Forests Food Finance

FROM A DECADE OF RESEARCH TO A DECADE OF IMPACTS

CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry

FTA HIGHLIGHTS OF A DECADE 2011-2021

Effective Tree Seed Systems

FRIDAY 5 NOVEMBER 2021

Ramni Jamnadass & Lars Graudal

Leader - FTA Flagship 1

Tree genetic resources to bridge production gaps and promote resilience

CIFOR · World Agroforestry · Alliance Bioversity International CIAT · CATIE · cirad · INBAR · Tropenbos International

Rising enthusiasm around the world for tree planting leading to a cascade of ambitious initiatives

- **Large scale tree planting initiatives, including the IUCN Bonn Challenge Secretariat, AFR 100, The Nature Conservancy, 1t.org, Trillion Trees, the Global Evergreening Alliance, Ecosia, Plan Vivo and various corporate entities; initiatives supporting tree planting: hundreds of millions of hectares have been pledged by governments, corporates and civil society for tree-planting, reforestation and restoration – primarily to sequester carbon.**
- **The United Nations Decade on Ecosystem Restoration runs from 2021 to 2030**
- **More than 100 world leaders have promised to end and reverse deforestation by 2030, in the COP26 climate summit's first major deal.**

Concern- massive scale and speed

- Many **poorly designed projects** have been implemented and many tree-planting brokers have proliferated but with **limited skill** and **knowledge** in the **science and application** of tree genetic resources and forestry
- Large scale tree planting efforts **without any indication of the species** planted and sometimes **large-scale use of invasive non-native species**
- **Exotic species promoted, low diversity monoculture** tree planting of one major favoured over more diverse portfolios
- **BOTTLENECK- LACK OF DIVERSE SEEDS (appropriate genetically diverse seed and seedling provenances)**
- **LACK OF $$$ INVESTMENT IN DIVERSITY and QUALITY SEEDS**

THE RIGHT TREE FOR THE RIGHT PLACE FOR THE RIGHT PURPOSE

Over the last decade we have sought to address twin concerns:

- How to **ensure that tree seeds and seedlings are planted in the right places for the right purposes**
- How to make **available quality** tree planting material.

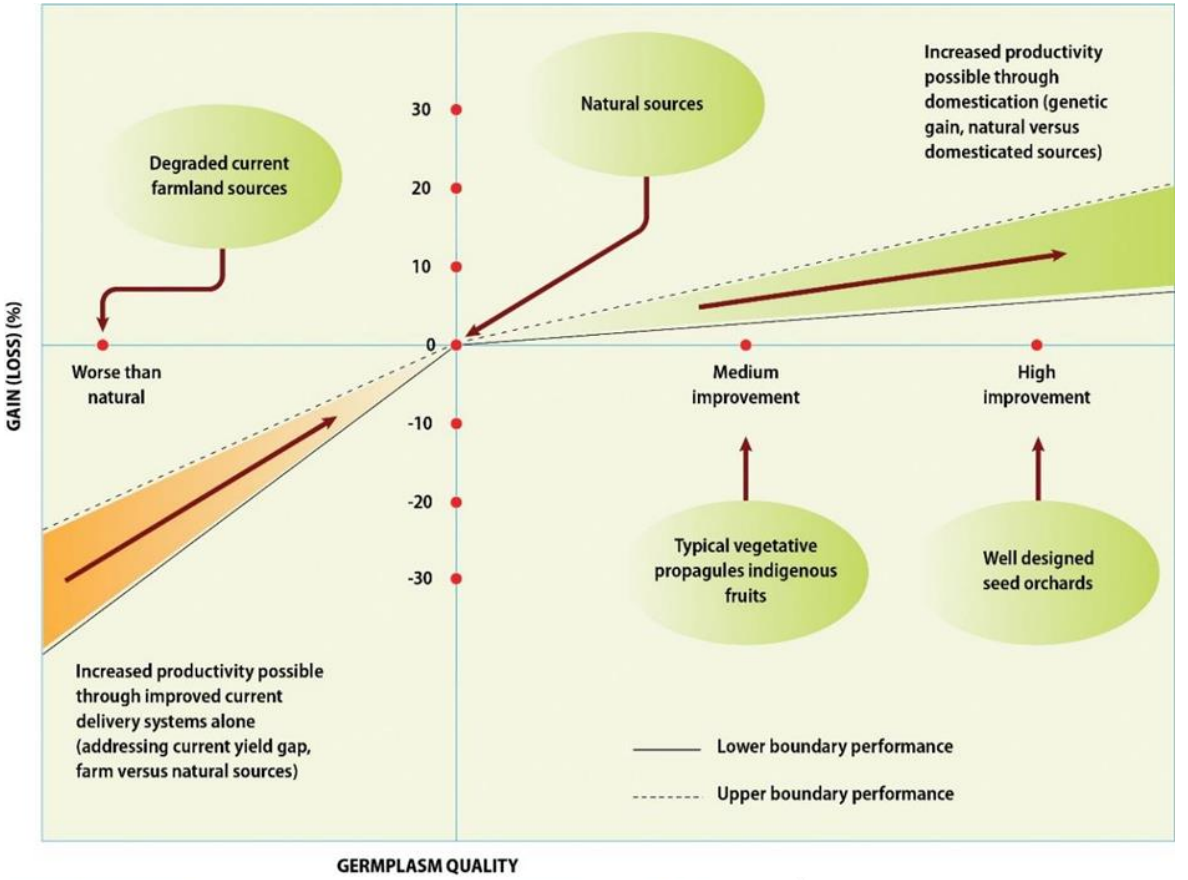
Improving the availability of quality tree seed

