2013

Increasing the Profitability of Fertilizer by Financed-Constrained Smallholder Farmers in Sub-Saharan Africa

Jim A. Jansen
University of Nebraska-Lincoln

Charles S. Wortmann
University of Nebraska-Lincoln

Matt Strockton
University of Nebraska-Lincoln

CORNHUSKER ECONOMICS

University of Nebraska–Lincoln Extension

February 27, 2013

Institute of Agriculture & Natural Resources
Department of Agricultural Economics
http://agecon.unl.edu/cornhuskereconomics

Increasing the Profitability of Fertilizer by Financed-Constrained Smallholder Farmers in Sub-Saharan Africa

Market Report	Yr Ago	4 Wks Ago	2/22/13
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	$127.70	$122.17	$124.00
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	186.21	172.33	169.01
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	155.22	146.11	139.11
Choice Boxed Beef, 600-750 lb. Carcass.	195.42	188.96	182.51
Western Corn Belt Base Hog Price Carcass, Negotiated.	86.71	87.38	77.62
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean.	85.76	84.68	81.44
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct.	*	91.00	105.00
National Carcass Lamb Cutout, FOB.	378.19	291.01	286.47
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	6.08	7.69	6.99
Corn, No. 2, Yellow Nebraska City, bu.	*	7.31	7.07
Soybeans, No. 1, Yellow Nebraska City, bu.	*	14.46	14.61
Grain Sorghum, No. 2, Yellow Dorchester, cwt.	10.93	12.16	11.63
Oats, No. 2, Heavy Minneapolis, MN , bu.	3.47	3.91	4.16
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	225.00	247.50	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	145.00	230.00	227.50
Grass Hay, Large Rounds, Good Nebraska, ton.	100.00	212.50	212.50
Dried Distillers Grains, 10% Moisture, Nebraska Average.	212.50	287.50	275.00
Wet Distillers Grains, 65-70% Moisture, Nebraska Average.	74.00	107.50	105.00

***No Market**

Background - Low commercial fertilizer use by smallholder farmers in developing regions of the world commonly limits productivity. Many of these farmers do not have the financial capacity to purchase enough fertilizer to maximize net returns on their limited investment per hectare. High fertilizer costs and low commodity prices often reduce profit potential, and competing needs for money often take priority. Such farmers need high net returns on their investments to justify the application of fertilizers.

Recommendations for non-finance constrained fertilizer use commonly strive to maximize average net returns across all planted acres. These recommendations are infeasible for smallholders with limited financial capacities. A more simple approach, given the nature of the smallholders' production system, seeks to maximize net returns on their limited fertilizer investment. Under this process, the producer focuses fertilizer application on crop-nutrient responses of those chosen to be grown with the highest marginal returns, until the limited financial resources are all exhausted.

The Research - A collaborative research team in Uganda led by Dr. Crammer Kayuki Kaizzi of the Ugandan Agriculture Research Association and agronomists from the University of Nebraska-Lincoln (UNL), with funding received from the Alliance of a Green Revolution in Africa (AGRA), conducted 80 field trials to determine nutrient response functions for 15 crop-nutrient combinations. These functions were for corn, sorghum, upland rice, dry bean, soybean and peanut (Kaizzi et al., 2012 a,b,c). Crop-nutrient combinations varied in profitability (see Figure 1 on next page). The response functions were curvilinear consistent with expectations of crop production and the need to vary application rate on crop combinations to obtain maximum returns on a limited investment. The combination

of crop-nutrient-rate information provides a way to estimate the amount of fertilizer that the farmer can apply and afford to use, to best meet his/her highest profit potential.

The fertilizer response relationships displayed in Figure 1 can be used to prioritize crop-nutrient-rate options. Depending on which crops the farmer wishes to plant, application of a low rate of N to upland rice and beans may be of highest priority if the financial constraint is severe. With a less severe financial constraint, the priority options include additional N applied to rice and beans, some N applied to maize and sorghum and some P applied to soybean and groundnuts. With no financial constraint, fertilizer should be applied for each crop-nutrient combination that maximizes net return per hectare for the given fertilizer cost to commodity value ratios.

