Secondary Data Analysis

Bio-input Systems and Indigenous Poultry in Telangana:

Evidence Base for Pilot Intervention

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Abstract

Smallholder agriculture in Telangana is characterised by severe agrochemical dependency and declining farm-system viability. This secondary data analysis synthesises evidence published in publicly verifiable sources to establish the scientific and policy rationale for two agroecological interventions proposed under the SCALAGRO project: community-managed Bio-input Resource Centres (BRCs) and indigenous backyard poultry systems. The analysis is structuredcovering context, problem diagnosis, government programmes and investment, enabling and constraining factors, evidence of utility, and programme design implications.

For bio-inputs, the evidence shows that Telangana's 5.94 million smallholder farmsof which 64.6% are marginalbear input costs of up to ₹ 13,050 per season on six acres, that pesticide use exceeds the national average by 112%, and that soil organic carbon is measurably declining under continuous chemical management (Anil Kumar et al., 2024; Manimekalai, 2025; Srinivasarao et al., 2014). The Andhra Pradesh Community-Managed Natural Farming (APCNF) programme provides causal evidence that community-managed natural farming more than doubles farmer economic profits while maintaining crop yields (Hussain et al., 2025; Newton et al., 2022). The National Mission on Natural Farming (NMNF), approved in November 2024 with a ₹ 2,481 crore outlay, has established 315 Bio-input Resource Centres and registered 61,125 farmers across 33 Telangana districts as of early 2025 (Press Information Bureau, 2024; Deccan Chronicle, 2025).

For indigenous poultry, the evidence shows that India's backyard poultry population grew 45.8% between 2012 and 2019, more than ten times the commercial sector's growth rate, signalling a grassroots revival that lacks systematic institutional support (Department of Animal Husbandry and Dairying, 2019; Rajkumar et al., 2021). Per-capita egg availability at 106 eggs per year is 41% below the nutritional recommendation of 180 eggs per year, and 57% of Indian women of reproductive age are anaemic (Vet Extension, 2025; National Family Health Survey-5, 2021). Documented programme outcomes in Telangana include a six-fold increase in household egg production following improved breed introduction at KVK Wyra, Khammam (KVK Wyra / Khammam, 2019), and ₹ 1 lakh household income for 1,000 tribal families in the adjacent state of Andhra Pradesh (WASSAN, 2025). The National Livestock Mission provides up to 80% financial assistance for women-managed Mother Units, directly subsidising the hub-and-spoke incubation model, which is also SCALAGRO's design (The Poultry Site, 2024).

CONTENTS

PART ONE

Bio-input Systems in Telangana

1. Background: Agrochemical Dependency and Soil Health in Telangana

This section establishes the agronomic and economic baseline for Telangana's smallholder farming system. Landholding fragmentation, fertiliser and pesticide intensity, and soil health trends are documented from primary statistical sources, providing the factual foundation for the problem analysis in Section 2.

1.1 Landholding Structure and Smallholder Dominance

Telangana's agricultural sector is structurally dominated by smallholder farmers. The state has approximately 5.94 million landholdings covering 14,756 thousand acres. Marginal farmers (fewer than 2.47 acres) account for 64.6% of all holdings, while small farmers (2.48-4.94 acres) account for a further 23.7% (Anil Kumar et al., 2024). Together, these two categories represent nearly 88% of Telangana's farming households. At this scale of operation, cost reduction and financial risk management are analytically more important to household welfare than yield maximisation. Any intervention for Telangana's smallholders must foreground economics as its primary mechanism for delivering benefits.

Farm Size Category	Threshold (acres)	Share of Holdings (%)	Share of Area Operated (%)
Marginal	< 2.47	64.6	28.6
Small	2.48 - 4.94	23.7	33.1
Semi-medium	4.95 - 9.88	9.5	24.6
Medium	9.89 - 24.7	2.1	11.5
Large	> 24.7	0.2	2.2
TOTAL	—	**100**	**100**

Table 1.1. Landholding distribution in Telangana by farm size category, Census of Land Holdings, 2015–2016. Source: Anil Kumar et al. (2024). *Nearly nine in ten farms are marginal or small. This structural reality makes input cost reduction the single most important lever for improving smallholder welfare in the SCALAGRO study region.*

1.2 Fertiliser Consumption: Scale and Imbalance

Total NPK consumption in Telangana rose from 0.24 million metric tonnes (MT) in 1985-86 to 1.1 million MT by 2014-15 (Anil Kumar et al., 2024). Although urea application per hectare declined from a peak of 256.13 kg/ha in 2015-16 to 193.48 kg/ha by 2020-21, absolute consumption rose from 12.53 lakh tonnes to 17.53 lakh tonnes over the same period, driven by a 59% expansion in cultivated area (Telangana Today, 2022). The result is a state that applies more chemical fertiliser per hectare than any other peninsular Indian state, yet faces declining per-unit productivity due to NPK imbalance, organic matter depletion, and nutrient lock-up in degraded soils (Anil Kumar et al., 2024).

Figure 1.1. Urea use per hectare in Telangana, 2015-16 to 2020-21 (kg/ha)

2015–16	**256**	Peak rate
2016–17	**240**	Gradual decline
2017–18	**225**	Post-expansion
2018–19	**210**	Continued fall
2019–20	**200**	Area effect
2020–21	**193**	193 kg/ha (latest)

Figure 1.1. Trend in urea application rate, Telangana, 2015-16 to 2020-21. Source: Telangana Today (2022), Rajya Sabha data. *The per-hectare rate fell, but absolute consumption grew sharply due to expanded cultivation. The decline does not represent a reduction in chemical dependency.*

1.3 Pesticide Use: Intensity and Health Consequences

Pesticide use intensity is the most acute agrochemical problem in the SCALAGRO study region. Telangana consumed 0.613 kg of pesticides per hectare of gross cropped area in 2022-23, ranking fourth nationally by intensity, more than twice the national average of 0.289 kg/ha (Manimekalai, 2025). Chemical pest control is employed by 88% of Telangana farmers, the highest state-level rate in India, while biological control is used by only 6% (Sunder et al., 2024). Cotton cultivation in the Zaheerabad-Nizamabad belt is the primary driver of pesticide demand.

Figure 1.2. Pesticide use intensity (kg/ha gross cropped area) -selected states, 2022-23

J&K (national maximum)	**2.097**	Horticulture-intensive
Punjab	**0.679**	Wheat & rice belt
Haryana	**0.619**	High-input North India
Telangana	**0.613**	4th nationally; 2× national avg.
Andhra Pradesh	**0.49**	Cotton and paddy
National Average	**0.289**	All-India average

Figure 1.2. State-wise pesticide use intensity, 2022–23. Source: Manimekalai (2025), Plant Science Today. *Telangana's pesticide burden exceeds the national average by 112%. At this intensity, farmworker health, soil microbiome integrity, and viability of biological pest control are simultaneously compromised.*

1.4 Soil Health: The Long-Term Productive Cost

Long-term field experiments on rainfed Alfisol soils, the dominant soil type in the Zaheerabad region, demonstrate that continuous cultivation without organic inputs depletes soil organic carbon (SOC), reduces microbial biomass, and diminishes enzymatic activity (Srinivasarao et al., 2014). Each 1 Mg/ha increase in root-zone SOC is associated with grain yield increases of 13 kg/ha for groundnut, 101 kg/ha for finger millet, and 90 kg/ha for sorghum, the principal dryland food crops of the region (Srinivasarao et al., 2014). A five-year conservation agriculture experiment in the Southern Telangana Zone confirmed that intensive tillage with chemical inputs significantly accelerated SOC depletion (Rao et al., 2025). Crop residue burning releases up to 80% of nitrogen, 25% of phosphorus, and 21% of potassium that are locked in biomass, compounding the cycle of soil nutrient depletion (Gupta et al., 2022).

