



THE SECOND REPORT  
ON THE STATE  
OF THE WORLD'S

**FOREST GENETIC RESOURCES**

**SUBMISSION BY**

**ROYAL BOTANIC GARDENS, KEW**



This report was prepared as a contribution to the FAO publication, *The Second Report on the State of the World's Forest Genetic Resources*.

Regional networks and international organizations were invited to submit written reports structured around the four strategic priorities of the Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources (FGR)– (1) improving the availability of, and access to, information on FGR; (2) conservation of FGR (*in situ* and *ex situ*); (3) sustainable use, development and management of FGR; and (4) policies, institutions and capacity building.

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**CONTRIBUTIONS OF THE ROYAL BOTANIC GARDENS, KEW TO THE  
IMPLEMENTATION OF THE GLOBAL PLAN OF ACTION FOR THE CONSERVATION,  
SUSTAINABLE USE AND DEVELOPMENT OF FOREST GENETIC RESOURCES**

**2012 - 2022**

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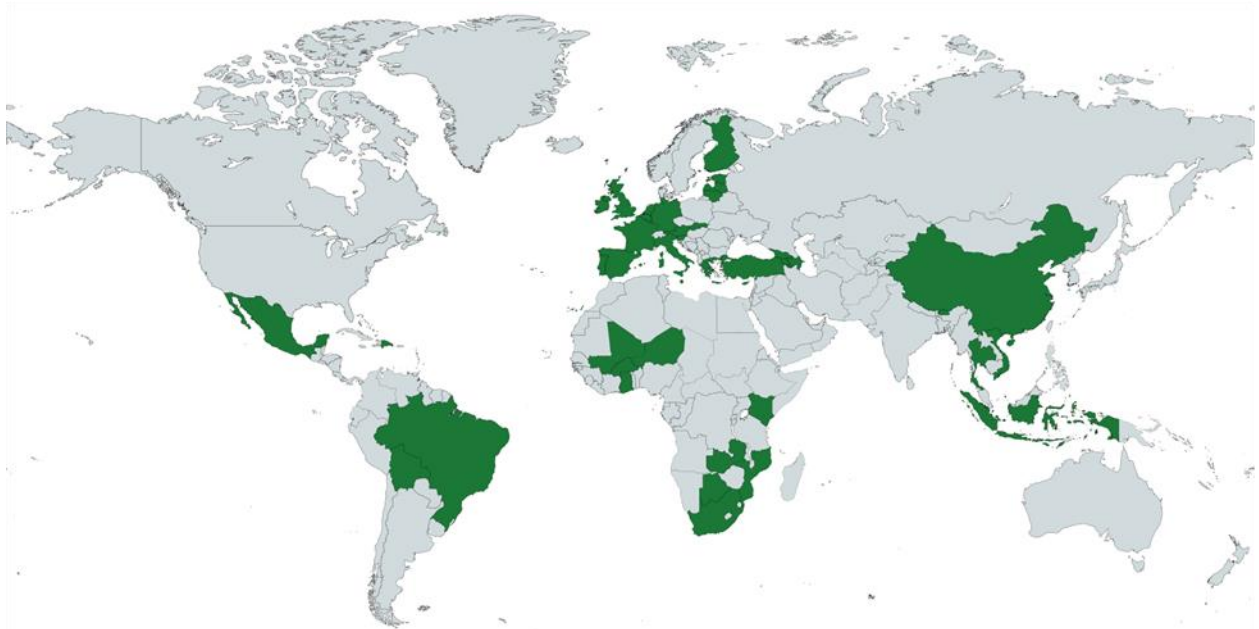
### **Introduction**

RBG Kew was founded in 1759 and operates across two sites: Kew Gardens in London, a UNESCO World Heritage Site, and at Wakehurst in Sussex, which is the home of RBG Kew's Millennium Seed Bank. We also have a permanent research station in Madagascar. We use the power of our science and the rich diversity of our gardens and collections to provide knowledge, inspiration and understanding of why plants and fungi matter to everyone.

Under the National Heritage Act (1983), RBG Kew was established as an Executive Non-Departmental Public Body (NDPB) with Exempt Charitable status. Our sponsor Department within government is the Department for Environment, Food and Rural Affairs (Defra), which also acts as our charitable regulator.

