



**National Seminar On**  
**"Management of Fertilizers for Higher Efficiency and Sustainable Crop**  
**Production"**  
**Indian Institute of Sugarcane Research (IISR), Lucknow on Friday, 8<sup>th</sup> July, 2016**



## Background

The single most important input which greatly influences the soil health, crop productivity and ecological balance is the fertilizer. Application of fertilizers to ensure balanced nutrient supply to crop plants and maintain soil health is assuming great importance in view of the fact that the present pattern of fertilizer use being unbalanced is incapable to maintain soil health, enhance crop productivity and sustain agricultural growth rate. Therefore, efforts are needed to ensure balanced and efficient use of nutrients on the principles of integrated nutrient supply system.

Let us understand this taking UP as an example. The fertilizer consumption (N+P<sub>2</sub>O<sub>5</sub>+K<sub>2</sub>O) in UP during 2014-15 was 167 kg against the national average of 131.8 kg/ha. Nitrogen makes the largest chunk being 124 kg, against 36 kg P<sub>2</sub>O<sub>5</sub> and 7 kg/ha of K<sub>2</sub>O ; the N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O use ratio being 16.9 : 4.9 : 1 which is highly skewed and unbalanced, compared to the normal ratio of 4:2:1. Most amazing is to see the distortion of N:P:K ratio in the so called agriculturally most advanced states in the country like Haryana, Punjab, Rajasthan etc (Table1). Further, what is alarming is the constant deteriorating

N:P:K balance over the time in the country (Fig.1).

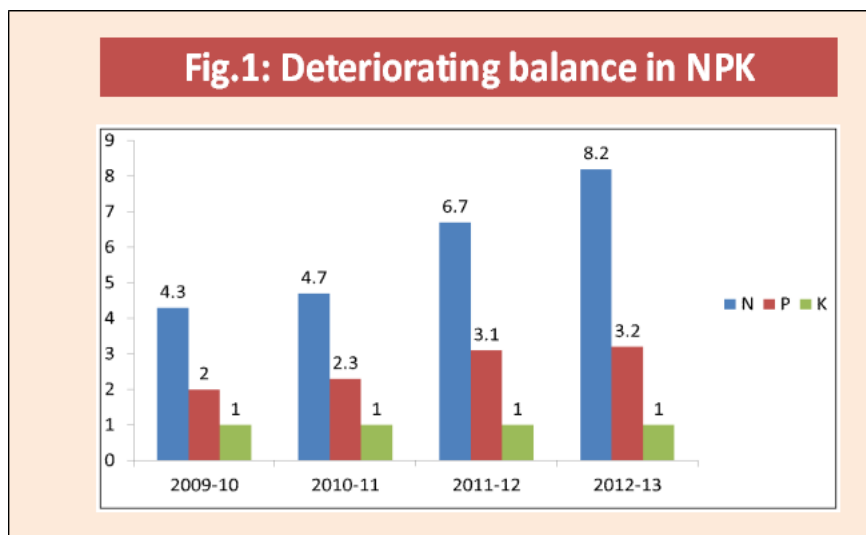
**Table 1: Skewed NPK use...selected States**

| Year    | NPK ratio |             |             |             |                |
|---------|-----------|-------------|-------------|-------------|----------------|
|         | All-India | Haryana     | Punjab      | Rajasthan   | Andhra Pradesh |
| 1       | 2         | 3           | 4           | 5           | 6              |
| 2000-01 | 7.0:2.7:1 | 73.9:21.3:1 | 42.5:11.9:1 | 92.1:30.5:1 | 6.5:2.9:1      |
| 2007-08 | 5.5:2.1:1 | 39.8:10.9:1 | 34.3:9.0:1  | 33.7:12.5:1 | 3.8:1.7:1      |
| 2010-11 | 4.7:2.3:1 | 20.5:7.1:1  | 19.1:5.9:1  | 24.9:11.8:1 | 3.9:2.1:1      |
| 2012-13 | 9.9:3.3:1 | 61.4:18.7:1 | 61.7:19.2:1 | 44.9:16.5:1 | 7.1:2.8:1      |

This distorted NPK ratio affects not only the productivity but also the soil health and leads to soil and underground water pollution. The deficiencies of secondary and micronutrients, particularly of sulphur, zinc and boron are also quite widespread, withholding not only the crop yields, but also continuously exhausting soil nutrient capital at an alarming rate in almost every part of the country.