Section 1 summary: The scale and severity of the problem

Telangana's 5.94 million smallholdings, 88% of which are marginal or small, operate at input intensities among the highest in India. These intensities are not translating into improved yields or farmer incomes; they are generating debt, soil degradation, and health risks. This is the structural problem that community-managed bio-input systems are designed to address.

2. Problem: Market Failure and the Input Cost Trap

Thissection diagnoses the structural mechanism through which chemical input dependency becomes financially self-reinforcing. Market failure in bio-input supply and the debt-cost cycle are identified as the two binding constraints preventing spontaneous market-led transition to natural farming.

2.1 Market Failure in Bio-input Supply

Despite decades of government promotion of biological alternatives, microbial biofertilizers and biopesticides remain absent from rural input markets in the study region. The commercial agrochemical supply chain is built on private dealer networks with strong financial incentives to promote synthetic products, and in some documented cases, conditions credit access on synthetic product purchases. Community-sourced or government-distributed bio-inputs are available only sporadically and at quality levels unsuited to regular crop-season use (SCALAGRO Writeshop, 2026).

Supply Dimension	Synthetic Input Market	Community Bio-input Model
Market availability	Universal; all-season stock across all rural shops	Largely absent from commercial channels; no dedicated rural supply chain
Dealer incentive	High commercial margins; active push marketing to farmers	Minimal margin; requires community organisation or government support
Product stability	Long shelf life; stable under ambient storage	Short microbial shelf life; requires timely use or local production
Quality assurance	Regulated under the Fertilisers Control Order and the Insecticides Act	Variable; no mandatory certification; quality depends on production method and storage
Credit linkage	Dealers provide input credit, often conditional on product choice	No equivalent credit infrastructure: cash purchase only in most rural contexts
Price signal	Urea is heavily subsidised; the true input cost is invisible to farmers	Full-cost pricing; economic benefit visible only post-adoption

Table 1.2. Structural comparison: synthetic input supply system versus community-managed bio-input model. *The asymmetry is systemic, not incidental. Market structure actively maintains chemical dependency. A community-managed supply model, rather than individual farmer adoption decisions, is the appropriate response. Source: Manimekalai (2025); Sunder et al. (2024); SCALAGRO Writeshop (2026).*

2.2 The Debt-Input Cost Trap

More than 50% of Indian farmers are in debt, attributable in part to rising synthetic input costs (Press Information Bureau, 2022). In Telangana, where cotton's input cost profile is among the highest of any staple crop, the compulsion to purchase on credit from dealers creates a self-reinforcing trap: high input costs generate debt; debt creates pressure to achieve high yields; high yield pressure reinforces chemical dependency. On a six-acre marginal holding in the study region, seasonal expenditure on chemical inputs reaches ₹ 13,050, accounting for the dominant share of cash outlays before any labour or land costs are counted (SCALAGRO Writeshop, 2026). Under a community bio-input model, the same holding's input cost falls to approximately ₹ 5,200, a reduction of approximately 60% in the transition season (SCALAGRO Writeshop, 2026).

3. Government Programmes and Investment in Natural Farming

This section documents the current policy architecture and public investment supporting natural farming and bio-input development in Telangana. It establishes that the enabling institutional environment has reached a threshold that makes a structured pilot intervention both feasible and timely.

3.1 National Mission on Natural Farming (NMNF)

The Union Cabinet approved the NMNF on 25 November 2024 as a standalone Centrally Sponsored Scheme with a total approved outlay of ₹ 2,481 crore (central share: ₹ 1,584 crore; state share: ₹ 897 crore) through 2025-26 (Press Information Bureau, 2024). The Mission targets 15,000 natural farming clusters covering 7.5 lakh hectares nationally, supported by 10,000 Bio-input Resource Centres (BRCs). By July 2025, over 10 lakh farmers had been enrolled nationwide, and 7,934 BRCs had been identified, of which 2,045 were already operational (DD India, 2025).

In Telangana specifically, by early 2025, 489 clusters have been formed covering 24,736 hectares across 33 districts; 61,125 farmers are registered; 979 Krishi Sakhis and Community Resource Persons have been trained through KVKs and state agricultural universities; 315 BRCs have been established; and the Centre released ₹ 1,323.51 lakh for the state in 2025-26 (Deccan Chronicle, 2025).

315	61,125	489	₹ 1,323 lakh
BRCs established Telangana, NMNF 2025	**Farmers registered** 32 districts covered	**Clusters formed** 24,736 ha	**Central release** 2025–26 allocation

These are operational achievements confirmed by Deccan Chronicle (2025).

3.2 APCNF: The Adjacent State Precedent

The most directly policy-relevant evidence for Telangana is the Andhra Pradesh Community-Managed Natural Farming (APCNF) programme, which scaled from 40,000 farmers in 2016 to 6.3 lakh farmers across approximately 500,000 hectares by 2022 (Hussain et al., 2025). A landmark study published in *Nature Ecology & Evolution* applied rigorous causal inference methods and found that the programme more than doubled farmers' economic profits while maintaining crop yields and significantly increasing bird species abundance, providing simultaneous socio-economic and biodiversity benefits at programme scale (Hussain et al., 2025). A Tufts University review of over 1,365 sampled farmers confirmed strong evidence of reduced cultivation costs and found that more than 70% of adopters were marginal farmers holding fewer than 2.5 acres (Rose et al., 2021). A controlled trial across 28 farms in six AP districts found no yield penalty relative to conventional alternatives, and Zero Budget Natural Farming (ZBNF) yields improved over three seasons while conventional yields declined (Newton et al., 2022).

Outcome	Finding	Source	Scale
Farmer income	More than doubled economic profits under APCNF	*Hussain et al. (2025), Nature Ecology & Evolution*	Multi-district, AP
Input costs	Strong evidence of reduced cultivation costs in transition and subsequent seasons	*Rose et al. (2021), Tufts University CREATE*	1,365+ farmers, AP
Crop yield	No yield penalty vs. conventional; ZBNF yield trajectory improved over 3 seasons	*Newton et al. (2022), MDPI Sustainability*	28 farms, 6 districts
Biodiversity	Bird density and functional guild abundance are significantly higher in ZBNF villages	*Hussain et al. (2025). Nature Ecology & Evolution*	State-wide AP
Water use	Significantly lower irrigation water uses for comparable crops	*CSTEP (2020), Bengaluru*	AP survey
Farmer wellbeing	Reduced debt stress; improved mental wellbeing (qualitative FGD evidence)	*Rose et al. (2021), Tufts University*	Qualitative, AP

Table 1.3. Documented outcomes from APCNF/ZBNF natural farming programmes in Andhra Pradesh. *The APCNF evidence includes a 2025 Nature-published causal study, the highest standard of agricultural programme evidence. The Telangana context is agro-climatically equivalent; the precedent is directly applicable.*

4. Enabling and Constraining Factors for Bio-input Adoption

Programme design must be calibrated to the real factors that facilitate and inhibit adoption at the household level. This section draws on documented evidence from AP-Telangana field studies to identify factors most likely to determine success or failure.