PATSPO- NICFI funded 'model tree seed systems'

Provision of adequate tree seed portfolios in Ethiopia

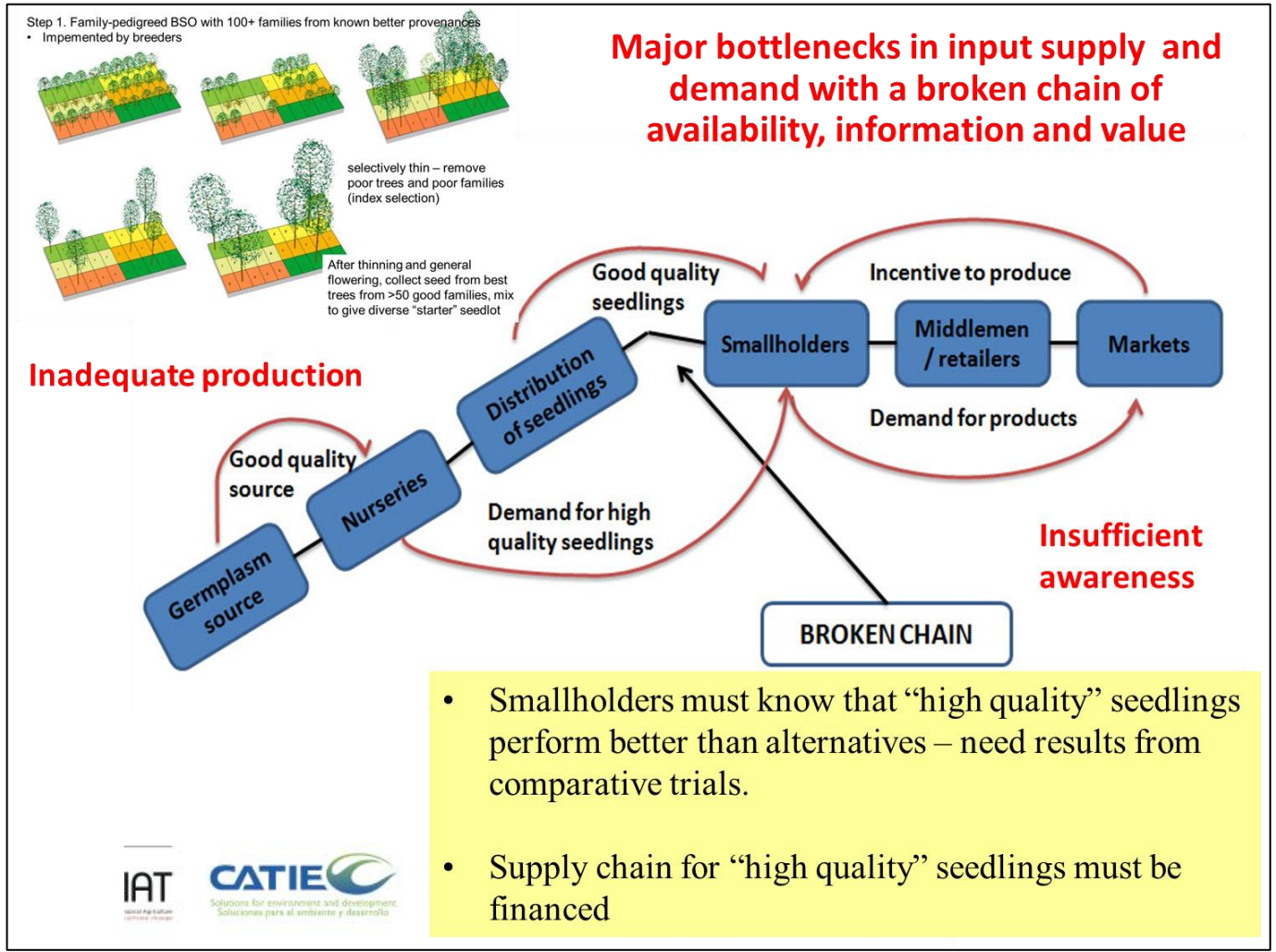
https://www.worldagroforestry.org/project/provision-adequate-tree-seed-portfolio-ethiopia

