DIVSEEK INTERNATIONAL NETWORK INC.

# Strategic Plan

## 2021-2026

DivSeekIntl.org

# What is DivSeek?

**The DivSeek International Network is a global** community that connects, combines and communicates expertise among stakeholders engaged in the management[1] and characterization[2] of plant genetic resources. DivSeek comprises leading researchers and practitioners drawn from a broad base of academic and research institutions, government agencies, and inter-governmental organizations around the world. DivSeek's key role is to facilitate and encourage the open dissemination of information about plant genetic resources and to promote benefit-sharing derived from their use, while respecting indigenous knowledge and the international treaties and conventions established to protect them.

DIVSEEK INTERNATIONAL NETWORK INC.

**This document defines major goals for the DivSeek International Network, with specific measurable objectives and strategies required to achieve them over the next five years.**

## Our Vision

**Our vision is a world in which all** researchers can access standardized digital information that increases respect for, and understanding of plant biodiversity. This will help to address emerging issues affecting agriculture and plant-derived value chains, and global challenges such as climate change, food and nutritional security, and limitations of natural resources, ultimately delivering economic, environmental and social benefits to all stakeholders.

## Our Mission

**We enable those who conserve and benefit** from the sustainable utilization of plant biodiversity to access and harness expertise, scientific evidence, technologies and global best practices that facilitate the characterization, utilization, exchange and traceability of genetic resources.

## Our Goals

**DivSeek helps to leverage and promote the sharing of information about plant genetic resources (PGR) to:**

1. Catalyze informed conservation, management, and traceability of PGR.
2. Facilitate utilization of PGR in crop improvement.
3. Increase awareness about the value of biodiversity and benefit-sharing mechanisms related to its use.

[1] Management of plant genetic resources (PGR) includes but is not restricted to the collection and acquisition, storage, distribution, multiplication, documentation and exchange of PGR-related information, and participation in the development and implementation of the legal framework regarding access and benefit sharing.

[2] Characterization of PGR includes data encompassing provenance, genetic and increasingly extensive phenotypic descriptions, and requires the operation and advancement of an accessible and interoperable bioinformatic infrastructure to store and retrieve information on PGR.

# How We Work

**The DivSeek International Network is a community** of practice comprising of 65 member organizations from more 30 countries. We aspire to expand the community, focusing in particular on new members from low and middle income countries (LMICs). Our member organizations and individual researchers represent a broad array of global leaders engaged in the conservation and characterization of plant genetic resources.

### The DivSeek International Network:

- Focuses on development of community standards, capacity building, and communication.
- Draws on the expertise of our members and showcases a variety of relevant technologies.
- Raises awareness about benefit-sharing 'best practices' that are respectful of indigenous knowledge and principles, and in keeping with international treaties and conventions
- Brokers leading-edge approaches to the acquisition, analysis and sharing of information relating to plant genetic resources for food and non-food uses.
- Shares information and recommendations with the wider community to demonstrate how innovation can unlock the potential of plant genetic resources.
- Strives for inclusiveness, collaboration, and open access.

### Working Groups provide the primary means for achieving our strategic goals and associated specific objectives (*Figure 1*). These focused advisory groups:

- Identify global challenges and bottlenecks.
- Determine specific gaps, targets and opportunities for scientific, policy and funding communities.
- Broker expertise by drawing on, co-opting and connecting expertise from within the DivSeek network and beyond.
- Promote innovative solutions in areas such as genomics, phenomics and policies relating to plant genetic resources.
- Work collectively to develop and promote standards and best practices that provide the research and breeding communities as well as those specifically dealing with plant genetic resources with a consistent approach to optimize value for society.

### Collectively, Working Groups:

- Provide a forum to identify funding opportunities, leverage collaborative funding applications, and promote new and existing multidisciplinary collaborations.
- Increase awareness about international agreements within the DivSeek International community.
- Provide scientific evidence to inform policy relating to plant genetic resources.
- Facilitate access to existing educational resources, training opportunities and internship programs.

