PROJECT PHOENIX

INTERNATIONAL OPTIONS TO INCENTIVISE THE NATIVE SEED SECTOR

JUNE 2021

First published 2021
Project Phoenix
Greening Australia (National Office)
Level 3, 349 Collins Street
Melbourne VIC 3000
Tel: 1300 886 589
Email: phoenix@greeningaustralia.org.au
Website: www.greeningaustralia.org.au

ISBN: xxx-x-xxxxxx-xx-x (Book)
xxx-x-xxxxxx-xx-x (epub)

Author: Dr Alexandra Lobb, ACIL Allen
Title: International options to incentivise the native seed sector
Notes: Includes bibliographical references

Cover by Kerry O'Flaherty, Design Consultant
Internal design by Puddingburn Publishing Services
Proofread by Puddingburn Publishing Services

Project Phoenix is supported by the Australian Government's *Wildlife and Habitat Bushfire Recovery program* and co-ordinated by Greening Australia.

Australian Government

Across all of our Project Phoenix activities and actions we pay respect to the Traditional Owners and Custodians of the lands and waters on which we work. We honour the resilience and continuing connection to country, culture and community of all Aboriginal and Torres Strait Islander people across Australia. We recognise the decisions we make today will impact the lives of generations to come.

ACKNOWLEDGEMENTS

Greening Australia would like to acknowledge the hard work and dedication of the Project Phoenix Management Team: Samantha Craigie, Patricia Verden, Brian Ramsay, Irene Walker, Courtney Sullivan, Rowan Wood, Paul Della Libera, Kim Phillipponi and Ella Campen.

CONTENTS

EXECUTIVE SUMMARY

Scope

The scope of the project is to conduct a desktop review to identify, review and assess international frameworks, agreements and legislation (including noting any evaluations conducted and relevant findings) related to the native seed sector.

Introduction

This project aimed to identify, review and assess international frameworks and legislation (including noting any evaluations conducted and relevant findings) related to the native seed sector.

The purpose of the review is to identify international frameworks and legislation that might be applicable to Australia's native seed sector in terms of their ability to incentivise the seed sector.

Issues

The native seed sector is an emerging sector around the globe, spurred by an increased focus on conservation and restoration. Direct incentives or sector-specific frameworks were very rare prior to the year 2000. This is because the native seed sector was not highly visible prior to 2000.[1] Indirect incentives, that is legislation that assisted conservation outcomes but were not aimed at such outcomes (such as the US Farm Bill), have been around for longer but are typically only seen in the United States (US) and in the European Union (EU).

As a result, there is limited information available to inform this review. Although effort was taken to ensure all relevant source documents were identified, this report is likely to be a sub-set of all international frameworks and legislation. It is neither a complete nor comprehensive report of every framework or piece of legislation that may be relevant to the native seed sector around the globe.

Outcomes

Countries where the native seed sector is more developed (and hence frameworks influencing the sector exist) include:

- US
- EU (including the UK as many frameworks were established prior to Brexit)
- Brazil.

Other countries were also considered, such as Canada and South Africa.

[1] Although issues pertaining to the natural environment, conservation and restoration were prevalent prior to 2000 there was not the focus on such issues as there is now.

We identified 29 frameworks across the globe, including six international agreements. We assessed ten as having direct relevance to the native seed sector. These were a mix of legislative and non-legislative frameworks administered by governments, consortia and not-for-profits. Five of these were detailed in case studies and assessed for applicability to the Australian native seed sector.

Findings

There is a range of potential laws, rules and frameworks around the world that may impact on (incentivise or disincentivise) the native seed sector. Lessons learnt include:

- Indirect policy mechanisms may not be the most efficient or effective way to incentivise the sector.
- Direct policy mechanisms can incentivise the native seed sector but careful consideration is needed to align policies and agendas across national, state and local environments, to create unconflicted and appropriate incentives for the sector.
- Non-legislative frameworks are more easily adopted over international boundaries as they do not create adverse policy outcomes and are within the native seed sector's locus of control.
- Community-based partnership approaches are particularly relevant for Traditional Owner communities and offer broader social benefits.

Evidence

Refer to Appendix A for a full bibliography.

Recommendations

The following recommendations have been made based on the lessons learnt from the case studies and the assessment for applicability to the Australian native seed sector. The lessons learnt from the case studies are summarised in the Findings section above and are provided in detail at the conclusion of each case study. The assessment of applicability to the Australian native seed sector indicates the suitability of each case study as low, medium or high.

Two of the five case studies (Case Study 2 — US Native Seed Strategy and Case Study 5 — International Standards) are assessed as being highly suitable for the Australian context as they are non-legislative frameworks that are easily adaptable.

Applicability of Case Study 3 — Brazil Xingu Seed Network was considered to be of medium suitability. This is because the application is to tropical native seeds in Traditional Owner communities which, while relevant to Australia, would have the ability to incentivise only part of the sector rather than the full sector.

Case Study 1 — US Farm Bill and Case Study 4 — EU German native seed certification are considered low in suitability for Australia. This is because both of these case studies focus directly on legislation and the legislative environment in the US and the EU is different to that in Australia.

1. **Use of direct policy, legislation or regulation to incentivise the native seed sector needs to be carefully considered with respect to the existing policy agenda and/or legislative framework at the national, state and local level. This will reduce the chance of inadvertent perverse outcomes (such as the potential for offsetting benefits or low additionality). (Case Study 1 and Case Study 4)**

2. **Targeted work in areas where there is a clear need for restoration and to increase social and economic outcomes for communities should be part of the Australian Native Seed Sector Strategy. These should be bottom up programs that are participatory in nature and modelled off international best practice (such as Case Study 3) and ideally incentivised through a direct policy agenda.**

3. **When adopting non-legislative frameworks such as strategies or voluntary standards consideration should be made for the following:**

    - Ownership of the framework (Case Study 2 and Case Study 5).
    - Commitment from those supporting the framework (Case Study 2 and Case Study 5).
    - Appropriate funding arrangements (Case Study 2).
    - Comprehensive understanding of existing frameworks so as to reduce duplication and unnecessary work (Case Study 5).

1 INTRODUCTION

1.1 Context

Greening Australia received $5 million under the federal Government's $50 million Bushfire Wildlife and Habitat Recovery Package. This funding has been allocated to Project Phoenix, which aims to increase native seed and plant supply in preparation for the restoration of bushfire affected areas and other valuable habitat. This aims to support a response to the recent challenges in two main ways: an immediate response to the bushfire impacts; and by developing a longer term vision to address systemic issues in native seed supply in Australia. Project Phoenix will deliver strategic outcomes under eight priorities.

Under Priority 2: *Build the capacity of the native seed and nursery industry through coordination of seed collection activities in bushfire affected areas and other vulnerable landscapes.*

This activity examines the efforts made in other countries to manage native seed for restoration purposes, to understand the successes and otherwise of these frameworks and to assess their applicability to the Australian native seed sector.

1.2 Scope

The scope of the project is to conduct a desktop review to identify, review and assess international frameworks and legislation (including noting any evaluations conducted and relevant findings) related to the native seed sector. The purpose of the review is to identify international frameworks and legislation that might be applicable to Australia's native seed sector in terms of their ability to incentivise the seed sector.

Although effort was taken to ensure all relevant source documents were identified, this report is likely a sub-set of all international frameworks and legislation. It is neither a complete nor comprehensive report of every framework or piece of legislation that may be relevant to the native seed sector around the globe.

1.3 Methodology

The methodology used in this study included a desktop review, the development of a 'mode of action' framework for assessment of the information found and the development of five case studies. Details on each part of the method is outlined below.

1.3.1 Desktop review

International frameworks and legislation (including evaluations) were identified through desktop review.

The primary search engine used was Google, including Google Scholar. The main search terms with reference to 'native seeds' and 'restoration' included:

- strategy (and a variety of country/regions e.g. Brazil, US, Europe, Canada, South Africa etc).
- legislation (and a variety of country/regions e.g. Brazil, US, Europe, Canada, South Africa etc).
- policy, frameworks, agreements, principles, standards, quality, incentives.

Relevant international agreements/conventions to which Australia is a signatory were sourced from: https://www.environment.gov.au/biodiversity/international.

1.3.2 Framework for assessment

Following sourcing the information, a method for the systematic analysis and comparison of the frameworks was developed. This is based on a 'mode of action framework' where the rationale, principles, policy instruments (types of incentives), target groups and any reported outcomes (evaluations) were examined.

Although there is limited information available on native seeds globally, five case studies were identified and analysed in detail. A second assessment, based on the case studies, examined the applicability of international frameworks and legislation to the Australian context.

Australia is large in terms of geography and diversity of environment and small in terms of population (market). It has a federated political system where much legislative control has been devolved to the states with respect to policies related to:

- the natural environment
- land use planning.

This, coupled with an open market economy (competition and free trade policy), means that adopting legislative frameworks from other countries is difficult.

1.3.3 Case study development

Five case studies were developed around examples that are either good practice and/or good learnings or are potentially transferable to the Australian context. Each case study identifies:

- focus (scope) of the framework and/or legislation
- objectives (purpose)
- approach to collaboration/coordination
- funding mechanism (if known)
- delivery approach (partner/procure)
- key lessons learnt from the use of the model (if available).

1.4 The rest of this report

The rest of this report is structured as follows:

- Section 2 provides an overview of the international frameworks, legislative arrangements and international agreements identified and assesses the frameworks for applicability and suitability to Australia.
- Section 3 details five case studies.
- Section 4 provides recommendations.

2 INTERNATIONAL FRAMEWORKS AND LEGISLATION

2.1 International frameworks

The desktop review identified relevant documents and sources for analysis with a focus on the native seed sector in the US, EU and Brazil. In addition, there is an international framework for ecological restoration and private sector approaches which are worthy of consideration.

Although an initial focus, legislation is not necessarily the most efficient nor effective way to incentivise the native seed sector as often legislation is conflicting within countries and what is applicable in some countries may not be applicable in others.

In addition, there is a range of non-legislative frameworks that, by virtue of being non-legislative, are easier to implement and may provide more efficient and effective incentives for the sector.

The identified frameworks relevant to native seeds in each of these countries are detailed below and presented in Table 2.1 (US and Canada), Table 2.2 (Brazil and EU) and Table 2.3 (international) in terms of:

- type of framework (legislative or non-legislative or internationally binding)
- impact on native seeds (direct or indirect)
- administration (government, consortia, other)
- principles (conservation, restoration, property rights, other)
- focus (public, private)
- target group (land holders, plant breeders, native seed sector, community, etc).

2.2 International conventions[2]

Australia is committed to several conventions that are related to biodiversity and participates in developing and implementing multiple frameworks dealing with the environmental and biodiversity conservation and sustainable use.

