“Right-sizing” in international agricultural development: An example
--Plant nutrient management practices
for small scale and subsistence farmers
Questions

• Should Agriculture in third world be Sustainable?
• Should Precision Technologies be implemented into the Third World?
• Could Precision Technologies be implemented into the Third World?
Questions

• What is your definition of Sustainable Ag.
  – Example?
• What is your definition of Precision Ag.
  – Example?
• How often is Precision Tech Sustainable
• If a Precision technology increased inputs could it still be considered Sustainable.
Sustainable Ag

• The Producer

• The Consumer
Precision Ag

- Average Producer
- Young/progressive
Compare
Mountains
Diversity
Family Farms
Family farms
Questions

• Should Precision Technologies be implemented into the Third World?
• Could Precision Technologies be implemented into the Third World?
Keep in Mind

Large Ag is in Most Countries
Precision Ag is not always Large
4 R’s

1. Right Source
2. Right Place
3. Right Rate
4. Right Time

IPNI: International Plant Nutrition Institute
Consistent Yield and Response

Exp. 502, 1971-2009

Ave Yld 42 bu/ac
N Need (Theoretical)

Exp. 502, 1971-2009

Optimum N Rate
Avg. 51 lb N/ac +/- 39

Max Yield
Avg. 44 bu/ac +/- 15

N need determined by N-up 112 – N-up check * 50% efficiency
The Nitrogen Cycle
Nitrogen

• Additions
  – $\text{N}_2$ Fixation, Industrial, Fertilizer, Decomposition, Rainfall and Lightning

• Losses
  – Leaching, Denitrification, Ammonia Vol., Plant Loss

• OM
  – 1,000 lbs N / 1% OM / 6in soil
  – Mineralization, Immobilization
Reference Strips

- **What**: A high rate of N applied in, across, through, over or under each and every field
- **How Much**: Minimum of 125% of yield goal recommended rate, this includes residual and preplant.
- **How and Where**: 10 to 100 ft wide, anywhere representative.
- **When**: Winter crops; before or after sowing (1+ months), Summer crops; before or immediately after planting.
N-Rich Strip
Mid-Season Evaluation of N Rich Strip (Ciudad Obregon, MX)
Average Wheat Yields = 150 bu/ac (irrigated spring wheat)
Reference Strips

• Are Very Visual..
Evolution of Multi rate NRS
Optical Sensors

• Numerical, describe the crops BIOMASS.
• DOES NOT really WORK WITH OUT A REFERENCE.........
• Multiple options
  – Companies
  – Resolution
Sensor Based N Rate Calculator

SBNRC and the N-Rich Strip

Using Sensor Data and the Nitrogen Fertilizer Optimization Algorithm, N-Rates are prescribed for each field and its condition/environment.
GreenSeeker™ Sensor Light Detection and Filtering

Detection of Reflected NIR and RED + Sun

NIR and RED Modulated Illumination

Target
Spectral Response to Nitrogen

Winter Wheat at Feekes 5 in potted soil

NDVI = \frac{\text{NIR} - \text{Red}}{\text{NIR} + \text{Red}}

- 0 Nitrogen
- 100 lb Nitrogen/acre

Photosynthetic Potential

Red

NIR

Measure of living plant cell’s ability to reflect infrared light

Wavelength, nm
Optical Sensors
What is needed for a Sensor Based Nitrogen Rate Calculator?

Yield Prediction Model
Response Index
Nitrogen Removal

The calculation looks like:

\[ N \text{ Rate} = \]
\[ (\text{Potential Yield of Farmer Practice} \times \text{RI}) \times \frac{\text{N in Grain}}{\text{NUE}} \]
Yield Prediction

SBNRC (YP0*RI = YPN)
100 Pre (100 lbs N/ac applied preplant)
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<th>SBNRC</th>
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Thank you!!!

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