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Yale Forest Forum's Unlocking Forest Sector Innovation: The Practice and Potential Pathways to Scaling Up webinar series

FROM FOREST TO BIOECONOMY: INTEGRATED INNOVATIONS FOR NON-WOOD FOREST PRODUCTS

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IUFRO Task Force T50-Building an Integrated Vision of the Forest-Based Sector within a Bioeconomy; Research Group 5.11.00 Non-wood forest products

September 17, 2026

AIMS

- Explain the importance of non-wood forest products (NWFPs) for the bioeconomy
- Introduce the concept of transition pathways based on innovation processes
- Derive lessons for innovation in NWFPs value chains



The role of NWFPs in the bioeconomy

FORESTS BEYOND WOOD

- Thousands of plant and fungi species are used for food, medicine, energy, construction, cosmetics, decoration, spirituality, and cultural practices.
- **NWFPs:** Renewable environmental products, primarily forest fungi and plants, whose non-wood parts, such as roots, rhizomes, bark, leaves, fruit and others, are harvested for human use, including both wild and cultivated species.
- Up to 5.8 billion people worldwide use NWFPs and producer income is estimated at USD 88 billion per year globally.





NON-WOOD FOREST PRODUCTS WITHIN THE BIOECONOMY

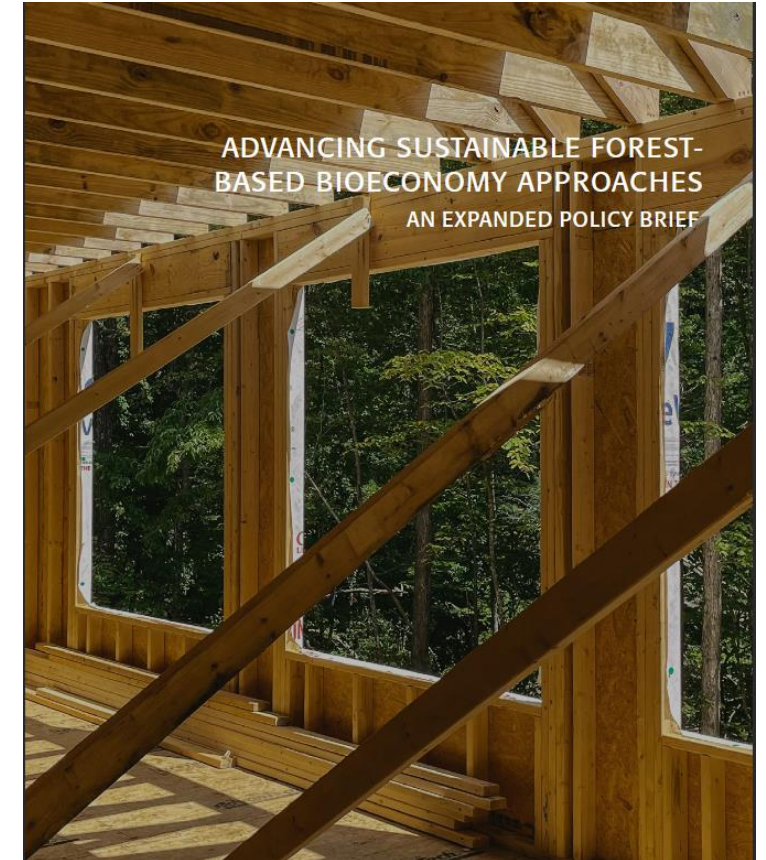
- Forest-based bioeconomy: the set of economic activities to grow, harvest, process, reuse, recycle, and sell forest products and associated forest ecosystem services
- NWFPs contribute to subsistence, income generation, livelihood support, green jobs, and major industries (e.g., health care, pharmaceuticals, cosmetics)
- NWFPs remain peripheral to policies, forest management, development plans, and bioeconomy strategies.
- Countries with biodiversity-rich ecosystems often look at biodiversity as a comparative advantage for bioeconomic transformation



NON-WOOD FOREST PRODUCTS TRANSITION PATHWAYS

- Transition pathway: coordinated sets of actions enabling a shift towards a forest-based bioeconomy
- There is no standard transition pathway
- Three identified pathways:
 - Support sustainable production and sourcing of NWFPs
 - Innovation for upgrading and industry development
 - Meeting consumer demand
- Innovation is transversal to the transition pathways towards forest-based, knowledge-based bioeconomies

