GENETIC ENGINEERING AND SEED BANKS: IMPACTS ON GLOBAL CROP DIVERSITY

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Genetic diversity is viewed as a means by which agricultural plants can adapt to the threat of climate change. Maintaining this diversity within agricultural crops is considered vital. The rise of genetic engineering within crop seeds is believed to have a significant impact on crop diversity resulting in monocultures and potentially contributing to a loss in diversity. The concern for loss of genetic diversity has given rise to a greater investment in seed banks as a viable option for preserving and generating seed diversity. However, there are issues associated with the creation of seed banks, including funding controversy and equitable access to genetic material.

I INTRODUCTION

It is believed that genetic engineering (GE) of crop seeds can significantly contribute to plant breeding by generating additional genetic diversity. However, the rise of GE crops can also contribute to a loss of diversity within agriculture by promoting monoculture crops in fields where all plants have the same genetic structure.[1] This has implications for agriculture dependent on crop diversity - genetic material from as many plants as possible is vital. Genetic diversity and plants with different traits supports plants adapting to the threats posed by climate change such as changing rainfall regimes and temperatures;[2] genetic diversity enables the potential for plant adaptation. Genetic diversity within crops is already low and the world's diet is primarily compromised of only 30 crops. Of those, wheat, corn and rice account for more than half of the world's food consumption.[3] A rise in monoculture crops would see crop genetic diversity continue to decrease.

Genetic engineering raises issues of intellectual property rights of patented genetic material and conservation diversity. These issues within agriculture are directly related; commercial

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[1] Paul Gepts, 'A Comparison between Crop Domestication, Classical Plant Breeding, and Genetic Engineering' (2002) 42 *Crop Science* 1780, 1780; Keith Aoki, 'Seeds Dispute: Intellectual-Property Rights and Agricultural Biodiversity' (2010) 3(1) *Golden Gate University Environmental Law Journal* 79, 79.

[2] TEDGlobal, 'One Seed at a Time Protecting the Future of Food', *TED Talks*, July 2009 (Cary Fowler) <http://www.ted.com/talks/cary_fowler_one_seed_at_a_time_protecting_the_future_of_food.html>.

[3] Green Prophet, 'Worldwide Seed and Gene Banks are "Libraries of Life"'(13 September 2010) Green Prophet <http://www.greenprophet.com/2010/09/worldwide-seed-banks/>.

companies patent seeds and agricultural inputs that promote monoculture, eroding biodiversity in both developed and developing countries.[4] In the United States, for example, the 20th century saw mass-scale industrialisation of agriculture resulting in private companies producing seeds and chemical based crop inputs such as fertilisers, herbicides and pesticides.[5]

Commercial agriculture changed from a version where farmers bred and adapted crops to local soil and growing conditions to a model of 'one seed feeds the world';[6] local conditions were modified to suit a particular seed using chemical supplements. This era was termed the *Green Revolution* and resulted in high-yield agriculture with associated environmental degradation and huge loss in plant genetic diversity.[7]

The genetic diversity of many food crops can be traced back to local varieties developed by subsistence farmers.[8] These genetic resources were characterised as the 'common heritage of mankind', to which plant breeders, researchers and agriculturalists had open access.[9] In current times, biotechnology and the use of GE seeds is becoming the dominant practice in countries such as the USA and Canada.[10] Crops such as soybean cotton, canola and corn are the most commonly engineered. It is estimated that 75% of crop biodiversity has been lost since the 1900's and onset of genetically engineered crops.[11] For example, approximately a century ago India had over 100,000 varieties of rice compared to a few 1,000 now.[12] Genetic diversity faces a continued loss. The construction of seed banks to act as storage facilities of seeds represents a key piece of infrastructure for building and preserving the genetic diversity of plants, and perhaps the future of mankind.[13] The rise of genetic engineering and intellectual property rights, has created a dilemma; should genetic resources be common heritage of humankind or should these resources be able to be privately owned via intellectual property laws? The use of seed banks relates to these issues with regard to equity of access to the genetic resources stored within them.

