
Factor productivity, nutrient and harvest status of rice in farmers' fields of Ghagrahat

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Abstract

Rice is the lifeline of food security in Asia, feeding billions and sustaining rural economies. Yet, productivity in farmers' fields often lags behind research station yields due to constraints in factor efficiency, nutrient management, and harvest practices. Understanding these dimensions is critical for bridging yield gaps, improving resource-use efficiency, and ensuring sustainability. This paper explores factor productivity, nutrient dynamics, and harvest status of rice in farmers' fields, drawing insights from field surveys and agronomic studies. Temporal and spatial variability of the major nutrients in farmers field are the important factors leading to skewed paddy productivity in the farmers' fields. The results of this exploratory study organized in 40 farm sites around Ghagrahat representing Indo gangetic plains indicated variability among farm sites for productivity, soil nutrient supply and nutrient use efficiency by genotypes. Rice productivity across different agro ecosystems varied widely. Nutrient harvest index calculated across farmers' field at these sites indicated steep variation for all the nutrients due to poor nutrient concentration in the grain and straw. To find out the contribution of a single fertilizer factor in the productivity of rice, the partial factor factor protuctivity was calculated. At Ghagrahat PFP was found to be 44.86% for N, 115.53% for P_2O_5 . At Mandya, the values of IE and nutrient ratios indicated sharp differences among farm sites with regard to nutrient uptake, genotypes indicating highly imbalanced nutrition which do not match with the crop nutrient requirements. This suggests for refinement of the current fertilizer practice being followed by the farmer.

Key words: Factor Productivity, Nutrient, Harvest, Rice, Farmers' Fields, Ghagrahat

Introduction

Rice productivity in farmers' fields is shaped by the interplay of factor efficiency, nutrient dynamics, and harvest management. Field surveys across diverse agro-ecological zones reveal wide variability in factor productivity, largely influenced by soil fertility, irrigation practices, and varietal choice. Imbalanced input use—particularly

excessive nitrogen with limited phosphorus and potassium—has led to declining nutrient use efficiency and widening yield gaps. Genotypic differences among rice varieties further determine nutrient uptake and conversion efficiency, underscoring the need for site-specific nutrient management. Nutrient assessments highlight

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deficiencies in phosphorus, potassium, and micronutrients, while nitrogen remains over-applied, creating skewed nutrient profiles. Integrated nutrient management (INM), combining balanced fertilizers, organic amendments, and biofertilizers, emerges as a sustainable pathway to restore soil health and enhance productivity. Harvest status surveys indicate yield gaps of 1–2 t/ha between research station trials and farmers' fields, attributed to nutrient imbalances, pest incidence, and suboptimal agronomic practices. Post-harvest inefficiencies—such as delayed harvesting, poor threshing, and inadequate storage—further reduce effective productivity. Mechanization and improved post-harvest handling can significantly minimize losses.

Materials and Methods

In about 40 farmer sites out of the identified farms including the frontline demonstrations representing the region / rice ecosystem in the district fields were selected among the survey sites and farmers fertilizer practice (FFP) were recorded for estimating soil nutrient supply and fertilizer efficiency parameters. These field sites truly represented the district/rice growing region covering major and dominant rice ecosystem / soil types and representing all strata of farmers (Small, marginal and large) and crop management levels recording low to high productivity levels. GPS coordinates (longitude, latitude and altitude data) of the selected farm sites were also collected for use in mapping. Bulk/composite soil sample (0-15 cm) from each of the selected farm holdings before land preparation and analyse for all physico chemical characters (available N, P_2O_5 , K_2O , pH and organic carbon content) on air dried, processed soil were performed. Recorded

all package of practices followed by the farmer particularly with regard to manures applied (quantity/ha), nutrient (NPK) contents in the manures, fertilizer practices, timing, and plant protection measures followed by each farmer. Information were collected regarding the variety planted/sown, date of sowing nursery, nursery management, date of planting, age of seedlings at transplanting, 50% flowering, harvest date and duration of the crop in each farmer's field.

Results and Discussion

Important soil fertility characteristics (pH, SOC, available N, P and K) analysed prior to planting from the farmers' fields is presented in the Table 1. The parameters assessed showed a fairly wide range of variability. Soils at Ghagraghat were sandy loam in texture with pH 7.2 to 8.6, 0.23-0.55% soil organic carbon, 165- 291 kg/ha available N, 19.30-54.60 kg/ha available P and 123 to 285 kg/ha available K. Hybrids, in general, recorded higher yields than HYVs. Earlier studies have been reported by (Sharma, et al. 2020, 2022, Brajendra et al. 2022, Tuti, et al. 2022).

