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4R NUTRIENT MANAGEMENT IN VARIOUS CROPS- A REVIEW

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Abstract:
The production of food crops worldwide is significantly secured by fertilizers. In fact, it's believed that fertilizers today sustain 40–60% of the world's crop production. The careful use of fertilizer nutrients is necessary to achieve future food security targets. The 4R Nutrient Stewardship standards were created by the fertilizer industry as a method to direct fertilizer Best Management Practices (BMP) in every region of the world.This method was required to address the growing worry that fertilizers are administered carelessly to the harm of the environment. The majority of users are extremely cautious about the rates of nutrients they apply due to the fact that farmers buy fertilizers at international prices in the majority of places, and these prices have been gradually rising over time. The fertilizer industry must unite in its promotion of BMs that support increased nutrient usage effectiveness and environmental sustainability while supporting the farmer's profitability in order to prevent needless policy intervention by governments.When their availability and crop demand are coordinated, nutrient utilization efficiency can be considerably boosted. Fertilizer nutrients can be applied at different times for more effective crop uptake. Other methods include split application times, controlled and slow release fertilizer technology, stabilizers, and inhibitors. Making every effort to retain nutrients where crops can utilize them is referred to as "right position." Small-scale agriculture systems, where the majority of fertilizer is spread sprayed, often without assimilation, present the greatest challenge to this problem. According to research, fertilizer placement can greatly increase fertilizer use efficiency by lowering nutrient delivery rates while simultaneously improving crop responsiveness.

Keywords: *Fertilizer, 4R, Agricultural, Nutrients,farmer.*

Introduction:

The total economic development of India includes agriculture. More specifically, close to 50% of India's national GDP comes from agriculture and related sectors. Food security for India's expanding population, which is projected to reach 1.33 billion people by 2020 (Anonymous, 2014), remains a significant concern. According to a summary of many research by IFPRI (2012), India's foodgrain demand will increase to 293 million (M) t by 2020 and 335 M t by 2026. Since there is less land available per person and there is less room for horizontal growth of the cultivated area, agricultural production must be intensified through higher crop yields per unit area. The 4R Nutrient Stewardship Framework is based on fundamental scientific principles that act as a route map for actions that have the best chance of advancing the social, environmental, and economic objectives of sustainable development. By applying the necessary fertilizers at the proper time and place to match crop demand during several crop growth periods, the

4R nutrient stewardship strategy ensures effective usage of applied fertilizers.

Precision nutrition management is built around this strategy. Farmers should be knowledgeable and informed of fertilization programmes, including what sort of fertilizer to apply, how much to apply, when to apply, how to apply, and where to apply it, before deciding how much fertilizer to apply to any crop. Using the proper source, rate, time, and location for nutrients can dramatically boost crop output while lowering the environmental impact of agricultural nutrients, according to experimental data (Sapkota et al., 2014).A successful nutrient management strategy for increasing sugarcane output, profit, and nutrient use effectiveness is subsurface drip fertigation.the Right Source of Nutrients, at the Right Rate, at the Right Time, and in the Right Place, according to the 4R Nutrient Stewardship principle. The fertilizer must be matched to the crop needs and soil characteristics to be from the right source. The balance of the different nutrients is a key component of the source, and improving nutrient use efficiency globally is a critical challenge. Finally, based on the characteristics of the soil, such as pH, some fertilizer products are favored by others. Simply said, the right rate refers to matching the fertilizer applied to the crop need. When you take into account the various production targets, crop residue management, preceding crop management, influence of legume crops in rotation, etc., this is far from being a successful process.

1 Importance of 4R in Indian Agriculture:

Smallholder farmers in India's intensively farmed regions frequently use nutrients excessively or insufficiently, apply them in an unbalanced way, at the incorrect time, or using improper techniques. Such methods have low crop productivity and financial returns and frequently have a significant environmental impact due to the usage of fertilizer. Several reviews of previous studies have been presented (T. Satyanarayana, Kaushik Majumdar, and Sudarshan Kumar Dutta, 2011; Johnston et al., 2009; Majumdar and Satyanarayana, 2011). Figure 1: 4R Nutrient Stewardship in Indian Agriculture According to the 4R Nutrient Stewardship concept, the ideal fertilizer application parameters are those that result in the favorable social, economic, and environmental results for all parties involved in the plant ecosystem.

Promoting the idea of using the proper sources of plant nutrients for cotton is IPNI agronomic (on the left). Limitations of broad fertilizer recommendations frequently utilized in India are discussed in 6 Better Crops: South Asia / 2016. Such broad recommendations, applied across huge areas, have led to inefficient fertilizer use, low crop output, and unstable farm income. The 4R Nutrient Stewardship framework, on the other hand, encourages the use of nutrients to ensure higher crop yields, better nutrient usage efficiency, and financial stability for small-holder farmers through the aforementioned four "rights" of nutrient management (Majumdar et al., 2013).