[2] We use the word 'conventions' instead of 'agreements' as it appears that Australia is not obligated under any international agreements relevant to native seeds. See https://www.environment.gov.au/biodiversity/international

Australia is obligated under the following conventions:[3]

- UN Convention on Biological Diversity
- Convention on International Trade in Endangered Species of Wild Flora and Fauna
- Ramsar Convention on Wetlands
- UN Convention to Combat Desertification
- UN Framework Convention on Climate Change
- World Heritage Convention.

For further information see Table 2.4.

Most of these are internationally binding and are administered by government (the exceptions being the Ramsar Convention and World Heritage Convention). All require commitments that are imposed through Australian national (and/or state) legislation.

While these conventions may theoretically incentivise the native seed sector, in practice it is the application of Australian national or state legislation that will actually incentivise a sector.

There are several important policy initiatives, legislation or regulation that enable Australia to comply with its international obligations (Table 2.4). Unless these have been specifically designed to influence the native seed sector then any incentives are likely to be indirect. As these are national (as opposed to international) legislative frameworks, an analysis of the policy, legislation or regulation in Australia that is a result of, or influenced by, international conventions is outside the scope of this report but should be considered as part of a separate review.

However, opportunities for the native seed sector lie in ensuring that any future treaties that Australia becomes a signatory to, such as the Nagoya Protocol (see Box 2.1) under the UNCBD, are directly related to incentivising the sector.

This is especially the case if new legislation is required to ensure that Australia complies with any requirements as it would be possible for the native seed sector to advocate for legislation that may have the potential to directly incentivise the sector. In the case of the Nagoya Protocol, this would be a real possibility as the Protocol is intrinsically linked to fundamental issues related to the native seed sector and Traditional Owners in terms of both genetic material and knowledge.

[3] See https://www.environment.gov.au/biodiversity/international

Box 2.1 NAGOYA PROTOCOL UNDER THE UNCBD

The Nagoya Protocol, ratified in 2014, focuses on 'Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity'. It is an international agreement (a transparent legal framework) aimed to ensure that benefits arising from the use of genetic resources and traditional knowledge are distributed in a fair and equitable way.

The key obligations under the Nagoya Protocol are:

- Access obligations
- Benefit sharing obligations
- Compliance obligations.

The Protocol has a suite of tools and mechanisms designed to assist with implementation including targeted financial support for capacity building.

Each country that signs up is required to develop appropriate benefits sharing legislation in relation to use of genetic resources and develop in-country research capability and institutions.

As of March 2021, 130 countries are signatories to the Nagoya Protocol but Australia is not among them.

Source: https://www.cbd.int/abs/

TABLE 2.1. IDENTIFIED FRAMEWORKS RELATED TO NATIVE SEEDS — US AND CANADA

COUNTRY	FRAMEWORK	TYPE	IMPACT	ADMINISTRATION	PRINCIPLES	FOCUS	TARGET GROUP	ADDITIONAL INFORMATION
US	Farm Bill	Legislative	Indirect	Government	Conservation and agricultural protectionism	Private	Landholder	See Case Study 1 — US Farm Bill
US	Federal Seed Act	Legislative	Indirect	Government	Property rights	Private	Plant breeders	Primarily for agricultural and vegetable seeds, the Act requires any seed shipped in interstate commerce be labelled with a seed analysis label. Labels aim to provide seed buyers with better information to make informed choices. The Act aims to harmonise State laws and fair competition within the seed trade.
US	Highway Bill	Legislative	Indirect	Government	Restoration	Public	Community	Since 1987, several US Highway Bills through the Department of Transportation require or encourage state government recipients of federal funding to plant native plants in conjunction with road construction
US	Environmental Protection Agency (EPA) Regulations	Legislative	Indirect	Government	Restoration	Public	Community	Programs under the EPA such as stormwater construction permits require sites to be restored with native vegetation of up to 70 per cent of a site.
US	Native Seed Strategy	Non-legislative	Direct	Consortia	Conservation	Public	Native seed sector	See Case Study 2 — US Native Seed Strategy
US	National Laboratory for Genetic Resources Preservation (NCGPR)	Non-legislative	Indirect	Government	Conservation	Public	Agrifood system	Provides genetic security for US agriculture focusing on: Acquiring, evaluating, preserving, and distributing critical genetic resources including plant, animal, insect, and microbial material for industry and the research community.

COUNTRY	FRAMEWORK	TYPE	IMPACT	ADMINISTRATION	PRINCIPLES	FOCUS	TARGET GROUP	ADDITIONAL INFORMATION
US	Seed Savers Exchange (SSE)	Non-legislative	Indirect	Not for profit	Conservation	Public	Agrifood system (focus on heirloom varieties)	Based in Iowa and begun 1975, this seed bank is now one of the largest in North America, with 20,000 different varieties plants. SSE facilitates communication and exchange of seeds among members and maintains seed banks at the National Centre for Genetic Resources Preservation in Fort Collins, Colorado, as well as at the Svalbard Global Seed Vault in Norway. SSE also offers services to non-members through the sale of more than 600 heirloom varieties.
Canada	Seeds of Diversity	Non-legislative	Direct	Not for profit	Conservation	Public	Agrifood system	Seeds of Diversity has a collection of over 2,900 regionally-adapted and rare varieties. A member-based organisation that work to protect Canada's seed biodiversity by growing and sharing it with others.

Source: Various — see Appendix A (Bibliography)

TABLE 2.2. IDENTIFIED FRAMEWORKS RELATED TO NATIVE SEEDS — BRAZIL AND EU

COUNTRY	FRAMEWORK	TYPE	IMPACT	ADMINISTRATION	PRINCIPLES	FOCUS	TARGET GROUP	ADDITIONAL INFORMATION
Brazil	Xingu Seed Network	Non-legislative	Direct	Consortia	Commercial conservation	Public	Native seed sector	See Case Study 3 — Brazil Xingu Seed Network
Brazil	National Restoration Policy	Legislative	Indirect	Government	Restoration	Public	Community	See Case Study 3 — Brazil Xingu Seed Network
Brazil	Forests Code	Legislative	Indirect	Government	Restoration	Private	Forestry	See Case Study 4 — EU German native seeds certification
EU	Biodiversity Convention and Habitats Directive	Legislative	Indirect	Government	Conservation	Public	Community	See Case Study 4 — EU German native seeds certification
EU	Preservation Mixtures Directive	Legislative	Indirect	Government	Property rights	Private	Plant breeders	See Case Study 4 — EU German native seeds certification
EU	European Native Seed Conservation Network (ENSCONET)	Non-legislative	Direct	Consortia	Conservation	Public	Native seed sector	Established under the European Commission in 2004 and co-ordinated by the Royal Botanic Gardens, Kew (UK), ENSCONET is a network for data, expertise, problem solving and facilities sharing arrangements, which has transformed the way native seeds are conserved in Europe (Eastwood and Muller 2010).
EU	Irish Seed Savers Association	Non-legislative	Indirect	Not for profit	Conservation and food security	Public	Agrifood system	Protects more than 600 non-commercial varieties of seeds in seed banks. Locates and researches rare varieties for Irish growing conditions.
EU (UK)	Millennium Seed Bank Partnership	Non-legislative	Direct	Consortia	Conservation and food security	Public	Agrifood system	Aimed at conserving seeds for food production, the Millennium Seed Bank Partnership has saved more than 10 per cent of the world's wild plant species, focusing on the most threatened species. At present, the bank houses 2.4 billion seeds and 96,000 seed collections representing more than 40,000 species.

COUNTRY	FRAMEWORK	TYPE	IMPACT	ADMINISTRATION	PRINCIPLES	FOCUS	TARGET GROUP	ADDITIONAL INFORMATION
Norway	Svalbard Global Seed Vault	Non-legislative	Direct	Consortia	Conservation and food security	Public	Agrifood and environmental system	The Doomsday Vault, opened in 2008, gives priority space to seeds that can ensure future food production and sustainable agriculture. The collection is primarily composed of seeds from developing countries. Holding more than 4,000 species the seed vault is managed by the Norwegian government, the Global Crop Diversity Trust, and the Nordic Genetic Resource Center.
Russia	Vavilov Research Institute	Non-legislative	Direct	Government	Conservation and food security	Public	Agrifood and environmental system	The world's oldest seed bank founded in 1921 and consisting of 12 research stations throughout Russia. It holds 60,000 seed varieties, and their herbariums contain some 250,000 of cultivated plant specimens and their wild relatives.

Source: Various — see Appendix A (Bibliography)

TABLE 2.3. IDENTIFIED FRAMEWORKS RELATED TO NATIVE SEEDS — INTERNATIONAL

COUNTRY	FRAMEWORK	TYPE	IMPACT	ADMINISTRATION	PRINCIPLES	FOCUS	TARGET GROUP	ADDITIONAL INFORMATION
International	Standards for Native Seeds	Non-legislative	Direct	-	Restoration	Public	Native seed sector	See Case Study 5 — International standards
International	Man and the Biosphere Program (UNESCO)	Non-legislative	Indirect	Government	Conservation	Public	Agrifood and environmental system	Scientific intergovernmental program aiming to enhance the relationship between people and their environments to improve human livelihoods and safeguarding natural and managed ecosystems.
International (EU-based)	Action for Solidarity, Equality, Environment and Diversity (ASEED)	Non-legislative	Indirect	Not for profit	Conservation	Public	Agrifood system	Advocacy group which campaigns for and provides educational material on biodiversity and cultural diversity in seeds including issues relating to the food system, climate change, trade and food sovereignty.
International (US-based)	Camino Verde	Non-legislative	Direct	Consortia	Conservation and restoration	Public	Native seed sector	Aims to protect biodiversity and understand Indigenous rights through a Living Seed Bank and research into multi-species systems.
International (Canada-based)	SeedChange	Non-legislative	Direct	Not for profit	Conservation	Public	Agrifood system	Works internationally to build resilience through ecological agriculture across five strategic areas: seed security and biodiversity, climate change adaptation and mitigation, rural economies, gender equality, and young farmers. Partnerships in farming communities have been developed in 12 countries around the world, promoting crop biodiversity and ensuring a secure source of food and livelihood for small-scale farmers.