## Working Groups

*Facilitate*

| | | | | | |
|---|---|---|---|---|---|
| 1. | **Phenotyping, Ontologies and Standards**<br>Phenotyping Experts, Gene Bank Managers, Breeders | **Phenotypic Characterization**<br>Adoption of new phenotyping strategies for PGR | **Database Development**<br>FAIR principles, link phenotypic data to PGR via DOIs, develop ontologies and community standards. | **Sharing**<br>Methods, standards, best practices, analysis tools | **Outcome**<br>Provide insights into phenotypic potential of PGR to accelerate breeding for climate-resilient crops |
| 2. | **Genomics of Gene Banks**<br>Genotyping (or Omics) experts, Gene Bank Curators, Breeders, Database Developers | **Genomic Characterization**<br>Gene bank accessions and structured populations | **Database Development**<br>FAIR principles, link genotypic data to PGR via DOIs | **Sharing**<br>Methods, standards, best practices, analysis tools | **Outcome**<br>Improved management of gene banks and enhanced utilization of PGR in breeding |
| 3. | **International Policies**<br>Divseek Members, Lawyers, Policy Makers | **Understanding Framework**<br>Legal and policy framework for data-sharing | **Science Driven**<br>Science-based discussions about implications of data sharing | **Sharing of Perspectives**<br>Enhance understanding and clarify best practices related to current benefit-sharing policies | **Outcome**<br>Increased awareness of access and benefit sharing<br>Publication of perspectives piece by DivSeek community |

***Figure 1** – Roles and outcomes of DivSeek Working Groups (PGR = plant genetic resources; DOI = digital object identifier)*

## Regional and Thematic Hubs

**Self-governing regional and thematic hubs** (Figure 2) bring together independent groups of members, non-members and associated experts to address issues relevant to national or regional priorities, as well as tackling more general issues.

These hubs create a focal point for the coordination of national or regional priorities, programs and projects that advance the DivSeek International mission and goals.

They also facilitate communication among scientists and policy makers to achieve a consistent and scientifically valid interpretation of international treaties and global agreements. This involves the provision of advice and proposals based on scientific evidence. to government, regional funding bodies, policy makers and international treaty negotiators.

### Finally, the hubs:

- Generate and disseminate training and educational resources,
- Advocate for national support of the DivSeek International Network,
- Benefit from access to the DivSeek International Network, and
- Provide periodic reports to the DivSeek Board.

# Pilot Hubs

1. Germinate Hub
2. Gene bank Genomics: Unlocking the potential of plant germplasm collections
3. DivSeek Hub for Latin America
4. Australasian DivSeek Hub
5. Does it Taste Good? Cultural and culinary characterization
6. Genomic technology to democratize and empower the conservation and use of genetic resources
7. DivSeek hub for Canada
8. Global-Durum: a global platform for leveraging durum wheat diversity
9. Genomic characterization of African orphan crops
10. DivSeek Hub: West Africa
11. Haplotype Catalog and PanGenome Hub: Chickpea

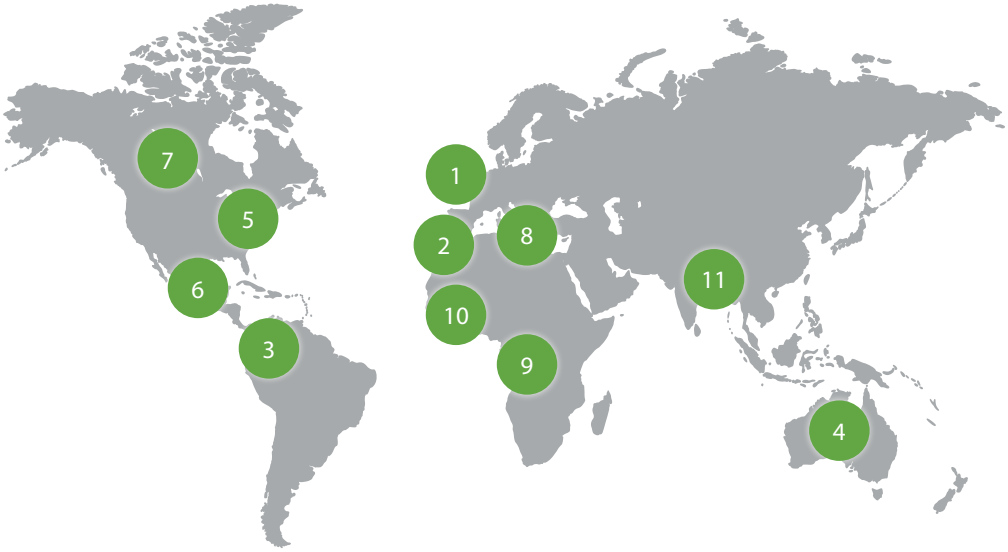



*Figure 2 – Initial pilot regional and thematic hubs established within the DivSeek Network*

# Achieving Specific Outcomes

**DivSeek may establish standing committees** to achieve specific outcomes, such as the development of community standards. External organizations with the requisite expertise and similar missions may be invited to join such committees, and DivSeek will also build on existing partnerships to achieve these aims.

DivSeek has a long history of interaction with the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). However, many non-food crops, minor crops and underutilized plant species lie outside the scope of the ITPGRFA[3].

[3] Annex 1 of the ITPGRFA includes a reference to 199 'priority crops'.

