



Environmental Sustainability and Climate Resilience in Indian Agriculture

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Thiruvananthapuram | 16 February 2026

Indian agriculture: both vulnerable and consequential

Climate resilient agriculture

- Reduce vulnerabilities
- Adaptive capacity (crop shifts, irrigation, technology)
 - Lower yield volatility
 - Income stability
 - Ability to absorb shocks

Environmental Sustainability

- Protect resource production base
- Soil organic matter
- Groundwater balance
- Nutrient efficiency
- Biodiversity
- Significant source of methane & nitrous oxide

Issues

- We are asking farmers to do two things at once:
 - Survive climate shocks.
 - Reduce environmental damage.
- Interlinked with each other and with viability
 - Climate resilience without sustainability is short-lived.
 - Sustainability without farmer viability is impossible.
- Framed as private incentives for public goods. Can they be aligned?
 - What works? Technology+policy
 - At what scale? Differentiated ?
 - Who pays? Pay for itself, transfers?

Example 1: Low emissions rice experiments in Tamil Nadu (ongoing, TNAU Study, 2026)

Experimental plots

- Direct Seeded Rice
- Alternate Wetting and Drying
- PPFM (pink pigmented facultative methylotrophs)
- Soil nutrient management

No yield penalties

- **Challenges:**
 - Adoption at scale
 - Differentiated approach



Example 2: Drones (Belton et al. 2025)

Quiet revolution in India (in labour-constrained areas)

- Helps move from intensive input use to precision use

Potential yield increase and cost savings

Environmental and human health via lower chemical use, safe spraying

- **Challenges**

- Drift
- Possible increased use of chemicals
- Monocropping
- Employment effects

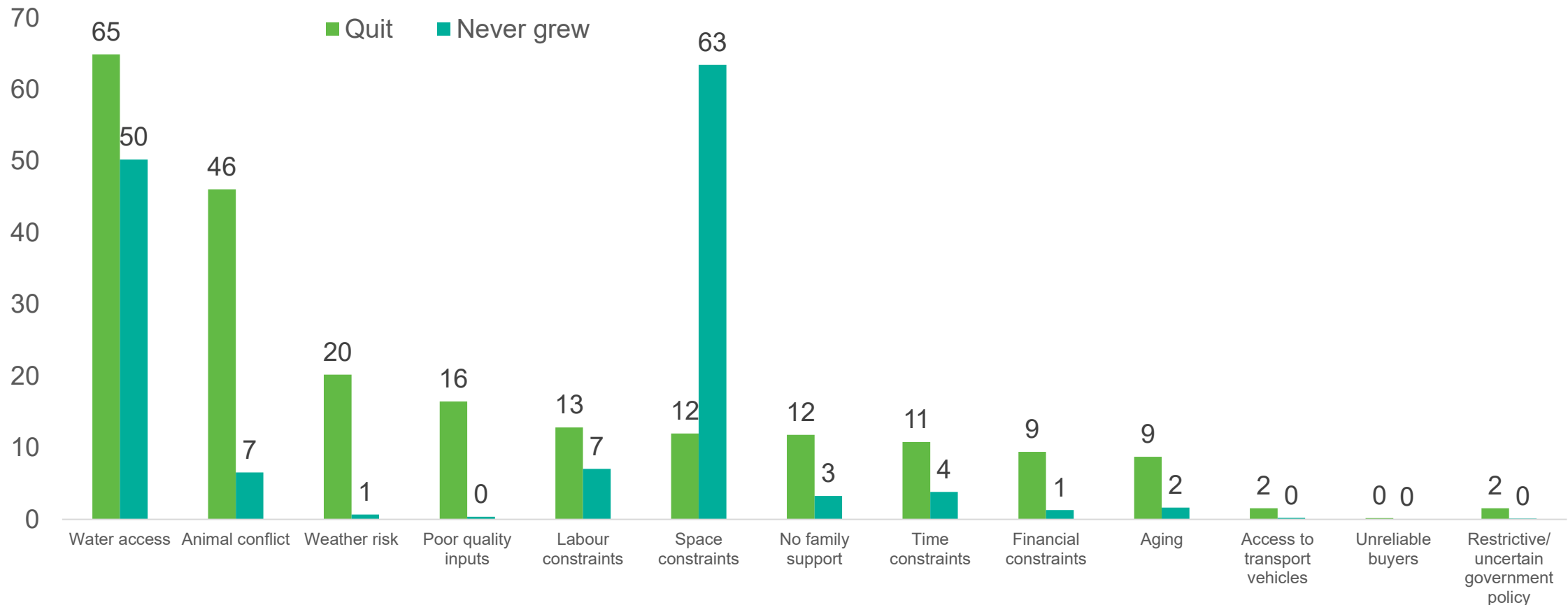


Example 3: Polyhouse based vegetable cultivation to address constraints

IFPRI Odisha INCATA Survey 2025

Access to water & land + wild animal conflict play a much larger role in preventing veg farming than market access

- 46% of who quit vegetables
- 26% of current vegetable farmers



Certification: Intended transformation via clusters

Contiguous cluster *ghers* (ponds)



Sustainability certification for shrimp (IFPRI study from Bangladesh, 2024)

- **Cluster interventions for group certification and traceability**
 - Aquaculture Stewardship Council (ASC)
- **Premise**
 - Switch way shrimp is farmed (environmentally responsible, food safety, etc.)
 - Certification can help access EU markets (gain higher-margin retail markets)
- **Challenges**
 - No perceptible yield or income differences
 - Some loss (with spillovers) on dietary and species diversity
 - Willingness to pay premium in EU markets is not *really* there