The yields ranged from 3.47 t/ha to 7.50t/ha at Ghagraghat indicating substantial variability among the farm (Table 2). Grain and straw nutrient concentration varied considerably at the test locations. Higher nutrient concentration in grain and straw were recorded in the samples at Ghagraghat, indicating wide variations in the nutritional status of the crop as also reflected by low soil nutrient availability and highly imbalanced fertilizer use by the farmers. Nutrient accumulation in grain indicated an average harvest index (translocation) of 85.09, 82.59 and 19.25 per cent at Ghagraghat, broadly reflecting the dry matter yields (Table 3). Nutrient

Table 1: Soil characteristics in the farmers field prior to planting during Kharif 2012

Parameters	Min	Max	Average	Sd
Ghagraghat, UP				
pH	7.20	8.60	7.92	0.39
SOC%	0.23	0.55	0.35	0.08
Avail. N (kg/ha)	165.00	291.00	202.40	32.08
Avail. P_2O_5 (kg/ha)	19.30	54.60	36.65	9.81
Avail. K_2O (kg/ha)	123.00	285.00	191.98	36.67

Table 2: Grain and straw yield, % variations during Kharif 2012

Parameters	Min	Max	Average	Sd
Ghaghraghat, UP				
Grain(t/ha)	3.47	7.50	4.96	1.28
Straw(t/ha)	4.23	9.78	6.27	1.79
Parameters	N (%)	P (%)	K (%)	Sd
Ghaghraghat, UP				
Grain	1.23	0.39	0.33	0.05
Straw	0.40	0.06	1.14	0.06

harvest index calculated across farmers' field at Ghaghraghat, indicated steep variation for all the nutrients. Unlike the grain yields, the nutrient harvest index recorded at Ghaghraghat was substantially higher.

Table 3: Nutrient uptake and harvest index

Parameters	Grain	Straw	NHI	Sd
Ghaghraghat, UP				
N(kg/ha)	62.11	26.41	85.09	25.56
P ₂ O ₅ (kg/ha)	20.24	4.26	82.59	41.38
K ₂ O (kg/ha)	17.41	72.99	19.25	31.57

Internal efficiency (IE, kg grain/kg nutrient accumulation) varied between the sites and genotypes. Average IE for hybrids at Ghaghraghat was 79.99, 241.45 and 285.41 kg grain/kg N, P₂O₅ and K₂O respectively (Table 4). This works out to a nutrient accumulation ratio of 17.82 kg N at Ghaghraghat, 4.93 kg P₂O₅ at Ghaghraghat per ton of

Table 4: Internal efficiency of nutrients in hybrids and HYVs Kharif 2012

Parameters	Internal efficiency	Soil efficiency (%)	Fertilizer use efficiency (%)	Partial factor productivity	Nutrient requirement
Ghaghraghat, UP					
N	79.99	43.73	87.72	44.86	17.82
P ₂ O ₅	241.45	66.86	23.94	115.63	4.93
K ₂ O	285.41	47.01	88.14	124.22	18.19
SD	31.18	12.51	36.94	43.55	7.55

grain. Soil efficiency worked out at Ghaghraghat varied from 43.73% for nitrogen to 66.66% for phosphorus and 47.01% for potassium. At Ghaghraghat FUE was found to be 87.72% for N, 23.94% for P₂O₅ and 88.14% for K₂O respectively. To find out the contribution of a single fertilizer factor in the productivity of rice, the partial factor productivity was calculated. At Ghaghraghat PFP was found to be 44.86% for N, 115.53% for P₂O₅. At Mandya, the values of IE and nutrient ratios indicated sharp differences among farm sites with regard to nutrient uptake, genotypes indicating highly imbalanced nutrition which do not match with the crop nutrient requirements. This suggests for refinement of the current fertilizer practice being followed by the farmer. Earlier studies have been reported by Vishwakarma, et al. (2012), Kumar, et al. (2014), Pushpalatha et al. (2015), Sharma et al. (2022) Padbhushan et al. (2022) Madhusudan, et al. (2022) and Ondrasek, et al. (2022).

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