# Values and Guiding Principles

- Scientific rigor, innovation and integrity
- Respect for biodiversity and associated traditional and indigenous knowledge
- Social acceptance and empowerment
- Inclusiveness, collaboration and open access

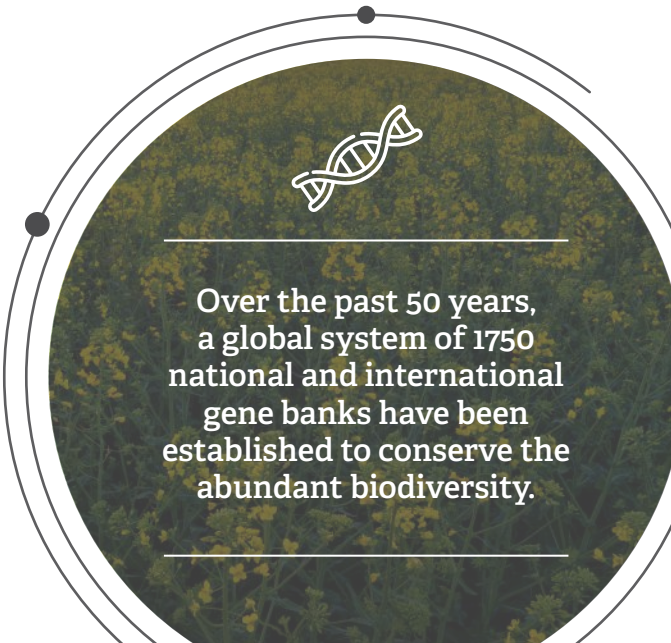
# Environment, Context and Timeliness

**Plant genetic resources** refers to all plant species found in nature, as well as to domesticated plants and crops, and ex situ resources such as living collections and seed banks. The biodiversity represented by these resources is dynamic and under constant and under constant threat from challenges such as climate change, deforestation, and urbanization. This is of great concern because plants are the earth's most important autotrophs; they feed the world, both directly and indirectly. They play a dominant role in terrestial balances of mass (water, carbon, nitrogen) and energy, thus defining our climate's future.

Plants have migrated within and between continents since antiquity. For domesticated plants and crops, migration has accelerated over the past 5,000 years, underpinning trade and cultural exchange. The exploitation of plants for food, feed, fuel, materials and medicines has driven much of this trade, but in the modern era it is important to protect not only biodiversity but also the knowledge held by indigenous communities.

The primary use of plants by humans is a source of food. Recent projections[4] indicate global food production needs to increase 30–70% by 2050 to keep pace with population growth. Plant genetic resources provide the foundation for the development of more resilient crops that meet challenges of climate variation, extend the range of crops that ensure food security, curb the decline in ecosystem biodiversity (including agricultural ecosystems), improve land and water availability, and enhance human development.

- The past century has seen rapid and accelerating genetic erosion of plant diversity, both in natural ecosystems and among cultivated plants.
    - For crop plants, this has led to the loss of traditional landraces, along with associated traditional knowledge. This is especially acute for minor crops that contribute to human nutrition, wellbeing and economic activity.
- Over the past 50 years, a global system of >1750 national and international gene banks have been established to conserve the abundant biodiversity (genetic variation) found in traditional landraces of crops and their wild relatives[5].
    - These house ~7 million crop germplasm accessions[6] including samples of diverse natural populations, with many more managed in situ.
    - Harnessing the extensive genetic variation within these gene banks could lead to the development of varieties with more sustainable yields or greater resistance to pests and diseases, varieties with improved taste and nutritional value, or carbon sequestering and climate-resilient cultivars that require fewer agricultural inputs.
    - Although the conservation of crop genetic variation is a critical first step, the use of biodiversity to address local and global challenges requires a new paradigm of information-led crop improvement.



- Technological advances, particularly in DNA sequencing, omics and molecular biology, sensors, imaging, robotics, computation, information science and the management of big data can now transform the way in which plant genetic resources are managed and utilized.

- The key international agreements that govern plant genetic resources include:

  1. the 1993 Convention on Biological Diversity (the "Convention"), the 2014 Nagoya Protocol to the Convention; and
  2. the 2004 International Treaty for Plant Genetic Resources in Food and Agriculture (the "Plant Treaty").

These agreements require users of certain plant genetic resources to abide by rules on accessing these resources and sharing defined benefits derived from their use. As drafted, these international regimes tie access and benefit sharing obligations to the use of physical genetic resources, but there is currently intense discussion and debate about the applicability of the agreements to genetic sequence data, otherwise known as digital sequence information (DSI).