Our mission is to understand and protect plants and fungi for the wellbeing of people and the future of all life on Earth, through 5 priorities:

- Delivering science-based knowledge and solutions to protect biodiversity and use natural resources sustainably: RBG Kew scientists will identify and strive to protect species of plants and fungi globally, as well as revealing those that could be new sources of food, medicine, fuel or materials.
- Inspiring people to protect the natural world: RBG Kew will promote and provide access to knowledge, ideas and beautiful gardens that motivate individuals to be advocates for nature.
- Training the next generation of experts: The world needs brilliant scientists and horticulturists. RBG Kew commits to training students from the UK and around the world.
- Extending our reach: RBG Kew is a public body and charity with global collections and influence. It must be for everyone, disseminating its knowledge and collections both physically and digitally for global benefit.
- Influencing national and international opinion and policy: RBG Kew will speak with confidence and prominence to advocate policies aligned with its mission. It will be an exemplar of environmental responsibility in all that it does, including by exceeding net-zero carbon emissions to become climate positive by 2030.



*Figure 1: Map of the countries where FGR-related projects are carried on by RBG Kew: Botswana, Kenya, Mali, Mexico, South Africa, Mali, Niger, Burkina Faso, Dominican Republic, Mozambique, Georgia, Armenia, Azerbaijan, Indonesia, Thailand, Bhutan, UK, Ghana, Zambia, Bolivia, Brazil, Turkey, Europe, Vietnam, China.*

**Priority Area 1: Improving the availability of, and access to, information on forest genetic resources**

Areas: 20 (Botswana, Kenya, Mali, Mexico, South Africa, Mali, Niger, Burkina Faso, Dominican Republic, Mozambique, Georgia, Armenia, Azerbaijan, Indonesia, Thailand, Bhutan, UK, Ghana, Zambia, Bolivia)

Projects: 16

Contributions:

- Establish and strengthen national FGR assessment, characterization and monitoring systems (Mexico, West Africa, Mozambique, Dominican Republic, UK, Bolivia)
- Enhancing access to FGR online resources (e.g., developing a user case and technical brief for the construction of an open-access database of UK National Tree Seed project seed collections and associated metadata)
- Promote the establishment and the reinforcement of FGR information systems (databases) to cover available scientific and traditional knowledge on uses, distribution, habitats, biology and genetic variation of species and species populations, including herbaria digitalisation (UK oaks, Ghana, Zambia)

## **Priority area 2: Conservation of forest genetic resources (*in situ* and *ex situ*)**

Areas: 20 (Botswana, Kenya, Mali, Mexico, South Africa, Mali, Niger, Burkina Faso, Dominican Republic, Mozambique, Georgia, Armenia, Azerbaijan, Indonesia, Thailand, Bhutan, UK, Ghana, Zambia, Bolivia)

Projects: 17

Contributions:

- Strengthen the contribution of primary forests and protected areas to *in situ* conservation of FGR (UK, Bolivia)
- Promote the establishment and development of efficient and sustainable *ex situ* conservation systems, including *in vivo* collections and genebanks (Mexico, UK)
- Support assessment, management and conservation of marginal and/ or range limits forest species populations (UK)
- Support and strengthen the role of forests managed by indigenous and local communities in the sustainable management and conservation of FGR (Mexico, Bolivia)
- Identify priority species for action (Mexico, China, UK, Thailand)
- Develop and implement regional *in situ* conservation strategies and promote ecoregional networking and collaboration (Mexico)
- Assessing conservation status, collecting and safeguarding (*in situ* and *ex situ*) some of the world's rare, threatened and/or highly useful tree and woody herbaceous plant species (Caucasus region, Indonesia, Thailand, Bhutan, Ghana, Zambia)
- Research on tree health (UK)

## **Priority area 3: Sustainable use, development and management of forest genetic resources**

Areas: 17 (Botswana, Kenya, Mali, Mexico, South Africa, Mali, Niger, Burkina Faso, Dominican Republic, Mozambique, Indonesia, UK, Europe, Turkey, Vietnam, Bolivia)

