Europe, and the push for agricultural innovation was correspondingly stronger.[23] In the early 1800s, US administrators were also establishing missions to collect new genetic materials. In 1819 requests were sent from the Department of the Treasury to the navy, requesting that seeds be collected on missions abroad.[24] These collection expeditions, coupled with an open breeding strategy of the government led to the proliferation of new varieties across the continent. The strategy included the distribution of seed packages from government to farmers - in 1897 alone the US government distributed 1.1 billion seed packets for planting.[25]

The rediscovery of the work of Gregor Mendel was a major breakthrough in scientific breeding, and provided the basis for the selection of traits based on genetics. Mendel's first law was originally published in 1866 but was only rediscovered at the turn of the century. Mendel described patterns of dominant and recessive genes in peas, principles which generated a clear vision for breeders as to how to improve crops. Mendel's laws allowed breeders to develop varieties that bred true to their parents, thus securing their traits in resulting plants.[26] Before this, any experimentation with scientific plant breeding had failed to guarantee the replication of traits that would allow breeders certainty of results.

---

21 Brockway, *Science and Colonial Expansion,* 35.

22 Graeme Dutfield, "Turning Plant Varieties into Intellectual Property" in *The Future Control of Food,* ed. Tansey and Rajotte, 31.

23 Dutfield in *The Future Control of Food,* ed. Tansey and Rajotte, 29.

24 Robert Evenson, "The Scientific Origins of the Green and Gene Revolutions" in *Intellectual Property, Growth and Trade (Frontiers of Economics and Globalization),* ed. Keith Maskus, (Oxford: Elsevier Science Publishing Company, 2008), 470.

25 Jack Kloppenburg, *First the Seed: The Political Economy of Plant Biotechnology 1492-2000.* (Cambridge: Cambridge University Press, 1990), 65.

26 Dutfield in *The Future Control of Food,* ed. Tansey and Rajotte, 29.

By the turn of the 20th century in the United States, through the application of Mendel's laws, breeders were beginning to have successes with corn. Hybridisation, a method of crossing two parent plants to reproduce the traits of both within the progeny, was creating an increase in yields. By 1920, Edward East and George Shull had developed a method called heterosis, by which a corn plant is first inbred and then crossed.[27] The use of this method, according to Kloppenburg, was "the first time in history that a seedsman was enabled to gain the full benefit from a desirable origination of his own."[28] The product of the cross, while producing elevated yields over open-pollinated varieties, could not breed true and lost the quality of increased yield within one generation. A farmer who wished to use hybrid seed had therefore to return to the market every season to purchase it. This discovery was the first in a long line of innovations that increasingly disconnected farmers from their input, creating a market for a product that farmers could not create themselves.[29] This development laid the foundations for the establishment of an industry for seed.

In the mid 1930s, the impacts of these new breeding methods were visible through dramatically improved corn yields and an ever growing private industry presence in the trading of seed. Companies began to take notice, most notably Pioneer Hi-Bred and DeKalb Agricultural Association, who became involved in the development of corn in the mid 1920s.[30] At first, private breeding and public breeding initiatives coexisted peacefully, but soon private breeders recognised that this public distribution culture was at odds with their view of the "seed as a commodity form",[31] and put pressure on the public sector to retract. In 1890, 56 seed companies in the United States formed the American Seed Trade Association, which instigated an assault on public breeding. Though their attempts were initially unsuccessful, after the First World War farmer participation in public breeding was suspended.[32] Successes in corn breeding had created an institutional place for research in other crops, which fostered research into other staple crops in the 1940s and 50s.

---

27 Evenson in *Intellectual Property, Growth and Trade,* ed. Maskus, 475.
28 Kloppenburg, *First the Seed*, 99.
29 Kloppenburg, *First the Seed,* 11.
30 Evenson in *Intellectual Property, Growth and Trade,* ed. Maskus, 475.
31 Kloppenburg, *First the Seed,* 63.
32 Dutfield in *The Future Control of Food,* ed. Tansey and Rajotte, 30.

The landscape of US agriculture was significantly revolutionised by these changes. According to Juma, by the 1940s it was already exhibiting monoculturalism.[33] Monoculturalism refers to uniformity in two forms - the genetic uniformity within a crop, and the reliance on a smaller base of crops on rotation. Throughout the 1940s and 1950s the scientific plant breeding endeavours of the United States were significantly internationalised. Through research initiatives led by the Rockefeller Foundation and the Ford Foundation, the United States sponsored the establishment of research institutes on cereal crops in Mexico, the Philippines and India. An agreement between the Rockefeller Foundation and the Mexican Government in 1943 led to the establishment of a joint research enterprise in wheat. Nobel Peace Prize recipient Norman Borlaug working in Mexico in 1944 developed semi-dwarf, high yielding varieties of wheat. Semi-dwarf varieties have smaller stems, and can thus support a larger number of seeds. The promise of higher yields, and thereby increased food security, fostered an international demand for the so-called high yielding varieties (HYVs), and they quickly spread to a number of nations in the South.

The spread of these high yielding seeds to many parts of the world is known as the Green Revolution. The Green Revolution saw the introduction of a package of inputs including new seeds, new irrigation systems and chemical fertilisers, the combination of which saw yields increase dramatically. The spread of dwarf varieties of wheat and rice was coordinated by two international centres – the International Maize and Wheat Improvement Centre (CIMMYT) and the International Rice Research Institute (IRRI) in 1965. Pearse records that by 1972-3 there were 16.8 million hectares of HYV wheat and 15.7 million hectares of HYV rice planted, of which over 90% was in Asia.[34] In the 1967 to 1992 period, world rice production doubled. In Indonesia, it tripled.[35] India's wheat yields rose by one-third after the introduction of the package,[36] which allowed the declaration of grain self-sufficiency in 1977.[37]

---

33 Juma, *The Gene Hunters,* 103.

34 Statistics exclude centrally planned economies, Mexico and Taiwan. Andrew Pearse, *Seeds of Plenty, Seeds of Want: Social and Economic Implications of the Green Revolution.* (Oxford: Clarendon Press, 1980), 38.

35 David Murray, *Seeds of Concern: The Genetic Manipulation of Plants.* (Wallingford: CABI Publishing, 2003), 120.

36 Peter Pringle, *Food, Inc: Mendel to Monsanto – The Promises and Perils of the Biotech Harvest.* (New York: Simon and Schuster, 2003), 50.

37 Doyle, *Altered Harvest,* 255.

The influence of these crops has lingered - CIMMYT maize is grown on 30 million acres across the world[38]– but the miracle of the Green Revolution was shortlived. Just four years after declaring grain self sufficiency, India imported $260 million US worth of wheat for its reserves.[39] The combination of chemical inputs and intensive farming damaged the soils and displaced many smallholder farmers. Critics of the revolution attack its social effects, its effects on biodiversity, the reliance on chemicals, and the losses in yields over the longer term.[40] Yields were not raised through miracle seeds, but through the use of complementary inputs and the promotion of monocultures at the expense of native cropping systems based on the rotation of a number of crops. Some critics are extremely vocal against the Green Revolution as a means of extending and consolidating power over the developing world. As Kloppenburg writes, "Western science not only made the seed the catalyst for the dissolution and transformation of precapitalist agrarian social formations, it also staffed an institutional network that has served as a conduit for the extraction of plant germplasm from the Third World."[41] The result was a transformation of agricultural practice for large sections of the world, and the increasing reliance on an ever dwindling number of genetically uniform varieties of essential crops.

Though technology was creating the space for a new private seed industry, the legal framework surrounding it was slow to develop. In a sense, the biological characteristics of hybrid corn provided intellectual property protection themselves through their non-replicability. Other plants, however, which did breed true required the external protection of the law. In the United States, the *Plant Patent Act,* enacted in 1930, granted the right to seek patents on varieties of asexually propagated plants. It was, however, too narrow in focus to provide significant protection for plant breeders over the varieties they developed. It was not until 1970, with the passing of the *Plant Variety Protection Act (PVPA),* that a workable domestic legal framework for rights for plant breeders in the United States was put in place. The Act created the right for breeders to receive eighteen-year protection certificates over new seed plants. It was enacted against the opposition from the Department of Agriculture, and soon began to

38 Pat Roy Mooney, *Seeds of the Earth – A Public or Private Resource?* (Ottawa, Canada: Inter Pares, 1979), 40.
39 Doyle, *Altered Harvest,* 255.
40 Mooney, *Seeds of the Earth,* 41.
41 Kloppenburg, *First the Seed,* 15.

transform the legal and institutional landscape of United States agriculture.[42] According to Juma, the effect of the legislation was the gradual erosion of the seed industry as a distinct entity, as seed companies were acquired by larger chemical firms, and the industry became part of larger corporate investment strategies.[43]

The PVPA was foreshadowed by international regulation on plant variety protection, the UPOV Convention, created in 1961 and entering into force in 1968. UPOV, the Union Internationale pour la Protection des Obtentions Végétales, (International Union for the Protection of New Varieties of Plants), is an international organisation created to coordinate national plant patenting laws. At a meeting in November 1961 members, predominantly European states, developed the Convention, which created plant variety protection in the form of plant breeders' rights. Rights are granted to varieties provided that they are novel, distinct and stable. The Convention included provisions to harmonise the intellectual property regulations over plants in its signatory nations, and gave detailed direction on the protections to be afforded new plant varieties. The Convention was amended in 1978 and 1991, the 1991 amendments extending the length of protection from 15 to 20 years.

Ownership of plant genetic resources is intrinsically linked to the debates about patenting life in general. The debates began with the United States Supreme Court case *Diamond v. Chakrabarty,* in which it was ruled that a protein engineered to clean oil spills was capable of being patented. The court held that "the patentee has produced a new bacterium with markedly different characteristics from any found in nature and one having the potential for significant utility."[44] This opened the door for the patenting of life, a possibility that had never been entertained by case law before. Patents provided a higher level of protection than PBR, and were thus a highly sought after type of protection. The case led to a wave of patent applications over plant varieties, seeds and DNA sequences. In the 1980s, concern was raised about the concentration of patent ownership in a small number of corporate hands, as companies consolidated their hold on resources through mergers and acquisitions. Mooney refers to

42 Mooney, *Law of the Seed,* 138.
43 Juma, *The Gene Hunters*, 82.
44 *Diamond v. Chakrabarty*, 447 U.S. 303 (1980).

these corporate actors as the "new seedsmen",[45] who make business through the consolidation of agricultural and chemical interests. These companies are accused of creating seed chemical packages, that is, tying seed directly to chemical inputs, and deriving profit from both.

Since the Green Revolution, advances in biotechnology have abounded. The potential of biotechnology to dramatically alter the performance of the seed has led many to herald a gene revolution, and to entrust to biotechnology the task of redressing the failings of the Green Revolution. In 1973, two researchers in the United States discovered the technology to split DNA, insert a foreign gene and recombine the DNA to incorporate the new gene. This discovery greatly enhanced the possibilities of biotechnology to harness the plant genome and alter the genetic makeup of crops. Biotechnology can be applied to the seed in several ways. It can introduce a foreign gene into a genome, it can control the manifestation of a specific trait and it can improve the transmission of a particular trait. Specific applications include enhancing the herbicide tolerance of crops, increasing virus resistance and lengthening shelf-life of perishable crops.[46] Biotechnologies are extremely important as they allow scientists to target the most desirable traits in crops, and thereby produce seeds with higher yields and resistance to certain pests.

Advances in biotechnology have highlighted the need to conserve the world's plant genetic resources, the raw materials from which scientists build their new varieties. In the 1970s the international network of research centres such as the CIMMYT and the IRRI was consolidated under the guidance of the Consultative Group on International Agricultural Research (CGIAR). These International Agricultural Research Centres (IARCs) are responsible for housing vast stores of the world's germplasm resources. Despite their work, much of the global germplasm has already been lost, particularly wild races. Some critics are wary of both the practices and the mandates of these centres. "The Third World...", writes Mooney, "is being invited to put all of its eggs in someone else's basket."[47] Despite their status as public institutions, there is concern about loss of control and sovereignty over

---

45 Mooney, *Seeds of the Earth,* 55.

46 Gyorgy Scrinis, *Colonizing the Seed: Genetic Engineering and Techno-Industrial Agriculture.* (Melbourne: Friends of the Earth, 1995), 16.

47 Mooney, *Seeds of the Earth,* 30.

resources, particularly from weak nation-states of the South.

Increasing concern about the management of the world's plant genetic resources led to the creation of the International Board of Plant Genetic Resources (IBPGR). The new organisation did nothing to dissipate concerns that the resources were being controlled by a small number of countries. The 1984 budget of the organisation was provided almost entirely by six nations, and the Board is not subject to any control by the United Nations.[48] In 1977, 65.8% of the budget went towards the resources of industrialised nations, and the share that went to the United States far exceeded its contribution.[49]

Two other international agreements shaped the late 20th century legal landscape in seeds - the 1992 *Convention on Biological Diversity* (CBD) and the 1994 *Trade Related Aspects of Intellectual Property Rights* (TRIPS) Agreement. The Convention on Biological Diversity affirms national sovereignty over genetic resources. The Article 3 of the CBD states that "the authority to determine access to genetic resources rests with the national government and is subject to national legislation."[50] This, in theory, gives nations significant scope to restrict the flow of genetic resources across borders. The provision illustrates the inherent conflict in the protection of plant genetic resources – that there are both humanitarian and commercial reasons to conserve biological diversity.[51]

TRIPS is a key multilateral agreement which promotes standardisation of intellectual property regimes. The TRIPS Agreement explicitly links, for the first time, the international trading system and intellectual property. Article 27.3 (b) is the relevant provision for plant genetic materials, stating that "contracting parties shall provide for the protection of plant varieties by patents and/or by an effective '*sui generis* system'."[52] This means that although a patent system is not mandatory on plant varieties, some form of IP system is. Micro-organisms, non-biological processes and microbiological processes must be protected under IP law. Many developing countries, including India and Brazil, opposed the

48 Mooney, *Law of the Seed,* 25.
49 Mooney, *Seeds of the Earth*, 23.
50 Convention on Biological Diversity (1992) Article 3: Principle. www.biodiv.org/doc/legal/cbd-un-en.pdf
51 Jack Kloppenburg and Daniel Lee Kleinman, "Plant Genetic Resources: The Common Bowl" in *Seeds and Sovereignty,* ed. Kloppenburg, 9.
52 Trade Related Aspects of Intellectual Property Rights (TRIPS) (1994) Article 27. 3(b) http://www.wto.org/english/docs_e/legal_e/27-trips_01_e.htm

regulations on intellectual property, arguing that IP was outside the mandate of the WTO.[53] What is meant by an effective *sui generis* system has been the centre of debate. Some countries have exploited the openness of the provision to create systems which make provision for the contribution of traditional communities to plant germplasm.

Over the past century, and particularly post World War II, the environment of seeds has been transformed, both legally and scientifically. Technological and scientific development have created a means through which to commodify the seed, and legal regulations have fortified the institutional space around it. The development of the seed as a commodity has occurred unevenly across the world, but increasing international standardisation has put pressure on developing nations to adopt the same legal protections for plant genetic resources. This development jeopardises other forms of ownership and management of the seed and puts pressure on agricultural producers to conform to restructured agricultural practice.