Source: Various — see Appendix A (Bibliography)

TABLE 2.4. IDENTIFIED AGREEMENTS/CONVENTIONS RELATED TO NATIVE SEEDS

CONVENTION	PRINCIPLES	TARGET GROUP	ADDITIONAL INFORMATION
UN Convention on Biological Diversity (UNCBD) https://www.cbd.int/	Conservation	Environmental system	Australia has been committed to the UNCBD since 1993, it is one of three "Rio Conventions". It has three objectives (1) conservation of biodiversity (2) sustainable use of its components (3) fair and equitable sharing of the benefits arising from the use of genetic resources. The UNCBD provides an important framework for integrating Australia's policies of natural resources, environment and biodiversity management. Under the CBD all parties are required to have a national biodiversity strategy and action plan, guiding national implementation of the CBD's Strategic Plan and its Aichi Biodiversity Targets. Australia runs a joint approach across all States and Territories as well as local governments and using this structure a new *Strategy for Nature* and a digital hub was designed. Australia's *Strategy for Nature 2019–2030*: https://www.australiasnaturehub.gov.au/national-strategy Australia's Nature Hub: https://www.australiasnaturehub.gov.au/
Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) https://cites.org/eng	Protection and conservation	Trade system	The CITES is an international agreement between governments. It aims to ensure that international trade in specimens of wild animals and plants does not threaten the survival of the species. There are 30,000 species of plants are listed under CITES. The Australian Government Department of Agriculture, Water and the Environment is Australia's CITES Management Authority and CITES Scientific Authority. The CITES Management Authority is responsible for implementing the Convention and it is the only body competent to grant import and export permits on behalf of a country. In Australia, these requirements are given effect through the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
Ramsar Convention on Wetlands https://www.ramsar.org/	Conservation	Environmental system	Australia (one of the first of 170 countries to become a contracting party to the Ramsar Convention) currently has 66 Wetlands of International Importance listed under the Convention. Australian Guidelines for Ramsar Wetlands have been developed to facilitate improved management of Ramsar sites and maintenance of ecological character under the Ramsar Convention and responsibilities under the EPBC Act.
UN Convention to Combat Desertification (UNCCD) https://www.unccd.int/	Restoration	Land and environmental systems	The UNCCD established in 1994, it is one of three "Rio Conventions" and is the sole legally binding international agreement linking environment and development to sustainable land management. There is little information available on Australia's commitments under the UNCCD.

CONVENTION	PRINCIPLES	TARGET GROUP	ADDITIONAL INFORMATION
UN Framework Convention on Climate Change (UNFCCC) https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change	Other	Environmental, agrifood and climate system	The aim of the UNFCCC is to prevent 'dangerous' human interference with the climate system. It is one of three 'Rio Conventions'. Australia became a signatory in 1994. Australia's climate change strategies are designed to meet the UNFCC, the Paris Agreement, the Kyoto Protocol and the Doha Amendment to the Kyoto Protocol Australia's commitments: https://www.industry.gov.au/policies-and-initiatives/australias-climate-change-strategies/international-climate-change-commitments Australia's climate initiatives https://www.industry.gov.au/policies-and-initiatives/australias-climate-change-strategies
World Heritage Convention http://whc.unesco.org/en/conventiontext/	Conservation and restoration	Environmental and other systems.	World Heritage Convention aims to promote cooperation among nations to protect outstanding value heritage around the world for current and future generations. Australia has 20 sites, of which 12 are natural environments and 4 are mixed sites. There are also four cultural sites.
UN Convention on Biological Diversity (UNCBD) https://www.cbd.int/	Conservation	Environmental system	Australia has been committed to the UNCBD since 1993, it is one of three "Rio Conventions". It has three objectives (1) conservation of biodiversity (2) sustainable use of its components (3) fair and equitable sharing of the benefits arising from the use of genetic resources. The UNCBD provides an important framework for integrating Australia's policies of natural resources, environment and biodiversity management. Under the CBD all parties are required to have a national biodiversity strategy and action plan, guiding national implementation of the CBD's Strategic Plan and its Aichi Biodiversity Targets. Australia runs a joint approach across all States and Territories as well as local governments and using this structure a new *Strategy for Nature* and a digital hub was designed. Australia's *Strategy for Nature 2019–2030*: https://www.australiasnaturehub.gov.au/national-strategy Australia's Nature Hub: https://www.australiasnaturehub.gov.au/

Source: Various — Australia's biodiversity commitments can be found at: https://www.environment.gov.au/biodiversity/international. See also Appendix A (Bibliography)

3 CASE STUDIES AND ASSESSMENT

The case studies presented below provide detail on a range of legislative and non-legislative frameworks and how they incentivise or inhibit native seed sectors around the world. These case studies have been chosen to canvas a range of options that could prove useful for the development of the Australian native seed sector.

International conventions were excluded from the case studies as they require application of national legislation in order to directly incentivise the native seed sector.

Initially, the focus of the case studies was to be on best practice approaches. However, as the research unfolded it was clear that a range of different frameworks (both legislative and non-legislative) exist and may be useful for the Australian context (see Section 2).

All case studies, with the exception of the international standards, have been in operation for long enough to be able to offer insights on how they have worked in practice and provide important lessons for the Australian native seed sector.

The five case studies chosen are as follows. Each is detailed below.

- Case Study 1 — US Farm Bill — a legislative approach to incentivise landholders
- Case Study 2 — US Native Seed Strategy — a strategic approach with government support
- Case Study 3 — Brazil Xingu Seed Network — a community-based network approach
- Case Study 4 — EU German native seed certification
- Case Study 5 — International standards for native seeds.

A discussion of the applicability and suitability of each case study to the Australian context is provided in Section 3.6.

3.1 Case Study 1 — US Farm Bill

The development of the native seed sector in the USA has been facilitated by the US agricultural policy agenda and legislation (known as the Farm Bill) which has focused on conservation since the 1930s.[4]

Table 3.1 presents a summary of the Farm Bill, with further details provided below.

[4] Conservation Programs — An Overview. (2021). *The National Agricultural Law Center*. Retrieved from https://nationalaglawcenter.org/overview/conservation-programs/

TABLE 3.1. SUMMARY TABLE — US FARM BILL

FOCUS AND SCOPE	The Farm Bill focuses on agricultural producer support through conservation-linked farm payments across six conservation programs.
OBJECTIVES AND PURPOSE	To protect agricultural productive capacity and provide income support for farmers. A secondary objective is to reduce negative environmental impacts resulting from agricultural production.
APPROACH TO COLLABORATION	Some programs have a collaborative element at a regional- or catchment-level and encourage partnerships with Traditional Owners, state and local governments and non-government organisations.
FUNDING MECHANISMS	$6 billion per year Federal Government program including long-term contracts and cost-sharing schemes (taxpayer funded).
DELIVERY APPROACH	Legislative but voluntary.

Source: Various

KEY LESSONS

Concerns with multiple and conflicting objectives, implementation and issues with efficient and effective return on investment for conservation outcomes.

3.1.1 Objectives and funding

The Farm Bill primarily supports agricultural production through conservation-linked farm payment programs or the 'paid diversion of land' for the purpose of conservation outcomes. However, the conservation outcomes are a secondary, not a primary aim of the supports, which were initially to:

- protect agricultural productive capacity by conserving essential resources, such as soils and water
- provide income support for important farm constituencies by reducing the amount of cropland in production as a means of increasing prices.[5]

In the 1970s, there was increased social focus on the environment which led to the addition of goals related to water quality and wildlife habitat and eventually the preservation of wetlands, grasslands, and farming more generally. These additional goals were added to the programs creating more objectives for a single legislative instrument to achieve.[6]

[5] Lichtenberg (2018).
[6] Ibid.

This was principally achieved through a 'land diversion or retirement' payment to farmers from the federal government (provided by taxpayers). Between 1986 and 2000, up to 90 per cent of funding was focused on reducing agricultural practice on certain land, approximately 22 million hectares of which has been paid for under a retirement program (Conservation Reserve Program) since its inception in 1985.[7]

Since 2002, the support payments have been expanded to included incentives for conservation on working land through voluntary federal programs (or cost sharing schemes) designed to encourage agricultural producers and landowners to undertake conservation practices.

By 2014, conservation programs accounted for approximately one-third of all payments to farmers, up from one fifth in 1990.[8] Consequently, government expenditure on these programs has more than tripled since 1990 to more than $6 billion a year. This is forecast to stay roughly constant until 2023.[9]

3.1.2 Administration

The US Department of Agriculture (USDA) through the Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA) is responsible for a portfolio of conservation programs. The aim is to 'provide financial assistance to farmers who adopt, install, or maintain conservation practices on land in production'.[10]

The two main programs (known as the 'working land' programs) account for 50 per cent of spend. These programs are:

- **Environmental Quality Incentives Program (EQIP)** provides financial support to those who adopt conservation practices on viable agricultural land. Example practices include nutrient management, conservation tillage and fences to exclude livestock from streams.[11]
- **Conservation Stewardship Program (CSP)** supports ongoing and new conservation projects for those who meet farm-wide stewardship requirements on working land (agricultural and forest). Eligibility requirements include demonstration of a high level of, and agreement to, additional environmental performance over the five-year contract. Participants receive financial assistance for adopting new conservation practices and for stewardship, based on previously adopted practices and the ongoing maintenance of those practices.[12]

[7] Conservation Programs — An Overview. (2021). *The National Agricultural Law Center*. Retrieved from https://nationalaglawcenter.org/overview/conservation-programs/
[8] Lichtenberg (2018).
[9] US Department of Agriculture, Conservation Programs, *Economic Research Service*. Retrieved from https://www.ers.usda.gov/topics/natural-resources-environment/conservation-programs/
[10] Ibid.
[11] Ibid.
[12] Ibid.

The remaining programs (known as 'land retirement' programs) are programs where land is taken out of production for between 10 and 15 years. The primary program is:

- **Conservation Reserve Program (CRP)** — 10–15-year contracts to retire land from agricultural production. Most of the land enrolled in the CRP was in crop production prior to CRP enrolment and is now planted to grass or trees. Most CRP contracts enrolled whole fields or whole farms. However, more recently, CRP contracts have funded high-priority, partial-field practices such as filter strips and grass waterways. Up to 2 million acres of grassland can also be enrolled in CRP if the land is used for grazing only.[13]

The other programs in the USDA portfolio include:[14]

- **Agricultural Conservation Easement Program (ACEP)** provides long-term or permanent easements for preservation of wetlands and the protection of agricultural land (crop land, grazing land, etc.) from commercial or residential development. This is a partnership program with American Indian tribes, state and local governments, and non-governmental organisations.
- **Regional Conservation Partnership Program (RCPP)** provides assistance to partners to solve problems on a regional or catchment level. This program can fund a wide range of activities including land retirement, easements, partial-field practices and conservation practices on working land.
- **Conservation Technical Assistance (CTA)** provides ongoing technical assistance to farmers who seek to improve the environmental performance of their farms.

