



RESEARCH AND DEVELOPMENT INITIATIVES FOR MANAGING SOIL HEALTH IN INDIA

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Soil health and quality remain a matter of great concern for the Government of India. In the last 25 years government made huge investment in arresting soil degradation and decline in fertility of the soils. For this purpose several developmental schemes have been implemented. Integrated Watershed Management Programme (IWMP) has benefitted thousands of the field functionaries and farmers directly through skill development and capacity building. National Mission for Sustainable Agriculture (NMSA), a recent initiative, is being successfully run across length and breadth of the country. Soil health management, a sub-scheme of NMSA, is promoting soil test-based balanced and integrated nutrient management in the country. Central Government, State Governments and NABARD are providing support in various forms to strengthen soil health programmes in different names. More recently (in 2015), a National Mission on Soil Health Card has been launched to provide soil test-based fertilizer recommendations to all the farmers in the country.

CARBON SEQUESTRATION

The rate and magnitude of soil C sequestration differs with soil quality, climatic conditions, land-use and management. Despite unfavourable climatic conditions, there are considerable opportunities for C sequestration in Indian soils. Adoption of the

best management practices (BMPs) such as intensive agriculture, growing of high biomass producing crops, residue recycling, application of organic amendments, adoption of agroforestry systems, diversified crop rotations, and conservation agriculture can play an important role in enhancing soil C sequestration. Balanced application of fertilizers and integrated nutrient management are other options that have capacity to enhance soil C sequestration by 20-600 and 100-1200 kg C ha⁻¹ yr⁻¹, respectively. Climate change is likely to influence the rates of accumulation and decomposition of SOM, especially in regions with low temperature. Per degree warming may increase SOC loss by 8-9% in regions with temperatures of 10-15°C compared to only about 2% in a soil at 35°C.

STRATEGIES FOR RESTORING, IMPROVING AND MAINTAINING SOIL QUALITY

Some of the strategic approaches for restoring, improving and maintaining soil quality and ensuring agricultural sustainability developed by the researches in the country include

- i. controlling soil erosion
- ii. promotion of agricultural management practices which enhance SOIL ORGANIC MATTER (SOM)
- iii. development and promotion of other bio-resources for enhancing microbial diversity
- iv. revamping and reorientation of soil testing programmes and ensuring site-specific nutrient management
- v. promotion of balanced multi-nutrient fertilizers,
- vi. increasing input (nutrients and water) use efficiency through precision farming techniques,
- vii. amendment of problematic soils
- viii. conservation tillage with promotion of land cover management



- ix. restriction on mining activities and misuse of top soil for other purposes such as bricks making
- x. launching of mass awareness programmes among farmers about importance of land and soil resource and its care, through all possible communication means
- xi. creation of national apex statutory bodies to coordinate land care and soil quality improvement programme in the country.

Additionally, induction of conservation agriculture is a necessity of Indian agriculture. Its application and adoption must be promoted in right earnest. Assessment of Developmental Initiatives Government of India is promoting the soil test-based balanced and INM encompassing chemical fertilizers, biofertilizers and locally available organic manures like farmyard manure (FYM), compost, vermicompost and green manures to maintain soil health and crop productivity.

GOVERNMENT INITIATIVES FOR PREVENTING SOIL EROSION AND RESTORATION OF DEGRADED LAND

In order to prevent soil erosion and land degradation, Government of India, Ministry of Agriculture is implementing various watershed programmes, namely; National Watershed Development Project for Rainfed Areas (NWDPR), Soil Conservation in the Catchments of River Valley Project and Flood Prone River (RVP&FPR), and Reclamation and Development of Alkali and Acid Soils (RADAS) across the country. Ministry of Rural Development is implementing the IWMP for the purpose. About 57.61 Mha area has been developed under various watershed development programmes of the Ministry of Agriculture and Ministry of Rural Development since inception up to 2011-12. Besides, 1.5 Mha of sodic land has been reclaimed using gypsum technology and 0.5 Mha saline land area has been reclaimed using sub-surface drainage technology across the country.

