Rice Science FOR DECISION-MAKERS

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REINFORCING RIGHT E-A-T FOR IMPROVED FERTILIZER APPLICATION

WHAT IS RIGHT E-A-T OF FERTILIZER APPLICATION?

Right E-A-T refers to the correct nutrient Element, Amount, and Timing of fertilizer application. It is the essence of PalayCheck's Key Check 5, which is about nutrient management, and is embedded in the integrated nutrient management framework (Figure 1). Key Check 5 targets sufficient nutrients during the tillering, early panicle initiation (EPI), and flowering stages. For farmers to know the right element and amount of fertilizer to apply, Key Check 5 recommends the use of visual observation coupled with nutrient diagnostic and decision support tools such as the Leaf Color Chart (LCC), Minus-One-Element Technique (MOET), Nutrient-Omission-Plot Technique (NOPT), and the Rice Crop Manager (RCM). The timing of fertilizer application depends on the critical stages at which each nutrient is needed.

Nitrogen (N), phosphorus (P), potassium (K), zinc (Zn), and sulfur (S) are among the essential elements that are now deficient in rice soils, but are needed for the proper growth and development of rice crops (DA-PhilRice, 2021). Ensuring that the growing crop receives the right nutrients at the right rate and time during its critical growth periods (tillering to EPI, and flowering) can lead to good crop growth, panicle development, and attainment of yield potential (Quilang et al., 2020).

KEY POINTS

- Providing the rice crop with the right nutrients at the right rate and time (i.e., tillering to early panicle initiation, and flowering) leads to high yield and income.
- Rice-Based Farm Households Survey (RBFHS) data show that rice farmers in irrigated lowland apply less fertilizer than the generally recommended rates, possibly due to economic and behavioral factors.
- Evaluation of the rice integrated crop management (RICE ICM) technologies showed that farmers can achieve the yield potential of the varieties they grow, and attain a certain degree of competitiveness through recommended crop management technologies and practices that include proper nutrient application using diagnostic and decision support tools.
- It pays to encourage farmers to adopt these tools and practices that may help them deal with the increasing prices of inorganic fertilizers.

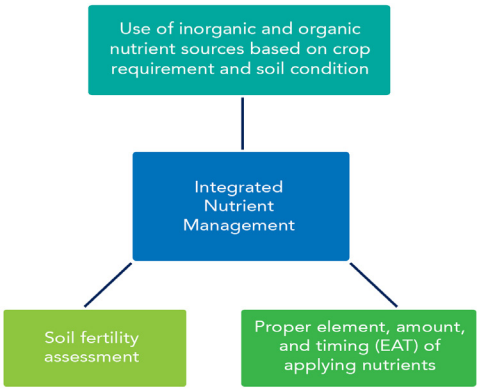

Fig 1. Integrated nutrient management framework.

GENERAL FERTILIZER RECOMMENDATION

Nutrient diagnostic and decision support tools enable site-specific nutrient management for farms. However, not all farmers have access to these tools or can have their soil analyzed in a laboratory. Alternatively, farmers can refer to general recommendations as a guide on the right E-A-T of fertilizer application. A general recommendation can be drawn from Quilang et al.'s (2020) study that evaluated RICE ICM technologies. This recommendation is a modification of the initial one based on the assessment from the NOPT for N, P, and K conducted on-station and on-farm in five different agro-climatic zones (ACZs) in the Philippines represented by the DA-PhilRice branch stations Agusan, Bicol, Midsayap, Isabela, and Nueva Ecija.

Table 1. Modified fertilizer recommedation in irrigated lowland using fixed-rate and fixed-time (FRFT) nutrient management.

Nutrient Element	Initial General Recommendation		Modified General Recommendation	
	Wet Season	Dry Season	Wet Season	Dry Season
	(kg/ha)			
N	97	141	97	139
P	28	42	28	35
K	28	42	43	50

Source: Quilang et al., 2020, and Ruba et al., 2019
Note: application of muriate of potash (MOP) is included in the modified general recommendation in areas with higher solar radiation (e.g., Nueva Ecija, Bicol, and Isabela) before or after panicle initiation

The modified general recommendation in irrigated lowland (Table 1) follows the splitting of N fertilizer application based on the critical growth stages of the crop: 25% at 7-14 days after transplanting (DAT), 25% at mid-tillering, and 50% at maximum tillering or EPI; with all P supplied at first application; and 70% K applied at 7-14 DAT and 30% 5-7 days before or after panicle initiation (PI). Additional fertilizer K source (i.e., muriate of potash) is recommended before or after PI especially in areas with higher solar radiation to increase grain size and weight.

ARE FARMERS APPLYING ENOUGH FERTILIZER?