- The rapid technological developments of the last few years have opened a window of opportunity to mobilize plant genetic variation and accelerate the rate of crop improvement for the sustainable production of food, feed, fibre, medicines, and renewable natural products.

## In order to harness the potential of plant genetic resources to meet a range of global challenges, we must first address the following limiting factors:

1. Paucity of information about accessions currently housed in gene banks.
2. Limited of use of genomic, phenomic and information technologies.
3. Obstacles in implementing national and international polices for benefit sharing.

[4] https://www.nature.com/articles/s43016-020-0074-1 (Herrano et al 2020) http://www.fao.org/fileadmin/templates/wsfs/docs/Issues_papers/HLEF2050_Global_Agriculture.pdf

[5] e.g. https://www.genebanks.org/genebanks/

[6] As listed in Annex 1 Priority Crops – see http://www.fao.org/fileadmin/templates/agphome/documents/PGR/PubPGR/ResourceBook/annex1.pdf; see also https://www.bioversityinternational.org/fileadmin/user_upload/online_library/publications/pdfs/Crop_genetic_Resources_global_commons/14.crops_list_under_multilater_system.pdf

# Stakeholders

**The DivSeek International Network** aims to catalyze interactions between researchers across disciplines, communities and industries at all levels, allowing them to benefit from increased access to plants and products that affect economic, social, health or environmental outcomes.

Our primary target audience includes the extensive community of multidisciplinary researchers, conservationists, gene bank curators, plant breeders, farmers, policy makers, funders, donors, and guardians of traditional knowledge involved in all aspects of the conservation, characterization, utilization and sharing of information about plant genetic resources.

**Our stakeholders will benefit from continued access to plant genetic resources and associated information, and will be empowered by the enabling technologies associated with DivSeek.**

**These include:**

- Those party to obligations arising from the implementation of the Nagoya Protocol on Access and Benefit Sharing including LMICs and first-nation peoples.
- Beneficiaries of traceability, including representatives of traditional plant breeders, owners and guardians of traditional knowledge, and other custodians of cultivated land.
- Researchers, plant breeders, funders and policy makers involved in mobilizing plant genetic variation to generate new crops and cultivars.
- Farmers, foresters, communities and a wide range of primary producers involved in the cultivation of plants and the development of plant-derived raw materials.
- The extensive added-value processing and supply-chain, end-users and consumers of food/feed, fibre, medicines, and other plant-derived products. This reflects increased awareness of the role of plant biodiversity in the quality of renewable raw materials, with additional potential for advanced engineering and construction materials.
- The wider plant and ecosystem conservation community.

**Our primary target audience includes** the extensive community of multidisciplinary researchers, conservationists, gene bank curators, plant breeders, farmers, policy makers, funders, donors, and guardians of traditional knowledge involved in all aspects of the conservation, characterization, utilization and sharing of information about plant genetic resources.

# Overall Goals and Specific Objectives (3–5 Years)

**We will achieve our vision for this strategic plan by addressing three key goals, each with a number of specific objectives.**

## Goal #1

**We will catalyze the advanced conservation, management and traceability of plant genetic resources.**

We currently have no definitive means to determine unequivocally the provenance of plant genetic resources. Standardized identity tracing, especially during rounds of regeneration, will improve the efficiency of gene bank curation and will improve stakeholder access to diversity. Furthermore, improved methods for standardized interoperability between gene banks will build user trust and contribute to long-term data sharing.

### What

Increasing recognition and awareness of the concept that a gene bank accession may formally represent a genetic population is central to the development of appropriate systems for the identification and tracing of plant genetic resources.

### How

We aim to establish and encourage the widespread adoption of standards for sampling, unique identifiers, controlled vocabularies and ontologies that are appropriate and contribute to the identity and traceability of plant genetic resources beyond gene bank accessions, encompassing the research and breeding communities as well the wider economic, social and environmental context. This may require a more detailed management of the current DOI system applied in formal treaties such as the ITPGRFA.

### Who Benefits

The global genetic resource management, research, breeding and farming communities, downstream processers, and users of plant products.

### Outcomes

A globally cohesive plant genetic resources community that can exchange standardized information and resources.

A common understanding of genetic relationships and lineages in plant genetic resources among the research, breeding and end-user communities.

## Objective #1

Develop and facilitate the adoption of standards for information exchange compatible with the management of plant genetic resources.

### Activity #1

Develop a framework for best practices in DNA genotyping to estimate diversity, establish lineages, relationships and fingerprints.

### Activity #2

Propose nomenclature standards for the genetically meaningful tracking of plant cultivars and derived genetic resources, and work with the breeding industry to adopt these standards.

**KPI #1** Building on the existing DOI system, propose a universal unique identifier system to distinguish between genetic resources at the level of individual plants/genotypes.

