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A CASE STUDY

Crop diversification to enhance nutrient use efficiency in Indian scenario

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Abstract : Indian agriculture is now facing second generation problems like raising or lowering of water table, nutrient imbalance, soil degradation, salinity, resurgence of pests and diseases, environmental pollution and decline in farm profit. About 2.5 million tone of additional food grains are required annually in the next 10 years to meet the demand of the growing population. This is a huge challenge as it has to come from shrinking both in quality and quantity. Crop diversification shows lot of promise in alleviating these problems through fulfilling the basic needs and regulating farm income, withstanding weather aberrations, controlling price fluctuation, ensuring balanced food supply, conserving natural resources, reducing the chemical fertilizer and pesticide loads, environmental safety and creating employment opportunity.

Key Words : Crop diversification, Management, Nutrient use efficiency

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INTRODUCTION

Crop diversification has been recognized as an effective strategy for achieving the objectives of food security, nutrition security, income growth, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development and environmental improvement. The necessity for crop diversification arise on account of the need for (i) reducing risks associated with yield, market and prices, (ii) arresting the degradation of natural resources and the environment and (iii) attaining national goals like employment generation, self-reliance in critical crop products and for earning foreign exchange. It also acts as a powerful tool in minimization of risk in farming. These considerations make a strong case for farm/crop diversification in India (Gupta and Tewari,1985).

Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crop whereas nutrient use efficiency (NUE) may be defined as yield per unit input. In agriculture this is usually related to the input of fertilizer,

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whereas in scientific literature the NUE is often expressed as fresh weight or product yield per content of nutrient. Improvement of NUE is an essential pre-requisite for expansion of crop production into marginal lands with low nutrient availability. The nutrients most commonly limiting plant growth are N, P, K and S. NUE depends on the ability to efficiently take up the nutrient from the soil, but also on transport, storage, mobilization, usage within the plant, and even on the environment

Nutrient use efficiency can be expressed several ways. Mosier *et al*. (2004) described 4 agronomic indices commonly used to describe nutrient use efficiency: partial factor productivity (PFP, kg crop yield per kg nutrient applied); agronomic efficiency (AE, kg crop yield increase per kg nutrient applied); apparent recovery efficiency (RE, kg nutrient taken up per kg nutrient applied); and physiological efficiency (PE, kg yield increase per kg nutrient taken up). Crop removal efficiency (removal of nutrient in harvested crop as % of nutrient applied) is also commonly used to explain nutrient efficiency.Improving nutrient efficiency is an appropriate goal for all involved in agriculture, and the fertilizer industry, with the help of scientists and agronomists, is helping farmers work towards that end. However, effectiveness cannot be sacrificed for the sake of efficiency. Much higher nutrient efficiencies could be achieved simply by sacrificing yield, but that would not be economically effective or viable for the farmer, or the environment.

This relationship between yield, nutrient efficiency, and the environment was ably described by Dibb (2000) using a theoretical example. For a typical yield response curve, the lower part of the curve is characterized by very low yields, because few nutrients are available or applied, but very high efficiency. Nutrient use efficiency is high at a low yield level, because any small amount of nutrient applied could give a large yield response. If nutrient use efficiency were the only goal, it would be achieved here in the lower part of the yield curve. However, environmental concerns would be significant because poor crop growth means less surface residues to protect the land from wind and water erosion and less root growth to build soil organic matter. As you move up the response curve, yields continue to increase, albeit at a slower rate and nutrient use efficiency typically declines.

Reasons for low nutrient use efficiency :

Imbalanced fertilizer use :

Farmer always try to use nitrogenous fertilizer due to this plant look greenish and tall but there is deficiency of another primary, secondary and micronutrient. Due to the lack of another primary, secondary and micronutrient farmers not achieve targeted yield, ultimately nutrient use efficiency declined.

Some states following NPK consumption ratio (4:2:1) at higher rate and some states following lower following NPK consumption ratio.

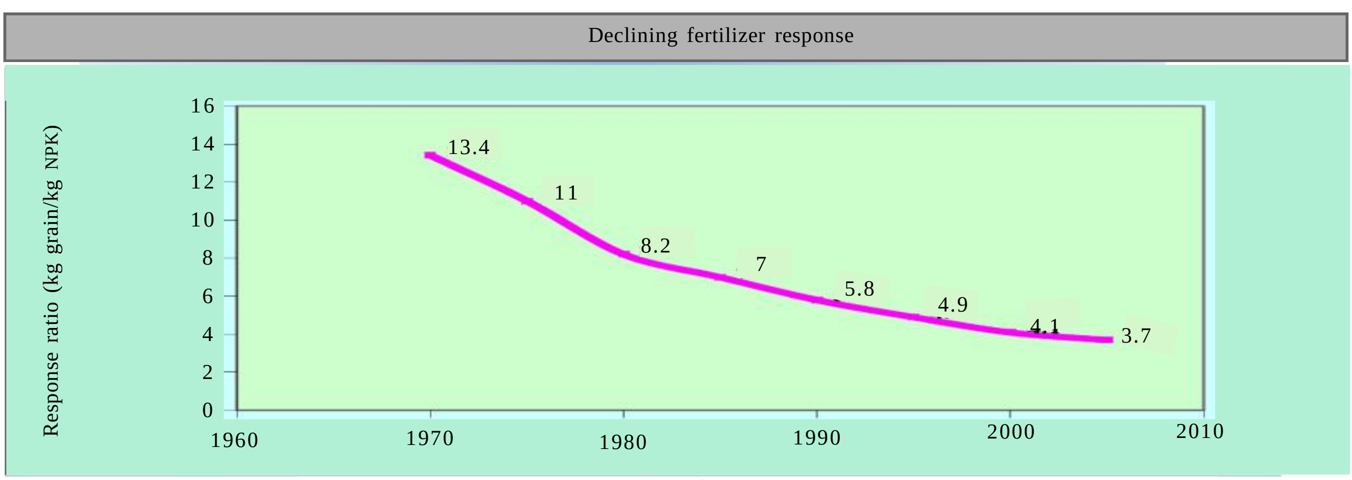
Inadequate use of secondary and micro nutrients :