2 Implementation For Sustainable Cropping System:

2.1 Right source is the first R: Matching the fertilizer types to crop needs:

1. Are the commercial or manure fertilizer nutrients available for instant or delayed crop uptake?
2. Is there a certain fertilizer mix that works best?
3. What nutrients are present in the soil already?

The soil provides important nutrients to plants in a variety of forms, including nitrate (NO_3^-) and ammonium (NH_4^+)

for nitrogen, primary (H2PO4 -) or secondary (HPO4 2-) orthophosphate for phosphorus, and elemental form (K+) for potassium. Plants take these nutrients through their root systems. Application of fertilizer is a typical method to deliver NPK to meet the crop's nutrient needs. In order to provide the plant with the necessary nutrients for the crop, it is crucial to choose the proper source of fertilizer. The most effective method of applying nutrients is through fertilization. Matching the amount of nutrients to the crop needs at the proper rate.

2.2 Right rate is the second R-Matching amount of nutrient as per crop requirement:

According to Mitscherlich (1909), the dose as the amount of nutrition rises, the growth rate and yields rise, but at decreasing rates.Consequently, using the suggested nutrients in a range of overlapping split doses different crops' nutritional requirementsIt's vital to gain developmental periods.greater uptake of nutrients and cane yield. To get the desired yield, it is important to have information on the number of nutrients (right rate)to be fertigated and applied. The notion applying the appropriate rate is supplying sufficient nutrients for crop production quality objectives (Hochmuth et al., 2014). Overfertilization can occasionally lead to both poison the crop and pollute the basement water.

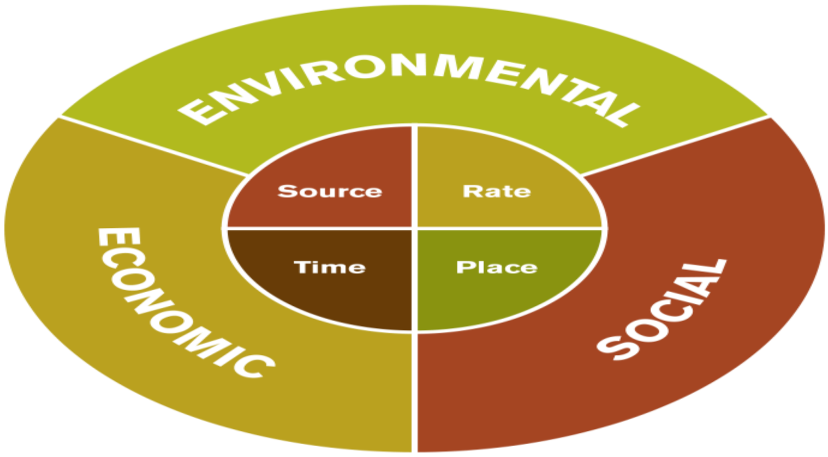

Figure 1: The 4R Nutrient Stewardship concept defines the right source, rate, time, and place for fertilizer application as those producing the economic, social, and environmental outcomes desired by all stakeholders to the plant ecosystem.

2.3 Right Time is the third R: Matching amount of nutrient as per crop requirement:

1.Plan for fertilizer nutrients to be accessible when crops need them, which is frequently just before planting.

2.Take into account the season and weather:Wintertime runoff of nutrients may be higher.

3.Saturated fields are unable to efficiently absorb nutrients.

4. Before a significant rainstorm, fertilizer application may increase the risk of nutrient runoff.

5.A decision-support tool for short-term planning of fertilizer applications is the MI EnviroImpact Tool.

6.Include odor mitigation, especially with manure

2.4 Right Place the 4th R : Lastly, choose the appropriate location:

1.Place fertilizer in the root zone so that plants may get the nutrients there.

2.Based on the following, think about each field's management techniques:

3.crop being raised

4.Type of soil

5.Slope

6.Separation from surface waters

7.Field-specific soil properties, such as the ability to deliver nutrients and its susceptibility to nutrient loss, can vary.