Vargas-Carpintero et al. 2026, Chamberlain & Smith-Hall 2023

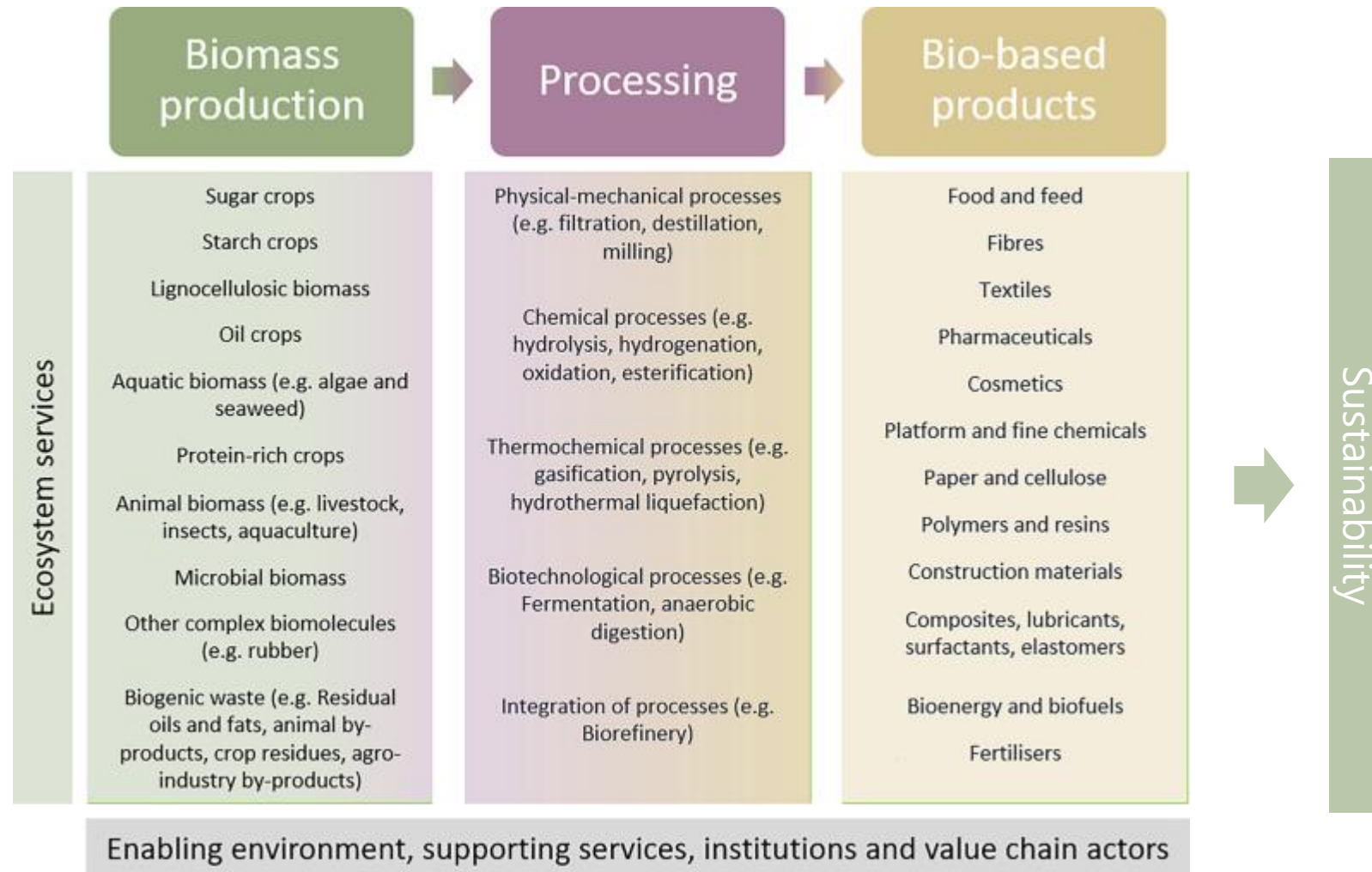


<https://www.iufro.org/media/fileadmin/publications/policy-briefs/scipol-coli26-policy-brief-extended.pdf>

The background of the slide is a close-up photograph of a beehive. The honeycomb cells are a warm, golden-yellow color. Several bees are visible, some on the comb and others near the entrance. A semi-transparent blue rectangle is overlaid on the left side of the image, containing the title text in white.

Innovation in NWFPs value chains

VALUE CHAINS AND WEBS AS OPERATIONAL FRAMEWORK FOR NWFPS

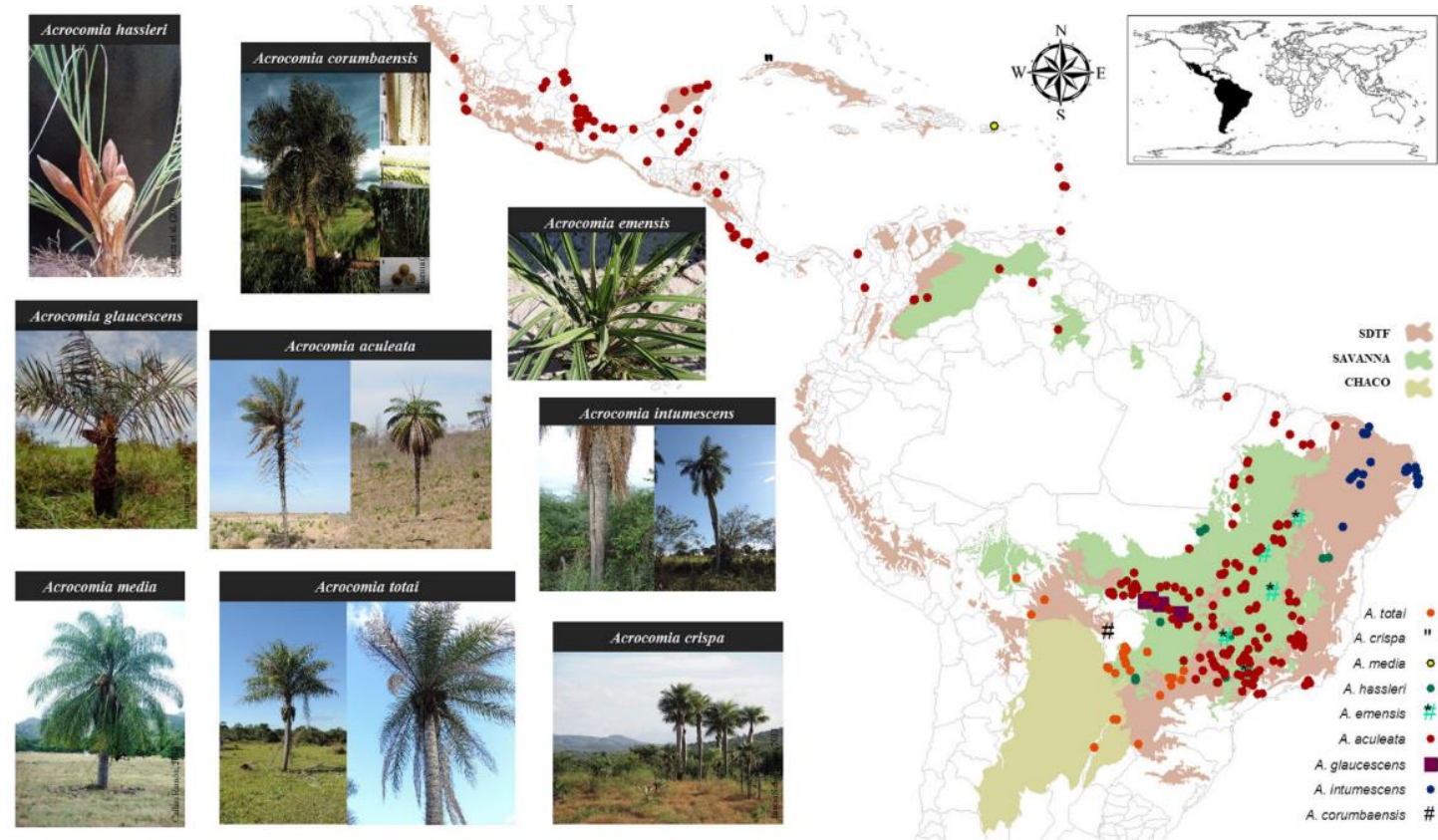


DIFFERENT TYPES OF INNOVATION IN NWFPS VALUE CHAINS

Innovation type	Key examples
1. Product	New products, uses and services; e.g. medicinal products, cork applications, myco-/truffle tourism
2. Process	Improved production and harvesting; agroforestry; silvopastoral systems
3. Organizational	Producer integration, vertical integration, shared brands, traceability
4. Marketing	Packaging, design, advertising, labelling, sales, certification
5. Policy	Regulation, collection licences, fiscal measures, legal recognition
6. Institutional	Certification schemes, lobbying organizations, new governance arrangements
7. Social	Revival of traditional uses, local support networks, social enterprises

THE CASE OF THE ACROCOMIA PALM

- *Acrocomia* is a genus of the family Arecaceae — palms spp., native to the neotropics
- *Acrocomia* palms grow from semi-arid, sub-humid to humid climates



