

Exploring the Potential of Bamboo for Low-carbon Renovation in Temperate Climate

From Plantation to Circular Building Material

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Tom De Mil - TERRA Teaching and Research Centre, Gembloux Agro-Bio Tech, University of Liège, Gembloux, Belgium

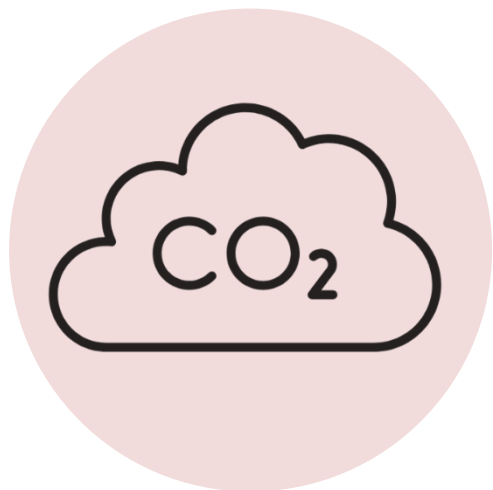
Context

Building sector



42%
of fossil energy
use

Source :
European Environment Agency



35%
of CO₂
emissions

Source :
European Environment Agency



71%
of EU buildings
are energy
inefficient

Source :
European Commission

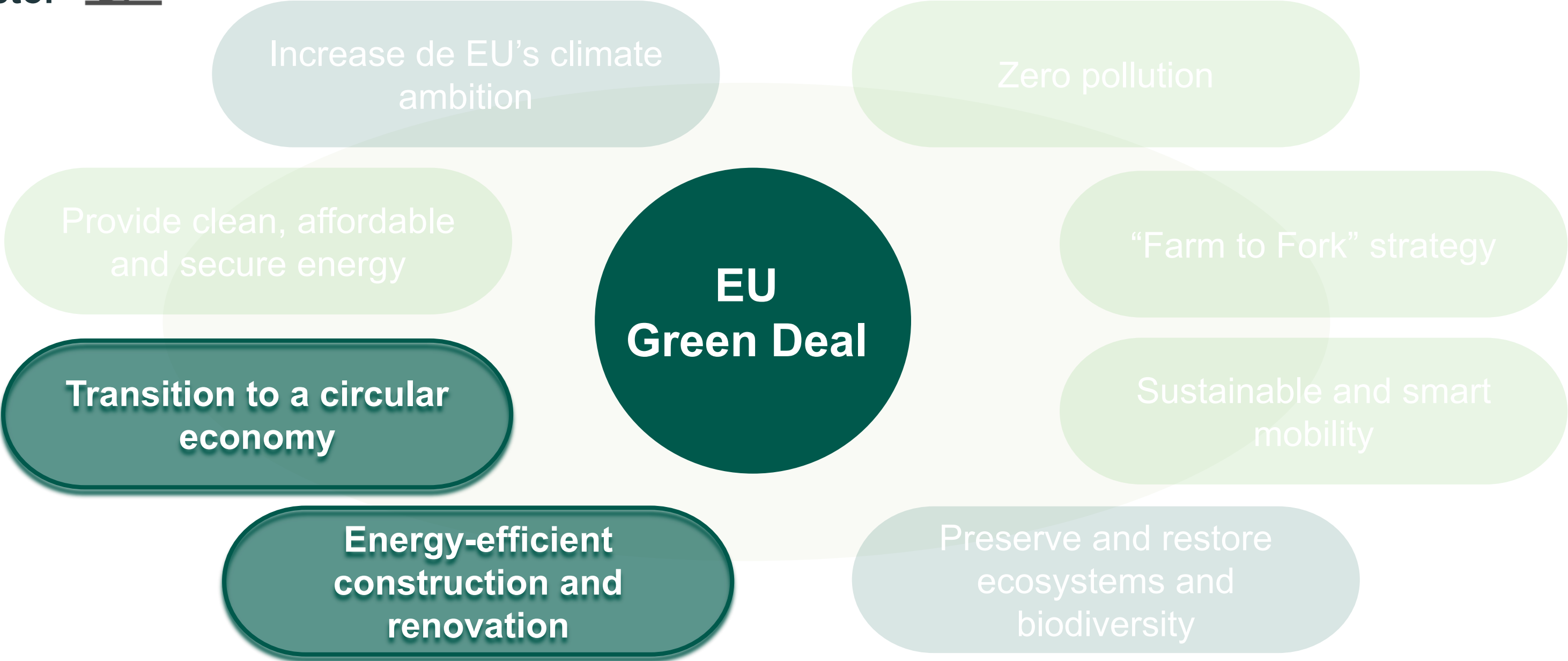
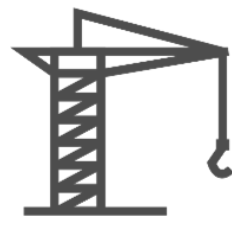


< 1%
renovated per
year (target: 3%)

Source :
European Commission

Context

Building sector



The European Green Deal. Source : FSC International

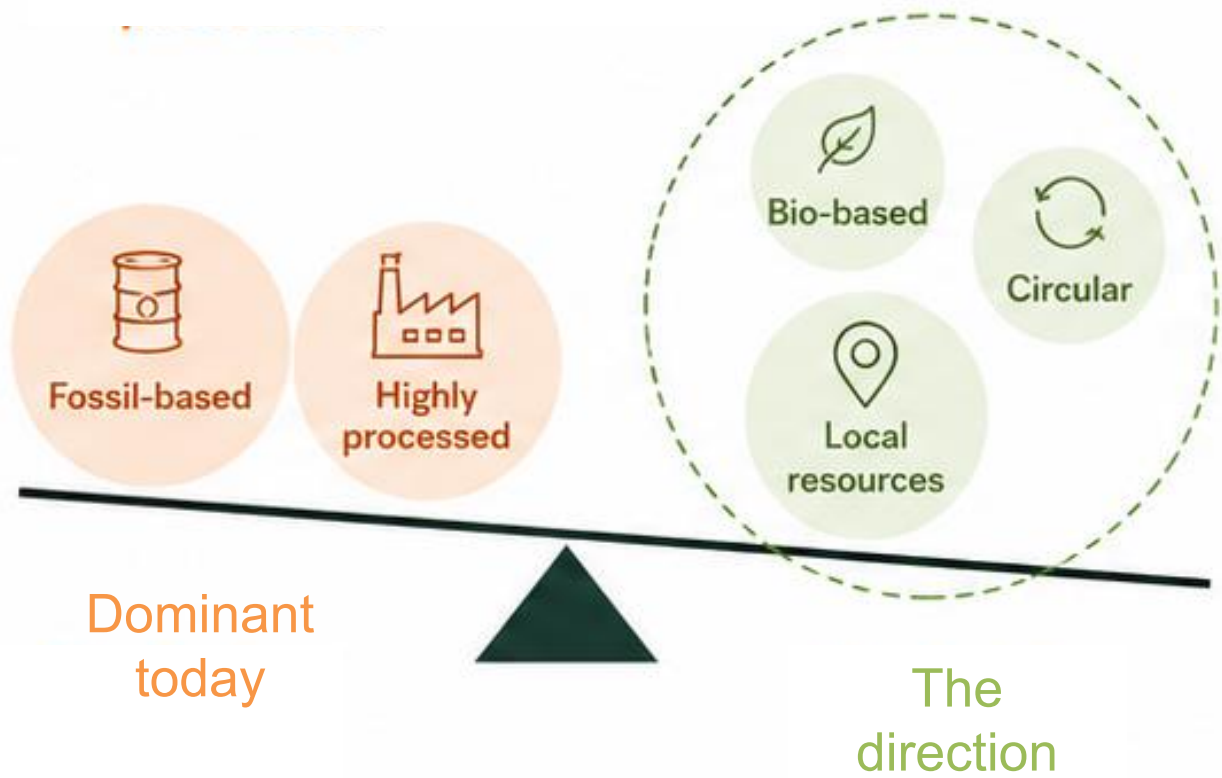
Renovate more. Renovate differently.

Context



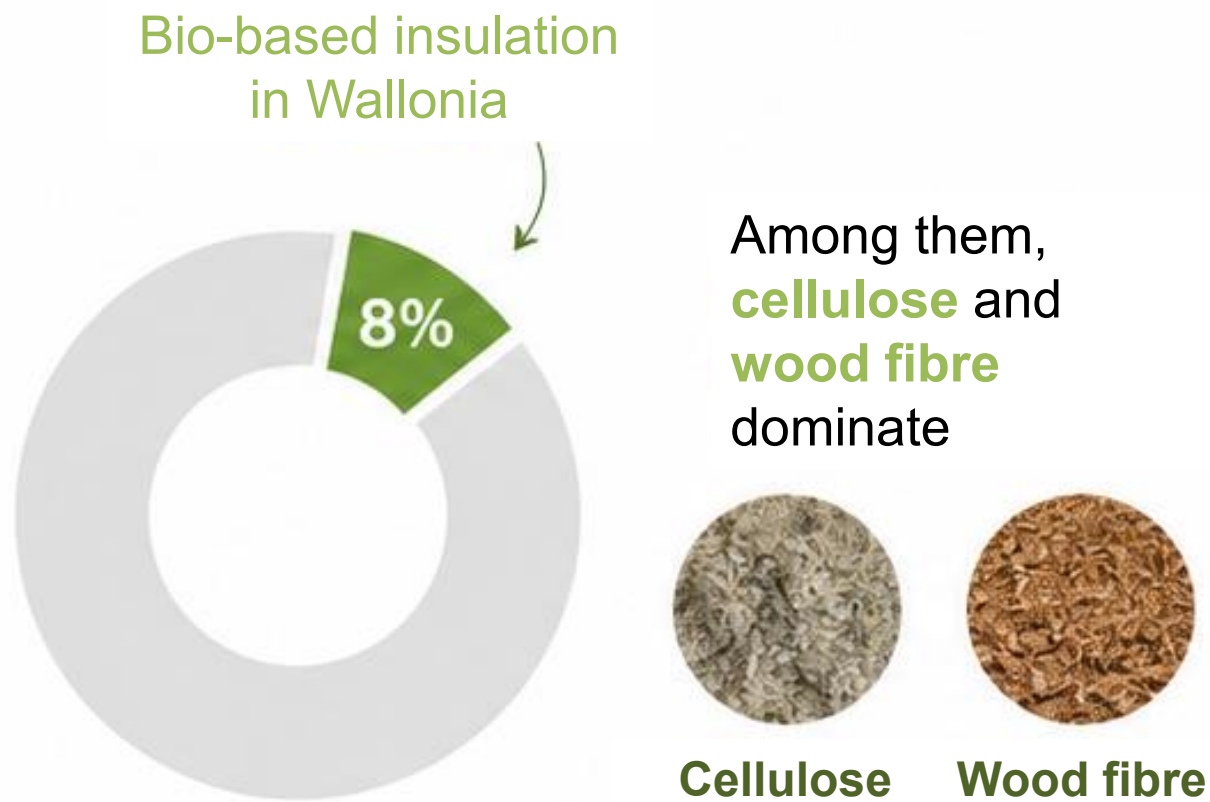
Insulation is essential to reduce operational energy