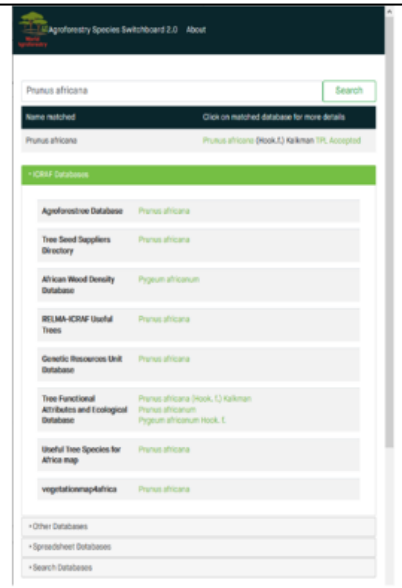
- *Building stakeholder partnerships*
- *Delivering improved orphan tree crops through supporting diverse breeding pathways*
- *Mainstreaming essential food tree diversity portfolios through rural resource centres*
- *Conserving diverse tree (genebanks) germplasm to support conservation, delivery and use*
- *Developing policies to support effective tree seed systems*
- *Enhancing capacity of all stakeholders*



Supporting better decision making

- *Building information platforms to support planting choice and seed system operation*
- *Designing maps and apps to guide appropriate planting under current and future climates*
- *Releasing statistical packages to support appropriate tree planting*





Agroforestry Species Switchboard

'one database to rule them all' – Luigi Guarino

Each species is linked to 55 web-based databases such as the ICRAF Agroforestree Database, the Plant Resources of Tropical Africa (PROTA), the CABI Invasive Species Compendium, Tropical Forages, USDA Food Composition Database or Kew's Plants Of the World Online (POWO)

172,395 plant species (excluding synonyms)
297,351 hyperlinks (excluding 'search databases')

Input into 'top-100' and 'top-830' lists of tree species for planting in tropics and subtropics

- Kindt R, Dawson IK et al. 2021. **The one hundred tree species prioritised for planting in the tropics and subtropics as indicated by database mining**. ICRAF Working Paper.
- Kindt R, Dawson IK et al. 2021 (in prep.). **Prioritizing tree species for restoration across the tropics: can native species choices be balanced with selection of species of global importance?**

Global Tree Knowledge Platform:
https://www.worldagroforestry.org/tree-knowledge

(all links from there – not repeated here)

Tree Databases
includes the **Agroforestree Database** which explores the uses and ecologies of over 600 tree species used in agroforestry systems globally and has been accessed > 300,000 times.