2.4 A Global Food System

The 20th century marks a considerable shift in the transformation of man's relationship with the environment and with agricultural practice. These changes include a shift towards mechanisation, the tendency towards large-scale farming, and a vast reduction in the numbers of people engaged in agriculture. Over the course of the 20th century, capital inputs from the non-agricultural sector, including machinery and chemicals, have come to substitute labour inputs, and have created enormous increases in crop yields.[54] According to the authors of *Whose Common Future?,* "'[a]griculture', in effect, has been redefined to mean 'economically competitive food production'."[55] Transformed agricultural practice has contributed to the foundation of a comprehensive industrial food system upon which much of the world depends.[56]

This transformation is particularly evident in the agricultural sectors of the developed world,

---

53 Pedro Roffe, "Bringing Minimum Global Intellectual Property Standards into Agriculture: The Agreement on Trade-Related Aspects of Intellectual Property Rights" in *The Future Control of Food*, ed. Tansey and Rajotte, 50.

54 Kloppenburg, *First the Seed,* 37.

55 The Ecologist, *Whose Common Future? Reclaiming the Commons.* (London: Earthscan, 1993), 52.

56 Helen Norbert- Hodge, Peter Goering and John Hodge. "From Global to Local: Sowing the Seeds of Community" in Gregory Pence, ed. *The Ethics of Food.* (Oxford: Rowman and Littlefield, 2002), 193.

where, Pringle states, yields of wheat, corn and rice doubled in the second half of the 20th century, and the number of tractors rose from seven to twenty-eight million.[57] Emphasis on staple crops with improved yields has led to a decrease in both research in and production of other crops and a tendency towards monoculturalism. Today, three-quarters of our diet is made up of just eight crops.[58] Doyle describes this as a type of "house-of-cards agriculture",[59] with a foundation that, through genetic uniformity in crops, becomes ever narrower.

The last one hundred years have seen a transformation in the way that food is produced and consumed around the world. They have catalysed the creation of a new institutional structure for food policy that is built around international organisations such as the FAO, the WTO and the UN Environment Program (UNEP).[60] The globalisation of food production has brought new regulatory challenges and increasingly disconnected consumers from the foods they consume. Critics have warned about the unsustainability of our current mode of food production. The reliance on non-renewable inputs such a fuels, the instability of climates and the existence of "complex, but inherently fragile, scientifically informed global information networks"[61] that bind this system together are all cause for concern about the continued ability to generate enough food to support the world's growing population without causing irreparable damage to the environment.

In the middle of this concern stands the seed, a resource vital for agricultural development but increasingly tangled in webs of ownership and entitlement that jeopardise the ability of farmers to produce it and innovators to share their advancements. A better understanding of the justifications for the property dimensions of this problem can help to create a clearer picture for the future of seed management.

---

57 Peter Pringle, *Food Inc.*, 14-15.
58 Mooney, *Law of the Seed,* 8.
59 Doyle, *Altered Harvest,* 17.
60 Geoff Tansey, "Food, Farming and Global Rules", in *The Future Control of Food,* ed. Tansey and Rajotte, 5.
61 Murphy, *People, Plants and Genes*, 281.

3. Theories of Property

3.1 Property Theory

The conflicts over the world's plant genetic resources, while they have political, cultural and social implications, are essentially proprietary questions. The root of the current situation, in which pressure is placed on the ability of farmers to control their inputs, and on the preservation of the world's genetic resources, is the existence of conflicting ideas about their management and ownership. Property theory explores the ways in which individuals or entities hold rights to objects and how those objects are constructed as valuable. It also examines the legal and institutional frameworks that provide protection for those who hold resources against potential competing claims to ownership.[62] Property theorists argue for a conception of property as a social institution which is created by the context of the society which it manages, and is a reflection of dominant powers' interests.[63]

Property theory has been dominated by a conceptual dichotomy between public and private property. This distinction delineates those resources that are subject to joint ownership and those subject to individual ownership. According to Wiber, public and private property within Western discourse are considered to exist in a binary, and are competing to displace each other.[64] In recent scholarship the concept of public property has been more closely examined. Management by the state, for example, is of a different character than management by a community in a commons. Generally, property is now divided into four main types – private, open access, common, and state regimes.[65] Private property refers to a system where ownership is concentrated in the hands of individuals, and the limits of that ownership are clearly defined. Common property is a system in which a specific and identifiable group have control over a resource.[66] State property regimes are those in which a central authority is the owner and manager of property, and open-access is a system in which the concept of

---

62 Franz von Benda-Beckmann, Keebet von Benda-Beckmann and Melanie Wiber, *Changing Properties of Property.* (New York: Berghahn Books, 2007), 6.

63 Christopher May, *A Global Political Economy of Intellectual Property Rights: The New Enclosures?* (London and New York: Routledge, 2009), 16.

64 Melanie Wiber, *The Voracious Appetites of Public versus Private Property: A View of Intellectual Property and Biodiversity from Legal Pluralism.* CAPRI Working Paper 40, IFRPI, 2.

65 Elinor Ostrom, "Private and Common Property Rights", in *Encyclopedia of Law and Economics, Vol. II: Civil Law and Economics* (Ghent, Belgium: University of Ghent, 2000), 335.

66 Ostrom, "Private and Common Property Rights", 335.

exclusion does not exist, and in which any contribution to a resource by a user is for the benefit of all.

3.2 Theory of Private Property

In the modern world, private property is a dominant form of resource organisation. Ownership in individual hands was a product of the 15th century enclosure movements in England. A series of government statutes over the 15th to the 19th century segregated land that was held in common and created private entitlement over it, leading to the displacement of the commoners and the creation of a class of landless labourers. Philosophers and legal theorists sought to explain and justify the phenomenon by which the commons, the primary land management system, were seized, demarcated and controlled by private landlords. One of the most popular theories espoused is the Labour Theory of Value from Locke's *Two Treatises of Government*, which states that when a person mixes their labour with an object, they remove it from its natural state and it becomes theirs. Locke states of man -

> the labour of his body and the work of his Hands, we may say, are properly his. Whatsoever then he removes out of the state of that Nature hath provided, and left it in, he hath mixed his Labour with and joyned to it something that is his own, and thereby makes it his Property.[67]

This theory is based on the assumptions that resources have no value, and in their natural state belong to no one. Justifications for private property under this theory are said to be instrumentalist – property law encourages human endeavour by providing reward for labour.

Hegel's *Philosophy of Right* is another popular justification for private property, in which ownership of property is the expression of an individual's freedom and personality. Appropriating property is done through an actualisation of will, through occupation or declaration. Other theories of property include moral entitlement theory, which states that individuals are entitled to property rights in things because they have a special relationship with the thing that they claim,[68] and utilitarian theory advocates private property as the most efficacious for society. According to May, the image of property shifted dramatically in the 17th Century. At this point, he says, "there was a move to conceive of property as something that could *only* be owned privately."[69] This contributes to contemporary view

---

67 John Locke, *Two Treatises of Government* [1689] (Cambridge: Cambridge University Press, 1960), 287-288.

68 Anthony Stenson and Tim Gray, "Cultural Communities and Intellectual Property in Plant Genetic Resources" in *Justice, Property and the Environment – Social and Legal Perspectives* ed. Tim Hayward and John O'Neill. (Aldershot/Vermont: Ashgate, 1997), 178.

69 May, *A Global Political Economy of Intellectual Property Rights*, 23.

that there is a single theory of property, one that does not accommodate the multiple ways in which resources can be held and managed.

Classical economics views private property as the optimal system of resource management.[70] Private property organisation and the market system are considered to be complimentary, a view predicated on the belief that the institution of private property is the best system for allocating scarce resources, as it attributes to an individual entity both the costs and benefits of the use of a resource.[71] Property is said to have evolved from a system in which group rights were standard, to one in which individual rights are privileged.[72] The theory of propertisation sees the spread of private property as an inevitable development. As Esther Kingston-Mann states, "[i]n discourses of privatisation we enter a world of myth and romance where courageous architects of private property rights confront starkly dichotomised choices between progress and backwardness."[73]

The concept of a right is intrinsic to private property. As Demsetz states, "[p]roperty rights are an instrument of society and derive their significance from the fact that they help a man form those expectations which he can reasonably hold in his dealings with others."[74] Rights in property are held and asserted against other individuals. Often, private property is referred to as a bundle of rights, a set of certain entitlements to it. According to Ostrom, this bundle is made up of any of five principal rights: the right to access the property; the right to retain units of it; the right to manage it; the right to exclude others from it; and rights to alienation, including rights to sell or lease it. In economic terms, Ostrom states that alienation is the most important right.[75]

2.3 Theory of Intellectual Property

Intellectual Property, as a facet of the private property, encompasses a number of legal protections over intangible creations of the mind. Intellectual property (IP) offers rights to own, use, sell and market an

---

70 Carol Rose, "The Comedy of the Commons: Commerce, Custom and Inherently Public Property", *University of Chicago Law Review* 53, 711 (1986): 110.

71 May, *A Global Political Economy of Intellectual Property Rights,* 18.

72 Benda-Beckmann *et.al.*, *Changing Properties of Property*, 6.

73 Esther Kingston-Mann, "The Romance of Privatisation and its Unheralded Challengers – Case Studies in England, Russian-Soviet and Post-Soviet History" in *Changing Properties of Property*, ed. Benda-Beckmann *et.al.*, 59.

74 Harold Demsetz, "Toward a Theory of Property Rights", *The American Economic Review* 57, no. 2, (May 1967), 347.

75 Ostrom, "Private and Common Property Rights", 339.

invention for a limited period of time. Types of IP protection include: patents, which protect inventions for a fixed period of time against appropriation, sale or use of third parties; copyright, which protects the expression of creative ideas; and trademarks, which protect designs, labels and logos relating to the product of a company.

As laws that govern non-physical objects, intellectual property rights require some level of abstraction, and the acceptance that ideas are allocable to one individual creator.[76] According to May, there is a clear divide between the function of IPR in theory and in practice. Knowledge objects, unlike physical property, are not vulnerable to scarcity. Vital to the operation of IP is therefore, he argues, the construction of knowledge as scarce.[77] It involves a conception of ideas as "separable and transferable knowledge objects"[78] rather than recognising that the construction of knowledge is often collaborative or incremental. There is an inherently political element to intellectual property, in that it determines the types of knowledge and creative expression which can be classified as property.[79]

Most justifications for intellectual property are utilitarian, they argue that the protection will encourage further innovation, and thus benefit society at large.[80] Innovators must be given some incentive to invent, and intellectual property laws guarantee them this incentive. Critics are wary of the tendency of these incentives to lead to monopoly, stifling innovation rather than encouraging it. Intellectual property rights can be used to push competitors from the market, reducing the number of innovators in a particular field. Further, many have criticised the link between high levels of IP protection and high levels of development. Lee Branstetter, in examining the impact of increased IP protections in developing countries, found no significant relationship between a higher level of intellectual property protection and local innovation.[81] James Boyle, in his article "The Second Enclosure Movement", argues that the rise of intellectual property protections is another form of

---

76 Carol Rose, "Possession as the Origin of Property" in *Property and Persuasion: Essays on the History, Theory, and Rhetoric of Ownership.* (Boulder: Westview Press, 1994), 80.

77 May, *A Global Political Economy of Intellectual Property Rights,* 42.

78 May, *A Global Political Economy of Intellectual Property Rights,* 47.

79 Tansey, "Food, Farming and Global Rules" in *The Future Control of Food,* ed. Tansey and Rajotte, 13.

80 Tansey,"Food, Farming and Global Rules" in *The Future Control of Food,* ed. Tansey and Rajotte, 14.

81 Lee Branstetter, "Do Stronger Patents Induce More Local Innovation?" in *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime,* ed. Keith Maskus and Jerome Reichman, (Cambridge: Cambridge University Press, 2005), 320.

enclosure and links the increase in IPR strength directly with the creation of private property rights in 15th Century England. He argues that the economic evidence for increasing IP protections is not convincing, and only serves to create an environment conducive to monopolies and cartels.[82] Echoing many other IP critics, he argues that rather than just providing incentives for innovation, IPRs have become a significant political and economic tool.[83]

Intellectual property law has always been subject to national jurisdiction. Though there is evidence of invention protection tracing back to 15th century Italy, comprehensive IP regimes are the product of the late 19th to 20th centuries. International negotiations in intellectual property began with the *Paris Convention for the Protection of Industrial Property* in 1883, and the *Berne Convention for the Protection of Literary and Artistic Works* in 1886. Though these Conventions brought together a number of countries to elucidate the principles of IP law, they did not create any standardisation of laws.[84] The Paris Convention did not define the term invention, and left it to individual nations to determine what was covered.[85] IP law still remains firmly within the rubric of domestic regulation, and intellectual property regimes offering various levels of protection exist in different countries of the world.

Since the 1960s and 1970s, the scope of IP law has expanded considerably. According to Dutfield, this expansion is three-fold – a widening of the subject matter that falls under the protection of IP, the creation of new rights (including plant breeders' rights) and the increasing international standardisation of IP regimes.[86] By the end of the 1970s most countries had patent regulations covering pharmaceuticals, but recourse to patenting of plant genetic resources was mixed.[87] The patenting of life has been a gradual process, and most developing countries continue to exhibit weaker IP protection in this area.[88] Following *Diamond v Chakrabarty*, a series of directives from the United States and European patent offices indicated a widening of subject material, from seeds, to plant

---

82 James Boyle, "The Second Enclosure Movement and the Construction of the Public Domain", *Law and Contemporary Problems* 66, no.3 (Winter/Spring 2003): 49-50.

83 James Boyle, "The Second Enclosure Movement and the Construction of the Public Domain", 57.

84 Graham Dutfield, *Intellectual Property Rights and the Life Science Industries,* 50.

85 Burton Ong, *Intellectual Property and Biological Resources: Perspectives on Contemporary Issues.* (Singapore: Marshall Cavendish Academic, 2004), 35.

86 Graham Dutfield, *Intellectual Property Rights and the Life Science Industries,* 19.

87 Graham Dutfield, *Intellectual Property Rights and the Life Science Industries,* 59.

88 Graham Dutfield, *Intellectual Property Rights and the Life Science Industries,* 70.

tissues, to DNA. In these developments, the United States was the frontrunner. A 1989 *European Directive on the Legal Protection of Biotechnological Inventions* took nine years to be adopted, and only four countries to this point have fully incorporated it into domestic law.[89]

Internationally, IP is supervised by the World Intellectual Property Organisation (WIPO), which became a UN agency in 1974. WIPO's mandate is to foster economic and social development through the transfer of technology.[90] Though the organisation has created many directives for the operation of IP regulation, the WTO's Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement has had the most impact on the international IP landscape. The TRIPS Agreement significantly altered the international IP environment by pushing for a standardisation of IP regulation across its signatory countries in the duration, type and subject matter of protection.

3.4 The Concept of the Commons

Originally, the term commons was used to refer to the system of land management that was replaced by private ownership during the enclosure movement. Until quite recently, the 'commons' were viewed as the inefficient and outmoded precedent to private property organisation. This view was largely created by Garrett Hardin's "The Tragedy of the Commons". In "The Tragedy of the Commons", Hardin claimed that individuals in a world of limited resources will seek to maximise their own gains over pursuing the common good, and thus that the commons system of landholding is doomed to fail. "The rational man," wrote Hardin, "finds that his share of the cost of wastes he discharges is less than the cost of purifying his wastes before discharging them. Since this is true for everyone, we are locked into a system of 'fouling our own nest' so long as we behave only as independent, rational, free enterprisers."[91] The article was a condemnation of common property as a management system, which assumed that self interest would overwhelm any ability to manage resources communally.