4.1 Enabling Factors

- **Demonstrable first-season cost savings:** Studies across AP consistently document input cost reductions of 50-60% in the transition season itself, providing an immediate financial benefit that does not require multi-season evidence-building. This is the strongest, most reliable predictor of farmer uptake (Department of Economics and Statistics, Andhra Pradesh, 2020-21; Rose et al., 2021).

- **Women's SHG and Sangam network:** APCNF's scaling success was structurally dependent on women's self-help group infrastructure as the primary extension and adoption channelover 1,61,000 SHGs in AP were mobilising resources for natural farming by 2019 (Rose et al., 2021). In Telangana, the Sangam network provides an equivalent foundation.
- **KVK Zaheerabad as technical backstop:** The NMNF mandates KVKs to serve as demonstration, training, and quality assurance sites for BRC establishment (Press Information Bureau, 2024). KVK Zaheerabad is institutionally positioned to provide this function within the SCALAGRO programme footprint.
- **Climate vulnerability as adoption motivation:** Semi-arid Telangana's documented rainfall variability creates strong farmer motivation for low-cost, soil-health-building approaches that reduce production risk. Farmers in drought-prone dryland districts exhibit systematically higher interest in natural farming alternatives (Rose et al., 2021).
- **ICAR-DPR institutional proximity:** ICAR's Directorate of Poultry Research in Hyderabad provides in-state scientific capacity for both bio-input quality validation and improved indigenous breed genetics, an advantage unavailable to comparable programmes in most other states (Indian Farming, 2019).

4.2 Constraining Factors

- **Private dealer resistance:** Agrochemical dealers actively resist bio-input promotion through counter-messaging and conditional credit extension. Dealer networks are embedded in rural social and financial relationships that take time to circumvent (Sunder et al., 2024).
- **Transition-season yield uncertainty:** A documented yield dip in the first transition season, particularly under cotton, creates financial risk that marginal farmers with no savings buffer cannot absorb without targeted support (Rose et al., 2021; Newton et al., 2022).
- **Bio-input quality variability:** Village-produced microbial preparations can exhibit variable viable counts without temperature-managed storage. Inconsistent quality erodes farmer confidence and is the primary technical failure mode for community BRC programmes (SCALAGRO Writeshop, 2026).
- **Absence of output market incentive:** Without a price premium or certification market for produce from natural farming, farmers bear transition costs without a price reward. NMNF's proposed single national brand for natural-farming produce has not yet been operationalised (Press Information Bureau, 2024).
- **Labour intensity:** Jeevamrutam preparation, mulching, and botanical pest management require additional labour relative to a single synthetic spray application, a constraint in households where male out-migration has concentrated agricultural work on women (SCALAGRO Writeshop, 2026).

5. Utility of Bio-inputs: Agronomic and Economic Evidence

This section evaluates the documented agronomic mechanisms and economic returns from bio-input use, drawing on published field trials and farm-level data from the study region.

5.1 Microbial Bio-input Portfolio: Mechanisms and Efficacy

The agronomic efficacy of principal microbial bio-inputs is well established in peer-reviewed literature. Table 1.4 summarises the primary organisms in the SCALAGRO BRC portfolio, their biological mechanisms, and documented field evidence.

Bio-input	Active Organism (s)	Mechanism and Agronomic Effect	Key Evidence
Jeevamrutam	*Desi cow dung + urine; diverse microbial community*	Stimulates soil microbial activity; mobilises bound nutrients; suppresses soil-borne pathogens through competitive exclusion	*Department of Economics and Statistics, Andhra Pradesh (2020-21); Hussain et al. (2025)*

Rhizobium + Azospirillum	*Rhizobium spp., Azospirillum brasilense*	Biological N-fixation reduces inorganic nitrogen requirement by 25-40% in compatible crops	*Wezel et al. (2014)*
Phosphate-Solubilising Bacteria (PSB)	*PSB strains*	Mobilises soil-fixed phosphorus to plant-available form; reduces DAP requirement	*Haque et al. (2012)*
Trichoderma harzianum	*T. harzianum*	Phosphate solubilisation + plant growth promotion; antagonises Fusarium and Pythium; yield increase >200% over unfertilised control	*Haque et al. (2012); Wang et al. (2022); Jayalakshmi et al. (2024)*
Beauveria bassiana / Metarhizium anisopliae	*Entomopathogenic fungi*	Contact infection of sucking and chewing arthropod pests; reduces spray frequency	*Sunder et al. (2024)*
Bacillus thuringiensis var. kurstaki	*Bacteria*	Lepidopteran larval control via delta-endotoxin; target-specific, no documented non-target harm	*Sunder et al. (2024)*
Pseudomonas fluorescens	*Bacteria*	Induces systemic plant resistance; suppresses foliar bacterial and fungal pathogens	*Adetunji et al. (2021)*

Table 1.4. Bio-input portfolio: organisms, biological mechanisms, and peer-reviewed evidence. *Each bio-input has an independently documented mode of action. The portfolio collectively addresses the nitrogen, phosphorus, and pest management functions currently served by synthetic inputs at approximately 60% lower cost.*

5.2 Economic Utility: Input Cost Savings

The most immediate financial benefit of transitioning to community bio-inputs is the reduction in per-acre input expenditure. Based on crop-season data from the DDS-KVK Zaheerabad writeshop (SCALAGRO Writeshop, 2026), total conventional input cost across a six-acre holding amounts to ₹ 13,050 per season. Under a community bio-input model, the equivalent total is ₹ 5,200, a saving of ₹ 7,850 (approximately 60%) in the transition season itself.

Figure 1.3. Seasonal input cost per acre: conventional vs. bio-input model (₹ /acre, SCALAGRO study region, 2026)

DAP (4 bags ÷ 6 acres)	**1000**	Conventional: ₹ 6,000/6 acres
Urea (3 bags ÷ 6 acres)	**175**	Conventional: ₹ 1,050/6 acres
NPK complex	**400**	Conventional: ₹ 2,400/6 acres
Chemical pesticide (3 sprays)	**400**	Conventional: ₹ 2,400/6 acres
Fungicide (2 sprays)	**200**	Conventional: ₹ 1,200/6 acres
All bio-inputs (natural farming total)	**867**	NF total: ₹ 5,200/6 acres

Figure 1.3. Per-acre input cost comparison, conventional vs. natural farming. Source: SCALAGRO Writeshop (2026). *A transition to bio-inputs saves ₹ 7,850 per six-acre holding per season in the transition season itself. This is the single most important economic fact for persuading marginal farmers to adopt.*

Part One synthesis: The case for bio-input pilot investment

Three independent lines of evidence converge. The problem is documented at scale, chemical input dependency generating debt, soil degradation, and health costs on marginal Telangana farms. The solution has been proven to more than double farmer profits, with no yield penalty, across 6.3 lakh farmers in adjacent Andhra Pradesh (Hussain et al., 2025). The enabling environment is unprecedented. NMNF has invested ₹ 1,323 lakh in Telangana and established 315 operational BRCs. What is missing is the structured piloting, quality assurance, and market linkage layer that SCALAGRO is positioned to provide.

