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Bioversity International

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

CGIAR

What it takes to build an ecoefficient genebank for the 21st century: experiences and lessons learned

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6 Oct 2022

Overview

- Motivation & goals
- Architects, fundraising & design
- Construction & inauguration
- Virtual tour
- Moving laboratories and collections (ongoing)
- Experiences & lessons learned
- The future

Old building, originally constructed as meat-quality lab, in dire need of renovation

2013 Decision to rebuild

Guiding principles:

- Functional
  - Staff & collection safety
  - Highest quality standards (QMS)
  - Growing importance of digital dimension of PGRFA
- Sustainable
  - Environmentally sound
  - Within budget constraints
- Open & Iconic building
  - Public awareness about PGRFA for food security
  - Contribute to training of next generation of PGR scientists

Functional

- Risks
  - **Flooding** : 1.5m above soil level
  - **Lightening** protection
  - **Earthquakes**: no 2nd floor, easily accessible emergency exits
  - **Fire**: non-flammable walls, ceilings & floors, sprinklers, emergency exits
  - **Physical security**: e-cards, video cameras
  - **Insects in herbarium**: -20C air pulses every few months
- Staff & visitors
  - **Health-hazard controls:** fume hoods, dust extractors, etc.
  - **Interaction among staff:** spaces to meet
  - **Disability-friendly**: ramps, toilets
- **'Digital genebank'** module

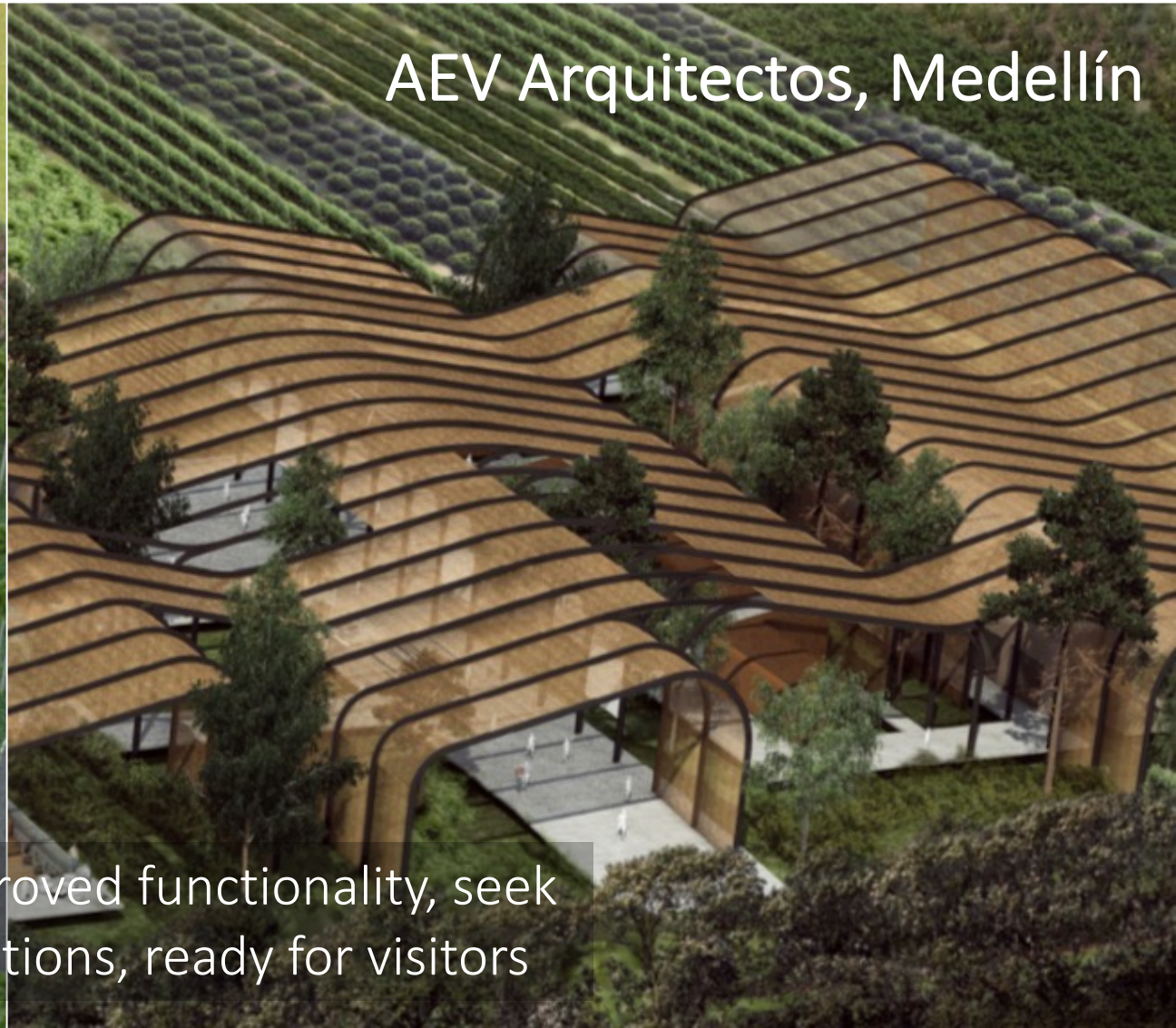
Sustainable

- Energy
  - Reduced use of air conditioning by reducing solar radiation
  - Use of natural light
  - Good insulation of cold rooms
  - Solar panels
- Water
  - Use of rainwater
  - Surrounding gardens without irrigation
- Green building certifications
  - Leadership in Energy and Environmental Design (LEED)
  - Leaving Building Challenge (LBC)

Open & iconic

- Open to the general public
  - Areas for visitors with windows providing views of into laboratories
  - Museographic exhibition about conservation and the importance of PGR
  - Iconic nature: easily recognizable as a symbol for the importance of PGR
- Capacity-building
  - Workshops on genebank-related topics
  - Space for visiting researchers, researchers on sabbaticals, and students
  - Scholarship program for student theses

2014 Private tender: two finalists



Tender conditions: improved functionality, seek LEED and LBC certifications, ready for visitors

Winner: AEV Arquitectos

ALEJANDRO ECHEVERRI + VALENCIA ARQUITECTOS

Parque Explora: science museum in Medellín

Starting in 2015 Fundraising & design

Ongoing fundraising efforts

Initial, optimistic design

Adjustments to fit budget envelop

2015-22 Fundraising

- Challenge: funding for **infrastructure** (not projects) in **Latin America** (not Africa)
- Total budget: **$17.2M**
  - Funders: $6.2M
  - Reserves: $11M

El futuro es de todos
Gobierno de Colombia

AGROSAVIA
Corporación colombiana de investigación agropecuaria

UKRI Biotechnology and Biological Sciences Research Council

Fundación Santo Domingo

SALL FAMILY FOUNDATION

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Supported by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

