

RiceAdvice

An Android-based app that provides customized guidelines for optimal fertilizer management for improving rice farmers' production and income



Key points

- ▶ An Android-based app available on Google Play
- ▶ Provides customized (field-level) recommendations for fertilizer management (which fertilizers, when and how much), expected crop duration and other good agricultural practices
- ▶ Can be adapted to any irrigated or favorable rainfed lowland in Africa
- ▶ Farmer supplies information: location, season, rice-growing environment, expected water availability, crop management practices, variety, typical yield, existing crop management, available fertilizers and their cost, and market price for paddy
- ▶ Increases yields (by 7–20%), profits (by 10–23%) and nutrient use efficiency
- ▶ Impact assessment showed that farmers in Kano (Nigeria) were able to take advantage of the recommendations even within their existing credit constraints
- ▶ We urge African governments to adopt and promote RiceAdvice to improve crop production, profit and nutrient use efficiency for all rice farmers.

Rice in sub-Saharan Africa and the issue of fertilizer use

Today, over 750 million people in sub-Saharan Africa consume rice as their staple food; however, domestic production has failed to keep pace with demand. Despite producing 18.8 million tonnes (Mt) of milled rice in 2020, sub-Saharan Africa still had to spend over US\$ 7 billion on rice imports of 14.6 Mt to satisfy demand.¹

Over much of the continent, rice is grown by smallholders, and new technologies and extension advice are rarely adopted. Moreover, African countries continue to supply 'blanket' nationwide or state-wide extension advice when much of the rest of the world has moved toward precision agriculture. Fertilizer use is generally inefficient as a result of the combination of blanket advice and lack of adherence to the advice provided.

Since inorganic fertilizer is a costly input for smallholders, any waste or inefficiency has economic as well as environmental impacts. Farm rice yields across the continent averaged 2.2 t per hectare in 2020 compared with the global average of 4.6 t/ha.² Although this figure is strongly influenced by the dominant farming system (smallholders) and growing environments (rainfed, not irrigated), African rice production still experiences massive gaps between farmers' yields and potential yields. Better production management, including better fertilizer recommendations and use efficiency, can go a long way to reducing that gap and increasing production.

Refining fertilizer recommendations

Historically, governments and development agencies have used simplified, blanket advice when promoting improved technologies. One possible

reason why adoption of these technologies has remained low is that, although on average the recommendations are accurate, for any given household the recommendations will not be perfect, with consequent over- or under-use of fertilizers — reducing yield and profit. Advances in information and communications technology have enabled decision-support tools to be developed and disseminated at low cost. Tools such as RiceAdvice that fine-tune management practices by accounting for local variations in environmental and economic conditions can improve yield, profit and nutrient use efficiency.

A solution: RiceAdvice

Attempts to improve nutrient management for rice have a long history.

- In the 1990s, the International Rice Research Institute (IRRI) developed site-specific nutrient management for smallholders in Asia.
- At the same time, AfricaRice was developing variety-, site- and season-specific nutrient-management recommendations for irrigated rice in the Sahel.
- In 2011, IRRI rolled out Nutrient Manager for Rice (a cloud-based tool tied into mobile phones and SMS) across the Philippines. And in 2012, AfricaRice and IRRI adapted the tool for the Sahel.
- This led to the development of a prototype of RiceAdvice in 2013.

RiceAdvice is an Android-based app (available from Google Play Store) that provides farmers with customized guidelines for optimal fertilizer management for rice based on target yield, which is determined by the extension worker and the farmer taking into consideration the latter's financial resources and current yield level. AfricaRice and its partners typically recommend targeting a yield level about 1 t/ha more than the farmer typically achieves without RiceAdvice. The farmer provides information in response to about 20 questions on location, season (wet or dry), rice-growing environment, expected water availability, crop management practices, variety, typical yield, existing crop management (e.g. rotation, organic input), available fertilizers and their cost, and market price for paddy. RiceAdvice then makes recommendations for optimal nutrient management (which fertilizers, when and how much), expected crop duration and other general good agricultural practices.