Since the 1980s, this image of the commons has been challenged by a group of common

[89] Graham Dutfield, *Intellectual Property Rights and the Life Science Industries,* 152.

[90] Maria Julia Oliva, "Promoting and Extending the Reach of Intellectual Property: The World Intellectual Property Organisation" in *The Future of Food,* ed. Tansey and Rajotte, 71.

[91] Hardin, "The Tragedy of the Commons", 44.

scholars. These scholars have argued for a more nuanced view of common ownership. They challenge the simple dichotomy of public/private resources and divide the concept of public ownership into different systems based on their operation, their structure and the resource to which they pertain. Common property scholars argued for more nuanced understandings of the term 'commons', asserting the difference between open access and common pool resources.[92] A common pool resource is a "resource used by a group of appropriators that is both non-excludable and depletable."[93] Ostrom argued that what Hardin described in "The Tragedy of the Commons" was actually an open-access system,[94] one in which all people could use resources without restriction, and not a commons, in which a fixed number of managers governed the resource. Unlike an open-access regime, the commons have a social infrastructure – cultural institutions, norms and traditions which bind members and the way they treat their resources.[95] Those in a common property management system also have the right to exlude non-members.[96] According to Bromley, a property system can best be understood as a type of authority system, and a commons authority system is based on reciprocal rights and duties among co-owners.[97] According to Ostrom, "common property regimes controlling access and harvesting from local streams, forests, grazing areas and inshore fisheries have evolved over long periods of time in all parts of the world, but were rarely given formal status in the legal codes of newly independent countries."[98] Rather than an ungoverned anarchical space characterised by misuse and exhaustion of resources, the commons are a viable system of property in their own right, capable of being effectively and responsibly managed.

In a volume entitled *Whose Common Future?* the authors of The Ecologist remind us that "for the vast majority of humanity, the commons are an everyday reality."[99] They add, "the modern nation

92 Ostrom, *Governing the Commons*, 26-27.

93 Oran R. Young,"The Problem of Scale in Human/Environment Relationships", *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains,* ed. Robert O. Keohane and Elinor Ostrom, (London: Sage Publications, 1995), 29.

94 Elinor Ostrom, *Governing the Commons.* (Cambridge: Cambridge University Press, 1990), 12.

95 David Bollier, *Silent Theft: The Private Plunder of Our Common Wealth* (2002) quoted in Keith Aoki, *Seed Wars: Controversies and Cases on Plant Genetic Resources and Intellectual Property.* (Durham: Carolina Academic Press, 2008), 100.

96 Ostrom, "Private and Common Property Rights", 336.

97 Daniel Bromley, "The Commons, Common Property, and Environmental Policy". *Environmental and Resource Economics* 2, (1992), 3.

98 Ostrom, "Private and Common Property Rights", 336.

99 The Ecologist, *Whose Common Future,* 7.

state has been built only by stripping power and control from common regimes and creating structures of governance from which the great mass of humanity (particularly women) are excluded."[100] Far from being a marginalised system in the modern world, commons are prevalent in many areas of the world, especially in the management of natural resources.

Over time, the concept of the commons has been extended beyond its application to land management to refer to any resource that is managed communally. The term is now often used to refer to the environment - the global commons – resources which are said to be held in common by all humankind. It is used to invoke a sense of custodianship over the world's resources, such as oceans and the atmosphere, and to encourage their conservation. According to Goldman, the term has become the "central metaphor of environmental politics",[101] which is either responsible for or detrimental to good environmental management. Some, including the authors of *Whose Common Future,* take issue with the way the term is used, and recognise that "by designating the atmosphere and biodiversity as 'global commons', the World Bank and other agencies have overridden the local claims of those who rely on the real commons."[102] Treating the commons as an abstract principle, scholars and international organisations alike are diminishing the salience of claims to common ownership.

The term is also used to refer to intellectual commons, describing the space for past innovation, and a creative environment to encourage further innovation.[103] An extension of this idea is the scientific commons. Generally, the scientific community has been underpinned by a culture of facilitating and enhancing knowledge and understanding, and thus based on openness and publishing of results.[104] However, shifts in the attitudes of universities in the 1970s and 1980s and the rise of patents have threatened this scientific commons, and the operation of scientific knowledge as a public good, an input available to produce future knowledge.[105]

---

[100] The Ecologist, *Whose Common Future*, 21.

[101] Michael Goldman, *Privatizing Nature: Political Struggles for the Global Commons.* (New Jersey and New Brunswick: Rutgers University Press, 1998), 1.

[102] The Ecologist, *Whose Common Future,* 170.

[103] The Rural Advancement Foundation International (RAFI). *Enclosures of the Mind: A Resource Kit on Community Knowledge, Biodiversity and Intellectual Property.* (Ottawa: RAFI, 1997), 2.

[104] Richard Nelson, "Linkages Between the Market Economy and the Scientific Commons" in *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime,* ed. Maskus and Reichman, 122.

[105] Keith Maskus and Jerome Reichman, "The Globalization of Private Knowledge Goods and the Privatization of Global

Recently open-access has been associated with open-source computer software, referring to operating systems and programs that are free and accessible, but are only capable of being used, not being owned. Users who access the software are free to use and add to it, but hold no title to it in property. The sudden spread and popularity of such software has illustrated that the form of ownership it engages is actually not as new a phenomenon as was thought. Some have argued that applying the open-source software model to biotechnology is a way to circumvent the existence of an overwhelming number of IP rights exerted over plants, genes and plant breeding processes. They advocate open-access as a principle that could promote openness and advancement in science.[106]

These four types of property are all relevant in historical and contemporary management of seed. 20th century seed management is characterised by a conflict between common and private property paradigms. With the diminished ability of the commons to operate, and the failure to institute any workable schema of common management in the international arena, new solutions have been proposed to overcome the impasse. State and open-access management are two possible solutions, each of which suggests new ways of managing seed as a commodity.

4. Property and the Seed

4.1 Property Theory and the Seed

Applying a property analysis to the plant genetic resource debate is an important step, because it reveals that the seed is viewed and valued in different ways by different actors. It illustrates that private property in seeds was not created in a void, but has commodified a resource that was already subject to other forms of ownership. The creation of intellectual property rights was facilitated by a congruence of favourable legal and technological circumstances that emerged in the United States at the turn of the century. It was consolidated internationally into a dominant property system through a discriminatory mechanism of value which draws a distinction between raw and elite germplasm, and

Public Goods" in *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime,* ed. Maskus and Reichman, 41.

[106] Jack Kloppenburg, "Seeds, Sovereignty, and the Vía Campesina: Plants, Property, and the Promise of Open Source Biology". November 2008. http://www.drs.wisc.edu/kloppenburg/_publications/2008%20Seeds%20and%20Sovereignty.pdf

grants monetary value to only elite varieties.

The discriminatory way that value and worth are calculated in seeds is at the centre of conflicts over their ownership. Seeds are a part of the natural world and a resource upon which we all depend, and thus are priceless. Assigning them a monetary value, however illogical it may seem, is an integral part of their commodification. Private property rights in seeds, following the tenets of intellectual property, are extended only to those varieties which are deemed to involve an inventive step. This excludes landraces - varieties developed under traditional breeding methods. By deeming traditional varieties part of the common heritage of mankind, their continued and uncompensated use as building blocks for propertised varieties is legitimised.

Whether they choose not to use propertised seed, are restricted by financial circumstances or by the research priorities of biotech firms, many farmers across the world continue to use landraces as their primary input. The challenge for the private property regime has been to ensure that varieties protected by intellectual property rights do not fall back into common property forms of management. It has succeeded through favourable technological circumstances and clever manipulation of the tenets of property law.

The interaction and conflict between common and private property management in seeds did not end with the issuing of the first patent. It is a divide that continues to shape the property landscape, and one that manifests itself differently in different parts of the world. Responses to the growth of private property control have not been uniform or unified. New ways of owning have displaced old ways of owning, and those opposing the spread of private property have both contradicted and supported it – making claims for compensation within it while simultaneously calling for its abandonment. Solutions for farmers in which they receive compensation for their resources, or access to elite varieties of the North free of charge, ignore the fact that common property and and private property are not just conflicting ideas about how plants should be held but are tied to complex institutions, to legal cultures and to ways of assigning value.

4.2 Common Property in Seeds

Long before the advent of private property regulation on plant genetic material, farmers as collective and individual agents controlled the seeds they harvested, a renewable, genetically diverse set of resources that could be selected, traded and interbred within that community of farmers. These resources were held as part of commons of farmers who managed the resource both individually and collectively. Kloppenburg describes the environment prior to the 1930s as constituted by "largely open systems that operated on the basis of reciprocity and gift exchange rather than the market. Indeed," he continues, "these customary arrangements usually functioned to stimulate and facilitate – rather than restrict – the wide dissemination of seed."[107]

The commons are for a significant share of the world's population an everyday reality,[108] and this is also true of the management of seeds. Propertised seed varieties are used in many parts of the developing world, but their use is not uniform across the nations of the South, and they have not been established to any notable extent in Africa. According to the Rural Advancement Foundation International (RAFI), in a study published in 1997, approximately 90% of the food requirements of the South are met through local domestic production, and two-thirds are based on community farming systems.[109]

Seed management in community farming systems is not devoid of rules, but is guided by management principles of its own. As Gepts writes, "one of the essential rules is the reciprocity in access among farmers and plant breeders across economic sectors and national borders."[110] Brush adds that in these systems, invention is a collective enterprise, and that artificial and natural selection of seed attributes are linked.[111] "Neither common heritage", he writes, "nor common property implies a lack of rules *(res nullius)*... Rather they imply community management *(res communes)* that involves regulated

---

[107] Kloppenburg, "Seeds, Sovereignty and the Via Campesina", 3.

[108] The Ecologist, *Whose Common Future?,* 7.

[109] RAFI, *Enclosures of the Mind,* 29.

[110] Paul Gepts, "Who Owns Biodiversity, and How Should the Owners Be Compensated?" *Plant Physiology* 134 (April, 2004): 1295.

[111] Stephen Brush, "The Demise of 'Common Heritage' and Protection for Traditional Agricultural Knowledge", in Conference on Biodiversity, Biotechnology and the Protection of Traditional Knowledge, April 4-6, 2003, Washington University, St. Louis, http://law.wustl.edu/centeris/Papers/Biodiversity/PDFWrdDoc/StLouis1.pdf, 16.

access to common resources and reciprocity among users."[112]

From a theoretical perspective, seeds can be viewed as any other resource held in common. Unlike land however, seeds as a resource are extremely mobile, and the duration of their development and improvement makes it difficult to trace to a distinct group of custodians. This difficulty of assignment is not just a product of the resource in question but of the way in which theory of the commons has developed. Seeds, too, have been caught up in the perception that property can be characterised by a dichotomy of private and public. Initiatives of public institutions and international breeding programs have been differentiated from private sector breeding, a rise in the latter having diminished the importance of the former.[113] However, public ownership and common ownership are not synonymous. Public breeding by governments must be distinguished from traditional breeding of landraces. In the light of the CBD, and principles of national sovereignty over natural resources, state sovereignty must also be distinguished from ownership in common.

The term common, when referring to plant genetic resources, is employed in several different ways. The term is used to refer to communities of farmers who develop plant varieties using traditional methods, to a global pool of resources liable to depletion, to part of our shared heritage, and to the culture of science that should surround plant variety development. Mary Footer explains the difficulties of applying the commons principle to plant genetic resources in her article "A Tale of Two Commons". She states that there are two commons in agriculture – the global commons of humankind's germplasm resources, and the "anthropocentric localized commons" of seeds.[114] These localised commons link plant genetic resources to local cultural values and the need to preserve both agricultural and cultural heritage.[115] She traces the global commons from the creation of the International Agricultural Research Centres (IARCs) in the 1960s and their consolidation under the CGIAR under the norm of free exchange of plant genetic material.[116] These institutions were created

[112] Stephen Brush, *Farmers' Bounty: Locating Crop Diversity in the Contemporary World.* (New Haven and London: Yale University Press, 2004), 221-22.

[113] Kloppenburg, *First the Seed,* 30.

[114] Mary Footer, "A Tale of Two Commons: Plant Genetic Resources and Agricultural Trade Reform" in *The Regulatory Challenge of Biotechnology: Human Genetics, Food an Patents* ed. Hans Somsen, (Cheltenham: Edward Elger, 2007), 174.

[115] Footer,"A Tale of Two Commons", 175.

[116] Footer,"A Tale of Two Commons", 178.

to foster research and preservation of crops under a public goods culture. The global commons, she states, have been enclosed by the provisions of the CBD, which consolidate control of genetic resources under national sovereignty. The localised commons, on the other hand, are made up of groups of traditional producers, who "continue to pursue a tradition that allows for diversified and heterogeneous agricultural production, relying on a mixture of wild species (landraces) and domesticated species of crop germplasm to ensure agricultural biodiversity."[117] These commons too, are in danger of being enclosed by the market, and by the growth of proprietary rights.[118]

Ostrom and Rose have developed a theory known as the limited commons which can also be applied to the management of seeds. It describes a system in which a resource may be viewed as a private resource to the wider world, but within a group or community is treated as a common resource. These limited commons, according to Ostrom, can have very loose governance structures.[119] Where such limited commons exist, a resource is only partially commodified.[120] Keith Aoki applies this model to the property environment in seeds, stating that in a regime characterised by strengthening IP protections, a limited commons theory can explain why some resources have not been subject to it, and continue to be managed in common.[121] Partial commodification is evident in the tensions between commoditised and non-commoditised seed, between elite germplasm and raw germplasm.

The *International Treaty on Plant Genetic Resources for Food and Agriculture* (ITPGR), created in 2001, can be seen as a type of limited commons. In this document, common heritage is sidelined in favour of such principles as sustainable use and benefit sharing in line with the CBD,[122]and a multilateral system for sharing plant genetic resources for food and agriculture is created. The Treaty lists the over sixty food crops and forages that form the basis of that system, and states that facilitated access to these resources must not be limited by IP. The Treaty has been ratified by over one hundred countries. ITPGR represents a new strategy in overcoming conflicts of ownership over seed.

---

117 Footer,"A Tale of Two Commons", 185.
118 Footer,"A Tale of Two Commons", 191.
119 Ostrom, *Governing the Commons,* 21.
120 Aoki, *Seed Wars,* 101.
121 Aoki, *Seed Wars,* 102.
122 Peter Drahos, "The Right to Food, Health and Intellectual Property in the Era of Biogopolies" in *Commercial Law and Human Rights,* ed. Stephen Bottomley and David Kinley (Aldershot: Ashgate Publishers, 2002), 222-23.

Prior to the implementation of the ITPGR another international document, the *International Undertaking on Plant Genetic Resources*, affirmed the principle that the world's genetic resources were the "common heritage of mankind". There can be no clearer example of the way in which the term commons has been distorted than the common heritage principle. The common heritage principle, elucidated in the 1972 UNESCO *Convention for the Protection of the World Cultural and Natural Heritage*, and the 1982 *Law of the Sea Convention*, was used to declare that cultural heritage sites, the seabed, and areas of Antarctica should not be under the sovereignty of nation-states but should remain the common heritage of all peoples.