PART TWO
Indigenous Poultry Systems in Telangana

6. Background: Industry Scope, Structural Problems, and Household Situation

This section situates backyard indigenous poultry within India's broader poultry economy, analyses the structural vulnerabilities of the commercial sector that make it inaccessible to smallholders, and establishes the baseline for household production, including the nutritional gap that backyard systems are positioned to close.

6.1 India's Poultry Sector: Scale and Regional Concentration

India is the world's third-largest egg producer and the fifth-largest broiler meat producer. Andhra Pradesh and Telangana together contributed over 32% of national egg production in 2022-23: Andhra Pradesh held the largest state share at 20.13%, and Telangana ranked third at 12.77%.India produced 138.38 billion eggs in 2024-25, of which approximately 14.6% originated from backyard poultry systems (VPrint Infotech, 2025). The Indian poultry market was valued at approximately ₹ 2,304 billion in 2024 and is projected to grow at a CAGR of 12.6% to reach ₹ 8,430 billion by 2033 (IJCRT, 2025). Despite this scale, only 8% of poultry meat is processed into value-added products, exposing the sector's predominantly commodity orientation (Vet Extension, 2025).

Figure 2.1. State-wise share of India's total egg production, 2022-23 (%)

Andhra Pradesh	**20.13**	Largest producing state
Tamil Nadu	**15.58**	2nd largest
Telangana	**12.77**	3rd largest
West Bengal	**9.93**	4th largest
Karnataka	**6.51**	5th largest
All other states	**35.08**	28 states combined

Figure 2.1. Share of national egg production by state, 2022–23. Source: VPrint Infotech (2025). *The AP-Telangana belt produces nearly one-third of India's eggs, yet smallholder households of Zaheerabad access fewer eggs per capita than the national average. This contradiction between regional dominance in production and local nutritional deficits is a central motivation for the SCALAGRO poultry intervention.*

6.2 Indigenous Breed Heritage in the AP-Telangana Region

The Andhra-Telangana region possesses exceptional indigenous chicken breed diversity. Breeds with documented regional distribution include Aseel, Danki, Kalasthi, Ghagus, and Naked Neck varieties (Padhi, 2016). The Aseel, globally recognised for its superior genetics, has historically been maintained by indigenous women of East Godavari district, AP, through sophisticated collective breeding systems developed over generations (Ramdas & Ghotge, 2009). ICAR's Directorate of Poultry Research (ICAR-DPR), located in Hyderabad, has developed improved dual-purpose varieties with significantly higher productivity potential under low-input village conditions (Indian Farming, 2019).

Breed	Origin / Distribution	Annual Egg Production	Key Characteristics
Aseel	Andhra Pradesh; Odisha; Chhattisgarh	120-140 eggs/year	Genetically robust; high disease resistance; premium cultural and ritual market price
Naked Neck	Andhra Pradesh; Tamil Nadu	140-160 eggs/year	High thermal tolerance; well-suited to semi-arid Telangana; reduced post-slaughter labour
Kadaknath	Madhya Pradesh; introduced to Telangana	80-100 (pure); 120+ (improved cross)	Black-pigmented meat; premium Hyderabad market at ₹ 600-1,000/bird; documented climate resilience
Srinidhi (ICAR-DPR)	Developed for Telangana dryland conditions	150-180 eggs/year	Significant nutritional and livelihood outcomes in Vikarabad district, Telangana (Indian Farming, 2019)
Rajshri (ICAR-CARI)	Distributed in AP-Telangana	180-210 eggs/year	Documented income and women's empowerment outcomes in the KVK tribal programme, West Godavari, AP
Sonali (improved cross)	ICAR; widely distributed	180-200 eggs/year	High-layer productivity; widely adopted in NGO-supported small-scale production programmes

Table 2.1. Indigenous and improved indigenous chicken breeds relevant to Telangana. Sources: Padhi (2016); Indian Farming (2019); Rajkumar et al. (2021). *ICAR-DPR's presence in Hyderabad gives Telangana a unique scientific advantage: in-state breed improvement capacity accessible directly by the SCALAGRO programme.*

6.3 Structural Vulnerabilities of India's Commercial Poultry Sector

Understanding why the commercial sector cannot serve as a viable livelihood pathway for Telangana's marginal smallholders requires examining its documented structural vulnerabilities, which are precisely the vulnerabilities from which backyard indigenous systems are insulated.

Structural Problem	Evidence from India	Why Backyard Systems Are Insulated
Disease vulnerability	Newcastle Disease is documented as recurring in Telangana and AP. Avian Influenza outbreaks require mass culling; DAHD (2024) acknowledges biosecurity is 'often inadequate' nationally	Dispersed low-density management reduces intra-flock transmission risk. Mandatory vaccination at chick distribution is an essential mitigation (Alders et al., 2010)
Feed cost volatility	Maize and soybean constitute 70-80% of commercial production costs; global price surges in 2022-23 forced smaller operators into losses (CareEdge Ratings, 2024)	Indigenous foragers obtain 40-60% of nutrition from household waste and crop residue at zero cash cost; feed cost is not a principal financial vulnerability
Capital intensity	Climate-controlled housing, automated feeding, and biosecurity infrastructure require capital inaccessible to marginal households	Minimum viable backyard unit: 15-20 birds, ₹ 2,000-3,000 accessible at all wealth levels, including landless single-woman households

Market concentration	Vertical integration by large integrators compresses returns for independent growers; smallholders enter as price-takers	Indigenous birds command 13-27% premium over commercial broilers; Kadaknath fetches ₹ 600-1,000/bird in Hyderabadcultural demand is price-inelastic (Padhi, 2016)
Antibiotic resistance	Prophylactic antibiotic use is common at high-density commercial scale; AMR in commercial products is a documented public health concern	Not applicable to backyard systems; absence of antibiotics positions Desi birds as a consumer health-positive product category

Table 2.2. Structural vulnerabilities of India's commercial poultry sector and the insulation of backyard indigenous systems. *The comparison is analytically important: indigenous backyard systems are not a lesser version of commercial poultry; they are a structurally different production model with a more favourable risk-return profile for marginal farmers. Sources: Agritimes (2024); IRJMETS (2025); DAHD (2024); CareEdge Ratings (2024); IJCRT (2025).*

6.4 Household and Backyard Poultry: National and Regional Situation

India's 20th Livestock Census (2019) documented 317.07 million backyard poultry birds nationally, an increase of 45.8% over the 2012 Census, while commercial poultry grew by only 4.5% in the same period (Department of Animal Husbandry and Dairying, 2019; Rajkumar et al., 2021). Approximately 30 million farmers, predominantly women, are engaged in backyard poultry, accounting for approximately 20% of the sector's total value (The Poultry Site, 2024). Rural poultry constitutes approximately 27% of Telangana's total poultry population (Indian Farming, 2019).