3.1.3 Key lessons

Implementation concerns

Multi-objective programs with multiple outcomes, such as the Farm Bill and its conservation programs, leads to inefficiencies. Such inefficiencies include the uptake of CRP, for example, being higher in areas where there is less need for conservation (e.g. the Plains) relative to those areas where there are considerably more problems (e.g. the Corn Belt and the Lakes). [15]

Offset benefits and lack of additionality

Payments (subsidies) from these programs are considered economically contentious, as although they provide environmental benefits, they also distort food prices, food supply and international trade by paying farmers not to farm in a bid to reduce the supply of agricultural products.[16]

[13] Ibid.
[14] Ibid.
[15] Lichtenberg (2014).
[16] Ibid.

In addition, several of these programs have what is known as 'slippage'. This means that as well as creating incentives to reduce negative environmental effects, these payments remove non-profitable farmland from the system meaning that, on average, farming becomes more profitable (as it occurs on better quality land) and this induces those farmers to expand their operations. This expansion is reported to at least partially offset any benefits accrued from reducing poor environmental practices.[17]

Further, the concept of 'additionality' also requires consideration. In this case, there is concern that farmers have been paid to 'retire' marginal land that may not have farmed anyway, and that they have been paid to undertake projects that they would have undertaken regardless (such as fencing off streams to reduce livestock entry).[18]

3.2 Case Study 2 — US Native Seed Strategy

In 2015, the Plant Conservation Alliance (PCA)[19] developed a national Native Seed Strategy[20] (the Strategy) to address widespread seed shortages resulting from increased demand primarily from government in response to natural disasters. This Strategy was the first of its kind and was developed through a collaborative partnership of government and private industry as well as Traditional Owners.

The Bureau of Land Management (BLM) was the owner of the Strategy as the largest land manager in the US. Every year, BLM purchases between 300,000 pounds (136 tonnes) and 7.5 million pounds (3,400 tonnes) of native seed.[21]

In total, key government agencies are responsible for some 615,000 acres (248,000 ha) of land (or roughly 25 per cent of US land) including:[22]

- BLM
- US Forest Service
- US Fish and Wildlife Services
- US National Park Service
- US Department of Defence.[23]

[17] Ibid.
[18] Ibid.
[19] A public-private partnership with the aim to ensure that native plant populations and their communities are maintained, enhanced and restored.
[20] US Department of the Interior, Resilience Through Restoration, *Bureau of Land Management.* Retrieved from https://www.blm.gov/programs/natural-resources/native-plant-communities/national-seed-strategy
[21] Harrison *et al.* (2020).
[22] Ibid.
[23] Ibid.

The Strategy was underpinned by a set of guiding principles[24] and was designed to increase coordination and develop relationships between agencies, tribes, states, and non-governmental organisations, as well as with the private seed and nursery industries. By 2020, there were 380 partners (Figure 3.1). Table 3.2 presents a summary of the Strategy, with further details provided below.

TABLE 3.2. SUMMARY TABLE — THE NATIVE SEED STRATEGY

FOCUS AND SCOPE	A national and coordinated approach to rehabilitation and restoration.
OBJECTIVES AND PURPOSE	Identify seed needs and ensure the reliable availability of genetically appropriate seed. Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration. Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration. Develop strategies for internal and external communications.
APPROACH TO COLLABORATION	A partnership between 380 public and private partners (including federal, state government, tribal, municipal and private land managers).
FUNDING MECHANISMS	Collaborative funding arrangements through co-ordinating agencies (primarily government departments). Between 2015–2020 there was $167 million invested.[25]
DELIVERY APPROACH	Non-legislative.

Source: Various

KEY LESSONS

Issues resourcing the Strategy, which sourced approximately 50 per cent of the estimated funds needed in 2015 to implement the Strategy by 2020.

3.2.1 Objectives and funding

The key objective of the Strategy is to ensure the availability of suitable seeds for the right locations at the right time. The Strategy outlined four goals:

1. Identify seed needs and ensure the reliable availability of genetically appropriate seed.
2. Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration.

[24] Plant Conservation Alliance (2015).
[25] Plant Conservation Alliance (2021).

3. Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration.
4. Develop strategies for internal and external communications.

Each of these goals had a series of objectives and actions designed to be achieved over the life of the Strategy (2015–2020) and were allocated to a coordinating agency (or sets of agencies/institutions).

A business case[26] was prepared in conjunction with the Strategy, which in 2015 estimated the cost of achieving the objectives was $358 million over five years. The 2020 Progress Report[27] notes only $167 million was invested — this is about 46 per cent of the 2015 estimate.

3.2.2 Administration

This Strategy is administered by the BLM in conjunction with multiple public and private stakeholders. Progress since the development of the Strategy in 2015 is presented in Figure 3.1.

FIGURE 3.1. PROGRESS ON THE US NATIVE SEED STRATEGY SINCE 2015

Source: https://www.blm.gov/sites/blm.gov/files/docs/2021-02/NSS%20Progress%202020%20Fact%20Sheet.pdf

[26] Olwell, P. and Bosak, S. (2015).
[27] Plant Conservation Alliance. (2021).

The next steps following the initial strategy have been outlined as:

- developing economic opportunities for farmers to grow locally adapted native seed
- further engaging American Indian Tribes and Alaska Native villages to honour their Indigenous knowledges and ensure culturally important plants are conserved
- increasing botanical capability within government to inform all restoration, rehabilitation and reclamation projects
- developing regional 'Seed Hubs' with partners who develop, store and deliver locally adapted native seeds
- increasing research on decisions based on science for every step, from seed collection to restoration
- increasing promotion through public education and awareness of the importance of locally adapted native seed in ecological restoration.[28]

3.2.3 Key lessons

Even with BLM ownership and a more directionally aligned policy agenda in the US, the strategy has only been able to achieve a modest outcome over five years.

This would suggest that securing funding and assurance on commitment to the Strategy from all vested parties is necessary to realise all outcomes.

3.3 Case Study 3 — Brazil Xingu Seed Network

In Brazil, restoration and conservation targets are largely driven by Brazil's commitments to international treaties such as the Bonn Challenge.[29] This has led to the development of the National Restoration Policy committing Brazil to restore 12 million hectares by 2030 (the target was decreed in 2017). This drives a huge increase in demand for native seed.

Decades of poor land use management in the Amazon basin has resulted in major transformation of the landscape. In the Xingu region in the south-east of the basin, 37 per cent of the region was deforested by 2017 (6.5 million ha). This resulted from massive government-based agricultural and forestry programs (agrarian reforms and settlement programs) in the 1970s designed to capitalise on high international commodity prices.

The changes to the landscape led to localised climate change, major water quality issues, serious land degradation and intense conflict between Indigenous owners and the agricultural industry.

[28] Plant Conservation Alliance (2021).
[29] International Union for Conservation of Nature (2021). https://www.bonnchallenge.org/

International pressures and local conflict led to a policy shift in Brazil towards a collective focus on land use planning on a regional level. The solution was borne from a shared responsibility campaign to improve water quality designed to restore the landscape and bring the community together in 2004. These efforts, coupled with an increased enforcement effort of ecological restoration requirements in Brazilian law, resulted in an increase in demand for native seeds and the creation of the Xingu Seed Network (XSN) in 2007 (see Box 3.1).

Table 3.3 presents a summary of XSN, with further details provided below.

Box 3.1 XINGU SEED NETWORK

The XSN began as an association of individuals (including farmers and agrarian reform settlers) and organisations working on community development in the Xingu region in 2007.

In its first year of operation, it consisted of ten seed collectors who harvested five tonnes of seeds from 120 species.

A change to the Brazilian Forest Code (2012) caused a sharp decline in demand for reforestation seeds in Brazil, but regardless, as of 2020 the Network consisted of 500 collectors producing 200 tonnes of seed from 220 different species which have contributed to restoring 6,000 ha in the region.

The Network now includes:

- 30 organisations
- 500 seed collector groups
- 19 regions
- 14 rural settlements
- 1 extractive reserve
- 4 storage facilities
- 6 indigenous ethnicities across 4 indigenous lands and 11 indigenous villages.

In addition, the Xingu Seed Network has generated a total of US$750,000 in income for 450 regional households. The financial gains have resulted in multiple social benefits to the local communities, such as improvements in health and nutrition and the empowerment of women.

This model has been adopted in two other areas in Brazil in 2011 and 2012 and has been shown to work for multiple restoration purposes, from improving water quality, to restoring national parklands (Chapada dps Veeadeiros National Park) to rehabilitating land around an artificial dam (Jirau hydroelectric dam).

Source: Schmidt *et al.* (2019) and other various.

TABLE 3.3. SUMMARY TABLE — XINGU SEED NETWORK

FOCUS AND SCOPE	A need to drive large-scale restoration using native seeds while improving regional partnerships and creating community benefits.
OBJECTIVES AND PURPOSE	To develop a local seed network to assist in reversing serious land degradation and drive community involvement (e.g. make better use of local knowledge).
APPROACH TO COLLABORATION	Designed around a collaborative approach at a community level with partnerships encouraged with governments and non-government organisations.
FUNDING MECHANISMS	Initially funded by SocioEnvironmental Institute (Instituto Socioambiental, ISA), now a commercial enterprise with support from international grants and philanthropy (e.g. Partnerships for Forests).
DELIVERY APPROACH	Incentivised by policy and legislation.

Source: Adapted from Schmidt *et al.* (2019).

KEY LESSONS

Potential consideration for Australia, especially in northern areas and for encouraging and supporting involvement of Traditional Owners in native seeds, restoration and potential for improved socioeconomic outcomes for Traditional Owners' communities.