Of the 1,460 gene banks around the world, the Food Authority Organisation (FAO)[14] states that only 35 meet international approval standards for long-term storage and worryingly, nearly one fifth of the 5.4 million seeds stored in these gene banks are degenerating.[15] Approved seed banks include the International Centre for Agricultural Research in Dry Areas (ICARDA) in Syria, the Pavlovsk Experimental Station (Berry Bank) located in Russia, the International Rice Research Institute (IRRI) located in the Philippines, the International Maize and Wheat Improvement Centre (CIMMYT) located in Mexico, the International Potato Centre (IPC) located in Peru and Ecuador and the Svalbard Global Seed Vault (the

[4] Aoki, above n 1, 80.
[5] Ibid.
[6] Ibid.
[7] Ibid.
[8] Stephen B Brush, 'Farmers' Bounty: Locating Crop Diversity in the Contemporary World (Yale University Press, 2004) 9.
[9] Aoki, above n 1, 83.
[10] Ibid.
[11] Food Authority Organization of the United Nations (FAO), *Crop Biodiversity: use it or lose it* (2013) <http://www.fao.org/news/story/en/item/46803/icode/>.
[12] Ibid.
[13] TEDGlobal, above n 2.
[14] Food Authority Organization of the United Nations (FAO) and International Plant Genetic Resources Institute (IPGRI), *FAO/IPGRI Gene Bank Standards* (1994) <ftp://ftp.fao.org/docrep/fao/meeting/015/aj680e.pdf>.
[15] Alex Steffen, *Seed Banks and the Global Crop Diversity Trust* (9 June 2005) World Changing <http://www.worldchanging.com/archives/002867.html>.

Svalbard Vault) located in Norway.[16]

Given these facts, seed banks appear to be a very positive initiative for preserving genetic diversity. This essay will focus on the Svalbard Vault. The reason being, it differs from other seed banks in that it is a *global* vault, rather than a national-level scheme. A global bank appears to be a practical way to protect global plant genetic diversity against threats such as pest, disease, climate change, flooding and droughts. A drawback of these systems however is that significant parties such as farmers, research scientists, plant breeders and companies do not have direct access to the seeds. Instead, samples must be requested from the depositing gene banks from the country of origin.[17]

These conditions have prompted concerns about exploitation of genetic resources by commercial companies and raise issues such as intellectual property rights and conflicts of funding interest. The concept of a global seed bank also raises issues regarding security and equitable access to genetic resources.

It is hoped that implementation of the multilateral *International Treaty on Plant Genetic Resources for Food and Agriculture* (PGRFA) (herein known as the *Treaty*)[18] will adequately address access and benefit-sharing issues and regulate control of intellectual property rights of resources such as GE seeds.

This paper will discuss the use of global seed banks as a measure for preserving plant genetic diversity in an international context. It will focus on the Svalbard Vault, a global seed bank, and highlight issues such as farmers' rights, intellectual property, security of the facility and potential for funding conflicts. Discussion of law will be restricted to the *Treaty*.[19]

II SVALBARD GLOBAL SEED VAULT AND THE GLOBAL CROP DIVERSITY TRUST

Located in Norway, the Svalbard Global Seed Vault (Svalbard Vault) is the largest vault in the world and the main back up of duplicate seeds.[20] The Svalbard Vault was opened in 2008 and contains more than half a million samples (500 seeds per sample) deposited on behalf of 1750 gene banks worldwide. The vault is sunk 125 meters into the Norwegian permafrost, maintained at a constant temperature of -18 ºC and located outside one of the world's most northerly habitations in the village of Longyearbyen. The vault has been installed with a number of security features. These include a concave tunnel head designed to deflect missile strikes, the vault has been built deep enough into the mountain to withstand nuclear explosion and rising sea levels and it would take two centuries to warm to freezing point should the electricity fail.[21]

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[16] Green Prophet, above n 3.