Concerns about germplasm freely collected from nations of the South subsequently providing the genetic material for the development of propertised varieties led to a series of debates known as the 'seed wars' at the Food and Agriculture Organisation (FAO) of the UN. Developing nations, led by delegations from Mexico, campaigned for a legally binding convention which would ensure free exchange of plant genetic resources.[123] What resulted instead was the creation in 1983 of the non-legally binding *International Undertaking on Plant Genetic Resources* (IUPGR). The IUPGR declared that plant genetic resources were the common heritage of mankind and should be available without restriction. It did not expressly recognise plant breeders' rights, the subject of the UPOV Convention in 1961.

Developed countries were generally wary of the negotiations, and wanted advanced varieties and material in breeding programs to be exempt from the common heritage principle. According to Mooney, these exclusions would have "simply put under force of international law the 'right' of the 'poor' to 'fully and freely' donate their botanical treasures to the rich and affirm the right of the 'rich' to receive such raw materials."[124] Despite its proclamation that all plant genetic material was common heritage, eight countries issued reservations on the Undertaking to exempt elite germplasm.[125] The IUPGR was concluded in 1983, without the United States, Japan or Canada as signatories.

---

[123] Juma, *The Gene Hunters,* 171.
[124] Mooney, *Law of the Seed,* 42.
[125] Kal Raustiala and David G. Victor, "The Regime Complex for Plant Genetic Resources", *International Organization* 58, (Spring 2004): 288.

The common heritage principle, while attempting to give salience to common property ownership, actually became a justification for the use of exotic germplasm by breeders as their building blocks without compensation. As Drahos notes,

> common heritage is an ambiguous concept. It may mean that a resource is not subject to ownership...and therefore it is open to anyone to appropriate, or it may mean that the resource is the subject of common ownership and cannot be appropriated without the consent of all.[126]

Conflict arose because the existence of a legally fortified system of private property in plant genetic resources fostered the belief that the term meant the former and not the latter. As Kloppenburg and Kleinman state, "ironically, in a world economic system based on private property, each side wants to define the possessions of the other as a common good."[127] The common heritage of mankind concept only highlighted the unbalanced way in which germplasm resources are treated in the international legal environment. These problems, coupled with the scepticism of common ownership created by Hardin's "Tragedy of the Commons" have led to the diminishment of the common heritage principle in international law and policy.

Proponents of the commons system of ownership have been very vocal about the ways in which the private property regime has displaced and devalued other forms of ownership. Livelihood Award winner Vandana Shiva, for example, has deplored the emphasis private property puts on individual rights, stating that such a system "excludes all kinds of knowledge, ideas and innovations that take place in the intellectual commons, in villages among farmers... and even in universities among scientists."[128] It is not just rights that are affected, but also the seed, and its value as a biological entity. In her volume *Monocultures of the Mind,* Shiva adds that "[p]atenting of genes thus leads to a devaluation of life forms by reducing them to their constituent parts and allowing them to be repeatedly owned as private property. This reductionism and fragmentation might be convenient for commercial concerns, but it violates the integrity of life as well as the common property rights of Third World peoples."[129]

---

[126] Drahos, "The Right to Food, Health and Intellectual Property", 222.

[127] Jack Kloppenburg and Daniel Lee Kleinman, "Seeds of Controversy: National Property versus Common Heritage" in *Seeds and Sovereignty,* ed. Kloppenburg, 185.

[128] Vandana Shiva, "GATT, Agriculture and Third World Women" in *Ecofeminism: Reconnecting a Divided World,* ed. Maria Mies and Vandana Shiva, (London: Zed Books, 1993), 238.

[129] Shiva, *Monocultures of the Mind,* 91.

The term commons has been used in multiple and conflicting ways, which has led to a tendency to disregard it as an ownership system. Far from being regarded as a viable and efficient property system, proponents of the private property regime in seeds have adopted the language of common property ownership to advocate their own valuing system, and ignored the substance behind it. The term common has been used as a way to signify lack of private value, that is, able to be used in the private property system without charge. Thus common has become synonymous with free, not shared.

This view ignores the fact that ownership in common has provided significant obstacles for private property to consolidate and expand. As Shiva writes "modern plant-breeding is primarily an attempt to eliminate the biological obstacle to the market in seed: its inherent ability to regenerate and multiply. Seed that reproduces itself stays free, a common resource under farmers' control."[130] Once a proprietised seed enters back into the commons by purchase, it can theoretically be resdistributed and held in common again. In this sense the achievement of the private property regime is creating a market in a commodity that can be so easily converted back into common property.

4.3 Seeds as Private Property

Private property management is the newest and most controversial addition to the property landscape of plant genetic resources. It is based primarily on two types of intellectual property rights – patents and plant breeders' rights – that have developed to protect the creations of scientific plant breeders in the second half of the 20th century. The institutional space for such protections opened up much earlier, beginning in the 1880s with the discovery of heterosis, or hybridisation in corn. These varieties were protected by virtue of their biology – their progeny did not carry on the characteristics of their hybridisation. Later developed plant varieties were not endowed with such biological protections. IPR in plant genetic resources began as a set of niche rights valid in a few countries of the industrialised North. By the end of the century, they had become a vital part of the regulatory framework of a vastly altered global agricultural system, and a significant challenge to commons management.

[130] Shiva, "Reductionism and Regeneration: A Crisis in Science" in *Ecofeminism*, ed. Mies and Shiva,30.

International law on plant variety protection (PVP) began in the 1960s with the UPOV Convention. The advent of private protections on plant varieties was the result of the dominant interests of two groups, the International Association of Plant Breeders (ASSINSEL), and the International Association for the Protection of Intellectual Property (AIPPI), which facilitated the drafting of the Convention.[131] As Dutfield states, "UPOV was created and shaped by plant breeders for plant breeders and they have a strong sense of ownership of the Convention. Public interest organizations have had minimal involvement."[132] UPOV's detailed provisions have been revised three times, the latest revisions in 1991.

UPOV created the entitlement to plant breeders' rights (PBR) over varieties of seed. Plant breeders' rights are now a feature of most developed country IP regimes. They are a less intensive form of property right than a patent, which only allow the protection of a product, not a process.[133] PBR in the 1991 UPOV Convention extends rights over "production or reproduction, conditioning for the purposes of propagation, offering for sale, selling for other marketing, exporting, importing or stocking" of plant genetic resources.[134] Once registered, the variety, and any other "essentially derived" from it is protected. To be eligible for protection an applicant must demonstrate that the variety is new and distinct, genetically uniform and stable. The variety does not need to have utility.[135] The 1991 version of the Convention removes the clause of earlier versions which permits farmers to save their seed for the next season's replanting.

Until 1970, when the United States enacted a form of Plant Variety Protection into domestic law, the impact of PVP under UPOV had been minimal. According to Mooney, pre-1970 plant breeders rights were seen as a "common market, or at best, West European phenomenon."[136] The *Plant Variety Protection Act,* enacted in 1970 against the recommendation of the Department of Agriculture,

[131] Dutfield in*The Future Control of Food,* ed. Tansey and Rajotte, 33.
[132] Dutfield in *The Future Control of Food,* ed. Tansey and Rajotte, 34.
[133] Juma, *The Gene Hunters*, 164.
[134] International Convention for the Protection of New Varieties of Plants (UPOV Convention) (March 19, 1991) Article 14(1) http://www.upov.int/export/sites/upov/en/publications/conventions/1991/pdf/act1991.pdf
[135] Carol Nottenburg, Philip G. Pardey and Brian D. Wright, "Addressing Freedom to Operate Questions for International Agricultural R&D" in *The Future of Food: Biotechnology Markets and Policies in an International Setting,* ed. Philip Pardey, (Washington, D.C.: International Food Policy Research Institute, 2001), 102.
[136] Mooney, *Law of the Seed,* 138.

granted eighteen-year certificates over new seed plants. The effects of the legislation were not immediate, but were pronounced. It led to an eventual restructuring of the entire seed industry in the United States, with small companies increasingly subsumed in larger conglomerates.[137]

In 1980, *Diamond v Chakrabarty* created the possibility of another, stronger type of protection – patents – for plant varieties. The decision led to the significant widening of patentable subject matter. Patents grant limited-duration monopolies over innovations including manufacturing processes, chemical compositions, novel products and designs.[138] Patent rights are more desirable than PBR because they include territorial protection, protection from copying, exclusive rights to make, sell and import.[139] Further, patents can be granted on a product, on a process, a use bound product patent (rights conferred pertain to a certain use) and product by process (a product is protected by virtue of the process used to create it). The extension of patents to plant varieties has not eliminated plant breeders' rights, the two continue to coexist. UPOV's 1991 amendments extend the duration of PBRs to 20 years, making them more patent-like.

The Green Revolution laid the foundations for the export of intellectual property protections through the distribution of propertised seed. Though the revolution pulled millions of people from the brink of starvation and provided food security for target nations of the South by introducing semi-dwarf varieties with higher yields, it also radically restructured agriculture in the areas it reached and tied producers into dependency on purchased outputs, including so-called miracle seeds. The revolution not only created a market for propertised seeds in areas of the world that were managing seed resources in common, it also set up a network of research centres which collected exotic germplasm from the varieties of areas of the South.

'Enclosing' the seed has required a significant amount of scientific and technological advancement as well as legal protection. So long as IP protections are uneven, and farmers have the ability to distribute their crops among themselves, there is always a risk that the seed will become

[137] Doyle, *Altered Harvest,* 306.
[138] Nottenburg *et.al* in *The Future of Food,* ed. Pardey, 101.
[139] Ong, *Intellectual Property and Biological Resources,* 8.

common property again, given that "a farmer may purchase seed of an improved plant variety and can consequently propagate the seed indefinitely for future use."[140] As an object capable of being privately owned, the seed relies on a complex web of legal and technological regulation that is neither universally available nor universally accepted. Keeping their product within the realm of technological and legal control is thus of the utmost importance for those wishing to uphold private property control in seeds.

In this sense, the TRIPS Agreement was a major achievement in the consolidation of intellectual property protections. The Agreement, formulated at the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), made IP explicitly for the first time a trade issue. It set minimum standards of protection for IP, incorporating them into the WTO system in full. For the purposes of plant genetic resources, Article 27.3(b) is the relevant provision, and states that micro-organisms and microbiological process must be covered by patent law, while plants, animals and "essentially biological processes" may be exempted from patent protection. Plant varieties must be protected, whether by patents or an "effective *sui generis* system".[141] What comprises an effective *sui generis* system is not specified, though the provisions of the UPOV Convention are said to fulfil the requirements. Already, some nations with traditionally low intellectual property protections are exploiting the ambiguity of the provision to provide compensation and rights to farmers and indigenous populations. The impacts of the Agreement are so far difficult to assess, developing countries were to enact it by 2005, while least developed countries have until 2013. Regardless, it is clear that TRIPS represents a significant expansion and consolidation of intellectual property protections, generally and in the field of plant genetic resources, around the world.

Private property requires the attribution of ownership to one individual or entity. In a resource such as seeds, where the existence of specific traits in a species may be the result of centuries of breeding and development, assigning ownership to one individual is a difficult proposition. Seeds as a subject of private property regulation are significantly different from other privately held resources, and

[140] Kloppenburg, *First the Seed,* 11.
[141] Trade Related Aspects of Intellectual Property Rights (1994) Article 27. 3(b) http://www.wto.org/english/docs_e/legal_e/27-trips_01_e.htm

thus, the theory behind private property is difficult to apply to their case. For example, Locke's labour theory of value sits uncomfortably with the reality of seed development. If property is acquired through the mixing of labour with a resource, then ownership should lie with traditional plant breeders, who have been labouring over seed varieties for centuries, not scientific breeders. Instead Locke's theory has been used in a resolutely narrow way, to support the proposition that the world's resources belong to no-one (*res nullius)* until they are actively seized.[142] Secondly, assuming that the utilitarian end of creating intellectual property in seeds is to encourage economic growth, a connection between high IP controls over plant genetic resources and economic growth has never been resolutely established. If we take moral entitlement theory as the justification, then it is possible to argue that those farmers who developed the world's landraces have a greater entitlement to ownership than do IPR holders.

Extension of intellectual property over seeds also introduces some important conceptual difficulties. One of the most commonly cited problems with the patenting of plant genetic material is the operation of the invention/discovery distinction. The invention/discovery distinction is a tenet of intellectual property which states that only that which has been invented, not merely discovered, can be protected by IPRs. According to Dutfield, allowing the patenting of genes has created a situation in which "the invention-discovery distinction has been blurred to the point of becoming almost meaningless."[143] Living things, he argues, cannot be described or be made to perform like mechanical processes.[144] Instead, the true nature of plant genetic resources is distorted in order to make IP protection applicable.

The other requirements for patenting – novelty and industrial applicability – are also difficult to apply to plant genetic resources. Wei explains that individual countries have interpreted the requirement for novelty differently. Disputes occur about the use of traditional knowledge, and the extent to which the application of this knowledge to create new goods can be considered novel.[145] The Australian patent system, for example, requires for novelty that the knowledge used is not available in written

[142] Stenson and Gray, "Cultural Communities and Intellectual Property in Plant Genetic Resources", 180.
[143] Dutfield, *Intellectual Property Rights and the Life Science Industries,* 165.
[144] Dutfield, *Intellectual Property Rights and the Life Science Industries,* 166.
[145] George Wei, "Fitting Biological Products within the Intellectual Property Framework: Challenges Facing Policy Makers" in *Intellectual Property and Biological Resources,* ed. Ong, 70.

form, which excludes oral traditional knowledge.[146] The inventive step in biotechnological research is also faced with similar challenges, only knowledge created in a laboratory is considered to be sufficiently inventive.[147]

One of the arguments for private property is that it extends over resources that are scarce, in order to prevent their mismanagement. Seeds are a renewable, not a scarce resource, and thus private property protections over them may hinder rather than help their management. Michael Heller addresses this possibility in his article "The Tragedy of the Anti-commons". Referencing the argument of Hardin in the "Tragedy of the Commons", Heller describes the reverse situation, in which the existence of too many rights of use over a resource creates an anti-commons, an environment in which no one single right-holder has effective use over a resource. The tragedy of the anti-commons is not the overexploitation of resources as in Hardin's commons but their underexploitation – where no one right holder can exercise the privilege of use.[148] The right to exclude others from use is ineffective, and thus resources are underconsumed. In plant genetic material these anticommons can be said to exist in the overlapping legal entitlements of different actors in seeds. The absence of a central international authority of patented plant varieties means that often more than one set of rights will exist for a single variety. An often cited example of this phenomenon is golden (vitamin A enriched) rice, over which 70 patents exist worldwide.[149] Dutfield claims that these anticommons situations are an inevitable consequence on the way in which the patent system is geared. "There is little", he writes, "that patent offices can do about such 'tragedies' except leave it to the patent holders involved either to accept the high transaction costs entailed by their need to acquire or licence other firms' patents or to collaborate with their rivals by setting up private collective rights organisations to pool their patents."[150]

IPRs over seeds do not conform to the theory behind private property in tangible or intangible assets. Their inclusion under the laws of intellectual property is a significant distortion of the tenets

[146] Wei in *Intellectual Property and Biological Resources*, ed. Ong, 70-71.
[147] Wei in *Intellectual Property and Biological Resources*, ed. Ong, 72.
[148] Michael Heller, "The Tragedy of the Anticommons: Property in the Transition from Marx to Markets", *Harvard Law Review* 111, (1998): 624.
[149] Aoki, *Seed Wars,* 112.
[150] Dutfield, *Intellectual Property Rights and the Life Science Industries,* 167.

that have supported and justified the extension of rights over other resources. According to Demsetz, however, property is a flexible institution which is designed to absorb new resources when potential benefit from a good rises.[151] As a social institution, property is designed to adapt to the context in which it operates, and the emergence of a market in seeds created the need for an artificial barrier against their appropriation. The granting of intellectual property protections over seeds has been based in the idea that plant breeders should be rewarded for their efforts in creating new varieties and protected against any unauthorised distribution and use of them. This is an instrumentalist approach to IPRs, which recognises that without such rights, free-riding would completely undermine the incentives to invest in developing new varieties.[152] Biotechnology is an extremely research intensive and time consuming field. It can cost hundreds of thousands of US dollars to develop varieties, and understandably the companies that engage in breeding aim to achieve an adequate return on their investments. Rights such as PBRs and patents provide breeders the opportunity to be compensated for their work. According to Wilkes, the engineering of Norin 10, the semi-dwarf wheat cultivar used in the Mexican breeding program and one of the key inputs for HYV wheat, has impacted the food supply of one quarter of the people on the earth.[153] The advancements that have been achieved in biotechnology should not be underestimated, and their immense contributions to the global food production capacity should be recognised.