The 2016-2017 RBFHS data show that N-P-K application in irrigated areas are generally lower than the modified general fertilizer recommendation (Table 2). This corroborates Briones' (2016) observation that N fertilizer application in the Philippines has been lower than in China and Vietnam since 2002, and Indonesia and Thailand since 2005 and 2010, respectively.

Briones (2016) associated rice farmers' low N use with their unwillingness to accept recommendations from farm technicians as they cannot appreciate the science behind them. Instead, they rely on traditional practices or on the experience of their fellow farmers. Additionally, farmers may fail to save money for expected expenses like fertilizers as they prioritize household expenses, and perhaps also spend their money on unnecessary wants. Other identified potential constraints were inadequate irrigation service, and farmers' aversion to risk. Farmers remain prone to mistakes in fertilizer application. Hence, the need to reiterate right E-A-T especially with the spiralling retail prices of inorganic fertilizers since 2021 (Figure 2).

Table 2. Average fertilizer use in irrigated ecosystem by season, Philippines, 2016-2017.

Nutrient Element	Wet Season	Dry Season
	n=2,103	n=2,156
	(kg/ha)	
N	98.42	96.05
P	9.39	8.87
K	16.67	16.01

Source of basic data: PhilRice RBFHS, 2016-2017
Note: excludes farmers who temporarily stopped farming and who experienced crop failure

'MAKE E-A-T RIGHT'

The rise in the prices of fertilizers can bloat the cost of producing rice and diminish the net income of farmers because they spend the most on fertilizers, among other material inputs. In 2020, fertilizers ate up an average of 8% of rice farmers' total rice production cost; seeds and pesticides accounted for only 3% to 4%. Farmers with limited capital may compromise fertilizer application to afford other essential inputs resulting in less yield.

Most of the supply of inorganic fertilizer in the country come from foreign sources and its industry operates in a free market led by the private sector (Ani & Festejo-Abeleda, 2018). Thus, the government has no control in its pricing but has been providing free or subsidized fertilizers to assist farmers.

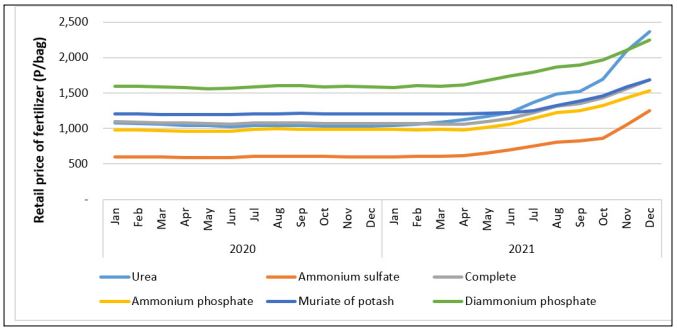

Fig. 2. Monthly retail prices of inorganic fertilizers in the Philippines, 2020-2021.

Source of basic data: Fertilizer and Pesticide Authority
Note: 2021 average monthly price data derived from the weekly retail prices of fertilizers

In addition, DA-PhilRice and other agencies are now promoting balanced fertilization that involves the combined use of organic and inorganic fertilizers. The campaign aims to reduce rice farmers' reliance on expensive chemical fertilizers by using organic materials as a more sustainable and cost-efficient nutrient management approach. The Department of Agriculture (DA) mandated the adoption of the balanced fertilization strategy (BFS) in 2020 (Abonong Swak Campaign) to enhance productivity and income.

BFS is the "application of plant nutrients in optimum quantities in the right proportion through the appropriate methods at the time suited for a specific crop and agro-climatic condition" to "improve fertilizer use efficiency" and build soil health. The use of organic fertilizers helps maintain good soil structure and replenish soil fertility for crop production. It also improves the soil's water-holding capacity, facilitates absorption of nutrients, and gives life to more microorganisms that are beneficial to crops. Through BFS, an average yield of 5-6 mt/ha was achieved in 272 demonstration sites – irrigated rice areas in the Philippines, from 1997 to 1998 (Concepcion et al., 1999).

In 2020, Quilang et al. evaluated RICE ICM technologies in raising yields and reducing irrigated lowland costs (8-9t/ha in the dry season and 5-6t/ha in the wet season at less than P10.00/kg production cost). They used high-yielding varieties recommended or adaptable in each selected ACZ, younger seedlings (14-18 days old), seed treatments for preventive pest management, water management, and mechanized transplanting and harvesting operations.

The importance of proper nutrient management can be drawn from the following findings of the study:

(a) Sites at PhilRice stations in Nueva Ecija, Isabela, and Albay hit the 7mt/ha yield level in the dry season (Table 3), which is way above the 4mt/ha national average. This proves that the yield potentials of varieties grown by farmers can be achieved through recommended crop management technologies and practices, including proper nutrient application. Also, the yield gap between experiment stations and farmers can be narrowed that can make them competitive with their Vietnamese and Thai counterparts.