[17] Andrew Kimbrell, *CFS Examines Svalbard Global Seed Vault* (2013) Centre for Food Safety (CFS) <http://www.centerforfoodsafety.org/issues/976/ge-food-labeling/press-releases/755/cfs-examines-svalbard-global-seed-vault>; Linda Pappagallo, *Syria's Seeds Are Locked Away in Norway, But Are Seed Vaults Safe?* (22 March 2012) Green Prophet <http://www.greenprophet.com/2012/03/syria-seed-bank-norway-biodiversity/>.

[18] *International Treaty on Plant Genetic Resources for Food and Agriculture*, opened for signature 3 November 2001 (entered into force 29 June 2004) available at <ftp://ftp.fao.org/docrep/fao/011/i0510e/i0510e.pdf> ('The *Treaty*'). Further, the homepage of the *Treaty* can be accessed at <http://www.planttreaty.org>.

[19] The *Treaty*.

[20] Pappagallo, above n 17.

[21] Ibid.

The Nordic Gene Bank (NordGen) manages the Svalbard Vault under a tripartite agreement between the Government of Norway, the Global Crop Diversity Trust (GCDT)[22], and NordGen. Storage of seed in the Svalbard Vault is free of charge. The facility, which cost nine million USD, has been funded entirely by the Norwegian government and offers a free of charge 'seed deposit service'. Operational costs are covered by the GCDT[23]and they seek to match the long-term nature of conservation needs with secure and sustainable funding and endowments of 260 million USD.[24] Implementation of the *Treaty* has enabled the idea of a global seed vault to become legally accepted.[25] The *Treaty* aims at 'establishing a global system to provide farmers, plant breeders and scientists with access to plant genetic materials' and supposedly 'ensuring that recipients share benefits they derive from the use of these genetic materials with the countries where they have been originated.'[26]

III COMMON HERITAGE PRINCIPLE AND THE TREATY

Seed banks and ensuring access to seeds and their genetic resources has historically been influenced by the idea of *common heritage*; the implicit system for managing the diffusion of crop genetic resources.[27] Common heritage implies genetic resources are public commodities not owned by a private group.[28] Its origins are seen in the free exchange of seed among farmers, the long history of diffusion through informal and formal mechanisms, established scientific practices and applying the term to other resources in the international arena.[29] Common heritage implies open access. Crop genetic resources derive originally from the natural processes of crop evolution: mutation, natural selection, exchange and decentralised selection. The principle of reciprocity is inherent to common heritage of genetic resources. Those taking seeds are expected to provide similar access to crop resources.[30] Farmers who openly provide seed expect to receive it in the same manner and the same is true for crop breeders. This principle is a vital aspect of the *Treaty*.[31]

The *Treaty* applies only to plant genetic resources considered useful for food and agriculture establishing the following objectives: (1) to encourage the conservation of plant genetic resources in order to preserve and enhance the genetic diversity of plant species and varieties of value to food or agriculture; (2) to provide a workable, juridical basis for rewarding farmers for their contributions in conserving, improving, and making available plant genetic resources; (3) further development of the system of national sovereignty over plant genetic resources first established in the Biological Diversity Treaty (CBD)[32], while ensuring that such exercise of sovereignty does not hinder international exchange of such resources; and

[22] Global Diversity Trust, <http://www.croptrust.org/main/>.
[23] Ibid.
[24] Ibid.
[25] Pappagallo, above n 17.
[26] Ibid.
[27] Stephen B Brush, 'The Demise of 'Common Heritage' and Protection for Traditional Agricultural Knowledge' in C. R. McManis (ed), *Biodiversity and the Law: Intellectual Property, Biotechnology and Traditional Knowledge* (Earthscan, London, 2007) 297, 298.
[28] Ibid.
[29] Ibid.
[30] Ibid.
[31] Shawn Sullivan, 'Plant Genetic Resources and the Law: Past, Present, and Future' (2004) 135 *Plant Physiology* 10, doi:10.1104/pp.104.042572, 11.
[32] *Convention on Biological Diversity* ('CBD Treaty'), UN Doc DPI/130/7 (opened for signature 5 June 1992, adopted 29 December 1992).