**KPI #2** Publication of standards, definitions and implementation studies for plant genetic resources.

## Objective #2

Facilitate FAIR information exchange.

### Activity #1

Promote the widespread adoption of information platforms for plant genetic resources that are findable, accessible, interoperable and re-usable (FAIR).

### Activity #2

Produce working examples of infrastructures that have met the requirements of Objective 1 and that demonstrate information gain as a result of the interoperable platforms developed under

**KPI #1** A FAIR plant genetic resources platform built from existing gene bank data resources, using mechanisms for interoperability agreed by community stakeholders.

**KPI #2** The identification of datasets that can be made FAIR compliant in terms of persistent identifiers and metadata, information content, completeness and uniqueness.

## Goal #2

**We will add value to plant genetic resources, facilitating wider utilization and accelerating crop improvement**

Plant biodiversity reflects variations in genetic composition, with emergent phenotypes dependent on interactions with specific growth environments or developmental stages. A wide range of approaches and technologies is now available for the characterization of plant genetic resources, with no consistent means of collating or comparing datasets, or sharing them among global stakeholders.

### What

Facilitate the systematic acquisition of digital information for characterization of crop genotypes, and link the data to product end use.

### How

We will bring together phenotyping experts, gene bank managers, breeders and other gene bank users (including scientists interested in the latest phenotyping technologies and strategies) to identify mechanisms for the standardized and repeatable phenotypic evaluation of gene bank accessions and their utilization in crop breeding programs.

### Who Benefits

Plant breeders, researchers, end-users and a wide range of stakeholders involved in the supply and use of food/feed, fibre, medicines and advanced engineering materials.

### Outcomes

Management of phenotypic information and related resources contributing to the diversity of crops, plant cultivars and ecosystems to address global and regional challenges for the sustainable production of food and other products.

## Objective #1

Identify best practices for routine and emerging phenotypic and genotypic methods for the characterization of plant genetic resources.

### Activity #1

Establish practical and cost-effective platforms for the routine and distributed assessment of plant phenotypes that are valuable to breeders, farmers and product supply chains.

### Activity #2

Review and establish standardized robust common vocabularies and ontological systems to represent phenotypic attributes relevant to crops.

**KPI #1** Use-case demonstration of a formal vocabulary for the description of dietary nutritional components associated with crop germplasm.

**KPI #2** Use-case demonstration of a field-based platform for the real-time measurement of vegetative yield.

## Objective #2

Ensure FAIR online access to the world's plant genetic resources.

### Activity #1

Work with gene banks and the breeding industry to establish the use and acceptance of terminologies for trait description that link seamlessly with plant genetic resources and genomic data about those resources

### Activity #2

Work with gene banks and the breeding industry to establish the use of a standardized vegetative yield measurement system.

**KPI #1** Development of formalized searchable data structures for trait data that can be linked to current plant genetic resources.

**KPI #2** Field and/or online demonstration of the yield measurement system and a workshop to train new users.

# Characterization of Plant Genetic Resources


Resource Sustainability

Resilient Crops

Fight Climate Change & Hunger

At least **1,750** national and international gene bank collections in the world.

**TECHNOLOGY** is changing the way PGR is explored.

**7** MILLION accessions curated.

**EFFECTIVE GENE BANKING:** Keep well, choose well, use well.

## Goal #3

**We will increase awareness and education about the biodiversity and relevance of plant genetic resources,**

In partnership with related networks and other stakeholders, we will establish DivSeek as an authoritative reference source for digital information about plant genetic resources. This will require the development of a clear and consistent approach to provide digital information that adds value to current plant genetic resources.

We will develop information-led mechanisms that enable DivSeek members, other researchers, breeders, and stakeholders to access and use plant genetic resources in a manner consistent with the Plant Treaty, Convention on Biological Diversity and Nagoya Protocol, in light of existing ambiguities in the application and interpretation of such conventions.

### What

We will formulate key messages that address how digital information may facilitate access to and the exchange and use of plant genetic resources, and that highlight our obligations for the responsible use and safeguarding of such information.

### How

We will generate educational and training materials, including those that contribute to formal educational programs for the next generation of plant genetic resources managers, and will organize corresponding seminars and workshops. We will also prepare and contribute to position papers and peer-reviewed publications outlining the current state of the art in plant genetic resources, and associated responsibilities.

Through regional and thematic hubs, we will identify training/education requirements in different contexts, provide means of dissemination to national and regional audiences, and identify opportunities for funders to contribute to our educational and training objectives.

### Who Benefits

The broad community of researchers, breeders, policy makers, farmers, and industries adding value to the plant-based value chain, as well as the environment and general public.

