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KHET BACHAO ABHIYAN: SAVING OUR FIELDS THROUGH BALANCED AND INTEGRATED NUTRIENT MANAGEMENT

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India's Green Revolution demonstrated the value of mineral fertilisers in raising crop yields and strengthening food security. Over time, however, repeated or imbalanced application - particularly excessive reliance on nitrogen without adequate phosphorus, potassium, secondary nutrients, micronutrients, or organic matter - has contributed to declining nutrient-use efficiency, rising cultivation costs, soil degradation, and nutrient losses to water and the atmosphere. The Khet Bachao Abhiyan responds to this challenge by promoting balanced and judicious fertiliser use rather than an abrupt withdrawal of mineral fertilisers (Food and Agriculture Organization of the United Nations [FAO], 2019; Indian Council of Agricultural Research [ICAR], 2026).

The campaign's central proposition is that fertiliser should be treated as one element within a wider nutrient-management system. Farmyard manure, compost, vermicompost, crop residues, green manures, biofertilisers, and carefully evaluated nutrient-rich by-products can complement mineral sources. When these inputs are selected according to soil condition, crop demand, climate, and local availability, they can maintain productivity while rebuilding soil organic matter and biological activity (Roy et al., 2006).

This article presents the scientific background and a practical implementation methodology for the campaign. Its aim is to help farmers, extension personnel, and local institutions reduce avoidable chemical dependence without compromising yield or income. The approach is therefore gradual, evidence-based, site-specific, and centred on soil health.

Background

Nutrient balance and crop performance: Healthy crop growth requires macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), together with secondary nutrients and micronutrients including sulphur, zinc, iron, and boron. These nutrients must be available in suitable proportions and at the growth stages when crops need them. Excess nitrogen may produce lush vegetative growth, but can also increase lodging, pest and disease susceptibility, nitrate leaching, and gaseous nitrogen losses. At the same time, insufficient P, K, sulphur, or micronutrients constrains yield and reduces the efficiency of applied nitrogen (Roy et al., 2006).

Balanced fertilisation therefore means more than applying a standard N-P-K dose. It requires matching nutrient sources and rates to soil-test results, crop removal, expected yield, previous crop effects, irrigation regime, and the nutrients returned through residues and manures. Blanket recommendations are especially unsuitable across contrasting Indian soils. Many alluvial and Vertisol fields may contain substantial native K reserves, whereas red and lateritic soils can be acidic, strongly P-fixing, and more vulnerable to K depletion.

Soil, water, and health consequences of misuse: Long-term nutrient imbalance and low organic-matter return can weaken soil aggregation, alter pH, reduce infiltration, and diminish the habitat and food supply of beneficial soil organisms. These changes can make fields more compact, erosion-prone, and less resilient to drought or intense rainfall. Excess nutrients that leave the root zone are also an economic loss: nitrate can contaminate groundwater, while nitrogen and phosphorus entering surface waters can stimulate eutrophication. High nitrate exposure in drinking water is a recognised health concern, particularly because of the risk of infant methaemoglobinaemia (World Health Organization, 2016).

The objective is not to replace one input dependency with another. Organic materials vary in nutrient content and release rate, and microbial inoculants require viable formulations, correct storage, and suitable soil conditions. Similarly, industrial by-products may contain useful nutrients but can also introduce salts, trace metals, or other contaminants. Sustainable nutrient management therefore combines agronomic benefit with quality control and risk assessment.

Integrated nutrient management as the campaign foundation: Integrated nutrient management (INM) combines mineral, organic, and biological nutrient sources in a coordinated plan. Mineral fertilisers supply concentrated and predictable nutrients; manures and composts contribute organic carbon and a broader nutrient spectrum; residues and green manures recycle nutrients within the farm; and biofertilisers improve biological nitrogen fixation or mobilise nutrients already present in soil. The proportions should change with the field, crop, season, and resources rather than follow a universal substitution target (Roy et al., 2006).