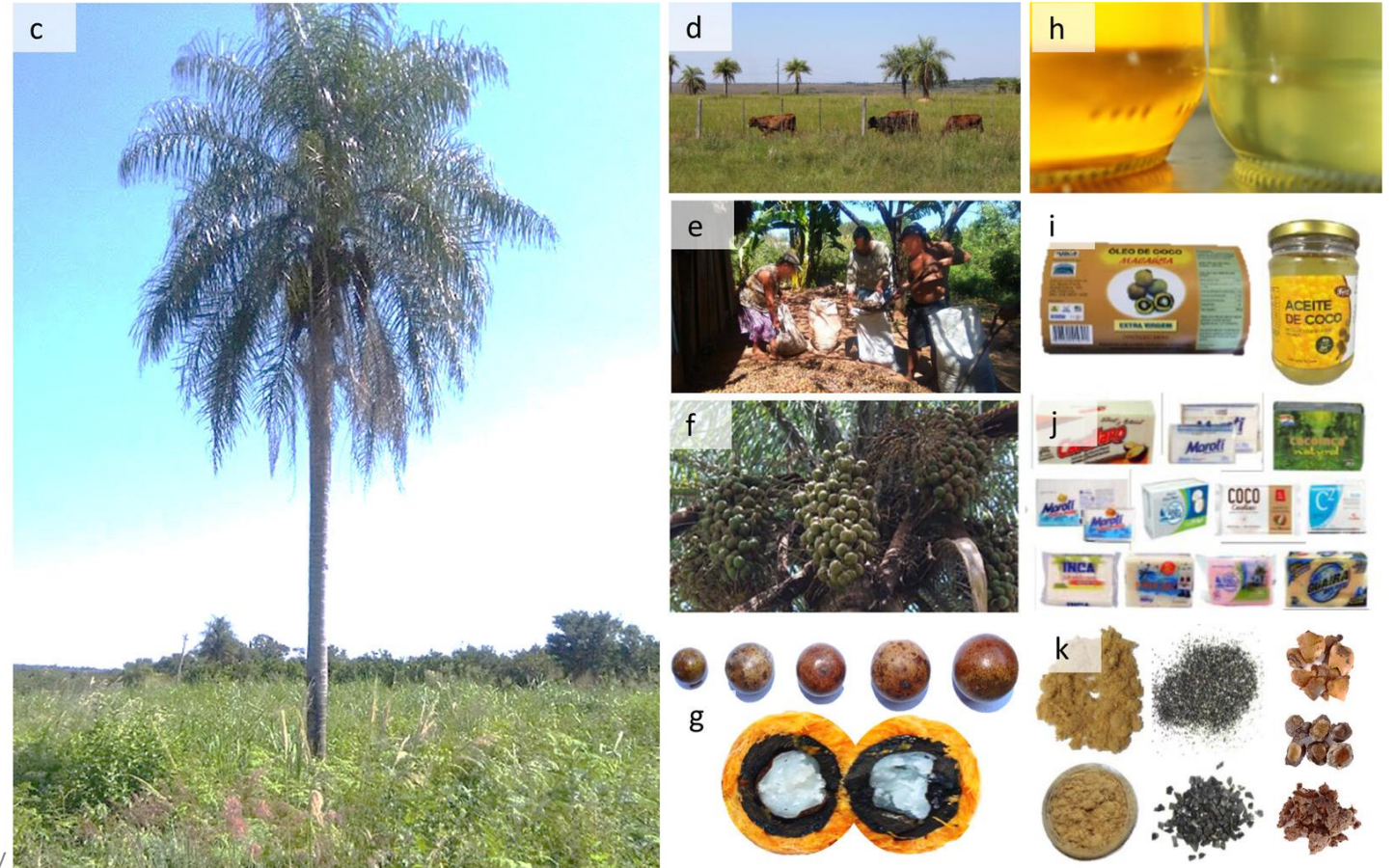
Cardoso et al. 2017; Ciconini et al. 2013; Crocomo and Melo 1996; Markley 1956; Evaristo et al. 2016; Vargas-Carpintero et al. 2021; 2022; De Lima et al. 2018; Vianna et al. 2017, Colombo 2018

Source: De Lima et al. 2018

THE ACROCOMIA PALM

- The oil-bearing fruits are the most valuable part in economic terms: 2.5–5 t oils/ha
- Paraguay and Brazil lead the implementation and development of acrocomia value chains (*A. totai* in Paraguay, *A. aculeata* in Brazil)

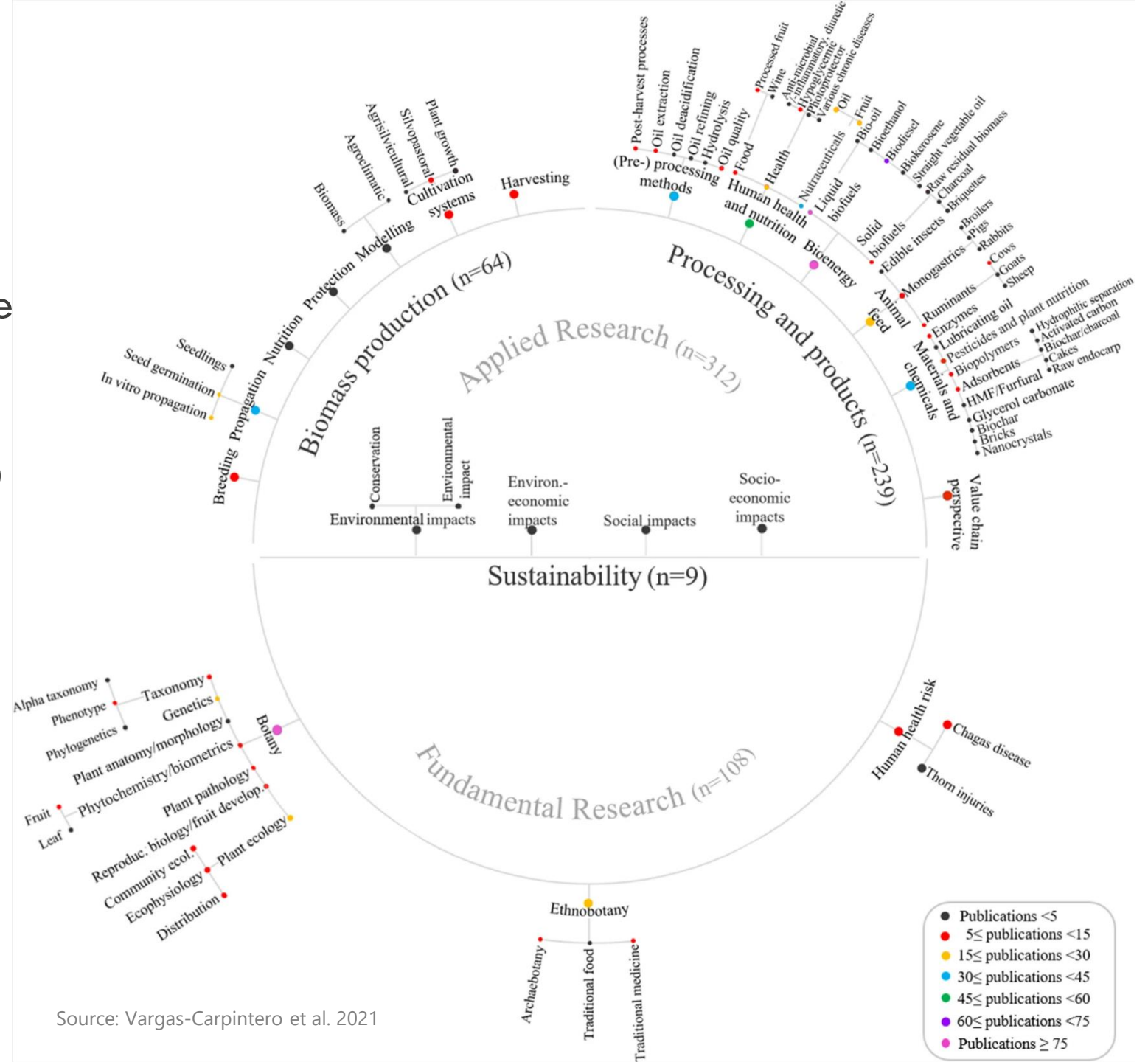
Cardoso et al. 2017; Ciconini et al. 2013; Crocomo and Melo 1996; Markley 1956; Evaristo et al. 2016; Vargas-Carpintero et al. 2021; 2022; De Lima et al. 2018; Vianna et al. 2017, Colombo 2018