8.The P-Index or phosphorus

9.Integrate GPS and data for variable rate seeding

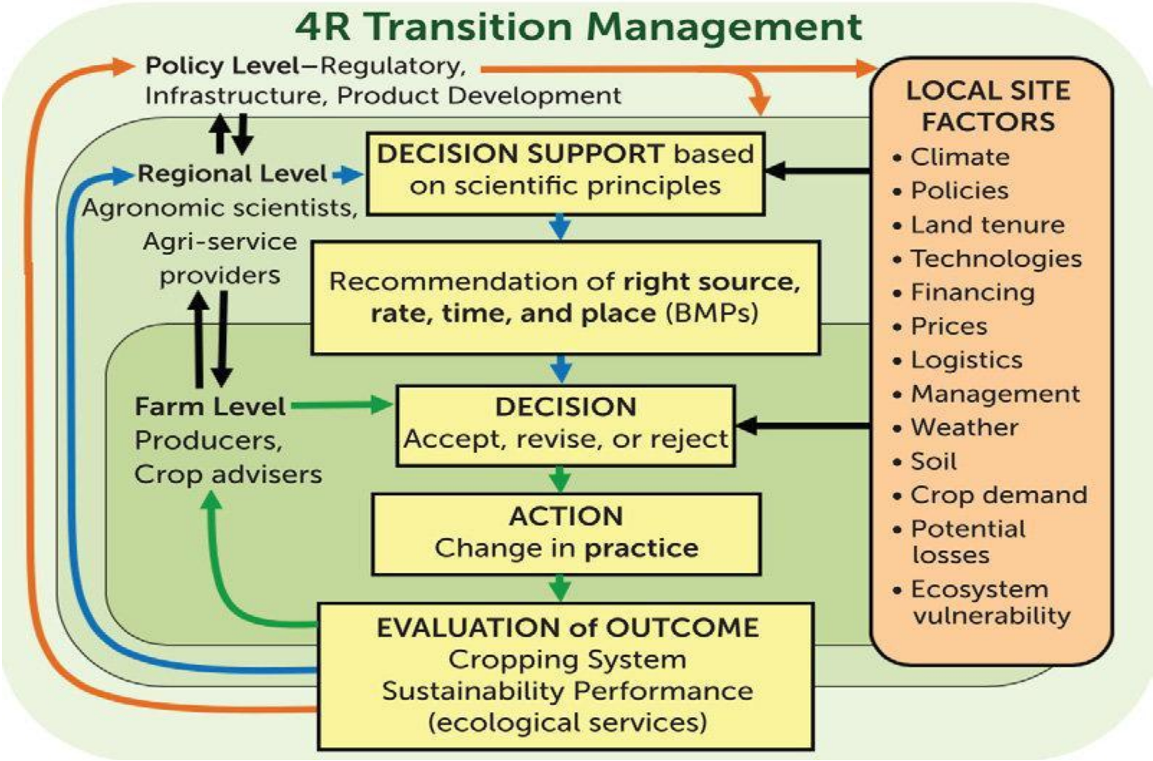

Figure 2: The-4R-nutrient-stewardship-concept-develops-best-management-practices-BMPs- through.

3 Fertilizer Best Management Practices that Address 4R

3.1 Yield Level:

Set attainable yield objectives that are at least 5 to 25% above average using historical data and yield monitors. Review the agronomic elements that are now being managed to grow each crop. Utilizing a complete set of all-proven BMPs for agronomic aspects such variety selection, plant population, row spacing, planting date, tillage practices, balanced fertilizer, and pest control leads to optimal production levels.

The employment of new yield-monitoring technologies in tandem with precision agriculture helps create yield histories that are more trustworthy and accurate. When field variances need to be adjusted, site-specific (within field) management can be employed to boost overall yield and nutrient efficiency.

3.2 Timing of Application:

On soils with a coarse texture, avoid applying nitrogen far in advance of the crop's needs. Applications of fall nitrogen should be limited to fine-textured soils in arid environments with low potential for leaching loss. Select ammonium or ammonium-producing nitrogen sources and wait until soil temperatures at the 4-inch level have fallen below 50 degrees Fahrenheit before applying them in the fall to spring crops.Make sure there is enough phosphorus available to support healthy seedling growth. The effectiveness of phosphorus banding on high-phosphorus-fixing soils is increased.

3.3 Nitrogen Application in Split

For both small grains and row crops, take into account split-nitrogen applications based on crop needs and plant growth stages. Among the possibilities for fertilizer application time are preplant, starter, top-dress, side-dress, and fertigation. Calculating extra nitrogen requirements can be aided by plant-soil studies. To ensure that crop yields do not suffer from a lack of nitrogen, application timing is crucial.

3.4 A Proper and Balanced Nutrient Supply

Manage to ensure that all necessary nutrients are present in sufficient amounts and are balanced with the need for nitrogen. To help assess need, soil testing is a crucial management tool. When calculating overall nutrient requirements, one must take into account the crops planted, the crop residues produced, and the crop rotation being used.

3.5 Correct ApplicationMethod

Use solid urea and urea-ammonium nitrate (UAN) liquid fertilizers as subsurface or surface band treatments in high-residue cropping systems to prevent nitrogen tie-up in crop residues or nitrogen loss by ammonia volatilization. If you use tillage, add broadcast urea, UAN, and manure to the soil to prevent ammonia volatilization and runoff losses.