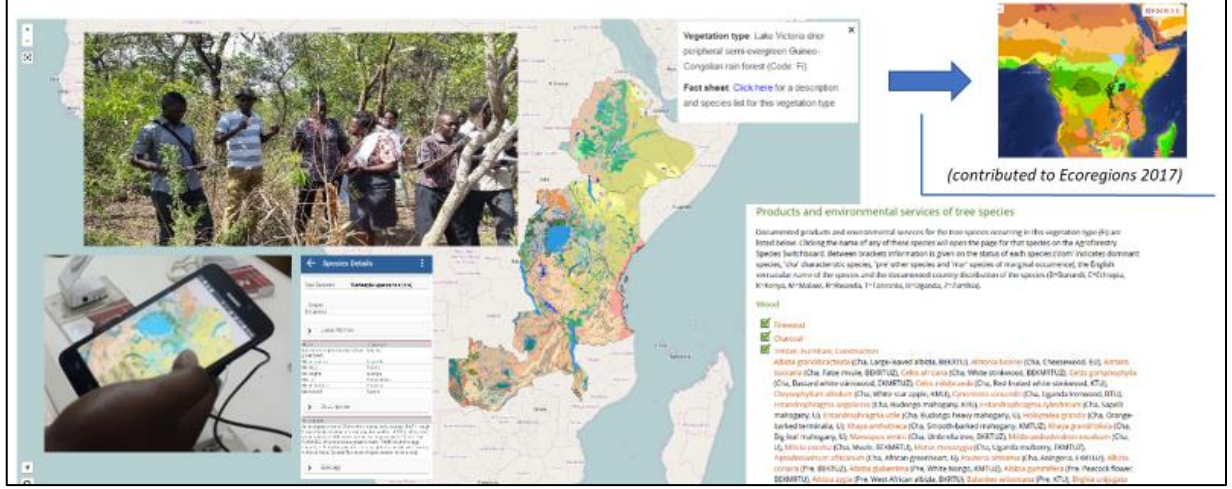
Apps and Maps
includes interactive maps such as the **vegetationmap4Africa** that helps development practitioners, growers and scientists to understand what tree species grow where in the region. Documentation has been downloaded > 40,000 times.

Guidelines
These include the **Tree Domestication Primer** and **Good Tree Nursery Practices** which guide scientists and practitioners. Downloaded > 50,000 times.

Analysis packages
These include **BiodiversityR** and **vegan** which provide a range of methods for ecologists to statistically analyse tree species diversity data. Together, these have been installed by users > 2,600,000 times.

CIFOR World Agroforestry https://www.worldagroforestry.org/tree-knowledge CGIAR Research Program on Forests, Trees and Agroforestry Global Landscapes Forum Resilient Landscapes

Apps and Maps: Africa Tree Finder and Vegetationmap4Africa



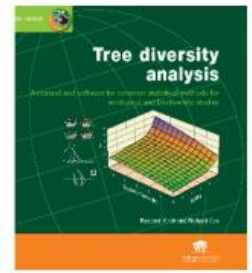
(contributed to Ecoregions 2017)

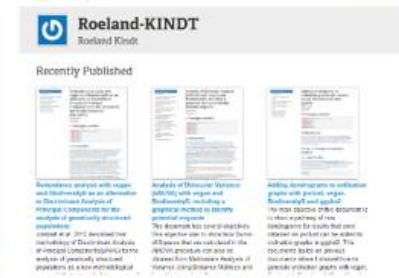
Analysis packages

Software Note | Open Access

WorldFlora: An R package for exact and fuzzy matching of plant names against the World Flora Online taxonomic backbone data