CGIAR Genebank Platform

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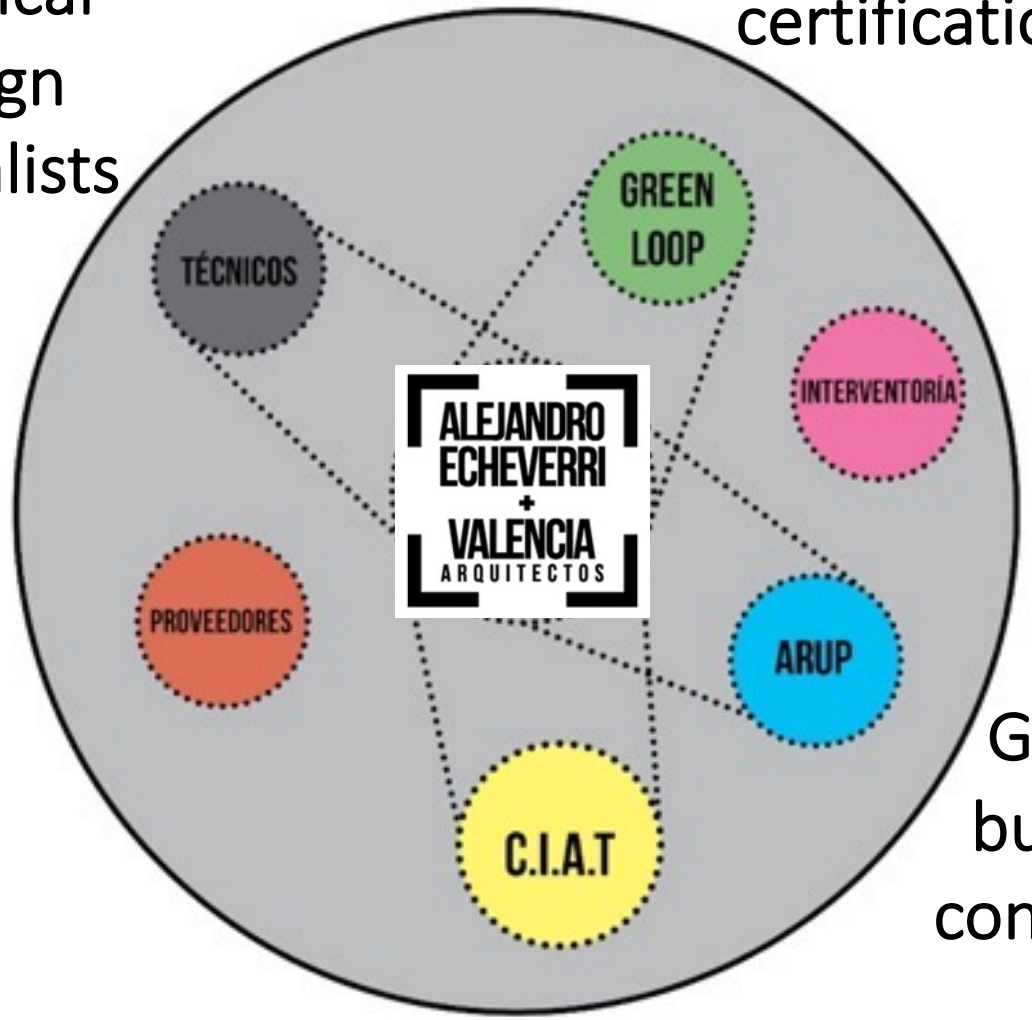
2015-17 Design

Technical-design specialists

Preparation for certifications

Open & iconic

Functional ⟷ Sustainable



Green-building consultant

Genebank

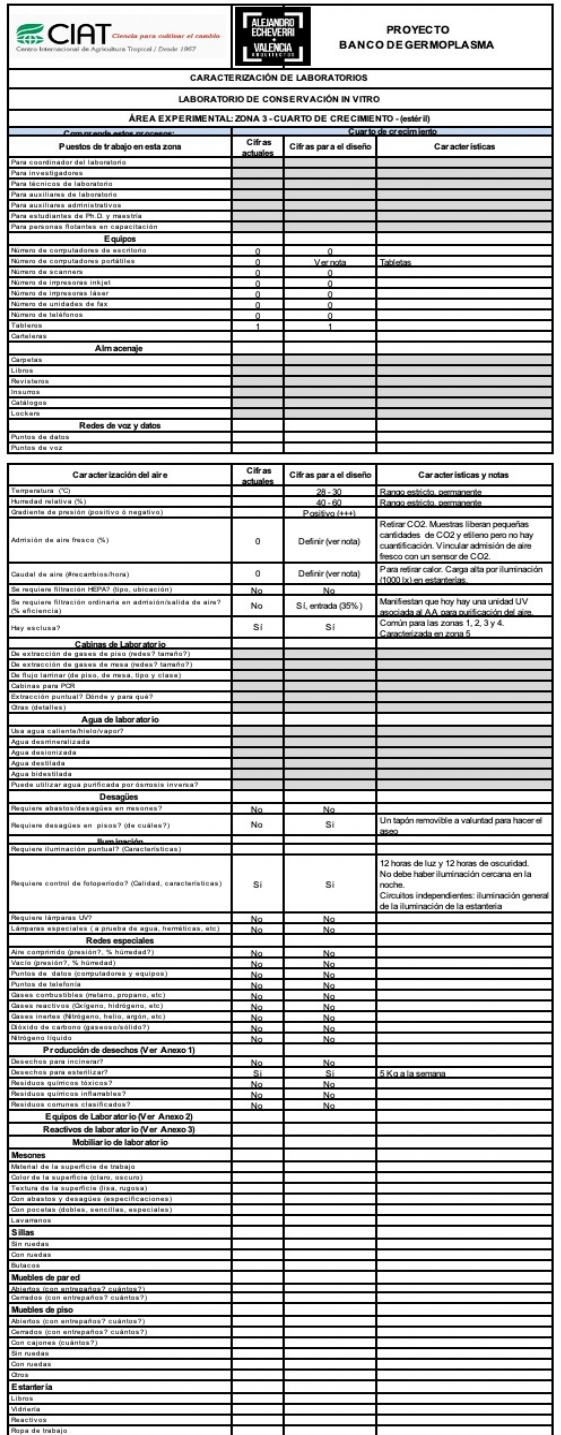
Functional requirements

Modular design around workflows: cold/drying/growth rooms, laboratories, offices

Functional requirements

For each of the > 100 rooms:

- Temperature and humidity
- Staff working in the area
- Equipment list
- Differential pressure level
- Sterility level (HEPA filters)
- Fume and laminar-flow hoods
- Furniture needed
- Phones, LAN, WiFi
- List of reagents being used
- Types of waste being produced



CIAT — Ciencia para cultivar el cambio
Centro Internacional de Agricultura Tropical / Desde 1967

ALEJANDRO ECHEVERRI VALENCIA ARQUITECTOS

PROYECTO
BANCO DE GERMOPLASMA

CARACTERIZACIÓN DE LABORATORIOS

LABORATORIO DE CONSERVACIÓN IN VITRO

ÁREA EXPERIMENTAL: ZONA 3 - CUARTO DE CRECIMIENTO - (estéril)

Cuarto de crecimiento

Puestos de trabajo en esta zona	Cifras actuales	Cifras para el diseño	Características
Para coordinador del laboratorio			
Para investigadores			
Para técnicos de laboratorio			
Para auxiliares de laboratorio			
Para auxiliares administrativos			
Para estudiantes de Ph.D. y maestría			
Para personas flotantes en capacitación			
Equipos			
Número de computadores de escritorio	0	0	
Número de computadores portátiles	0	Ver nota	Tabletas
Número de scanners	0	0	
Número de impresoras inkjet	0	0	
Número de impresoras láser	0	0	
Número de unidades de fax	0	0	
Número de teléfonos	0	0	
Tableros	1	1	
Carteleras			
Almacenaje			
Carpetas			
Libros			
Revisteros			
Insumos			
Catálogos			
Lockers			
Redes de voz y datos			
Puntos de datos			
Puntos de voz			

