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1.0 INTRODUCTION

Rice (Oryza sativa L.) is an important staple for more thanhalf of the world's population. It accounts for 18.99% of calorie, 1.83% of fatand 12.73% of protein intake per day (FAOSTAT, 2011). The demand for rice mayincrease by 60% by 2025 (Fageria et al., 2003). The demand for rice is growingparticularly in sub-Saharan Africa due to rapid population growth, consumerpreference and rising income. Nigeria is the largest consumer of rice insub-Saharan Africa with an estimated demand of 6.7 million metric tons ofmilled rice (USDA, 2017). Production is estimated at 3.8 million metric tons ofmilled rice and has failed to keep pace with the growing demand resulting tothe importation of 2.6 million metric tons of milled rice to fill the gap.(USDA, 2017).

Low yield has been identified as major constraint to riceproduction in Nigeria where average yield is estimated at 1.88 tons per hectare(USDA, 2017). Soil nutrient depletion and low fertilizer use have been commonlycited as yield limiting factors in Nigeria (Ezui et al., 2010; Liverpool-Tasieet al., 2014). Farmers understand the need to apply nutrients to their land butlittle is used due to the economic and social factors surrounding access tofertilizer. High cost and delayed delivery of fertilizer are major limitationsto its use in rice production. The expenses incurred in procuring fertilizer inSub-Saharan Africa are two to six times the cost in Europe or the United States(Sanchez, 2002). Cost of importation, market inefficiencies and transportationcost are some of the factors responsible for high fertilizer prices.Excessively high fertilizer cost usually reduces the profitability offertilizer use (Kaizzi et al., 2012a).

Several studies have reported significant increase in yieldof rice with fertilizer application. Ishaya and Dauda (2010) reported optimumyield of 7 tons/ha with application of 130 kg/ha of nitrogen in the sudansavanna. Kamara et al. (2011) observed yield increase of 3 tons/ha with theapplication of 100kg/ha of N to NERICA varieties. In a trial conducted byJibrin et al. (2010) in the sudan savanna, 120kg/ha of N increased yield by62.9%.

1.1 Statement of Problem

The Fertilizer recommendation for all irrigated lowland ricein Nigeria has been 100 kg/ha N, 60kg/ha P_2O_5 and 60kg/ha K_2O (Chude et al.,2011) with the assumption that the need for applied nutrients is constant overvarieties, seasons and diverse agro-ecological zones. Fertilizerrecommendations are commonly developed without considering the cost offertilizer relative to the price of paddy typically referred to as fertilizercost to paddy price ratio (CP). Instead, the fertilizer rates needed to attainmaximum yield have often been estimated. The CP is an indicator of how much ofan output is required to purchase a kilogram of a nutrient (Liverpool-Tasie etal., 2014). As the fertilizer cost increases relative to price of paddy, theEconomically Optimum Rate (EOR), described as the nutrient rate needed tomaximize net return to fertilizer use, is expected to decrease (Wortmann etal., 2007). In Nigeria, Liverpool-Tasie et al. (2014) observed that the CP canbe as low as 1.7 and high as 11.2 in some years and farming systems. Applyingfertilizer at existing recommendations when the CP is high could lead to lownet returns on fertilizer use. Kaizzi et al. (2012a) and Kaizzi et al. (2014)developed regression equations to relate CP and EOR for maize and ricerespectively. This provided a means for estimating EOR at any CP value.

In addition, Nitrogen is the most limiting nutrient in riceproduction as it is prone to losses by volatilization,

leaching anddenitrification (Wortmann et al., 2010). The high cost of nitrogen in thedeveloping world requires that higher yield are attained with minimum nitrogenfertilization (Havlin et al., 2014). Adoption of improved agronomic practicesto increase efficient use of fertilizer N is therefore critical toprofitability and environmental sustainability. Agronomic efficiency andpartial productivity are components of Nitrogen Use Efficiency that are closelyrelated to profitability and are higher at EOR (Wortmann et al., 2007). InUganda, application of N at EOR was observed to increase nitrogen useefficiency in upland rice compared to N rate that gave maximum yield (Kaizzi etal., 2014). Similarly, Kaizzi et al. (2012a) and also observed higherefficiency of N use by maize at EOR in Uganda.

1.2 Justification

Existing blanket fertilizer recommendations for lowland ricerequire periodic revision because the growth and need of crops for supplementalnutrients can vary greatly among fields, seasons and years as a result ofdifferences in crop-growing conditions, crop and soil management, and climate.Furthermore, the variation across locations and seasons of CP (Liverpool-Tasieet al., 2014) requires that fertilizer recommendations be fine-tuned to ensuremaximum profitability of fertilizer use. Additionally, the inability toaccurately determine fertilizer rates leads to over fertilization in some yearsand locations and under fertilization in others with lower NUE. As a result,there is a clear need to improve fertilizer management strategies.

1.3 Aims and Objectives

The general objective of the study therefore was to providerecommendations for optimizing yield and profit from fertilizer use by ricefarmers. The specific objectives were to;

Quantify the response of lowland rice to N, P and K

Determine the economically optimal nutrient rate for N, P, Kat different fertilizer cost to paddy price ratios (CP).

Evaluate the Nitrogen Use Efficiency of lowland rice in thesavanna.

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