3.3.1 Objectives and funding

The XSN objectives are to:

- generate income for its regional communities
- promote training for seed collectors
- conserve the forests, values and cultures of regional communities
- strengthen sustainable supply chains of forest products
- offer market-quality seeds.[30]

Collectors need to fulfil certain criteria to be eligible for network membership, such as ensuring that they comply with legislation that prescribes preservation or restoration of forest areas on their own land.[31]

The XSN has a commercial focus with a well-developed financial system and a suitable cash flow to ensure payment to collectors. In 2015, the association sold 17 tonnes of seeds, generating about $US95,000.[32]

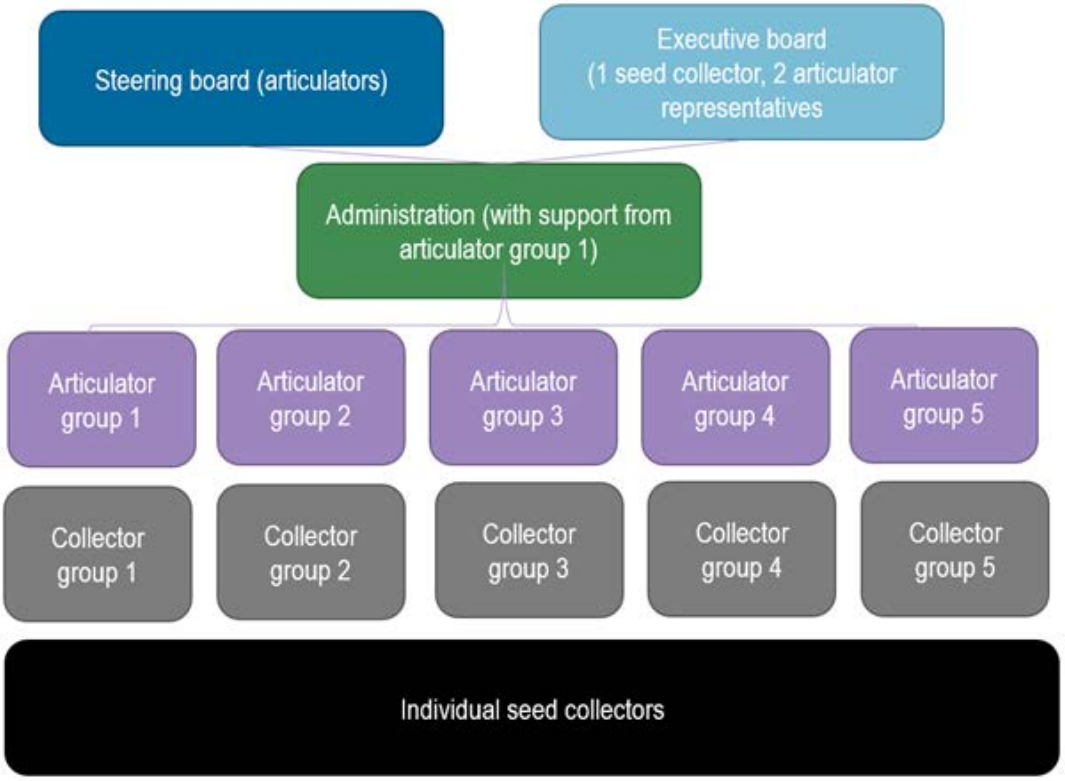
[30] Xingu Seed Network. Retrieved from https://www.edf.org/sites/default/files/rsx_english.pdf
[31] Ibid.
[32] Ibid.

Prior to 2015, all income generated was transferred to seed collectors and administrative and management costs were supported through project grants such as that provided by the Amazon Fund. Since 2015, changes in costs structures have meant that some administrative costs can now be covered by the network.[33] XSN manages its own finances creating autonomy as commercialisation generates regional incomes, thereby creating value in a sustainable manner.

3.3.2 Administration

In 2014, the XSN became a legal entity as an association for social and commercial purposes. The structure of the network involves several levels of organisations (known as articulators) leading the network and working with groups of collectors on a regional basis (Figure 3.2).

FIGURE 3.2. ORGANISATIONAL STRUCTURE OF XSN



Source: Adapted from Xingu Seed Network. https://www.edf.org/sites/default/files/rsx_english.pdf

Seed collector groups plan seed production on an annual basis with consideration given to the supply requirements. Simultaneously, the articulators develop an understanding of market demand on an annual basis through established partnerships with landowners.

[33] Ibid.

Brazilian law requires assessment of seed quality and purity for commercial purposes. This work is carried out by partner universities and research institutes through articulator partnership arrangements.

The costs of native seed production need to be quantified prior to any price setting, including the costs of collection, infrastructure and administration. XSN, through a participatory approach, defined a rate of 50 per cent to cover the network costs with the remaining being distributed to collectors.

The price of each species of seed is determined by collector groups in a collaborative way, with direction from technical staff who are involved in the network. Pricing information is presented in Table 3.4. Table 3.4 shows that of 130 native species sold in 2017, nearly half of the species were lower priced.

This group of seeds (57 species) accounts for more than 80 per cent of the total production and more than 30 per cent of total revenue from the native seed trade. This demonstrates that in the case of XSN, a community-based market with transparent profit-sharing enables seed collectors to produce a high number of species at affordable prices.[34]

XSN has a website that lists all types of seeds for sale and instructions for placing orders online.[35]

TABLE 3.2. XSN PRICE, PRODUCTION AND REVENUE FROM SEED COMMERCIALISATION (2017)*

SEED PRICE (US$/KG^{-1})	NUMBER OF SPECIES	PRODUCTION (KG)	REVENUE (US$)
1 to 15	57	21,382	108,240
15 to 35	34	2,992	64,214
35 to 60	22	1,340	66,205
60 to 110	17	724	56,179
Total	**130**	**26,438**	**294,839**

Source: Table 2, Schmidt *et al.* (2019).

*Data only available for 2017.

[34] Schmidt *et al.* (2019).
[35] Xingu Seed Network. Retrieved from https://www.edf.org/sites/default/files/rsx_english.pdf

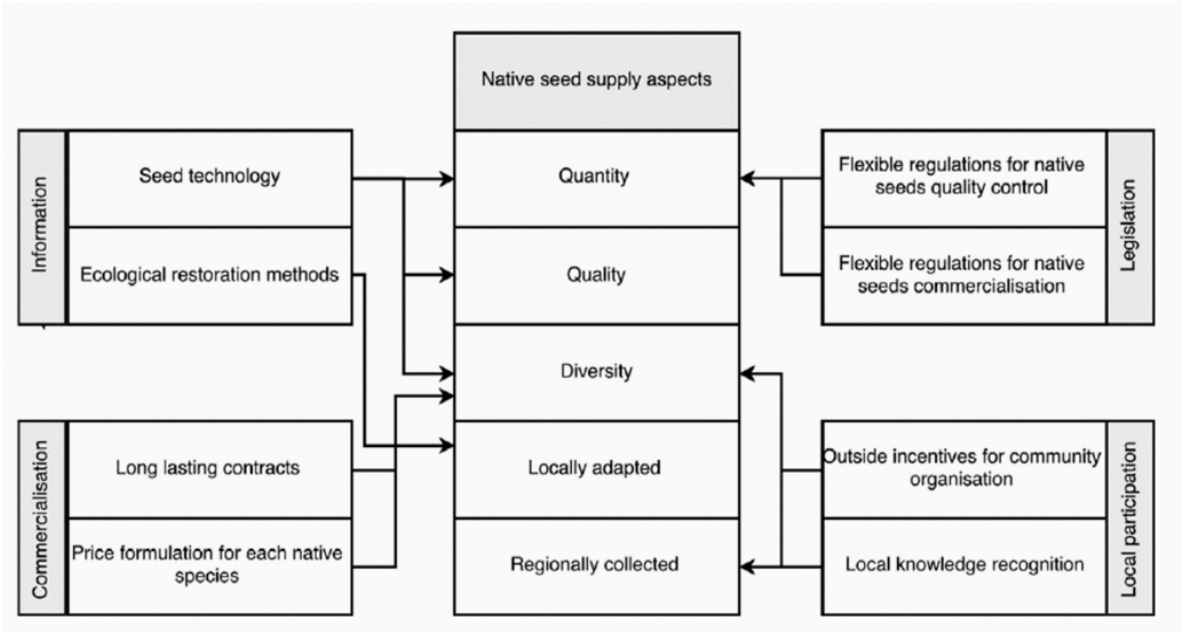
3.3.3 Key lessons

The main lessons from the XSN include:[36]

- The benefits of a community-based approach to native seed production can go beyond native seed supply and restoration/conservation/environmental benefits to improved social outcomes.
  - For example, participation by women in the collecting of seeds provides empowerment opportunities and generates further social benefits.
- Legislation can be both an incentive and a barrier to the development of a native seed sector, particularly:
  - the changing nature of national policy agendas can have a marked impact on a network's development
  - having a defined advocacy platform is important to minimising barriers to operation.
- The importance of financial support in the establishment phase to allow the network to reach scale and work to commercial opportunities and financial autonomy.

Schmidt *et al.* (2019) draw together lessons learnt for three Brazilian case studies including the XSN into a conceptual framework (Figure 3.3). This framework is designed to inform the development of network and community-based native seed production.

FIGURE 3.3. CONCEPTUAL FRAMEWORK FOR DESIGNING COMMUNITY-BASED NETWORKS FOR THE NATIVE SEED SECTOR



Source: Schmidt *et al.* (2019).

[36] From Schimdt *et al.* (2019) and Xingu Seed Network. Retrieved from https://www.edf.org/sites/default/files/rsx_english.pdf

3.4 Case Study 4 — EU German native seed certification

The native seed sector in Germany is legislated under EU directives, federal laws and provincial laws. This has led to certification schemes and zoning requirements that are often considered enviable for emerging native seed sectors around the world. However, much of the legislation is contradictory in intent, which means that although there are systems and processes in place to control for provenance and quality, the market continues to operate inefficiently and without transparency and is not encouraging restoration efforts.[37] Table 3.5 presents a summary of the German certification and zoning scheme, with further details provided below.

TABLE 3.5. SUMMARY TABLE — EU GERMAN NATIVE SEED CERTIFICATION

FOCUS AND SCOPE	Applies to Germany in regulations adopted under EU directives for nature conservation and seed breeding.
OBJECTIVES AND PURPOSE	To provide market transparency and increase the quality of native seed available on the market while ensuring provenance.
APPROACH TO COLLABORATION	None.
FUNDING MECHANISMS	User payers certification schemes.
DELIVERY APPROACH	Legislative.

Source: Various.

KEY LESSONS

Concerns with conflicting legislation, stringent zoning and the high costs of certification suggest that these requirements have not been effective in facilitating market transparency or the development of the native seed sector in Germany.

3.4.1 Objectives and funding

The German native seeds market is estimated to have:

- 120 producers and collectors
- cultivated on 1,000 hectares
- selling 200 tonnes of 400 species per annum
- a market turnover of Euros 12 million per annum.[38]

[37] Mainz and Wieden (2019).
[38] Mainz and Wieden (2019) and Mainz (2021).

There are multiple levels of regulation from the EU, Federal German and German provincial law. There are two primary EU level legislative agreements on nature conservation that are implemented through the German Federal Nature Conservation Act. These are:

- The Biodiversity Convention (Rio, 1992)
- Habitats Directive (92/43/EEC).

In March 2010, the Federal Nature Conservation Act was amended to require approval of planting of non-native seed in natural surroundings. This led to an increase in the demand for native seed with up to 2,000 tonnes of native seed needed by 2020 (ten times greater than estimated production).[39]

Seed breeding laws are also legislated under EU directives, namely to protect plant breeders' rights.

In 2010, the Preservation Mixtures Directive (2010/60/EU) allowed for native fodder crops to be traded (previously this was illegal) at up to five per cent of total seed trade (directly contravening the Federal Nature Conservation Act requiring the exclusive use of native seeds). This EU Directive led to the German Preservation Mixture Regulation (ErMiV). These regulations saw the introduction of native seed zones to protect the origin of species and certification to ensure quality in the marketplace.[40]

3.4.2 Administration

Complicated by conflicting legislation, the demand signals under the Federal Nature Conservation Act do not align with the breeding regulations.