Most insulation remains fossil-based or highly processed





Only 8% bio-based insulation in Wallonia





Wood resources are under pressure



Climate change



Forest disturbances

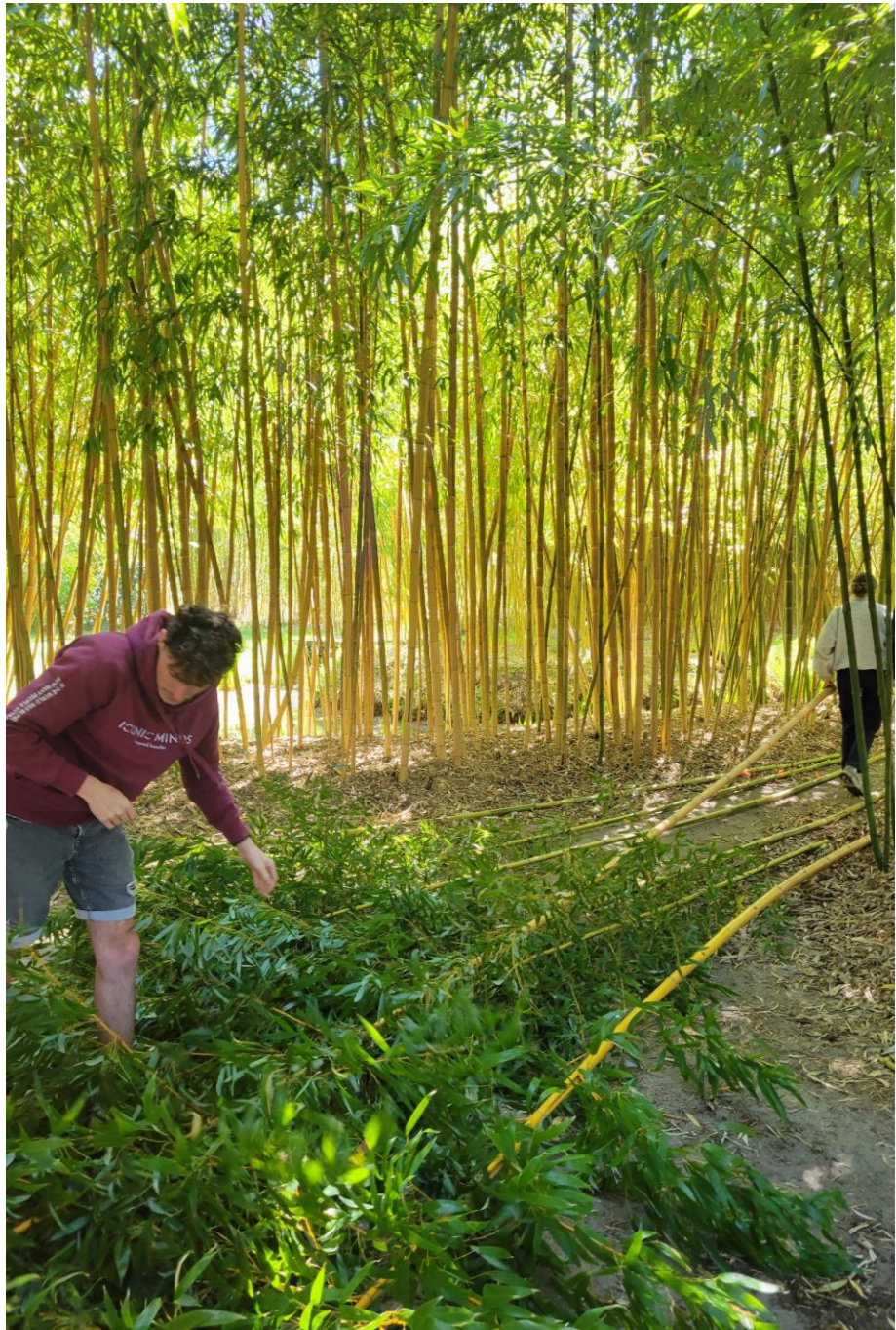
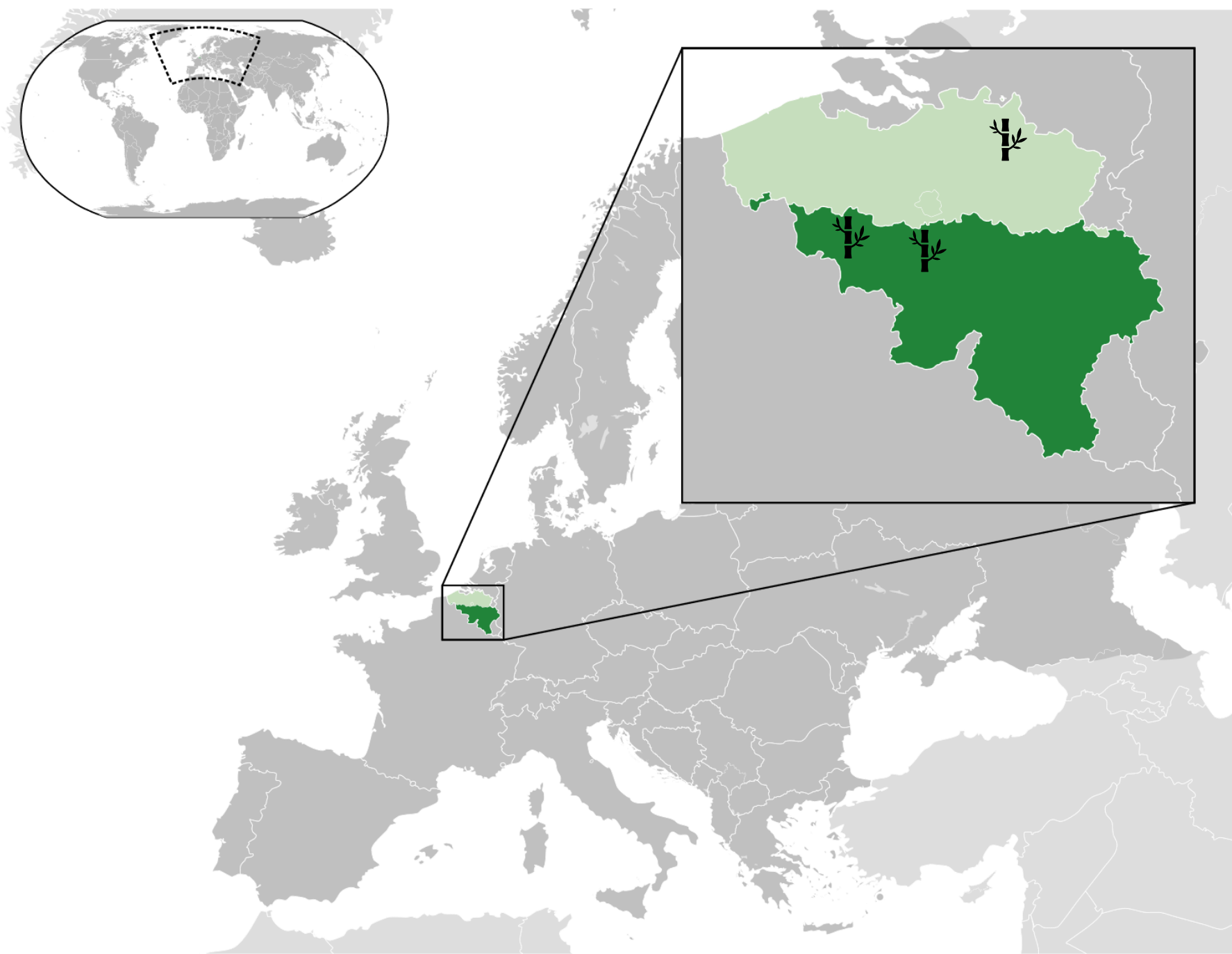


Competing uses
(construction, industry, energy,...)



Need to diversify our local bio-based resources

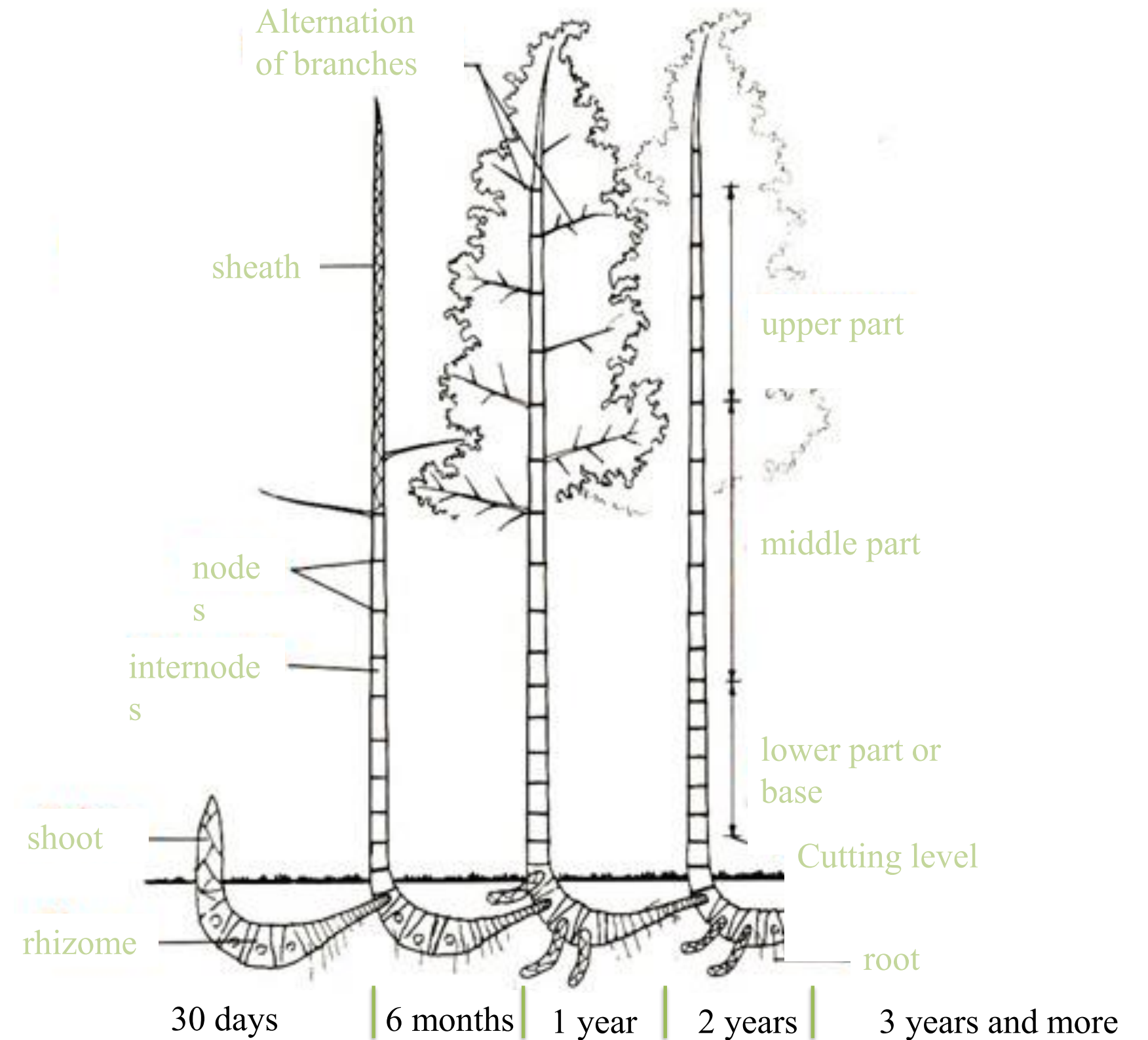
Why bamboo?



Why bamboo?

- **Rapid growth ($\approx 1\text{m}/\text{jour}$)**
- High yield
- Ecosystem services
- Thermal properties
- **60,000** tons imported per year

Source : Reilly, D. (2024). Parametric bamboo.



Source : Diroux, D. (2018). Bamboo Construction Manual. Terran. (Translated by A. Romboux)

Why bamboo?

- Rapid growth
- **High yield (26,7 à 98,7 t/ha)**
- Ecosystem services
- Thermal properties
- **60,000** tons imported per year

→ In comparison, **spruce**, the most widely used species in Belgium, has a yield of **10t/ha**

Source : Chen et al. (2014). Growth characteristics of moso bamboo (Phyllostachys edulis) plantations at various altitudes in Da-an area, Nantou County. Quart J Chin For, 47, 181-192.



Why bamboo?

- Rapid growth
- High yield
- **Ecosystem services**
- Thermal properties
- **60,000 tons imported per year**

Sources :

- INBAR. (2014). *Bamboo: A Strategic Resource to Help Countries Mitigate the Impact of Climate Change (Synthesis Strategy Report 1)*. (Translated by A. Romboux).
- Chiti et al. (2024). *Carbon sequestration in a bamboo plantation : A case study in a Mediterranean area*. *Journal of Forestry Research*, 35(1), 51.
<https://doi.org/10.1007/s11676-024-01696-9>



Why bamboo?

