



# Overcoming Barriers to Valorizing Legume Ecosystem Services

## Authors:

Rui S. Oliveira  
Alexandros Tataridas  
Irene Katsaros  
Maria Celeste Dias  
Helena Freitas

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# Executive Summary

Legumes are central to agroecological transitions. Their ability to fix atmospheric nitrogen, enhance biodiversity, and improve soil health makes them vital for sustainable farming. Yet, despite well-documented benefits, legume-based cropping systems remain underused globally. This white paper explores the agronomic, economic, institutional, and cultural barriers limiting the recognition and widespread exploitation of ecosystem services provided by legumes and outlines strategic recommendations to unlock their full potential.

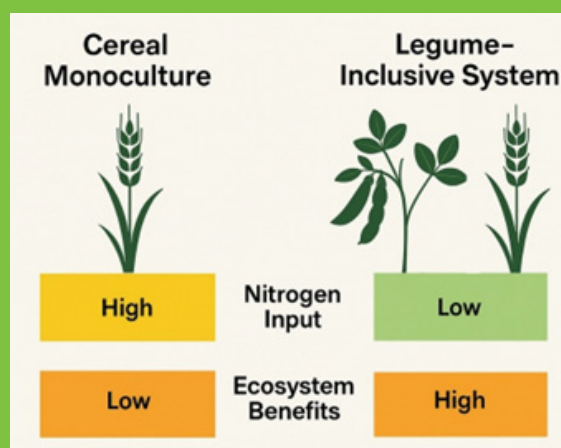
## 1. Introduction

Legumes such as beans, peas, and lentils offer multifunctional ecosystem services crucial for resilient agriculture. Beyond nitrogen fixation, these crops contribute to water regulation, conservation, and climate adaptation. However, uptake among farmers remains low. The reasons are multifaceted, ranging from scientific knowledge gaps to economic and cultural constraints. Bridging these divides requires an integrated strategy involving participatory research, policy reforms, and supply chain innovations.

## 2. Scientific Gaps and Agronomic Constraints

### Knowledge fragmentation

Most existing research on legumes emphasizes short-term productivity outcomes, particularly nitrogen fixation and yield gains in cereal rotations. However, broader ecosystem services such as water conservation during droughts, pest and disease regulation, and long-term improvements in soil structure are understudied (Figure 1). Even when these benefits are acknowledged, variability in environmental conditions and farming practices make them difficult to quantify at the landscape scale.



**Figure 1.** Comparison of nitrogen input and ecosystem benefits between cereal monocultures and legume-inclusive systems. Legumes reduce nitrogen dependency while enhancing broader ecological functions.

## Limited breeding and management tools

The lack of targeted breeding programs for legumes hinders their performance in diverse agroecosystems. Unlike cereals, many legume species are poorly adapted to modern agronomic demands. Challenges in synchronizing growth cycles in inter-crops, managing nutrient competition, and handling pests and diseases are major concerns for farmers.



## 3 Economic and Market Disincentives

### Financial barriers for farmers

Farmers frequently face higher upfront costs when adopting legume-based systems due to specialized seed needs, modified machinery, and training requirements. Legume yields are also less stable compared to conventional grains, making them less attractive to risk-averse growers. This is particularly problematic for smallholders who cannot afford experimental transitions.

### Inadequate valuation of ecosystem services

Though legumes reduce reliance on fertilizers and enhance agroecosystems health, these services are barely monetized. Market incentives overwhelmingly reward yield rather than sustainability, making it financially unrewarding to prioritize legume-based diversification. Efforts to internalize these ecosystem services into payment systems (e.g., carbon markets, biodiversity-nature credits) are still nascent and fragmented.

## 4 Institutional and Policy Barriers

### Policy misalignment

Despite recent reforms, agricultural policy frameworks such as the EU's Common Agricultural Policy (CAP) continue to favor monocultures and cereal-dominated systems. There is insufficient support for intercropping, crop diversification, or transitioning to legume-rich rotations. Moreover, agri-environmental schemes often overlook the multifunctionality of legumes.