The image shows two screenshots of the RiceAdvice app interface. The left screenshot displays the 'Output' screen with the following information:

- FARMER AND PLOT INFORMATION:** Farmer name: Ado Kofu, Village: Fochi, Rate: Agilas, Season: Wet, Rice growing environment: irrigated, Variety: FARO 41 (SPI 90203), Establishment: Transplanting, Field size (ha): 1.0, Typical Yield (t/ha): 3.6, Expected sowing date: 24/07/2020, Target yield (t/ha): 5.5, Optimum sowing window: 1 Jun - 31 Jul, Expected crop duration (days): 101-110, Expected heading age: Less than 20 days.
- TOTAL FERTILIZER REQUIRED:** Fertilizer to be purchased: Urea 46-0-0: 185 kg, NPK 15-15-15: 173 kg.
- FERTILIZER APPLICATION PLAN:** Fertilizer to be purchased (kg/ha): Urea 46-0-0: 9 kg, NPK 15-15-15: 173 kg.
- FERTILIZER COST AND PADDY PRICE:** Total fertilizer cost: NGN107,400.00, Expected total paddy income: NGN25,000.00.
- GOOD AGRICULTURAL PRACTICES:** Better fertilizer response requires: 1 well leveled field for good water management and uniform rice growth, 2 sowing/transplanting on time, following optimum sowing window (if applicable), 3 uniform sowing/transplanting for good canopy establishment, 4 weed-free fields, 5 don't apply fertilizer at high water level or when water stress is severe.

The right screenshot displays the 'Output' screen with the following information:

- FERTILIZER APPLICATION PLAN:** Fertilizer to be purchased (kg/ha): Urea 46-0-0: 9 kg, NPK 15-15-15: 173 kg.
- FERTILIZER COST AND PADDY PRICE:** Total fertilizer cost: NGN107,400.00, Expected total paddy income: NGN25,000.00.
- GOOD AGRICULTURAL PRACTICES:** Better fertilizer response requires: 1 well leveled field for good water management and uniform rice growth, 2 sowing/transplanting on time, following optimum sowing window (if applicable), 3 uniform sowing/transplanting for good canopy establishment, 4 weed-free fields, 5 don't apply fertilizer at high water level or when water stress is severe. To reduce inorganic fertilizer application rate in the next season: 1 keep straw as much as possible during harvesting, 2 prepare for organic input. For those who manually harvest rice: 1 rice should be harvested when 80-90% of grains are matured, 2 stems should be cut at least 15 cm from the ground, 3 harvested panicles should be kept on a tarpaulin to prevent contamination from stones and mud before threshing, 4 threshing should be carried out as soon as possible, 5 if drying is needed, paddy should be dried on a cemented floor or on a tarpaulin to avoid contamination, 6 avoid grain spillage during harvesting, threshing, cleaning and drying, 7 do not dry paddy in extremely high temperatures or directly under the hot sun, 8 keep paddy from coming in contact with water (rain, drizzle etc), 9 check the moisture content of the paddy (ideally between 12-14%) before milling, 10 consider parboiling if moisture content of paddy at harvest is below 12%.

The advantage of RiceAdvice over its predecessors is that it does not need a live internet connection to be able to provide its recommendations (connection is required only for periodic updates). This means that it can be used in remote villages that do not have good connectivity.



Roll-out

RiceAdvice has since been adapted for use in Benin, **Burkina Faso**, Ethiopia, Ghana, Guinea, Madagascar, **Mali**, Mauritania, Niger, **Nigeria**, Rwanda, **Senegal**, Sierra Leone and Tanzania. (Countries given in bold are where RiceAdvice is currently disseminated together with partners.)

As it is being rolled out, RiceAdvice is being deployed by public- and private-sector extension and development agents and NGOs. By the end of 2020 over 100,000 recommendations from RiceAdvice had been generated for use by farmers.

The Kano impact study

In 2020, Nigeria imported nearly 2 Mt of milled rice at a cost of almost \$1 billion to satisfy about 30% of domestic demand.³ The human population of Nigeria is increasing at around 2.5% per year, but rice consumption is growing at 6% per year.