Keeping the above in mind, a seminar was organized by NEFORD in joint collaboration with IISR Lucknow, on 8<sup>th</sup> July 2016. The seminar was a part of the program of SDIP project, being implemented by NEFORD with CUTS international. The participants (>60) included scientists from Agriculture Universities, ICAR institutes, KVKs and Civil Society Organizations. The seminar focused on the following four issues:

- Low fertilizer use



efficiency and how the same could be improved with higher yields.

- Wide gap between the normal and the actual NPK ratio. Could this gap be minimized and brought near normal? How?
- Implications of external factors, like fertilizer policy, availability, MSP etc., on soil-health and fertilizer use efficiency.
- Soil-health card scheme: its success and effectiveness.

In order to effectively address these challenges and to ensure sustainable soil health and crop yield enhancement, concerted efforts are needed to develop innovative and cropping system specific nutrient management research and extension programmes by involving all stakeholders. The topics delivered and the experts who presented the papers are listed below:

| Topics   | Speakers   |
|--|--|
| 1. Status of demand and supply of different fertilizers in UP.               | Sri Om Veer Singh (Jt. Director-fertilizer, UP)          |
| 2. Soil fertility status and nutrient needs of major cropping systems of UP. | Dr. V.K. Singh (Head Division of Agronomy, IARI)         |
| 3. Fertilizer management for commercial/cash crops like sugarcane.           | Dr. T.K. Srivastava (Principal Scientist-Agronomy, IISR) |
| 4. Nutrient management of salt-affected soils in UP.                         | Dr. Y.P. Singh (Principal Scientist-Agronomy, IISSR)     |
| 5. Precision nutrient and fertilizer management for maximizing FUE           | Dr. B.S. Dwivedi (Head Division of Soil Science, ICAR)   |
| 6. Soil health card scheme: how to make it more effective and purposeful.    | Dr. Vandana Dwivedi (Additional Commissioner-INM, GOI )  |

### Major observations:

The seminar was conducted under the Chairmanship of Dr. S.R. Singh, the former Vice-chancellor, RAU (Bihar) and a renowned scientist himself. Dr. K.N. Tiwari, the ex-Director, Potash institute, delivered the introductory lecture, giving a broad view of the issues related to fertilizer management in India in general and UP in particular. Large scale application of urea and DAP in UP has led to both distortion of N:P:K ratio and deficiencies of micro-nutrients. The mono-cropping and rice-wheat cropping system, and less or no use of organic matter has further worsened the situation. Further, the faulty fertilizer pricing and subsidy policies have also adversely affected the soil health.

The change in cropping system with inclusion of legumes, balanced application of nutrients, application of organic manures, bio-fertilizers, incorporation of crop residues and industrial wastes will go a long way in improving the soil health and FUE. While welcoming the participants, Dr. R.K. Singh emphasized on the widening gap between the normal and the actual N:P:K ratio, low fertilizer use efficiency as well as low yield as major concerns which need to be handled (Table 2). Also, there is a need to have a look on the fertilizer policies and other factors which influenced selection and application of fertilizers affecting soil health. Dr. S.R. Singh, the Chairman, stressed on the need for mechanisation for incorporation of straw (both rice and wheat) in the soil. This will not only enhance the soil quality, but also save the straw from being burnt, causing environmental hazard.

With these initial remarks, the speakers were invited to make their presentation.