(4) creation of a Multilateral System of Access and Benefit-Sharing, which will coordinate exchanges of plant genetic resources, and in some cases, require payments by persons or entities who commercially exploit such resources, to the nations from which such resources originated.[33]

Relevant to common heritage, Article 9 of the *Treaty* strongly reaffirms the principle of Farmers' Rights[34] and requires each member state, 'subject to its national legislation', to take measures to promote and protect Farmers' Rights, including: protection of traditional knowledge relevant to PGRFA; The right to equitably participate in sharing benefits arising from the utilization of PGRFA; and the right to participate in making decisions, at the national level, on matters related to the conservation and sustainable use of PGRFA.[35]

The *Treaty* is implemented through the Global Plan of Action. The obligation being to undertake capacity building, technology transfer and exchange of information activities referred to in Articles 14, 13(2), 13(4) and 18(3).[36] Whilst the Global Plan of Action provides a framework for the conservation and sustainable use of plant genetic resources, and has been adopted by many countries, implementation has been limited. The FAO Conference Resolution adopting the *Treaty* notes that the *Treaty* is to facilitate implementation of the Global Plan of Action, and likewise implementation of the Global Plan of Action will contribute to the success of the *Treaty*.[37]

IV ISSUES FOR CONSIDERATION

A *Multilateral System for Access and Benefit Sharing*

Central to the *Treaty* is the implementation of the Multilateral System for utilisation and conservation in research, breeding and training. This system aims to guarantee facilitated access in return for benefit sharing as instructed in the *Treaty's* Preamble; agriculture worldwide relies on genetic resources that originated elsewhere.[38] It is extremely difficult to attribute country of origin to genetic resources of major crops since they are widely distributed *ex situ* in both gene banks and in production. This situation has arisen due to movements of people, resources and through collecting efforts across millennia. It is hoped the Multilateral System will provide access to a wide array of genetic resources without restriction, enabling significant advances be made in crop improvements integral to food security and sustainable agriculture.

In creating the multilateral agreement caution was taken not to undermine provisions of the CBD, in particular Article 15 giving States sovereign rights over their own natural resources. It is believed the *Treaty* does balance access and benefit-sharing with Article 10 specifying that these should be 'complementary' and mutually reinforcing'. However, a limitation of the multilateral agreement is the breadth of crops listed by the *Treaty* because there is no

[33] Ibid.
[34] Charles R. McManis, 'Biodiversity, Biotechnology and Traditional Knowledge Protection: Law, Science and Practice' in C. R. McManis (ed), *Biodiversity and the Law: Intellectual Property, Biotechnology and Traditional Knowledge* (Earthscan, London, 2007) 1-6.
[35] Ibid.
[36] David H. Cooper, 'The International Treaty on Plant Genetic Resources' (2002) 11(1) *Review of European, Comparative & International Environmental Law* 1-11.
[37] FAO Resolution, 3/2001 (Rome, 3 November 2001), Article A (5).
[38] Cooper, above n 36, 4.

completely objective way of compiling a definitive list of *all* genetic resources.[39] It does cover the major food crops plus forages,[40] with Article 11 stating the list is 'established according to criteria of food security and interdependence'. Whilst it covers globally and regionally important staples, different species of minor staples important for local food security in local areas are absent; no list could every include all these without becoming unwieldy.[41]

B *Intellectual Property, UPOV and TRIPS*

Applying intellectual property rights to plant material has been highly controversial in many countries. Many cultural and moral objections have been raised against the idea of owning life. In addition, many people fear that the expansion of intellectual property rights could restrict traditional uses of plants and other substances found in nature.[42] Patents covering modified living organisms were first approved by the United States Supreme Court in 1980,[43] and since then intellectual property rights covering organisms and/or their components have become commonplace in many countries. These intellectual property rights have expanded internationally through treaties such as the *International Convention for the Protection of New Varieties of Plants*[44] (UPOV) (first drafted in 1961 and revised in 1972, 1978 and 1991) and the World Trade Organization's (WTO) *1994 Agreement on Trade-Related Aspects of Intellectual Property* (TRIPS *Agreement*).[45]

These treaties, agreements among sovereign nations, established common features of certain intellectual property rights. In ratifying the treaties, each nation signatory pledged to enact those common features into its national law. One of the most controversial of those features is contained in Article 27.3(b) of the TRIPS *Agreement*. This agreement requires all WTO member states to provide intellectual property protection such as patents, for plant varieties.[46] As a result of the TRIPS article, WTO member countries have an obligation under international law to make available some intellectual property protection for plant varieties.