### Outcomes

Greater awareness of the challenges/opportunities in managing data relating to plant genetic resources.

Deeper understanding of mechanisms, obligations and technologies available to facilitate access to and the use of plant genetic resources, particularly for access and benefit sharing.

## Objective #1

Establish an education, training and dissemination program.

### Activity #1

Develop a globally-relevant DivSeek training program focusing on standards, protocols and opportunities for sharing digital information related to plant genetic resources.

### Activity #2

Provide evidence-based input to clarify best practices related to the sharing of digital data and information about plant genetic resources, and to the sharing of benefits derived from their use.

### Activity #3

Develop an internet resource for standards, best practices and standard operating procedures, and arrange corresponding seminars and workshops.

## Objective #2

Increase awareness of access and benefit sharing obligations, and propose best practices for the implementation of such obligations by the DivSeek community and other researchers.

### Activity #1

Improve understanding and awareness of access and benefit sharing obligations within the DivSeek community and among other researchers.

**KPI #1** Development and distribution of educational materials on access and benefit sharing and related topics

**KPI #2** Explore the potential adaptation of educational materials to take account of different national and regional legislation.

**Activity #2:**

Develop best practices within the DivSeek Community and among other researchers in relation to the Nagoya Protocol. This will include proposing and promoting guidelines based on feedback from public forums.

**KPI #1** Identify parts of the Nagoya Protocol for which best practices can be established

**KPI #2** Develop background materials and draft best practice guidelines

**KPI #3** Identify and contact external organizations and agencies for potential collaborations

# Challenges and Risks

- Ensuring that international members and stakeholders have a clear understanding of DivSeek's mission, vision and goals.
- Awareness of the full scope of traditional custodians and end-use stakeholders in the biodiversity of plant genetic resources beyond food crops.
- Global engagement across diverse user communities with vastly different levels of investment and development.
- Ensuring broader education about plant genetic resources, obligations and the opportunities and challenges posed by information derived from plant genetic resources.
- Addressing concerns and building trust in systems of information exchange at various levels including breeders, local industries, nations, and indigenous custodians and knowledge holders.
- Defining the role of DivSeek in education.
- Engagement of DivSeek membership contributing to clear deliverables by ensuring objectives are prioritized and relevant (key gaps and critical path).
- The challenge of Big Data integration (generic architecture) and the identification and awareness of risks associated with Big Data (managing issues of biodiversity and knowledge 'piracy', and networked vs locally-managed knowledge).
- Current lack of coordination in data management systems for plant genetic resources, including the inability to carry out comparative analysis (within and between crops) and the requirement for open-source generic platforms.
- Lack of common (and generic) standards for the definition of accessions and downstream genetic materials, and the exchange of data related to plant genetic resources.
- In the context of the Convention on Biodiversity and Nagoya Protocol, there is little consensus about implementation. DivSeek is aware of the range of issues and consequences for the management, characterization and downstream use of plant genetic resources. However, innovation in genomics and information science is providing new opportunities for a wide range of stakeholders, many of whom are unaware of their obligations under the Nagoya Protocol and how information technology may facilitate benefit sharing.

# Governance and Resources

- DivSeek International Network Inc. is a not-for-profit corporation registered in Canada and hosted by the Global Institute for Food Security. It has a set of Bylaws that underpin its purpose and provide the legal framework for its activities, which are overseen by a member elected Board of Directors. Directors are elected for 2–3 years and may serve two terms. Membership is open to interested parties and is subject to the approval of the Board. Each member organization has one membership vote. There are no membership fees, but members must agree to comply with DivSeek Bylaws.

- The DivSeek International Network Board of Directors is comprised of elected representatives
    - The role of the Board is to operate good governance practices, develop strategies to meet DivSeek goals, monitor the execution of plans, review Working Group activities and advice, and ensure compliance with DivSeek Bylaws and not-for-profit regulations.

- DivSeek has two categories of members: regular members and special members, the latter excluded from fiduciary duties or obligations due to the nature of their professional responsibilities. The DivSeek Bylaws also provide for a category of observers. These are entities that do not wish to become members, or are not approved as members, but may be invited to DivSeek meetings. Such entities may include, for example, the ITPGRFA. A small executive team, led by a Managing Director, provides a central focal point to support and communicate DivSeek activities.

- DivSeek derives much synergy from the breadth and diversity of its member organizations, individual scientists and other experts who contribute in many ways and act as ambassadors for the DivSeek mission and goals as set out in this Strategic Plan.

