



# Precision Agriculture

## Lesson 1A - Presentation

# Precision Agriculture

## Lesson 1, Part A

## Agriculture, Food and Natural Resources Content Standards

- PS.03.04. Apply principles and practices of sustainable agriculture to plant production.
- PST.05.03. Apply geospatial technologies to solve problems and increase the efficiency of AFNR systems.

# What is Precision Agriculture?

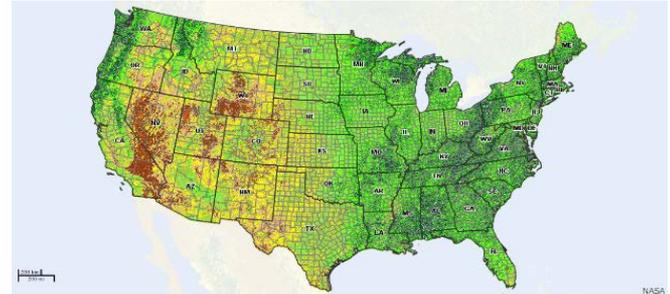
- A method of farm management.
- Includes planting:
  - The right seed
  - At the right place
  - At the right time
  - At the right depth
  - With the right nutrients and other inputs
- Technology is often used to help the operator make management decisions.

# Precision Agriculture History

- Geographic Information System (GIS)
- Yield and Moisture Monitor
- Global Position System (GPS)
- Advanced Sensors, Monitors and Meters
- Remote Sensing

# Geographic Information System (GIS)

- Allows user to track, recall and analyze information about individual points on a map.
  - Created by Roger Tomlinson in 1960s.
  - Only government and large industries could afford it.
  - Now in almost every aspect of commerce, construction, research and travel.



# Yield and Moisture Monitor

- Introduced in the 1990s
- Mass Flow Sensor
  - Captured the amount and weight of grain being harvested.
- Moisture Sensor
  - Took readings on the moisture in the grain and speed of combine.
- Displayed the yield being harvested.
- Did not record data for future use.



# Does the moisture of grain matter?

- One bushel of corn weighs 56 pounds.
- Determine the amount of corn you are actually purchasing in the following situations:
  - 100 bushels at 15% moisture = \_\_\_\_\_ pounds of actual corn.
    - Solution:  $100 \times 56 = 5600 \times (1.00 - .15) = 4,760$  lbs.
  - 100 bushels at 23% moisture = \_\_\_\_\_ pounds of actual corn.
    - Solution:  $100 \times 56 = 5600 \times (1.00 - .23) = 4,312$  lbs.
- Does knowing the moisture matter? Explain why or why not. (T,P,S)

# Global Position Systems

- GPS became available to civilians.
- GPS was added to Yield Monitoring Systems.
  - Could now track location of crop being harvested.
  - Data could now be saved for future use.
  - Maps could now be created and printed.
  - Maps could be used for year-to-year analysis.



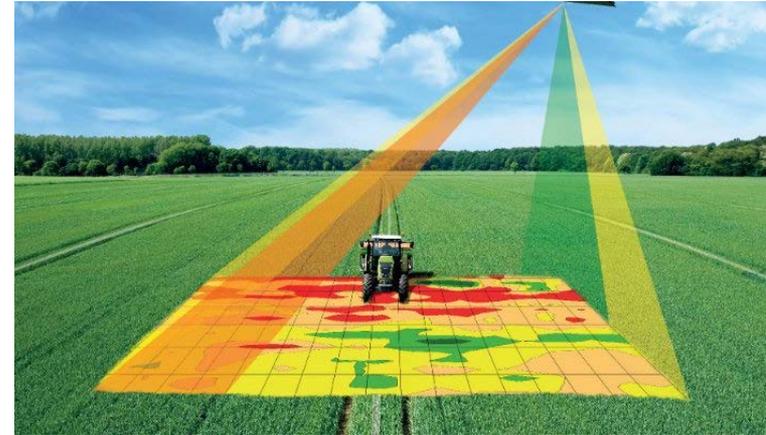
# Advanced Sensors, Monitors, Meters

Increases the “precision” in Agriculture

- Sensors can:
  - Track:
    - Number of seeds planted per foot
    - If multiple seeds are planted at one spot
    - Seed skips
    - Plugged planter
    - Depth of seed
    - Moisture, pH and temperature of soil
    - Type of weeds
    - Chemical level
  - Drive our tractors straight
  - Etc.
- Meters:
  - Allow users to vary the rate of delivery of “inputs” on the run.
    - Uses a “prescription”
    - Spreaders, sprayers, planters and irrigation units have meters that can vary application rates based upon prescriptions.