Projects: 19

Contributions:

- Supporting reforestation, reversing or alleviating land degradation and desertification through seed conservation and research (Mexico, Dominican Republic, Indonesia, Mali, Niger, Burkina Faso, Bolivia)
- Enhancing the *ex situ* conservation of native useful plants for human wellbeing by building the capacity of local communities to successfully conserve and use these species sustainably (Africa, Mexico, Bhutan, Mozambique, Mali, Niger, Burkina Faso, UK, Bolivia)
- Develop and reinforce national seed programmes to ensure the availability of genetically appropriate tree seeds in the quantities and of the (certified) quality needed for national plantation programmes (Mexico, Brazil, UK)
- Promote restoration and rehabilitation of ecosystems using genetically appropriate material (Mexico)
- Support climate change adaptation and mitigation through proper management and use of FGR (UK, Uganda, Bolivia)
- Promote appropriate use of emerging technology to support the conservation, development and sustainable use of FGR (UK, Turkey, Indonesia, Vietnam)
- Develop and reinforce research programmes on tree breeding, domestication and bioprospection in order to unlock the full potential of FGR (UK, Turkey, Europe)

#### **Priority area 4: Policies, institutions and capacity-building**

Areas: 17 (Mexico, China, UK, Ghana, Zambia, Georgia, Armenia, Azerbaijan, Indonesia, Thailand, Bhutan, Botswana, Kenya, Mali, South Africa, Mali, Niger, Burkina Faso, Dominican Republic, Mozambique, Bolivia)

Projects: 21

Contributions:

- Develop national strategies for in situ and ex situ conservation of FGR and their sustainable use (UK, Ghana, Zambia, Bolivia)
- Develop collaboration and promote coordination of national institutions and programmes related to FGR (Ghana)
- Establish and strengthen educational and research capacities on FGR to ensure adequate technical support to related development programmes (Bolivia)
- Promote the participation of indigenous and local communities in FGR management in the context of decentralization (Bolivia)
- Promote and apply mechanisms for germplasm exchange at regional level to support research and development activities, in agreement with international conventions (Mexico, Ghana, Zambia)
- Reinforce regional and international cooperation to support education, knowledge dissemination, research, and conservation and sustainable management of FGR (Mexico, China, UK)
- Strengthen efforts to mobilize the necessary resources, including financing, for the conservation, sustainable use and development of FGR (Mexico)

#### **Concluding remarks**

##### **Seed accessions of tree species conserved ex situ at the Millennium Seed bank (MSB):**

Of the 57,958 species listed on World's tree species database maintained by the Botanical Gardens Conservation International (BGCI), at least 6,700 species (11.56%) represented by 16065 accessions are already conserved at the MSB. Of the 4,165 genera included in the BGCI tree list, 1,496 (36%) are represented at the MSB holding. In addition, there are 9,139 species from 13,869 accessions are either listed as trees, shrubs, or mallees according to collector's observation, but these are not matched with a tree species on BGCI list.