(b) Production cost was reduced to less than P10.00/kg in some sites in each season brought about by the higher yield level and cost-efficient technologies. Production cost in the Philippines in 2013-2014 was estimated to be at P12.41/kg against Thailand's and Vietnam's P8.85/kg and P6.53/kg, respectively (Bordey et al., 2016).

Table 3. Nutrient management-based field performance in the wet and dry seasons in sample sites, Philippines, 2018-2019. (Quilang et al., 2020)

Sites	2018 Wet Season		2019 Dry Season	
	Yield (mt/ha)	Production cost (P/kg)	Yield (mt/ha)	Production cost (P/kg)
Nueva Ecija LCC	5.48	7.14	7.93	5.98
Nueva Ecija FRFT	5.27	7.49	7.78	6.40
On-farm	4.98	7.61	7.75	5.86
Isabela LCC	5.18	9.34	5.52	7.94
Isabela FRFT	4.33	10.38	6.17	8.50
On-farm	6.48	7.72	7.10	7.27
Bicol LCC	4.28	11.98	7.22	7.66
Bicol FRFT	3.75	14.47	6.62	8.05
On-farm	4.79	10.02	5.69	8.26
Agusan LCC			3.89	11.94
Agusan FRFT	4.93	9.73	4.18	12.68
On-farm	5.36	7.64	5.00	8.44
Midsayap LCC	5.40	8.18	2.47	12.80
Midsayap FRFT	5.56	9.10	2.60	13.06
On-farm	5.56	8.49	3.22	10.97

LCC - leaf color chart
FRFT - fixed-rate and fixed-time

CONCLUSION

The Philippines has no competitive and comparative advantage in producing inorganic fertilizers. It has always relied on foreign sources for most of its fertilizer supply and, therefore, has no control in terms of its pricing. Leading farmers into adopting tools and practices for proper and site-specific nutrient management offers another way to minimize their production costs amid increasing prices of chemical fertilizers. That is, the right E-A-T of fertilizer application through balanced fertilization. Nutrient management through this approach ensures efficient use of fertilizers and helps narrow yield gaps. The evaluation and adoption of RICE ICM technologies proved that such yield gap could indeed be narrowed with the help of proper nutrient management based on general recommendations. Complemented with other best crop management practices, the cost of producing rice can also be reduced to a level that can make our rice farmers competitive to a certain degree. Efforts must now be focused on diffusing to farmers the recommended technologies and practices to attain such objectives.

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CALL FOR ACTION

- Develop site-specific nutrient recommendations as a general guide for rice farmers in different ACZs. A general guide that suits the local conditions in their area is a practical option that must be developed and delivered through Agriculture Extension Workers (AEWs).
- Promote the adoption of RICE ICM technologies that are appropriate and adaptable in different areas. The PalayCheck system asserts that a holistic approach is essential to enhance the yield and reduce the production cost of rice farmers, which will make them competitive.
- Operationalize appropriate strategies that can convince rice farmers to optimize their fertilizer application. This involves supporting research that will help identify factors guiding rice farmers' fertilizer application, they be agronomic, economic, or behavioral. Strategies and policies should then be designed and implemented accordingly.
- Reinforce the use of decision support/diagnostic tools and adoption of balanced fertilization by rice farmers through extension services for proper nutrient management. Balanced fertilization contributes to cost efficiency and sustainability by reducing farmers' reliance on expensive inorganic fertilizers through the use of organic materials as supplement.
- Involve farmers in technology demonstrations to let them appreciate and better understand the science behind the recommendations of agronomists and AEWs. This will hasten and sustain their adoption of technologies.
- Increase the availability and accessibility of tools such as MOET, LCC, and RCM by incentivizing local agri-input suppliers. Supply must be ensured while creating demand for such technologies to stimulate farmer adoption.

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ABOUT THE MATERIAL

Rice Science for Decision-Makers is published by the Department of Agriculture-Philippine Rice Research Institute (PhilRice). It synthesizes findings in rice science to help craft decisions relating to rice production and technology adoption and adaptation. It also provides recommendations that may offer policy triggers to relevant rice stakeholders in search of opportunities to share their knowledge on rice-related products.

The articles featured here aim to improve the competitiveness of the Filipino rice farmers and the Philippine rice industry through policy research and advocacy.

This issue reiterates the role of proper nutrient management through the application of the right Element, Amount, and Timing of fertilizers to help rice farmers deal with the increasing prices of inorganic fertilizers.

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