Under ErMiV, there are three key factors which restrict the efficiency of the system and the development of the native seed sector in Germany.

1. Collection of native seed can only occur in designated regional protected areas and must be approved by local authorities.[41] This means collection opportunities for specific species that only exist outside protected areas are not available.
2. Regional designated production or 'zones' of seed are regulated to eight regions but these regions are required to be 'matched' with seed from 22 areas of origin based on specific climatic and geophysical features. This means:
   - areas of propagation of native seeds for restoration purposes do not align with the origin of species requirements
   - volumes of native seeds in the 22 regions are not able to fulfil the restoration requirements of each region and missing species are being replaced with those from adjacent regions of origin (undermining the premise of the regulation).

[39] Ibid.
[40] Ibid.
[41] Non-fodder species are not covered by this regulation and means that regional production for non-fodder species is different than for fodder species.

3. Marketing native seeds in what is known as a 'preservation mixture' requires certification. As a result:
   - two independent certification schemes exist but they impose significant costs in terms of external audits as well as time and effort required for documentation, testing, packaging and labelling.
   - implications are that the costs are too high and 'rogue' product (primarily imported from less regulated countries in the EU) continues to enter the market and undermine quality controls.

3.4.3 Key lessons

The legislative framework needs to align across federal and state legislation to minimise contradictory signals and the introduction of regulation needs to balance cost with practicalities and keep in mind the regulatory objectives.

Regarding establishing zones for production and/or origin of species, the lessons learnt from Germany include defining zones on a small scale can inhibit the use and availability of seed in one area, at the expense of another. That is, a larger zone will facilitate market development. Alignment of production and origin zones would appear logical and restricting zones to within states borders is likely to be inconsistent with biodiversity principles.

The imposition of certification schemes needs to considered with respect to costs to minimise the continued availability of 'rogue' product to infiltrate the market.

3.5 Case Study 5 — International standards for native seeds

The Society for Ecological Restoration (SER) published its second edition of *International Principles and Standards for the Practice of Ecological Restoration* in 2019. [42] This framework is based on eight principles (Figure 3.4).

In 2020, Pedrini *et al.*[43] developed a framework for International Standards for Native Seeds in Ecological Restoration (Standards) based on SER's Standards. This acknowledges the fundamental importance of native seed in ecological restoration projects. The intersection of restoration and the native seeds sector is presented in Figure 3.5.

Table 3.6 presents a summary of the International Native Seeds Standards, with further details provided below.

[42] Gann *et al.* (2019).
[43] S. Pedrini *et al.* (2020).

TABLE 3.3 SUMMARY TABLE — INTERNATIONAL STANDARDS FOR NATIVE SEEDS

FOCUS AND SCOPE	International guidance for standards in the native seed sector with specific focus on restoration.
OBJECTIVES AND PURPOSE	To provide a suite of tools and guidance for testing and labelling of native seed for restoration purposes.
APPROACH TO COLLABORATION	Based on SER Standards, which have been developed through a comprehensive stakeholder consultation process, including with international experts.
FUNDING MECHANISMS	N/A.
DELIVERY APPROACH	Non-legislative but highlights guidance for appropriate regulatory approaches.

Source: Pedrini *et al.* (2020).

KEY LESSONS

Recognises adaptation of international restoration standards to native seeds. Acknowledges native seed is fundamental for ecological restoration and a necessary input.

FIGURE 3.4. SER'S PRINCIPLES OF ECOLOGICAL RESTORATION

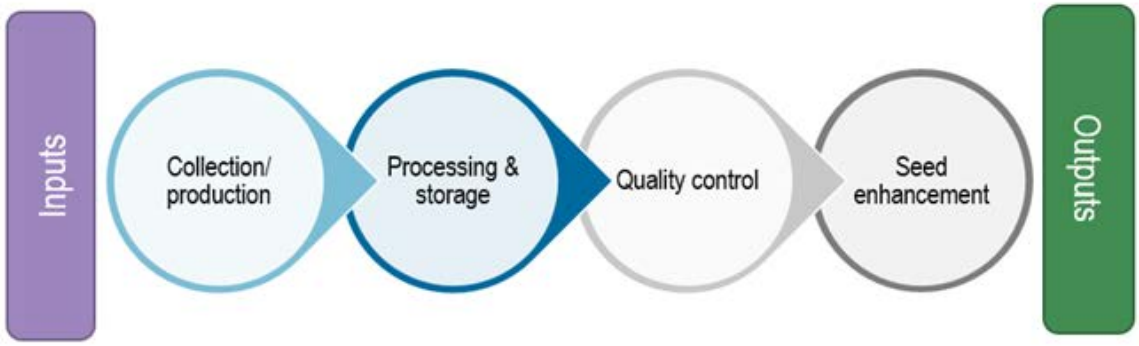
Source: *Gann et al.* (2019).

FIGURE 3.5. INTERSECTION OF RESTORATION AND THE NATIVE SEEDS SECTOR

Source: Cross *et al.* (2020).

Pedrini *et al.* (2020) make the case that native seed quality is fundamental to the development of the native seed sector and the restoration sector. Application of quality standards to the native seed sector work across the supply chain (Figure 3.6).

FIGURE 3.6. NATIVE SEED SUPPLY CHAIN



Source: Adapted from Pedrini *et al.* (2020).

3.5.1 Objectives and funding

The Standards aim to optimise the quality of seed (see Box 3.2) across the supply chain and the provision of information on quality to enable better purchasing and decision making and decrease the likelihood of credibility issues between native seed suppliers and the restoration sector.

Box 3.2 DEFINING SEED QUALITY

Seed quality is defined by all the quantifiable, intrinsic features of a batch of seed including:

- Purity
- Viability
- Germination
- Dormancy state (where applicable).

Source: Pedrini *et al.* (2020).

As a set of standards and principles, there is no funding directed towards uptake which is expected to be voluntary. Funding may need to be provided for infrastructure, including seed testing equipment to allow the sector to move to adoption of these standards.

3.5.2 Administration

Administration of native seed standards is likely to require a regional or local focus due to the geographical and biological differences across restoration sites. The advantage of international (or even national) standards is the use of a consistent approach that does not undermine the regional focus.

Pedrini *et al.* (2020) consider the case for nationalising testing and certification but conclude that existing national testing systems and facilities such as those in the US legislated under the Federal Seed Act are not suitable for native seeds. These systems have been established for agricultural seed which is far less genetically diverse and variable than native seeds.

Native seed testing is unique as it requires regional and local knowledge and an assessment of provenance that is often lost at a national level and not necessary for agricultural seed testing. In addition, dormancy[44] is not an attribute that characterises agricultural seed as it has been bred out over time.

Consideration is also given to national (or multinational) certification schemes such as those in Germany (see Section 3.4) based on European Directives. The criticism here is that once again these enforceable standards are not bespoke to native seeds and as a result, are sub-standard for the sector. Pedrini *et al.* (2020) note that the standards they have developed could in the future be used to create international certification of native seed suppliers and testing facilities.

[44] 'Dormancy' is a term used to explain the morphological and physiological state of the seed that controls the expression of germination.

3.5.3 Key lessons

While the application of international principles and standards for ecological restoration have been successfully made to a set of international standards, native seed sector considerations of funding and administration need to be further considered.

The Australian native seeds sector would be well-placed to consider adopting these international standards as voluntary rather than mandatory standards in an attempt to incentivise quality assurance and better flows of information across the supply chain.

3.6 Suitability and applicability to Australia

Australia is large in terms of geography and diversity of environment and small in terms of population (market). It has a federated political system where much legislative control has been devolved to the states with respect to policies related to:

- the natural environment
- land use planning.

These factors need to be considered in applying international frameworks to Australia.

Figure 3.7 presents the applicability and suitability of each of the frameworks considered in this chapter to the Australian context. The assessment of applicability to the Australian native seed sector indicates the suitability of each case study as low, medium or high.

Two of the five case studies (Case Study 2 — US Native Seed Strategy and Case Study 5 — International Standards) are assessed as being highly suitable for the Australian context as they are non-legislative frameworks that are easily adaptable.

The applicability of Case Study 3 — Brazil Xingu Seed Network was considered to be of medium suitability. This is because the application is to tropical native seeds in Traditional Owner communities which while relevant to Australia would have the ability to incentivise only part of the sector rather than the full sector.

Case Study 1 — US Farm Bill and Case Study 3 — EU German native seed certification are considered low in suitability for Australia. This is because both of these case studies focus directly on legislation and the legislative environment in the US and the EU is different to that in Australia.

FIGURE 3.7. SUITABILITY OF KEY FRAMEWORKS TO AUSTRALIA (LOW, MEDIUM AND HIGH)

COUNTRY	FRAMEWORK	SUITABILITY TO AUSTRALIA (LOW, MEDIUM, HIGH)	ADDITIONAL COMMENTS
USA	Farm Bill	Low	Does not concord with Australian competition policy or free trade agreements.
USA	Native Seed Strategy	High	Being developed under Project Phoenix (Activity 3.1).
Brazil	Xingu Seed Network	Medium	Relevant to regions and traditional owner communities with high restoration needs.
EU	German native seed certification	Low	Establishing a scheme requires legislative alignment.
International	Standards for Native Seeds	High	As voluntary standards directly applicable to Australia.

Source: ACIL Allen

4 RECOMMENDATIONS

4.1 Key findings

There is a range of potential laws, rules and frameworks around the world that may impact on (incentivise or disincentivise) the native seed sector. Lessons learnt include:

- Indirect policy mechanisms may not be the most efficient or effective way to incentivise the sector.
- Direct policy mechanisms can incentivise the native seed sector but careful consideration is needed to align policies and agendas across national, state and local environments, to create unconflicted and appropriate incentives for the sector.
- Non-legislative frameworks are more easily adopted over international boundaries as they do not create adverse policy outcomes and are within the native seed sector's locus of control.
- Community-based partnership approaches are particularly relevant for areas where there is a need for restoration and for Traditional Owner communities as they offer broader social benefits.