- Rapid growth
- High yield
- Ecosystem services
- **Thermal properties**
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Source : Wang et al. (2018). Thermal insulation performance of bamboo- and woodbased shear walls in light-frame buildings. *Energy and Buildings*, 168, 167-179



Opportunity ?

Why bamboo?

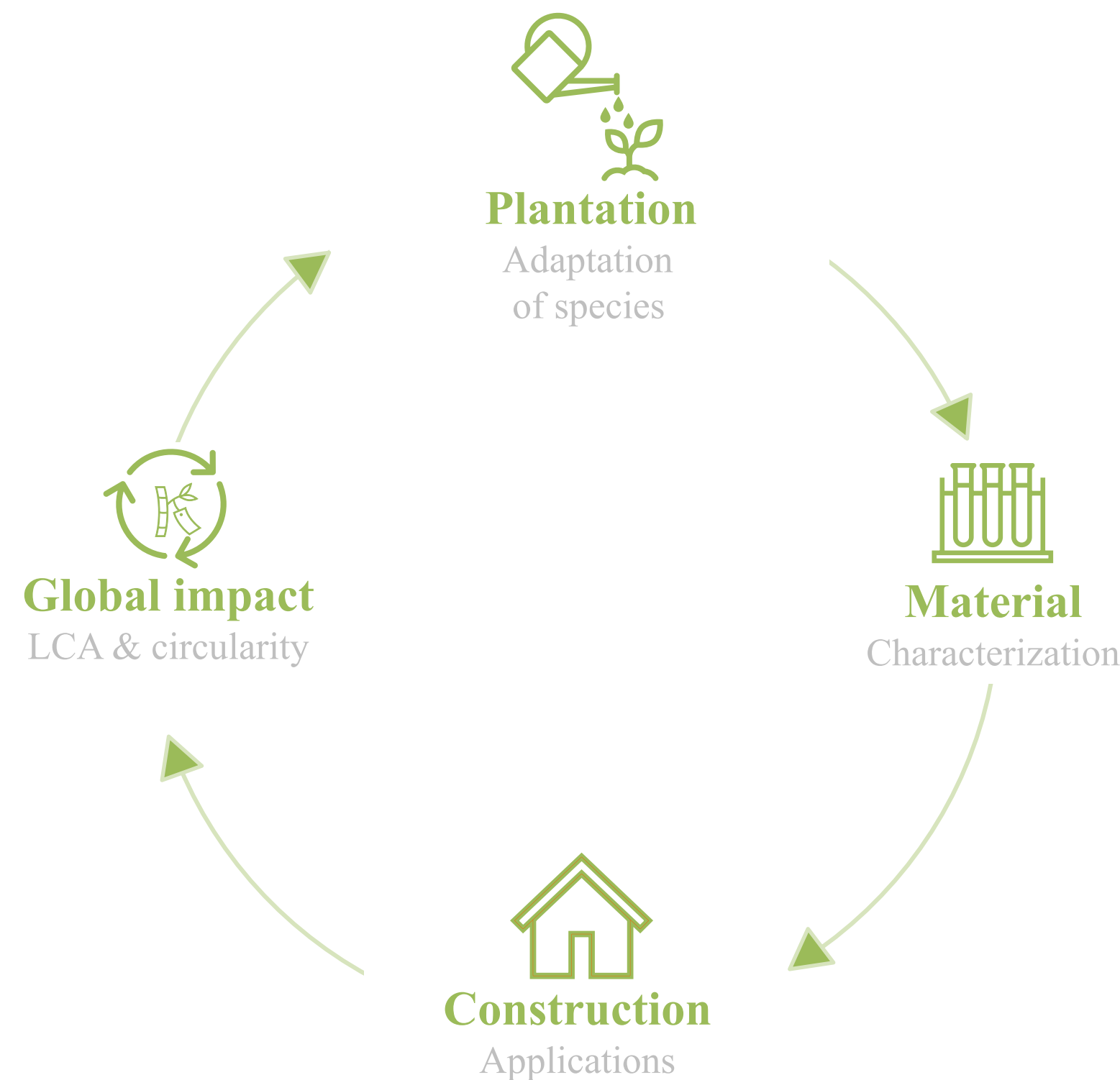
- Rapid growth
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- Ecosystem services
- Thermal properties
- **60,000 tons imported per year**

Source : WITS/World Bank/ Bamboo imports by country (2021).



*Bamboo Import Europe, the largest importer and seller of bamboo products for consumers in the European Union.
interiorbusiness.nl (Translated by A. Romboux)*

Research approach

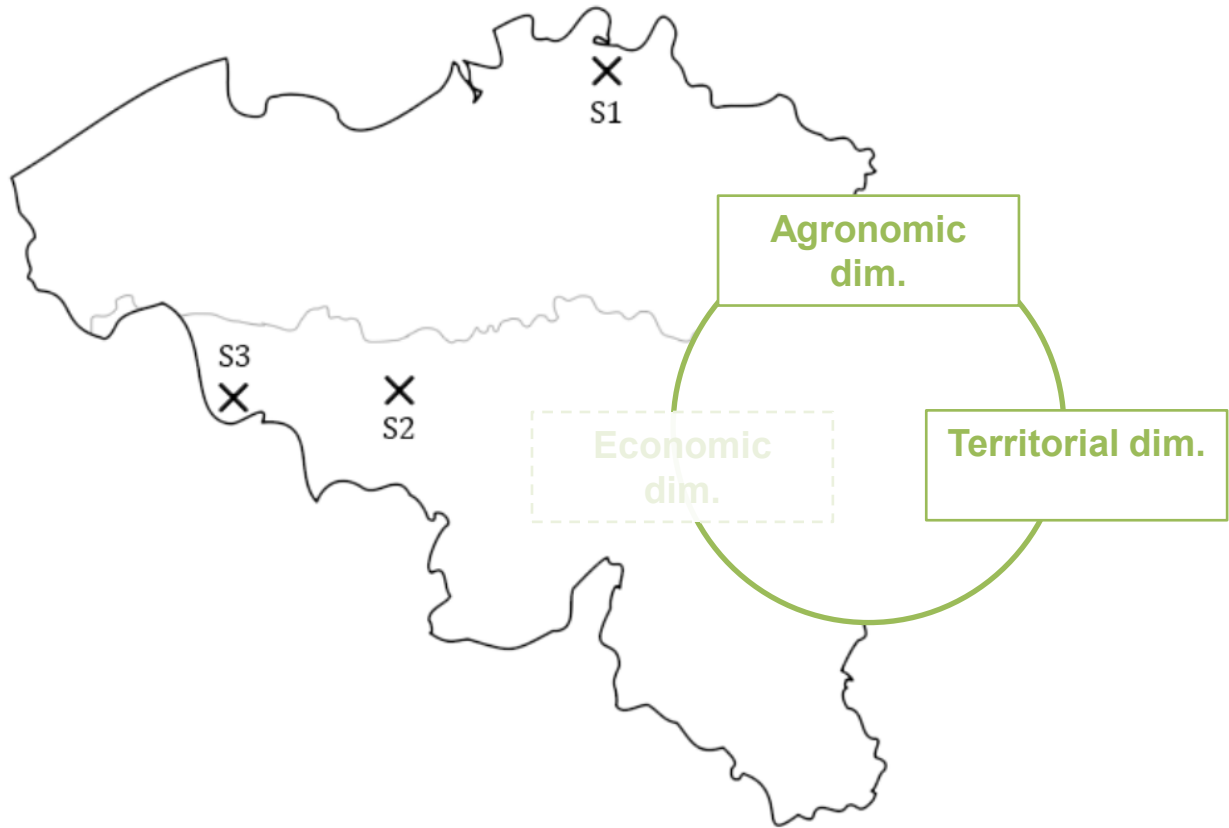


→ Material performance starts in the field



Goal of the research

1.
Demonstrate the potential for valorization certain bamboo species



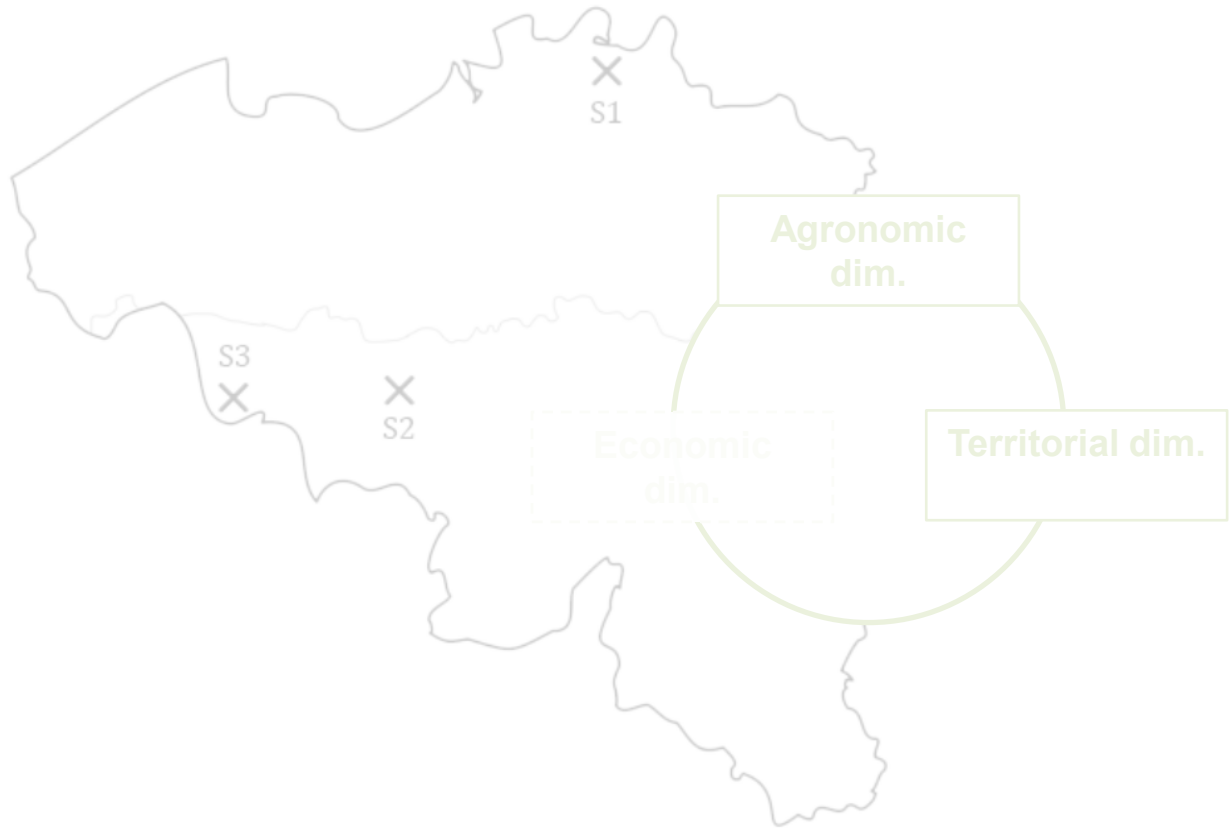
Selected species	Chosen sites	Legend
<i>Phyllostachys aureosulcata</i>	Oprins plantation	S1
	Nekto plantation	S2
<i>Phyllostachys edulis</i>	Degallaix plantation	S3
	Nekto plantation	S2

