Promotion of balanced fertilizer use in coconut farming

K. Ponnusamy, V. Selvamani, and P Subramanian
ICAR-Central Plantation Crops Research Institute, Kasaragod, Keralam

1. Introduction

The productivity and profitability are key variables for farmers in coconut farming. Increased productivity will come from an interplay of harnessing biotic and abiotic factors. Soil fertility is the base for better plant growth and ecological sustainability. It supports plant growth and ensures food security. However, continues cropping, imbalancedchemical fertilizers use and poor nutrient management have resulted in soil degradation, nutrient imbalance and productivity decline. The root cause of the "hidden hunger" experienced in the country lies in poor soil health. In this context, it is imperative to promote balanced fertilizer use to realize higher productivity in farming.

2. Current fertilizer usages in coconut

Since soil management happens in the field, it would have been worthwhile to know the

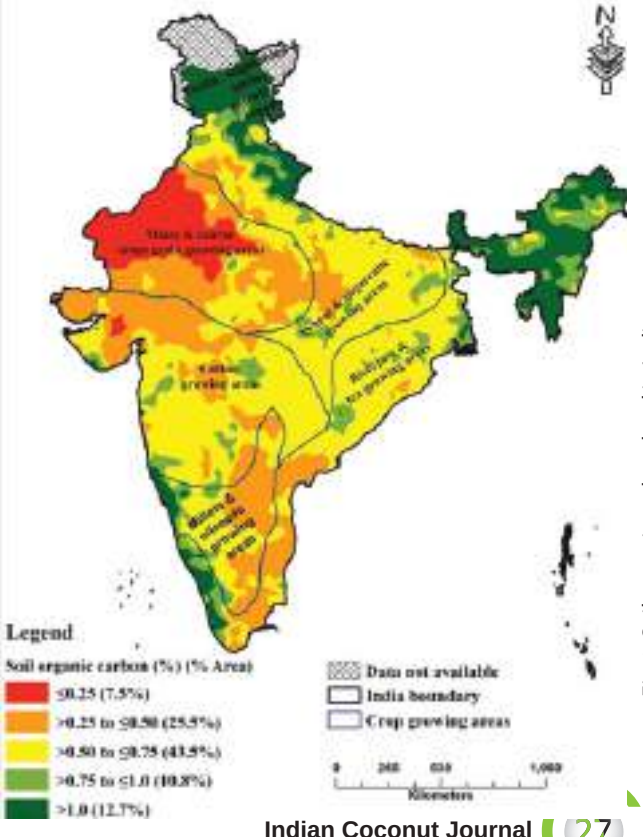

Fig 1. Soil organic carbon level in India

E-mail: ponnusamyk@hotmail.com

understanding level of farmersabout declining soil fertility bythemselves, reasons preventing them from changing the practices, and kinds of support they actually need. While farmers who undertake coconut farming on commercial scale tend to follow recommended fertilizer dosages with or without soil test, resource poor farmers do not follow the recommendations in toto due to several factors. Although, subsidies certainly play an important role in the fertilizer use pattern, farmers' decisions are shaped by a range of other factors such as resource availability, labour constraints, market uncertainty, tenancy arrangements, extension support, and risk aversion. These social and economic dimensions deserve more attention while promoting balanced fertilizer use in coconut farming.

3. Essential nutrient requirement in farming

Coconut needs macro and micro nutrients in right proportions. This includes N, P, K, Ca, Mg, S, B, Zn, Mn, Fe, Cu, Mo, Cl etc. Overuse of nitrogenous fertilisers, and inadequate application of phosphorus, potassium, and micronutrients have eventually resulted in declining soil fertility, lower fertiliser use efficiency, and increasing nutrient imbalance. Soil organic carbon is also very essential and its level for the whole country is depicted in Fig 1.

4 R Approach for balanced fertilization use in coconut farming

The foundation of balanced fertilization is the 4R approach: applying the Right source of nutrients, at the Right dose, at the Right time, and using the Right method. Nutrients do not act in isolation; the deficiency or excess of one element significantly hampers the plant's ability to utilize others, directly impacting overall crop yield.

4. Need for moving towards balanced fertilizer use

In the midst of geopolitical tensions resulting in escalating fertilizer supply disruptions worldwide, high Nutrient Use Efficiency (NUE) practices have become game-changers to enable farmers to maintain balanced crop nutrition while slashing the use of bulk NPK and water-soluble fertilizers by 25 per cent to 50 per cent.Traditional NPK fertilizers, critical for nitrogen (N), phosphorus (P), and potassium (K) supply, face acute global shortages. Production halts, export bans, shortages of basic raw materials such as ammonia and sulphur, and skyrocketing prices are

likely to threaten yields. High NUE practices counter this crisis by delivering nutrients more efficiently to plants, minimizing losses from leaching, volatilization, or runoff-common issues with conventional products that waste up to 50-70 per cent of applied fertilizers.