The Government implemented a centrally sponsored scheme 'RADAS' through Macro Management of Agriculture (MMA) Scheme in seven states. Since inception up to March, 2013 almost 9.0 lakh ha has been developed. National Mission for Sustainable Agriculture (NMSA) was launched in April, 2014 with a component of Reclamation of Problem soils (viz., saline, alkali and acid soils). The cost norm under this programme for reclamation of problematic soils is 50% of cost to the limit of Rs. 25,000 ha⁻¹ and Rs 50,000 per beneficiary for salt-affected soils.

FERTILIZER POLICY AND NUTRIENT MANAGEMENT

There is a great concern about the adverse effects on soil health as well as productivity due to widening ratio of N:P:K use due to unsound policy decisions taken earlier, favouring prices of N and ignoring those of P and K. This has now been corrected to some extent. But without wholesome policies on pricing of fertilizers and of the agricultural commodities keeping long-term perspective in view, the impending disastrous effects of nutrient imbalances cannot be ruled out. Keeping in view the conservative population estimate of 1.4 billion needing minimum food-grains of 301 Mt by the year 2025, it will be necessary to use 30-35 Mt of NPK from fertilizer carriers and an additional 10 Mt from organic and biofertilizer sources. Thus, it will be essential for the country to raise the consumption and production of chemical and organic sources of plant nutrients by 2025 to meet these targets.

CONSIDERATIONS FOR FUTURE

Green Revolution technologies created revolutionary and significant growth in food production turning India from a country living on ship to mouth situation to the overflowing granaries during the last five decades. So extensive has been the over-exploitation of the soil resource that most of our soil-based production systems have started showing the signs of fatigue. Consequently, the factor productivity and rate of response of crops to applied fertilizers under intensive cropping systems have been showing progressive decline year-after-year. The current status of nutrient use efficiency is quite low due to deterioration in physical, chemical and biological health of soils. Unfavourable soil physical conditions lead to poor crop yields and fertilizer use efficiency in irrigated as well as rainfed agriculture. Also, the biological indices are reliable as early warning signals of changes in soil health, no attempts have been made to include these indices in soil quality assessment programmes.

Soil health management is a widely studied area in Soil Science across the country, but most of the researches are limited to soil fertility and nutrient management. A lot of basic, strategic and applied research work has been carried out in different agro-ecological regions during the last five decades, leading to a better understanding of soil health and development of viable technology packages based on sound soil and nutrient management strategies. Soil health and quality have remained matters of a great concern for the Government of India. Government has made huge investments in arresting soil degradation and improving the declining status of soil fertility in the country. For this purpose several developmental schemes



have been implemented. In 2015, National Mission on Soil Health Card has been launched to provide soil-test-based fertilizer recommendations to all the farmers across the country. However, shortage of trained technical manpower is a major limitation coming in way of the successful implementation of these programmes. Soil health management at the country-scale is not possible without partnerships and networks. At present these programmes are being implemented through the partnerships among the Department of Agriculture and Cooperation and Farmers' Welfare, Department of Fertilizers, Department of Agricultural Research and Education (DARE) and others. There is an urgent need of fostering strong partnerships and networks for successful implementation of the soil health management programmes at the country-level.

Skill development, capacity building and trainings on soil health management are essential with evolution of new tools and techniques. Use of information and communication technologies

may add value to the relevance of these programmes and make them more meaningful. Therefore, strong hands-on training network should be made an essential part of the successful soil health management programmes. Major policies of Government may be given a serious relook in view of country's changing priorities and to harness the fullest potential of mega initiatives like soil health mission. Some of the important policies, which may be relooked into include diversion of agricultural lands for other competitive uses, nutrient-based subsidy (NBS) and its impact on soil health, efficient use of fertilizer nitrogen etc.