It is generally held and expected that intellectual property rights will protect extant material from being removed from the public domain. Despite this, controversial cases have occurred. For example, in the United States a patent was granted covering a variety of yellow beans believed by many to have been widely used for generations in Latin America.[47] Another case heard in Canada, *Monsanto Canada Inc v Schmeiser*[48], is also considered important when discussing intellectual property rights and plant genetic resources. The outcome of this case was thought to encourage certain types of activities and investment, by way of granting intellectual property rights, potentially giving rise to the erosion of biodiversity.[49] In this case

[39] The *Treaty*, Annex 1.
[40] The *Treaty*.
[41] Cooper, above n 36, 6.
[42] Ibid.
[43] *Diamond v. Chakrabarty*, 447 US 303, 309 (1980).
[44] *International Convention for the Protection of New Varieties of Plants,* opened for signature 2 December 1961, 815 UNTS 89 (entered into force 24 April 1968) ('UPOV Act').
[45] McManis, above n 34, 1-6; *Marrakesh Agreement Establishing the World Trade Organization,* opened for signature 15 April 1994, 1867 UNTS 3, annex 1C (Agreement *on Trade-Related Aspects of Intellectual Property Rights)* (entered into force 1 January 1995) ('TRIPS *Agreement').*
[46] Kimbrell, above n 17.
[47] Timothy Pratt, 'Small yellow bean sets off international patent dispute', *New York Times*, 20 March 2001.
[48] *Monsanto Canada Inc v Schmeiser* [2004] 1 SCR 902; 2004 SCC 34
[49] Aoki, above n 1, 80-3.

the difference between 'raw' and 'worked' seeds was an important distinction. 'Worked' seeds could be protected by intellectual property laws whereas 'raw' (wild and weedy relatives of cultivated crops) were beyond protection.[50] This has implications if corporations have additional advantages in access to genetic resources in seed banks compared with farmer. Corporations may potentially patent any cultivars of seed that have been donated by localised farmers in areas that employ heritage cultivars, perhaps wild relatives of 'modern day' hybridised seeds. There is a perception that the advantages and disadvantages of intellectual property rights are reflected in the *Treaty* in a balanced manner; that there is inherent bias in favour of plant breeders' rights over patents in the provisions for commercial benefit-sharing.[51] The *Treaty* may benefit small seed companies compared with large multinationals.[52] However, areas of concern have been raised.[53] In some jurisdictions, even though there is a multilateral agreement, a patent holder could still restrict the use of 'protected' material by others, even if it was obtained using the system.[54] This situation may arise in jurisdictions where it is possible to patent DNA sequences without any structural modification. This is to the detriment of access and equity and in contradiction of the spirit of the *Treaty*.[55]

C *Farmers' Rights and Complexity of Seed Deposit Framework*

Farmers have made significant contributions to the conservation and development of plant genetic resources. The *Treaty* reflects this through the notion of Farmers' Rights, including the protection of traditional knowledge and the right to participate equitably in benefit-sharing and in national decision making. The FAO 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 centers of origin/diversity.'[56] Such rights are also recognised in Article 9 of the *Treaty*.

There is concern that the multilateral agreement with a global seed vault (rather than a national facility) such as Svalbard is too convoluted to enable a local farmer to gain access to genetic plant resources stored in the vault; it is thought that the 'common heritage' principle is not reflected. If a particular genetic resource had ceased to exist in a particular country, would that farmer know of the 'services' offered by the Svalbard Vault? Would they have, or need, financial resources and means to be able to request seeds from Svalbard? A concern with the *Treaty* is that the interpretation and realisation of farmers' rights is weak and not the same across all countries.[57] The agreement states that farmers, researchers, plant breeders, companies and scientists do not have direct access to the seeds. Instead, they must request samples from the depositing gene banks from the country of origin; as a result farmers may have the least equity in their ability to request samples compared with other groups such as researchers and plant breeders.