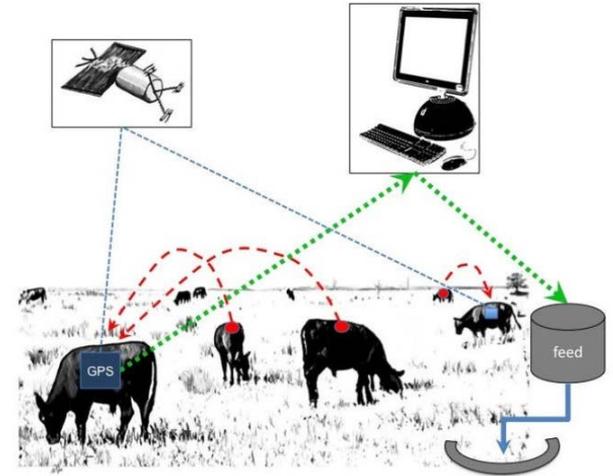
# Remote Sensing

- Images are collected
  - Identifies variation in plant health and soil conditions
- Introduced in the late 1990s
- Slow start
  - Unreliable and timely delivery
    - Few satellites for public use
    - Sky needed to be clear
  - Very costly
- More reliable and affordable now
- UAVs “Drones” now being used
  - Higher resolution
  - Less affected by clouds



# What about the Future?

- Detection “on the fly”:
  - Crop health
  - Water utilization
  - Soil types
  - Nutrient utilization
  - Weed, insect, disease detection
  - Range condition
  - Rotate pastures using GPS
  - Virtual fences
  - Etc.



# Precision Ag Vocabulary Fun!

<https://quizlet.com/join/mPXWZnyG3>



# Precision Agriculture

## Lesson 1A – Notes



# Intro to Ag

## Precision Ag - Lesson 1, Part A



### What is Precision Agriculture?

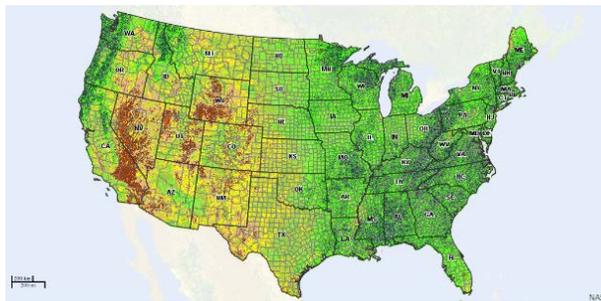
- A method of farm.
- Includes planting:
  - The right
  - At the right
  - At the right
  - At the right
  - With the right \_\_\_\_\_ and other \_\_\_\_\_.
- \_\_\_\_\_ is often used to help the operator make \_\_\_\_\_.

### Precision Agriculture History

- \_\_\_\_\_ Information System (GIS)
- \_\_\_\_\_ and \_\_\_\_\_ Monitor
- Global Position System (\_\_\_\_\_)
- Advanced \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_
- \_\_\_\_\_ Sensing

### Geographic Information System (GIS)

- Allows user to \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ information about individual points on a map.
  - Created by \_\_\_\_\_ in 1960s.
  - Only government and large industries could \_\_\_\_\_ it.
  - Now in almost every aspect of \_\_\_\_\_, \_\_\_\_\_, research and \_\_\_\_\_.



### Yield and Moisture Monitor

- Introduced in the \_\_\_\_\_.
- Mass \_\_\_\_\_ Sensor
  - Captured the \_\_\_\_\_ and \_\_\_\_\_ of grain being harvested.
- \_\_\_\_\_ Sensor
  - Took \_\_\_\_\_ on the moisture in the grain and \_\_\_\_\_ of combine.
- Displayed the \_\_\_\_\_ being harvested.
- Did not record \_\_\_\_\_ for \_\_\_\_\_ use.



# Intro to Ag

## Precision Ag - Lesson 1, Part A



Does the moisture of grain matter?

- One \_\_\_\_\_ of corn weighs \_\_\_\_\_ pounds.
- Determine the amount of corn you are actually purchasing in the following situations:
  - 100 bushels at 15% moisture = \_\_\_\_\_ pounds of actual corn.
  
  - 100 bushels at 23% moisture = \_\_\_\_\_ pounds of actual corn.
  
- Does knowing the moisture matter? Explain why or why not. **(T,P,S)**

Global Position Systems(\_\_\_\_\_)

- GPS became available to \_\_\_\_\_.
- GPS was added to Yield \_\_\_\_\_ Systems.
  - Could now track \_\_\_\_\_ of crop being harvested.
  - \_\_\_\_\_ could now be \_\_\_\_\_ for future use.
  - \_\_\_\_\_ could now be created and printed.
  - Maps could be used for year-to-year \_\_\_\_\_.



# Intro to Ag

## Precision Ag - Lesson 1, Part A



### Advanced Sensors, Monitors and Meters increased the “precision” in Agriculture

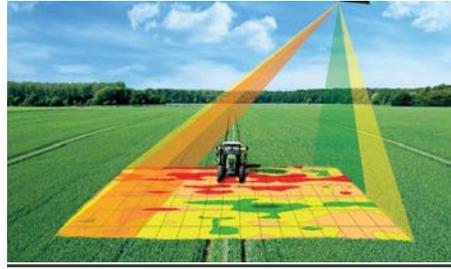
- Sensors can:
  - Track:
    - \_\_\_\_\_ of seeds planted per foot
    - If \_\_\_\_\_ seeds are planted at one spot
    - Seed \_\_\_\_\_
    - \_\_\_\_\_ planter
    - \_\_\_\_\_ of seed
    - \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ of soil.
    - Type of \_\_\_\_\_
    - \_\_\_\_\_ level
  - Drive our tractors \_\_\_\_\_
  - Etc.
- Meters:
  - Allow users to \_\_\_\_\_ the rate of delivery of “\_\_\_\_\_” on the run.
    - Uses of a “\_\_\_\_\_”
    - Spreaders, sprayers, planters and irrigation units have \_\_\_\_\_ that can vary \_\_\_\_\_ rates based upon prescriptions.