## Annexes

### Future projects

Country(s) / Region / International	Project/plan description	Priority area(s)
Mexico	This project aims to strengthen the capacity of smallholder farmers to mitigate climate change, conserve biodiversity, and improve their livelihoods through the enhancement of tree diversity and their ecosystem services in shade-grown coffee plantations in the Tropical Montane Cloud Forest (TMCF) in Veracruz, Mexico. The main objectives are to 1) develop a methodology for the selection and agroecological management of species with high potential for carbon sequestration in the TMCF; 2) support the conservation of native trees; and 3) increase the livelihoods of smallholder farmers from the sustainable use of forest goods and services in the shade-grown coffee plantations.	1, 2, 3
Tropical America	To overhaul the taxonomy of Lauraceae world-wide by integrating species level-taxonomy, a species-level phylogeny and artificial intelligence to classify images from herbarium and permanent forest plot specimens. This will create a community resource that will be utilised to maximise species discovery and assess climate change sensitivities of tropical biodiversity over long tropical thermal gradients.	4
Global	<p>Global and national initiatives to halt the loss of plant diversity require adequate knowledge of species and their occurrences. Such knowledge is lacking for most of the world's biodiversity hotspots, with much of the tropics being characterised by low numbers of records and very uneven sampling (Oliver et al. 2020). For example, the plant diversity of the Amazon rain forest, an area believed to contain 650 species of tree per ha, is documented by an average of 0.0014 occurrence records per ha (14 per 100 km<sup>2</sup>). For comparison, Costa Rica, is documented by 10,539 records per 100 km<sup>2</sup>). Our knowledge of plant diversity in the tropics is therefore both very uneven and incomplete, making it unsuitable for managing areas for plant conservation at this critical time. Compounding this, there is no globally coordinated exploration strategy to target the knowledge gaps, biases and sources of new records. Global collections such as Kew are seeing a decline in the number of records they accession each year, and it seems unlikely that the gaps will be filled without a concerted, coordinated effort to address this worrying lack of information. It is time for the Kew and the botanical community to invigorate and focus their exploration efforts to where they will fill in the most gaps and best support the halting of biodiversity loss.</p> <p>By 2024, we propose to deliver a coordinated global strategy to fill in those gaps, by 1) producing a gold-standard baseline of taxonomic &amp; geographic data (currently lacking), using it to 2) identify and characterise dark diversity (gaps in occurrences), 3) prioritise areas and taxa for gap-filling and TIPAs, and 4) establish an international consortium to seek the funding to undertake a massive and coordinated field campaign to fill them.</p>	
Global	World Forest ID and RBG Kew are creating the world's largest georeferenced forest risk commodity sample database to halt illegal trade and deforestation. Sample analysis helps identify and determine the origin of products, using techniques such as XyloTron (wood anatomy), DART-TOF and SIRA mass spectrometry, but these are costly approaches for many ODA countries. However, DNA-based identification offers cheaper, more accessible, solutions that can be readily adopted for enforcement worldwide. This project leverages Kew's unique collection to develop the first georeferenced DNA library of forest risk commodities for scalable, low-cost supply chain provenancing.	1, 3, 4

UK	Whole genome sequencing of samples of native oak from 60 sites in the UK. Analysis will look for associations between genotypes and environmental factors and future potential maladaptation.	1,3
UK	Long read data will be used to construct a pan-genome for ash which will allow for accurate location and genotyping of structural variants in ash. This will be combined with existing short-read data to identify structural variants associated with resistance to ash dieback	1,3
UK	Collect seed, tissue samples and data from trees and shrubs in the UK, focussing on: disease-tolerant ash; areas of high genetic diversity and local adaptation (informed by emerging genomic studies; species of relevance to restoration and research; and gap-filling existing ex-situ collections.	2
UK	Explore heterogeneity in tree seed morphological and germination traits and links to the maternal environment. Develop and test protocols for high-throughput optical screening of tree seed in commercial production, studying impacts of screening of the quality and germinability of seed entering the tree production chain.	3
Bolivia	Network of IPA sites designated and mapped countrywide, aiming to integrate into policy and action plans on biodiversity conservation and sustainable development in Bolivia. Capacity to be built and Bolivian network established in IUCN and IPA assessment, highlighting useful plants. Study on centres of diversity of Bolivian useful plants and sustainable use of FGR.	1,2,4,



Publications	Links
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<p>Mattana, E., Ulian, T. and Pritchard, H.W. (2021). Seeds as natural capital. Trends in Plant Science.</p>	<p><a href="https://doi.org/10.1016/j.tplants.2021.08.008">https://doi.org/10.1016/j.tplants.2021.08.008</a></p>
<p>Evaluation &amp; Planning Workshop report. Kew's Great Green Wall cross-border project (Burkina Faso - Mali – Niger) Agadir – Morocco 27th – 31st March 2017. Compiled by Stéphane Rivière, Bokary Kelly, Sidi Sanogo, Palo Ceci, Beth Ambrose &amp; Tiziana Ulian</p>	<p><a href="https://www.kew.org/sites/default/files/2019-02/GGW%20workshop%20report%20March%202017%20UPDATED%20with%20Annexes.pdf">https://www.kew.org/sites/default/files/2019-02/GGW%20workshop%20report%20March%202017%20UPDATED%20with%20Annexes.pdf</a></p>
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