2.
Assess their potential use as insulation to meet renovation goals



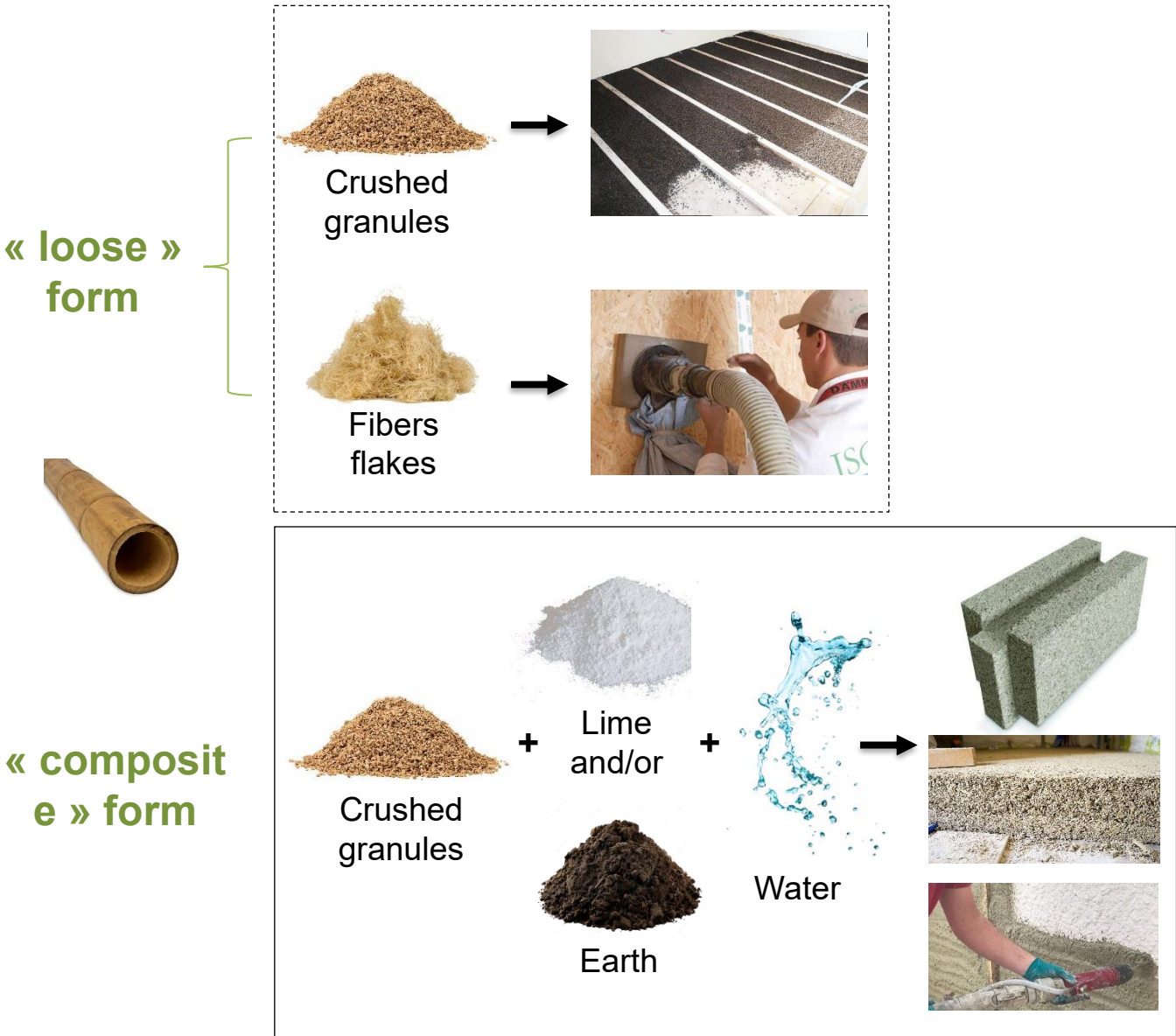
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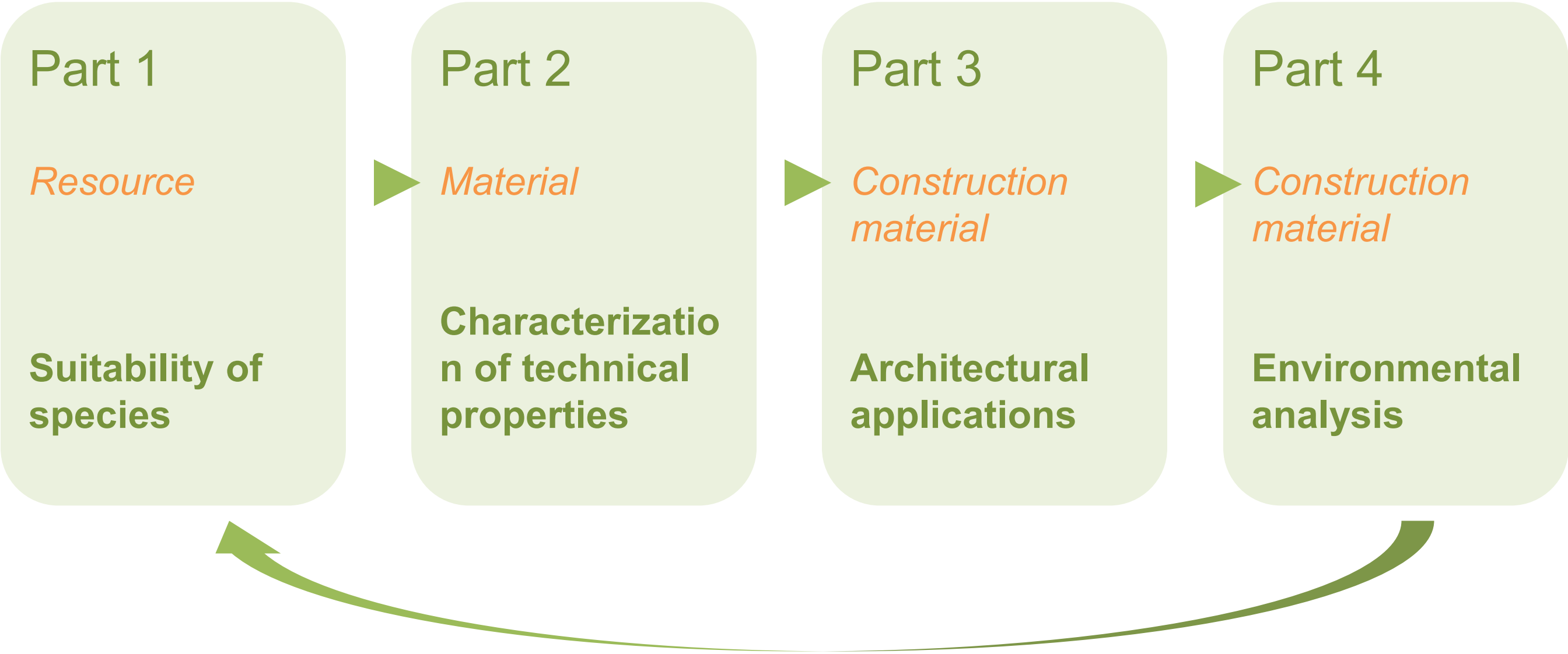
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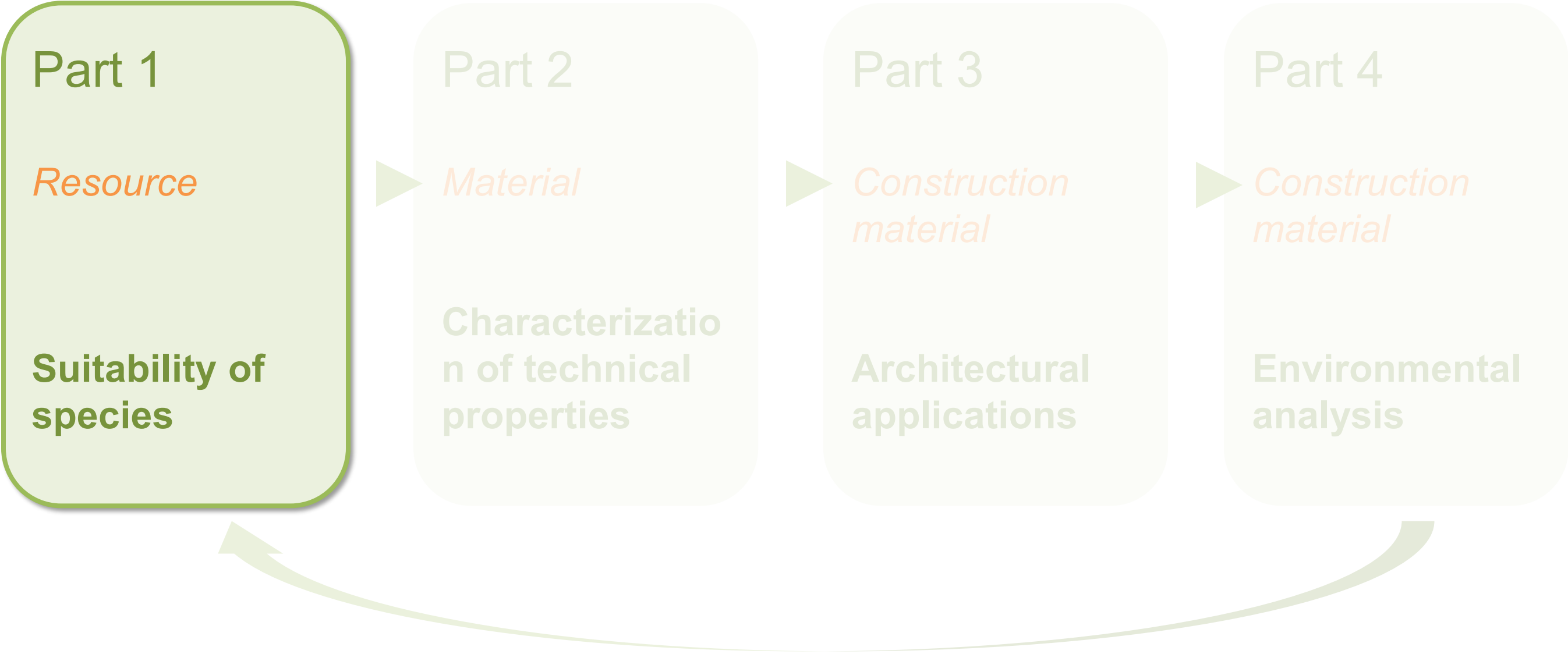
Methodology

Exploratory, interdisciplinary and eco-design approach



Methodology

Exploratory, interdisciplinary and eco-design approach



Agronomic Validation : Scientific gap

Native habitat



- ✓ Many studies
- ✓ Data
- ✓ Morphology

Belgium



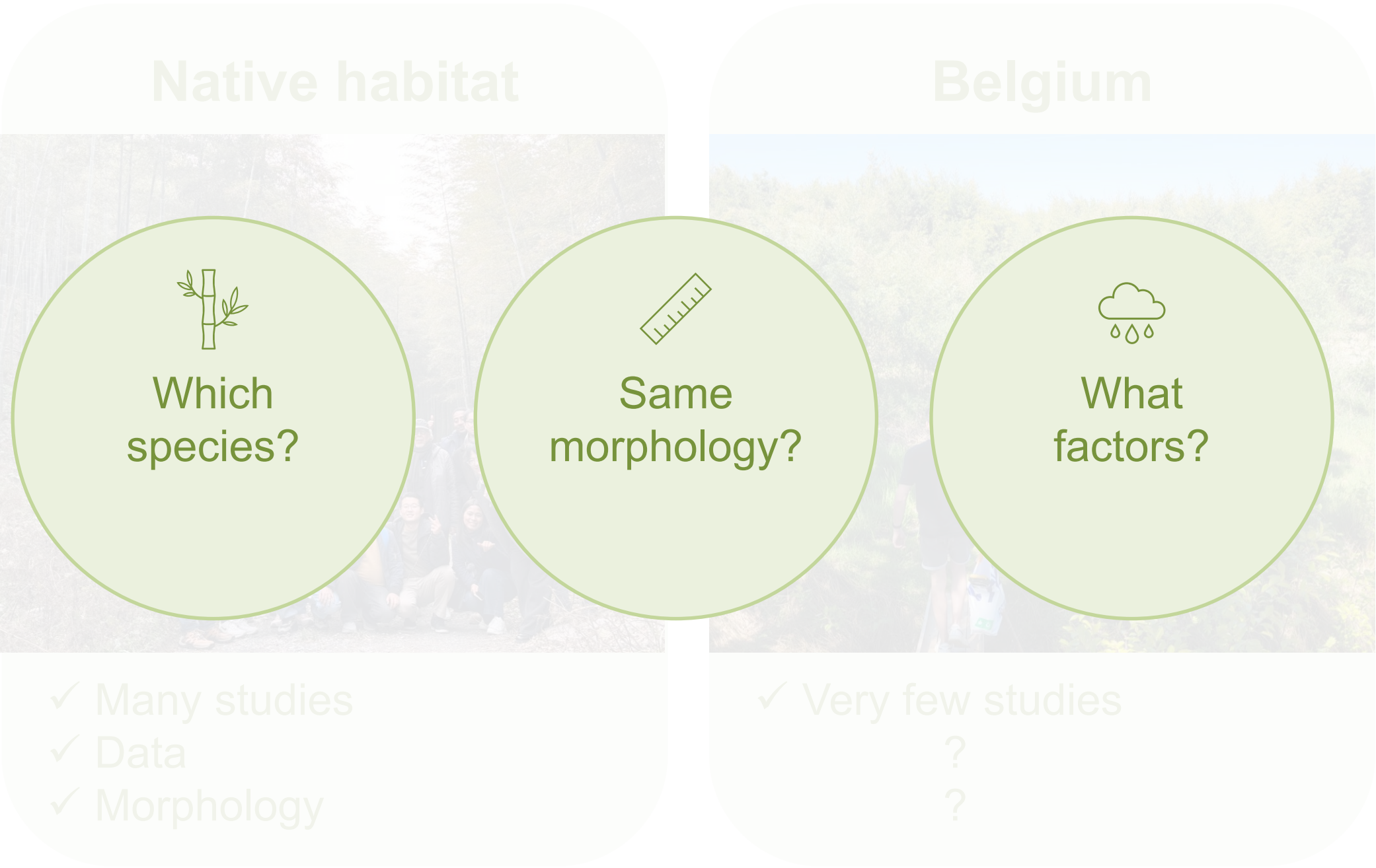
- ✓ Very few studies
- ?
- ?