### Remote Sensing

- \_\_\_\_\_ are collected
  - Identifies variation in plant \_\_\_\_\_ and \_\_\_\_\_ conditions
- Introduced in the late 1990s
- Slow start
  - \_\_\_\_\_ and \_\_\_\_\_ delivery
    - Few satellites for \_\_\_\_\_ use
    - Sky needed to be \_\_\_\_\_
  - Very \_\_\_\_\_
- More \_\_\_\_\_ and \_\_\_\_\_ now
- Unmanned Aerial Vehicles (UAV) aka “\_\_\_\_\_” now being used
  - Higher \_\_\_\_\_
  - Less affected by \_\_\_\_\_

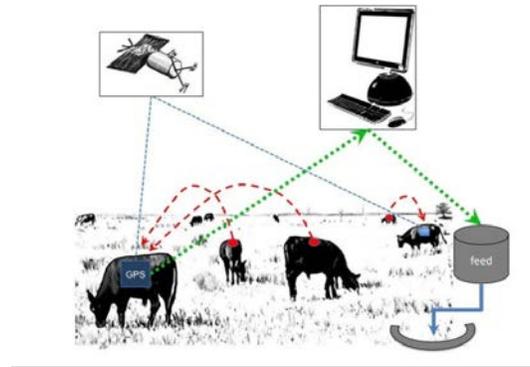


# Intro to Ag Precision Ag - Lesson 1, Part A



## What about the Future?

- Detection “\_\_\_\_\_”:
  - \_\_\_\_\_ health
  - \_\_\_\_\_ utilization
  - Soil \_\_\_\_\_
  - \_\_\_\_\_ utilization
  - Weed, insect, disease \_\_\_\_\_
  - \_\_\_\_\_ condition
  - Rotate \_\_\_\_\_ using GPS
  - Virtual \_\_\_\_\_
  - Etc.



## Precision Agriculture Vocabulary Fun

- Use the following link to learn and practice vocabulary related to Precision Agriculture.
  - <https://quizlet.com/join/mPXWZnyG3>



# Precision Agriculture

## Lesson 1B - Presentation

# Precision Agriculture

## Lesson 1, Part B

# Components of Precision Agriculture

- A *GPS Receiver*
- Equipment with *sensors*
- Equipment with *meters*
- A *monitor*
- *Software*

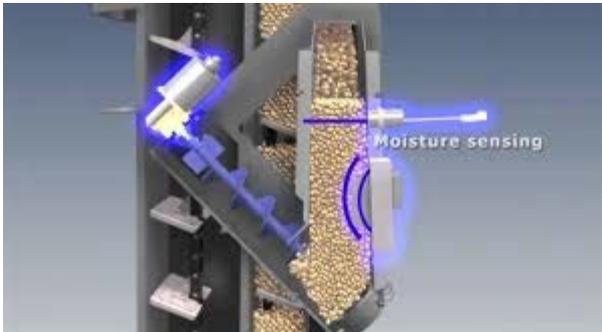
# GPS Receiver

- Tracks the equipment location in a field



# Equipment with Sensors

- “Sense” the conditions in which you are farming
- “Sense” the operation of the equipment
- Take readings about each area of the field



High Rate Seed Sensor

# Equipment with Meters

- Control the amount of inputs
  - Seed, fertilizer, pesticides, water, etc.
- Can steer the equipment
  - Aids in precise field placement

