Digitization: The Next Revolution in Agriculture
Presentation Notes
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Slide 2: Challenges Facing Production Agriculture

- Meeting global food demand is a significant challenge.
- Global population is expected to exceed 9.6 billion by 2050.
    - *Source: http://esa.un.org/unpd/wpp.*
- Economic prosperity, advances in medicine,healthcare and technology are giving rise to an emerging middle class, that by 2050 will be larger than the entire population of mankind in 1980.
- Middle class citizens demand more animal protein. In fact, the dietary percentage of meat consumption is expected to increase from 9% in 1965 to 14% by 2030.
    - *Source: UN FAO Food Balance Sheet, World Health Organization Global and regional food consumption patterns and trends."*
- These factors are giving rise to a dramatic increase in food required per person and a decrease in arable land per person.
    - *Source: The World Bank, Food and Agriculture Organization of the United Nations (FAO-STAT), Monsanto Internal Calculations.*
- The basic formula states that over the next 35 years we need to produce more crop calories per acre, and we are likely going to need to do it with less resources and with greater uncertainty.

Slide 3: Digital Data Represents the Real World

- The landscape in agriculture is changing rapidly.
- The physical world - everything that affects agriculture - is becoming digitized: the genetics of every seed, the environmental conditions that affect production on each farm, the information created and collected from hardware used in every field, and the remote sensing of each plot of land on Earth.
- The data is environmental (weather data) as well as operational (field-level data captured from equipment).
- For example, a farmer can now see planting data compared to yield.
- In the not so distant future, we will have discretely measured and digitized every activity and condition that drives mankind's conversion of natural resources into food.

Slide 4: Technology Advancement Enables Data Sciences

- There are several technology advancements outside of agriculture that are enabling us to digitize the farm.
    - Electronic circuits are getting cheaper and more powerful - as a result, computing capability is 32 times what it was 10 years ago, for the same cost.

        - *Sources: Wikipedia.org, anandtech.com, Intel, CNET.com, processortimeline.info, thocp.net.*
    - Wireless data transfer is getting cheaper, with a 75% drop in price over the past 4 years.
        - This stat is a combination of mobile data traffic against the revenue of telecom carriers – the data use has increased against the revenue, indicating a drop in transfer price.
        - *Sources: Cisco (global wireless data use), Statista (global carrier data revenue estimate).*
    - And data storage is getting cheaper, with a 97% drop in price per gigabyte over the past 10 years.
        - *Source: Wayback Machine (Statistic Brain).*
- These trends in computing and wireless capabilities enable us to manage extremely large data sets more efficiently. They allow us to transfer large volumes of data and develop models that can more quickly analyze those data sets.
    - There are now more connected mobile devices (8.6B) than people (7.1B)
        - *Source: GSMA Wireless Intelligence, Machina Research, A.T. Kearney Analysis and http://esa.un.org/unpd/wpp/.*
    - And so, the combination of cheap hardware and ubiquitous and cheap wireless access is driving us to have more connected mobile devices than people.
    - These are not just mobile phones – cash registers, cars, and even farm equipment are now connected to the internet.
    - And all this equipment is increasingly embedded with more and more sensor devices.
- At the same time, wireless access is becoming ubiquitous, so all of this digitized data can be easily available to devices with wireless connections.

Slide 5: How Data Science Works

- While farmers are now able to generate more data about their farming operations than ever before, they need to be able to gain actionable insights from their data to access its value.
- At the Climate Corporation, we use data science to help farmers protect and improve their farming operations.
- Data science is the combination of three different areas of expertise: computer science; physical sciences like agronomy, crop science, and soil hydrology; and statistics.
- One thing that makes us different is that we have in-house experts in all of these areas who work together to take the complex interactions in the field and help farmers answer the question: what does this information tell farmers about how they can make better decisions for the future?
- Our teams build predictive models that we put to work for the farmer by delivering hardware and software tools that help make and execute more scientifically informed decisions, bringing farming from an era of intuition to an era of analytics-based decision making, ultimately improving the productivity and sustainability of farming operations.