Source: Vargas-Carpintero et al. 2021
<https://doi.org/10.1007/s13593-021-00729-5>

KNOWLEDGE BASE

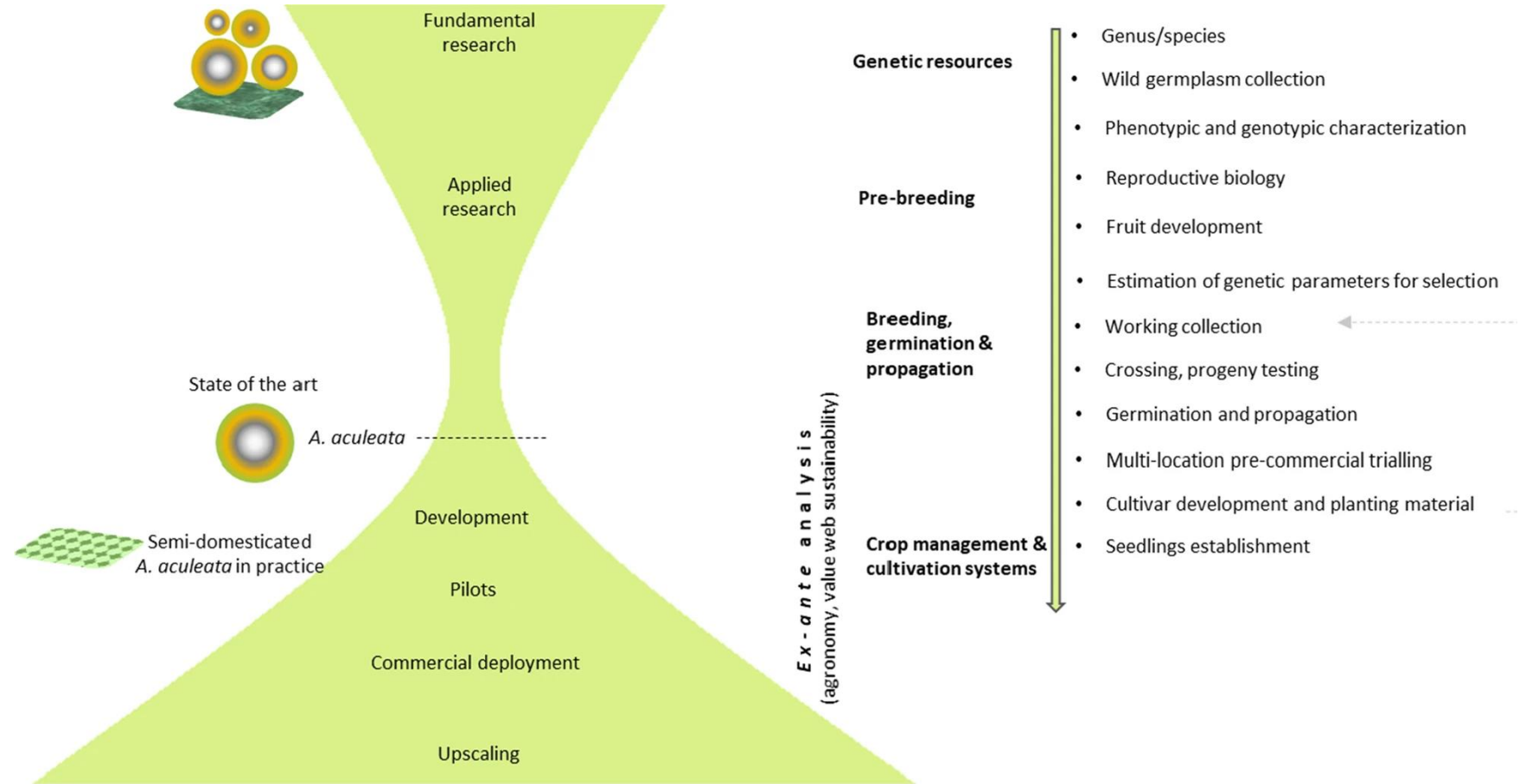
- Multi-purpose feature: Value web approach
- Focus on processing and products (mainly biodiesel)