This system possibly results in the farmer having no real power to decide what, when and how to use any particular seed. Without a consistent, strong international focus on realising

[50] Ibid.
[51] Cooper, above n 36, 15.
[52] Ibid.
[53] Ibid.
[54] Ibid, 9.
[55] Ibid.
[56] Resolution No. 5/89 adopted by FAO Conference 25th Session (Rome, 11–20 November, 1989).
[57] Farmer's Rights Project, *Resources Page for Decision-Makers and Practitioners* (20 June 2013) <http://www.farmersrights.org/>.

the rights of farmers who conserve and sustainably use genetic resources, genetic variety of crops and related agricultural biodiversity may suffer.[58] India, for example, includes an interpretation of farmers' rights in its *Plant Variety Protection and Farmers' Rights Act*.[59] The Act allows farmers a restricted right to save and sell seed they have produced on-farm as they always have, even if it contains genes from a protected variety.

Most seed banks at a national level require a simple Memorandum of Understanding with depositors, allowing for informed consent by depositors.[60] Nongovernmental organisation (NGO) groups such as Centre for Food Safety (CFS)[61] are concerned that the Svalbard framework gives little chance that seed banks and collections, especially those that are local, smaller scale and/or from developing countries, will not have the legal funding or expertise to decipher the agreement. The GCDT spend millions of dollars in acquiring local and smaller seed collections from developing countries for incorporation within the Svalbard Vault, and it is thought that due to the complexity of the deposit agreement these developing countries will not be able to give informed legal consent.

Additionally, farmers' rights are at odds with the *Treaty* because many farmers and farming communities do not claim exclusive rights in the traditional cultivars and plant varieties they have cultivated over time. Moreover, existing law is designed to protect innovations in new and clearly distinguishable plant varieties and cannot accommodate individual farmers contributing through using informal methods to select for better crops or sought-after plant characteristics.[62]

The discretion of each State to shape their own plant protection laws is dependent upon the international agreements to which they are party to, and these may in turn impact which plant resources can be banked within the global seed bank. For example, the components of plant variety protection that a State must adopt depends upon whether they are a member of WTO only, WTO and the *1991 UPOV Act*,[63] WTO and the *1978 UPOV Act*,[64] either the *1991 UPOV Act* or the *1978 UPOV Act* only or have no agreements relating to the protection of plant varieties.[65] States will differ in which agreements they have entered thus influencing what genetic resources will be banked under the *Treaty* into a global vault such as the Svalbard Vault. The complicated nature of such international agreements are worthy of a fuller discussion elsewhere.[66]

D *Patenting of Genetic Resources*

Depositing the world's wealth of crop varieties that have been considered 'humanity's common heritage' into a global seed bank raises intellectual and patent ownership issues and is a concern of the Svalbard Vault.[67] The legality of the framework supporting the deposit

[58] Ibid.
[59] *Plant Variety Protection and Farmers' Rights Act* (India) 'Act No. 53 of 2001'.
[60] Farmer's Rights Project, above n 56.
[61] Centre for Food Safety, Homepage, <http://www.centerforfoodsafety.org/about/.>
[62] Laurence, R. Helfer, *Intellectual property rights in plant varieties International legal regimes and policy options for national governments* (FAO Legislative Study 85, 2004) 17.
[63] UPOV Act
[64] Ibid
[65] Helfer, above n 61.
[66] Ibid.
[67] Kimbrell, above n 17.