### Weak value chains

A major bottleneck lies in the underdeveloped infrastructure for legume processing and distribution. Farmers lack access to reliable markets, storage facilities, and processing units tailored to legumes. In mixed cropping systems, technical hurdles such as harvesting and separating different crops further raise operational costs.

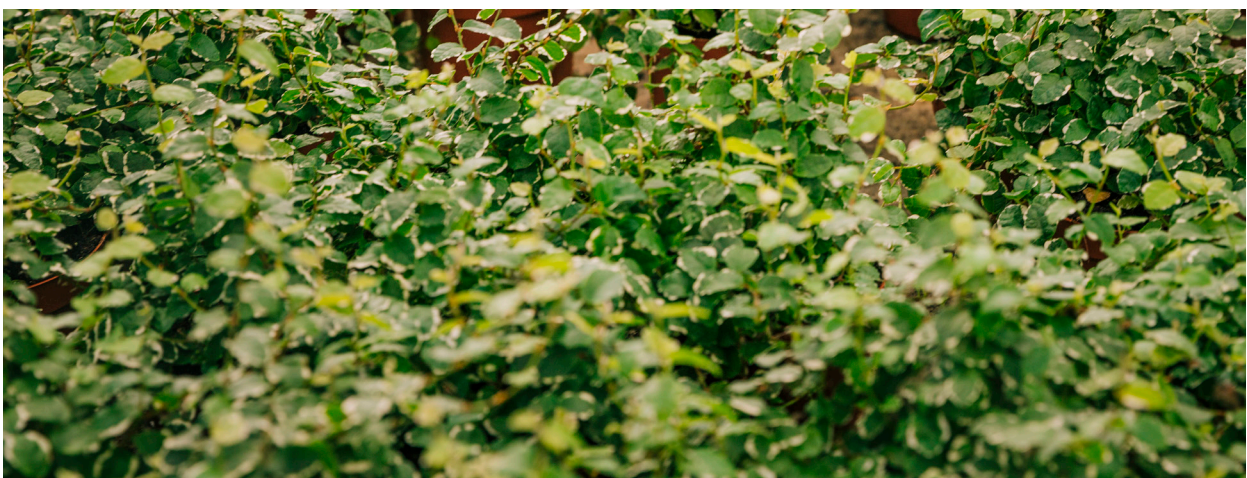
## 5 Cultural Resistance and Social Barriers

### Farmer reluctance

Adopting legumes often requires a shift in mindset, away from high-input, yield-maximizing systems to more regenerative models. Many farmers are unfamiliar with managing legumes or distrustful of their profitability, especially when institutional support is lacking.

### Consumer preferences

Consumer demand for legume-based foods remains modest in many regions, driven by dietary habits and limited awareness of their environmental benefits. This affects market development, which in turn feeds back into farmer hesitancy.



# 6



## Strategic Recommendations

Actions	Examples
Promote transdisciplinary research	Fund long-term, multi-scalar studies capturing the ecological and economic benefits of legumes. Support plant breeding programs focused on resilience traits, such as drought tolerance and pest resistance.
Revise policy incentives	Integrate legume-inclusive practices into subsidy schemes and agri-environmental payments. Recognize ecosystem services (e.g., carbon sequestration, biodiversity, soil health) in agricultural reward systems.
Strengthen extension services	Develop tailored agronomic guidelines and toolkits for diverse legume systems. Facilitate peer-to-peer learning and demonstration farms.
Invest in value chain infrastructure	Support cooperatives and SMEs to develop local processing and storage solutions. Create public-private partnerships to boost marketing and branding of legume-based products.
Raise consumer awareness	Promote dietary shifts toward legumes through public campaigns. Highlight environmental and health benefits on product labeling.

# Conclusion

Legumes can transform agricultural landscapes by enhancing ecological sustainability, reducing input dependency, and supporting food security. However, systemic barriers continue to prevent their full integration. To valorize their ecosystem services, we must move beyond short-term yield metrics and adopt a holistic approach that combines science, economics, policy, and cultural change. Doing so will not only benefit farmers but also safeguard ecosystems for future generations.



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