Source: Vargas-Carpintero et al. 2021

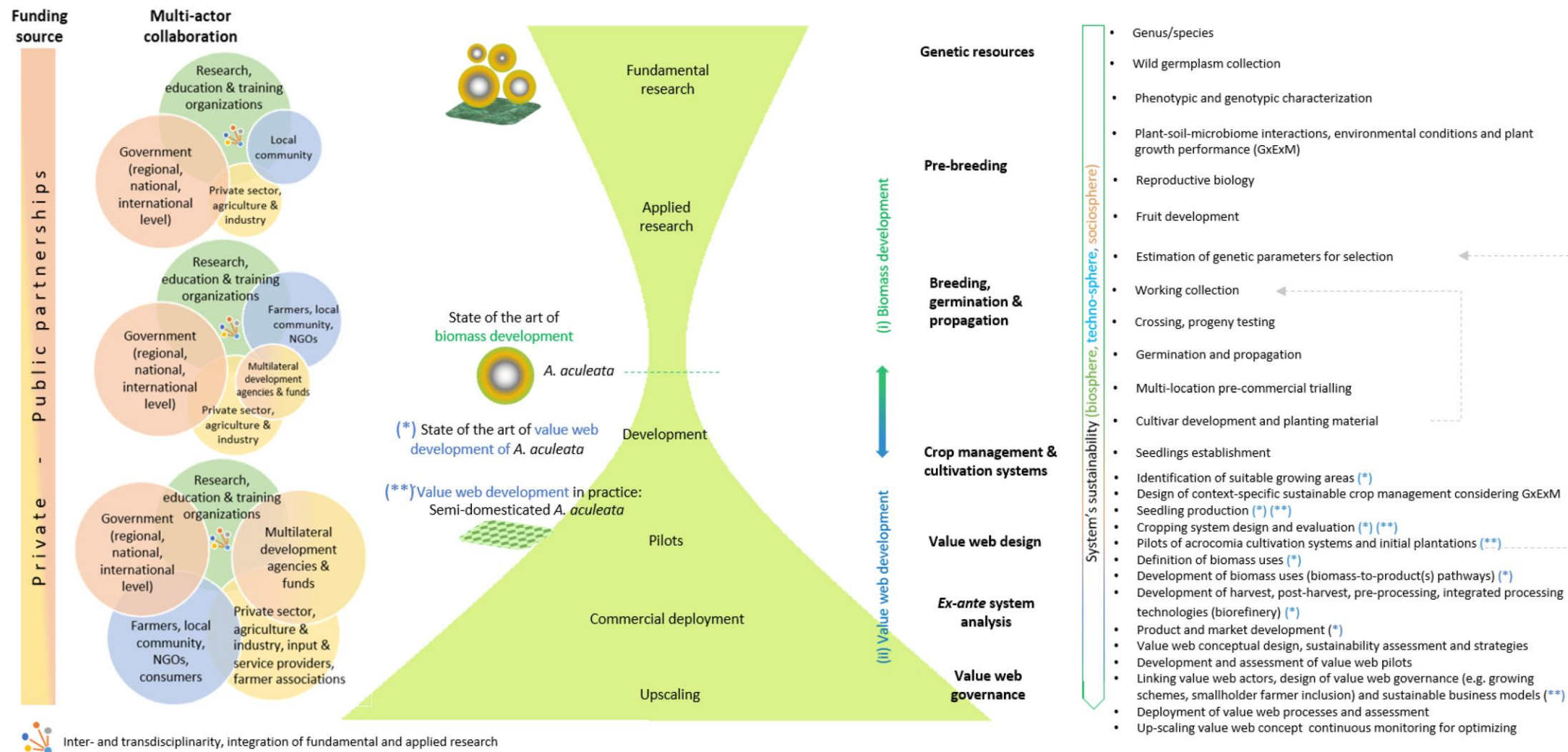
R&D FROM BOTANY TO CULTIVATION

- Semi-domesticated status of *A. aculeata*
- Commercial cultivation starting in Brazil



Source: Vargas-Carpintero et al. 2021

R&D FROM CULTIVATION TO MARKETS

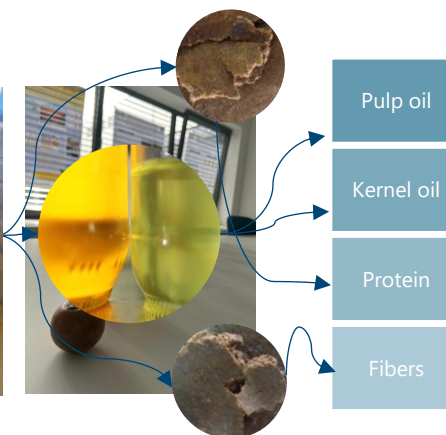
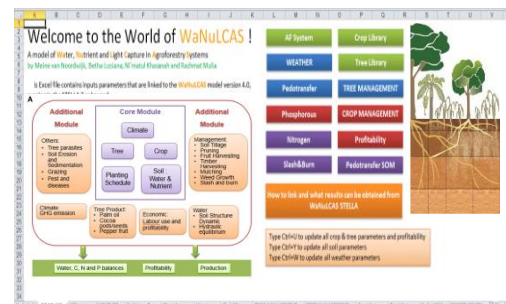


Source: Vargas-Carpintero et al. 2022
<https://doi.org/10.3390/land11101748>

FROM THE SEED TO HIGH ADDED VALUE PRODUCTS



Goal: To develop a biorefinery concept for high value refined oils, proteins and dietary fibers from macauba fruits, while addressing major gaps for the development of a sustainable value web