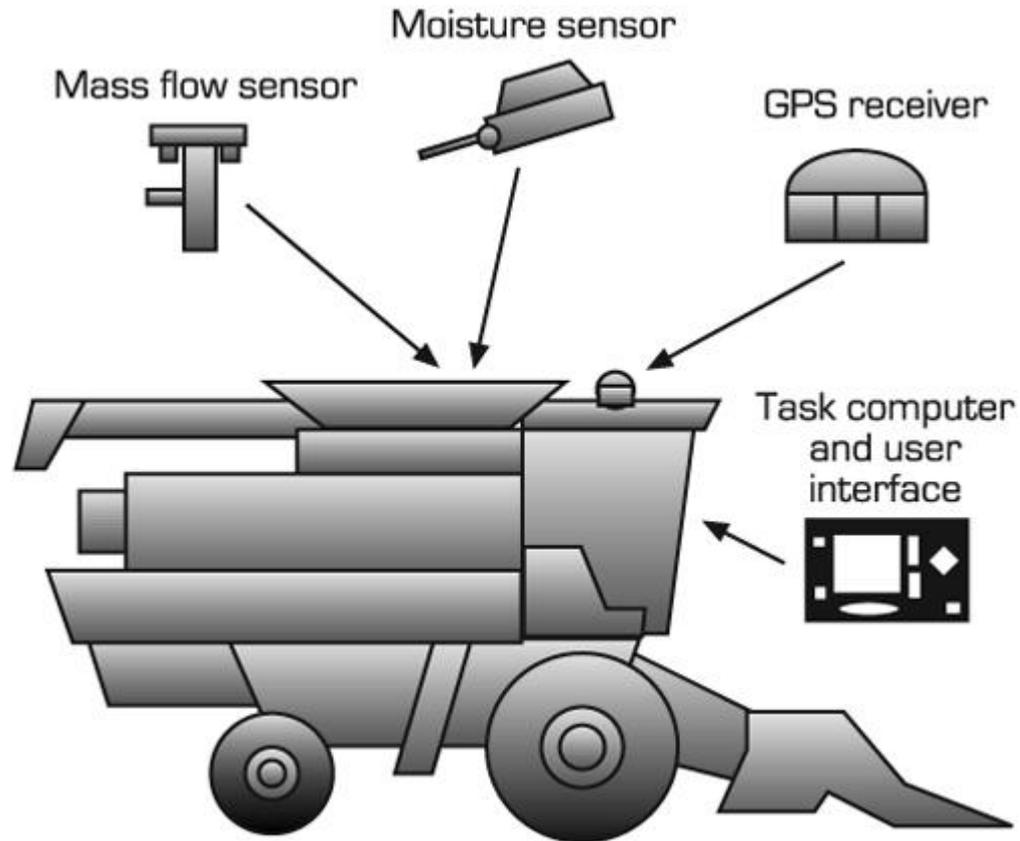
# Monitors

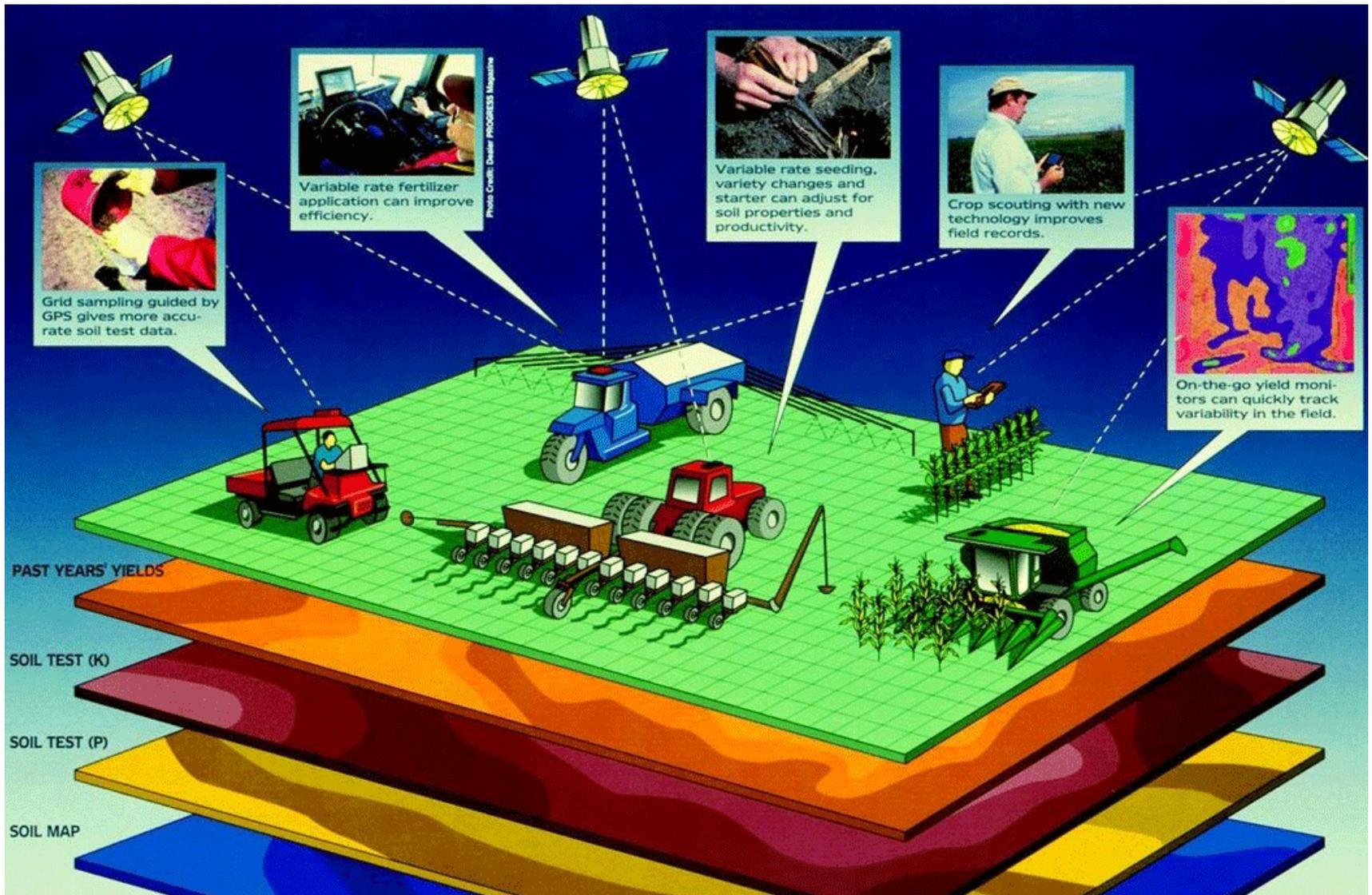
- Indicate the rate inputs are being applied.
- Tells the operator if equipment is working at peak performance.
  - Gives off a warning if not working properly.
- Acts as a user interface.
  - Operator can make adjustments on the go.
- Records all information gathered by GPS, sensors and meters.
  - Used later to help with decision making.