Roeland Kindt





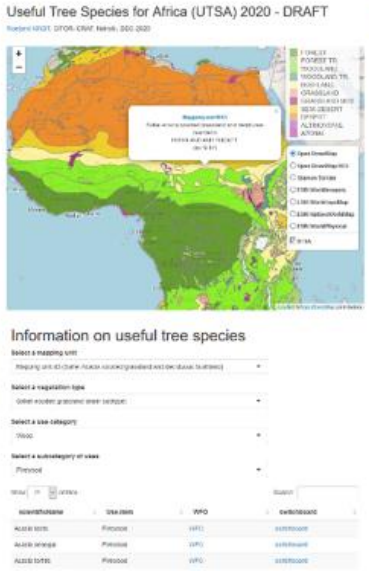
https://rpubs.com/Roeland-KINDT

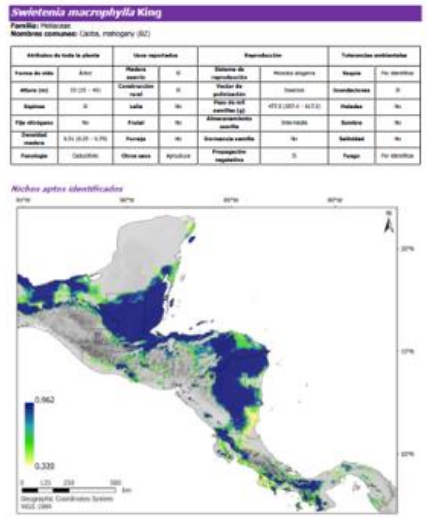
- **vegan** Community Ecology Package
  - > 2,400,000 installations in Rstudio
  - > 27,000 citations in GoogleScholar
- **BiodiversityR**
- **WorldFlora** and **RcmdrPlugin.WorldFlora**
- **AlleleShift** (new 2021)

Apps and Maps

Useful Tree Species for Africa

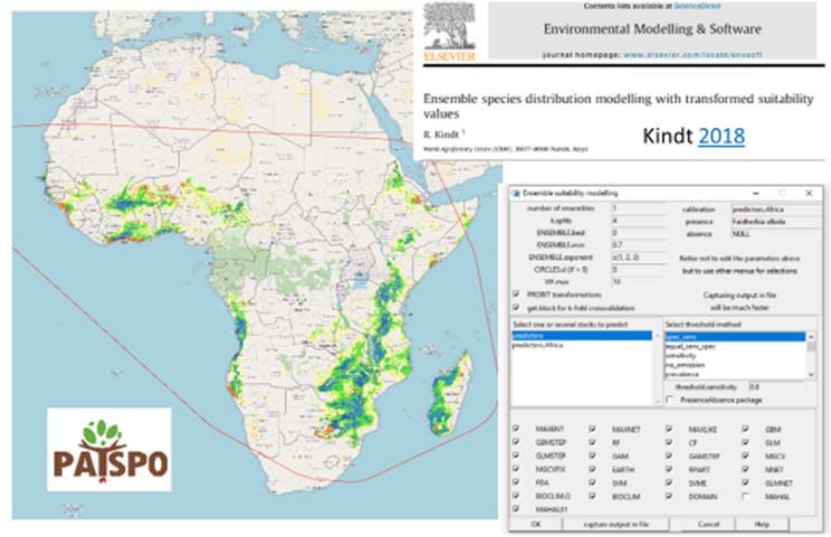
Google Earth KML overlay
ShinyApp (2021)





Climate Change Atlas for Central America

Climate change atlas for Africa – ensemble modelling with *BiodiversityR*



- Ensemble modelling based on 25 algorithms (maximum entropy, boosted regression trees, random forests, artificial neural networks, support vector machines, (stepwise) GLM, (stepwise) GAM, BIOCLIM, DOMAIN, …)
- Unique features such as tuning of ensemble weights, 'environmental thinning' of presence observations, transformation of suitability values, count suitability maps…
- Baseline and future (2050s) modelling for various sets of species
  - 150+ useful tree species selected by PATSPO Ethiopia restoration project
  - 126 vegetable species important in Africa (in collaboration with World Vegetable Centre, van Zonneveld et al. 2020)
  - 100 species identified by the African Orphan Crops Consortium
  - 23 priority species for Gambia GCF
- *BiodiversityR* has already been installed > 180,000 times in RStudio
- Graphical User Interface and manuals

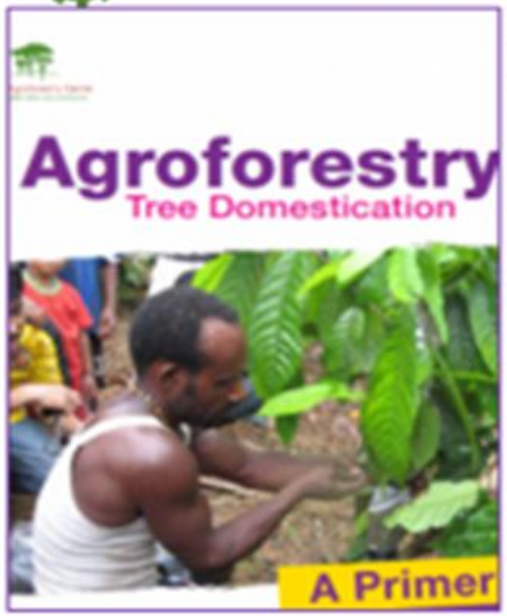
https://www.worldagroforestry.org/tree-knowledge