Sri Om Veer Singh, Joint Director (fertilizer) UP, made a presentation on "Status of Demand and Supply of Different Fertilizers in UP." Supply of fertilizers against demands plays a vital role in the choice of fertilizers at the time of planting. Often when the desired fertilizer is not available in the market, the farmers purchase whichever fertilizer is easily available. For example, non-availability of DAP at the time of sowing, often delays wheat planting

**Table 2: Status of Nutrient-use-efficiency**

| Nutrient | Efficiency percentage |
|----------|-----------------------|
| N        | 30-50                 |
| P        | 10-20                 |
| K        | <80                   |
| S        | 8-12                  |
| Zn       | 2-5                   |
| Fe       | 1-2                   |
| Cu       | 1-2                   |
| Mn       | 1-2                   |

which results in low yields. Dr. Singh gave a detailed description of the nutrient/fertilizer requirement in the state vis-à-vis consumption of fertilizers. Data indicates that urea and DAP are mostly used by the farmers. The total amounts of N:P:K used during 2015-16 were 180 kg N/ha, compared to 73.23 kg P/ha and 13.83 Kg K/ha. Thus, the N:P:K ratio was 13.01 : 5.32 : 1 against the normal ratio of 4:2:1. Although, as per the data shown by Dr. Singh, the demand of fertilizers are well met in UP, but many participants had a different view. Also, there were doubts about easy availability of micro-nutrients in the state.

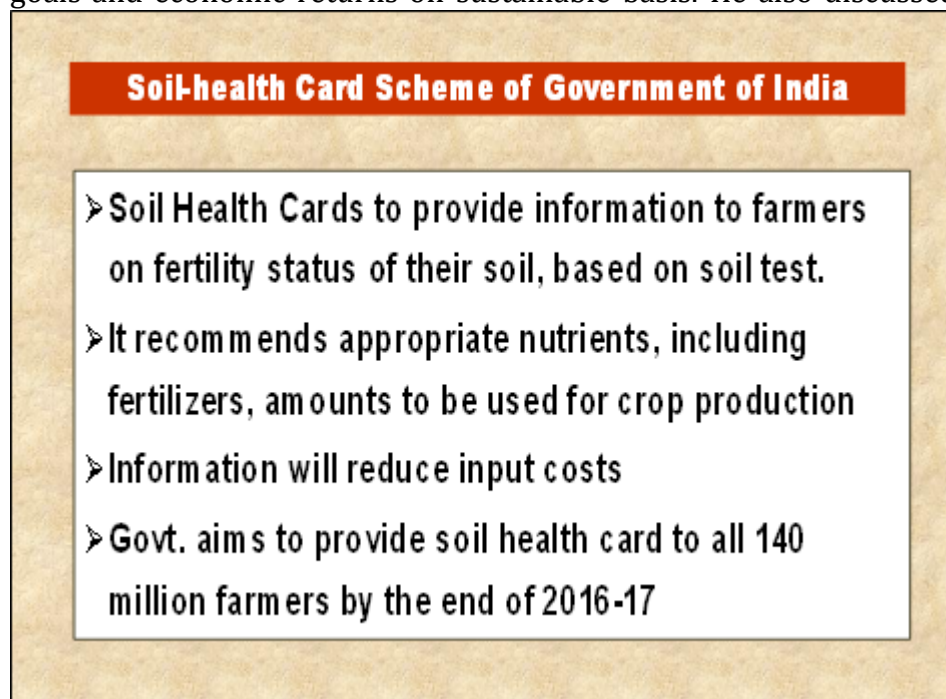
Dr. V.K. Singh discussed the 'Soil fertility status and nutrient needs under pre-dominant cropping systems of Uttar Pradesh'. Dr. Singh's data clearly showed a wide gap between the yields obtained under farmer's practice vis-à-vis the potential under improved practices. He also showed that 93% farmers do not apply potassium (K) while 88% farmers of those who apply K, use it below the recommended dose. Most farmers are also unaware about the role of K in crops. Dr. Singh listed out a number of issues related to the farmers fertilizer management practices in UP. These were : imbalanced fertilizers use and skewed towards N; mismatch of nutrient application ratio with its removal ; substantial nutrient removal from soil in intensive cropping; non availability of fertilizers at peak demand its quality; fertilizer scheduling and its method of application, eradication of legumes from cropping systems; non availability of appropriate technology for residue recycling. Dr. Singh said that the small and marginal farmers don't leave any crop residue in the field. Clearly, it is the problem of bigger farmers. Dr. Singh clearly demonstrated superiority of site-specific nutrient management (SSNM) to farmers practice (FFR) and SR. He also demonstrated the beneficial effects of micronutrients like Sulphur and Zink on crop yields.