# Putting it all Together





# Big data comes to the farm

US farms generate **\$375 billion** from crops.

Almost all new farm equipment is equipped with sensors.

**60%** of farmers report using some sort of precision data.

**80%** of data now stays on tractors.

Farmers choose whether to use data themselves, share it locally or upload it to the cloud.

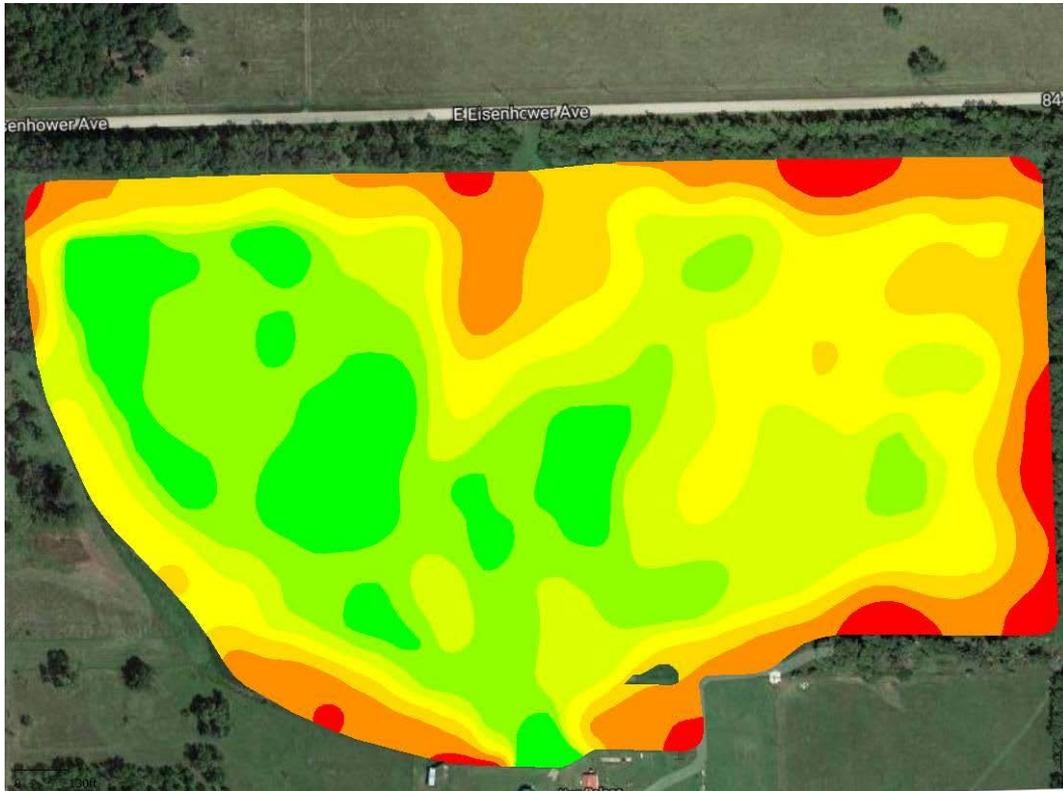
Farmers say data analytics have reduced input costs by **15%**; crop yields up by **13%**.

Source: American Farm Bureau Federation, 2015

# What is the Goal of Precision Ag?

- Primary goal = identify **variability** in the field.
  - Differences in the field
- Allows an operator to adapt management practices to the different areas of a field.