Planting material

Cultivation systems

Pre-processing and biorefining

Product development

Industry partners



FUNDED BY

With support from



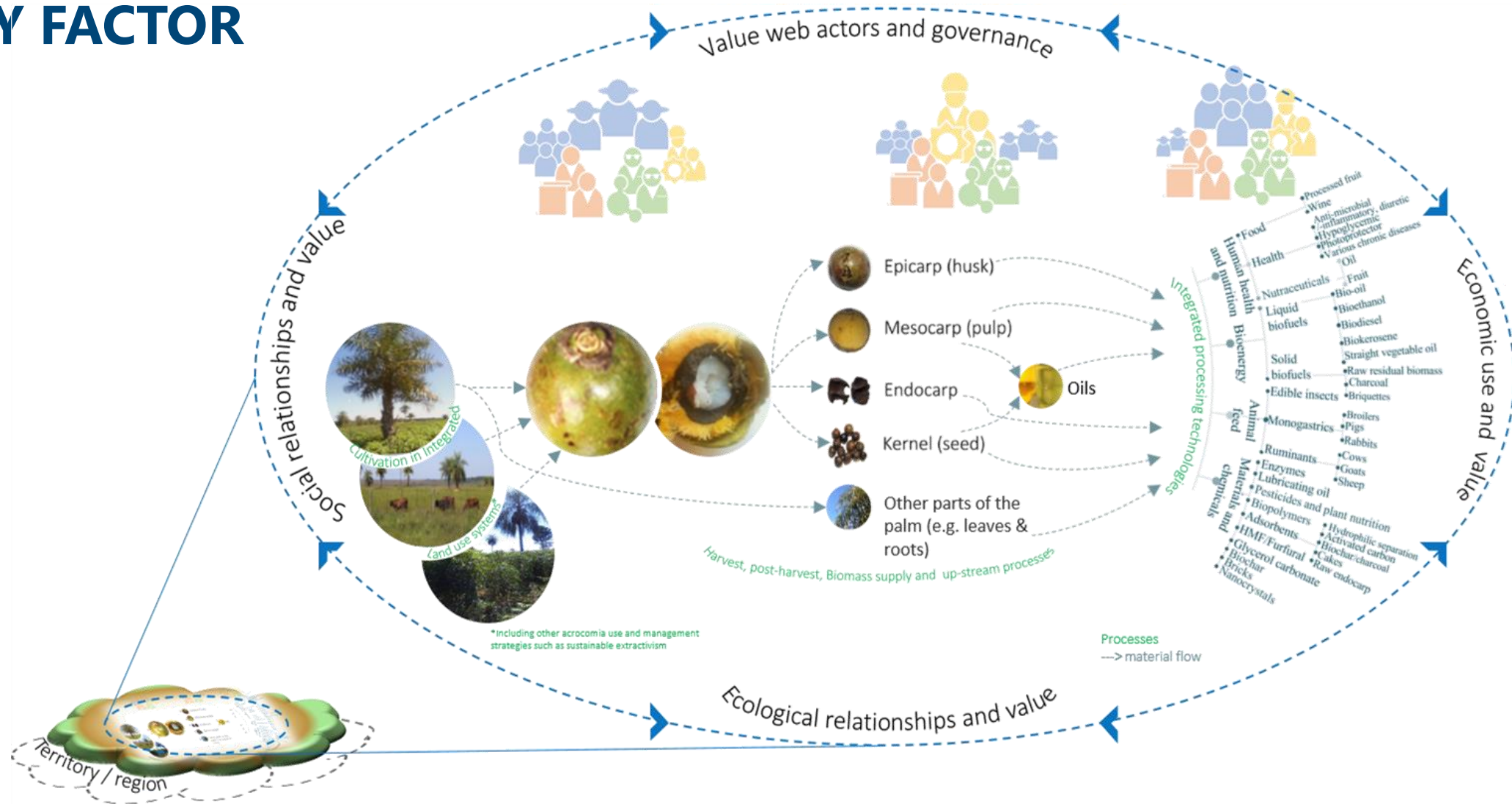
www.acroalliance.info

by decision of the German Bundestag

The background of the slide is a photograph of a terrarium. It shows a dark, moist, brown soil surface. In the lower right foreground, a small, pinkish-white earthworm is visible, partially buried in the soil. The terrarium's edge is visible on the right side. A semi-transparent blue rectangle is overlaid on the left side of the image, containing the title text.

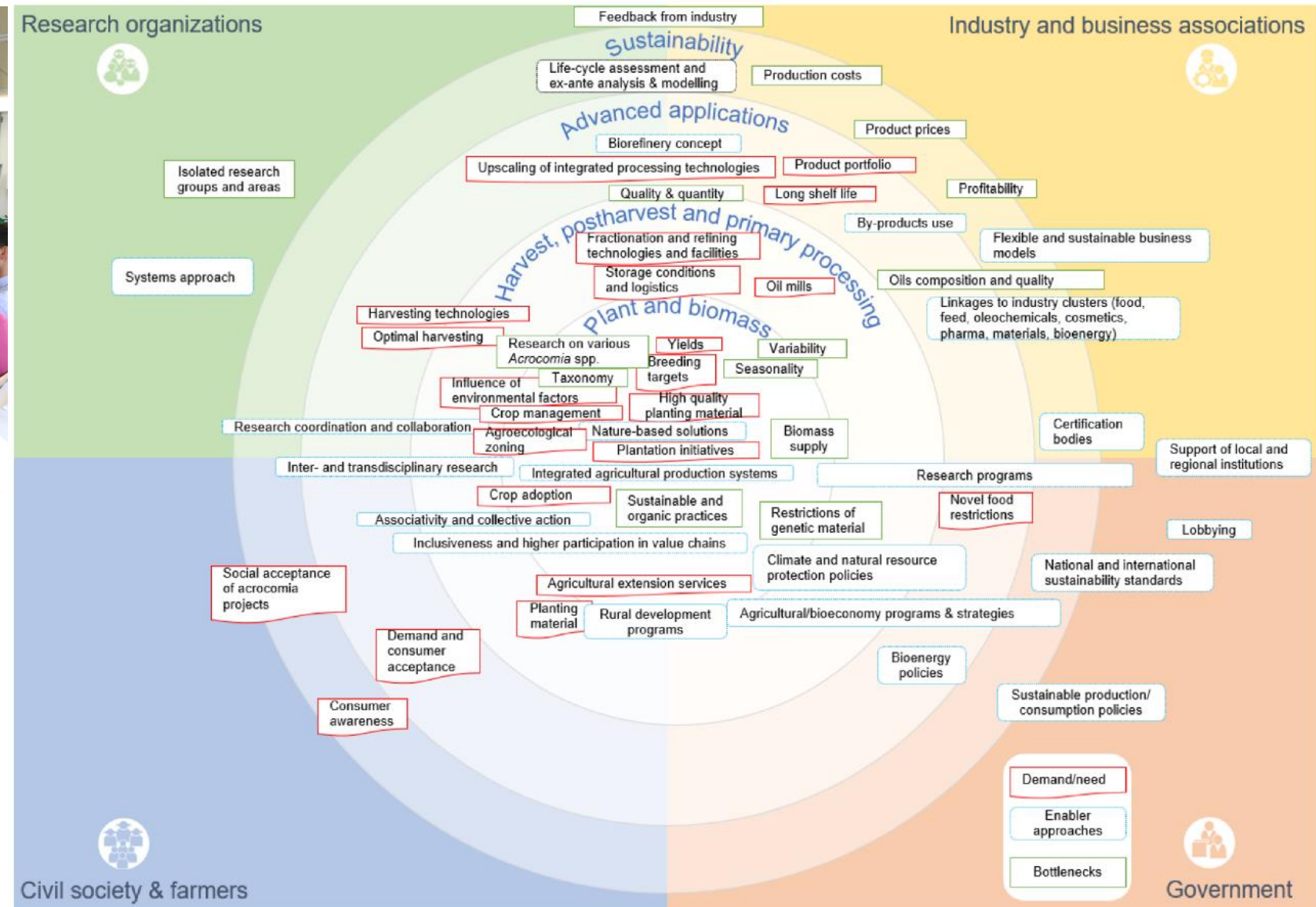
Lessons for innovation in NWFPs value chains