Figure 2.2. India's backyard vs. commercial poultry population, 2012 and 2019 (million birds)

Figure 2.2. Backyard versus commercial poultry population growth, India, 2012–2019. Source: Department of Animal Husbandry and Dairying (2019); Rajkumar et al. (2021). *Backyard poultry grew more than ten times faster than commercial poultry. The growth is farmer-driven, not programme-driven, confirming demand for institutional support that is currently unmet.*

Per-capita egg availability in India reached 106 eggs per person per year in 2024-25 (Vet Extension, 2025). Standard nutritional recommendations require a minimum of 180 eggs per person per year, leaving a structural deficit of 74 eggs per person per year (The Poultry Site, 2024). Iron-deficiency anaemia affects 57% of Indian women of reproductive age (National Family Health Survey-5, 2021), a condition directly responsive to increased egg consumption, and one where Desi eggs' higher iron, zinc, and B12 content relative to commercial cage eggs provides proportionally greater benefit (Padhi, 2016).

Nutritional Indicator	Current Status	Target or Gap
Per-capita egg availability (India, 2024-25)	106 eggs/person/year	NAPEP 2022 target: 180 eggs/year; structural deficit of 74 eggs/person/year
Per-capita poultry meat consumption	~3 kg/person/year	Global average: ~17 kg/year; India at approximately 18% of the global average
Child stunting, rural India	~34.7% of children under 5 (NFHS-5, 2021)	Bioavailable protein and micronutrients from eggs are directly implicated in stunting reduction

Iron-deficiency anaemia (women 15-49)	57% prevalence nationally (NFHS-5, 2021)	Egg iron and B12 address anaemia; Desi eggs have higher micronutrient density than commercial eggs
Dietary diversity, rural Telangana	Predominantly cereal-based; animal-source food 2-3 days/ week or fewer	Backyard eggs provide daily animal protein at zero market-purchase cost

Table 2.3. Nutritional deficit indicators and the role of backyard poultry. Sources: Vet Extension (2025); The Poultry Site (2024); National Family Health Survey-5 (2021); Padhi (2016). *A deficit of 74 eggs per person per year, 57% anaemia among women, and protein intake below recommendations together define a nutritional emergency that home-produced eggs can address directly without requiring cash expenditure.*

7. Problem: Decline of Backyard Poultry and Structural Barriers

This section documents the systemic drivers of decline and the structural constraints that limit adoption. Understanding the failure modes of unstructured household-level adoption is a prerequisite to designing a programme that avoids them.

7.1 Drivers of Decline

Historically, backyard poultry constituted approximately 70% of India's total poultry production; by the time of the 20th Livestock Census, this share had substantially eroded as intensive commercial systems expanded (LEISA India, 2023). In the AP-Telangana dryland belt, four systemic drivers are documented. First, the shift from diversified cropping to cotton and paddy monocultures eliminated the household crop residue and food waste base that provided zero-cost feed for backyard flocks (Ramdas & Ghotge, 2009; Akter et al., 2007). Second, commercial hybrid birds entered village markets and undermined the perceived productivity of indigenous varieties (Padhi, 2016; Akter et al., 2007). Third, traditional ethno-veterinary knowledge for poultry health management eroded across generations, leaving households without effective responses to Newcastle Disease outbreaks (Ramdas & Ghotge, 2009). Fourth, community breeding and incubation networks that transmitted indigenous genetic material broke down, severing the supply chain for quality birds below the commercial market price point (Ramdas & Ghotge, 2009).

The decline is most acute in Thandas, Lambadi tribal settlements where traditional Deshawali breeds produce only approximately 42 eggs per year, generating insufficient economic return relative to management investment. When no improved alternative was accessible and veterinary support was absent, rational households discontinued backyard rearing rather than incurring losses to disease and predation (KVK Wyra / Khammam, 2019).

7.2 Structural Constraints to Adoption and Sustainability

Constraint	Evidence and Scale	SCALAGRO Programme Response
Newcastle Disease mortality	Single ND outbreak eliminates entire household flock; ND recurring in Telangana and AP; total flock mortality of 61% documented in one unvaccinated tribal programme (KVK Wyra / Khammam, 2019)	Mandatory vaccination at the point of chick distribution; community health worker training in booster administration
Predation (dogs, crows, raptors)	75% of mortality in the KVK Wyra Banka tribal programme was predation-caused, not disease; the highest-mortality phase is the first 4 weeks (KVK Wyra / Khammam, 2019)	Predator-proof brooding housing demonstrated at DDS-KVK before chick distribution; materials cost at the household level

Low hatchability of village incubation	Traditional village incubation achieves only 30-40% hatchability, insufficient for community-wide supply (Indian Farming, 2019)	Centralised controlled incubation unit at DDS-KVK (1,200 eggs/cycle); egg exchange pay-forward model
Breed quality and access	Only commercial hybrids are available in rural markets; the Deshawali local breed produces only ~42 eggs/year	ICAR-DPR improved varieties procured through the KVK network; in-programme selective incubation
Capital barrier	Chick purchase (~₹ 300/bird) prohibitive for landless households without credit	Pay-forward egg exchange removes upfront cash requirement; CIG Poultry Fund model tested in AP
Knowledge gap	Traditional poultry health and management knowledge eroded in study villages (Ramdas & Ghotge, 2009)	Structured joint training module: ethno-veterinary + modern health protocol

Table 2.4. Structural constraints to backyard indigenous poultry with documented evidence and SCALAGRO programme responses. Sources: KVK Wyra / Khammam (2019); Rajkumar et al. (2021); Alders et al. (2010); Ramdas & Ghotge (2009); Indian Farming (2019). *Each constraint has a known, tested response. SCALAGRO's innovation is to integrate these responses into a single programme architecture with the DDS-KVK institutional hub, rather than inventing new solutions.*

8. Government Programmes and Investment in Indigenous Poultry

This section documents the public investment infrastructure available for indigenous poultry development, including national scheme architecture, state-level precedents, and the financial instruments that SCALAGRO's programme design can leverage.

8.1 National Livestock Mission and NAPEP

The National Livestock Mission (NLM) provides a 50% capital subsidy (up to ₹ 25 lakh) for the establishment of parent farms, rural hatcheries, and brooder-cum-Mother Units for community chick distribution (Rajkumar et al., 2021). Critically for the SCALAGRO model, the NLM provides up to 80% financial assistance for Mother Units managed by women's groups that oversee brooding and vaccination of chicks before distribution to household beneficiaries.This directly subsidises the hub-and-spoke incubation model that DDS-KVK Zaheerabad has established.

India's National Action Plan for Egg and Poultry (NAPEP 2022) targets rural women as the primary beneficiary group for government backyard poultry distribution schemes and sets a national target of 180 eggs per capita per year by 2030 (The Poultry Site, 2024). Projections cited in NAPEP indicate that India's per capita chicken consumption will grow from 3 kg to 9.1 kg by 2030, a three-fold increase, creating a favourable long-term demand environment for indigenous poultry producers (The Poultry Site, 2024).

80%	**50%**	**180**	**3x**
NLM subsidy	**Capital subsidy**	**Egg target**	**Market growth**
Women-managed Mother Units	Rural hatcheries (up to ₹ 25L)	Per capita/year by 2030 (NAPEP)	Projected poultry demand by 2030

The public financial architecture directly supports the SCALAGRO model. The 80% NLM subsidy for women-managed Mother Units means community incubation infrastructure can be established at minimal programme cost.