# Yield Map



Dark Green – Highest

Med. Green – 2<sup>nd</sup> Highest

Light Green – 3<sup>rd</sup> Highest

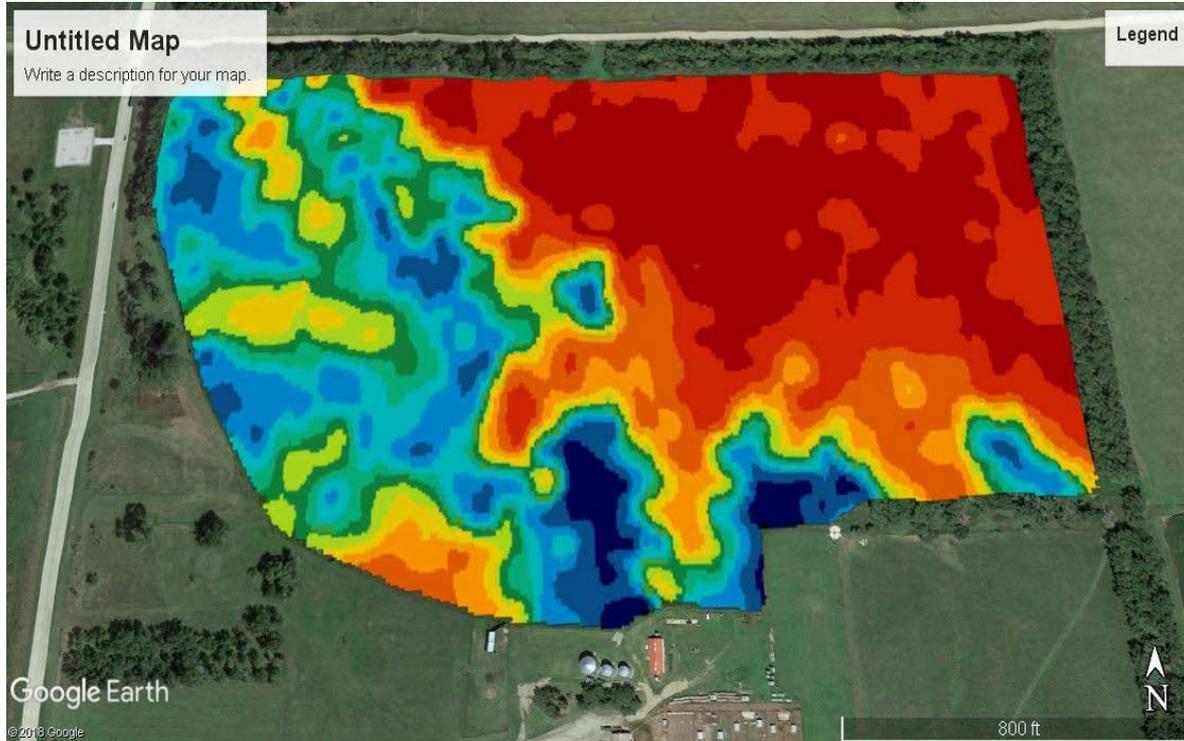
Yellow – 4<sup>th</sup> Highest

Gold – 5<sup>th</sup> Highest

Orange – 6<sup>th</sup> Highest

Red - Lowest

# Corresponding Soil Quality Map



- Dark Blue – Best
- Medium Blue – 2<sup>nd</sup> Best
- Light Blue – 3<sup>rd</sup> Best
- Dark Green – 4<sup>th</sup> Best
- Med Green – 5<sup>th</sup> Best
- Light Green – 6<sup>th</sup> Best
- Yellow – 7<sup>th</sup> Best
- Light Orange – 8<sup>th</sup> Best
- Dark Orange – 9<sup>th</sup> Best
- Red - Poorest

# Analyze the Maps (Mingle/Pair/Share)

- Compare the Soil Quality and Yield Maps
  - What similarities are there?
    - What could account for the similarities?
  - What differences are there?
    - What could account for the differences?

# Why is Precision Ag and Management Used?

- Resource Management!
  - Management on a **granular** scale.
    - Look at small portions of a field
    - Manage its unique characteristics
    - Place inputs accordingly for that portion
  - Saves money on seed, chemicals, water, time, etc.
  - Add the right inputs at the right time, in the right place at the right rate!
  - Can increase profitability.
    - Put less inputs where the field is less productive no matter what you do.
    - Apply the most and best product to the most productive areas.
    - Be more precise with input placement.
      - Example: **Singulation**



# Precision Agriculture

## Lesson 1B – Notes



# Intro to Ag Precision Ag - Lesson 1, Part B



### Components of Precision Agriculture

- A \_\_\_\_\_
- Equipment with \_\_\_\_\_
- Equipment with \_\_\_\_\_
- A \_\_\_\_\_
- \_\_\_\_\_

### GPS Receiver

- \_\_\_\_\_ the equipment \_\_\_\_\_ in a field

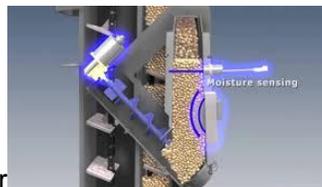


### Equipment with Sensors

- “Sense” the \_\_\_\_\_ in which you are farming
- “Sense” the \_\_\_\_\_ of the equipment
- Take \_\_\_\_\_ about each \_\_\_\_\_ of the field



High Rate Seed Sensor



Moisture Sensor

### Equipment with Meters

- Control the \_\_\_\_\_ of \_\_\_\_\_
  - \_\_\_\_\_, fertilizer, pesticides, \_\_\_\_\_, etc.
- /Can \_\_\_\_\_ the equipment
  - Aids in \_\_\_\_\_ field \_\_\_\_\_



# Intro to Ag Precision Ag - Lesson 1, Part B



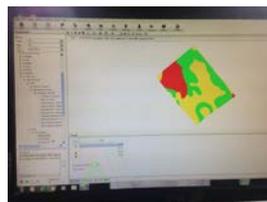
## Monitors

- Indicate the \_\_\_\_\_ inputs are being applied.
- Tells the operator if equipment is working at \_\_\_\_\_ performance.
  - Gives off a \_\_\_\_\_ if not working properly.
- Acts as a user \_\_\_\_\_.
  - \_\_\_\_\_ can make adjustments \_\_\_\_\_.
- \_\_\_\_\_ all \_\_\_\_\_ gathered by GPS, sensors and meters.
  - Used \_\_\_\_\_ to help with \_\_\_\_\_ making.