Kano is one of seven states in northwest Nigeria that form the 'rice basket' of the country, which contributes 72% of national production.

Experimental design

An impact assessment in 2016–2017 covered 700 households from 35 villages. Villages were randomly assigned to one of three groups:

- 17 'control' villages (340 households) received blanket fertilizer recommendations from the Federal Ministry of Agriculture and Rural Development;

- 13 villages (260 households) received RiceAdvice recommendations (information only);
- 5 villages (100 households) received RiceAdvice recommendations *plus* all of the fertilizer recommended by RiceAdvice — this in-kind contribution was to demonstrate the impact of farmers having access to credit to buy inputs for the season.

In each case, an extension agent visited each farm two to four times per season. Socioeconomic data were collected along with data on adherence to the RiceAdvice or blanket recommendations, yield, previous-season crop management and information on the planning for the current season. Profit was calculated from yield, average market price for paddy and cost of inputs — reported cost of inputs for those in the control and information-only groups, and the actual cost of the inputs provided in-kind for those who received them.

Results

Farmers who received RiceAdvice recommendations alone increased their yields by 7% over the control (250 kg/ha), which translated into a 10% increase in profit (\$120 per hectare), while those who received the fertilizers as well increased their yields by 20% (730 kg/ha) and their profit by 23% (\$275 per hectare). Approximately 8115 farmers benefited from personalized advice in 2016 and generated additional production of 7625 tonnes, worth \$3.7 million. In the survey area, the average cultivated rice area is 0.87 ha. Calculations based on an average treatment effect suggest that universal adoption of RiceAdvice by all 124,000 rice farmers in Kano State would result in a net gain of \$59 million.

On average, the farmers in the three groups used about the same amounts of fertilizer. However, those provided RiceAdvice typically adjusted the levels up or down according to RiceAdvice recommendations, which also adjusted the balance between urea and compound (nitrogen–phosphorus–potassium, NPK) fertilizers to ensure appropriate balance of nutrients. Those receiving RiceAdvice did, however, make their NPK application earlier than the blanket recommendation (control group).

Scaling up

Another study conducted in Kano identified three major bottlenecks to further scaling up of RiceAdvice, leading to three recommendations.

1. Improve farmers' access to financial (credit) and input supply services.
2. Identify and test business models for RiceAdvice service providers.
3. Include female extension workers to reach female rice farmers.⁴

A major challenge to further scaling up is to identify partners who can disseminate RiceAdvice with their own resources. AfricaRice is available to backstop such efforts, especially in the area of tailoring to local conditions.

At present RiceAdvice is adapted to irrigated lowland and rainfed lowland areas with good water supply, and is amenable to adaptation to any such rice area in Africa. Less favorable rainfed systems (e.g. those prone to drought, including rainfed uplands) will require additional biophysical data — for example, actual or forecast rainfall (amount and distribution) during the cropping season and soil type — as yield response to nitrogen fertilizer is highly dependent on soil moisture, and high sand content and low clay content results in more rapid drainage.

This in turn will need, and lead to, support for training and equipment for extension services, encouraging private service provision (especially youth) and general expansion of digital extension services across the continent.

We urge African governments, ministries and extension agencies, and international development partners, to adopt and promote RiceAdvice as a way to improve crop production from blanket fertilizer recommendations and improve the incomes of all rice farmers.

For full details of the impact study, see: Arouna A, Michler JD, Yergo WG and Saito K. 2020. One size fits all? Experimental evidence on the digital delivery of personalized extension advice in Nigeria. *American Journal of Agricultural Economics*, 103(2): 596–619. <https://doi.org/10.1111/ajae.12151>

Endnotes

- 1 United States Department of Agriculture (USDA) data and calculations therefrom.
- 2 USDA data.
- 3 Calculations from USDA data.
- 4 Zossou E, Saito K, Assouma-Imorou A, Ahouanton K and Tarfa DB. 2020. Participatory diagnostic for scaling a decision support tool for rice crop management in northern Nigeria. *Development in Practice*, 31(1): 11–26. <https://doi.org/10.1080/09614524.2020.1770699>

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