This principle is consistent with the Khet Bachao Abhiyan's emphasis on Soil Health Cards, balanced fertiliser use, organic inputs, vermicomposting, and biofertilisers (ICAR, 2026). The campaign should therefore be understood as a productivity-and-soil-health programme: it seeks smarter nutrient use, not simply lower fertiliser consumption.

Methodology

Review and synthesis approach

This article is a narrative, practice-oriented technical synthesis; it does not report a new field experiment. The original extension content was reorganised around five evidence domains: balanced plant nutrition, soil and water protection, biological nutrient processes, recycling of farm resources, and field-level decision support. The discussion was aligned with international guidance on integrated plant nutrition and responsible fertiliser management, peer-reviewed literature on biofertilisers and green manures, and current ICAR extension messaging.

Recommendations were screened against four practical criteria: (i) compatibility with soil and crop conditions; (ii) potential to maintain yield while improving nutrient-use efficiency; (iii) feasibility for farmers in terms of cost, labour, and local availability; and (iv) safeguards against contamination or inappropriate substitution. Because this is not a systematic review or meta-analysis, it does not assign universal savings percentages or fertiliser doses. Rates and products must be selected through locally validated recommendations, label directions, and soil-test interpretation.

Field implementation framework

Step 1: Diagnose the field before prescribing inputs

The process begins with representative soil sampling and interpretation of pH, organic carbon, available N, P, K, sulphur, and relevant micronutrients. The diagnosis should also record crop sequence, yield history, residue management, irrigation, drainage, erosion risk, and locally available manures or biomasses. These observations distinguish an actual nutrient deficiency from a constraint caused by acidity, salinity, water stress, compaction, or poor rooting.

Step 2: Construct a balanced nutrient basket

The nutrient plan should combine the minimum effective mineral fertiliser requirement with dependable organic and biological sources. In acidic red and lateritic soils, locally suitable low-grade rock phosphate may provide P gradually, particularly when used with compost, green manures, or other acidifying biological processes. Phosphorus-enriched compost or vermicompost can be prepared by incorporating approved P sources into organic material under a controlled composting process. Such options must be compared with soluble fertilisers on the basis of soil pH, crop duration, and expected response.

Crop demand should guide fertiliser choice. Single superphosphate supplies both P and sulphur and can be useful for pulses and oilseeds where sulphur contributes to protein and oil synthesis. Slow-release P sources may suit longer-duration fruit or plantation systems when soil conditions support their dissolution. Highly soluble diammonium phosphate should not be used merely by habit when a different source better matches the soil and crop.

Step 3: Mobilise nutrients through biological processes

Biofertilisers can complement fertilisers when strains, carriers, storage, and application methods are appropriate. Rhizobium in compatible legumes, Azotobacter, Azospirillum, cyanobacteria, and other plant-growth-promoting microorganisms can support biological N inputs or improve nutrient acquisition. Phosphate-solubilising microorganisms, including selected Bacillus, Pseudomonas, Aspergillus, and Penicillium strains, release organic acids or enzymes that increase the availability of sparingly soluble P; other microorganisms can contribute to K mobilisation. These benefits are strongly influenced by soil and environmental conditions, so inoculants should be quality-assured and demonstrated locally (Khan et al., 2007; Sharma et al., 2013; Vessey, 2003).

Step 4: Build organic matter and recycle farm nutrients

Leguminous green manures such as Sesbania, sunhemp, and cowpea can add biologically fixed N and fresh organic matter to rice-based systems. Green leaf manure from suitable trees, including Gliricidia, Pongamia, and neem, can further supplement nutrients where biomass is safely available. The amount of mineral N that can be replaced varies with biomass production, incorporation time, water regime, and synchrony between decomposition and crop demand; labour and land availability also affect adoption (Becker et al., 1995).

Crop residues, weeds, animal dung, and other farm biomasses should be recycled through well-managed composting or vermicomposting rather than burned or discarded. Mature compost returns carbon and nutrients to the field, while vermicompost can provide biologically active material that supports root growth and nutrient cycling. Feedstock quality, moisture, aeration, decomposition stage, and freedom from contaminants determine the value of the final product.

