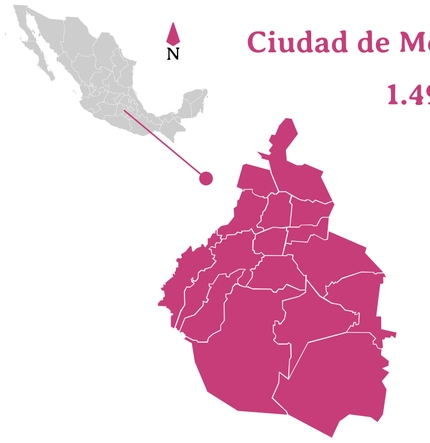
Territory Map

CDMX — Nopal

Politecnico di Torino



Ciudad de México

1.494,3 km²

16 Districts 1.812 Colonies

9.209.944 inhabitants

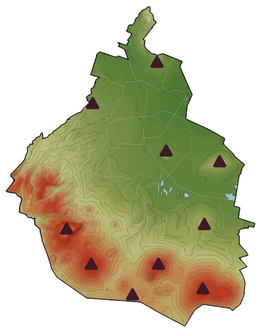
35y average age

6.163,3 in/km²

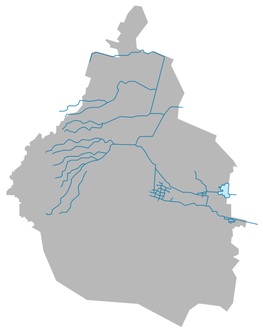
57 Indigenous languages

52,2% 47,8%

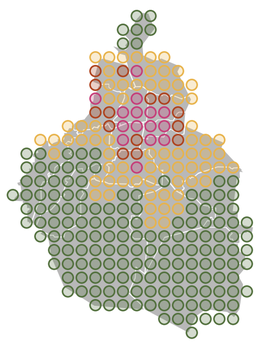
Morphology



Hidrography

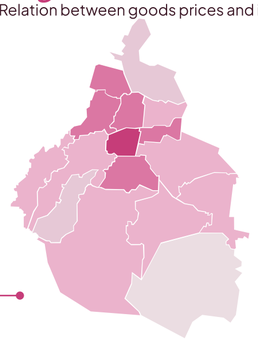


Pollutants - PM 2.5, PM 10, SO2

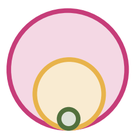


Engels Index

Relation between goods prices and incomes



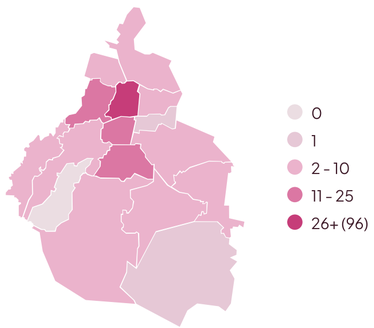
Productive sectors



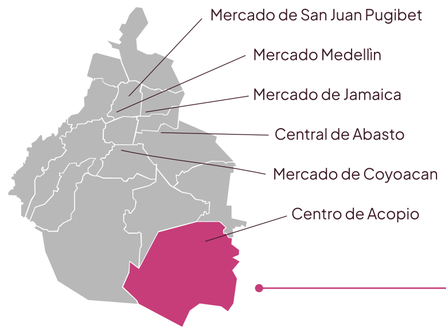
4.669.730 Millions MXN

CDMX GDP

197 Museums located in CDMX



Places of interest of Agriculture



Agriculture

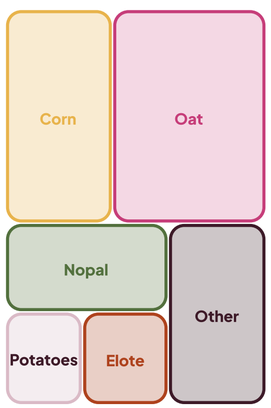
People involved

16%

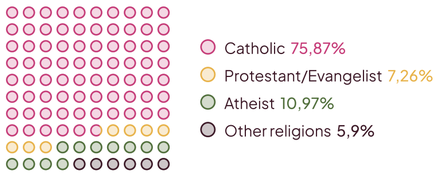
84%

14.771,88 ha

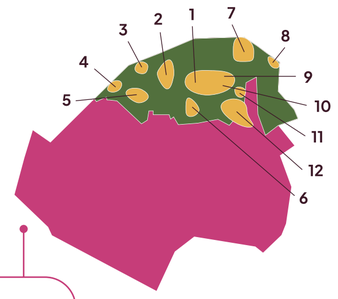
cultivated surface in CDMX



Religions



Cultivation surfaces - Milpa Alta



- Urban Areas
- Cultivated Areas
- Forests and Vegetation

1 Villa Milpa Alta
2 San Pedro Atocpan
3 San Bartolomé Xicomulco
4 San Salvador Cuauhtenco
5 San Pablo Oztotepec
6 San Lorenzo Tlacoyucan
7 San Antonio Tecòmitl
8 San Agustìn Ohtenco
9 San Francisco Tecoxpa
10 San Jerònimo Miacatlàn
11 San Juan Tepenàhuac
12 Santa Ana Tlacotenco