Caracterización del aire	Cifras actuales	Cifras para el diseño	Características y notas
Temperatura (°C)		28 - 30	Rango estricto, permanente
Humedad relativa (%)		40 - 60	Rango estricto, permanente
Gradiente de presión (positivo o negativo)		Positivo (+++)	
Admisión de aire fresco (%)	0	Definir (ver nota)	Retirar CO2. Muestras liberan pequeñas cantidades de CO2 y etileno pero no hay cuantificación. Vincular admisión de aire fresco con un sensor de CO2.
Caudal de aire (#recambios/hora)	0	Definir (ver nota)	Para retirar calor. Carga alta por iluminación (1000 lx) en estanterías.
Se requiere filtración HEPA? (tipo, ubicación)	No	No	
Se requiere filtración ordinaria en admisión/salida de aire? (% eficiencia)	No	SI, entrada (35%)	Manifiestan que hoy hay una unidad UV asociada al AA para purificación del aire.
Hay esclusa?	SÍ	SÍ	Común para las zonas 1, 2, 3 y 4. Caracterizada en zona 5.
Cabinas de Laboratorio			
De extracción de gases de piso (redes? tamaño?)			
De extracción de gases de mesa (redes? tamaño?)			
De flujo laminar (de piso, de mesa, tipo y clase)			
Cabinas para PCR			
Extracción puntual? Dónde y para qué?			
Otras (detalles)			
Agua de laboratorio			
Usa agua caliente/hielo/vapor?			
Agua desmineralizada			
Agua desionizada			
Agua destilada			
Agua bidestilada			
Puede utilizar agua purificada por ósmosis inversa?			
Desagües			
Requiere abastos/desagües en mesones?	No	No	
Requiere desagües en pisos? (de cuáles?)	No	Si	Un tapón removible a voluntad para hacer el piso
Iluminación			
Requiere iluminación puntual? (Características)			
Requiere control de fotoperiodo? (Calidad, características)	Si	Si	12 horas de luz y 12 horas de oscuridad. No debe haber iluminación cercana en la noche. Circuitos independientes: iluminación general de la iluminación de la estantería
Requiere lámparas UV?	No	No	
Lámparas especiales (a prueba de agua, herméticas, etc)	No	No	
Redes especiales			
Aire comprimido (presión?, % húmedad?)	No	No	
Vacío (presión?, % húmedad)	No	No	
Puntos de datos (computadores y equipos)	No	No	
Puntos de telefonía	No	No	
Gases combustibles (metano, propano, etc)	No	No	
Gases reactivos (Oxígeno, hidrógeno, etc)	No	No	
Gases inertes (Nitrógeno, helio, argón, etc)	No	No	
Óxido de carbono (gaseoso/sólido?)	No	No	
Nitrógeno líquido	No	No	
Producción de desechos (Ver Anexo 1)			
Desechos para incinerar?	No	No	
Desechos para esterilizar?	Si	Si	5 Kg a la semana
Residuos químicos tóxicos?	No	No	
Residuos químicos inflamables?	No	No	
Residuos comunes clasificados?	No	No	
Equipos de Laboratorio (Ver Anexo 2)			
Reactivos de laboratorio (Ver Anexo 3)			
Mobiliario de laboratorio			
Mesones			
Material de la superficie de trabajo			
Color de la superficie (claro, oscuro)			
Textura de la superficie (lisa, rugosa)			
Con abastos y desagües (especificaciones)			
Con pocetas (dobles, sencillas, especiales)			
Lavamanos			
Sillas			
Sin ruedas			
Con ruedas			
Bulleros			
Muebles de pared			
Abiertos (con entrepaños? cuántos?)			
Cerrados (con entrepaños? cuántos?)			
Muebles de piso			
Abiertos (con entrepaños? cuántos?)			
Cerrados (con entrepaños? cuántos?)			
Con cajones (cuántos?)			
Sin ruedas			
Con ruedas			
Otros			
Estantería			
Libros			
Material			
Reactivos			
Ropa de trabajo			

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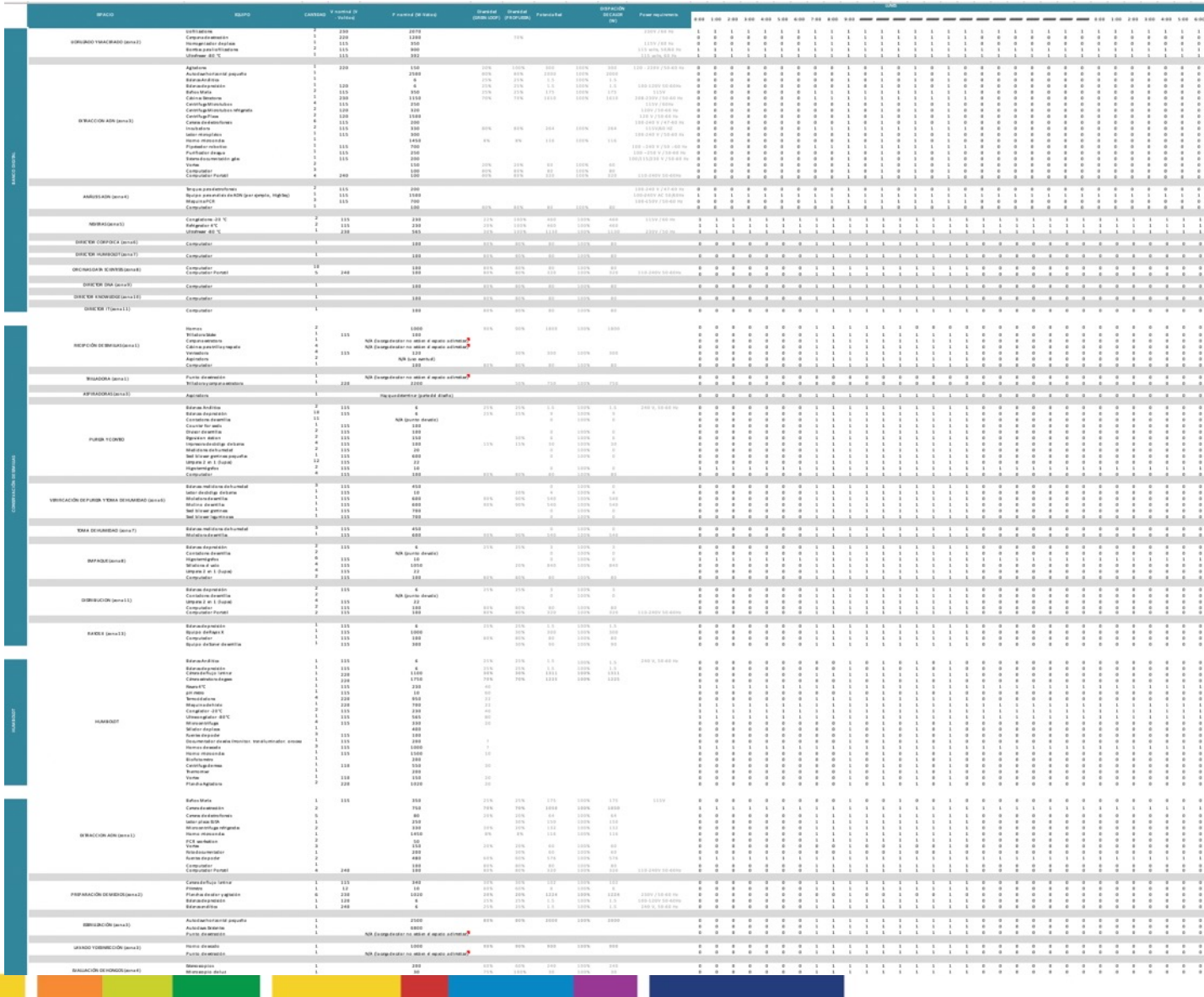
Functional requirements

To determine thermal loads:

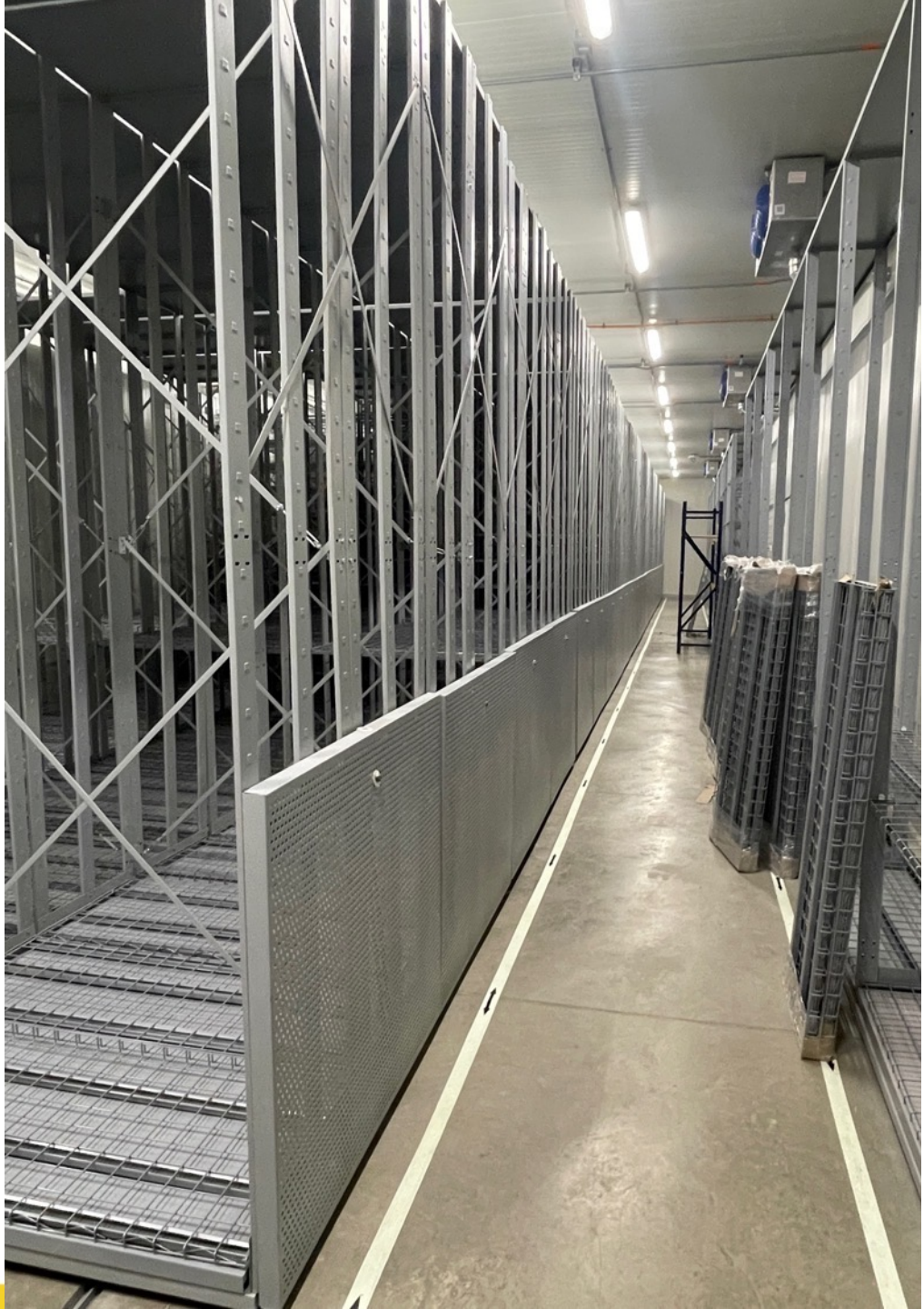
- Time of each staff working in each room each day of the week
- Power (W) consumed by each equipment
- No. of hours each equipment is used each day of the week
- Frequency with which each door is opened



Functional requirements

Additional private tenders:

- **Custom-designed shelving systems**
  - Five cold rooms (seeds)
  - Two drying rooms (seeds)
  - Herbarium
  - Three growth rooms (in-vitro)
  - Storage rooms in the basement
- **Furniture**
  - Laboratories
  - Offices



Sustainability: LEED

LEED rating system_©U.S. Green Building Council, 2022

- Applying for ***Building Design and Construction*** (BD+C v4) certification at US Green Building Council
- Collect points for each of the categories
- Platinum level: 80+ points

LEED categories

Energy

- Use of renewable energy
- LEDs + lightening control system
- Canopy to reduce energy consumption
- Energy-efficient air-conditioning equipment w/o CFC

Water

- 100% of water consumed by the building is from the rainwater collection system (up to 4,200 m^3 per year)
- Black and gray waters are treated and filtered on site to create a closed hydrological cycle
- Water efficient toilets, showers, and taps
- No irrigation for surrounding gardens and accession demonstration plots

LEED categories

Materials & resources

- Forest Stewardship Council (FSC) certified wood for canopy
- Paints, adhesives, sealants with lowest levels of volatile organic compounds
- Materials in contact with water without ingredients included in the Red List of building materials (harmful to health)
- More than 90% of waste generated during construction recycled or reused
- Waste storage & separation room

Air quality

- Filtered air-renewal system for closed spaces
- Monitoring and control systems for temperature and CO_2
- No smoking in closed or open spaces

Sustainability: Living Building Challenge

Seven ‘petals’

Place

Restoring a healthy interrelationship with nature.

Water

Creating developments that operate within the water balance of a given place and climate.

Energy

Relying only on current solar income.

Health + Happiness

Creating environments that optimize physical and psychological health and well being.

Materials

Endorsing products that are safe for all species through time.

Equity

Supporting a just and equitable world.

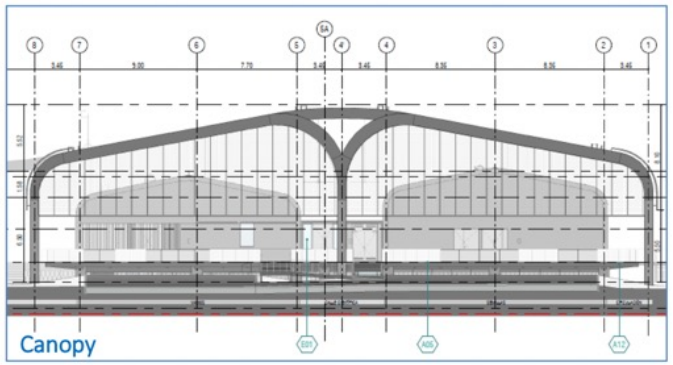
Beauty

Celebrating design the uplifts the human spirit.

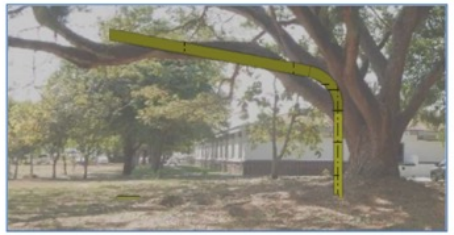
Open & iconic

- Inspired by native forests
- Easily recognizable, like the Svalbard Global Seed Vault

Figure 1 – Shapes Canopy and Tress



CIAT Trees



Canopy inspired in trees

Oct 2018 – Dec 2021 Construction

Construction oversight committee

- Composition
  - Science (2) + Legal (1) + Finance (2) + Operations (1) + Procurement (1) + Fundraising (1) + Regional rep (1) + Secretary (1)
- Role
  - Financial control, legal clearance, coordination of private tenders, construction progress monitoring, technical oversight, coordination with fundraising efforts
- We met approx. 70 meetings during the construction phase
  - Detailed meeting minutes for auditors
- External audit
  - Construction process
  - Detailed plans for moving the collections