Despite the existence of compelling reasons why breeders should have the right to receive benefit from their work, the purpose of IP in seeds not always reflected in its use. Within some intellectual property systems, rights are no longer just protection of invention but also a source of significant power.[154] In the 1980s in the US concern was evinced about the concentration of patents in the hands of a small number of biotechnology firms and the tendency towards monopoly within the industry. Those companies that hold the bulk of patents are transnational corporations normally engaged in agriculture, as well as pharmaceuticals and chemicals. Increasingly, their research is focused

[151] Demsetz, "Toward a Theory of Property Rights", 350.
[152] Garrison Wilkes quoted in Lawrence Helfer, *Intellectual Property Rights in Plant Varieties: The Legal Regulations and Policy Options for National Governments.* FAO Legislative Study, 85/204, 2-3.
[153] Kloppenburg and Kleinman, "The Common Bowl" in *Seeds and Sovereignty*, ed. Kloppenburg, 3.
[154] Doyle, *Altered Harvest,* 302.

on the development of seed-chemical input packages that tie genetically engineered seeds to complementary artificial fertilisers and pesticides. These companies are highly geared towards the market of farmers in the developed world, to markets from which they have the potential to derive profit.

Significant from a property perspective is the way in which private property has expanded from its originally limited jurisdiction to an almost inescapable facet of the global agricultural system. IP as a property system has come to dominate the property landscape of plant genetic resources and made it almost impossible for other systems of management to coexist. Those who seek access to the most advanced varieties of key crops have little choice but to purchase them, tying them into a relationship of dependence with international agrochemical firms. The negative impact of IPRs arises when they are applied in systems for which they are ill-fitted and counter to the realities of plant management. As Pringle writes, "if the keys to the creation of new miracle plants that defy pests, or grow well despite droughts or floods...are locked up in the safe of agribusiness, it is hard to see how poor nations will ever reap the benefits."[155] Both the profits and the agricultural benefits of biotechnological research are concentrated in advanced industrialised nations, but with the proliferation of propertised seed and the push for harmonisation of IP regimes, other states are drawn into accepting private property regulation without reaping the benefits.

Further, the private property system has cemented itself by creating a seemingly arbitrary distinction between raw and elite germplasm. The private property regime protects propertised seed, that is, seed that has been engineered through scientific breeding techniques, and excludes varieties produced through traditional breeding techniques. The unprotected varieties, however, have provided and continue to provide the genetic characteristics which are used to engineer propertised varieties. Propertised seed is a fundamentally different resource from the traditional varieties that were the basis of agriculture before the turn of the 20th century. Its spread has led to the loss of biodiversity – since 1970, 96% of corn planted in the United States is hybrid corn[156] – and has demoted the seed from its

[155] Pringle, *Food Inc.*, 13.

[156] Nina Vsevolod Fedoroff and Nancy Marie Brown, *Mendel in the Kitchen: A Scientist's View of Genetically Modified Foods*

place at the centre of agricultural production to the status of simply an input.[157]

There are still a multitude of organisations that continue to operate under a public goods culture, distributing varieties without the enforcement of patents for the benefit of farmers and scientific advancement. Institutions like the World Vegetable Centre (AVDRC),[158] and the public research institutions such as the IRRI continue to supply the fruits of their research without charge. Patents, have, however, somewhat paralysed these public institutions. According to Pringle, the expanding interest of biotech corporation in staple crops has made it difficult for these institutions to provide varieties to disadvantaged farmers.[159] The CGIAR system institutions find themselves constrained by the need to negotiate access to IPR protected germplasm in order to complete their research.[160] IP protections create obstacles for public research institutions to both access resources and to distribute the fruits of their research.

4.4 Utility and Value in the Seed

Russian scientist Nikolai Vavilov, through extensive collection and collation of botanical samples, managed to map out what are now called the Vavilov Centres of Origin – as close as possible to determining where each of the world's important food crops originates. Not only did he find that all the world's major crops originated from centres making up under a quarter of the world's arable land,[161] he also found that these centres were mostly located in the global South. His findings provided the foundations for later claims of nations of the South that their resources have been taken for the gain of others – the world's 'breadbasket' nations are almost devoid of crops of any dietary significance, while most of the world's most important crops are derived from centres in the South.

These findings, along with an expose of the workings of the seed industry were published in 1979 by Pat Roy Mooney in his volume *Seeds of the Earth*. The small volume was swiftly seized upon by activists for the developing world, who used it to support claims that an extremely valuable resource

(Joseph Henry Press: 2004), 62.

157 The Ecologist, *Whose Common Future,* 56.

158 The World Vegetable Centre, http://www.avrdc.org/

159 Pringle, *Food Inc.,* 94.

160 Michael Blakeney, "Agricultural Research: Intellectual Property and the CGIAR System", in *Global Intellectual Property Rights: Knowledge, Access and Development*, ed. P. Drahos and R. Mayne, (London: Palgrave Macmillan, 2002), 112.

161 Mooney, *Seeds of the Earth,* 3.

was being removed from the periphery without compensation. The book significantly altered views about the way in which the value of germplasm was designated. It illustrated the political and corporate forces at play in the seed sovereignty debate.[162] Some authors argue that Mooney presents an exaggerated and distorted picture of the actual value of seed resources. Frankel challenges Mooney's assertion that breeders rely on a constant supply of germplasm from the South, and accuses him of fostering a "litigious community insisting of sovereign rights" which has the potential to damage conservation efforts.[163] Activists have criticised breeders of the North for robbing the South of its genes, then selling them back in the form of high yielding varieties. The general sentiment is that resources have been taken from developing nations under the understanding that they are common and costless, but later return a commodity which can be bought and sold.[164]

Thus, the world's plant genetic resources raise an important question of value – as a resource that it is almost impossible to put a price on. Claims for compensation for genetic resources are either based in retrospectivity, or on a possible future utility, both of which are rejected by seed company representatives as being baseless and impossible to quantify.[165] But, as Kloppenburg and Kleinman argue, just because it is difficult for plant germplasm to take on a price does not mean that it should not be given value.[166] The utility of seeds is not granted to it purely through its genetic manipulation. Genes do not have inherent financial value, but their manipulation at certain tems and in certain ways may render them profitable.[167] If the scientifically bred seed is seen as a commodity, traditional breeders can add utility to it, but not value.

The question of value is further complicated by the issue of genetic erosion. Not only does the private property regime only value certain resources, and certain contributions to those resources, the spread of these seeds has led to the disappearance of others, and the subsequent loss of genetic

---

[162] Robin Pistorius, *Scientists, Plants and Politics: A History of the Plant Genetic Resources Movement.* (Rome: International Plant Genetic Resources Institute, 1997), 70.

[163] Otto Frankel, "Genetic Resources: Evolutionary and Social Responsibilities" in *Seeds and Sovereignty,* ed. Kloppenburg, 44.

[164] Kloppenburg, *First the Seed,* 169.

[165] William L. Brown, "Plant Genetic Resources: A View from the Seed Industry" in Kloppenburg, *Seeds and Sovereignty*, 220.

[166] Kloppenburg and Kleinman, "Seeds of Controversy: National Property Versus Common Heritage" in Kloppenburg, *Seeds and Sovereignty* , 188.

[167] H. Garrison Wilkes, "Plant Genetic Resources over Ten-Thousand Years" in Kloppenburg, *Seeds and Sovereignty*, 80.

diversity. The world's landraces are an important source of sustenance for many people, but the potential worth of their genetic information for biotechnological research is also significant. As Evenson, Gollin and Santaniello note, "costs of conserving germplasm thus necessitate some implicit ranking of the value of different species."[168]

Genetic erosion has increased the 'perceived value' of plant germplasm. That is, those who hold it consider that it is now worth more to plant breeders than it once was.[169] William Brown in his article "Plant Genetic Resources: A View from the Seed Industry", throws doubt on the value of landrace genetic material. He argues that the majority of breeding is done through the selection of traits from elite varieties, not landraces, and that the value of unimproved germplasm must be weighed up against the preservation value of collection. Elite lines, he states, can cost a company hundreds of thousands to develop, in contrast to an unquantifiable unknown potential of landraces.[170] As Fowler and Falcon argue, "[n]o substantial market for PGR has ever existed. Traditional farmer varieties, though used as breeding materials, have never been sold as such. Developing countries clinging to the hope that they will someday get lucky and win the gene lottery are likely to be disappointed."[171]

Unlocking the secrets of the genome has equipped plant breeders with a new set of tools, but also with a new set of responsibilities. The new technologies allow scientists to more directly target and enhance or reduce specific traits in species. As Farnham states of the technology "[w]ith the advent of biotechnology, the entire gene pool of living things carried potential value."[172] Scientists and corporate breeders are now in the position to determine which traits are valuable, and which are not.

The great triumph of private property regulation is that it has taken a resource that for millennia was handled effectively under one system, and subsumed it under a system of private rights consolidated in a transformed system of agricultural production. It has done so through a mechanism of valuing which turns the tenets of common property against themselves. Private property in seeds

---

[168] Evenson, Gollin and Santaniello, *Agricultural Values of Plant Genetic Resources.* (Wallingford: CABI Publishing, 1998), 4.
[169] Raustiala and Victor. "The Regime Complex for Plant Genetic Resources", 279.
[170] Brown, "Plant Genetic Resources: A View from the Seed Industry" in *Seeds and Sovereignty,* ed. Kloppenburg, 225.
[171] Falcon, and Fowler. "Carving up the Commons", 213.
[172] Timothy Farnham, *Saving Nature's Legacy: Origins of the Idea of Biological Diversity.* (New Haven and London: Yale University Press, 2007), 123.

relies on a discriminatory mechanism of value which renders common property resources free to appropriate yet charges for the use of resources it creates from their genetic material. This undermines common property, a viable management system, and one to which seeds as a natural resource fit more logically.

5. Potential Strategies for the Resolution of Property Issues in Seeds

The property environment in seeds is one of conflicting views of management. The operation of seeds as a common property resource is increasingly threatened by the spread and internationalisation of intellectual property protection, while intellectual property protections continue to consolidate the benefits of plant breeding in a limited number of hands. The strategies that have been pursued to overcome these tensions in seed ownership fall into three broad categories – those that seek reservations from private property protection in the form of rights or exceptions, those that rely on the principle of national sovereignty to deliver more equitable results for communities, and those that seek to radically transform the property environment, such as open source biotechnology. Each of these strategies has its strengths and weaknesses as an achievable and equitable way to overcome the stifling effects of private property protections and their marginalisation of other systems of management.

5.1 Resolutions – For Whom?

Analysis of the plant genetic resource ownership debate from a property perspective is, theoretically, a means through which to evaluate solutions for those who have been disenfranchised by the spread of private property. According to Mayozer and Roudart, the inequalities between developing and developed world agricultural producers have never been greater.[173] Detractors of the private property system deplore the ways in which IPRs have disenfranchised farmers and left them with no choice but to embrace private property in seeds. Any analysis of solutions to the impact of IP protections over seeds must ask who the potential beneficiaries of any such solution should be.

[173] Marcel Mazoyer and Laurence Roudart. *A History of World Agriculture: From the Neolithic Age to the Current Crisis.* (New York: Monthly Review Press, 2006), 441.

The private property regime in seeds is tied to a transformed agricultural system which has developed to utilise propertised seeds and their complementary inputs. It is a system based on large-scale, intensive farming of a few select crops, in combination with artificial fertilisers, chemical herbicides and insecticides and mechanisation, and operates according to its own logics of production, distribution and consumption. Although these changes are relatively new in the history of agriculture, they have altered, perhaps irrevocably, the practice of farming in the agriculturally dominant nations of the world. Returning to a system completely free of these technologies and methods seems untenable.

Evident in the seed war debates of the FAO is a clear sense of the need to compensate producers who have lost from the removal of germplasm from the South. Who should be compensated for this removal is often unclear. A seed's centre of origin is not necessarily its centre of development. As Wilkes notes, the centre of origin for wheat is the Near East, but its most productive variations were developed elsewhere.[174] Frankel adds that the genes for 'dwarfing' the varieties of wheat and rice that became the products of the Green Revolution originate in Japan and Taiwan, neither of which is a developing country.[175] Compensating custodians of genetic resources is extremely difficult, especially because up until recently, genetic resources have been considered 'common heritage', and therefore not traceable to an indentifiable group.

What is then an appropriate and realistic solution for the disenfranchised custodians of the world's germplasm resources? Free access to propertised varieties is not necessarily the best solution for farmers of the Third World. The Green Revolution showed that widespread application of high yielding varieties can cause more harm than good to local agricultural systems if applied indiscriminately. As Kloppenburg notes, "does the Sudan really want access to a Funk Seed Company sorghum line that, through recombinant DNA transfer, has had a bacterial gene added that provides resistance to a proprietary herbicide produced by Funk's corporate parent, the transnational agrichemical giant Ciba-Geigy corporation?"[176] Solutions must therefore be critical about what is firstly,

[174] H. Garrison Wilkes, "Plant Genetic Resources over Ten-Thousand Years" in *Seeds and Sovereignty*, ed. Kloppenburg, 68.
[175] Otto Frankel, "Genetic Resources: Evolutionary and Social Responsibilities" in *Seeds and Sovereignty*, ed. Kloppenburg, 37.
[176] Kloppenburg, *First the Seed,* 287.

achievable, but more importantly appropriate for farmers.

5.2 Rights Reservation Strategies

5.2.1 The Rights Reservation Approach

Rights reservation strategies are those that attempt to build rights or exemptions for farmers and researchers into the private property system of ownership. They are a pragmatic solution which recognises the realities of private property regulation without resigning all control or reward for farmers to corporate interests. Solutions of this nature include community IPRs, farmers' privilege and farmers' rights. The focus of such solutions is the need to compensate farmers and traditional breeders, or to devise ways in which to obviate the impacts of privatised seed on their activities. Networks of farmers, supported by NGOs, contest that it is their right to have access to varieties that they have had a hand in developing. As Borowiak states, " if "breeders' rights" was the pivot upon which agribusinesses lobbied for changes in commercial law, "farmers' rights," "indigenous rights," and, more recently, "human rights" provide the ground upon which resistance to plant variety IPRs is being waged."[177]

There is a strong undercurrent of theft of resources in the positions of those who campaign for compensation. With statements of writers such as Mooney, who claim that developing world germplasm is worth billions to the developed world seed industry, and the admission of United States cabinet official Warren Christopher that the value of South germplasm contribution annually to its two leading crops is US$10.2 billion,[178] many have asked how these resources have been taken without any form of compensation to the nations that hold them. This has led to allegations of biopiracy – a term used to refer to the extraction of biological materials with properties of use commercially without consent or compensation of the nation-state in which it is found. According to Ong, "[t]he biopiracy label is part of the rhetoric used to communicate the injustice, or perceived inequity which emerges from the particular methods of exploiting genetic resources."[179]

---

[177] Borowiak, "Farmers' Rights: Intellectual Property Regimes and the Struggle over Seeds", 512.