Milpa Alta is the main producer of Nopal in CDMX

228,41 km²

12 Pueblos Originarios

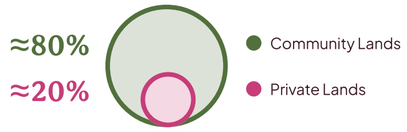
152.685 inhabitants

30y average age

511,9 in/km²

4% of population speaks indigenous languages in Milpa Alta

Milpa Alta - Cultivated areas



Main Nopal Events



Feria del Nopal



Nopalera en el corazòn

Nopal in the Escudo Mexicano



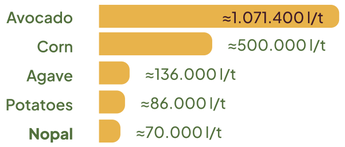


The mith of the foundation of Tenochtitlan (now Mexico City)

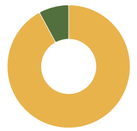
Nopal species



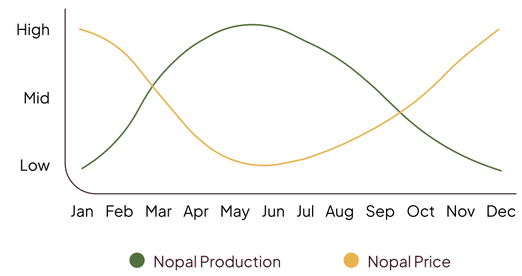
Water consumption



Nopal Production in America

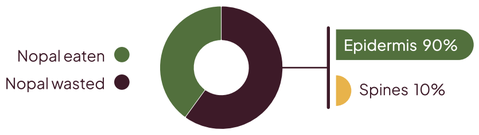


Nopal prices and level of production



Nopal Waste

~40.000 t of Nopal yearly waste produced in Milpa Alta



Main Nopal Stakeholders in Mexico

Instituto Politécnico Nacional

RED IIINOCA

DELEGACIÓN MILPA ALTA

Gobierno de México

MORELOS PODER EJECUTIVO

Challenges and Opportunities

Politecnico di Torino

Description

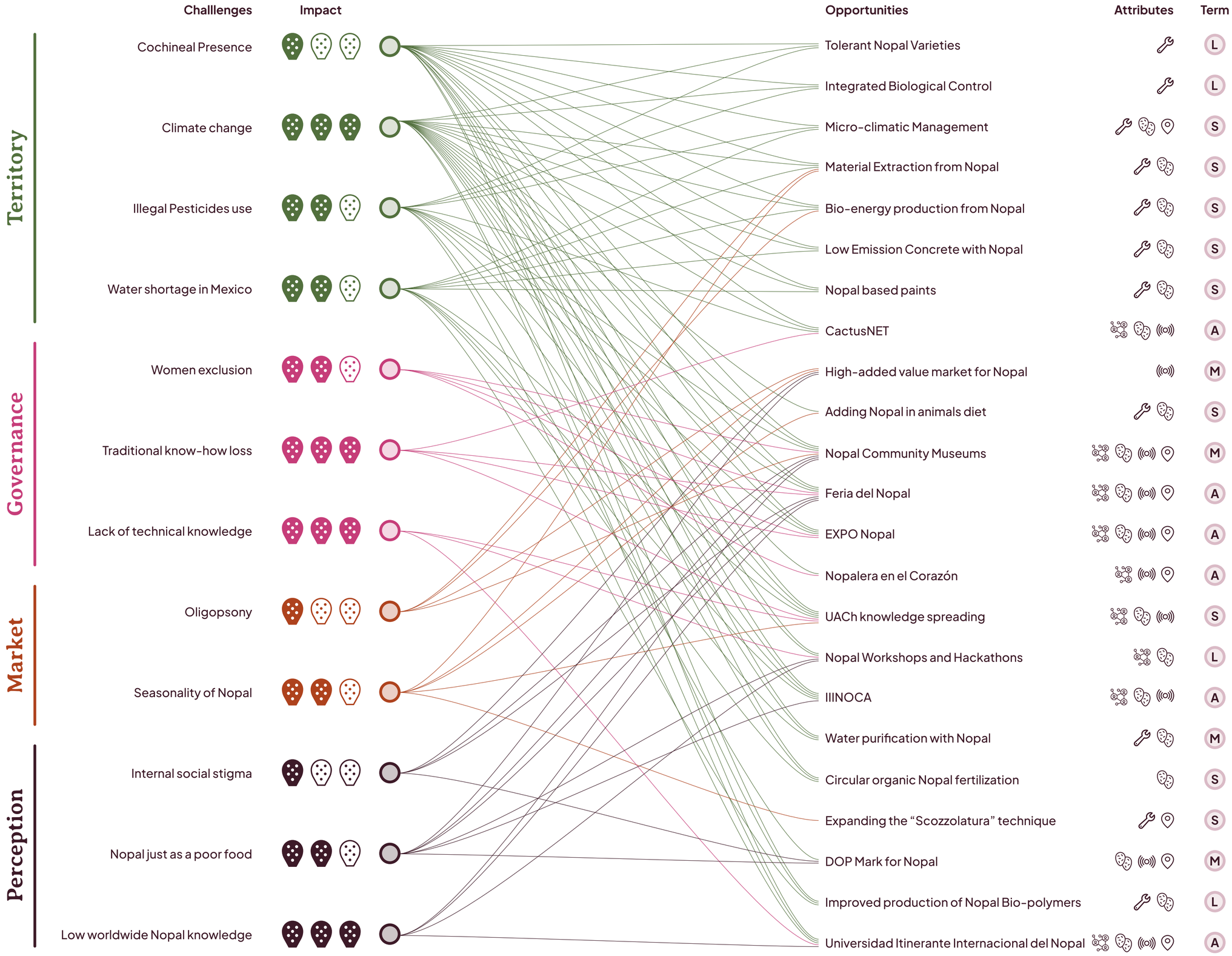
The Challenges and Opportunities map translates the critical points identified in the Holistic Diagnosis into a structured field of possible interventions. Fifteen documented challenges are grouped into four systemic categories, each challenge is linked to one or more opportunities. These opportunities, already active initiatives within the nopal ecosystem or original interventions proposed by already existent studies or this thesis, first among them the Ruta del Nopal. This distinction between existing and proposed opportunities allows to build a communication strategy that extends real precedents rather than inventing solutions in isolation.

