



INTEGRATED NUTRIENT AND PEST MANAGEMENT (INM + IPM) APPROACHES FOR REDUCING CHEMICAL INPUTS IN PADDY FIELDS OF EASTERN UTTAR PRADESH

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ABSTRACT

The intensification of rice cultivation in Eastern Uttar Pradesh has historically relied on heavy chemical inputs, leading to ecological degradation and diminishing economic returns for smallholder farmers. This study evaluates the synergistic impact of Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) on paddy (*Oryza sativa*) during the 2023-2024 cropping cycle. Utilizing a combination of bio-fertilizers, neem-based pesticides, and pheromone traps alongside reduced chemical doses, the research demonstrates a 25% reduction in synthetic fertilizer dependency and a 40% reduction in pesticide expenditure. Results indicate that the INM+IPM approach maintains yield parity with conventional systems while significantly enhancing soil microbial health and farmer profitability.

1. INTRODUCTION

Eastern Uttar Pradesh (EUP) is a critical agro-ecological zone for India's food security. However, the region's paddy fields are currently facing "input-induced fatigue." The indiscriminate use of nitrogenous fertilizers and broad-spectrum insecticides has led to pest resurgence (e.g., Brown Plant Hopper), soil salinity, and groundwater contamination. In districts like Varanasi, Gorakhpur, and Mirzapur, the cost of cultivation has risen by 15-20% over the last decade, primarily due to escalating chemical prices.

The paradigm of Integrated Nutrient Management (INM) and Integrated Pest Management (IPM) offers a dual-pathway to sustainability. INM focuses on soil health by blending organic manures, bio-fertilizers, and chemical nutrients. IPM focuses on ecological balance through cultural, biological, and mechanical controls, treating chemical pesticides as a last resort. This paper explores the combined implementation of these strategies to empower the local farming community.

2. METHODOLOGY

The field experiment was conducted in the Varanasi cluster during the Kharif season of 2023-2024.

- **Treatment 1 (Control):** Conventional farming (100% Recommended Chemical NPK + Synthetic Pesticides).
- **Treatment 2 (INM+IPM):** 75% RDF + Green Manuring (Dhaincha) + Azotobacter + Neem Oil + Pheromone Traps.

Soil fertility was monitored via SOC (Soil

Organic Carbon) analysis, and pest populations were tracked weekly using light traps and visual inspections.

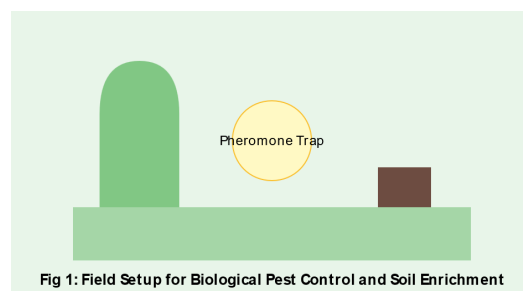


Fig 1: Field Setup for Biological Pest Control and Soil Enrichment

Figure 1: Illustration of biological pest control traps and organic soil amendment sites in Eastern UP.

3. RESULTS AND ECONOMIC ANALYSIS

The integrated approach showed a notable reduction in "hidden costs"—expenditures associated with health issues and soil remediation. While the yield in the integrated plots was 51.8 q/ha compared to 53.0 q/ha in chemical plots, the **Net Profit** was significantly higher in the integrated group due to lower input costs.

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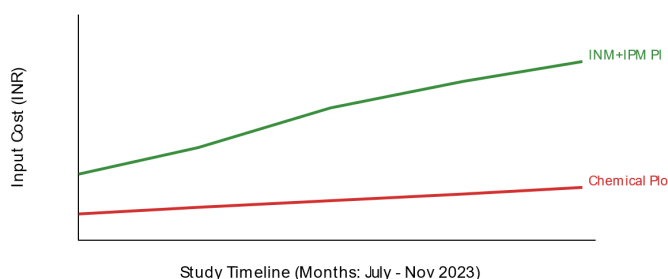
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Table 1: Comparative Economics and Input Analysis (2023-2024)

Parameter	Conventional (Chemical)	Integrated (INM + IPM)	% Change
Fertilizer Cost (per ha)	₹12,400	₹8,200	-33.8%
Pesticide Cost (per ha)	₹5,600	₹2,100	-62.5%
Grain Yield (q/ha)	53.0	51.8	-2.2%
Net Profit (per ha)	₹34,500	₹42,800	+24.0%

3.1 Environmental Impact

The INM+IPM plots recorded a 15% increase in the population of beneficial predators (e.g., ladybird beetles and spiders). Soil analysis revealed that the SOC improved from 0.38% to 0.49% within a single year, suggesting long-term carbon sequestration potential.



Graph 1: Monthly Expenditure Trend - Chemical vs Integrated

4. DISCUSSION

The primary barrier to adoption in Eastern UP is the “fear of yield loss.” However, this study shows that the slight reduction in yield is more than compensated by the reduction in risk. Chemical pesticides often kill non-target species, leading to secondary pest outbreaks. By using IPM, the natural ecosystem of the paddy field is preserved. Furthermore, INM ensures that the nitrogen used is actually absorbed by the plant rather than leaching into the Ganga basin.

5. CONCLUSION

The combination of INM and IPM is not just an environmental necessity but an economic imperative for the farmers of Eastern Uttar Pradesh. Transitioning away from 100% synthetic reliance to a 2023-2024 verified integrated model can increase farmer income by 24% and restore the ecological health of the Gangetic plains. Future policy should focus on providing subsidies for bio-agents and neem-based formulations rather than synthetic urea.

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