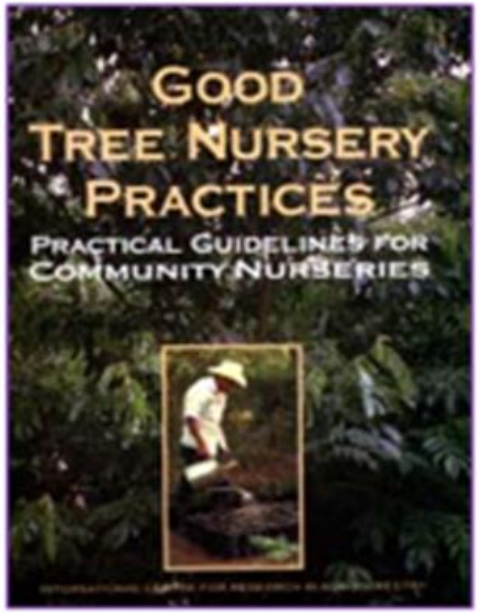
Guidelines

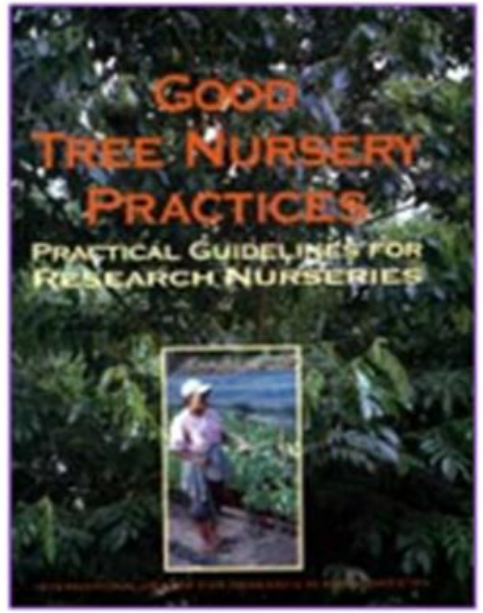
Tree Seeds for Farmers

Mama Wangari visited ICRAF seed lab

Guidelines







The Resources for Tree Planting Platform

https://www.worldagroforestry.org/output/resources-tree-planting-platform

SeedIT

DIVERSITY for RESTORATION

Alliance

Bioversity International

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

User input:

- Restoration site conditions
- Location
- Restoration objectives

Output:

- Different recommended species combinations
- Recommended seed zones and seed sources
- Propagation info
- Monitoring recommendations