Morphology influences
construction use



First objective of this research :
Characterize Belgian-grown
Phyllostachys morphology

Agronomic Validation : Scientific gap



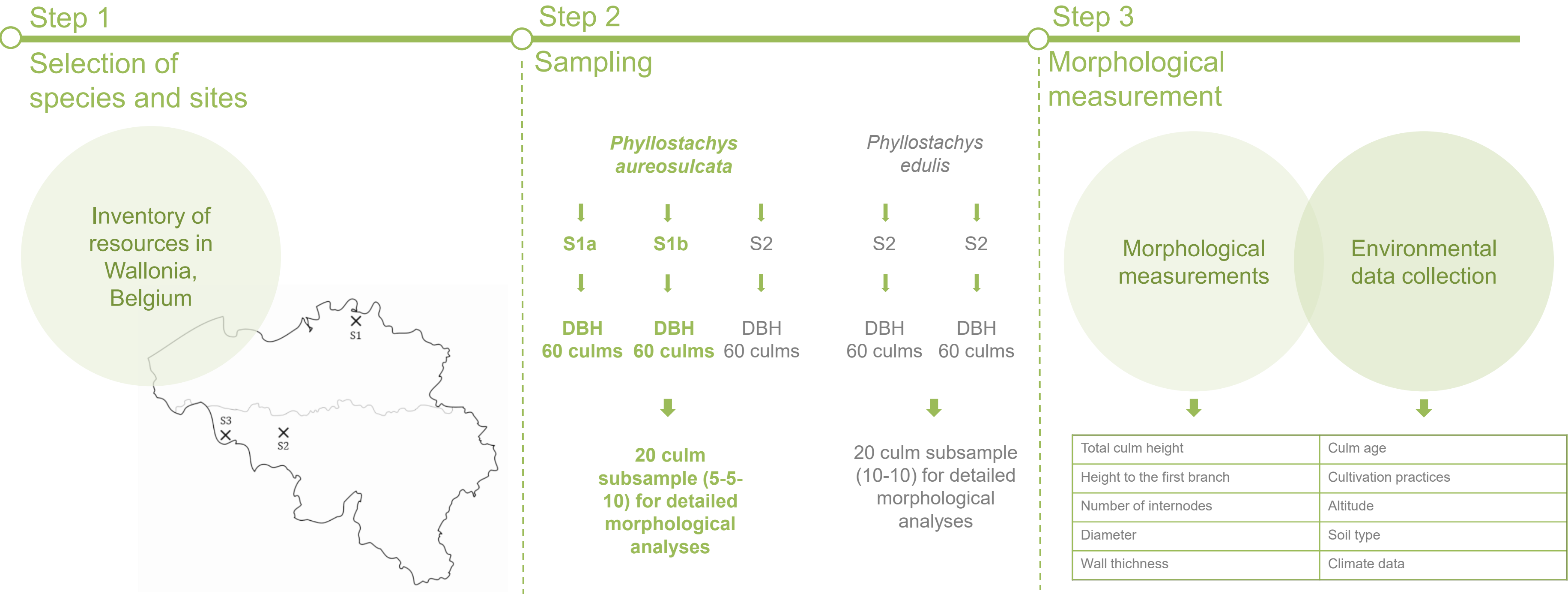
Morphology influences construction use



First objective of this research :
Characterize Belgian-grown *Phyllostachys* morphology

Agronomic Validation : Methodology

Development of a morphological measurement protocol



Step 3

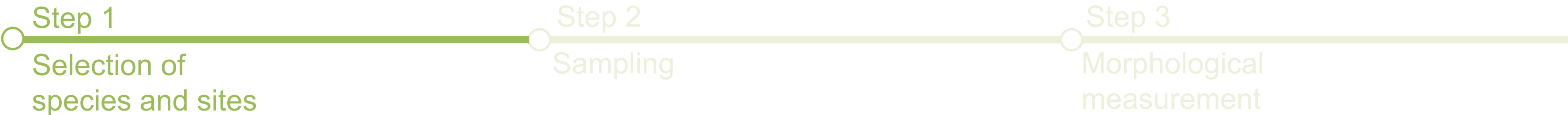
Morphological measurement

Morphological measurements

Environmental data collection

Total culm height	Culm age
Height to the first branch	Cultivation practices
Number of internodes	Altitude
Diameter	Soil type
Wall thickness	Climate data

Agronomic Validation : First results

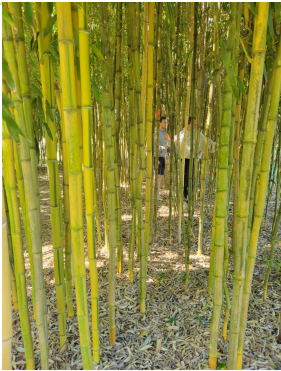
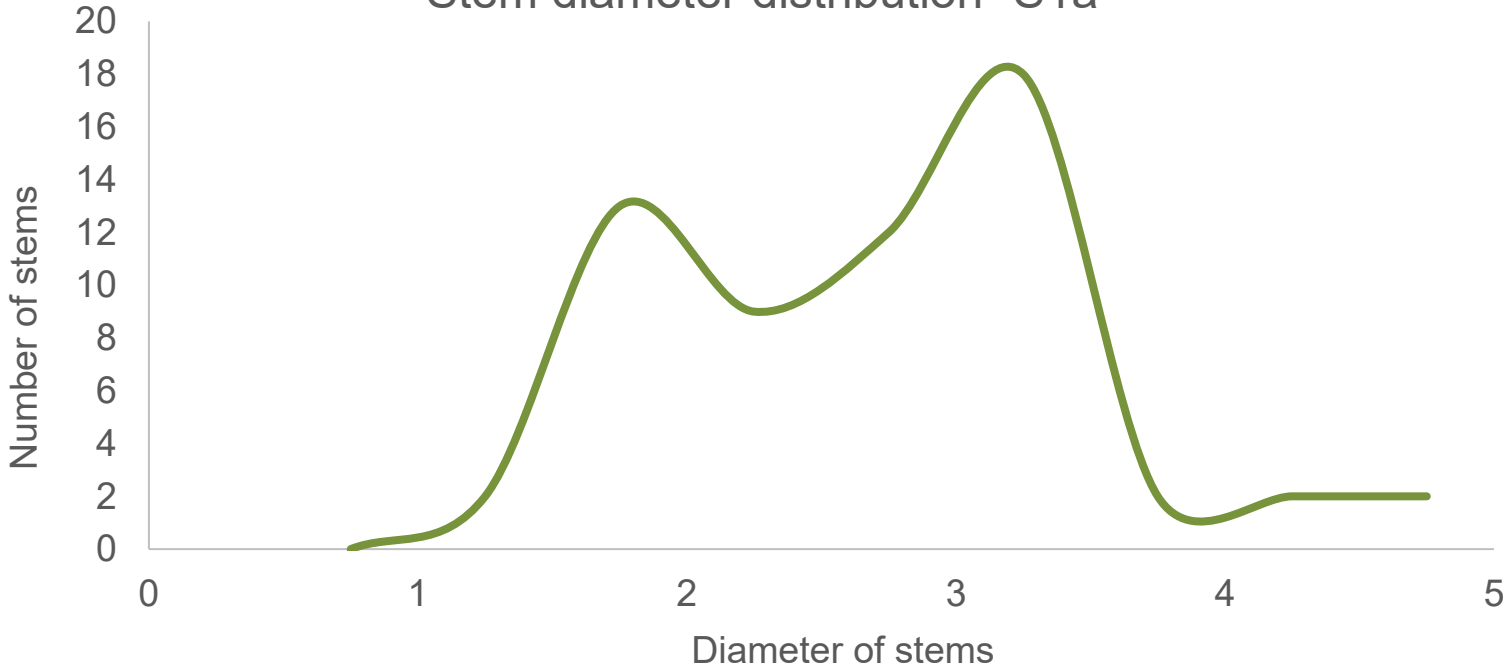
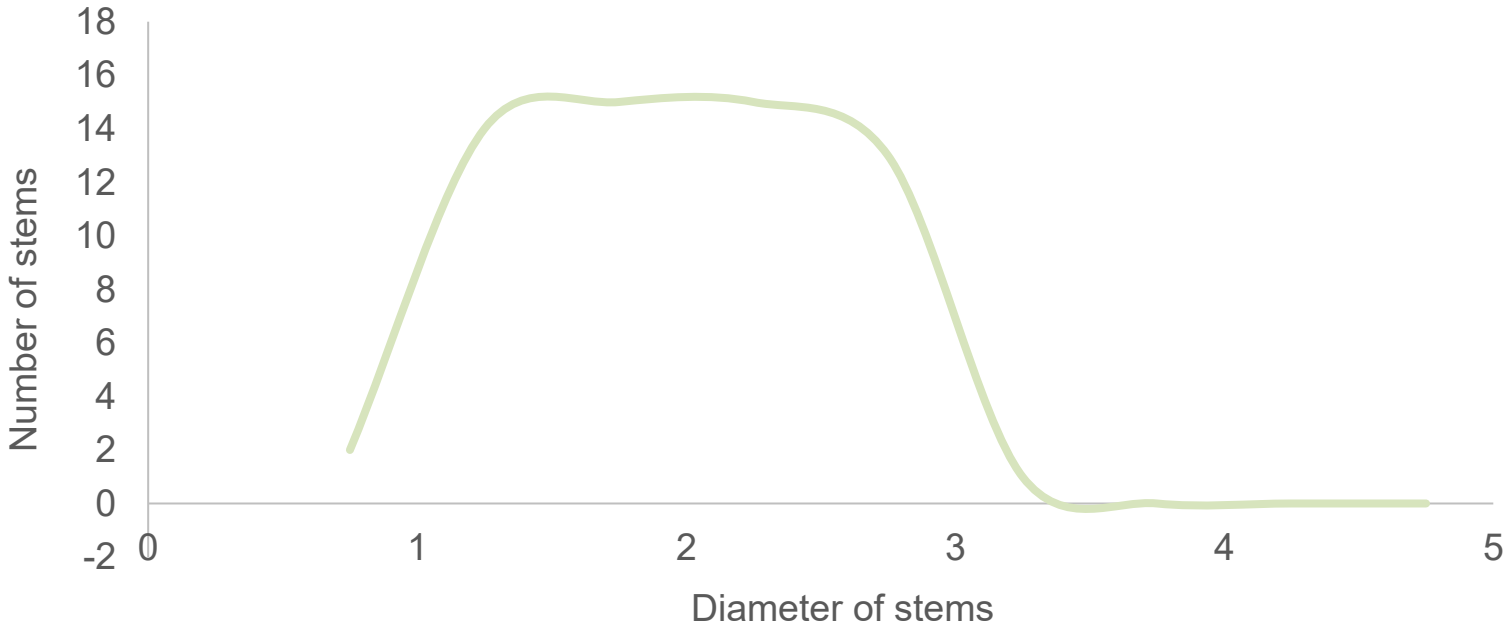