[178] United States Secretary of State Warren Christopher in a letter of August 16th, 1994 quoted in RAFI, *Enclosures of the Mind*, 4.

[179] Ong, *Intellectual Property and Biological Resources,* 8.

The concept of farmers' rights was introduced in the 1980s, in response to what many saw as the aggressive spread of plant breeders' rights over developed varieties. Commission on Plant Genetic Resources (CPGR) Resolution 5/89 defines farmers' rights as 'rights arising from the past, present and future contributions of farmers in conserving, improving and making available plant genetic resources, particularly those in the centres of origin/diversity."[180] They are generally regarded to be collective rather than individual rights.[181] The 1989 session of the FAO saw the official recognition of the concept of farmers' rights, and the commitment to establish an international fund. The fund would be directed at nations with strong plant breeding industries to donate for *insitu* resource conservation.[182] 2001's ITPGR addressed farmers' rights, stating that rights over seeds will not "limit any rights that farmers may have to save, use, exchange and sell farm saved seed or propagated material".[183] However, the provision places responsibility for the implementation of farmers' rights within national jurisdiction. Since, a number of legislative measures have been taken, including India's *Protection of Plant Varieties and Farmers' Rights Act* (2001), and the *African Union Model Law on Rights of Local Communities, Farmers, Breeders and Access* (2000), a model statute for African state domestic implementation.[184]

There have been a number of legislative initiatives aimed at using the ambiguity of the 'sui generis' concept to implement systems that are in the favour of producers. One such example is the *Plant Variety Protection* legislation in Thailand. Designed to fulfill the requirements of 27.3(b), it gives farmers and communities access to developed plant varieties, and forces commercial plant breeders to agree to commit at least 5% of the benefits they accrue from their varieties to holders of the original germplasm.[185] India's plant variety protection legislation contains one of the strongest affirmations of farmers' rights in domestic legislation. It creates a system of parallel plant breeders' and farmers'

---

[180] Graham Dutfield, *Intellectual Property, Biogenetic Resources and Traditional Knowledge.* (London: Earthscan, 2004), 39.

[181] Regine Andersen, *A History of Farmers' Rights.* The Fridtjof Nansen Institute Paper 8/2005. http://www.fni.no/doc&pdf/FNI-R0805.pdf, viii.

[182] Stenson and Gray, "Cultural Communities and Intellectual Property"in *Justice, Property and the Environment,* ed. Hayward and O'Neill, 181.

[183] FAO. *International Treaty on Plant Genetic Resources for Food and Agriculture,* (2001). Part III, Article 9. http://ftp.fao.org/docrep/fao/011/i0510e/i0510e.pdf

[184] GRAIN Archive of PGR Related Legislation: www.grain.org/brl/?typeid=45

[185] Witoon Lianchamroon in Robert Ali Brac de Perriere and Frank Seuret. *Brave New Seeds: The Threat of GM Crops to Farmers.* (London: Zed Books, 2000), 109.

rights.[186] The legislation defines an 'extant' variety as "(ii) a farmers' variety; or (iii) a variety about which there is common knowledge; or (iv) any other variety which is in the public domain."[187] These varieties are eligible for plant variety protection under the Act. Further, a gene fund is set up to compensate farmers for their contribution to agriculture.[188] These successes have been made in the face of strong opposition; many consider the 1991 UPOV Convention to be the only effective *sui generis* system.[189]

Farmers' privilege is another reservation, but does not take the form of a positive right. Instead, it provides an exemption to plant breeders' rights which allow farmers to reuse purchased seed and to exchange it within informal networks of farmers, as long as it generates no commercial gain. A feature of the 1978 UPOV Convention, the 1991 version saw the provision significantly curtailed, and any attempt to use such a privilege to enhance the position of farmers now seems a remote possibility.

Community IPRs are another solution devised to overcome problems of access caused by private IPRs. According to Stenson and Gray, the concept of communitarian IPRs is based on recognising community sovereignty over resources, as distinct from ownership. There have been some instances in which indigenous communities have had rights in the form of IPRs granted, but only in an implicit way.[190] That is, their ownership has been recognised in less formalised arrangements than private IPRs. A system of community IPRs has been considered in Brazil, in India and in the Philippines, but without power and effective mechanisms to enforce them, community IPRs remain an incomplete solution.[191]

5.2.2 Evaluating Farmers' Rights as a Strategy for Resolving Property Problems

From a property perspective, there are a number of difficulties with rights reservation strategies. It is difficult to ground claims for compensation in any claim other than moral entitlement theory of property.[192] Moral entitlement theory is a theory whereby property is granted according to moral right

[186] Susette Biber-Klemm and Thomas Cottier. *Rights to Plant Genetic Resources and Traditional Knowledge: Basic Issues and Perspectives.* (Wallingford: CABI Publishing, 2005), 90.
[187] *Protection of Plant Varieties and Farmer's Rights Act,* (2001) India Article 2(J). http://www.grain.org/brl_files/india-pvp-2001-en.pdf
[188] C.S. Srinivasan, "Exploring the Feasibility of Farmers' Rights", *Development Policy Review* 21, no.4 (2003): 442.
[189] Borowiak, "Farmers' Rights: Intellectual Property Regimes and the Struggle over Seeds", 522.
[190] Anthony Stenson and Tim Gray, *The Politics of Genetic Resource Control.* (New York : St. Martin's Press, 1999), 82.
[191] Kloppenburg, "Seeds, Sovereignty, and the Vía Campesina", 2.
[192] Stenson and Gray, "Cultural Communities and Intellectual Property in Plant Genetic Resources", 179.

to an object due to a connection between object and property.[193] In this sense, they rely on anachronistic claims to own resources, and are based on moral entitlement to receive some compensation for loss.

Stenson and Gray are critical of claims based in moral entitlement, and on claims based on rights in general. "If Third World campaigners wish to argue for intellectual property rights for cultural communities," they argue, "they should abandon the idea that these communities are entitled *by right* to intellectual property over genetic resources, and instead concentrate on consequentialist arguments", which they ground in autonomy.[194] Through the pursuit of rights reservation strategies, patents have been overturned, farmers have won small concessions over their freedom to use stored seed, agreements have been made to funnel compensation to owners of genetic resources, but these represent minor incursions into the rapidly expanding private property system. Further, farmers' rights value resources only in terms of their contribution to industrial agriculture, and assume that monetary compensation is the principal goal.[195] Modelling the entitlement of traditional farmers to their own crops upon the same form as propertarian IPRs is a major concession to the dominant form of resource organisation which does little to obviate the dependence of farmers upon the private property regime.

The major problem with rights reservation strategies is implementation rather than conceptualisation. Brush states that the recognition of the work of farmers through farmers' rights is "moral, but largely rhetorical."[196] This is because the concept has, since its inception, struggled with problems of implementation and translation into domestic law. Such solutions require financial concessions, which often, both governments and private sector organisations are not prepared to make. The proposed FAO fund for *insitu* resource capacity building has been established, but donations have been negligible, and nothing in law compels countries to donate. Community IPRs have also suffered

[193] Stenson and Gray. *The Politics of Genetic Resource Control,* 81.
[194] Stenson and Gray, *The Politics of Genetic Resource Control,* 83.
[195] David A. Cleveland and Stephen C. Murray, "The World's Crop Genetic Resources and the Rights of Indigenous Farmers", *Current Anthropology* 38, no. 4 (August-October, 1997): 491.
[196] Brush, *Farmers' Bounty,* 255.

from a lack of practical support.[197]

Another concern is the ability to find a way around farmers' rights. Srinivasan believes, for example, that the Indian Plant Variety Protection laws create an adversarial environment between breeders and farmers rather than fostering openness and sharing upon which access depends. Instead of paying the required amount to farmers for their contributions, he attests, breeders will steer clear of PBRs which are linked to farmers' rights, and tend towards patents or technological solutions.[198] Farmers' rights as a solution require enforcement, as their recognition puts financial strain on the breeding industry nationally and internationally.

On the other hand, Borowiak is positive about the impact of farmers' rights. He argues that as farmers' rights offer a "unique form of resistance" against plant breeders' rights, by creating a new form of right rather than simply trying to negate the operation of plant breeders' rights.[199] These strategies can see benefits flowing directly to farmers, both in terms of rights and remuneration. They can be a way to recognise the contribution of the community of farmers to the varieties they have helped to develop without attributing to them ownership.[200] In this sense, rights reservation strategies are mild, concessional strategies that do not overturn the existing environment of intellectual property protection, but seek ways to recognise traditional contributions within that system.

Rights reservation strategies may create actual, material results for communities of farmers and their varieties. As a property solution, however, they are based only in a justification of being morally entitled to gains from crop germplasm development, and thus will always rely on the cooperation of national and plant breeding industry agents to ensure their protection. They seek compensation and privileges for traditional breeders but do not attempt to challenge in any way the property system that has replaced the commons. It seems unlikely that they alone will be able to redress imbalances in ownership created by private property controls.

---

197 Stenson and Gray, *The Politics of Genetic Resource Control,* 3.
198 Srinivasan, "Exploring the Feasibility of Farmers' Rights", 445.
199 Borowiak, "Farmers' Rights", 513.
200 Stenson and Gray, "Cultural Communities and Intellectual Property in Plant Genetic Resources", 178.

5.3 National Sovereignty under the *Convention on Biological Diversity*

5.3.1 The National Sovereignty Approach

National sovereignty is an increasingly prevalent principle of resource control which has come to override the concept of common heritage in plant genetic resource management. Recently affirmed in the 1992 Convention on Biological Diversity (CBD), the national sovereignty principle places the control of plant genetic resources in the hands of nation states, and rather than seeing the resource as common, recognises that it is possible to trace certain plant genetic resources to specific indigenous communities.[201] The CBD was adopted at the Earth Summit in 1992, creating financial incentives for developing nations to conserve their biodiversity. According to Abbott there are two grounds for the affirmation of national sovereignty over plant genetic resources - "to provide an economic incentive to countries for preserving genetic resources by assuring compensation for their use, and secondly, to enhance economic welfare in countries that house existing stocks of genetic resources by assuring compensation for genetic assets.[202]

The CBD is just the most recent development in a long history of state involvement in plant genetic resources. In fact, state intervention in the development of seeds can be traced back to the Columbian Exchange.[203] Since the advent of scientific plant breeding, the state has been a vital part of distributing and developing the seed. According to Murphy, without the public sector push for the development of new plant breeding technologies and methods, the trebling of food production that has occurred in the past 50 years would not have been possible.[204] The public sector, he argues, as a creator and disseminator of research on the seed has been instrumental to agricultural improvement.[205]

---

[201] Carol Thompson, "International Law of the Sea/Seed: Public Domain versus Private Commodity", *Natural Resource Journal* 44, (2004): 850.

[202] Frederick M. Abbott, "Patents, Biotechnology and Human Rights: The Preservation of Biodiverse Resources for Future Generations" in *Biotechnologies and International Human Rights,* ed. Francesco Francioni, (Oxford: Hart Publishing, 2007), 317.

[203] Lawrence Busch. "The State of Agricultural Science and the Agricultural Science of the State" in *From Columbus to ConAgra: The Globalisation of Agriculture and Food,* ed. Alessandro Bonanno *et.al.* (Kansas: University of Kansas Press: 1994), 74.

[204] Murphy, *People, Plants and Genes,* 261.

[205] Murphy, *People, Plants and Genes,* 263.

Indeed, before the 20th century the state was the principle vehicle of seed research. Evenson reports that at the beginning of the 20th Century research expenditure in the United States was two-thirds public and at the end, only one-third public.[206] This massive shift in expenditure has had significant consequences for the agriculture industry, and for the production of food in general. In developed agricultural nations of the North, the importance of the state as a broker of research has been significantly diminished.

In a number of developing nations, the relationship between the state and the seed began in the FAO "seed wars", when plant germplasm was recognised as a valuable and increasingly scarce resource. In an attempt to safeguard against so-called biopiracy, many nations have become increasingly defensive of their plant genetic resources. The concern about the acquisition and privatisation of these resources has caused germplasm rich nations to erect barriers around their resources, an action which has implications for both private and common property management. As Fowler and Falcon write, "they [governments] are thus closing the commons themselves by enacting restrictive legislation governing access to genetic resources and by restricting the scope of international agreements aimed at facilitating access to those resources".[207] They add that "governments seem ill prepared to adjust to the transformation they are creating."[208]

As actors in the seed sovereignty debate, states have, with varying degrees of success, played a role as intermediary between private industry and farmer interests. The CBD affirmed the sovereignty of nations over their germplasm resources, in a hope that more equitable bilateral agreements between state and private industry would be created as a result. Imbuing nations with sovereignty over their resources was to give them a broker-like position, from which they could better defend the entitlements of traditional farmers while still receiving a share of the commercial rewards from plant breeding.

The most commonly touted success story of this type of arrangement is the contract between American pharmaceutical firm Merck and INBio, a government affiliated biodiversity organisation in

[206] Robert Evenson, "Agricultural Research and Intellectual Property Rights" in *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime,* ed. Maskus and Reichman, 194.
[207] Falcon and Fowler. "Carving up the Commons", 202.
[208] Falcon and Fowler. "Carving up the Commons", 198.

Costa Rica. Under the deal, INBio provides Merck with 10 000 samples of soil, plants and animals it needs for its pharmaceutical research, and Merck compensates INBio with $1.1 million US, as well as a portion of licence fees from its patents. 10 percent of INBio's budget goes to the Costa Rican National Park Fund.[209] The agreement has provided a model for a partnership between private sector organisations and states to create equitable transfers of resources.[210]

As a principle organising the management of plant genetic resources, state sovereignty is a complicated concept. Sovereignty confers the right to legitimately command authority over a given jurisdiction.[211] It is not synonymous with ownership, and sovereignty in terms of the CBD has an element of custodianship. States may exercise a sovereign right over their natural resources, but in doing so are expected to safeguard and protect those resources.[212] According to Bromley, this suggests that "'ownership' resides with the citizenry at large, management and control resides with a class of bureaucrats, while use resides with a subset of the citizenry."[213] The affirmation of state sovereignty does not render plant genetic resources a part of a state property regime, but instead places the state firmly between common and private ownership, giving it the task of negotiating between them.