Mid 2020

July 2021

6,429 m^2 canopy
7,035 m^2 construction

Solar farm on campus

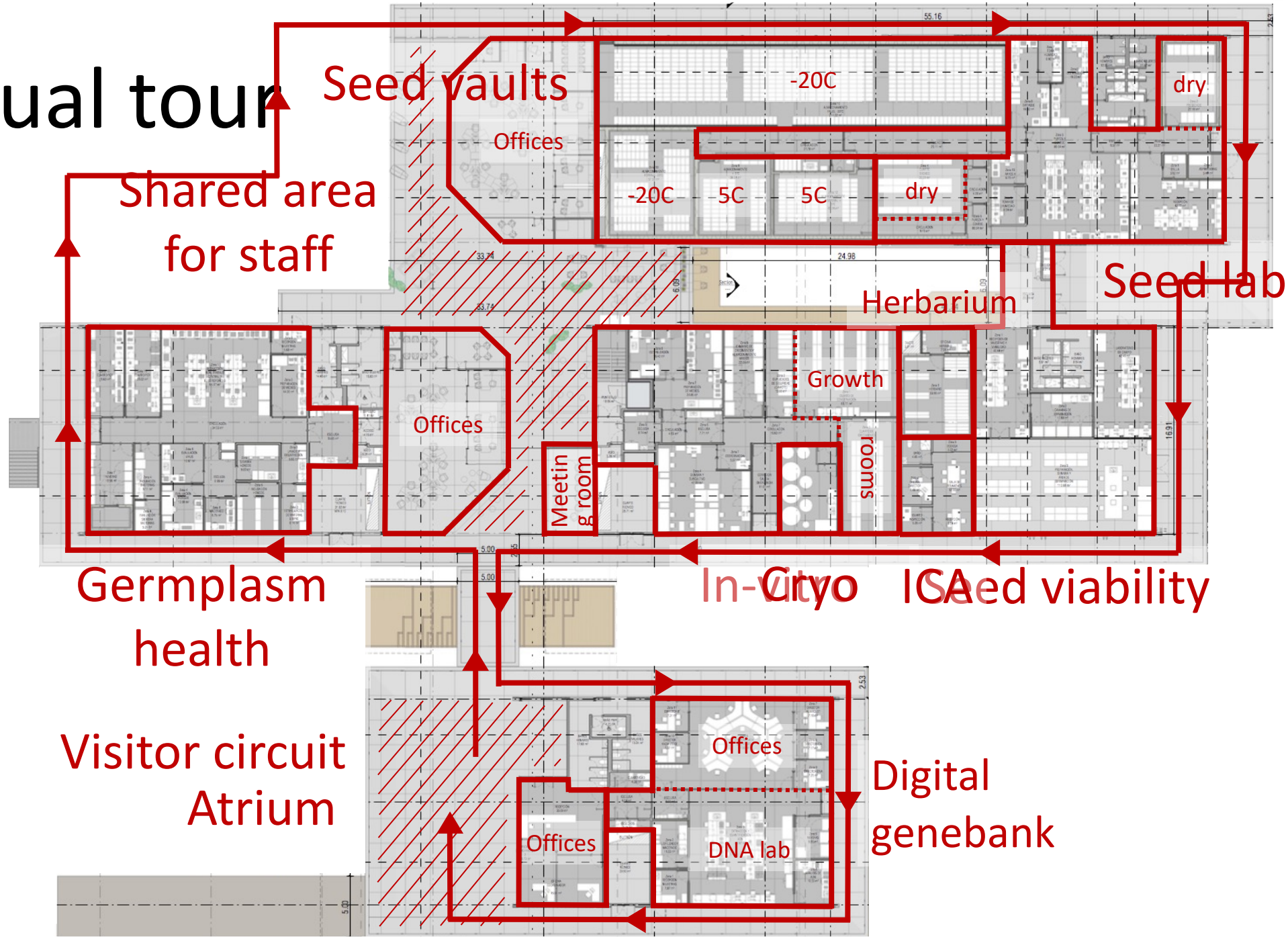
Inauguration by Iván Duque, President of Colombia

Attended by Colombian Ministers of Ag and Science, Directors of Agrosavia, ICA and Humboldt Inst., OnCGIAR leadership, Crop Trust Director, Alliance leadership, BMGF, RF and BMZ representatives, ...

15 March 2022

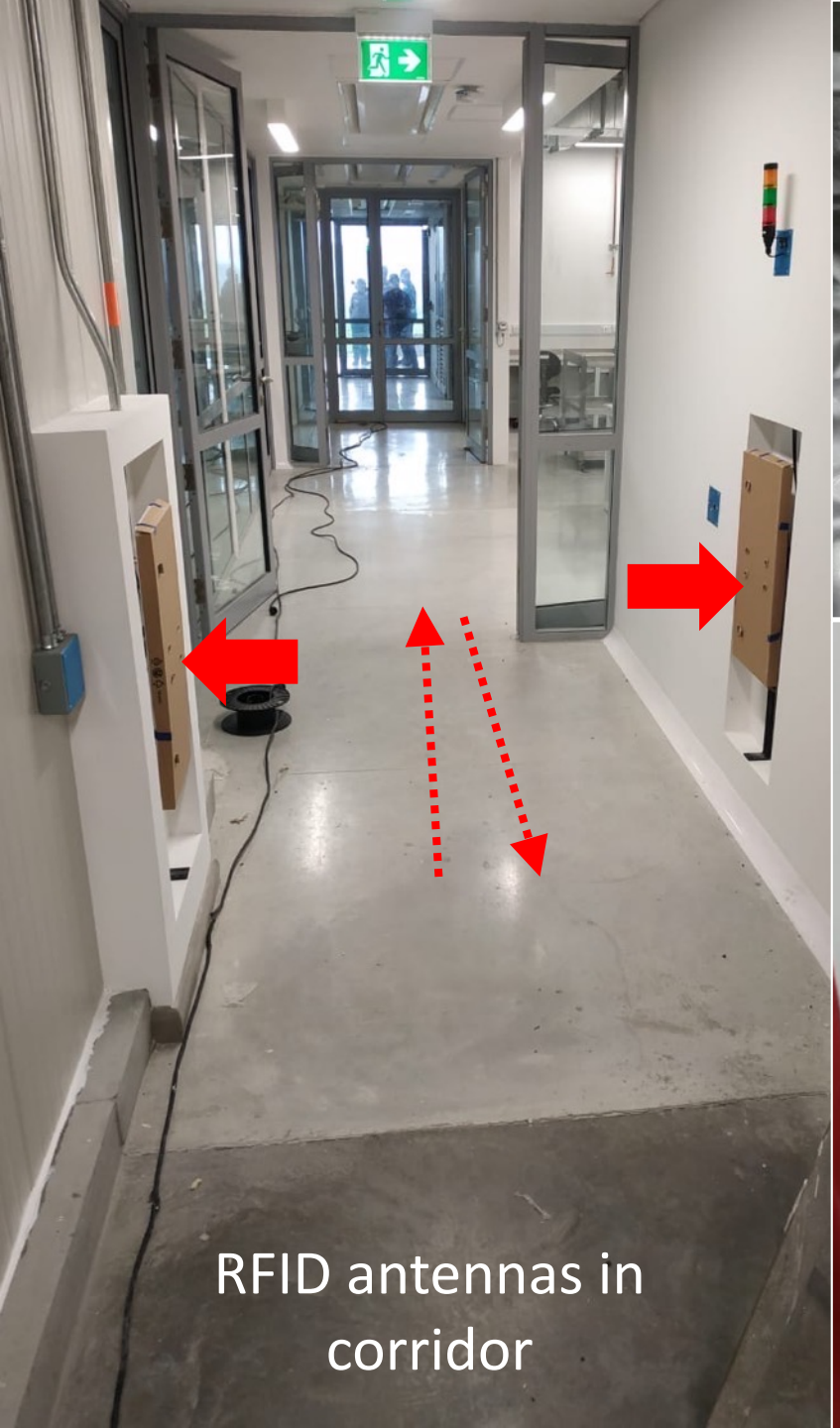
Cristián Samper announcing a $17M donation of the Bezos Earth Fund and Jeff Bezos