4.2 Recommendations

Key recommendations from this review are as follows:

1. **Use of direct policy, legislation or regulation to incentivise the native seed sector needs to be carefully considered with respect to the existing policy agenda and/or legislative framework at the national, state and local level. This will reduce the chance of inadvertent perverse outcomes (such as the potential for offsetting benefits or low additionality). (Case Study 1 and Case Study 4)**

2. **Targeted work in areas where there is a clear need for restoration and to increase social and economic outcomes for communities should be part of the Australian Native Seed Sector Strategy. These should be bottom up programs that are participatory in nature and modelled off international best practice (such as Case Study 3) and ideally incentivised through a direct policy agenda.**

3. **When adopting non-legislative frameworks such as strategies or voluntary standards consideration should be made for the following:**

    - Ownership of the framework (Case Study 2 and Case Study 5).
    - Commitment from those supporting the framework (Case Study 2 and Case Study 5).
    - Appropriate funding arrangements (Case Study 2).
    - Comprehensive understanding existing frameworks so as to reduce duplication and unnecessary work. (Case Study 5).

APPENDIX A — BIBLIOGRAPHY

Abbandonato, H., Balestrazzi, A., Bonomi, C., Blandino, C., Cameron, C., Campbell, C., De Vitis, M., Dello Jacovo, E., Dixon, K., Fiegener, R., Frachon, N., Frischie, S., Galvez, C., Guest, F., Hawes, C., González, M., Iannetta, P., James, E., Jiménez-Alfaro, B & Wijayasinghe, M. (2019). *Native Seed Ecology, Production & Policy — Advancing knowledge and technology in Europe.*

Abbandonato, H., Pedrini, S., Pritchard, H.W., De Vitis, M. and Bonomi, C. (2018). Native seed trade of herbaceous species for restoration: a European policy perspective with global implications. *Restoration Ecology*, 26(5), pp. 820–826.

Agricultural Marketing Service. (2021). *Agricultural Genetic Resources Preservation Research: Fort Collins, CO.* U.S. Department of Agriculture. Retrieved from https://www.ars.usda.gov/plains-area/fort-collins-co/center-for-agricultural-resources-research/paagrpru/

Agricultural Marketing Service. (2021). *Federal Seed Act.* US Department of Agriculture. Retrieved from https://www.ams.usda.gov/rules-regulations/fsa

Alliance, P.C. (2015). *National seed strategy for rehabilitation and restoration 2015–2020*. Washington (DC): US Department of the Interior, Bureau of Land Management. Retrieved from http://www.blm.gov/ut/st/en/prog/more/CPNPP/0/seedstrategy.html

Amigo, I. (2018). *Brazil's plant biodiversity still not fully present in its seed banks.* Mongabay. Retrieved from https://news.mongabay.com/2018/07/brazils-plant-biodiversity-still-not-fully-present-in-its-seed-banks/

ANDES Association and the Potato Park. (2015). *Biocultural Heritage Innovations in the Potato Park.* IIED, pp. 36–43. Retrieved from https://pubs.iied.org/sites/default/files/pdfs/migrate/G03917.pdf

Antoniazza, L., Campos-Filho, E.M., Vieira, D.L.M. (2021). *Seed-Based restoration: how experiences in Brazil are increasing in both scale and co-benefits.* International Network for Seed-Based Restoration. Retrieved from https://ser-insr.org/news/2021/2/10/seed-based-restoration-how-experiences-in-brazil-are-increasing-in-both-scale-and-co-benefits.

ASEED Europe. (2005). *About us.* Retrieved from https://aseed.net/abouttext/

Australian Government Department of Environment. (2014). *Australia's Fifth National Report to the Convention on Biological Diversity.* Department of the Environment, Canberra.

Barbaroux, P. (2014). From market failures to market opportunities: managing innovation under asymmetric information. *Journal of Innovation and Entrepreneurship*, 3(1), pp. 1–15.

Beckert, J. (2020). Markets from meaning: quality uncertainty and the intersubjective construction of value. *Cambridge Journal of Economics*, 44(2), pp. 285–301.

Bocci, R. (2009). Seed Legislation and agrobiodiversity: conservation varieties. *Journal of Agriculture and Environment for International Development*. Retrieved from https://www.researchgate.net/publication/277114054_Seed_Legislation_and_agrobiodiversity_conservation_varieties

Bocci, R. (2009). *Seed legislation and agrobiodiversity: conservation varieties*. *Journal of Agriculture and Environment for International Development* (JAEID), 103(1/2), pp. 31–49.

Camhi, A.L., Perrings, C., Butterfield, B. and Wood, T. (2019). Market-based opportunities for expanding native seed resources for restoration: A case study on the Colorado Plateau. *Journal of Environmental Management*.

Camino Verde. (2021). *It's why we do what we do.* Retrieved from https://caminoverde.org/why

Campelo, L., (2017) New legislative proposals poses threat to Brazil's native seed supply, experts warn. *Brazil de Fato.* Retrieved from https://www.brasildefato.com.br/2017/12/14/new-legislative-proposal-possess-threat-to-brazils-native-seed-supply-experts-warn

Canadian Seed Institute, (2017). *Canada's Seed System — A Summary Description*, Canadian Seed Institute.

COAG Standing Council on Environment and Water. (2012). *Australia's Native Vegetation Framework.* Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Cole, C. (2019). *Bipartisan, Bicameral Legislation Introduced to Protect Native American Seeds and Traditional Food Products.* Retrieved from https://cole.house.gov/media-center/press-releases/native-american-seeds-protection-act-2019

Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). Retrieved from https://cites.org/eng

Cordis EU Research Results. (2011). *European native seed conservation network.* European Commission. Retrieved from https://cordis.europa.eu/project/id/506109/reporting

Cross, A.T., Pedrini, S. and Dixon, K.W. (2020). Foreword: International Standards for Native Seeds in Ecological Restoration. *Restoration Ecology*, 28, pp. S216–S218.

de Urzedo, D.I., Fisher, R., Piña-Rodrigues, F.C., Freire, J.M. and Junqueira, R.G. (2019). How policies constrain native seed supply for restoration in Brazil. *Restoration Ecology*, 27(4), pp. 768–774.

De Vitis, M., Abbandonato, H., Dixon, K.W., Laverack, G., Bonomi, C. and Pedrini, S. (2017). The European native seed industry: characterization and perspectives in grassland restoration. *Sustainability*, 9(10), p. 1682.

De Vitis, M., Mondoni, A., Pritchard H.W., Laverack G., Bonomi, C. (eds). (2018). *Native Seed Ecology, Production & Policy — Advancing knowledge and technology in Europe*. MUSE, Trento.

Eastwood, R.J., and Müller J.V. (2010). *European Native Seed Conservation Network.* Botanic Garden Conservation International (BGCI). Retrieved from https://www.jstor.org/stable/10.2307/24811004

Economic Research Service. (2021). *Conservation Programs.* US Department of Agriculture. Retrieved from https://www.ers.usda.gov/topics/natural-resources-environment/conservation-programs/

European Botanic Gardens Consortium. (2021). *Europe.* Botanic Gardens Conservational International. Retrieved from https://www.bgci.org/our-work/where-we-work/europe/

Euroseeds. (2021). *Euroseeds 2021 Congress.* Retrieved from https://www.euroseeds.eu/

Federal Research Center (2021). *All-Russian Institute of Plant Genetic Resources named after N.I. Vavilova.* Ministry of Science and Higher Education. Retrieved from http://www.vir.nw.ru/.

First Nations Development Institute. (2015). Seed Saving and Seed Sovereignty. Retrieved from https://www.firstnations.org/wp-content/uploads/publication-attachments/2015-Fact-Sheet-11-Seed-Saving-and-Seed-Sovereignty.pdf

Frischie, S., Miller, A.L., Pedrini, S. and Kildisheva, O.A. (2020). Ensuring seed quality in ecological restoration: native seed cleaning and testing. *Restoration Ecology*, 28, pp. S239–S248.

Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett, J.G., Eisenberg, C., Guariguata, M.R., Liu, J. and Hua, F. (2019). International principles and standards for the practice of ecological restoration. *Restoration Ecology*, 27, pp. S1–S46.

Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett, J.G., Eisenberg, C., Guariguata, M.R., Liu, J. and Hua, F., (2019). Historical principles and concepts of ecological restoration and allied activities. *Restoration Ecology*, 27.

Gann, G.D., McDonald, T., Walder, B., Aronson, J., Nelson, C.R., Jonson, J., Hallett, J.G., Eisenberg, C., Guariguata, M.R., Liu, J. and Hua, F., (2019). *International principles and standards for the practice of ecological restoration: Summary.* Washington, DC: Society for Ecological Restoration.

Gibson Roy, P., (2015) *Investigating techniques for producing species-rich native seed crops for biodiversity restoration*, Churchill Fellowship Report., The Winston Churchill Memorial Trust of Australia.

Global Trees Campaign. (2021). *Global Conservation Consortia.* Retrieved from https://globaltrees.org/projects/global-conservation-consortia/

Golay, C., and Bessa, A. (2019). The right to seeds in Europe. *The Geneva Academy of International Humanitarian Law and Human Rights.* Retrieved from https://www.geneva-academy.ch/joomlatools-files/docman-files/The%20Right%20to%20Seeds%20in%20Europe.pdf.

Harrison, S.P., Atcitty, D., Fiegener, R., Goodhue, R., Havens, K., House, C.C., Johnson, R.C., Leger, E., Lesser, V., Opsomer, J. and Shaw, N. (2020). *An assessment of the need for native seeds and the capacity for their supply: Interim report*. Washington, DC: The National Academies Press.

Howell, K. (2020). *27 Organisations Working to Conserve Seed Biodiversity.* Foodtank. Retrieved from https://foodtank.com/news/2020/07/26-organizations-working-to-conserve-seed-biodiversity/

Hubbard, K. (2021). *A Short History of Intellectual Property Rights on Sed and What Farmers Should Know*. The Natural Farmer.

Institute for Applied Ecology. (2021). *National Seed Strategy.* Native Seed Network. Retrieved from https://nativeseednetwork.org/national-seed-strategy/

International Network for Seed-Based Restoration. (2021). *Native Seed Protocols.* Retrieved from https://ser-insr.org/protocols

International Union for Conservation of Nature. (2021). The Bonn Challenge, *Restore our Future Boon Challenge,* Retrieved from https://www.bonnchallenge.org/

Irish Seed Savers (2021). Retrieved from https://irishseedsavers.ie/

Janke, T. (2018). From smokebush to spinifex: Towards recognition of Indigenous knowledge in the commercialisation of plants. *International Journal of Rural Law and Policy*, (1), pp. 1–27.

Jones, T.A. and Young, S.A., (2005). Native seeds in commerce: more frequently asked questions. *Native Plants Journal*, 6(3), pp. 286–293.

Lichtenberg, E. (2014). Conservation, the Farm Bill and US Agri-environmental policy. *Choices*, *29* (316-2016-7746).

Lichtenberg, E. (2018). Conservation Programs in the 2018 Farm Bill. *AEI Paper & Studies*, p. 3D.