SYSTEMS AND COLLABORATIVE APPROACH TO INNOVATION AS KEY FACTOR



Source: Vargas-Carpintero et al. 2022
<https://doi.org/10.3390/land11101748>

MULTI-ACTOR DIALOGUE



<https://bioeconomy-science-hub.uni-hohenheim.de/acrocomia>

Source: Vargas-Carpintero et al. 2022
<https://doi.org/10.3390/land11101748>

PARTICIPATORY PROCESSES AND SOLUTION-ORIENTED RESEARCH



Nexus Network

Nature x Value Webs x Territories



SUMMARY

WORKSHOP NEXUS

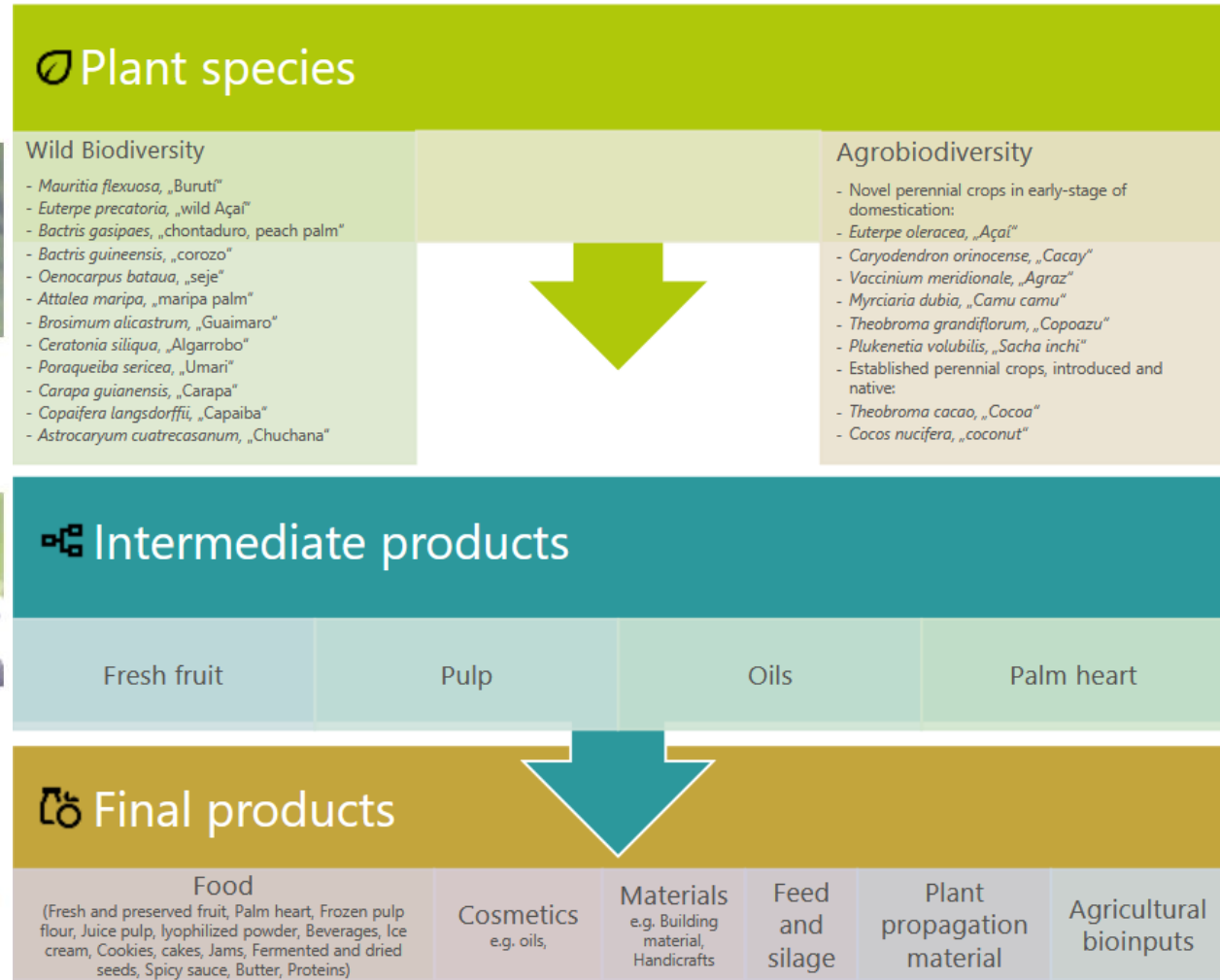
Biodiversity-based value webs and territorial bioeconomy systems in Colombia: practice and research perspectives

University of Hohenheim, Dept. Biobased Resources in the Bioeconomy | Alexander von Humboldt Biological Resources Research Institute, Center for Biodiversity Economics and Finance

16-18 Sep 2024, Bogotá | Stuttgart

WITH THE SUPPORT OF

Embajada de Colombia en Alemania



TOWARDS INNOVATION SYSTEMS

- Ensuring sustainable production and sourcing, innovating for upgrading and industry development, and meeting demand for sustainable products are complementary pathways
- NWFPs are not the focus of any innovation systems, and forest policies rarely support them
- Integrated implementation of the transition pathways and actions requires resources, investments, and political commitment.



TAKE-HOME MESSAGES

- NWFPs hold significant potential to contribute to the transition towards a sustainable forest-based bioeconomy, creating added value while incentivizing sustainable forest management and conservation.
- Innovation is essential for unlocking the potential of NWFPs and can lead to a variety of transition pathways.
- Multi-actor collaboration and a systems approach to innovation are key factors in fostering innovation across NWFPs value chains.

JOINT CONFERENCE OF
IUFRO Division 5 AND SWST
May 30 – June 3, 2027

Future Forest Use: Advancing Wood Science and Forest Products for a Circular Bioeconomy

REGISTRATION OPEN

Early Bird registration deadline:
January 25, 2027

CALL FOR ABSTRACTS

Submission deadline:
October 26, 2026

Visit: iufro-div5-2027.ee

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► **Advancing non-timber forest products for sustainable forest-based bioeconomies**

Organiser: Ricardo Vargas-Carpintero, University of Hohenheim/Alexander von Humboldt Biological Resources Research Institute, Colombia

Session co-organiser(s): Smith-Hall, Carsten (University of Copenhagen)

Vargas-Carpintero, Ricardo (University of Hohenheim/Alexander von Humboldt Biological Resources Research Institute)

Chamberlain, James (Independent researcher)
Ivana Živojinović (BOKU University)

<https://iufro-div5-2027.ee/>

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Task Force T50
Building an Integrated Vision of the Forest-Based
Sector within a Bioeconomy

<https://www.iufro.org/task-forces/t50-building-an-integrated-vision-of-the-forest-based-sector-within-a-bioeconomy>

JOIN THE BIOECONOMY DIALOGUE



<https://link.springer.com/book/10.1007/978-3-032-09098-0>



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THANKS FOR YOUR ATTENTION

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SEMINAR

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FAO INNOVATION TYPOLOGY

Technological	Technology is the application of science and knowledge to develop techniques that deliver products and services that enhance the sustainability of agrifood systems. Technologies are innovative when they are introduced, adapted or used in new ways in a given context.
Social	Social innovation is the development and adoption of new ideas (approaches, products, services and models) to meet social needs and create new social relationships or collaborations. It represents new responses to pressing social demands and existing gender inequalities that affect the process of social interactions and is aimed at improving human well-being and empowering women and the most vulnerable and marginalized peoples. In this publication, social innovation is treated together with policy and institutional innovations.
Policy	Policy innovation comprises novel processes, tools and practices used for policy dialogue, design and development that result in better enabling environments for addressing complex issues. It involves the development or adaptation of legislation, policies and strategies to address emerging challenges and societal needs or inefficiencies in existing systems through integrated approaches and the inclusion of multiple actors. In this publication, policy innovation is treated together with social and institutional innovations.
Institutional	Institutional innovations are new rules, organizations and processes that guide collective action and arise from it. They can involve changes in the operations, governance structures, multistakeholder engagement, participatory decision-making processes and cultural norms of formal and informal organizations and institutional arrangements. They take place when people or organizations strategically mobilize others through network relationships to repair or replace institutions. In this publication, institutional innovation is treated together with social and policy innovations.
Financial	Innovative finance helps generate additional development funds by tapping new funding sources or engaging new partners, enhancing the efficiency of financial flows by reducing delivery times or costs, and improving the outreach of finance to make financial flows more results-oriented and beneficial for youth, women and vulnerable groups.