agreements has been investigated by NGO's such as the CFS. The CFS was interested in determining whether the contract between the Svalbard Vault and depositors of seed created an advantage for corporations in their efforts to control and patent seed genetics. A legal memorandum was created by the CFS outlining the relevant legislation[68] and CFS concluded that the framework does indeed provide additional advantage to corporations seeking to patent plant genetics.[69] This concern is based in the provisions and the possible interpretations of the multilateral Treaty.[70] However, CFS acknowledge that determining this was not clear cut since the Svalbard Vault deposit agreement is extremely complicated and involves interpretation of international law.[71]

It is important to note that the *Treaty* does not automatically mean seed deposited in the Svalbard Vault are patentable, it is not *a priori*. Instead, the *Treaty* states plants '...are under the management and control of the contracting parties and in the public domain.'[72] Because the information shared is regarding plants in the public domain, the individual plants themselves will not be patentable. However, while the genetic resources of seeds or plants deposited in Svalbard Vault will not be patentable, the genetic information and properties of deposits can still be used by corporations to facilitate the creation of new patentable plant hybrids and GE varieties. A suggestion for addressing this issue has been to completely de-link the deposit agreement from the *Treaty*. CFS believes this would be a critical first step in reducing the potential of the Svalbard Vault to facilitate corporate commercial and patent exploitation of the genetic resources deposited there.[73]

All seeds stored in the Svalbard Vault remain the property of the country or institution that sent them, and under the terms of the *Treaty*, any seeds accepted for storage at the Vault must be freely available. This means that any seed stored must be easily accessible by contacting the gene bank that sent them. This very arrangement has been criticised by NGO's, stating that the deposit system actually contributes to the decline of biodiversity by giving greater seed access to biotechnology companies. Biotechnology companies could contact the depositing seed bank directly or through institutions whose research they fund and patent crop seeds.[74] As stated, potential for this to occur rests completely on interpretation of the deposit agreement.[75]

E *Relationship with the GCDT - Controversial Funding*

The issue of who funds the global seed bank is of importance. Whilst the Norwegian government funded the construction, it is money from contributions to the GCDT that funds the operation of the Svalbard Vault.[76] If a corporation whose business models were associated with declining biodiversity through techniques such as mono cropping and production of GE organisms like Monsanto were to be a major funder of the GCDT, it would appear to contradict the initial intention of the global vault. The list of GCDT supporting entities

[68] Ibid.
[69] Ibid.
[70] The *Treaty*.
[71] Kimbrell, above n 17.
[72] The *Treaty*, Article 11.2.
[73] Kimbrell, above n 17.
[74] Deniza Gertsberg, 'Controversy with the Doomsday Vault', *GMO Journal* (online), 22 March 2012 <http://gmo-journal.com/index.php/2012/03/22/controversy-with-the-doomsday-vault/>
[75] Ibid.
[76] Global Diversity Trust, above n 22.

include philanthropist foundations such as the Bill and Melinda Gates Foundation, corporations associated with promotion of GE crop seeds and seed companies that vigorously strive to patent plant genetics. The Bill and Melinda Foundation, by far the largest NGO donor, gave nearly $30 million to the GCDT.[77] This Foundation also has ties to GE organism producer Monsanto, purchasing $23 million of Monsanto shares in 2010.[78] Other foundations with ties promoting GE crops that have also contributed to the GCDT include the Rockefeller Foundation and the Syngenta Foundation. Companies that have donated money to GCDT include DuPont/Pioneer HiBred and Syngenta.[79] These companies are responsible for the majority of GE creation and marketing. Essentially, philanthropic foundations such as the Bill and Melinda Gates Foundation are promoting mutually exclusive models – supporting GE seed producers associated with mono cropping and declining biodiversity while at the same time funding the GCDT who support biodiversity preservation.