5.3.2 Evaluating National Sovereignty as a Strategy for Resolving Property Problems

Since the 1980s, the environment in plant genetic resource management has been permeated by a sense of injustice from many gene-rich developing nations. The CBD is important in that it recognises firstly that these gene resources have value, and secondly that their ownership can be traced to specific communities. National sovereignty is said to herald the possibility of equitable solutions for traditional communities of farmers in future negotiations over plant genetic resources. Unlike the concept of farmers' rights, which according to Kloppenburg and Kleinman has "potentially narrow connotations",[214] the national sovereignty principle offers a comprehensive solution for negotiating

[209] Michael Flitner, "Biodiversity: Of Local Commons and Global Commodities" in *Privatizing Nature,* ed. Goldman, 163.
[210] Raustiala and Victor, "The Regime Complex for Plant Genetic Resources", 289.
[211] Daniel Philpott, "Ideas and the Evolution of Sovereignty" in *State Sovereignty: Change and Persistence in International Relations* (Pennsylvania State University Press: 1997), ed. Sohail Hashmi, 17.
[212] Miranda Schreurs,"Conservation, Development and State Sovereignty" in *State Sovereignty: Change and Persistence in International Relations* (Pennsylvania State University Press:1997), ed. Sohail Hashmi, 202.
[213] Bromley, "The Commons, Common Property, and Environmental Policy", 10.
[214] Kloppenburg and Kleinman, "Seeds of Controversy" in *Seeds and Sovereignty,* ed. Kloppenburg, 197.

access and compensation for traditional farmers.

Considerable expectations are placed on public sector research to fill the gaps that are left by private research. Public sector breeding is expected to develop the crops that are not of high research priority to corporate breeders, and to "optimize public benefits" from advancements in agriculture.[215] It is hoped that with support from the private sector through arrangements under the CBD, these expectations will be more effectively met.

Ensuring that the state sovereignty principle is used effectively is essential to its ability to solve the property problems created by IPRs. In some circumstances it can actually work to the detriment of commons management. As Falcon and Fowler write that "in an attempt to prevent the closing of the commons by patents and in a simultaneous attempt to exploit market opportunities of their own, countries are now restricting access to once public materials."[216] In these circumstances the desire to affirm state sovereignty overrides the intended outcome, to use national sovereignty as a means to negotiate more equitable results for traditional communities. The principle of state sovereignty does not outright benefit traditional farmers outright, it must be used in specific ways to ensure that community interests are served.

The major concern with the principle of national sovereignty and its ability to achieve results for traditional farmers is ensuring that the link between government and traditional communities is firmly established. The CBD, recognising this challenge, requires that prior informed consent of the use of a bioresource come not just from the state in question but also the local community involved. The Merck/INBio agreement is heralded as the model example of the type of arrangement that can be made through the provisions of the CBD. However, it may not be applicable or even possible in all situations. Not all countries may be fortunate enough to attract an interested commercial partner, and according to Falcon and Fowler, "it is difficult to see how peasants and indigenous peoples can provide informed consent to bioprospecting activities and construct exchange agreements adequately sensitive

[215] Gurdev S. Khush, "Biotechnology: Public-Private Partnerships and Intellectual Property Rights in the Context of Developing Countries" in *Biodiversity and the Law: Intellectual Property, Biotechnology and Traditional Knowledge.* ed. Charles McManis, (London: Earthscan, 2007), 184.

[216] Falcon and Fowler, "Carving up the Commons", 202.

to their own interests."[217]

Further, the contractual relationships that are created through the use of the national sovereignty may exclude a range of potential beneficiaries from attaining commercial benefit. As Brush notes, "If knowledge and genetic resources collected under contract lead to a patentable product, communities that are not part of the contract but have the same resources can be deprived of the opportunity to commercialize their knowledge".[218] McAfee criticises the INBio organisation for claiming to represent the national interest yet not clearly defining how and to whom the commercial benefits will be spread.[219] Brush argues that the CBD is a final act of commons enclosure, one that has shifted the debate from an abstract international level firmly into the realm of domestic legislation, forcing national legislatures to make provisions for biocontracting.[220]

The principle of national sovereignty can only form an adequate solution if it is treated not as an ends in itself but as a means to negotiate more equitable, contractual relationships over resources. It can, at best, elevate the bargaining position of those countries with germplasm resources, redistributing some of the gains from the current proprietary system into the hands of germplasm-rich states. In principle, it radically restructures the property environment, but the potential for the misuse of the intermediary position of nation-states is high. National sovereignty under the CBD can have potentially positive impacts for traditional communities, but only if it is correctly managed.

5.4 Proprietary Resolutions: Open Source Biotechnology

5.4.1 The Open Source Biotechnology Approach

Open source as a resource organisation paradigm has risen to popularity through its application to the software industry and the development of open source software. Since the 1990s a number of computer software programs have been developed which operate under general public licence – they can be copied and distributed, used and improved, without any of these actions conferring rights in property. Neither the underlying program nor the modifications made by any user can be the subject of

[217] Kloppenburg,"Seeds, Sovereignty, and the Vía Campesina", 9.
[218] Stephen Brush, "Bioprospecting the Public Domain". *Cultural Anthropology,* Vol. 14, No. 4 (Nov., 1999): 539.
[219] K McAfee, "Selling Nature to Save It?" *Society and Space* 17 (1999), quoted in Noel Castree, "Bioprospecting: From Theory to Practice (And Back Again)", *Transactions of the Institute of British Geographers* 28, no. 1 (March 2003): 46.
[220] Stephen Brush, "Bioprospecting the Public Domain", 544.

intellectual property rights. Those who add to these programs get no incentive in right, but do have the incentive of being able to access the technology free of charge.[221]

As Boyle explains, "[t]he importance of open-source software is not that it introduces us to a wholly new idea; it is that it makes us clearly see a very old idea."[222] It draws its logics of operation from much older philosophies of resource management, and is closely linked to the idea of commons management. Open access principles create, according to Kloppenburg, a kind of limited commons, in which only those who consent to share are included'.[223] Recently, attempts have been made to extend the same model of development and distribution to biotechnology. This recognises the fact that seeds, like software, are produced at a high cost to the developer, but can be copied and distributed amongst consumers much more cheaply and easily.

Applied to biotechnology, open source practices could create a "protected commons" for biological research,[224] in which licences to technologies within the system are free. Participatory plant breeding, as defined by Hope, is based on facilitating more equitable access to technology for the benefit of those marginalised by current modes of research.[225] Varieties and technologies would be available under licences that confer access, and any improvements made on varieties under these licences would also be exempt from private property protection. The strength of such a model is that it recognises that farmers are both consumers and developers of seed.[226] The proposed model would transform the environment in plant breeding, encompassing plant varieties, methods of plant breeding and complementary technologies.

Organisations currently operating to promote open source biotechnology include MASIPAG in the Philippines – a group of scientists and farmers who collect, develop and distribute rice varieties. MASIPAG trains farmers in the basic methods of hybridisation and selection and collects landraces

---

221 James Boyle, *The Public Domain: Enclosing the Commons of the Mind.* (New Haven and London: Yale University Press, 2008), 192.

222 Boyle, "The Second Enclosure Movement", 48.

223 Kloppenburg, "Seeds, Sovereignty, and the Vía Campesina", 11.

224 Heike Baumüller and Geoff Tansey, "Responding to Change" in *The Future Control of Food,* ed. Tansey and Rajotte, 193.

225 Janet Elizabeth Hope, *Open Source Biotechnology* (doctoral thesis). http://rsss.anu.edu.au/~janeth/OpenSourceBiotechnology27July2005.pdf.

226 Aoki, *Seed Wars,* 116.

and hybrid varieties alike.[227] CAMBIA, a research institute based in Australia, promotes the BiOS – Biotechnology Open Source – initiative, extending a type of licence which, while distributed free of charge, asks for contributions from those who derive profit from open access technologies.[228]

The open source software movement and those who campaign for farmers' rights have similar aims of attempting to achieve access to a resource whose development works most effectively when an open environment of innovation is permitted.[229] Open source biotechnology is a practice with the possibility to return control of resources to farmers, while also radically changing research priorities. Beyond this, open source biotechnology represents an attempt to redress the failings of public sector research over the second half of the 20th century and to direct it away from purely serving the aims of the private sector..[230]

5.4.2 Evaluating Open Source Biotechnology as a Potential Resolution for Property Problems

From a property perspective, open source in biotechnology is a unique suggestion because it translates the way that seeds have been held for centuries into a new model which also reflects conservation and technological access problems. As a type of resource management, open access is a system in which no ownership exists (*res nullius).* Under open access regimes, there is no mechanism to exclude users, which can foster the tendency to overuse and exploitation by individual users. This is similar to the situation described in Hardin's "Tragedy of the Commons". The successes of the open source software movement, however, challenge the proposition that innovation will only be effective under a system which confers individual rights of ownership.

There are a number of authors who are critical of open access as a management system. It can be seen as the result of a breakdown in commons management or as an anarchical absence of property management. According to Bromley, "Open access results from the absence - or the breakdown - of an authority system whose very purpose was to assure compliance with a set of behavioral conditions with

[227] Boru Douthwaite, "Enabling Innovation: A Practical Guide to Understanding and Fostering Technological Change" quoted in Aoki, *Seed Wars*, 115.
[228] CAMBIA - http://www.cambia.org/daisy/cambia/home.html
[229] Aoki, *Seed Wars,* 114.
[230] Kloppenburg, "Seeds, Sovereignty, and the Vía Campesina", 26.

respect to the natural resource."[231] Bromley argues that in many cases of resource management, commons management has "deteriorated" into a scheme of open access. The inability to achieve effective group management of a resource and to exclude those outside the demarcated commons group causes the common management system to break down.[232]

Open access can prove a way to reinvent the commons philosophy, without relying on a management system that has proven itself unable to effectively resist private property controls. It operates under the same logics of openness and absence of private rights, while adapting to the realities of a system currently dominated by private IPRs. Open source biotechnology could create a new form of organised resistance behind which farmers' rights advocates and preservationists alike could mobilise.[233] It does not only attempt to circumvent ownership issues but also recognises that private plant breeding industries are targeted primarily towards certain, potentially lucrative crops. Crops like cassava and beans are lower priority for private breeders, but feed many of the world's poor.[234] It would also give smaller companies a greater chance to compete with larger companies by reducing the barriers to industry entry and the costs of variety development.[235]

One of the main issues in applying open source principles to seeds is whether the model is actually appropriate for biotechnology research. Though the resources in question, software and seeds, are similar, the industries built around them function differently. According to Carol Kovacs of IBM, in the software industry, most of the major competitors are already cross-licensed, which is not the case in the plant breeding industry.[236] She warns against the application of a model to this different sort of industry, in which innovation and reward are more closely linked. Aoki notes that genetic information is far less codified than software and far more dynamic.[237]

Open source biotechnology's major obstacle as a transformative property model is

[231] Daniel Bromley, "The Commons, Common Property, and Environmental Policy", 13.
[232] Daniel Bromley, "The Commons, Common Property, and Environmental Policy", 14.
[233] Aoki, *Seed Wars,* 115.
[234] Eran Binenbaum *et.al*, "South-North Trade, Intellectual Property Jurisdictions, and *Freedom to Operate* in Agricultural Research in Staple Crops", *Environment and Production Technology Division Discussion Paper*, (University of California Berkeley, 2000), 4.
[235] Aoki, *Seed Wars,* 119.
[236] Stephan Herrera, "Jefferson: Biography", *Nature Biotechnology* 23, no. 6, (June 2005): 643.
[237] Aoki, *Seed Wars,* 119.

actualisation. Though there are many proponents of the open source biotechnology system, it runs counter to the developments in the seed industry over the past century, and thus for it to have any considerable impact, it requires a significant revision of the relationships of actors within the seed industry. For example, technologies distributed by CAMBIA are unable to be mixed with proprietary technologies, creating reluctance from breeders to use them.[238] The question of how this type of management would be compatible with other international regulations such as the CBD and TRIPS has not been firmly elucidated.

As a property solution, the open source model is the one that best engages with the untenability of the commons/ private property impasse, and creates a solution whereby research is accessible, and the potential for resource theft or an anticommons research situation is obviated. The success of open source biotechnology as a solution for farmers relies on its execution, and the creation of infrastructure that could support it internationally, and clarify its relation to other schemas of ownership. As the most theoretically desirable way to transform the ownership environment in seeds, it is also the most difficult to achieve.

6. Conclusion

Over the course of the 20th century the property environment in plant genetic resources has been radically transformed. New ways of owning these resources, in the form of intellectual property protections including patents and plant breeders' rights, have replaced millenia-old systems of management in common. They have relied on technological developments which place a barrier between farmers and their inputs, and an imbalance of power which has allowed a small number of countries to dictate the shape of a global intellectual property regime. Intellectual property, as a form of private property, is based on the establishment of novelty and an inventive step, and traces ownership back to a single inventor. All of these principles are difficult to apply to the development of seeds. The spread of private property controls over seeds was not an inevitable development, but one

[238] Kloppenburg, "Seeds, Sovereignty, and the Vía Campesina", 14.

that served the interests of a small class of dominant corporate actors in the United States at the turn of the century. An examination of the theory behind the two forms of property that have characterised the 20th century ownership environment in seeds reveals that private property has only cemented itself through subverting the tenets of common property regulation and perpetuating an image of scarcity in a renewable, replicable resource. In reality, commons management has existed as an effective means of managing plant resources for millennia. In the second half of the 20th century, with the increasing standardisation of IP regimes worldwide, the ability of the commons to function as a management system has been further jeopardised. Campaigning for the recognition of farmers' rights, deference to the principle of national sovereignty and the possibility of an open source property system overhaul are three solutions that are posed to overcome the impasse between common and private property in seeds. Only open source biotechnology provides a solution that, while based on the same philosophy as common ownership, is inventive enough to redress the inequalities that private property has created.

Bibliography

Abbott, Frederick M., "Patents, Biotechnology and Human Rights: The Preservation of Biodiverse Resources for Future Generations." In *Biotechnologies and International Human Rights,* edited by Francesco Francioni, 315-331. Oxford: Hart Publishing, 2007.

Andersen, Regine. "A History of Farmers' Rights". *Fridtjof Nansen Institute Paper* 8, (2005). Available at: <http://www.fni.no/doc&pdf/FNI-R0805.pdf.> [Accessed 27 August 2009].

Aoki, Keith. *Seed Wars: Controversies and Cases on Plant Genetic Resources and Intellectual Property.* Durham: Carolina Academic Press, 2008.

Benda-Beckmann, Franz von, Keebet von Benda-Beckmann and Melanie Wiber. *Changing Properties of Property.* New York: Berghahn Books, 2007.

Biber-Klemm, Susette and Thomas Cottier. *Rights to Plant Genetic Resources and Traditional Knowledge: Basic Issues and Perspectives.* Wallingford: CABI Publishing, 2005.

Binenbaum, Eran, Carol Nottenburg, Philip G. Pardey, Brian D. Wright and Patricia Zambrano, "South-North Trade, Intellectual Property Jurisdictions and *Freedom to Operate* in Agricultural Research in Staple Crops", *University of California Berkeley Environment and Production Technology Division Discussion Paper* (2000).

Blakeney, Michael. "Agricultural Research: Intellectual Property and the CGIAR System", in *Global Intellectual Property Rights: Knowledge, Access and Development*, edited by P. Drahos and R. Mayne, 108-123. London: Palgrave Macmillan, 2002.

Bonanno, Alessandro, Lawrence Busch, William Friedland, Lourdes Gouveia, and Enzo Mingione, eds. *From Columbus to ConAgra: The Globalisation of Agriculture and Food.* Kansas: University of Kansas Press, 1994.

Borowiak, Craig. "Farmers' Rights: Intellectual Property Regimes and the Struggle over Seeds." *Politics and Society* 32, (2004): 511-543.

Boyle, James. *The Public Domain: Enclosing the Commons of the Mind.* New Haven and London: Yale University Press, 2008.

Boyle, James. "The Second Enclosure Movement and the Construction of the Public Domain." *Law and Contemporary Problems* 66, no.3 (Winter/Spring 2003): 33-74.