TRANSITION PATHWAYS FOR NWFPS VALUE CHAINS

Table 4.1 Three NWFP transition pathways and prioritised actions across five intervention fields			
Pathway → Intervention field ↓	(A) Sustainable production and sourcing	(B) Upgrading and industry development	(C) Meeting consumer demand
From forest to markets	Forest management plans for natural populations, harvesting guidelines, inventories and monitoring (Gov/Res/Coop/SME) Expansion of agroforestry and forest-farming (Gov/CSO/Coop/SME) Cultivation of priority species (Priv/Res/Gov)	Local value addition at primary stage (Coop/SME) Infrastructure, quality labs, and food safety (Gov/DFI) R&D for new products (Res/Gov/Priv) Decrease of obstacles for businesses; remove market barriers (Gov)	Institutional procurement (school meals, hospitals) (Gov) Local and international market development (Coop/SME/CSO/Gov) Capacity-building for quality assurance (SME/Coop/Gov)
Innovation	R&D on germplasm and cultivation (Res/Gov/Priv) Extension services and technical advice for smallholders (Res/Gov/Priv) Sustainable management and conservation practices (Gov/Res/SME/Coop) Organisational and managerial capacities of producers (SME/Coop/CSO)	Product and process innovation (low-tech & high-tech) (Res/Priv/Gov) Tech transfer hubs for upscaling (Res/Priv/Gov)	Certification/branding (Priv/CSO) Product mainstream use (Priv/Gov) Premium markets for sustainable products (Priv/Gov)
Finance	Global funds and working-capital facilities (DFI/Bank) Minimum NWFP selling price schemes (Gov/Priv/Coop) Blended mechanisms for de-risking investments (Gov/Priv/DFI)	Innovation grants (Gov/DFI) Risk-sharing and guarantees for SME (Gov/DFI)	Blended finance for market entry (Gov/Priv/DFI) Re-investment of price premiums (Gov/Priv/CSO)
Multi-actor collaboration	Engagement of value chain stakeholders (Coop/SME/CSO/Priv) Strengthening of producer organisations (SME/Coop) Farmer inclusiveness (Gov/Res/Coop/SME)	Industry forums (Gov/Priv/CSO/SME/Res) Capacity building for farmers, entrepreneurs, and SME (Gov/CSO/SME)	Codex engagement for priority products (Gov/Res) Science to advance innovations (Res/Gov/Priv)
Policy to practice	Secure tenure, adequate access, and benefit sharing (Gov) Public policies on sustainable NWFP harvesting and resource management (Gov) NWFP in national statistics for tailoring policies (Gov)	Information access and transparency (Gov/SME/Priv) Policies on traditional knowledge and access (Gov) Enabling business environment (Gov) Establishment of R&D programmes to leverage NWFP value chains and sustainable use (Gov/Res/Priv)	National NWFP strategy (Gov) Transparent price and performance (Gov/Priv/SME/Coop)
Gov = government; Res = research; DFI = development finance institution; CSO = civil society organisation; SME = small/medium enterprise; Priv = large-scale businesses; Coop = Producer cooperative			

PRIORITY ACTIONS FOR ADVANCING NWFPS INTEGRATION IN THE BIOECONOMY

KEY MESSAGES – NON-WOOD FOREST PRODUCTS	
NWFP are key resources supporting the transition to a sustainable forest-based bioeconomy. Ensuring sustainable production and sourcing, innovating for upgrading and industry development, and meeting demand for sustainable products are complementary pathways that can overcome barriers such as informality, limited recognition, weak stakeholder involvement, financing, and weak market linkages.	
From forest to markets	• Develop species-specific and context-dependent management plans and sustainable harvesting guidelines; strengthen monitoring systems to maintain ecological balance and prevent overexploitation. • Support domestication and cultivation of priority NWFP; improve post-harvest processing and invest in infrastructure for quality control, testing, and certification. • Promote local and regional market development through public-private investment while building producer capacities to meet quality standards and add value locally. • Remove barriers to businesses and trade while ensuring sustainable management.
Innovation	• Invest in R&D and innovation for forest farming and NWFP cultivation, processing, and product development; strengthen partnerships to accelerate technology adoption across the value chain. • Develop production models that integrate conservation with sustainable management and strengthen producer organisations to enhance marketing, value addition, and bargaining power. • Develop certification, branding, and communication strategies that highlight the ecological and social benefits of NWFP, strengthening access to ethical and mainstream markets.
Finance	• Strengthen partnerships with development banks, global funds, and private enterprises, and promote blended financing that leverages public, private, and NGO resources. • Develop risk-sharing and finance models linked to price stabilisation and provide innovation grants to producer organisations and SME to boost entrepreneurship and value addition. • Reinvest gains into community development and resource management; promote fair-trade approaches that empower local producers and sustain long-term social and environmental benefits.
Multi-actor collaboration	• Engage market stakeholders and create multi-actor platforms that promote coordination, transparency, and sustainable sourcing among producers, firms, NGO, and governments. • Support and build the capacity of producer organisations, smallholders, entrepreneurs, and SME to enhance competitiveness, market access, and organisational strength. • Facilitate the inclusion of NWFP in international standards such as the <i>Codex Alimentarius</i>; establish global networks to foster innovation and collaboration among early-career scientists.
From policy to practice	• Ensure that legislation supports sustainable production, trade, and conservation while safeguarding traditional knowledge through fair benefit-sharing and intellectual property mechanisms. • Engage local practitioners in policymaking to align regulations with customary practices and equitable access. • Incorporate NWFP data into national statistics and enhance species- and product-level information on volumes and values to inform evidence-based policy making, and resource and value chain management. • Develop national strategies that foster business growth, market development, and equitable benefits, while promoting transparency in pricing and social/environmental impacts across the value chain, and safeguarding NWFP use for subsistence and livelihood.