## Software

- Keeps track of information \_\_\_\_\_.
  - Throughout the \_\_\_\_\_
  - Across multiple \_\_\_\_\_
- Allows operator to
  - \_\_\_\_\_ data
  - Make \_\_\_\_\_ decisions to improve production
    - “\_\_\_\_\_” inputs to “\_\_\_\_\_” outputs and profit

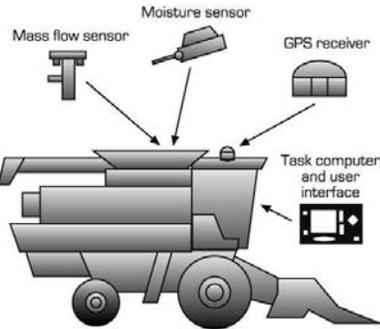




# Intro to Ag Precision Ag - Lesson 1, Part B



## Putting it all Together



## “Big Data Comes to the Farm”

- U. S. Farms generate \$\_\_\_\_\_ from crops.
- Almost all new farm equipment is equipped with \_\_\_\_\_.
- \_\_\_\_\_% of farmers report using some sort of precision data.
- 80% of data now \_\_\_\_\_.
- Farmers choose whether to use data themselves, \_\_\_\_\_ it locally or to upload it to the \_\_\_\_\_.

## What is the Goal of Precision Ag?

- Primary goal = identify \_\_\_\_\_ in the field.
  - \_\_\_\_\_ in the field
- Allows an operator to \_\_\_\_\_ practices to the different \_\_\_\_\_ of a field.





## Intro to Ag Precision Ag - Lesson 1, Part B

### Why is Precision Ag and Management Used?

- \_\_\_\_\_ Management!
  - Management on a \_\_\_\_\_ scale.
    - Look at \_\_\_\_\_ portions of a field
    - Manage its \_\_\_\_\_ characteristics
    - Place \_\_\_\_\_ accordingly for that portion
  - Saves \_\_\_\_\_ on seed, chemicals, water, time, etc.
  - Add the right \_\_\_\_\_ at the right \_\_\_\_\_, in the right \_\_\_\_\_ at the right \_\_\_\_\_!
  - Can increase \_\_\_\_\_.
    - Put less inputs where the field is less \_\_\_\_\_ no matter what you do.
    - Apply the most and best product to the \_\_\_\_\_ productive areas.
    - Be more \_\_\_\_\_ with input placement.
      - Example: \_\_\_\_\_



# Precision Agriculture

## Lesson 1 – Vocab List



## ***Intro to Ag - Precision Agriculture - Lesson 1*** ***Vocabulary***

**Traditional Farming Practice** – A farm management practice in which each herd, field or the entire farm operation is viewed as a single uniform environment managed in the same manner.

**Precision Agriculture** – A farm management practice in which each field is analyzed to identify micro environments that require different management to increase profitability by placing the exact level up inputs to produce the greatest yield at the least expense through the use of Information Technology and GPS.

**Precision Farming:** Managing crop production inputs (seed, fertilizer, lime, pesticides, etc.) on a site-specific basis to increase profits, reduce waste and maintain environmental quality.

**ROI – Return On Investment** – The amount of increased income due to an investment.

**ROI Ratio** - The amount of time it takes for the increase in profits to pay for the initial investment.

**GPS – Global Positioning System** – A constellation of approximately 30 well-placed satellites that orbit the Earth making it possible to pinpoint the geographic location of a receiver.

**GPS Receiver** – An antenna that communicates with the GPS satellite constellation.

**AOI – Area Of Interest** – A defined area used in a GIS system for analysis. A field is an example of an AOI.

**Variability** – differences in conditions within an area of interest. May be soil type, fertility, moisture retention, or other agronomic or environmental factors.

**Seeding Rate** – Determines what the Planting Population is. The higher the seeding rate, the more seeds per acre are planted.

**Innovation** – The creative adaptation of new technologies and design to provide a functional solution.

**Sensor** – A piece of equipment that measures something such as a weight, volume, density, or level of something.

**Meter** – A piece of equipment that applies an agronomic input such as seed, fertilizer, insecticide or herbicide.

**Monitor** – A piece of equipment that displays information.

**Trilateration** – The calculating of a location utilizing 3 or more positioning satellites.

**Triangulation** – The calculating of a location utilizing 3 or more known locations on the earth's surface.



# Precision Agriculture

## Lesson 1 – Vocab Worksheet



## Intro to Ag - Precision Agriculture - Lesson 1 Vocabulary Worksheet

**Match the definition in the right column to the correct term found in the column on the left. Place the number of the matching definition on the blank provided in front of the appropriate term.**