F *Political Instability*

The threat of civil war within a country poses a problem for the security of a global seed bank. A global seed bank located in a stable country appears a reasonable strategy for protecting the world's seeds, especially if it accepts seeds from a country where civil war is a threat. However, the country of choice for the global vault needs to be carefully selected, for war would endanger not just that country's seeds but also those of the global community. Whilst civil war does not appear to pose a threat in Norway, it is an issue for consideration. Syria and the ICARDA seed bank located in Aleppo, is a case in point. This seed bank focuses on plants suitable for sustainable agriculture in arid climates and houses seeds from 131,000 varieties of plants gathered from across the Middle East, Central Asia and North Africa.[80] Unfortunately, the civil war in Syria threatens these already tenuous operations and ICARDA has recently deposited a shipment of duplicated seeds within the Svalbard Vault.[81] Worse, ICARDA is not alone. Many seed banks elsewhere are struggling to preserve their collections;[82] seed banks in Iraq and Afghanistan have been destroyed or severely damaged over the course of the wars.[83] It appears the service provided by the Svalbard Vault to Syria is welcomed, as long as it does not become a way to control the destiny of Syria's (and indeed global) food supplies.

V CONCLUSION

I believe seed banks, and the Svalbard Vault in particular, may potentially guarantee farmers a constant supply of their own seed varieties that are adapted to localised evolving conditions. However, there are many issues to consider when deciding to place all the world's plant genetic resources in one basket. Whilst the Svalbard Vault is a global vault designed to store the seeds of the world, individuals, farmers, and researchers must still be encouraged to

[77] Gertsberg, above n 73.
[78] Ibid.
[79] Ibid.
[80] *The Seed Hunter* (Directed by Sally Ingleton, produced in association with ATSE Crawford Fund, AusAid, Australian Centre For International. Agricultural Research, Centre For Legumes In Mediterranean Agriculture, Grains Research And Development Corporation and International Centre For Agric. Research In The Dry Areas <http://www.seedhunter.com/>.
[81] Ross Andersen, 'After 4 Years, Checking Up on The Svalbard Global Seed Vault', *The Atlantic* (online), 28 February 2012 <http://www.theatlantic.com/technology/archive/2012/02/after-4-years-checking-up-on-the-svalbard-global-seed-vault/253458/>.
[82] FAO, above n 11.
[83] Andersen, above n 80.

maintain their own national-level seed banks. It is important to ensure that traditional varieties of seed are being collected and stored.

There appears to have been a shift from the common heritage principle of open access to genetic resources in favour of treating plant genetic resources as 'sovereign national property'. This can be seen in the CBD treaty[84] and in the *International Treaty on Plant Genetic Resources for Food and Agriculture*. We are beginning to realise the true value of biodiversity as a public commodity.[85] It is hoped the implementation of the *Treaty* provides a modern, overarching framework for conservation and sustainable use of genetic resources, of which seed banks can play an integral role. However, the conservation regimes of the CBD and the *Treaty* seem at odds with current trade regimes such as TRIPS for example, in which the WTO makes it mandatory for states to provide some form of intellectual property patent protection for genetic resources. This is at odds with the principles of the *Treaty*[86] in which open access is being encouraged.

A suggestion for addressing the issue of additional access and patenting ability of corporations has been to completely de-link the deposit agreement from the *Treaty*. This would be a critical first step in reducing the perceived potential of the Svalbard Vault to facilitate patent exploitation of the genetic resources deposited there.[87]

I do feel the endowment of $260 million from the GCDT seems a very paltry sum to secure the future of agriculture. Although as Cary Fowler in his TED talk eloquently points out, it would only take 30 million dollars in endowment to protect the entire wheat genome, which seems very little in comparison to the money invested in space exploration for example.[88] More transparency in funding would be beneficial, considering the criticism of companies heavily involved in GE donating large sums of money to the global seed bank.

A *global* seed bank is potentially invaluable, but issues of intellectual property and the supposed advantages of corporations in accessing and patenting genetic resources must be adequately addressed for the international community to be reassured.

[84] *CBD* Treaty, above n 32.
[85] A.J. Beattie, 'Why conserve biodiversity?' in R.A. Bradstock and Ords (eds), *Conserving Biodiversity - Threats and Solutions* (Surrey Beatty and Sons Pty Ltd, 1995) 3, 5; David Hunter, James Salzman and Durwood Zaelke, *International Law and Policy* (Foundation Press, 4th ed, 2010) 172.
[86] The *Treaty*.
[87] Kimbrell, above n 17.
[88] TEDGlobal, above n 2.