Campaign for balanced use of fertilizers

Government of India undertook vigorous efforts by launching Balanced Fertilizer Use campaign through involving ICAR institutes, line departments and KVKs. Major emphasis is on motivating farmers to use fertilizers judiciously and strictly according to soil test based nutrient management, integrated nutrient practices and eco-friendly alternatives, citing concerns over the ongoing West Asia crisis and rising international prices of agricultural inputs. Major accomplishments of this campaign are furnished as under:

- 12,979 awareness camps / Sangoshthis / field days / harvest days / exposure visits covering 7.17 lakh farmers.
- 4,916 Sarpanch Sammelan (including current & former Panch/Sarpanch/Zila Parishad members).
- 8383 FPOs/SHGs/FIGs programme for promoting organic resource integration.
- 3,145 trainings on balanced/suitable alternative/ integrated use of fertilizer covering 1,11,509 participants.

- 7,928 demonstrations on green manuring, biofertilizer and other organic sources.
- 9,609 Input dealers' interface for awareness on judicious use of fertilizers.
- Publicity material including banners, posters, and hoardings was displayed at 53,619 locations across the country to create wider publicity.
- 74 messages from VIPs (inc. current & Ex Ministers/ MPs/MLAs) shared with farmers.
- 944 Radio/Community radio talks and 200 TV programmes/digital communications.
- Shared literature and extension materials, and made digital appeal over Social Media (WhatsApp group, Facebook, X and Instagram etc.) covering 2.712 crore users.

5. Efficient resource management practices

Efficient utilization of nutrient resources available within the farm through in situ waste recycling, application of biofertilizers, green manuring and green leaf manuring can provide low-cost nutrient supply and substitute the recommended fertilizers to a certain extent.

Basin management with legume cover crops

Growing of leguminous plants such as Pueraria phaseoloides, Mimosa invisa, Calopogoniummucunoides, cowpea (Vigna unguiculata), sunhemp (Crotalaria juncea), horse gram (Macrotyloma uniflorum), daincha (Sesbania aculeata) and Sesbania spinosa in coconut basins during the monsoon season can contribute about 15–25 kg of fresh biomass and 100–200 g of organic nitrogen per basin.

Cover cropping

Cover cropping is recommended in coconut monocropping systems to prevent soil erosion and to addorganicmatterandnutrientstothesoil.Leguminous crops such as cowpea (Vigna unguiculata), Sesbania aculeata, Mimosa invisa, Pueraria phaseoloides, Centrosema pubescens, Stylosanthesgracilis and Calopogoniummucunoidesare suitable as cover crops. Green manure crops such as sunhemp (Crotalaria juncea) and kolinji (Tephrosia purpurea) can be sown during May- June after pre-monsoon showers and incorporated into the soil during August- September at maximum vegetative growth. Seeds can be produced from National Seed Corporation Centers.

Gliricidia

Planting three rows of Gliricidia sepium at 1 m × 1 m spacing between two rows of coconut and pruning the leaves during February, June and October can produce around 8 t biomass per hectare annually. Application of this biomass can substitute about 90%, 25% and 15% of the N, P_2O_5 and K_2O requirement, respectively. Growing Gliricidia as fence cum green manure crops in coconut growing regions would provide two tonnes of biomass per year.

Biomass recycling through composting

- **Coir pith compost:** A rapid, simple and farmer-friendly co-composting technology for coir pith has been developed. This product is available as "Kalpa Soil Care".
- **Vermicompost:** A technology for vermicomposting of coconut palm wastes using the local earthworm Eudrilus sp. has been developed. This compost product is available as "Kalpa Organic Gold".
- **Vermiwash:** A technology for production of vermiwash from coconut leaf vermicompost has been developed. This product is available as "Kalpa Vermiwash".

Soil amendments

In acidic soils, dolomite or agricultural lime should be applied at the rate of 1 kg per palm per year for coconut and 250–500 g per plant per year for arecanut and cocoa, 15–30 days before fertilizer application. In alkaline soils, gypsum can be applied at the recommended rate based on soil test results to ameliorate soil conditions and enhance nutrient uptake.

Split application

Apply fertilizer in 2 splits under rainfed conditions during May and September, and four equal splits under irrigated conditions during September-October, December, February- March and May

Fertigation

Adopt fertigation wherever irrigation is available which can reduce chemical fertilizer requirement by about 25-50% while maintaining productivity.

Biofertilizers application

Apply "Kera Probio" @ 100 g per palm. It is a talc formulation of Bacillus megaterium and is effective for raising robust coconut seedlings. An Arbuscular Mycorrhizal Fungal (AMF) bioinoculant, "KerAM", has

also been developed as a soil-based AMF bioinoculant for coconut seedlings. Biofertilizers can be procured from State Agriculture Universities.

Coconut wastes as mulch

Coconut leaves, husk and coir pith can be effectively utilized as mulches to reduce soil moisture loss. On decomposition, these mulches enrich the soil organic matter pool and supply nutrients. Coconut husk is particularly rich in potassium and can contribute to potassium nutrition.