3.6 Manure Credit

For any animal manures that are available, get a lab analysis. Subtract the entire amount of fertilizer required from the amount of nutrients present. Subtract this amount of nitrogen from the total amount needed by the crop and use crop advisor predictions for the rate of nitrogen release.

3.7 Soil and Tissue Testing: These tests aid in figuring out how much nitrogen and phosphorus are present in the soil or in the crop that is growing. The recommended soil and tissue sample methods for nitrogen depend on the crop and the country's diverse regions. Use crop expert advice to choose the testing procedures and nitrogen credits to apply.

Finding out the relative phosphorus condition of the soil is the first stage in phosphorus management. Corrective treatments must be done to raise the soil test phosphorus levels to the appropriate range if the soil lacks sufficient levels of phosphorus for optimum growth. When phosphorus soil test values are high, crop removal should be equal to application rates.

3.8 Irrigation Water Credits:

Analyze the nitrate-nitrogen content of irrigation water. The estimated nitrogen that is applied through irrigation water should be deducted from the total amount that the crop requires.

3.9 Control of Erosion:

Utilizing agronomic BMPs and conservation tillage techniques together helps to prevent soil erosion and maintain soil and nutrient levels. Controlling erosion lowers the loss of all nutrients, increases nutrient effectiveness, and enhances water quality.

3.10 Use of Cover Crops:

In locations with heavy rainfall, the use of winter cover crops can help stop nitrate-nitrogen from leaching. Relative nutrients are absorbed by cover crops, which then replenish the soil for the succeeding crop.

Conclusion:

Enhancing crop productivity and nutrient use efficiency most definitely depends on precise nutrient management (NUE). This might be accomplished by employing the 4R principles, which call for providing the right nutrients from the right source in the right amount at the right time in the right place. The drip fertigation system, in particular the subsurface drip fertigation (SSDF) system, has the capacity to deliver the proper dose of fertilizer nutrients at the proper location at the proper time as and when the plants require them. This is in accordance with the 4R nutrient stewardship approach. SSDF is regarded as an environmentally favorable method since it reduces the fixation of P and K in soil and prevents pollutants associated with fertilizers, including leaching (also of applied K), volatilization, and denitrification losses of nitrogen.

The establishment of balanced sets of indicators for performance in the economic, social, and environmental spheres is a goal for industry. Applying the right source at the right rate, at the right time, and in the right place are the three R's of 4R Nutrient Stewardship, which stress sustainability. The full impact of their actions on sustainability must be taken into account by everyone involved in the application of crop fertilizers, from those who make the applications to those who make recommendations. Support at the policy level is required for the creation and delivery of decision support for site-specific adaptive management methods.

References:

1.Anonymous,2014. United States Census Bureau http://www.census.gov/population/international. Accessed on 11th April, 2014.

2.Bar-Yosef B, Martinez HJJ, Sagiv B, Levkovitch I, Markovitch I, Phene CJ.1991. Processing tomato response to surface and subsurface drip phosphorus fertigation. Bard Project Scientific Report, Bet Dagan. 175- 91.

3.Biswas BC. 2010. Fertigation in High Tech Agriculture: A Success Story of A Lady Farmer. Fertilizer Marketing News 41(10): 4-8

4.Griffith B.and Moody L.202. 4R's Chapter"The Efficient Fertilizer Use Manual",

5.Hochmuth G, Mylavarapu R, Hanlon E. 2014. The four Rs of fertilizer management. Univ. of Florida, Electronic Data Information Source.

6.Johnston, A.M., H.S. Khurana, K. Majumdar, and T. Satyanarayana. 2009. Jornal of Indian Society of Soil Science. 57(1):1-10

7.Mitscherlich EA. 1909. The law of the minimum and the law of diminishing soil productivity (In German). Landwirtschaftliche Jahrbuecher, 38: 537-552.

8.Majumdar, K., A.M. Johnston, S. Dutta, T. Satyanarayana, and T.L. Roberts. 2013.Indian Journal of Fertilisers. 9(4):14-31.

9.Majumdar, K. and T. Satyanarayana.2011. Karnataka Journal of Agriculture Sciences. 24(1):81-85.

10.Majumdar, K., P. Dey, and R.K. Tewatia. 2014..Indian Journal of Fertilisers. 10(5):14-27.

11.Sapkota TB, Majumdar K, Jat ML, Kumar A, Bishnoi DK, McDonald AJ, Pampolino M. 2014. Precision nutrient management in conservation agriculture based wheat production of Northwest India: Profitability, nutrient use efficiency and environmental footprint. Field Crops Research 155: 233-244.

12. Sapkota TB, Majumdar K, Jat ML, Kumar A, Bishnoi DK, McDonald AJ, Pampolino M. 2014. Precision nutrient management in conservation agriculture based wheat production of Northwest India: Profitability, nutrient use efficiency and environmental footprint. Field Crops Research 155: 233-44.