Brac de Perriere, Robert Ali and Frank Seuret. *Brave New Seeds: The Threat of GM Crops to Farmers.* London: Zed Books, 2000.

Bradnee Chambers, W. *Interlinkages and the Effectiveness of Multilateral Environmental Agreements.* New York and Tokyo: United Nations University Press, 2008.

Brockway, Lucile H. *Science and Colonial Expansion: The Role of the British Royal Botanic Gardens.* New Haven, Connecticut: Yale University Press, 2002.

Bromley, Daniel. "The Commons, Common Property, and Environmental Policy." *Environmental and Resource Economics* no.2, (1992): 1-17.

Brush, Stephen. "Bioprospecting the Public Domain." *Cultural Anthropology* 14, No. 4 (November 1999): 535-555.

Brush, Stephen. "The Demise of 'Common Heritage' and Protection for Traditional Agricultural Knowledge", in *Conference on Biodiversity, Biotechnology and the Protection of Traditional Knowledge.* St Louis: Washington University, April 4-6 2003. Available at: <http://law.wustl.edu/centeris/Papers/Biodiversity/PDFWrdDoc/StLouis1.pdf> [Accessed 27 August 2009].

Brush, Stephen. *Farmers' Bounty: Locating Crop Diversity in the Contemporary World.* New Haven and London: Yale University Press, 2004.

Buanec, Bernard Le and Patrick Heffer. "The Role of International Seed Associations in International Policy Development." *Journal of New Seeds* 4, no.1 (2002): 77 – 87.

Castree, Noel. "Bioprospecting: From Theory to Practice (And Back Again)." *Transactions of the Institute of British Geographers* 28, no. 1 (March 2003): 35-55.

Cleveland, David A., and Stephen C. Murray. "The World's Crop Genetic Resources and the Rights of Indigenous Farmers." *Current Anthropology* 38, no. 4 (Aug-Oct. 1997): 477-515.

Demsetz, Harold. "Toward a Theory of Property Rights". *The American Economic Review* 57, no. 2, (May 1967): 347-359.

Doyle, Jack. *Altered Harvest: Agriculture, Genetics, and the Fate of the World's Food Supply.* New York: Viking, 1985.

Drahos, Peter. "The Right to Food, Health and Intellectual Property in the Era of Biogopolies" in *Commercial Law and Human Rights,* edited by Stephen Bottomley and David Kinley, 215-234. Aldershot: Ashgate Publishers, 2002.

Dutfield, Graham. *Intellectual Property, Biogenetic Resources and Traditional Knowledge.* London: Earthscan, 2004.

Dutfield, Graham. *Intellectual Property Rights and the Life Science Industries: A Twentieth Century History.* Burlington: Ashgate Publishing, 2003.

Evenson, R.E., D. Gollin, V. Santaniello, eds. *Agricultural Values of Plant Genetic Resources.* Wallingford: CABI Publishing, 1998.

Falcon, W. and Cary Fowler. "Carving up the Commons – Emergence of a New International Regime for Germplasm Development and Transfer." *Food Policy* 27, (2002): 197-222.

Farnham, Timothy. *Saving Nature's Legacy: Origins of the Idea of Biological Diversity.* New Haven and London: Yale University Press, 2007.

Fedoroff, Nina Vsevolod and Nancy Marie Brown. *Mendel in the Kitchen: A Scientist's View of Genetically Modified Foods.* Joseph Henry Press, 2004.

Footer, Mary. "A Tale of Two Commons: Plant Genetic Resources and Agricultural Trade Reform" in

The Regulatory Challenge of Biotechnology: Human Genetics, Food an Patents edited by Hans Somsen. Cheltenham: Edward Elger, 2007.

Gepts, Paul. "Who Owns Biodiversity, and How Should the Owners Be Compensated?" *Plant Physiology* 134 (April 2004): 1295–1307.

Goldman, Michael. *Privatizing Nature: Political Struggles for the Global Commons.* New Jersey and New Brunswick: Rutgers University Press, 1998.

Hardin, Garrett. "The Tragedy of the Commons." *Science* 162, (1968): 1243-1248.

Hashmi, Sohail (ed). *State Sovereignty: Change and Persistence in International Relations.* Philadelphia: Pennsylvania State University Press, 1997.

Helfer, Lawrence. *Intellectual Property Rights in Plant Varieties: The Legal Regulations and Policy Options for National Governments.* FAO Legislative Study, 85/204.

Heller, Michael. "The Tragedy of the Anticommons: Property in the Transition from Marx to Markets." *Harvard Law Review* 111, (1998): 621-688.

Herrera, Stephan. "Jefferson: Biography." *Nature Biotechnology* 23, no. 6, June 2005.

Hope, Janet Elizabeth. *Open Source Biotechnology.* Doctoral Thesis for the Australian National University. http://rsss.anu.edu.au/~janeth/OpenSourceBiotechnology27July2005.pdf. [Accessed 27 August 2009].

Juma, Calestous. *The Gene Hunters: Biotechnology and the Scramble for Seeds.* London: Zed Books, 1989.

Kloppenburg, Jack. *First the Seed: The Political Economy of Plant Biotechnology 1492-2000.* Cambridge: Cambridge University Press, 1990.

Kloppenburg, Jack. R, ed. *Seeds and Sovereignty: The Use and Control of Plant Genetic Resources.* Durham: Duke University Press, 1988.

Kloppenburg, Jack, and Daniel Kleinman. "Seeds of Struggle: Genetic Resources and Geopolitics." *Technology Review* 90, (February/March 1987), 47-53.

Kloppenburg, Jack. "Seeds, Sovereignty, and the Vía Campesina: Plants, Property, and the Promise of Open Source Biology". November 2008.
http://www.drs.wisc.edu/kloppenburg/_publications/2008%20Seeds%20and%20Sovereignty.pdf

Keohane, Robert O. and Elinor Ostrom, eds. *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains.* London: Sage Publications, 1995.

Lappe, Marc. and Britt Bailey. *Against the Grain: The Genetic Transformation of Global Agriculture.* London: Earthscan, 1999.

Locke, John. *Two Treatises of Government* [1689]. Cambridge: Cambridge University Press, 1960.

Maskus, Keith, ed. *Intellectual Property, Growth and Trade (Frontiers of Economics and Globalization) volume 2.* Oxford: Elsevier Science Publishing Company, 2008.

Maskus, Keith, and Jerome Reichman, eds. *International Public Goods and Transfer of Technology under a Globalized Intellectual Property Regime.* Cambridge: Cambridge University Press, 2005.

May, Christopher. *A Global Political Economy of Intellectual Property Rights: The New Enclosures?* London and New York: Routledge, 2009.

Mazoyer, Marcel and Laurence Roudart. *A History of World Agriculture: From the Neolithic Age to the Current Crisis.* New York: Monthly Review Press, 2006.

McManis, Charles R, ed. *Biodiversity and the Law: Intellectual Property, Biotechnology and Traditional Knowledge.* London: Earthscan, 2007.

Mies, Maria and Vandana Shiva. *Ecofeminism: Reconnecting a Divided World.* London: Zed Books, 1993.

Mooney, Pat Roy. "The Law of the Seed." *Development Dialogue* 1-2, (1983).

Mooney, Pat Roy. *Seeds of the Earth – A Public or Private Resource?* Ottawa, Canada: Inter Pares, 1979.

Murphy, Denis J. *People, Plants and Genes: The Story of Crops and Humanity.* Oxford: Oxford University Press, 2007.

Murray, David. *Seeds of Concern: The Genetic Manipulation of Plants.* Wallingford: CABI Publishing, 2003.

Ong, Burton. *Intellectual Property and Biological Resources: Perspectives on Contemporary Issues.* Singapore: Marshall Cavendish Academic, 2004.

Ostrom, Elinor. "Private and Common Property Rights" in *Encyclopedia of Law and Economics, Vol. II: Civil Law and Economics.* Ghent, Belgium: University of Ghent, 2000.

Ostrom, Elinor. *Governing the Commons.* Cambridge: Cambridge University Press, 1990.

Pardey, Philip, ed. *The Future of Food: Biotechnology Markets and Policies in an International Setting.* Washington, D.C.: International Food Policy Research Institute, 2001.

Pearse, Andrew. *Seeds of Plenty, Seeds of Want: Social and Economic Implications of the Green Revolution*. Oxford: Clarendon Press, 1980.

Pence, Gregory. *The Ethics of Food.* Oxford: Rowman and Littlefield, 2002.

Pistorius, Robin. *Scientists, Plants and Politics: A History of the Plant Genetic Resources Movement.* Rome: International Plant Genetic Resources Institute, 1997.

Pringle, Peter. *Food, Inc: Mendel to Monsanto – The Promises and Perils of the Biotech Harvest.* New York: Simon and Schuster, 2003.

Raustiala, Kal and David G. Victor. "The Regime Complex for Plant Genetic Resources." *International Organization* 58, (Spring 2004): 277–309.

Rose, Carol. "Possession as the Origin of Property" in *Property and Persuasion: Essays on the History, Theory, and Rhetoric of Ownership.* Boulder: Westview Press, 1994.

Rose, Carol. "The Comedy of the Commons: Commerce, Custom and Inherently Public Property", *University of Chicago Law Review* 53*,* 711 (1986).

Scrinis, Gyorgy. *Colonizing the Seed: Genetic Engineering and Techno-Industrial Agriculture.* Melbourne: Friends of the Earth, 1995.

Shiva, Vandana. *Monocultures of the Mind: Perspectives on Biodiversity and Biotechnology.* London: Zed Books, 1993.

Shiva, Vandana. *The Violence of the Green Revolution: Third World Agriculture, Ecology and Politics.* London: Zed Books, 2000.

Shiva, Vandana, Patrick Anderson, Heffa Schuecking, Andrew Gray, Larry Lohmann, David Cooper. *Biodiversity: Social and Ecological Pespectives.* London, Zed Books, 1991.

Srinivasan, C.S. "Exploring the Feasibility of Farmers' Rights." *Development Policy Review* 21, no. 4 (2003): 419-447.

Stenson, Anthony and Tim Gray. "Cultural Communities and Intellectual Property in Plant Genetic Resources" in *Justice, Property and the Environment – Social and Legal Perspectives* edited by Tim Hayward and John O'Neill. Aldershot/Vermont: Ashgate, 1997.

Stenson, Anthony and Tim S. Gray. *The Politics of Genetic Resource Control.* New York: St. Martin's Press, 1999.

Tansey, Geoff and Tamsin Rajotte, eds. *The Future Control of Food: A Guide to International Negotiations and Rules of Intellectual Property, Biodiversity and Food Security.* London: Earthscan, 2008.

Thompson, Carol. "International Law of the Sea/Seed: Public Domain versus Private Commodity." *Natural Resource Journal* 44, 2004: 841-866.

Wiber, Melanie. *The Voracious Appetites of Public versus Private Property: A View of Intellectual Property and Biodiversity from Legal Pluralism.* CAPRI Working Paper 40, International Food Policy Research Institute.

The Ecologist. *Whose Common Future? Reclaiming the Commons.* London: Earthscan, 1993.

The Rural Advancement Foundation International (RAFI). *Enclosures of the Mind: A Resource Kit on Community Knowledge, Biodiversity and Intellectual Property.* Ottawa: RAFI, 1997.

Legislation and Cases

International Undertaking on Plant Genetic Resources (IUPGR), Food and Agriculture Organisation, (1983). [Internet] Available at:
<ftp://ftp.fao.org/ag/cgrfa/iu/iutextE.pdf> [Accessed 27 August 2009].

Convention on Biological Diversity (CBD), United Nations (1992). [Internet] Available at:
<http://www.cbd.int/doc/legal/cbd-un-en.pdf.> [Accessed 27 August 2009].

Trade Related Aspects of Intellectual Property Rights (TRIPS), World Trade Organisation (1994). [Internet] Available at:
<http://www.wto.org/english/tratop_e/trips_e/t_agm0_e.htm> [Accessed 27 August 2009].

International Treaty of Plant Genetic Resources for Food and Agriculture (ITPGR), Food and Agriculture Organisation, (2001). [Internet] Available at:
<ftp://ftp.fao.org/docrep/fao/011/i0510e/i0510e.pdf> [Accessed 27 August 2009].

GRAIN. Archive of Biodiversity Rights Legislation. [Internet] Available at:
<http://www.grain.org/brl/> [Accessed 27 August 2009].

Diamond v Chakrabarty 447 U.S. 303 (1980).

LINDSAY ASH
Address: Neulerchenfelderstr. 2/17
Vienna 1160
AUSTRIA
Date of Birth: 01/02/1985
Email: ashlindsay@hotmail.com

EDUCATION HISTORY – TERTIARY

Institution: University of Vienna, Austria/ University of Leipzig, Germany
Duration: 2007-2009
Degree: Master of Arts in Global Studies
Major areas of study: Global History, European Politics, International Law, Area Studies, Political and Economic Theory, Study of International Institutions.

Institution: Macquarie University, Sydney, Australia
Degree: Bachelor of Laws
Duration: 2004 – 2006 (placed on hold while studying Masters Degree, to be resumed on a part-time basis from 2010)
Current GPA: 3.786
Major Areas of Study: Constitutional, Criminal and Property Law

Institution: Macquarie University, Sydney, Australia
Degree: Bachelor of Arts
Duration: 2004 - 2006
GPA: 3.620
Major Areas of Study: World History, Modern History, German, International Politics.

EDUCATION HISTORY – SECONDARY

Institution: Trinity Senior High School, Wagga Wagga
Certificate: Higher School Certificate, 2002
Results (University Admissions Index): 98.65
Awards Received: Class of 2002 Dux (best overall performance), "Class of 1981 Most Consistent Student" Award, Apex Award for Community Involvement, Academic Achievement Awards (awarded to the student with the highest marks) in Advanced English, Ancient History, Economics, English Extension 1, Legal Studies and Studies of Religion.

EMPLOYMENT HISTORY

November 2005 - July 2007: Senior Customer Service Representative, Video Ezy Gladesville, Sydney.

October 2005 – July 2006: Administrative Assistant and Project Support Manager (voluntary), Oxfam International, Sydney.

August 2004 - October 2005: Education/ Tutoring Services, Acclaim Education.

December 2002 - July 2003: Administrative Assistant, Peter Street Dental Practice

LANGUAGES

Geman Proficiency: Intermediate-Advanced
Courses Taken: Level B1.1 at Goethe Institut in Berlin, Germany, Advanced level German at the University of Vienna.

COMMUNITY SERVICE

2001 – Present – Member of Amnesty International
2005 – 2006 Administrative Assistant and Project Support Manager for Oxfam International Sydney Office, one day per week on a voluntary basis.
2004 – 2005 – Group Coordinator, Clean Up Australia Day

Student Activities and Leadership:
2009 – Participant, European Conference on African Studies, Leipzig, Germany
2008 – Participant, International Congress on Global and World History, Dresden, Germany
2008–Participant, Utrecht Network Summer School: Minorities and Democratic Participation, Queen's University Belfast, Northern Ireland
2003-2007 – Member of Macquarie University Law Society.
2007 - Content Manager and contributing writer for student legal publication *The Brief*.
2005 - Organiser of Macquarie University Oxfam Fair Trade Coffee Stall
2005 – Leader of the Environmental Committee, Dunmore Lang College
2002 –Vice Captain, Trinity Senior High School,
2000-2002 Member of Student Council, Mt Erin High School