Dr. T.K. Srivastava spoke on 'Fertilizer management for commercial/cash crops (sugarcane)'. The salient updates were : there exists a mismatch between N supply and N acquisition ability at the soil root interface; sugarcane ratoon crop is comparatively poor in N acquisition, hence 25% higher N dose is recommended; sugarcane crop response well to applied nutrients when soil organic carbon content is 0.65% or higher;

potassium availability is crucial for ratoon yield; Zinc and Sulphur have started showing response in ratoon; micronutrients play major role as root system is not that efficient.

Dr. Y.P. Singh discussed the 'Nutrient management of salt-affected soils in UP' and listed a number of causes of low productivity in such soils. In order to increase nutrient availability in sodic-soils, Dr. Singh emphasized upon lowering down soil pH and ESP to reduce effect of salts on plant growth through reclamation. Addition of organic matter through press-mud, green manuring, FYM will create favourable plant growth environment. Planting of salt tolerant crop varieties is a better option. His data also showed positive effects of microbial bio-formulations on grain yield as well as on soil properties. Dr. Singh also emphasized upon the selection of suitable cropping sequences according to the stages of soil reclamation.

In his presentation on 'Precision Nutrient and Fertilizer Management for Maximizing Fertilizer Use Efficiency' (FUE), Dr. B.S. Dwivedi discussed the drivers of low FUE and emphasized upon the need for enhancing nutrient use efficiency to achieve high yield goals and economic returns on sustainable basis. He also discussed in detail and gave



**Soil-health Card Scheme of Government of India**

- Soil Health Cards to provide information to farmers on fertility status of their soil, based on soil test.
- It recommends appropriate nutrients, including fertilizers, amounts to be used for crop production
- Information will reduce input costs
- Govt. aims to provide soil health card to all 140 million farmers by the end of 2016-17

experimental evidences and examples of proven ways for improving FUE that included: precision nutrient management such as SSNM, STCR, customized fertilizer, LCC, SPAD etc.; IPNS; inclusion of legumes; sustained release fertilizer materials;

conservation agriculture, etc. Dr. Dwivedi emphasized upon the need for strengthening fertilizer product research, such as, on modified urea materials, PAPR, use of low grade indigenous sources, like RP, mica, sylvite, water soluble fertilizers etc. There is also a need to strengthen R&D to improve FUE, and especially to develop/refine soil test methods, revamp soil testing services, revisit fertilizer prescription approaches, etc.

A question of raised if the industry could develop package of balanced fertilizers including micronutrients and sell it to the farmers? However, no proper answer for this question could be found.