Legend

- A Active
- S Short Term
- M Mid Term
- L Long Term

Attributes

- Technological: to realize, analyze, improve or update a technology or a methodology.
- Community: grouping, activating, or connecting people and cultures for the creation or identification of networks.
- Development: human, social, or economic development from the application or acceptance of nopal as a resource.
- Communication: translate, spread, or exchange knowledge and narratives to align stakeholders, build awareness, and bridge systemic gaps between communities.
- Territory: to contextualize, adapt, or locate systemic solutions within specific environmental, spatial, geopolitical and social boundaries.



Challenges and Opportunities

Politecnico di Torino

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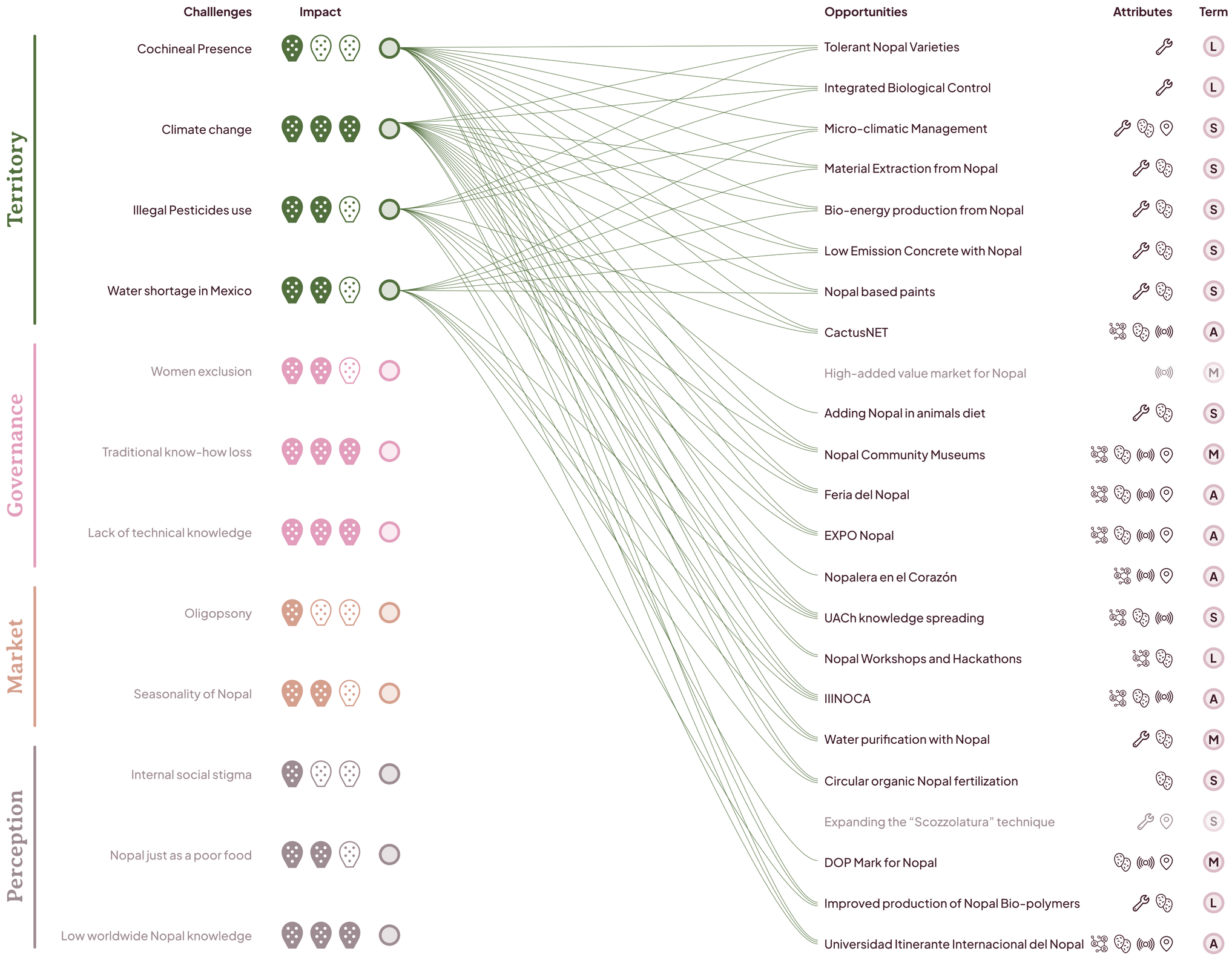
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	Challlenges	Impact
Territory	Cochineal Presence	
	Climate change	
	Illegal Pesticides use	
	Water shortage in Mexico	
Governance	Women exclusion	
	Traditional know-how loss	
	Lack of technical knowledge	
Market	Oligopsony	
	Seasonality of Nopal	
Perception	Internal social stigma	
	Nopal just as a poor food	
	Low worldwide Nopal knowledge	