The Uganda Fertilizer Optimization Tool - To enable full optimization across the 15 crop-nutrient response functions, the Excel-Solver based Uganda Fertilizer Optimization Tool was developed by the Agricultural Economics and Agronomy and Horticulture Departments at UNL. The tool considers the land area that the farmer wishes to plant to each crop, expected commodity values at harvest, the costs of fertilizer use and the budget constraint. The output includes the recommended fertilizer rate for each crop and the expected effects on crop yields and net returns.

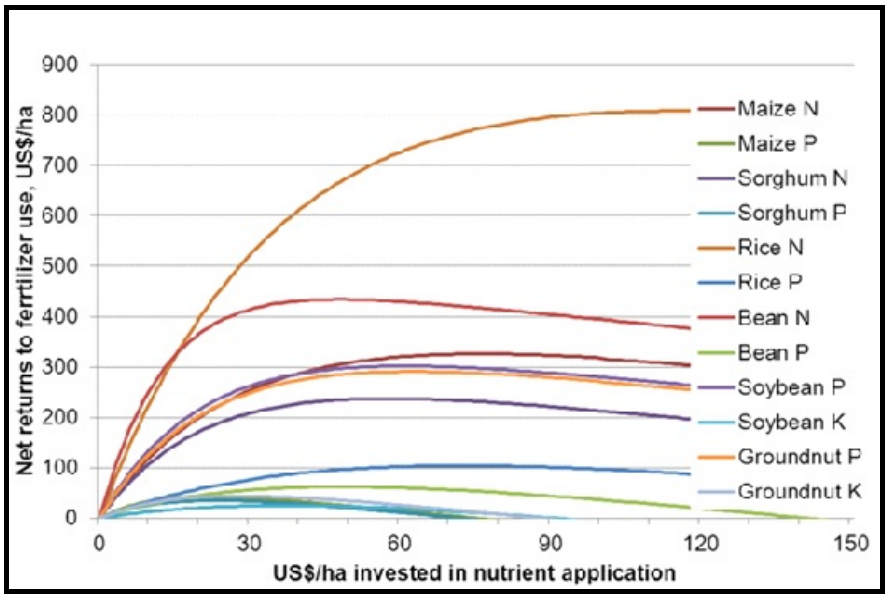

Figure 1. Nutrient Response Functions

By taking into consideration the unique inputs of each smallholder, the tool allocates fertilizer to the crops with the highest marginal return, until the producer's budget is exhausted. This tool enables capital constrained farmers to make informed choices about limited resources and aid in helping break the cycle of poverty. The outlined approach was introduced to 60 government and non-government extension staff in Uganda, with training for the remaining extension staff planned.

Wider Applications - This approach has the ability to increase the profitability of fertilizer use for finance-constrained crop production throughout Sub-Saharan Africa and on other continents. The crop-nutrient response functions will need to be determined for the appropriate crops and region in which the tool will be applied, but the underlying process will remain very similar.

References:

Kaizzi, C.K., J. Byalebeka, O. Semalulu, I. Alou, W. Zimwanguyizza, A. Nansamba, P. Musinguzi, P. Ebanyat, T. Hyuha and C.S. Wortmann, 2012. "Maize response to fertilizer and nitrogen use efficiency in Uganda." *Agronomy Journal.* 104:73-82.

Kaizzi, C.K., J. Byalebeka, O. Semalulu, I. Alou, W. Zimwanguyizza, A. Nansamba, P. Musinguzi, P. Ebanyat, T. Hyuha and C.S. Wortmann, 2012. "Sorghum response to fertilizer and nitrogen use efficiency in Uganda." *Agronomy Journal*, 104:83-90.

Kaizzi, C.K., C. Wortmann, J. Byalebeka, O. Semalulu, I. Alou, W. Zimwanguyizza, A. Nansamba, P. Musinguzi, P. Ebanyat, T. Hyuha, 2011. "Optimizing smallholder returns to fertilizer use: bean, soybean and groundnut." *Field Crops Res.* 127:109-119.

Jim Jansen, (402) 472-4624
Research Assistant
Department of Agricultural Economics
University of Nebraska-Lincoln
jim.jansen@huskers.unl.edu

Charles Wortmann, (402) 472-2909
Agronomist, Professor
Department of Agronomy and Horticulture
University of Nebraska-Lincoln
cwortmann2@unl.edu

Matt Stockton, (308) 696-6713
Agricultural Economist, Associate Professor
West Central Research and Extension Center
University of Nebraska-Lincoln
mstockton2@unl.edu