

The impact of Urea Deep Placement (UDP) technology on rice yields and agronomic practices: evidence from a randomized trial in Kwara State, Nigeria



BILL & MELINDA
GATES *foundation*

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1. Modern input use is crucial for improving agricultural productivity in developing economies.
2. There is a longstanding conundrum on low usage of some of these technologies in many countries
3. Though fertilizer use in sub Saharan Africa generally remains low, there are signs of increased use in several countries including Nigeria, Malawi, Zambia and Ethiopia (Sheahan and Barrett, 2016).
4. This increase is occurring alongside growing interest in sustainable intensification (SI) which pays particular attention to increasing the efficiency of fertilizer use for increased productivity with minimal negative effects on the environment (Montpelier, 2013).
5. **UDP is a SI technology with the potential to increase farmer productivity in Nigeria while reducing fertilizer costs and the negative environmental effects of inorganic fertilizer use**

What is UDP?

Placement of 1-3 grams of urea super granules (USG) or briquettes at a 7-10 centimeters (cm) soil depth shortly after the paddy is transplanted



➤ Higher yields:

- More efficient nutrient absorption due to targeted approach
- Less competition between rice plant and weeds
 - Lower cost of weeding (labor or chemicals)

➤ Lower input costs/fertilizer use

- More efficient nutrient absorption  less applied nitrogen and lower costs
- Environmental benefits

Research contribution and questions? MICHIGAN STATE UNIVERSITY

- Limited empirical evidence about the claims of UDP yield effects on actual farmer fields
 - Using a randomized experiment we are able to make more confident causal claims about the technology that is absent in the current literature
 - Limited analysis on the effect of UDP adoption on other farmer practices
- 1. What is the average productivity effect of UDP use relative to non-UDP use among rice producers in Kwara State?*
 - 2. What substitution or complementary effects on other inputs or labor are attributable to UDP take-up?*

- Information about the UDP technology and access to the urea super granules (USG) were allocated to farmers with **equal probability** in a treatment and control group.
- This design ensures that **observable and unobservable factors are balanced** across treatment and control farmers
- On average, estimates of adoption, yield and behavior differences between treatment and control groups gives us **unbiased estimates of the treatment effect** on farmers

Study area: Edu and Patigi LGAs, Kwara

- Rice farmers from 45 rice producing villages in LGAs in Kwara State
- Villages were randomly assigned into treatment and control groups
- Baseline survey conducted
- Treatment phase (planting season 2014)
 - Information about UDP
 - Village promoters trained, demonstration plot set up, field day during which videos are shown and more information provided
 - Guaranteed supply of USG through village promoters
- End-line survey
- Dissemination to farmers and ADP in Kwara (May 2016)



$$Y_{ijt} = \beta_0 + \beta_1 T + \beta_3 X_{ijt} + \delta_v + \varepsilon_{ijt} \quad (1)$$

- Take up of UDP
- Rice yields (kg/acre)
- Prilled Urea Use:
- Applied Nitrogen
- NPK use and Using NPK and Urea
- Chemical use
- Labor

Some key findings(ITT): Take up & yields

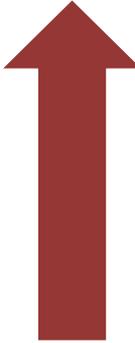
↑
Increased probability of adoption by 37.5%

↑
21% increase in rice yields





28% decline
in quantity
of applied
nitrogen

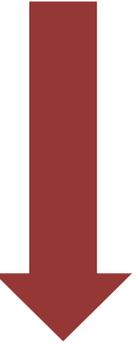


Increased
quantity of
NPK used

- UDP adoption reduced the quantity of prilled urea used (almost complete substitution) but it also reduced total Urea use and the quantity of applied nutrients
- Increased use of NPK
- Increased probability of using both urea and NPK

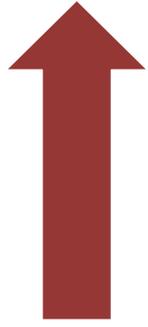


Doubles the
quantity of
applied
chemicals



42%
reduction in
non-harvest
labor

- Increased quantity of chemicals used for weeding
- Reduced quantity of labor used for weeding
- Reduced quantity of labor used for all non-harvest activities



5 percentage point increase in take up but not statistically significant

- Limited additional effect of providing a 20% price discount

- **Why?**

- Seems major effect comes from the information and guaranteed supply
 - Could this be related to the last mile problem?
 - Could this be related to fertilizer quality assurance?



The additional effect of a price discount



- The average distance travelled by farmers in our sample to the nearest input market is about **15km**, though for those at the 90th percentile of distribution of distance travelled is about **40km**.
- Most farmers spend on average **N700** as transportation cost to get fertilizer. **Those who are remote pay N1000, sometimes N2000**
- Transportation alone adds about **15%** to the price of fertilizer and sometimes **up to 37%** for remote farmers
- Other transactions costs such as needing to make multiple trips

- The UDP technology increased farmers rice yields by about 21% while reducing the quantity of applied nitrogen on rice plots by 28%
 - **With more nutrient absorption and less nutrient loss, UDP could significantly reduce farmers cost of fertilizer use while maintaining or improving yields.**
- UDP has environmental benefits from the reduced chemical run off into waterways that constitute water supply for households
- In addition to more efficient nutrient absorption, another potential mechanism through which UDP affects farmer outcomes is thought its **positive effect on the likelihood of using both single nutrient fertilizers (Urea) alongside compound fertilizer such as NPK which is recommended for optimal rice production**

- Though we do not find any evidence that the labor intense nature of USG application overwhelms the labor need the technology, UDP use increased the use of chemicals for weeding. This is likely due to poor adherence to the recommended practices - **implications for extension**
- Information and a guaranteed supply of USG in farmers' villages appears to be enough to encourage UDP without a price discount indicating the potential to encourage fertilizer adoption at lower cost to government under the right atmosphere
- **Innovative approaches to disseminate inputs by the private sector (such as the village promoter model) should be supported (possibly temporarily) to strengthen the links between farmers and input suppliers and likely expand farmer access to and appropriate use of technologies**

Thank you for your attention....

Questions?