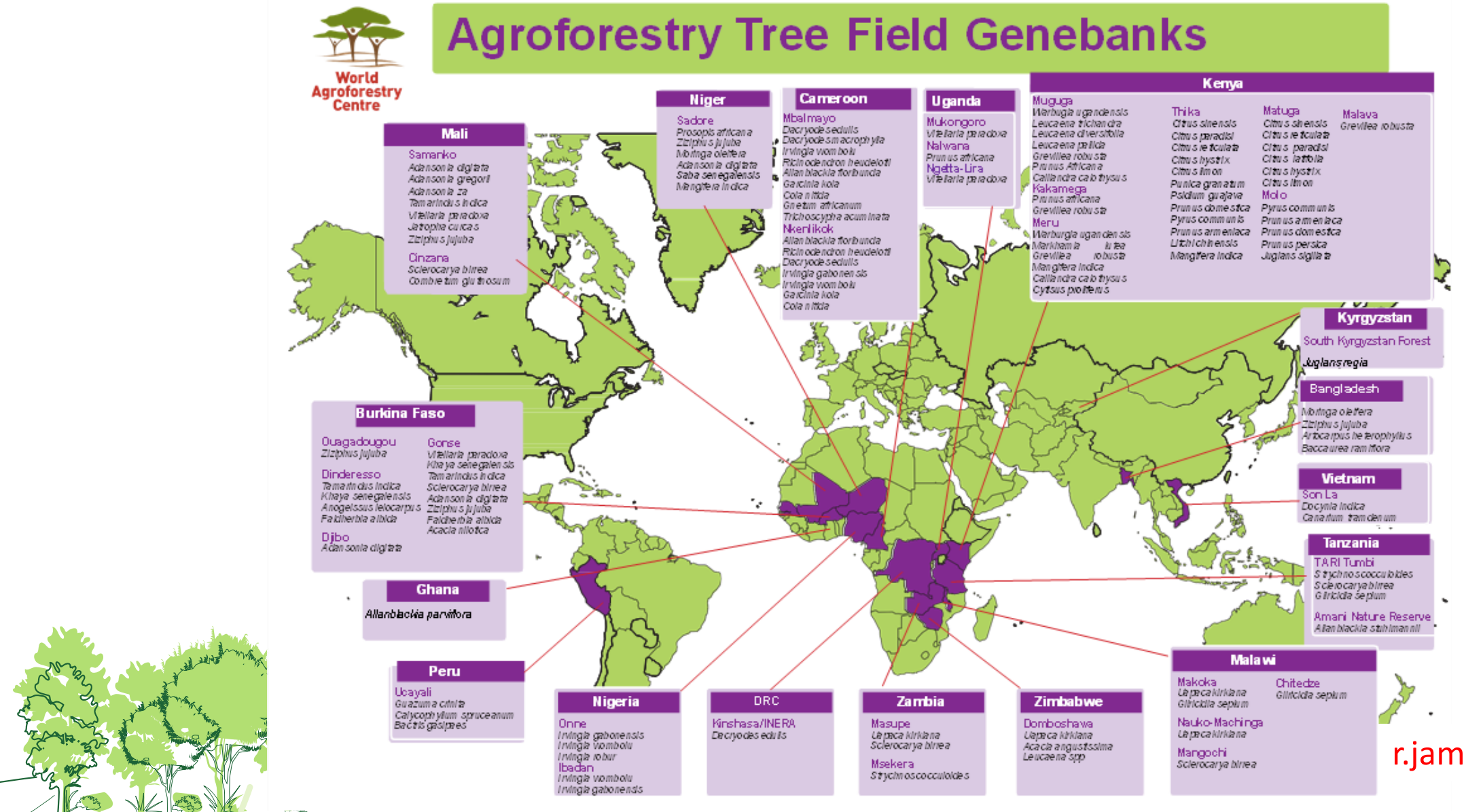
https://www.diversityforrestoration.org/

The right tree is planted in the right place, for the right purpose: a real return on investments

Ex-ante analysis has shown modest investments to improve seed and seedling genetic quality will have significant quantifiable livelihood and environmental benefits.

Paying less than 5% extra for a seedling will allow investing in better quality-generating huge returns. Applied on 20% of AFR100 will generate extra 5 billion USD in income, sequester 19 million more tonnes of CO2 and save a further 4 million tonnes of soil. In addition comes biodiversity values from using native species

Tree Field Genebanks - diverse tree species collections
Seed Sources & material for future breeding



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Concluding Messages

Donors/Investors: Integrated Tree Seed Systems requires long term investments - A MIGHTY TREE STARTS FROM A SEED- so work in wanting to plant diverse tree species starts at improving the quality of their seeds.

Tree planters and Investors: work with experts to improve tree seed quality at the project design stage of tree planting initiatives as there is a solid knowledge and science behind integrated seed systems.

Experts of seed seedling systems: you should and must scale out existing experience and knowledge to support the burgeoning forest landscape restoration and broader tree planting initiatives.

Integrated Tree Seed System EXPERTS of FTA- Flagship 1

Lars Graudal, Jens-Peter B Lillesø, Ian K Dawson, Abrham Abiyu, James M Roshetko, Isaac Nyoka, Alain Tsobeng, Roeland Kindt, Fabio Pedercini, Soren Moestrup, Riina Jalonen, Evert Thomas, Stepha McMullin, Sammy Carsan, Prasad Hendre, Chris J Kettle, Li Yanxia, Ramni Jamnadass

Thank you so very much for all your excellent work

Hope to work with you again and soon in FTA PHASE 3