A virtual tour

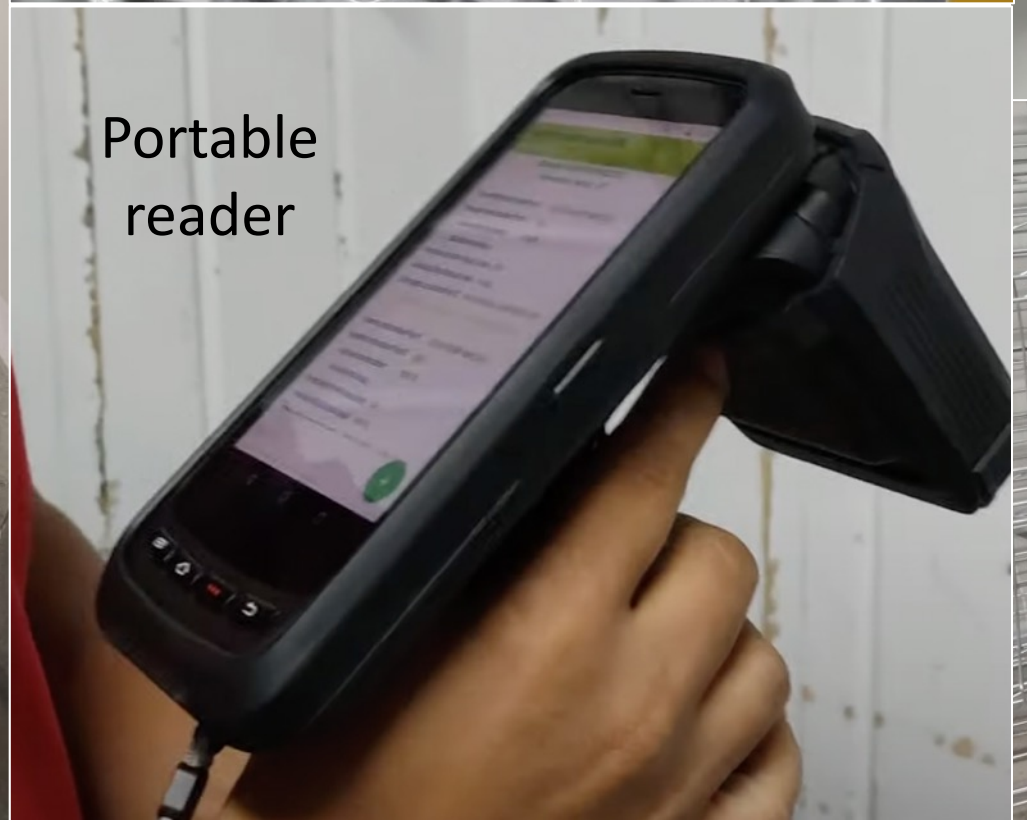


Seed conservation

- Threshing area
- Seed lab
- 2 drying rooms
- Two -20C rooms
- Two +5C rooms
- Distribution & packaging areas


RFID antennas in corridor


G9
COR2019B
Phaseolus x(P.vulgaris x P.parvifolius)
COL003GRP99IBS2020112399997
RFID tags + datamatrix barcode

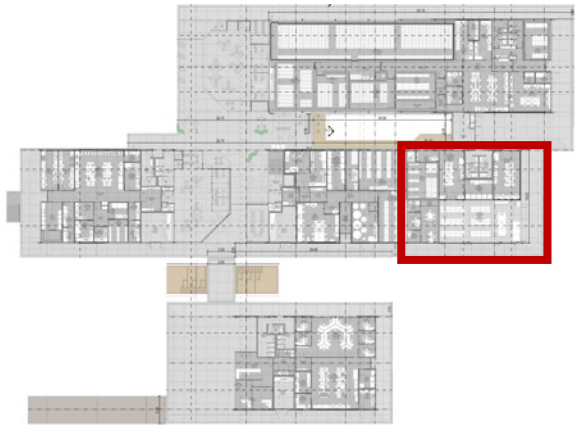

Portable reader


RFID antenna in cold room


RFID antenna in drying room

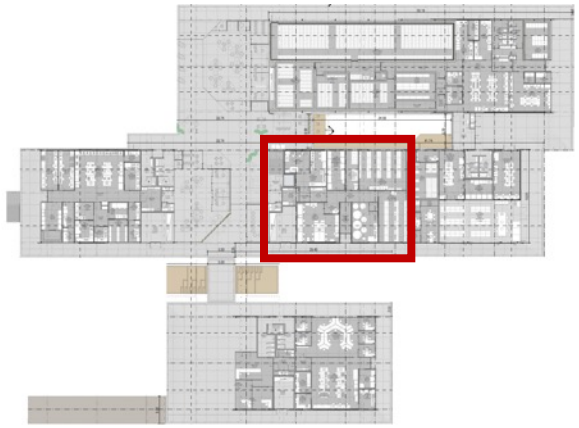
Other seed areas

- Germination area
- Viability lab
- Herbarium
- ICA offices
- Exit towards greenhouses



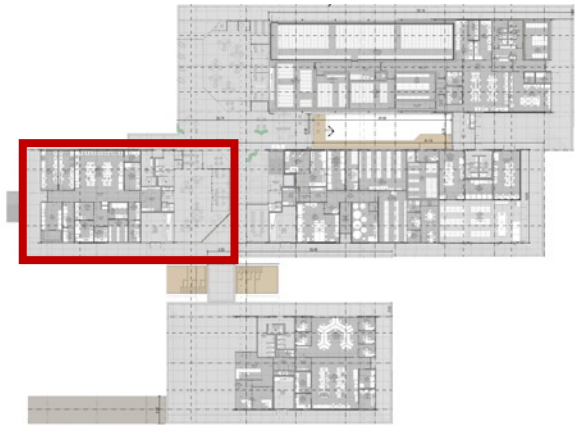
In-vitro conservation

- Propagation lab
- Three growth rooms
- Cryo area
- Lab for media preparation



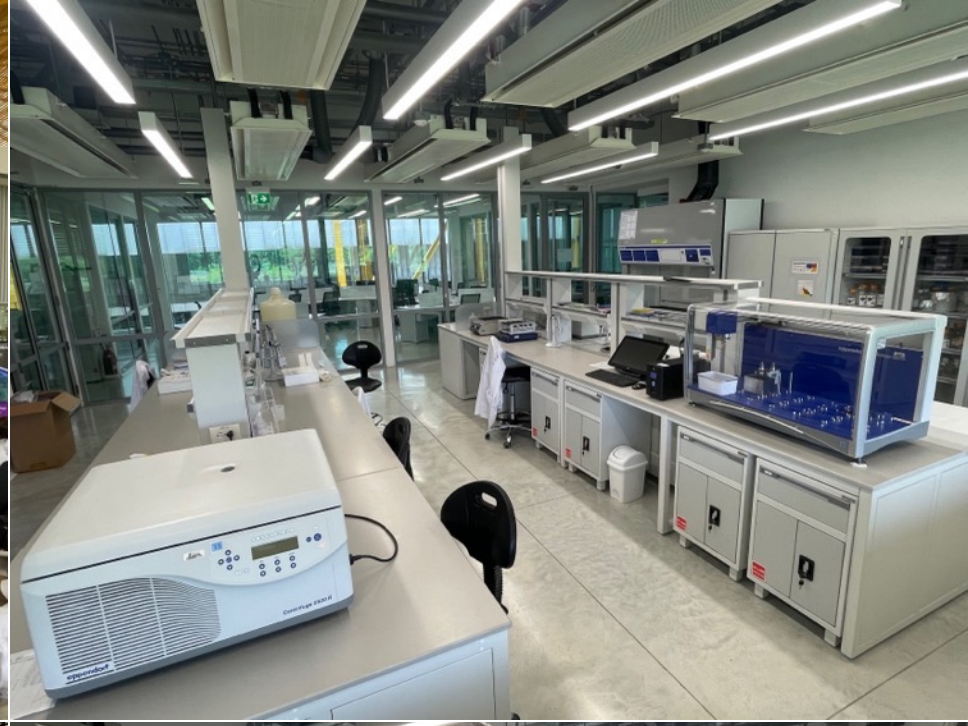
Germplasm health lab

- Central lab
- Areas for viral, fungal, bacterial assays
- Molecular diagnosis area