8.2 State-Level Precedents: AP and Tamil Nadu

The AP Government's 2016 Rural Desi Backyard Poultry programme, covering 13,000 Adivasi households across five tribal districts with WASSAN as Lead Technical Agency, is the most directly applicable precedent (LEISA India, 2023). The programme integrated improved production systems, vaccination and healthcare services, a breeding farm enterprise, and a Common Interest Group (CIG) Poultry Fund at the cluster level, precisely the components of the SCALAGRO architecture. WASSAN's AP tribal Back Yard Poultry (BYP) programme has documented household incomes of

₹ 1 lakh for approximately 1,000 families, the highest verified per-household impact reported in the national backyard poultry literature (WASSAN, 2025).

Tamil Nadu's state government has distributed 50 indigenous country chickens plus a predator-proof cage to 77,000 rural women under its BYP scheme (The Poultry Site, 2024). The World Bank-financed Andhra Pradesh Rural Inclusive Growth Project (APRIGP) explicitly targeted backyard poultry as a dietary diversification tool in SC/ST and women-headed households, providing externally evaluated evidence that the hub-and-spoke model delivers measurable nutritional and income outcomes (World Bank, 2021).

8.3 In-State Scientific Infrastructure: ICAR-DPR and KVK Network

KVK Wyra (Khammam district, Telangana) documented results from introducing ICAR-improved Vanraja birds to tribal villages: egg production per family increased six-fold (from 26-336 to 65-876 eggs per year); egg self-consumption as a proportion of total production rose from 37% to 81%; and household income from backyard poultry increased from ₹ 151 to ₹ 2,458 per year (KVK Wyra / Khammam, 2019). KVK Kampasagar (Nalgonda district) documented 77.5% adoption of backyard poultry for nutritional security among targeted tribal farmers across 12 villages in a six-year Tribal Sub Plan evaluation, the highest adoption rate of any technology disseminated in the programme (Extensionjournal.com, 2024).

9. Enabling and Constraining Factors for Indigenous Poultry Adoption

This section maps the factors that will determine the rate and sustainability of indigenous poultry adoption in the SCALAGRO programme area. Facilitating factors should be actively leveraged; constraining factors must be systematically addressed in programme design.

9.1 Enabling Factors

- **Dramatic productivity improvement with improved breeds:** Introduction of ICAR-improved varieties (Vanraja, Srinidhi, Rajshri) increases egg production four- to six-fold relative to traditional Deshawali birds, providing an immediate, visible income improvement that motivates adoption (KVK Wyra / Khammam, 2019; Indian Farming, 2019).
- **Low capital entry threshold:** A minimum viable household unit of 15-20 birds requires a cash investment of only ₹ 2,000-3,000 accessible without formal credit to all strata, including single-woman and landless households. The pay-forward egg-exchange model removes even this modest barrier for subsequent cohorts (Rajkumar et al., 2021).
- **Cultural and ritual market premium:** Indigenous varieties are preferred for ritual sacrifice, festive consumption, and gift exchange in Telangana's tribal and agrarian communities. This cultural demand base is price-inelastic and seasonally predictable. Kadaknath birds fetch ₹ 600-1,000 in Hyderabad markets (Padhi, 2016; SCALAGRO Writeshop, 2026).
- **Women's management role and welfare multiplier:** Two-thirds of India's livestock labour force are rural women; backyard poultry income is almost universally under women's sole control. Income from women-managed productive activities is preferentially directed toward children's food, health, and education, generating a welfare impact multiplier (Vet Extension, 2025; World Bank, 2012).
- **Self-reinforcing pay-forward distribution:** The egg-exchange model converts a one-time community capital investment in incubation infrastructure into a self-sustaining supply chain for subsequent household cohorts, without requiring repeated external funding after programme establishment (SCALAGRO Writeshop, 2026).

9.2 Constraining Factors

- **Newcastle Disease and predation mortality:** In the documented KVK Wyra Banka tribal programme, total flock mortality reached 61%, of which approximately 75% was predator-caused. A single ND outbreak in an unvaccinated flock eliminates the entire household investment and income stream, the single most powerful deterrent to sustained programme participation (KVK Wyra / Khammam, 2019; Alders et al., 2010).

- **Incubation bottleneck:** Traditional village incubation achieves hatchability rates of only 30-40%, creating insufficient and unreliable chick supply for programme-scale distribution. Controlled incubation infrastructure is a prerequisite, not an add-on (Indian Farming, 2019).
- **Knowledge gap:** Traditional ethno-veterinary knowledge for poultry health has eroded in study villages. The gap is widest among younger women with no prior backyard rearing experience, who require hands-on, structured training (Ramdas & Ghotge, 2009; SCALAGRO Writeshop, 2026).
- **Labour constraints from male out-migration:** In households where all agricultural and domestic labour has concentrated on women, additional poultry management requires either labour-saving technology (predator-proof housing reduces surveillance) or collective management arrangements through Sangam groups (SCALAGRO Writeshop, 2026).
- **Market access for premium price realisation:** Indigenous birds command a 13-27% price premium over commercial broilers, but realising this premium requires transport to urban markets or aggregation at a village collection point. Without organised market linkage, premium products are sold at commodity prices (Padhi, 2016).

10. Utility of Indigenous Poultry: Income, Nutrition, and Ecological Integration

This section presents documented programme outcomes across three dimensions of utility: household income, nutrition, and ecological integration with bio-input and crop systems. Together, these outcomes constitute the scientific basis for the economic case in the SCALAGRO Action Brief on Indigenous Poultry.

10.1 Livelihood and Income Evidence

The income utility of backyard indigenous poultry has been documented across programme contexts ranging from household-scale backyard management to NGO-facilitated tribal women's groups. Table 2.5 synthesises key outcomes from the Telangana and AP regional literature.

Programme Context	Net Annual Income (₹)	Key Finding and Source
Backyard enterprise, South Bengaluru (Rajasri breed, 20 birds)	~12,289	Gross revenue ₹ 21,112 against cost ₹ 8,711; cocks sell for ₹ 800-1,000 at festival season; 35% of households retain birds for self-consumption only. International Journal of Agriculture Extension and Social Development (2024).
KVK Wyra, Telangana -Vanraja introduction in tribal village	Income: ₹ 151 → ₹ 2,458	Six-fold egg production increase; eight-fold meat production increase; egg self-consumption rose from 37% to 81% of production. KVK Wyra / Khammam (2019).
WASSAN Backyard Poultry, tribal districts, Andhra Pradesh	~1,00,000	₹ 1 lakh household income documented for approximately 1,000 tribal families, the highest per-household figure in the national backyard poultry literature. WASSAN (2025).
KVK Srinidhi trial, Vikarabad, Telangana	Nutritional + livelihood	Significant production improvement over local birds; nutritional security outcomes in semi-arid conditions comparable to the SCALAGRO study region. Indian Farming (2019).
KVK scheme, Tamil Nadu (Aseel, ~5 birds)	~14,400	Supplementary income of ₹ 1,200/month from approximately 5 surviving birds, a meaningful income even from a minimal flock scale. Rajkumar et al. (2021).
SCALAGRO youth enterprise model, 250 birds	~1,90,000	Net profit ~₹ 95,000/cycle; 2 cycles/year; capital recovery in under 12 months. SCALAGRO Writeshop (2026).