→ 2 representative species
→ 3 sites

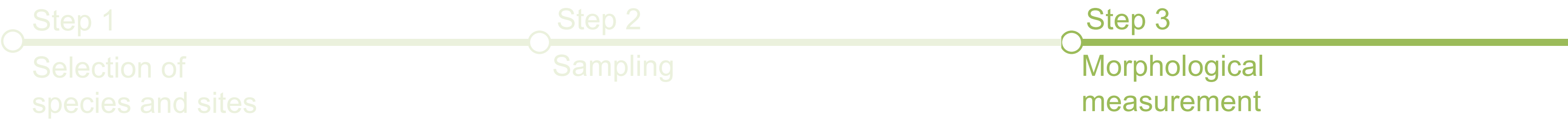
Espèces sélectionnées	Sites retenus cultivant les espèces	Légende	
P. aureosulcata	Plantation Oprins	S1	S1a S1b
	Plantation Nekto	S2	
P. Edulis (Moso)	Plantation Degallaix	S3	
	Plantation Nekto	S2	

Agronomic Validation : First results



S1a	S1b
Variety: <i>P. aureosulcata</i> 'Aureocaulis' Age: 14 years Purpose: Ornamental arboretum Location: 51°20'55"N 4°49'39"E Soil : sandy 	Variety: <i>P. aureosulcata</i> 'Alata' Age: 12 years Purpose: Experimental plot research Location: 51°20'55"N 4°48'01"E Solil: sandy 
Stem diameter distribution -S1a 	Stem diameter distributionS1b 

Agronomic Validation : First results

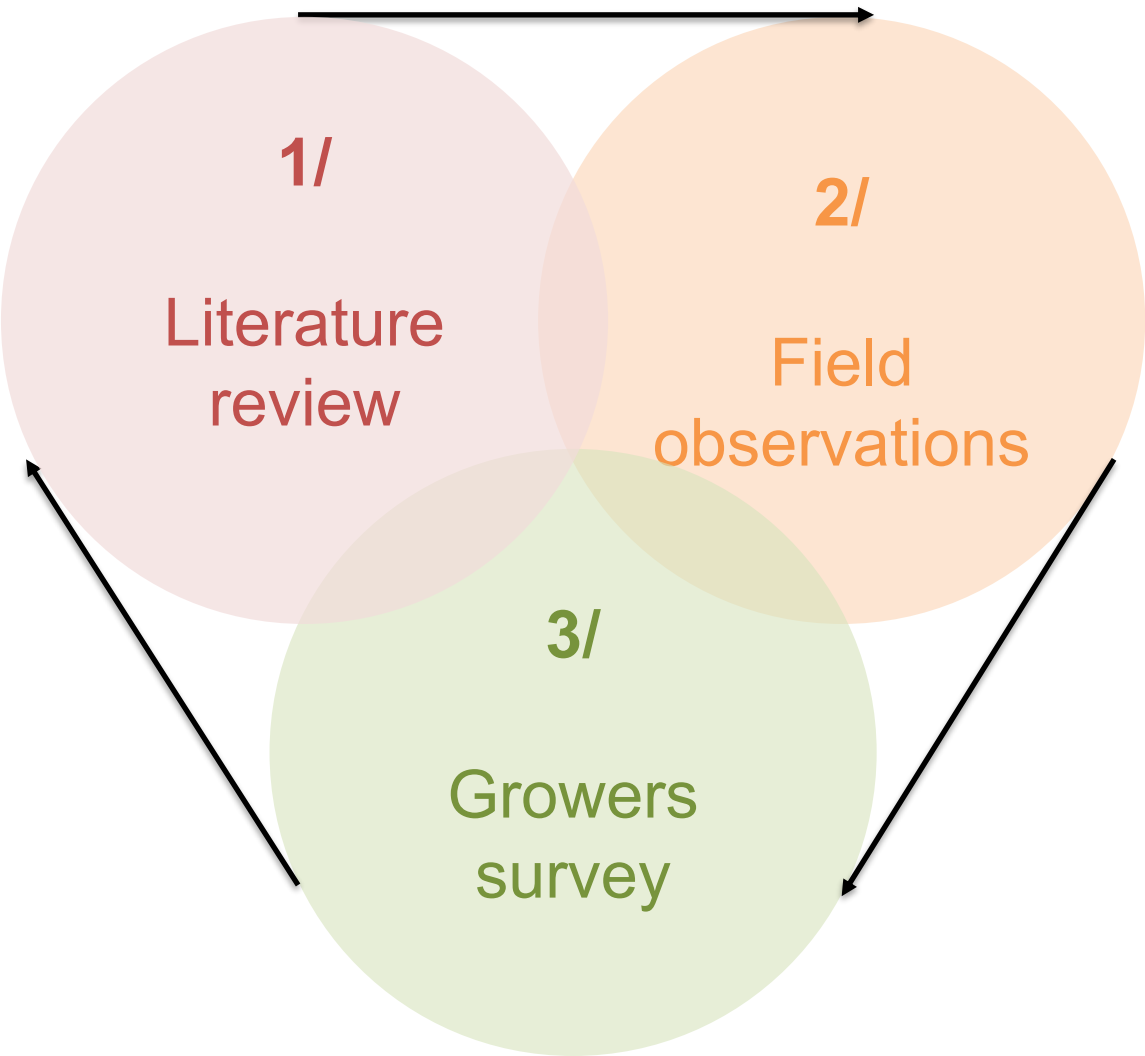


	Study (Shi et al., 2020)	S1a - Arboretum	S1b - experimental plot
Total height [m]	Up to 9	Up to 9,3 (Average = 7,2)	Up to 7,5 (Average = 7)
DBH (Diameter at Breast Height) [cm]	Up to 4	Up to 5,4 (Average = 3,4)	Up to 3,5 (Average = 2,6)
Internode length [cm]	Up to 39	Up to 41,5 (Average = 33,9)	Up to 42 (Average = 33,8)

→ Belgian bamboo can reach dimensions comparable to those reported in the literature