At the beginning of the monsoon, coconut husks may be buried with the concave side facing upwards in trenches between coconut rows. The trenches may be 1.5–2.0 m wide and 0.3–0.5 m deep, with each layer of husk covered with soil. Husks can also be placed in a single layer around the base of palms up to a radius of 2 m, with the convex side facing upwards.

Crop diversity for resource-use efficiency

High Density Multi-Species Cropping System (HDM-SCS)

In coconut monocropping, the active root zone of coconut occupies only about 25% of the available land area. The remaining area can be efficiently utilized for growing suitable intercrops. A high density multi-species cropping system involving coconut, black pepper trailed on coconut palms, nutmeg, banana and pineapple enhances crop diversity and increases crop density per unit area compared to monocropping.

Integrated nutrient management practices comprising farm waste recycling, 100g of Azospirillum and 100g of phoshphobacteria application, green manuring and vermiwash application, along with 35% of the recommended fertilizer dose, can produce coconut yield comparable to the application of 70% of the recommended fertilizers. High density multi- species cropping system generates 25 t of recyclable biomass annually and substitute 65% of N&P fertilizer recommendations. Thus, this Integrated Nutrient Management(INM) approach under HDMSCS can save about 35% of chemical fertilizers.

Coconut-Based Integrated Farming System (CBIFS)

A coconut-based integrated farming system can include animal components such as dairy units, goats and poultry, along with crop components such as coconut, fodder grass in the interspaces, banana along the borders and black pepper trailed on coconut palms.

In one hectare of coconut garden, about 120 tonnes of fresh fodder of hybrid Napier grass varieties such as CO 3, CO 4 and CO 5 can be produced annually, which is sufficient to meet the fresh fodder requirement of 8–10 milch animals. Effective recycling of organic wastes generated within the integrated farming system can substitute, the entire nitrogen and phosphorus requirement and nearly 70% of potassium requirement, thereby reducing dependence on external fertilizer inputs and improving resource-use efficiency.

6. Role of CPCRI in promoting balanced use of fertilizers

ICAR-CPCRI, since its inception is actively promoting efficient resource use practices for increasing the coconut productivity. It is involved in conducting frontline demonstrations, training and extension publications on Integrated Nutrient Management (INM). While celebrating World Soil Day every year on 5th of December, CPCRI used to distribute soil health cards to farmers after analyzing available nutrient status. Recently, CPCRI is vigorously undertaking campaign on 'Balanced Fertilizer use' through 15 teams of My Village My Pride (Mera Gaon Mera Gaurav- MGMG) for 45 days in major coconut growing states. Each team carries out campaign activities in 4 – 5 villages and provide inputs for alternative sources of nutrients also.

7. Expected benefits of intensive campaign on balanced fertilizer use

- Balanced nutrient application, preventing deficiencies and excess use

- Improving soil fertility and long-term productivity
- Enhancing crop yield and quality through scientific fertilizer use
- Reduction in input costs by avoiding unnecessary fertilizers
- Increasing nutrient use efficiency for maximum benefit
- Preventing soil degradation (acidity, salinity, imbalance)
- Providing site-specific recommendations for better accuracy
- Encouraging integrated nutrient management, including organic and bio fertilizers
- Eliminating guesswork in fertilizer application

8. Actionable sustainable nutrient use strategies towards Viksit Bharat @ 2047

- Adoption of AI-based fertilizer recommendations for precise decision-making
- Integration with GIS & remote sensing for location-specific nutrient management
- Use of digital soil monitoring tools (sensors, smart systems) for real-time analysis
- Promotion of nano-fertilizers for higher efficiency and reduced losses
- Ensures scientific and balanced nutrient application using Soil Health Cards
- Site-Specific Nutrient Management: Moving away from generalized fertilizer schedules to practices tailored to local soil health.
- Frequent Soil Testing: Regular testing to understand specific deficiencies rather than guessing.
- Split Application: Applying fertilizers in segments throughout the crop growth stages rather than all at once, which increases nutrient use efficiency.
- Modern Innovations: Embracing nano-fertilizers and advocating for subsidy reforms that prioritize a balanced NPK ratio (the recommended 4:2:1 ratio vs. the common 7:3:1 ratio seen in many areas).

9. Conclusion

When soils are deficient in nutrients, especially micronutrients, the food produced from those soils may also be nutritionally poor. Excess or deficient application of nutrients in perennial crops leads to nutrient imbalance, declining soilfertility and reduced yield. Adoption of soil test-based nutrient application, fertigation, in situ biomass recycling, biofertilizers, green manuring, mulching, crop diversification and integrated farming system approaches can improve nutrient-use efficiency and reduce dependence on external fertilizer inputs. These practices support self-sustainable nutrient management, improve soil health and enhance productivity and profitability in coconut farming. As climate variability, supply chain instability, and input cost inflation continue to challenge conventional agricultural models, innovative NUE solutions offer farmers a reliable alternative that combines productivity with sustainability. The ability to maximize nutrient uptake while minimizing wastage is becoming increasingly critical for safeguarding long-term agricultural output. ■