Louwaars, Niels & de Boef, Walter & Edeme, Janet. (2013). Integrated Seed Sector Development in Africa: A Basis for Seed Policy and Law. *Journal of Crop Improvement*, 27, pp. 186–214. Retrieved from https://www.researchgate.net/publication/249644277_Integrated_Seed_Sector_Development_in_Africa_A_Basis_for_Seed_Policy_and_Law

MacCallum, K. (2020). *Open Access: Selecting native plant material for restoration projects in different ecosystems.* Society for Ecological Restoration. Retrieved from https://www.ser.org/news/508864/Open-Access-Selecting-native-plant-material-for-restoration-projects-in-different-ecosystems.htm

Mainz, A.K. (2021). Native Seed Production in Germany. *International Network for Seed-Based Restoration.* Retrieved from https://ser-insr.org/webinars/2016/11/17/native-seed-production-in-germany

Mainz, A.K. and Wieden, M. (2019). Ten years of native seed certification in Germany–a summary. *Plant Biology*, 21(3), pp. 383–388.

McCune, L.M. (2018). The protection of indigenous peoples' seed rights during ethnobotanical research. *Ethnobiology Letters*, 9(1), pp. 67–75.

Nagoya Protocol. Retrieved from https://www.cbd.int/abs/

Millennium Seed Band Partnership (2021). *Africa*. Retrieved from http://brahmsonline.kew.org/msbp/Where/Africa

Millennium Seed Band Partnership (2021). *Seed Conservation Techniques Training Course 2021*. Retrieved from http://brahmsonline.kew.org/msbp

Muller, J., Linington, S. (2007). The *European Native Seed Conservation Network — progress towards target 8 of the Global Strategy for Plant Conservation*. 3rd Global Botanic Gardens Congress.

Native American Seeds Protection Act. (2019). Retrieved from https://www.congress.gov/bill/116th-congress/house-bill/3916/all-info

Native Seeds (2021). *About Natiseseeds.eu.* Retrieved from http://db.nativeseeds.eu/home

Nevill, P.G., Cross, A.T. and Dixon, K.W., (2018). Ethical seed sourcing is a key issue in meeting global restoration targets. *Current Biology*, 28(24), pp. R1378–R1379.

Norwegian Government Security and Service Organisation. (2021). *Svalbard Global Seed Vault.* Retrieved from https://www.regjeringen.no/en/topics/food-fisheries-and-agriculture/svalbard-global-seed-vault/id462220/

Oldfield, S. (2019). The US national seed strategy for rehabilitation and restoration: Progress and prospects. *Plant Biology*, 21(3), pp. 380–382.

Olwell, P. (2019). Native Seeds: An Unrecognized and Undervalued Resource. *The Bulletin of the Ecological Society of America*. Wiley Periodicals. Retrieved from https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/bes2.1488

Olwell, P. (2019). *Seeds and stewards of the future: A U.S. collaboration.* Society for Ecological Restoration. Retrieved from https://www.ser-rrc.org/resource/seeds-and-stewards-of-the-future-a-u-s-collaboration/

Olwell, P. and Bosak, S. (2015). *National Seed Strategy Business Plan 2015–2020.* US Department of Interior. Retrieved from https://www.blm.gov/sites/blm.gov/files/uploads/programs_natural-resources_native-plant-communities_national-seed-strategy_NSS-BUSINESS-PLAN.pdf

Ontario Plant Restoration Alliance (2020). *Norfolk County Seed Conservation Strategy.* http://www.opra.ca/seed-strategy-projects.html

Partnerships for Forests (2021). Xingu Seeds Network: harvesting native forest seeds. Retrieved from https://partnershipsforforests.com/partnerships-projects/xingu-seeds-network-harvesting-native-forest-seeds/

Pedrini, S. and Dixon, K.W. (2020). International principles and standards for native seeds in ecological restoration. *Restoration Ecology*, 28, pp. S286–S303.

Pedrini, S., Dixon K.W. and Cross, A.T. (Eds) (2020). Standards for Native Seeds. *Ecological Restoration*, Special Issue, 28(S3), pp. S213–S303.

Perroni, E. (2017). *Twenty Seed Saving Initiatives Preserving Biodiversity Around the World.* Foodtank. Retrieved from https://www.resilience.org/stories/2017-08-04/twenty-seed-saving-initiatives-preserving-biodiversity-around-the-world/

Plant Conservation Alliance, (2021). *National Seed Strategy for Rehabilitation and Restoration Progress Report 2015–2020*, p. 1. Retrieved from https://www.blm.gov/sites/blm.gov/files/uploads/NationalSeedStrategy_MakingProgress_2018.pdf

Prendeville, H.R. (2019). *USDA Supporting the National Native Seed Strategy.* US Department of Agriculture. Retrieved from https://www.usda.gov/media/blog/2017/03/13/usda-supporting-national-native-seed-strategy

Puchalski, J. (2004). International Programmes for Seed Preservation of European Native Plants. *Bulletin of Botanical Garden*, 13, pp. 11–18. Retrieved from https://www.academia.edu/22763589/International_Programmes_for_Seed_Preservation_of_European_Native_Plants

Ramsar Convention on Wetlands. Retrieved from https://www.ramsar.org/

Reimer, A. (2013). *Trends in US Agricultural Conservation Programs.* National Agricultural and Rural Development Policy Center. Retrieved from https://aese.psu.edu/nardep/publications/policy-briefs/trends-in-u-s-agricultural-conservation-programs

Rivière, S. and Müller, J.V. (2018). Contribution of seed banks across Europe towards the 2020 Global Strategy for Plant Conservation targets, assessed through the ENSCONET database. *Oryx*, 52(3), p. 464.

Royal Botanic Gardens. (2021). *Seed Collection.* Royal Botanic Gardens Kew. Retrieved from https://www.kew.org/science/collections-and-resources/collections/seed-collection

Sanches, R.A. and Tomiko Futemma, C.R., 2019. *Seeds network and collective action for the restoration and conservation of Xingu River's springs* (Mato Grosso, Brazil). Desenvolvimento e meio ambiente.

Santilli, J., (2016) Commentary on the Brazilian seed law. *Farmers' Crop Varieties and Farmers' Rights,* pp. 338–345. Retrieved from https://www.bioversityinternational.org/fileadmin/user_upload/online_library/publications/pdfs/Farmers_Crop_Varieties_and_Rights/20.BrazilianSeedLaw-Santilli.pdf

Santo, M.D.E, Soares, A.L., Veloso, M. (2018). *Botanic Gardens, People and Plants for a Sustainable World.* Eighth European Botanic Gardens Congress Lisboa 2018, p. 201. Retrieved from http://www.eurogard2018.org/wp-content/uploads/Botanic-Gardens-People-and-Plants-for-a-Sustainable-World_2020_page.pdf

Schmidt, I.B., de Urzedo, D.I., Piña-Rodrigues, F.C.M., Vieira, D.L.M., de Rezende, G.M., Sampaio, A.B. and Junqueira, R.G.P., (2019). Community-based native seed production for restoration in Brazil–the role of science and policy. *Plant Biology*, 21(3), pp. 389–397.

Seed Savers Exchange. (2021). *Keeping Heirloom Seeds Where they Belong.* Retrieved from https://www.seedsavers.org/

SeedChange. (2021). *Welcome to SeedChange.* Retrieved from https://weseedchange.org/

Seeds of Diversity, *Seed and Food Biodiversity.* https://seeds.ca/sw8/web/diversity

Shaw, N.L., Youtie, B. and Olwell, P., (2011). *Building bridges between agencies, researchers, famers and non-governmental organizations to create collaborative native seed programs*. Proceedings: 7th European Conference on Ecological Restoration; Avignon, France; August 23–27,. Society for Ecological Restoration, Europe Chapter.

Society for Ecological Restoration. (2019). *Restoring Land, Water & Community Resilience.* Retrieved from http://ser2019.org/wp-content/uploads/2019/09/SER2019-Book-Of-Abstracts.pdf

The Xingu Seeds Network (2021). *The Xingu Seeds Network.* AMAZ Amazon Super Plants. Retrieved from https://liveamaz.com/xingu-seeds-network

U.S. Department of Agriculture. (2012). *Native Plant Materials Policy A Strategic Framework.* Retrieved from https://www.fs.fed.us/wildflowers/Native_Plant_Materials/documents/NativePlantMaterialsPolicy_Sept2012.pdf

UN Convention on Biological Diversity (UNCBD). Retrieved from https://www.cbd.int/

UN Convention to Combat Desertification (UNCCD). Retrieved from https://www.unccd.int/

UN Framework Convention on Climate Change (UNFCCC). Retrieved from https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change

UNESCO. (2021). *Man and the Biosphere (MAB) Programme.* Retrieved from https://en.unesco.org/mab

Urzedo, D.I.D., Piña-Rodrigues, F., Feltran-Barbieri, R., Junqueira, R.G. and Fisher, R. (2020). Seed networks for upscaling forest landscape restoration: is it possible to expand native plant sources in Brazil?. *Forests*, 11(3), p. 259.

Van Loon, Robin. (2017) Greening Africa: The Practice and Purpose of Sowing Native Seeds. *Wild Forests & Fauna.* Retrieved from https://wildff.org/greening-africa-sowing-native-seeds/

Van Slageren, W. (2003). The Millennium Seed Bank: building partnerships in arid regions for the conservation of wild species. *Journal of Arid Environments*, 54(1), pp. 195–201.

Wallace, Eric J, (2018). This Seed Bank reserves Biodiversity by Opening Its Doors to Farmers, *Atlas Obscura.* https://www.atlasobscura.com/articles/seed-banks-in-africa

Westengen OT, Haug R, Guthiga P and Macharia E (2019) Governing Seeds in East Africa in the Face of Climate Change: Assessing Political and Social Outcomes. *Frontiers in Sustainable Food Systems.* Retrieved from https://www.frontiersin.org/articles/10.3389/fsufs.2019.00053/full

Wight, A. (2020). *Around the world, Indigenous seed banks are helping to preserve culture, boost nutrition and protect the environment.* Ensia. Retrieved from https://ensia.com/features/indigenous-seed-banks-culture-nutrition-environment/

Williams, M.I., Dumroese, R.K., Pinto, J.R. and Jurgensen, M.F. (2015). *Foundational Literature for Moving Native Plant Materials in Changing Climates.* US Department of Agriculture. Retrieved from https://www.fs.fed.us/rm/pubs/rmrs_gtr347.pdf

World Heritage Convention. Retrieved from http://whc.unesco.org/en/conventiontext/

Wozniacka, G. (2019). *A New Bill Could Help Protect the Sacred Seeds of Indigenous People.* Civil Eats. Retrieved from https://civileats.com/2019/10/09/a-new-bill-could-help-protect-the-sacred-seeds-of-indigenous-people/