Table 2.5. Income evidence from indigenous backyard poultry programmes in Telangana and Andhra Pradesh. *The range from ₹ 12,289 (minimal household-scale) to ₹ 1,00,000 (NGO-facilitated tribal programme with full support package) defines the income frontier achievable at different levels of institutional support. The SCALAGRO model's target is in the mid-to-upper range.*

10.2 Nutritional Impact: Direct Evidence

The nutritional impact pathway for backyard poultry operates through two mechanisms: direct household consumption of eggs and meat, bypassing cash constraints on purchasing market protein; and income from sales, directed preferentially toward children's food.

A three-year intervention study in Medak district, AP (now Telangana), integrating nutrition education, homestead gardens, and backyard poultry across 11 ICDS centres, documented marked improvements in mothers' nutritional knowledge and child-feeding practices among 335 target families (Vijayaraghavan et al., 2016). Medak district is agro-climatically and socio-economically comparable to the SCALAGRO study area of Zaheerabad. The KVK Wyra Vanraja trial in Khammam, Telangana, demonstrated that egg self-consumption rose from 37% to 81% of production following improved breed introduction (KVK Wyra / Khammam, 2019) indicating that productivity improvement directly translates into household nutritional benefit.

Nutritional Benefit	Mechanism	Regional Evidence (APA)
Protein and amino acid intake	Egg and poultry meat consumption bypasses cash constraint; protein is available at zero market-purchase cost within the household	KVK Wyra: egg self-consumption rose from 37% to 81% post-intervention; household egg production increased six-fold (KVK Wyra / Khammam, 2019)
Iron and B12 (anaemia prevention)	Indigenous Desi eggs contain higher iron, zinc, and B12 than commercial cage eggs; directly beneficial for anaemic women	57% anaemia prevalence in Indian women (National Family Health Survey-5, 2021); Desi egg micronutrient advantage documented by Padhi (2016)
Child nutritional status	Income from women-managed poultry preferentially directed toward child food expenditure; welfare multiplier effect	Vijayaraghavan et al. (2016): marked child feeding improvement across 335 families in a 3-year Medak district trial
Dietary diversity	Eggs add daily animal-source food to a cereal-dominated rural diet	World Bank (2021) APRIGP: backyard poultry targeted as dietary diversification intervention in tribal habitations
Food security (liquid asset)	Poultry birds are liquid household assetsconsumed or sold in response to income or food shocks	International Journal of Agriculture Extension and Social Development (2024): 35% of households retain birds exclusively for household consumption

Table 2.6. Nutritional benefit categories of backyard indigenous poultry. Sources: Vijayaraghavan et al. (2016); KVK Wyra / Khammam (2019); National Family Health Survey-5 (2021); Padhi (2016); World Bank (2021). *Nutritional impact is not a secondary benefit; it is the primary welfare pathway for the most vulnerable household members. Evidence across three independent Telangana and AP studies is consistent.*

10.3 Ecological Integration with Bio-input and Crop Systems

Indigenous poultry in dispersed household and field-integrated systems provide three categories of ecological service. First, foraging birds consume insects, weed seeds, and small invertebrates, reducing arthropod pest populations without chemical input and supplementing the IPM functions of the bio-input system (Department of Economics and Statistics, Andhra Pradesh, 2020-21; Khadse & Rosset, 2019). Second, poultry manure is a high-nitrogen amendment that complements Jeevamrutam-based BRC inputs, contributing to the restoration of soil organic matter and the rebuilding of the microbial community (Srinivasarao et al., 2014; Rao et al., 2025). Third, rotational poultry access to harvested fields contributes to residue decomposition and weed management, reducing subsequent-season tillage labour.

Part Two synthesis: The case for indigenous poultry pilot investment Income utility is documented from ₹ 12,289 (minimal household scale) to ₹ 1,00,000 (full programme support) per household per year. Nutritional utility is documented by three independent regional studies. Ecological utility is mechanistically established through manure, pest suppression, and residue functions that compound with the bio-input system's value. The constraining factors, disease, predation, and incubation, all have known, costed, and tested responses demonstrated in Telangana and AP.

PART THREE
Cross-Cutting Synthesis

11. Integration, Binding Constraints, and Programme Design Implications

This section establishes that bio-input systems and indigenous poultry are functionally interdependent, not parallel interventions. It consolidates binding constraints and their programme responses and derives six evidence-based programme design implications.

11.1 The Integration Case: Bio-inputs and Poultry as a Single System

The most analytically important finding in this review is the systemic interdependence of bio-input and indigenous poultry interventions. Three biological cycles connect them. The manure cycle: bovine and poultry manure serve as the primary organic substrates for Jeevamrutam preparation and BRC microbial inoculant production. The soil restoration cycle: microbial bio-inputs restore soil biological communities, improving crop yields and quality and increasing the biomass and residue available as poultry feed. The residue cycle: improved crop health yields more and higher-quality stover, which closes the loop as zero-cost livestock feed.

Integration Link	From the Bio-input Perspective	From the Poultry Perspective
Manure → Bio-inputs	Cattle manure = primary substrate for Jeevamrutam; cow urine activates microbial preparations	Poultry manure = high-N supplement to BRC substrate; enhances microbial biomass and product viability
Bio-inputs → Crop health	Microbial inoculants restore soil function, suppress pathogens, reduce input costs, and improve yield quality	Healthier crops + reduced pesticide frequency = safer, richer foraging environment for free-range poultry
Crop residue → Poultry feed	Better crops generate more stover and grain waste for zero-cost supplementary livestock nutrition	Poultry foraging on post-harvest fields removes insects and weed seeds, reducing next-season pest pressure for the crop
Poultry → Soil	Poultry manure N, P, K contribution to the field soil complements bio-input amendments in a compounding effect	Rotational poultry field access contributes to residue decomposition, reducing tillage labour
Economic synergy	BRC enterprise generates ₹ 1.2-2.8 lakh annual surplus; provides cash flow enabling household livestock investment	Backyard poultry income provides a cash buffer, enabling farmers to sustain the first-season bio-input transition
Governance synergy	BRC managed through women's Sangam collectives at the cluster level	CIG Poultry Fund (AP tribal model) uses the same Sangam infrastructure for community-managed revolving chick distribution

Table 3.1. Functional integration linkages between bio-input and indigenous poultry systems in the SCALAGRO model. *The integration logic derives from the documented circular flow of manure, crop biomass, and poultry feed in traditional mixed farming systems. SCALAGRO's programme design intentionally reconstitutes this circular economy. Sources: Department of Economics and Statistics, Andhra Pradesh (2020-21); LEISA India (2023); WASSAN (2025); SCALAGRO Writeshop (2026).*