- Financial and other resources required to maintain capacity and capability to meet goals, include:
    - Identifying how best to leverage and combine expertise
    - Stimulate and encourage innovation by identifying tangible targets
    - Partnering with like-minded not-for-profit organizations
    - Engagement and interaction with members and other stakeholders
    - Innovation within DivSeek – how to deliver objectives

- Annual meetings: DivSeek International Network is required to hold an Annual Meeting of Members, at which Financial Statements and Auditors are also approved.

DIVSEEK INTERNATIONAL NETWORK INC.

**DivSeek was founded in 2012, and has now established a clear mission and set of goals for the coming period (2021–2026) and beyond. It is currently developing a funding strategy to enable the delivery of objectives contributing to these goals.**

In particular, over the next five years, the DivSeek International Network intends to raise funds for:

**A.** hosting, governance, and coordination of the network

**B.** operational delivery, including that of working groups and links with independent international hubs

**C.** sponsoring specific activities or prizes

**D.** education/training

**E.** communications to stakeholders

# Glossary of Terms and Concepts

**Access and benefit sharing (ABS):** the way in which genetic resources may be accessed, and how the benefits that result from their use are shared between the people or countries using the resources (users) and the people or countries that provide them (providers).

**Accession:** an accession is a group of related plant material from a single species which is collected at one time from a specific location or obtained from a personal or institutional donor. Each accession is an attempt to capture the diversity present in a given population of plants.

**Best practice:** a procedure that has been shown by research and experience to produce optimal results and that is established or proposed as a standard suitable for widespread adoption.

**Big Data:** extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations and interactions.

**Biodiversity:** the variety and variability among living organisms and the ecological complexes in which they occur. Typically a measure of variation at the genetic, species, and ecosystem level. For crop plants, may also encompass different combinations of gene variants found between cultivars or landraces, or encompass the wider variation accessible within primary or secondary genepools. It is possible to increase crop biodiversity through artificial mutation, wide hybrid crosses or other interventions.

**Bioinformatics:** an interdisciplinary field that develops methods and software tools for managing and understanding biological data, in particular when the data sets are large and complex.

**Characterization:** ***(1)*** a description of the distinctive nature or features of an organism; ***(2)*** detection of variation as a result of differences in either DNA sequences or specific genes (genotype), or any aspect of morphology, physiology, biochemistry, interaction with biotic or abiotic environment, appearance or quality traits (phenotype).

**Community of practice (CoP):** a group of people who share a common concern, a set of problems, or an interest in a topic and who come together to fulfill both individual and group goals.

**Conservation of PGR:** maintenance of broad plant genetic diversity within each of the species (i.e., intraspecific genetic diversity) with a known or potential value in order to ensure availability for exploitation by present and future generations.

**Convention on Biological Diversity (CBD):** informally referred to as the Biodiversity Convention, this is a multilateral international treaty established in 1992, and currently with 192 State parties. The Convention has three main goals: the conservation of biological diversity; the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources.

**Crop wild relatives (CWR):** plant species that share genetic origins with crop species, but are not domesticated. May represent a wild ancestor of the domesticated plant, or another closely related taxon. An increasingly important resource for improving agricultural production and for maintaining sustainable agro-ecosystems.

**Curation of PGR:** the action or process of selecting, organizing, and conserving accessions within a gene bank.

**Digital data**: The discrete, discontinuous representation of information or works in electronic form, which is stored, manipulated, communicated and displayed by c omputational tools.

**Digital object identifier (DOI):** persistent identifier or handle used to identify objects uniquely, which is standardized and creates a permanent link for an item on the internet.

**Digital sequence information (DSI):** Widely acknowledged as a placeholder term for which no consensus on a replacement or precise definition currently exists. Essentially encompasses the information content arising from the sequencing of DNA, RNA or proteins, but may include derived information and annotations. In combination with other digital data relating to single or collections of organisms, may provide insights into the understanding of genomic and environmental contributions to phenotype and genetic variation associated with provenance or historical selection.

**DNA fingerprinting:** DNA profiling is the process of determining an individual's DNA characteristics. DNA analysis intended to identify a species, rather than an individual, is called DNA barcoding.

**Domesticated crops:** Plants that have been subject to artificial selection to increase their suitability for human requirements. This includes selection for traits affecting taste, yield, storage, cultivation practices and local adaptation.

**Evaluation:** Assessment of germplasm for any agronomic (production) or end-use quality traits. May include quality parameters and resistance to abiotic and biotic stresses under various growth conditions for the identification of specific traits for breeding purposes.

**Ex situ conservation:** literally "off-site conservation", describes the process of protecting a population or species, variety or breed (cultivar) of plant or animal outside of its natural habitat; primarily achieved in the form of gene banks or living collections where accessions are stored in order to conserve the genetic resources of crop plants and their wild relatives.