Soil Health Card Scheme is a flag-ship program of the government of India and a lot of emphasis is being given on its implementation to achieve the targets. Dr. Vandana Dwivedi, Additional Commissioner (INM), Government of India who directly deals with this scheme, was to deliver the talk on 'Soil Health Card Scheme: How to make it more effective and purposeful?', but due to some unavoidable reasons could not do so; Dr. B.S. Dwivedi presented her paper, instead. The scheme has four components: (i) The Soil



Health Card; (ii) Training for Soil Analysis; (iii) Financial assistance for nutrient applications; (iv) Abstract of financial norms for capacity building and (v) Mission management. The paper described in detail the scheme of implementation, monitoring and achievements and the challenges. The scheme adopts a cycle of 3 years and each cycle split into year wise targets. The aim is to collect 2.53 crore soil samples and

generate 14 crore cards. Information on 12 parameters: primary nutrients (N: P: K) and secondary nutrient (s); 5 micronutrients (B, Zn, Mn, Fe and Cu), besides others such as pH, EC and OC are to be collected and printed on the card and given to the farmers. For various reasons, the achievements are far from the set targets (Table 3).

| States      | Target in Millions (2015-17) | % of target met |
|-------------|------------------------------|-----------------|
| Maharashtra | 12.97                        | 26.41           |
| MP          | 12.79                        | 9.77            |
| Rajasthan   | 12.76                        | 9.40            |
| Kerala      | 0.7                          | 8.15            |
| Punjab      | 4.62                         | 7.60            |
| UP          | 26.39                        | 5.39            |
| J&K         | 0.91                         | 3.92            |
| Haryana     | 4.36                         | 2.10            |
| WB          | 7.19                         | 1.27            |
| Karnataka   | 9.21                         | 0.68            |

(Source: Ministry of Agriculture)

A paper on 'Latest developments in policy for decontrolled fertilizers' was delivered by Dr. R.K. Nayak (IFFCO) which was prepared in collaboration with Dr. D.S. Yadav. With a brief historical background, Dr. Nayak enlisted the different policies in the past and their weaknesses, notified from time to time and discussed in detail the 'Nutrient Based Subsidy' (NBS) policy, notified w.e.f. 1.4.2010 as an option for gradual reform. The aim of NBS was to ensure balanced application of fertilizers and promote efficiency and competitiveness in the industry. However, since the nitrogenous fertilizer were not covered under NBS policy, the sale of urea increased at the cost of P&K, leading to imbalance use of fertilizer. In view of this, there is a demand to bring urea also under NBS policy. In this connection, it is worth while to note the following:

- After food, fertilizer is the second highest in terms of subsidy (0.73 lakh crore or 0.5 % of GDP). This has led to a high Fiscal Deficit. Also, only 35% of total fertilizer subsidies reach small farmers. The rest leaks out to black market, large farmers and inefficient producers. Further, the administered price of urea is approximately Rs 5000/- per tonne while the average production cost of urea is about Rs. 18000/-per tonne. This means, Government subsidizes 70% of the cost.
- Government subsidizes 30% of the cost on P (Phosphorous) and K (Potassium) fertilizers. Prices of P and K were partially decontrolled under nutrient based subsidy scheme in 2010.

Following above presentations, the house was open for discussion which continued for an hour and finally the major outcomes of the seminars were jotted down.

### **Recommendations and follow up :**

#### **1- Fertilizer management: general**

- In order to accomplish increasing food demand, nutritional security, depleting resource base and environmental threats, efficient management of resources in system perspective is need of hour.
- Location-specific nutrient recommendations for varying yield targets needs to be developed.
- GIS based resource mapping for different cropping systems in various agro-ecologies needs to be emphasized.
- These maps can be integrated with farmer's crop management practices and socio-economic conditions for developing site-specific input prescriptions.
- Integration of agronomic BMPS with nutrient recommendation.
- Strengthen soil testing research and services.
- Improve fertilizer recommendations – look beyond STCR
- Develop/validate/refine SSNM protocols for important cropping systems
- Ensure availability of seed of green manure crops
- Farm machinery for CA??
- Expand arena of fertilizer use research to soil-plant-animal-human continuum (i.e., FUE vs. animal and human nutrition)
- Select more remunerative short duration crops and cultivars which need less water and nutrients so as to minimize effects of climate change.
- Ensure efficient use of organics along with that of fertilizers, bio-fertilizers, crop residues and industrial wastes.