Opportunities	Attributes	Term
Tolerant Nopal Varieties		L
Integrated Biological Control		L
Micro-climatic Management		S
Material Extraction from Nopal		S
Bio-energy production from Nopal		S
Low Emission Concrete with Nopal		S
Nopal based paints		S
CactusNET		A
High-added value market for Nopal		M
Adding Nopal in animals diet		S
Nopal Community Museums		M
Feria del Nopal		A
EXPO Nopal		A
Nopalera en el Corazón		A
UACh knowledge spreading		S
Nopal Workshops and Hackathons		L
IIINOCA		A
Water purification with Nopal		M
Circular organic Nopal fertilization		S
Expanding the “Scozzolatura” technique		S
DOP Mark for Nopal		M
Improved production of Nopal Bio-polymers		L
Universidad Itinerante Internacional del Nopal		A

Challenges and Opportunities

Politecnico di Torino

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Challenges and Opportunities

Politecnico di Torino

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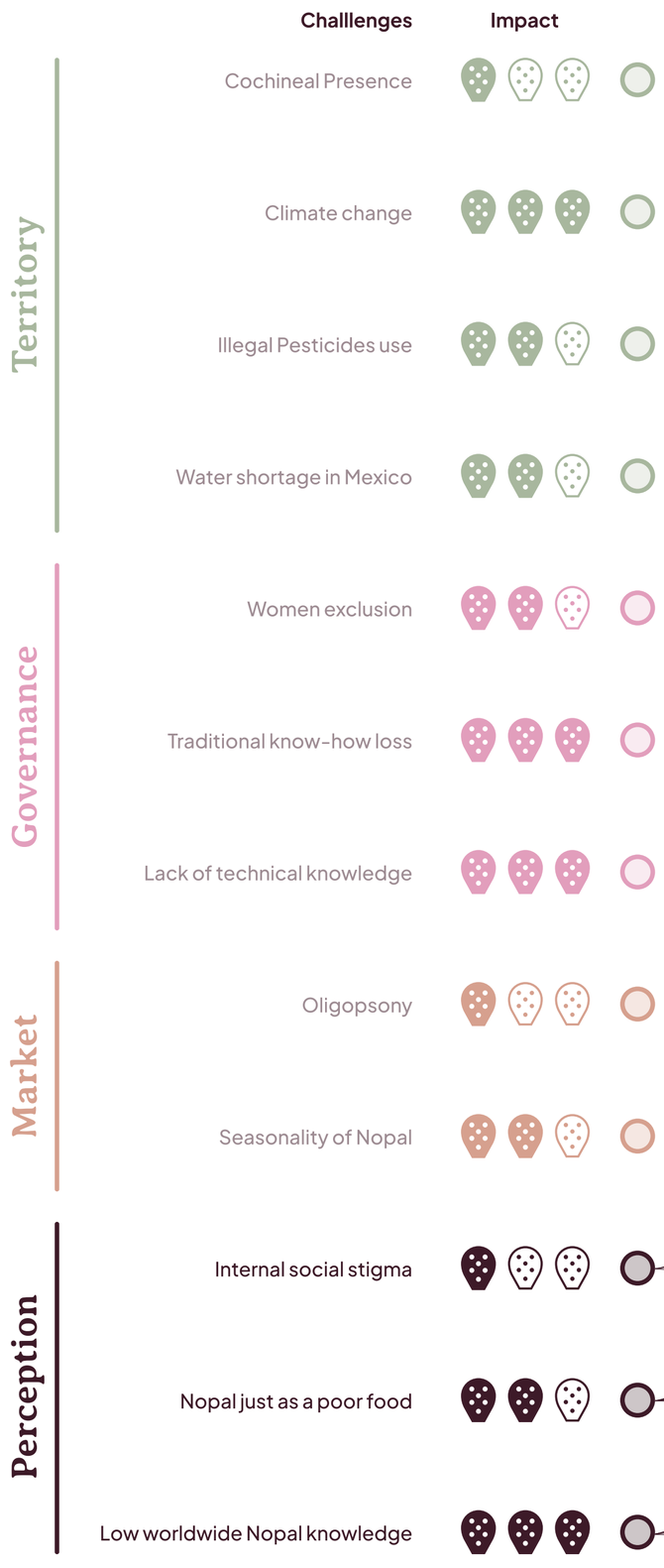
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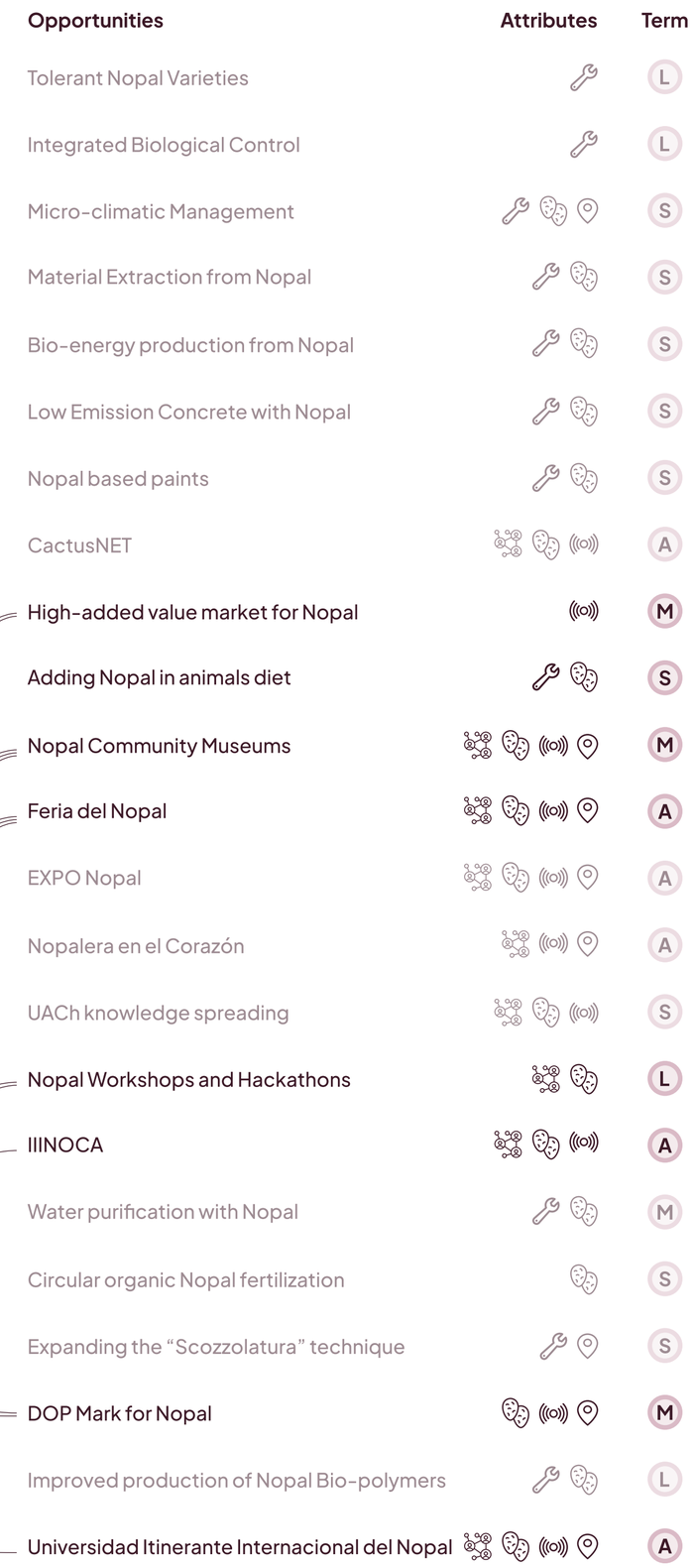
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System Map