Digital genebank

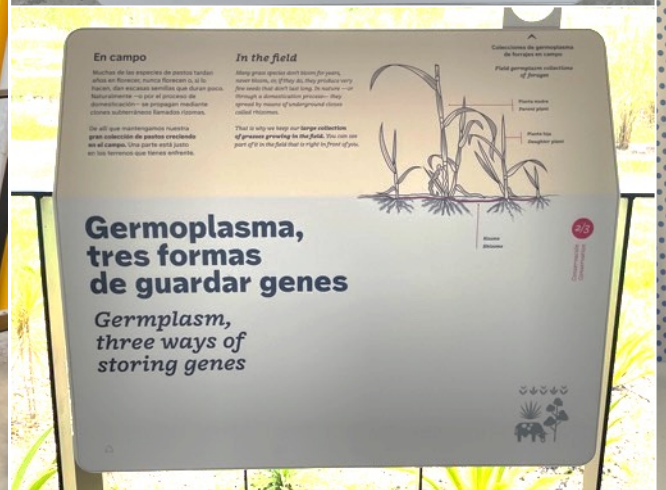
- DNA lab
- Open office for students, visiting scientists
- Atrium for events

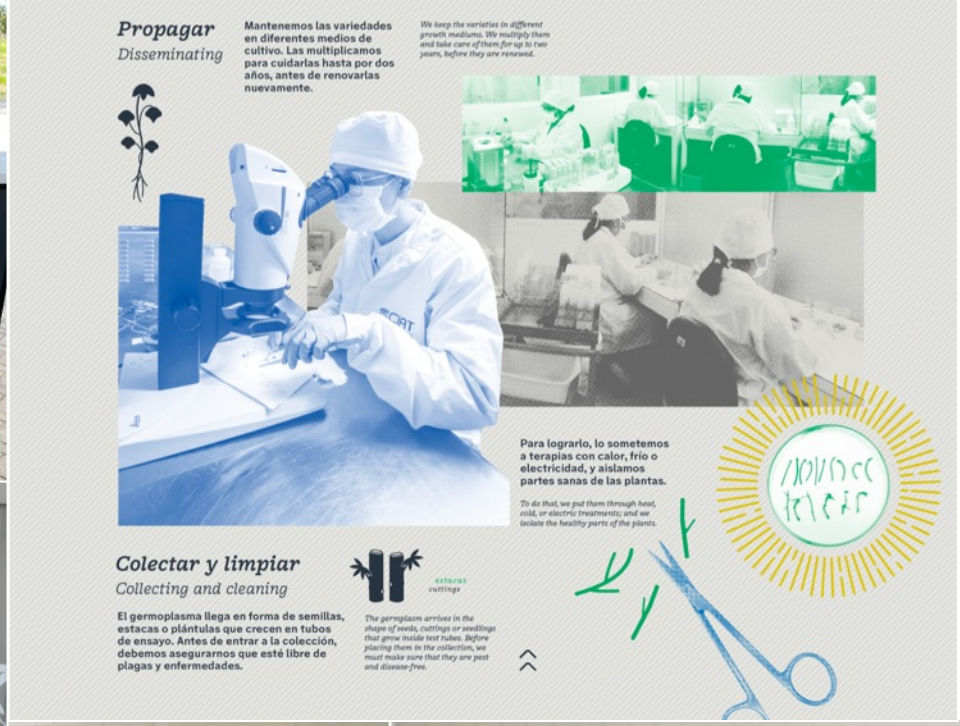



Pastos que protegen
Forages that Protect


Semillas
Seeds
Germoplasma, tres formas de guardar genes
Germplasm, three ways of storing genes


In vitro
In vitro
Germoplasma, tres formas de guardar genes
Germplasm, three ways of storing genes


En campo
In the field
Germoplasma, tres formas de guardar genes
Germplasm, three ways of storing genes


Propagar
Disseminating
Mantenemos las variedades en diferentes medios de cultivo. Las multiplicamos para cuidarlas hasta por dos años, antes de renovarlas nuevamente.
We keep the varieties in different growth mediums. We multiply them and take care of them for up to two years, before they are renewed.
Para lograrlo, lo sometemos a terapias con calor, frío o electricidad, y aislamos partes sanas de las plantas.
To do that, we put them through heat, cold, or electric treatments; and we isolate the healthy parts of the plants.
Colectar y limpiar
Collecting and cleaning
El germoplasma llega en forma de semillas, estacas o plántulas que crecen en tubos de ensayo. Antes de entrar a la colección, debemos asegurarnos que esté libre de plagas y enfermedades.
The germplasm arrives in the shape of seeds, cuttings or seedlings that grow inside test tubes. Before placing them in the collection, we must make sure that they are pest and disease-free.


PROUDLY PURSUING
LEED
CERTIFICATION
El agua
The Water
El Hábitat
The Habitat


En la variedad está el comer
Variety is the spice of life
Arar y vivir de la tierra es primordial para la supervivencia humana. Ciudades y cultivos brotaron juntos, y de su mano —o mejor, de sus ramas—, nos libramos de tener que peregrinar en busca de alimentos, como lo hicimos por milenios.
La domesticación, sin embargo, trajo efectos a largo plazo, como la erosión genética.
En búsqueda de yucas más suaves, mayor cantidad de frijoles por cosecha o pastos más nutritivos, los cultivos, generación tras generación, obtuvieron los atributos deseados y perdieron otros, que si quedaron en el ADN de sus parientes no domesticados. Pero la profusión de genes silvestres dejó de estar segura en ecosistemas cada vez más escasos y alterados.
Además, el reemplazo de muchas variedades tradicionales y adaptadas a condiciones locales por unas cuantas más comerciales acabó de empobrecer la diversidad genética de los cultivos.
¿Cómo afrontar la lluvia de amenazas que erosionan la diversidad genética de nuestros cultivos?
En este pabellón te lo contamos.
Plowing the earth and living off it is paramount to the survival of humankind. Cities and crops emerged together, and they have lent us a hand —or, better, a branch— in the process of liberating ourselves from the need to roam around searching for food, as we certainly did for millennia. Domestication, however, has brought about certain long term effects such as genetic erosion.
In the search for less bitter cassava, a larger amount of beans per harvest, or more nutritious grasses, crops have, over the generations, gained the traits that we desired, but they have also lost other traits that are still present in the DNA of their non-domesticated relatives. However, the profusion of wild genes is no longer safe in ecosystems that become scarcer and altered every day.
Furthermore, the replacement of many traditional varieties that were adapted to local conditions for a few more commercial ones has ended up impoverishing the genetic diversity of crops.
How to face the storm of threats that erode the genetic diversity of our crops?
You'll find out in this pavilion.
20 especies de plantas alimentan la humanidad cotidianamente.
20 species of plants feed humanity on a daily basis.
5000 se han utilizado en todo el mundo.
5000 have been used around the world.
369 000 podrían ser útiles.
369 000 are potentially useful.