## **2- Fertilizer Management: sugarcane**

- Sugarcane crop responds well to applied organic amendments under both tropical and sub-tropical conditions to an extent that 100 % substitution of inorganic fertilizers is plausible. Keeping this in view sugar factory by product sulphitation press mud cake be mandatorily provided by sugar mills to all the sugarcane growers of their area on a nominal price.
- Recycling of sugarcane trash as mulch in ratoon crop should be widely disseminated and adopted to harness its nutrition potential and also to conserve water and labour needed for hoeing.
- Breeding strategies may be redesigned to develop nitrogen efficient varieties of sugarcane as existing ones has been found to lack in the acquisition capacity of N from the available pool.

## **3- Fertilizer management: sodic soils**

- In sodic soils, apply 20-25% more N than the recommended dose for normal soils that too in splits to compensate volatilization losses.
- For enhancing nutrient use efficiency in sodic soils, reclamation protocol needs to be followed to lower down soil pH and ESP.
- Practice green manuring with sesbania at least once in two year which will add N equivalent to 60-80kg N through urea, and minimize N-losses.
- Promote cultivation of salt tolerant crop varieties and cropping systems.
- Halophilic microbial bio-formulations for enhancing nutrient release and availability needs to be applied.
- Sodic soil needs to be enriched with organic matter through manures, vermicompost, municipal waste compost, etc.

## **4- Soil health card scheme**

- The SHC is an inventory of soil parameters essential for plant growth which tells about how much plant nutrients are available in Soils; their deficiency & sufficiency which are very important to work out the optimum doses of fertilizers, right time and correct method of application for specific crop to maximize crop yields without deteriorating soil health. However, the following questions require appropriate solutions.
  - Grid system of soil-sampling is controversial and flawed.
  - Per farmer holding varies from 0.8 to 1.1 hectare. In 10 hectares area which is the grid size in rain-fed areas, there could be 10 to 15 farmers. How soil-test from one farmer's field could be useful to others?
  - Chemical analysis of NPK and micro-nutrients indicates their availability, without reflecting on soil-fertility, while soil-productivity also includes soil-water relationship, management systems, etc.
  - There are total 1206 soil-testing labs in the country with a capacity of 128 lac samples/annum. So, it would take over 10 years to complete the scheme.
  - Difficulties in implementation: Manpower, lab facilities etc.

### **5- Fertilizer pricing and subsidy policies**

- Active support from govt. for acquisition of assets abroad and availability of adequate funds. According to Fertilizer Association of India (FAI), budget allocations get exhausted in first five months of the financial year due to gross under-budgeting for the fertilizer subsidy in the successive Union Budgets. The year ends with carry forward of huge amount of unpaid subsidy bills which has been of the order of Rs 30 to 40,000 crores for the past few years.
- Complete decontrol of fertilizer sector and bringing urea under NBS policy. There is wide price differential between urea on one hand and P and K fertilizer on the other. For Example, Di-ammonium Phosphate (DAP) retails at about Rs 24,000/- a tonne, which is quite costly. This has discouraged the use of P and K fertilizer, resulting in a serious nutrient imbalance in the soil.
- Simplify payment procedures as approved by CCEA, merger of primary freight with product subsidy and doing away with monthly supply plan P&K fertilizer.
- Fertilizer prices follow the trend in international petroleum prices and, hence, the International market is volatile.
- Most of the Fertilizer manufacturing co-operatives are loss making due to the high interest burden.
- On one hand, tax payers pay for subsidies (and MSP), yet consumers still suffer from food inflation due to low production.
- Farmers don't move to fruits, vegetable, horticulture cropping, because they require special non-Urea fertilizers, which are not easily available at cheap rates.

#### **➤ Follow up:**

- It was decided that the proceedings of the seminar should be sent to all the participants, including CSOs/KVKs and to the concerned Government Departments for necessary action and use. It would be of interest to follow their responses and if need be further discussion may be arranged.













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