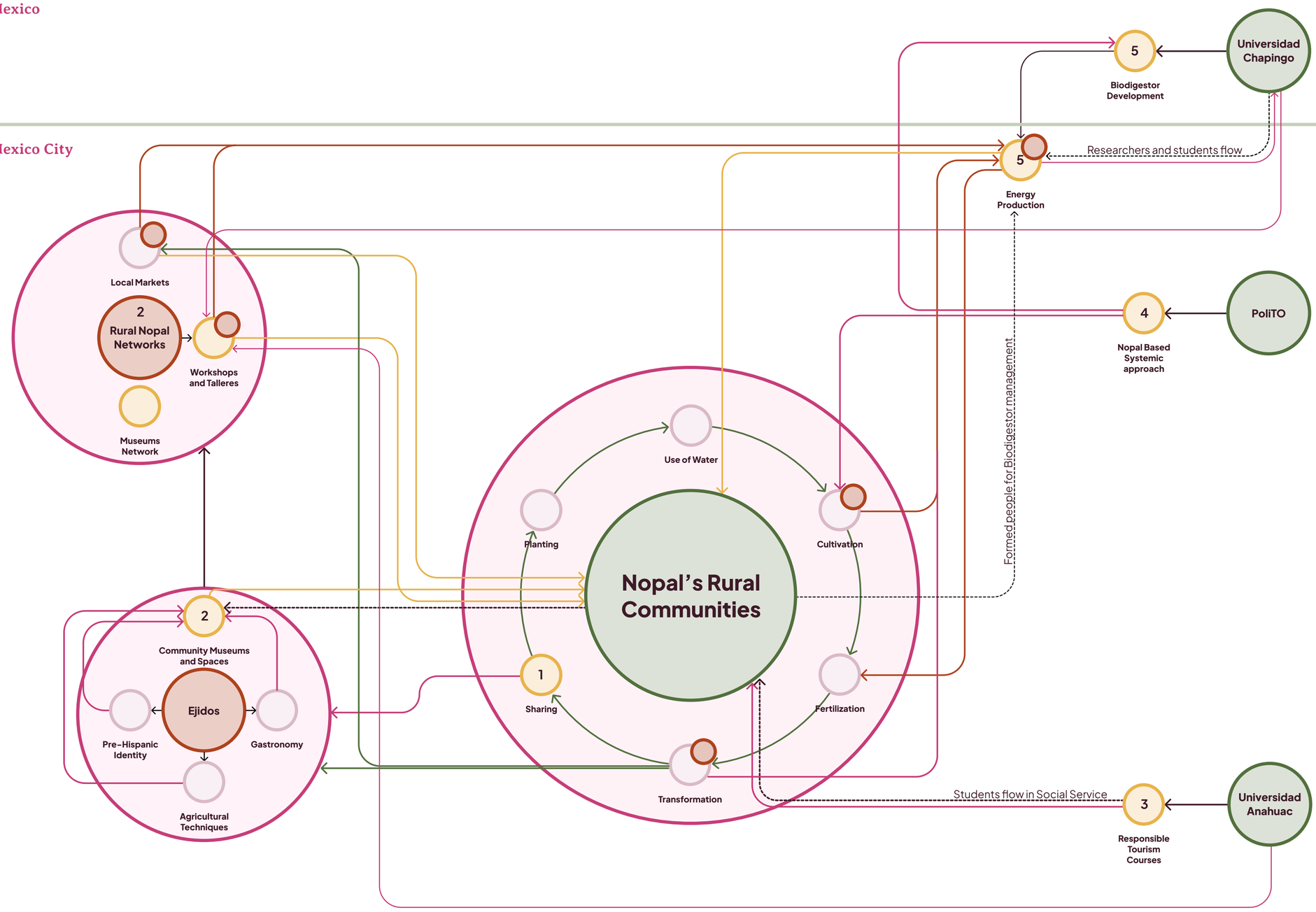
Politecnico di Torino

World

America

Mexico

Mexico City



Legend

- Project Core
- Partners & Stakeholders
- Places and Hosts
- Existent Phases
- Project Phases
- Nopal Waste

Connection
Knowledge Flow
Waste Flow
Economic Flow
People Flow
Resource Flow

Description

This System Map is based on the existance of a rural community which most important resource is Nopal. That is the rural community of Milpa Alta.

1. Sharing

To build the strenght of the community, people need to start sharing knowledge, techniques and resources as a real network: some rural communities built a real intranet to share digital data with a real closed circuit network.