Step 5: Diversify cropping systems

Cereal-legume rotations and intercropping use rooting patterns, seasonal niches, and biological N fixation more effectively than continuous cereal cultivation. Legumes can reduce the N requirement of the system, while diverse roots capture water and nutrients from different soil layers. The fertiliser plan for the following crop should credit the preceding legume and retained residues instead of treating every season as independent.

Step 6: Improve placement, timing, and delivery

Efficient application is as important as the nutrient source. Because P moves slowly in most soils, placement near the active root zone generally improves access. In puddled rice, basal incorporation and, where feasible, deep placement of urea supergranules can reduce avoidable N losses. Splitting N and K into smaller doses aligned with crop demand is especially useful in sandy, lateritic, or high-rainfall situations where leaching risk is greater. Labour availability, moisture, and farm machinery must be considered when choosing a placement method.

Foliar nutrition can correct a diagnosed in-season deficiency or supplement soil application when root uptake is restricted by drought, salinity, or other adverse conditions. Emerging products such as nano-DAP may improve P-use efficiency in specific crop and application combinations, but results are product-, dose-, crop-, and environment-specific. Recent field evidence in wheat is promising, yet it also supports the need for locally validated protocols rather than blanket replacement claims (Reddy et al., 2025).

Step 7: Evaluate alternative by-products with safeguards

Fly ash, wood ash, rice-husk ash, press mud, and related by-products can contain K, calcium, magnesium, sulphur, silicon, or other useful elements. Their agricultural use should be considered only after laboratory characterisation of pH, salinity, nutrient content, and potentially toxic elements. Source traceability, crop suitability, permitted application rates, and long-term soil monitoring are essential. Fly ash, for example, may improve selected soil properties at low, appropriate rates, but excessive application can suppress microbial activity and increase heavy-metal risk (Pandey & Singh, 2010).

Step 8: Select responsive varieties and monitor outcomes

Varieties that sustain acceptable yield under moderate nutrient supply can improve net returns when the real cost of fertiliser is considered. Each field plan should be evaluated using crop yield, fertiliser cost, labour, visible deficiency symptoms, soil-test trends, organic carbon, and any relevant environmental indicators. Farmer-managed comparison strips can show whether a reduced or rebalanced dose performs as intended before the practice is expanded.

Extension and artificial intelligence support

Location-specific advice is essential because soil type, rainfall, irrigation, cropping pattern, labour, and organic-resource availability vary sharply among villages and farms. Extension programmes should combine soil-test interpretation, field demonstrations, farmer feedback, and training on composting, inoculant handling, and safe by-product use. Demonstrations should compare yield, cost, and soil-health outcomes so that farmers can see that INM means more efficient production rather than forced yield reduction.

Artificial-intelligence decision tools can strengthen, but should not replace, local agronomic judgement. A useful system would integrate soil-test data, crop stage, expected yield, weather forecasts, irrigation, local input availability, and previous field performance. Its recommendations should be explainable, linked to approved agronomic guidance, and reviewed by extension specialists. Feedback from farmers can then refine subsequent recommendations and turn each participating field into a monitored learning site.

Conclusion

The Khet Bachao Abhiyan offers a practical pathway for protecting soil while safeguarding farm productivity. Its message is not that all mineral fertilisers are harmful, but that inefficient and imbalanced use imposes avoidable costs on farmers, soils, water, and society. The most durable response is balanced, soil-test-based fertilisation integrated with organic matter recycling, biological inputs, crop diversification, and better timing and placement.

Implementation should proceed field by field. Reliable diagnosis, quality inputs, locally validated rates, farmer demonstrations, and monitoring are necessary to convert broad principles into economic gains. Biofertilisers, green manures, composts, nano-fertilisers, and industrial by-products each have potential, but none is a universal substitute. Their value depends on matching the intervention to the soil-crop system and managing associated risks.

By combining scientific evidence with farmers' experience, the campaign can improve soil biological activity, nutrient-use efficiency, resilience, and net returns. Protecting the field ultimately protects the farmer: healthy soils support stable harvests, cleaner environments, and more secure rural livelihoods.

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