Singh (2011) projected that in 2025 almost all primary, secondary and micro nutrients will be deficient however, food grain production will be increases continuously.

Declining fertilizer response :

Nutrient use efficiency can be enhanced through :

Slow release fertilizer, control release fertilizer,



Source: Department of Agriculture and Co-operation

Fig. 1 : Declining fertilizer response

smart release fertilizer, customized fertilizer and value-added fertilizer, therefore, nutrient should be applied at:

- –Right dose - through soil testing
- –Right time-synchrony between crop demand and nutrient supply. split dose of nitrogen, using chlorophyll meter, SPAD, LCC
- –Right place and
- –Right crop management.

Kumar *et al*. (1996) observed the effect of rice-rice was check cropping system and they concluded that the rice yield equivalent yield was found higher in rice-rice which was significantly higher to all the rest treatment but at par with rice-rice, rice-maize, rice-sunflower rice-groundnut. Lower rice yield equivalent yield was found in rice-Indian mustard due to lower yield of Indian mustard. However nutrient use efficiency for N, P, K recorded in rice-groundnut, rice-sunflower and rice-green gram, respectively. Benifit cost ratio recorded higher in rice-sunflower. Chitale *et al*. (2003) was found in a trial conducted on rice-wheat-fallow to check cropping system and they concluded that the rice yield equivalent yield was found higher in rice-potato-cowpea which was significantly higher to all the rest treatment. This system produced additional yield of 150 per cent over rice-wheat-fallow,152 per cent over rice-table pea-maize and 168 per cent over rice-mustard –GM cropping system. Higher productivity of rice-potato was owing to the replacement of wheat with high value and high priced potato in the system along with the cowpea as a vegetable crop in summer. However, nutrient use efficiency for N, P, K recorded in rice-potato-cowpea cropping system. Benefit cost ratio recorded in rice–brinjal-GM due to the lower cultivation cost and higher selling price. Rice-potato-cowpea cropping system. Rice –brinjal-GM and rice –onion-GM also enhances soil fertility status. Wallia *et al*. (2006) conducted experiment and they took rice-wheat as check crop sequence and concluded that rice yield equivalent yield was found higher in maize-potato-onion which was significantly higher to all the rest treatment. Maize-potato-onion crop sequence save water. REY is higher due to high yield of potato and onion crops and ultimately enhances system productivity. However, nutrient use efficiency for N, P, K recorded in groundnut-toria+gobhi sarosn is mainly due to higher yield price and potential and due to Leguminous crop. Benefit cost ratio significantly recorded higher in rice-potato-green gram to the rest treatment. Tuti *et al*. (2007) conducted an trial they concluded that PEY (kg/ha) recorded significantly higher in pigeonpea-wheat to rest of all treatment but at par with pigeonpea-lentil mainly due to fairly good yield of wheat and its good market price and also due to pigeonpea leguminous crop. Same trend follow through pigeonpea–lentil crops. Higher biomass production resulting in more efficient utilization of land and available resources. However, Nutrient use efficiency for N, P, recorded higher in pigeonpea-lentil and for K pigeonpea-wheat. Benefit cost ratio significantly recorded higher in pigeonpea-lentil to the rest treatment. Chaudhary *et al*. (2008) conducted an trial, maize-fallow was check cropping system and they concluded that the maize yield equivalent yield was found higher in maize-tomato which was significantly higher to all the rest treatment and at par with maize cauliflower. Irrespective of highest yield, potato based system recorded lower MEY than tomato, cauliflower and cabbage based cropping system. This difference is mainly due to the high sale price realized for these crops in the market than potato. However, nutrient use efficiency for N, P, K recorded higher in maize-frenchbean, maize-cabbage and maize-cabbage, respectively. Benefit cost ratio recorded higher in maize-tomato.

Conclusion :

The review studies shows that for nutrient use efficiency may be inhance through effective crop diversification in Cereals, the major culprit for low NUE. The most prominent option is : Diversification of cereals with leguminous crops, through Inclusion in the cropping system in between or as an inter crop besides improving NUE, diversification maintains soil health and enhances economic condition of small .

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