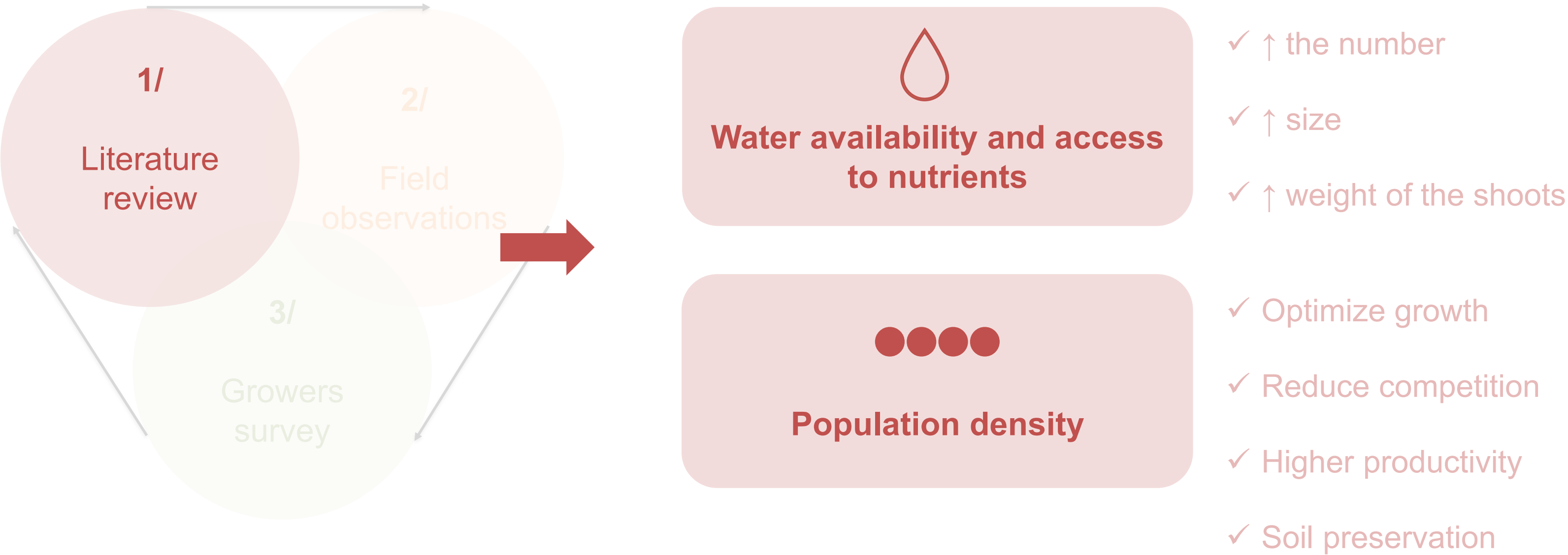
Agronomic Validation : First results

Hypotheses about the differences in diameter between the sites



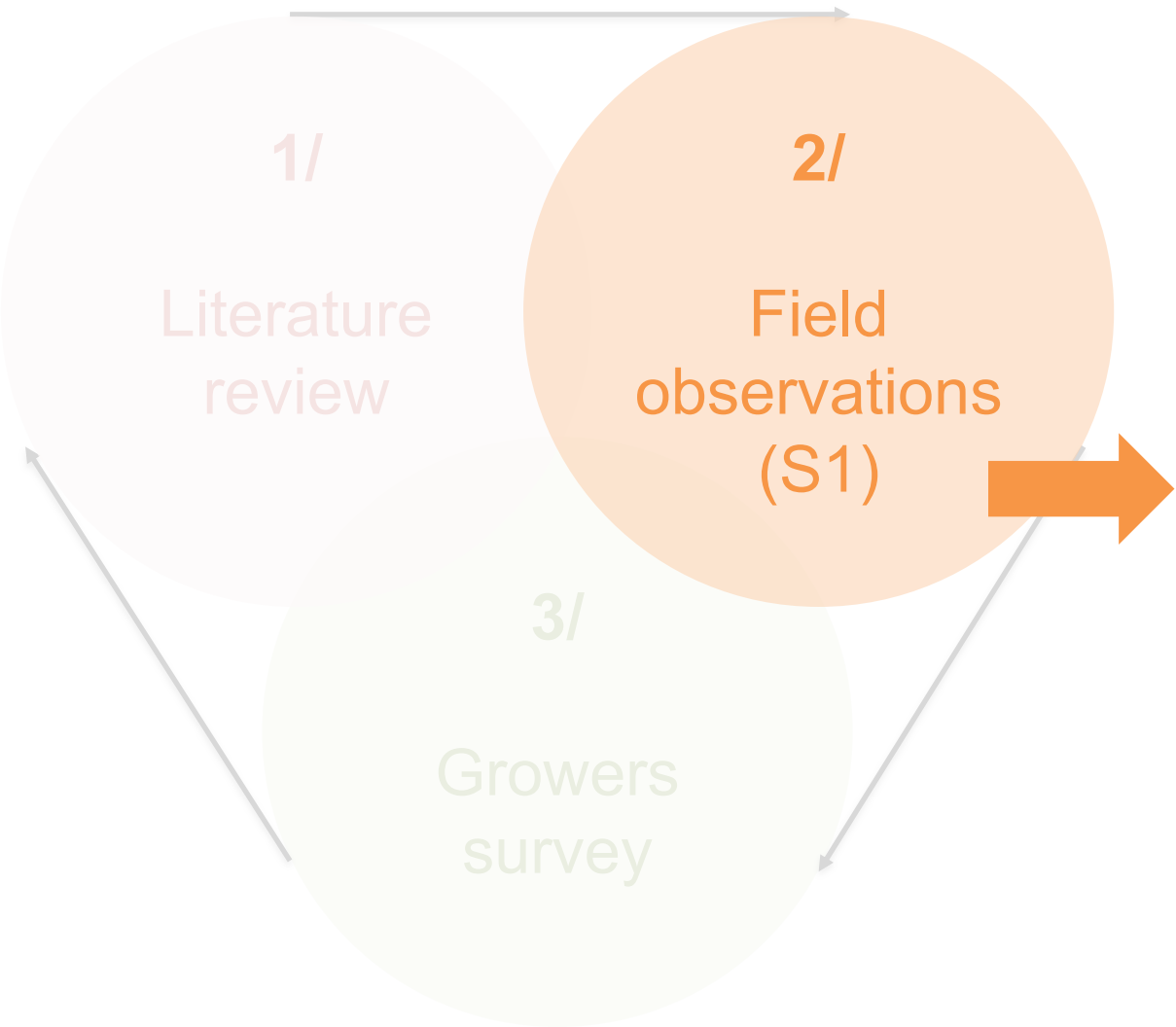
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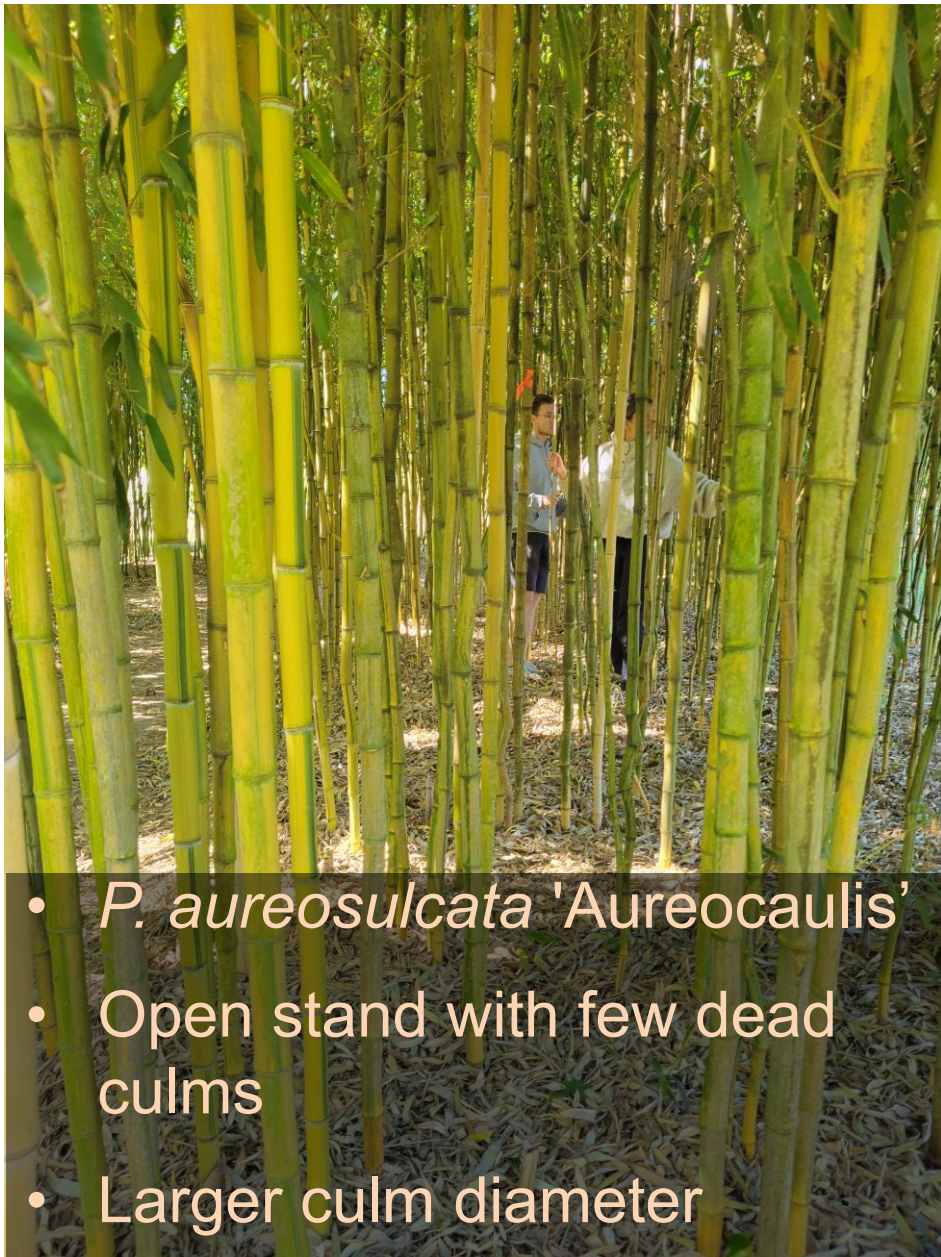


Agronomic Validation : First results

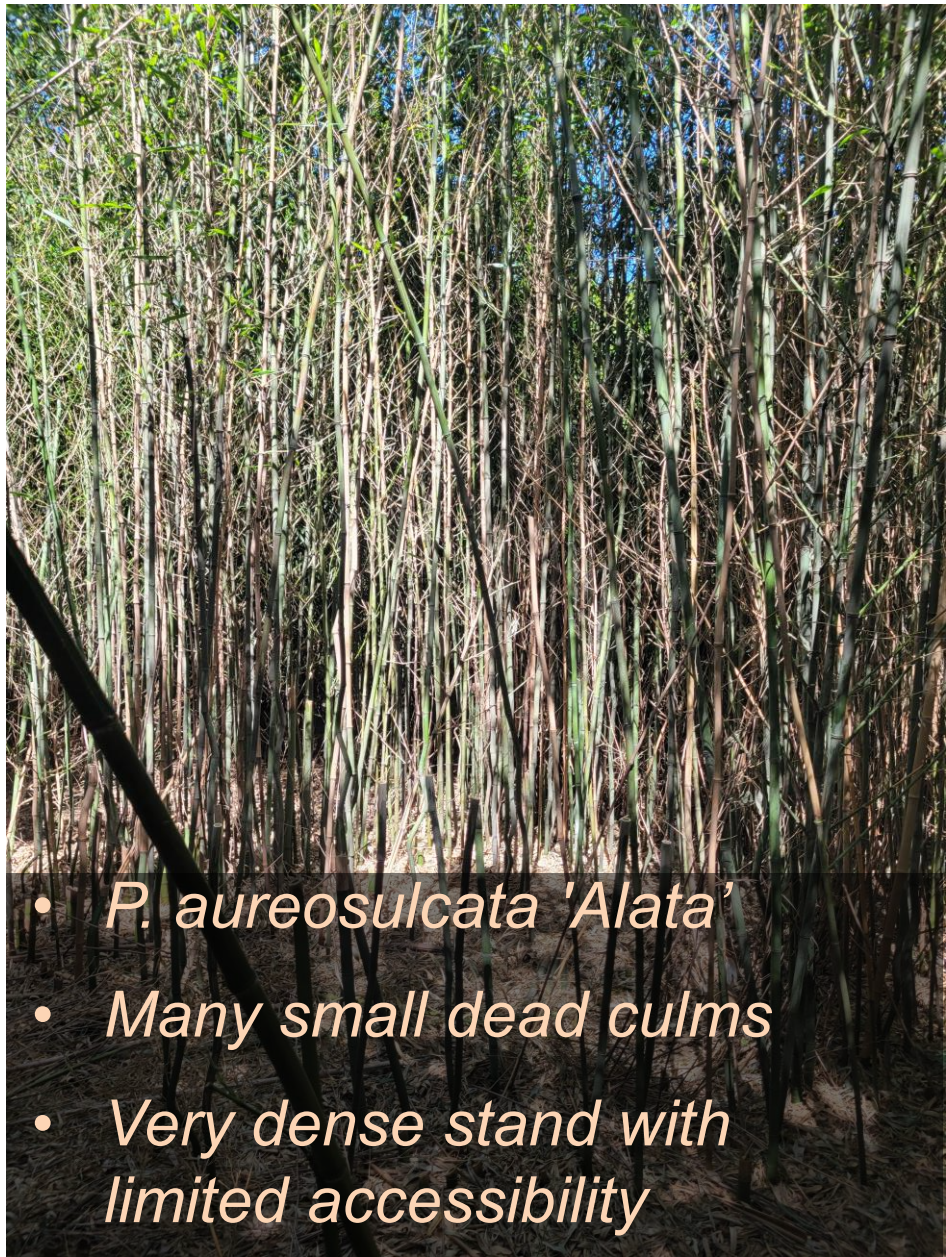
Hypotheses about the differences in diameter between the sites