11.2 Consolidated Binding Constraints and Programme Responses

Binding Constraint	Evidence Base	SCALAGRO Programme Response	Domain
Absent community bio-input supply	Rural markets carry no bio-inputs; only episodic government distribution	Community BRC at DDS-KVK; NMNF infrastructure of 315 BRCs already operational in Telangana (Deccan Chronicle, 2025)	*Bio-inputs*
Inconsistent bio-input quality	Village-produced microbials have variable viable counts; primary technical failure mode	KVK technical backstop; standardised substrates; quality-testing protocol	*Bio-inputs*
No output price premium	Farmers bear transition costs without a certified-market reward	PGS group certification linkage; NMNF single-brand advocacy	*Bio-inputs*
First-season yield risk	Cotton yield dip in the first transition season; marginal farmers cannot absorb the cash flow gap (Newton et al., 2022)	Staggered transition; poultry income as a cash bridge during the transition year	*Bio-inputs + Poultry*
No controlled incubation at the village	30-40% village hatchability is insufficient for programme-scale supply	DDS-KVK incubation centre (1,200 eggs/cycle); egg-exchange pay-forward model	*Poultry*
Newcastle Disease mortality	Unvaccinated flock mortality of 61% documented (KVK Wyra / Khammam, 2019)	Mandatory vaccination at the point of distribution; trained community health worker per cluster	*Poultry*
Predation (75% of mortality)	75% of mortality is predation-caused in the KVK Wyra tribal programme (KVK Wyra / Khammam, 2019)	Predator-proof housing training and demonstration before chick distribution	*Poultry*
Capital barrier	~₹ 300/bird is prohibitive for landless households without credit	Pay-forward egg exchange removes cash barrier; CIG Poultry Fund revolving model	*Poultry*
Knowledge erosion	Ethno-veterinary knowledge eroded; younger women have no backyard rearing experience (Ramdas & Ghotge, 2009)	Structured joint training - ethno-veterinary + modern protocol; hands-on at KVK	*Poultry*
Premium market access	13-27% indigenous bird premium available but requires transport or aggregation (Padhi, 2016)	Village-level aggregation point; direct buyer-farmer linkage; festival season planning	*Poultry*

Table 3.2. Consolidated binding constraints and SCALAGRO programme responses across both intervention domains. *No binding constraint in either domain requires a novel intervention. The challenge is integration and sequencing, not invention.*

11.3 Six Evidence-Based Programme Design Implications

- **Sequence bio-input and poultry interventions in the same village cluster simultaneously.** The circular ecology of the integrated system requires both components to be in the same village during the same season. A BRC without poultry misses half its organic substrate supply chain; poultry without bio-inputs misses the crop-health pathway that generates feed residue (Department of Economics and Statistics, Andhra Pradesh, 2020-21; Khadse & Rosset, 2019).
- **Vaccination is non-negotiable before chick distribution.** The documented 61% flock mortality in unvaccinated tribal programmes makes unvaccinated distribution a programme failure mode. Vaccination cost per chick is negligible relative to the household investment in the bird's lifecycle (KVK Wyra / Khammam, 2019; Alders et al., 2010).
- **Housing infrastructure before birds.** 75% of documented mortality is due to predation, not disease (KVK Wyra / Khammam, 2019). Predator-proof brooding housing must be trained and demonstrated, and preferably constructed, before chicks are distributed. Distributing birds into unprotected environments is the fastest way to destroy programme trust.
- **Embed PGS certification from programme inception, not as a later phase.** The absence of an output price premium is a primary reason natural-farming adopters do not sustain beyond the first season (Press Information Bureau, 2024). PGS group certification must be initiated at programme start to be operational by the first harvest.
- **Use poultry income as the financial bridge during bio-input transition.** The documented first-season yield uncertainty under cotton transition (Rose et al., 2021; Newton et al., 2022) creates a cash flow gap that marginal farmers cannot absorb. Regular income from backyard poultry provides the bridge that makes the transition risk tolerable.
- **Build both interventions on Sangam governance infrastructure, not parallel programme structures.** APCNF's scaling success was institutionally dependent on pre-existing SHG/Sangam networks (Rose et al., 2021). The AP BYP programme's CIG Poultry Fund uses the same governance architecture as LEISA India (2023) and WASSAN (2025). SCALAGRO will use existing Sangam structures for both BRC enterprise governance and poultry pay-forward fund management.

12. Conclusions: The Case for Launching the SCALAGRO Pilots

This section draws together the converging lines of evidence to state, directly and with scientific specificity, why the secondary evidence base justifies proceeding with SCALAGRO pilot investment in both bio-input and indigenous poultry systems in Telangana.

This secondary data analysis has synthesised 47 published and verifiable sources to assess the evidence base for two proposed SCALAGRO pilot interventions. Three conclusions are supported by the data.

First, the problems are documented, acute, and not self-correcting through market mechanisms. Telangana's marginal smallholders face an input cost burden of up to ₹ 13,050 per season on six acres, pesticide intensity more than twice the national average, and measurable soil biological decline under continuous chemical management (Anil Kumar et al., 2024; Manimekalai, 2025; Sunder et al., 2024; Srinivasarao et al., 2014). Backyard poultry, the historic source of household protein and women's income, has declined due to systemic drivers that the market has not corrected (Rajkumar et al., 2021; Ramdas & Ghotge, 2009; Akter et al., 2007; KVK Wyra / Khammam, 2019).

Second, both interventions have been proven at scale in adjacent-state and in-state KVK trials. APCNF's Nature-published causal evidence demonstrates that community-managed natural farming more than doubles farmer economic profits without a yield penalty across 6.3 lakh farmers in Andhra Pradesh (Hussain et al., 2025). KVK Wyra in Khammam, Telangana, documented a six-fold increase in household egg production and a sixteen-fold increase in household income from backyard poultry following the introduction of improved breeds, within the same state, tribal socio-economic context, and agro-climatic zone as the SCALAGRO study region (KVK Wyra / Khammam, 2019). WASSAN's AP tribal BYP programme documented an average income of [1] 1 lakh per household for 1,000 families (WASSAN, 2025). The evidence is not only sufficient in quantity but also regionally specific and methodologically robust.

Third, the enabling environment in 2025–26 is historically unprecedented. The NMNF has invested ₹ 1,323 lakh in Telangana, established 315 BRCs, and registered 61,125 farmers, infrastructure that SCALAGRO can operate within rather than build from scratch (Press Information Bureau, 2024; Deccan Chronicle, 2025). The National Livestock Mission's 80% subsidy for women-managed Mother Units directly finances the hub-and-spoke incubation model established at DDS-KVK Zaheerabad (The Poultry Site, 2024). ICAR-DPR in Hyderabad provides in-state genetic and technical support for the development of indigenous breeds. The Sangam network provides the community governance architecture for both the BRC enterprise and the poultry pay-forward fund management. The remaining binding constraints, bio-input quality assurance at community scale, controlled incubation for chick supply, PGS certification, and market linkage, are precisely the gaps that SCALAGRO's structured pilot design addresses. They are the specific, bounded, and costed functions that justify SCALAGRO's added value above what the NMNF and NLM provide independently.

Final synthesis: Why the evidence base justifies launching the SCALAGRO pilots now

Problem documented. Solution proven. Enabling environment unprecedented. Binding constraints bounded and addressable. The convergence of these four conditions defines a programme opportunity window that is unlikely to recur in the same form: NMNF infrastructure is new and receptive to quality support; KVK Zaheerabad is institutionally positioned and motivated; the Sangam network provides governance at no additional programme cost; and the APCNF evidence base including a 2025 Nature publication provides scientific legitimacy that was not available to earlier programme advocates. SCALAGRO's pilots are not speculative investments in unproven technology. They are a structured effort to translate well-established, regionally proven agroecological solutions into a supported implementation model for Telangana's most economically marginalised farming households.

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