Slide 6: Data Science Delivered Through Digital Tools

- We bring data science to life in the form of digital tools. They can provide the opportunity to increase yields by identifying where management practices can be adjusted or improved, or where inputs could be used more efficiently.
- All of the information we analyze at Climate begins and ends with a farmer's field. We use data from every interaction taking place in the field to build our models — interactions between the soil and the plant, the plant and the weather, and many other interactions that impact yield. These models drive our tools and provide insights to the farmer, helping with key decisions like how much nitrogen to apply.

Slide 7: Nitrogen Management

- The Climate Corporation's advanced monitoring and planning tools use sophisticated models to track how nitrogen is moving through a field to provide insights that help farmers project nitrogen shortages before they occur and make application decisions with confidence.
- The U.S. Nitrogen Advisor tool is focused on providing a graphical view of available Nitrogen throughout the season based on a model of the nitrogen cycle and crop uptake of nitrogen during the season.
- As a planning tool, it helps the grower plan nitrogen applications and see estimated surplus at maturity (or shortfall).
- As a monitoring tool, it helps the grower keep tabs on nitrogen availability throughout season to enable action.

Slide 8: Opportunity for Proactive Fertility Management Through Modeling

- Our research shows that more than 10% of fields lose yield due to insufficient nitrogen – this causes an average U.S. dollar loss of $134/ha ($54/acre).*
- A surplus, while less damaging to the bottom line, causes loss of $32.50/ha ($13/acre), and more than 40% of fields are running a surplus.*
- By optimizing nitrogen application, Nitrogen Advisor has the potential to have a direct and substantial impact on revenue.
    - **Representative and random sample of >3,800 Nitrogen Advisor Fields where main Nitrogen application was mineral fertilizer. Assumes $4/bushel corn, $0.40 /lb-N fertilizer costs and average yield of 168 bushels per acre.*

Slide 9: Nitrogen Management Use Case: Yield Opportunity

- In the 2015 growing season, one of our U.S. customers used Nitrogen Advisor to optimize his nitrogen application during a season with unseasonably heavy rains.
- After applying fall anhydrous and starter planting, this farmer watched nitrogen continually drop in the Nitrogen Advisor, to the point of a shortage.
- The farmer made an additional application of nitrogen on 6 July, leaving a test strip to check against.
- When comparing results between the check strip and the rest of the field, the farmer confirmed the impact of the nitrogen shortage on yield, also confirming the value of the Nitrogen Advisor's recommendations – 543 vs. 438 bu/ha (217 vs. 175 bu/acre).

Slide 10: Satellite Imagery Use Case: Disease Management

- In the 2014 growing season, satellite images provided insights that one of our customers could have used to improve yield. Imagery for his field indicated a hybrid's susceptibility to Grey Leaf Spot about midway through the season.
- The field was planted with two hybrids. The hybrid planted on the far right of the field was susceptible to the disease.
- The farmer could have applied a fungicide in July to mitigate the impact of the disease.
- The farmer also learned more about the performance of the hybrid, realizing that it did not perform well against Grey Leaf Spot and he won't plant it next year.

Slide 11: The Future of Digital Ag

- Digital ag is still just emerging – while it is providing farmers value today, there is tremendous opportunity still to be realized.
- Customized insights: We can expect to see increasingly customized insights as data connectivity and integration to digital ag platforms improves and enables farmers to gain insights from their field data.
- Sub-field insights: Today, digital ag provides field-level insights. In the future, we can expect to be able to analyze smaller increments.
- Expanded features: Today, our digital ag tools focus on fertilizer, satellite images and prescription creation, but digital ag has the potential to expand into many more areas of operations on the farm to provide insights on pests, disease and irrigation.
- Expanded crops: Most digital ag tools today are focused on corn and soy, but digital ag can provide value to any crop. Our next areas of expansion include wheat and canola.
- Expanded geography: Digital ag has the potential to help farmers all over the world optimize their operations – today our tools are available to farmers in the U.S., but within the next 10 years we're looking to expand into Canada, Brazil, Argentina and Western and Eastern Europe.
- Our approach to expansion is to focus on what will add the most value for farmers.