S1a - Arboretum

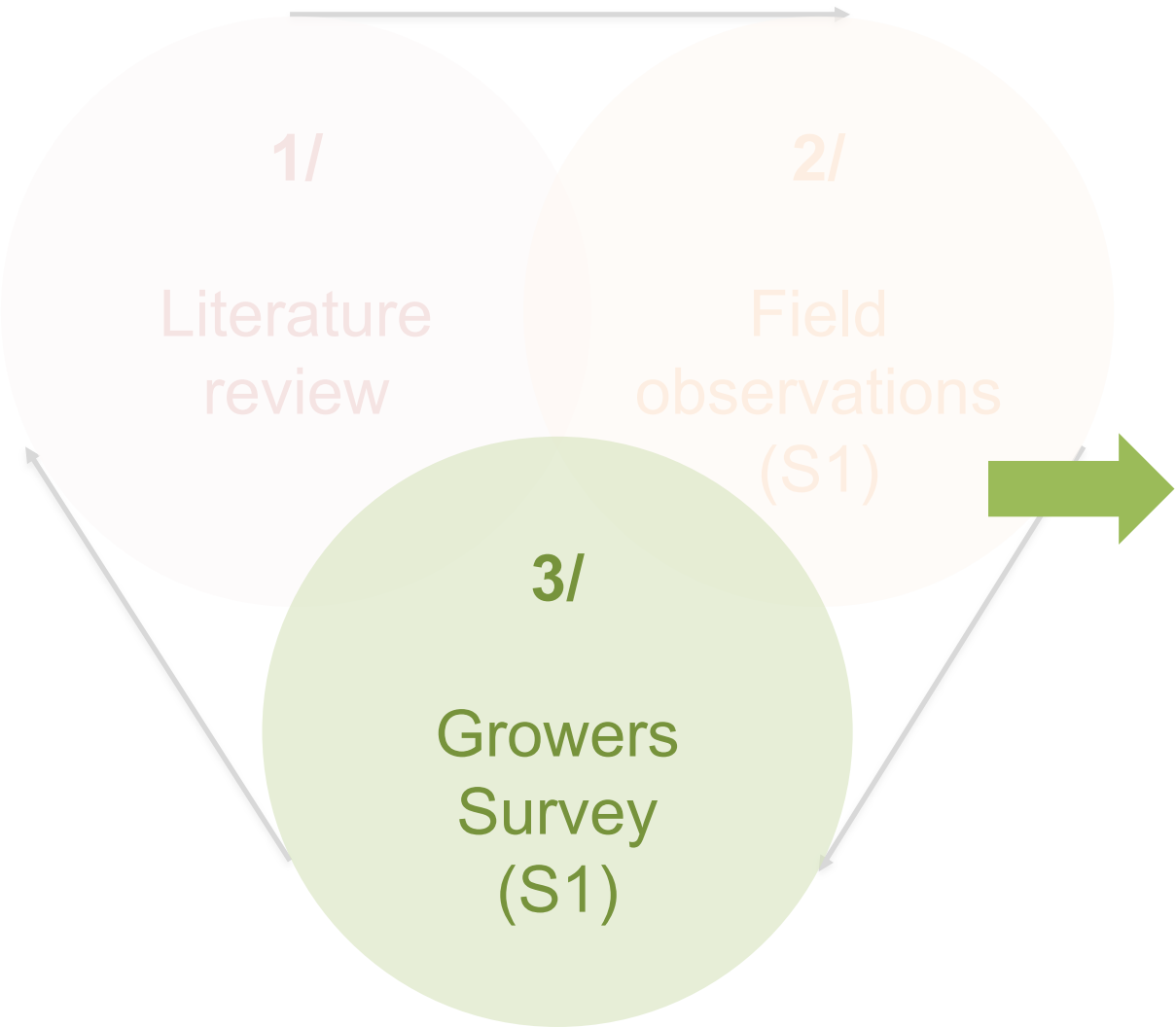


S1b – Experimental plot

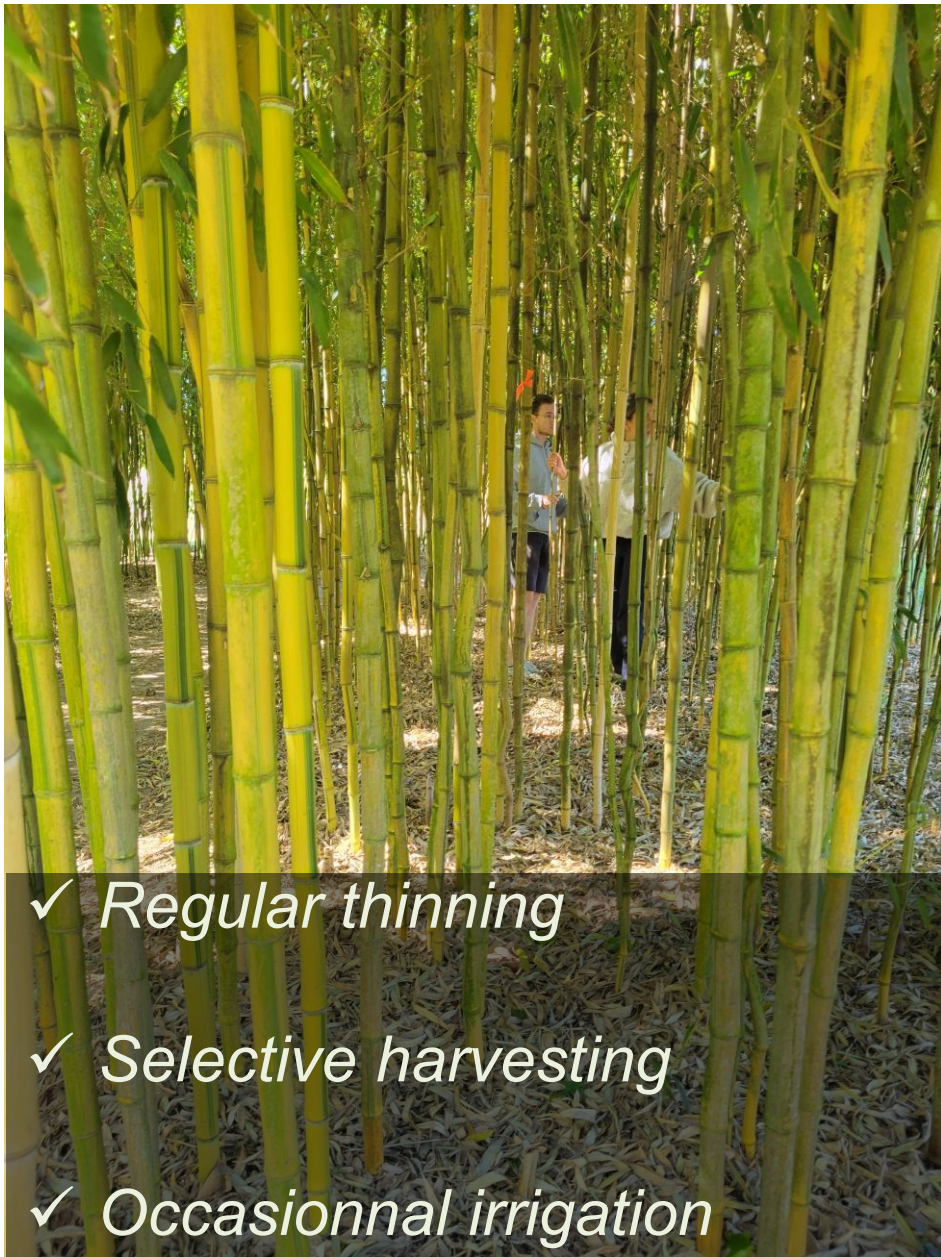


Agronomic Validation : First results

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S1a - Arboretum

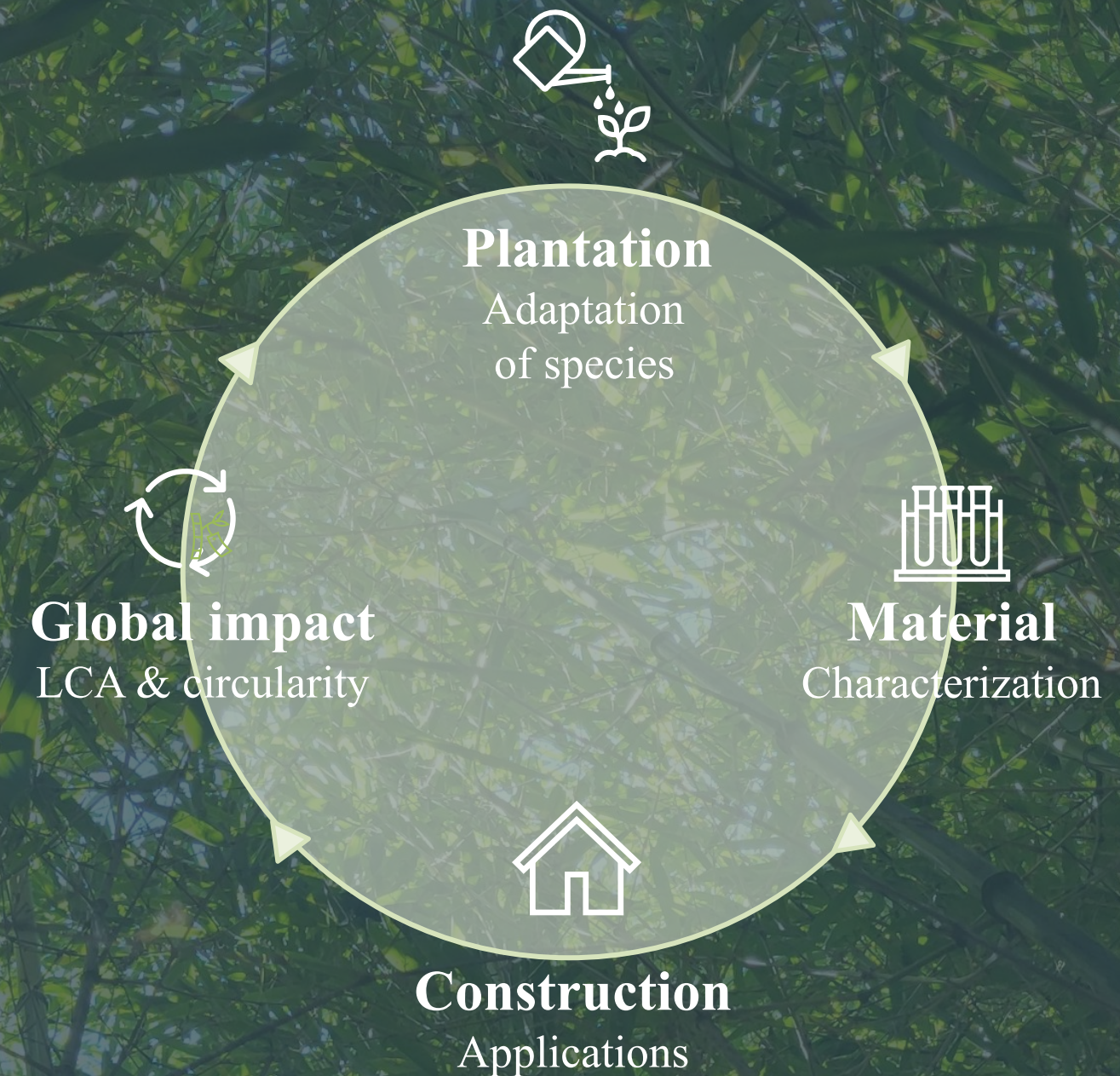


S1b – Experimental plot



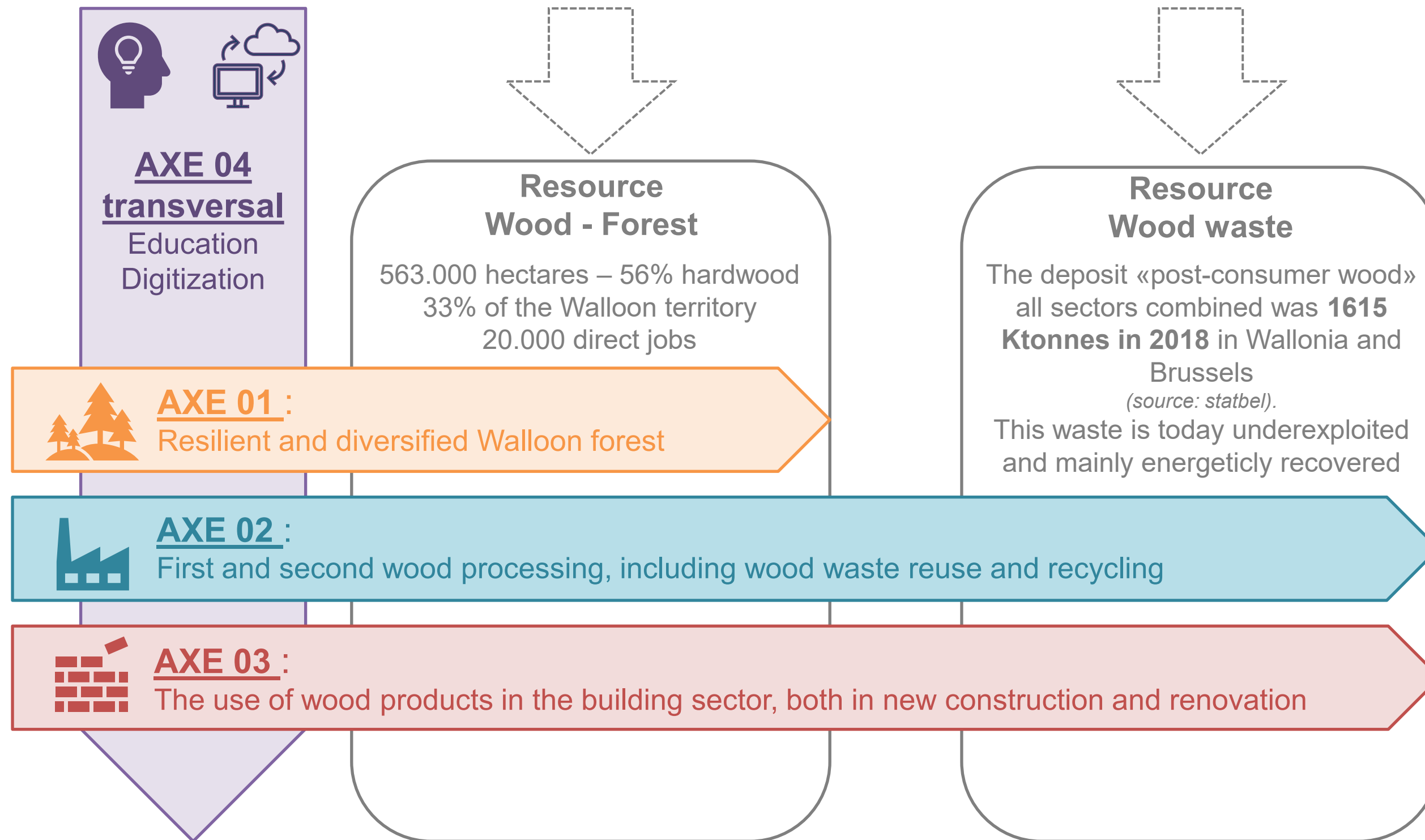
Conclusion

- ✓ Bamboo shows **promising adaptation**
- ✓ **Management practices** may be as important as climate in determining
- ✓ Developing local bio-based materials requires considering the **entire value chain**, from plantation to building



IIS VALBOWAL

Development of a complete value chain supporting the local, sustainable and circular use of forest and wood products in Wallonia





Thank you for your attention

Let's keep in touch !

Linkedin



My publications



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Tom De Mil - Tom.DeMil@uliege.be

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