**Findability, accessibility, interoperability, and reusability (FAIR):** Set of principles that act as an international guideline for high-quality data stewardship. The phrase '(meta)data' is used where Findable, Accessible, Interoperable, and Re-useable principles should be applied to both metadata and data.

**Food security:** The availability and access of food to all people. Nutritional security encompasses food security, which encompasses nutrient content.

**Gene bank (also written as genebank):** a type of biorepository that preserves living genetic material. For plants, this is typically achieved by stocking the seed (cf. seed bank) or maintenance of perennial plants in a plantation or botanic garden. Additional methods may include in vitro or cryogenic storage, including freezing plant cuttings or pollen.

**Genetic erosion:** loss of genetic diversity (decrease in population variation), due to random genetic drift and inbreeding, is both a symptom and a cause of endangerment to small isolated populations.

**Genomics:** the interdisciplinary field of biology focusing on the structure, function, evolution, mapping, and editing of genomes. A genome is an organism's complete set of DNA, including all of its genes.

**Genotype:** the genetic constitution of an individual organism. Genotyping typically involves using molecular assays based on DNA sequence variation (q.v. DNA fingerprinting).

**Germplasm:** living tissue from which new plants can be grown. This may be a seed or other plant part such as a leaf, a piece of stem, pollen or just a few cells from which a whole plant may be propagated. Collectively, germplasm embodies the information for the genetic makeup of a species, a valuable natural resource of plant biodiversity.

**In situ conservation:** the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

**Indigenous knowledge:** the information, skills and philosophies developed by societies with long histories of interaction with their natural surroundings.

**Informatics:** the science of processing, analyzing and managing data for storage retrieval and utilization.

**Innovation:** an original idea that leads to the creation of a new material, product, device or method, or to a significant improvement in an existing one, potentially but not necessarily involving the use of modern technologies.

**International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA):** an international agreement, known as the International Seed Treaty, with the overall goal of supporting global food security, allowing governments, farmers, research institutes and agro-industries to work together by pooling their genetic resources and sharing the benefits from their use. It protects and enhances food crops while giving fair recognition and benefits to local farmers who have nurtured these crops through the millennia.

**Interoperability:** initially defined for information technology to allow for information exchange, interoperability is a characteristic of a product or system that interfaces perfectly with other products or systems in terms of unrestricted implementation or access. A good example of interoperability is the building of coherent services for users when the individual components are technically different and managed by different organizations.

**Knowledge 'piracy':** knowledge is appropriated or patented for profit without permission. Also known as biopiracy when applied to biological resources.

**Landrace:** a domesticated, locally adapted, traditional variety of a species of animal or plant that has developed over time, through adaptation to its natural and cultural environment of agriculture and pastoralism, and due to isolation from other populations of the species.

**Low and middle-income countries (LMICs):** The World Bank currently defines low-income economies as those with a gross national income (GNI) per capita, calculated using the World Bank Atlas method, of $1,035 or less in 2019. Lower middle-income economies are those with a GNI per capita between $1,036 and $4,045, upper middle-income economies are those with a GNI per capita between $4,046 and $12,535, and high-income economies are those with a GNI per capita of $12,536 or more.

**Minor crops:** typically highly diverse crops that may have high added value and/or are cultivated in a limited area. Relatively few plant protection products are authorised for these crops. May also be termed underutilized crops or orphan crops.

**Nagoya Protocol:** full name "Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity", a 2010 supplementary agreement to the 1992 Convention on Biological Diversity. Nutrition security encompasses food security, which encompasses nutrient content.

**Ontologies:** a representation, formal naming and definition of the categories, properties and relations between the concepts, data and entities that substantiate one, many, or all domains of discourse. More simply, an ontology is a way of showing the properties of a subject area and how they are related, by defining a set of concepts and categories that represent the subject.

**Phenomics:** the systematic measurement and analysis of qualitative and quantitative traits, including physiological, biochemical, and imaging data, for the refinement and characterization of a phenotype. Phenotype: the set of observable characteristics of an individual resulting from the interaction of its genotype with the environment.

**Physical genetic resources:** any material of plant origin, including reproductive and vegetatively propagated material, containing functional units of heredity.

**Plant genetic resources (PGR):** are plant genetic materials of actual or potential value. As collections, they may represent the variability within the genepool of a species and reflect variation arising from human (domesticated) and natural selection over millennia.

**Seed bank:** a collection of seeds amassed to preserve genetic diversity, hence a type of gene bank. There are many reasons to store seeds, including the preservation of genes that plant breeders need to increase yield, disease resistance, drought tolerance, nutritional quality and other desirable traits.

**Structured PGR:** development of pre-breeding and structured populations for curation in gene banks and for utilization by plant breeders.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