Moving laboratories & collections

- Germplasm health lab and DNA lab have moved
- Bean & forage collections: Oct 2022
- Cassava collection: Q1, 2023

Next steps

Bean and forage collections

	MOVING THE BEAN AND FORAGES COLLECTIONS TO FUTURE SEEDS	Before the move 2021 Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Moving 2022 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Before the move	**Register inventories and repackage bean seed pouches stored at -18C**: withdraw from cold room, temperature-equilibrate, seed-count, re-package, re-barcode and attach RFID tags; return to cold room in old building																				
	Test-drive, check and monitor Future Seeds cold rooms, shelving systems, seed laboratories, and herbarium																				
Moving the bean collection	**Transfer previously repackaged bean seed pouches to Future Seeds**: withdraw from cold room, temperature-equilibrate, and transfer re-packaged seed pouches to Future Seeds; register new locations in the database																				
	Continue registering inventories, repackaging and transfering bean seed pouches stored at -18C to Future Seeds: withdraw from cold room, temperature-equilibrate, seed-count, re-package, re-barcode and attach RFID tags, and transfer to Future Seeds; register new locations																				
	Register and transfer bean-seed inventories in temporary storage (5C): withdraw from cold room, temperature-equilibrate, seed-count, re-barcode, and transfer to Future Seeds; register new locations																				
	Move equipment: move equipment needed for managing and distributing the bean collection to Future Seeds																				
Moving the forage collection	**Register inventories and repackage forage seed pouches stored at -18C**: withdraw from cold room, temperature-equilibrate, seed-count, re-package, re-barcode and attach RFID tags, and transfer to Future Seeds; register new locations																				
	Register and transfer forage-seed inventories in temporary storage (5C): withdraw from cold room, temperature-equilibrate, seed-count, re-barcode, and transfer to Future Seeds; register new locations																				
	Move equipment: move equipment needed for managing and distributing the forage collection to Future Seeds																				
Moving samples for acquisition	**Inspect and select samples from backlog of 13,000 bean/forage samples in acquisition pipeline stored at 5C**: withdraw selected subset of samples from cold room, temperature-equilibrate, re-package and re-barcode, and transfer to Future Seeds; register new locations																				
Moving the herbarium	**Inventory herbarium specimen and move to Future Seeds**: withdraw from storage, re-barcode, attach RFID tags, repackage into boxes, move to herbarium room in Future Seeds and register new locations																				

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Experiences & lessons learned: costs

- Genebank was built without a cost overrun
  - Lots of planning and monitoring; exchange rate helped!
- Costs of LEED certification
  - Approx. 10-15% additional material/building costs; should be amortized through approx. 20% reduced electricity & water utility costs
  - 25K for green-building consultants + 5K for certification
- Building features (canopy) that reduce environmental impact may entail higher maintenance costs
  - Par of Bezos funds for upkeep and maintenance
- Future purchases of certain consumables & equipment could be more costly

Experiences & lessons learned: staff time

- Genebank manager + 6 staff contributed to design, construction, and the commissioning of the building; everyone's working to move labs & collections
- Challenge: competing priorities and emergencies, in addition to running the genebank:
  - Genebank financial (2017) and technical (2019) audits
  - COVID lockdowns (2020) and public unrest and campus closure (2021), requiring emergency responses to save the collections, particularly for cassava
  - Development of a business plan for a Long-term Partnership Agreement for bean & forages with the Crop Trust (2022)
  - Challenges related to the One-CGIAR restructuring process (2021/12)

Experiences & lessons learned: delays

- Delay in fully commissioning the building
  - Approx. 1 year instead of estimated 1-2 months
  - Initial estimates were unrealistic: impossible to get everything working correctly without any adjustments and corrective actions
  - Also: supply chain constraints
- Moving of collections substantially delayed
  - Distribution of accessions suspended for longer than anticipated
  - Space constraints for cassava collection in current building because of extra copy prepared for moving the collection

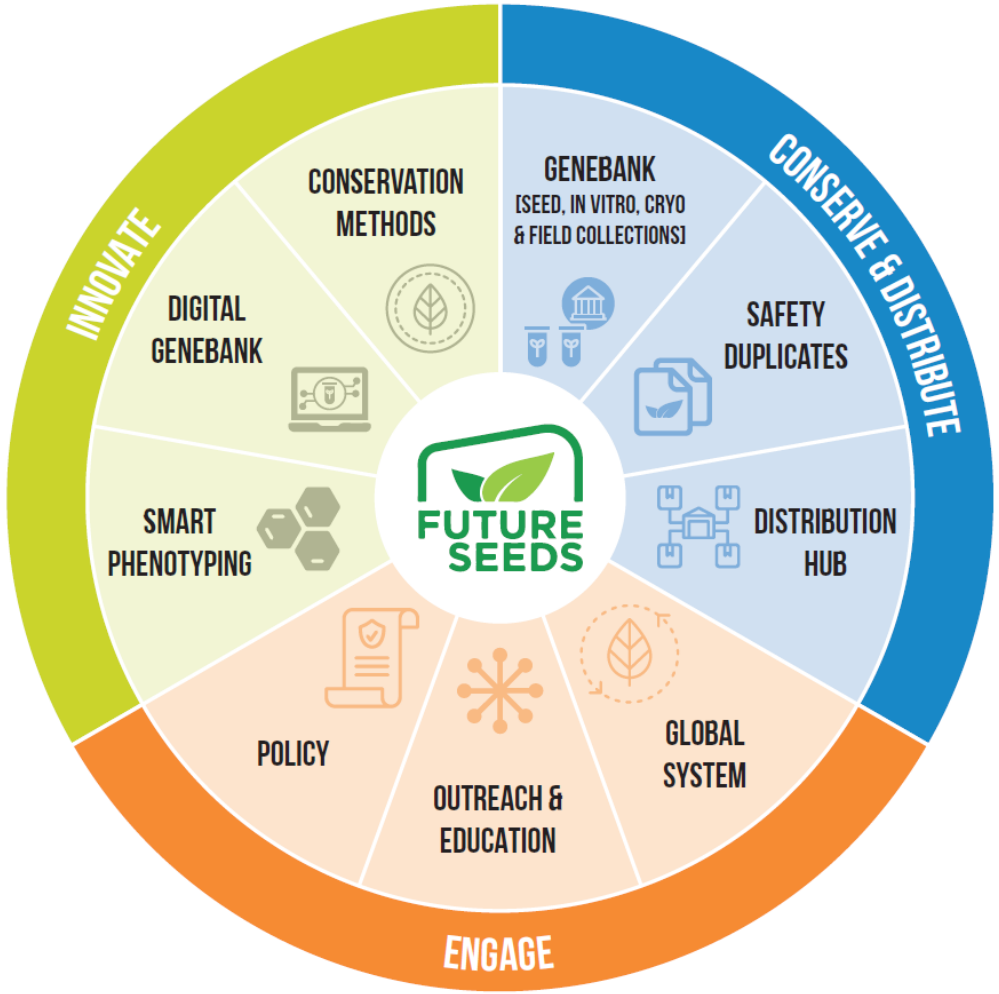
Experiences & lessons learned: publicity

- Lots of publicity: > 130 outlets
  - Interviews on Colombian radio and YouTube talk shows
  - Popular TV documentary
- Need to manage expectations
- 4-5-fold increase in visitors: outreach and science-education plan

FINANCIAL TIMES
Science
Forbes COLOMBIA
REUTERS
EL TIEMPO
SciDevNet
EL PAÍS
EL ESPECTADOR 1887
AFP
THE HILL
EFE: Agencia EFE
MONGABAY NEWS & INSPIRATION FROM NATURE'S FRONTLINE
FOOD navigator.com

The future

- Conserve & distribute germplasm collections and host safety duplicates of other collections
- Innovate to improve conservation methods and to enrich collections with actionable information to facilitate their use
- Engage the public to raise societal awareness about the vital role of crop diversity, participate in the ongoing policy dialogue, and contribute to training the next generation of PGR scientists



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Thank you!

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