2. Community and Network

In order to share, the Ejido (already a community space) becomes a space to build Network between rural families and farmers.
The thesis research has highlighted that other rural communities built community museums to preserve ancestral culture and techniques, enhancing the economical situation in rural areas and getting a higher social relevance. Later, building a network between community museums will lead to the creation of a cultural path allowing people to know more about Nopal, thanks to nopal based workshops and giving farmers a new income with local markets.

3. Responsible Tourism Course

An Italian case study (AITR - Associazione Italiana Turismo Responsabile) showed how a responsible tourism enhance the added value of the resources from rural areas and allows them to be part of a turistic path without compromise nature and ancestral knowledge.

4. Nopal Based Systemic Approach

Systemic Design allows to build a system for rural areas where waste and by-products becomes resources. Nopal can be used as a stable fertilizant after the biogas porduction.

5. Energy Production

The development of a Biodigestor usable in rural context and by farmers allows rural communities to be less conditioned by economical crisis. The Project will be executed by UACh in collaboration with PoliTO and U.Anahuac.

Roadmap

Politecnico di Torino

Opportunities

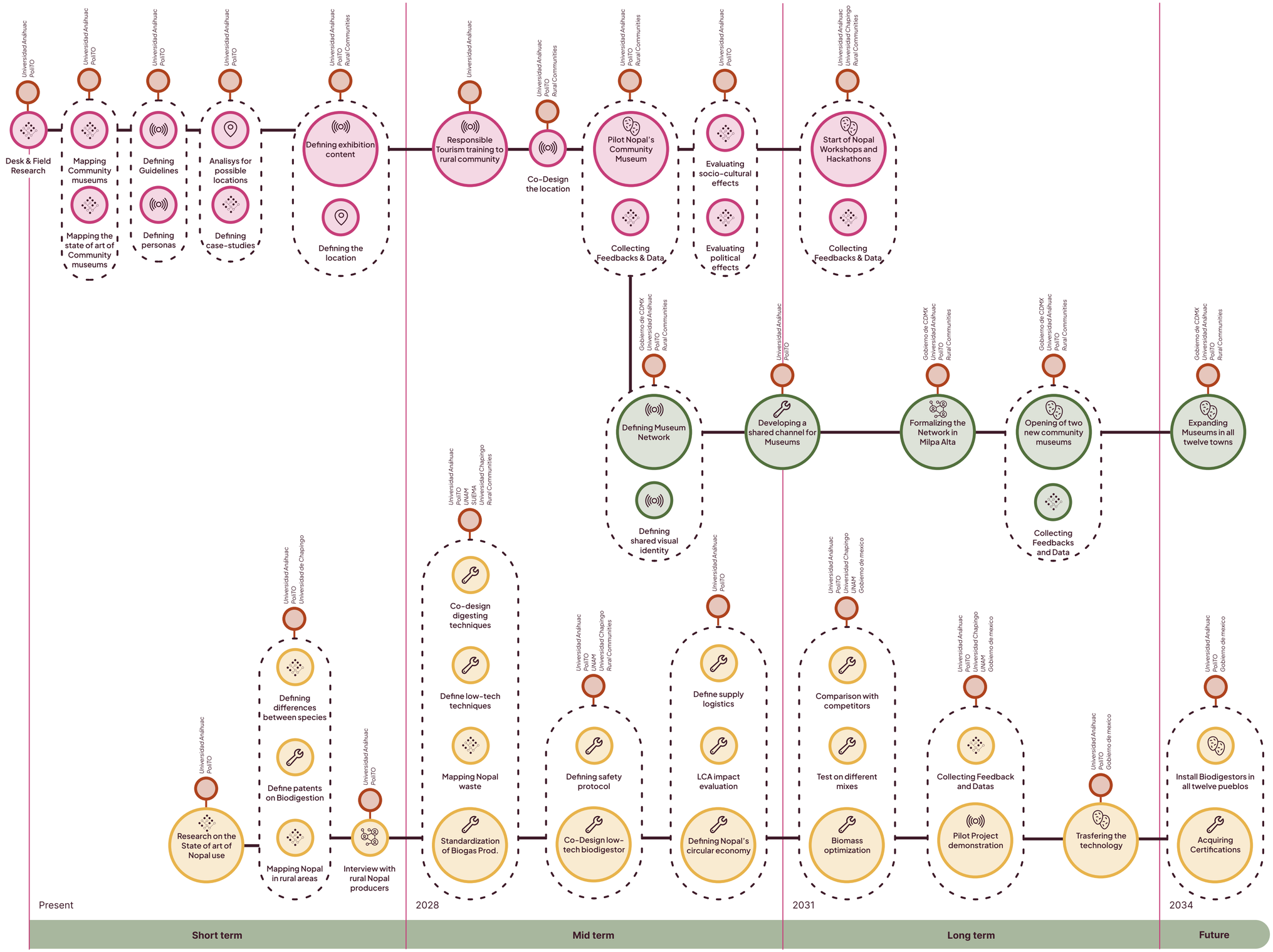
- Nopal Community Museum
- Network of Nopal Museums
- Nopal Biodigestor for energy prod.

Legend

- Primary Action
- Secondary Action
- **Groups of actions** (To make at the same time)
- Stakeholder

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- Mapping: collect, visually represent, or analyze spatial and quantitative data regarding material flows, resources, waste volumes, and system boundaries.
- Territory: to contextualize, adapt, or locate systemic solutions within specific environmental, spatial, geopolitical and social boundaries.



Nopal Production

Politecnico di Torino

Planting

1 Cutting Nopal pad

2 Artificial Planting

2 Natural dispersion

Cultivating

3 Fertilization & irrigation

4 Use of pesticides

5 Plant height control (Pruning)

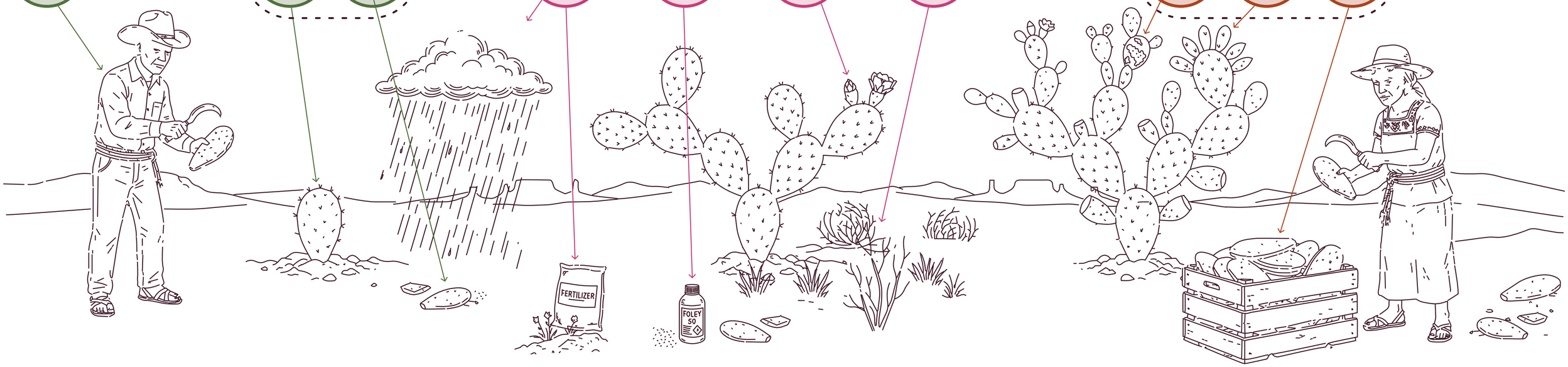
6 Weed Control

Harvesting

7 Collecting cochineal

7 Collecting Tunas

7 Collecting Nopal Pads



Description

The Production Map shows a short sequence of actions necessarily to the planting, growing and harvesting of Nopal.
Later shows the potential uses of Nopal, with the procedure to obtain the extracted materials from the plant.
As showed in the map, the procedures for the material extraction in most cases doesn't require heavy or complex machinery, making Nopal based materials a good and reliable option in low-tech applications.

Legend

Alternative Processes: Identifies a branching node where system pathways or operations are mutually exclusive alternatives.

S Simple action: the action or the process **doesn't require** complex or heavy machinery.

C Complex action: the action or the process **requires** complex or heavy machinery.

C S Both present: the action or the process is strictly **related with quantities** of material to transform.

N Nopal Mark: It is possibile to use the raw Nopal Biomass for the application

Transformation

Nopal Pads

- S Cleaning → S Cutting → S Maceration → S Filtration → S Pressing → Mucilage
- S Cleaning → S Cooking → S Pouring → Nopal Extract
- S Cleaning → S Drying → C Grinding → S Sifting → Nopal Flour
- S Cleaning → S Maceration → C Filtration → S Pressing → Lignocellulosic Fibers
- S Cleaning → S Spines Drying → C Sifting → C Delignification → C Grinding → Cellulose Nanoparticles
- S Cleaning → S Insect sacrifice → S Drying → S Pressing → Natural Cochineal Pigments

Tuna

- S Cleaning → S Juice Extraction → S Filtration → S Concentration → S Incapsulating → S Drying → Natural Tuna Pigments
- S Cleaning → S Seed choice → S Cleaning → S Drying → S Pressing → S Filtration → Tuna Seed Oil

Material

Mucilage
Nopal Extract
Nopal Flour
Lignocellulosic Fibers
Cellulose Nanoparticles
Natural Cochineal Pigments
Natural Tuna Pigments
Tuna Seed Oil

Use

- Medicine & Cosmetics
- Buildings & Concrete
- Bio-Polymers
- Water Filtration
- Energy Production N
- Cultural Heritage
- Gastronomy N
- Fashion & Clothes