\_\_\_\_\_ AOI – Area Of Interest

\_\_\_\_\_ GPS – Global Positioning System

\_\_\_\_\_ GPS Receiver

\_\_\_\_\_ Innovation

\_\_\_\_\_ Meter

\_\_\_\_\_ Monitor

\_\_\_\_\_ Precision Agriculture

\_\_\_\_\_ Precision Farming

\_\_\_\_\_ ROI Ratio

\_\_\_\_\_ ROI – Return On Investment

\_\_\_\_\_ Seeding Rate

1. The amount of time it takes for the increase in profits to pay for the initial investment.

2. Managing crop production inputs (seed, fertilizer, lime, pesticides, etc.) on a site-specific basis to increase profits, reduce waste and maintain environmental quality.

3. The calculating of a location utilizing 3 or more known locations on the earth's surface.

4. A piece of equipment that applies an agronomic input such as seed, fertilizer, insecticide or herbicide.

5. A farm management practice in which each herd, field or the entire farm operation is viewed as a single uniform environment managed in the same manner.

6. Differences in conditions within an area of interest.

7. The calculating of a location utilizing 3 or more positioning satellites.

8. A piece of equipment that measures something such as a weight, volume, density, or level of something.

9. An antenna that communicates with the GPS satellite constellation.

10. A piece of equipment that displays information.

11. A defined area used in a GIS system for analysis.



# Intro to Ag - Precision Agriculture - Lesson 1

## Vocabulary Worksheet

\_\_\_\_\_ Sensor

12. The amount of increased income due to an investment.

\_\_\_\_\_ Traditional Farming Practice

13. A constellation of approximately 30 well-placed satellites that orbit the Earth making it possible to pinpoint the geographic location of a receiver.

\_\_\_\_\_ Triangulation

14. The creative adaptation of new technologies and design to provide a functional solution.

\_\_\_\_\_ Trilateration

15. A farm management practice in which each field is analyzed to identify micro-environments that require different management to increase profitability by placing the exact level up inputs to produce the greatest yield at the least expense through the use of Information Technology and GPS.

\_\_\_\_\_ Variability

16. Determines the planting population.



# Precision Agriculture

## Lesson 1 Quiz



*Intro to Agriscience  
Precision Ag - Lesson 1 Quiz*

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***T/F Section – Reach each statement carefully and determine if it is a True (T) statement or a False (F) statement. Place a T or an F on the blank in front of the statement. If the statement is false, write the word or words that would make the statement true in the blank provided.***

---

- \_\_\_\_\_ 1. Precision Agriculture is a method of farm finance.  
\_\_\_\_\_
- \_\_\_\_\_ 2. When GIS was first introduced, only government and large industries could afford it.  
\_\_\_\_\_
- \_\_\_\_\_ 3. Mass Flow Sensors were added to Yield Monitors so the location of a crop could be tracked.  
\_\_\_\_\_
- \_\_\_\_\_ 4. Meters can track things such as the number of seeds planted, seed skips and the depth of seed.  
\_\_\_\_\_
- \_\_\_\_\_ 5. One bushel of corn weighs 56 pounds.  
\_\_\_\_\_

---

***Matching Section - Match each vocabulary word in the column on the left with its proper definition from the column on the right.***

---

- |                        |     |   |
|------------------------|-----|---|
| _____ Area of Interest | 6.  | The calculating of a location utilizing 3 or more known locations on the earth’s surface. |
| _____ Innovation       | 7.  | The amount of increased income due to an investment.                                      |
| _____ Monitor          | 8.  | The calculating of a location utilizing 3 or more positioning satellites.                 |
| _____ ROI              | 9.  | A defined area used in a GIS system for analysis.   |
| _____ Triangulation    | 10. | The creative adaptation of new technologies and design to provide a functional solution.  |
| _____ Trilateration    | 11. | A piece of equipment that displays information.   |

---

***Multiple Choice Section - Reach each question or statement carefully. Circle the correct answer from the choices below each question.***

---

12. Which technology was introduced in the late 1990s, had a slow start because the sky needed to be clear and was very costly?
- a. Geographic Information System
  - b. Global Position System
  - c. Remote Sensing
  - d. Yield Monitor





*Intro to Agriscience*  
*Precision Ag - Lesson 1 Quiz*

20. Give two examples of how Precision Agriculture can be used in animal production.
  
  
  
  
  
  
  
  
  
  
21. Precision Ag and management is used to manage \_\_\_\_\_.
  
  
  
  
  
  
  
  
  
  
22. What does it mean to manage on a “granular” scale?
  
  
  
  
  
  
  
  
  
  
23. With Precision Ag, operators aim to add the right \_\_\_\_\_ at the right \_\_\_\_\_ at the right \_\_\_\_\_ at the right \_\_\_\_\_.
  
  
  
  
  
  
  
  
  
  
24. Name one way an Ag producer can increase profitability using Precision Ag.
  
  
  
  
  
  
  
  
  
  
25. The concept of one seed in one spot every time is called \_\_\_\_\_.



# Precision Agriculture

## Lesson 1 Quiz Answer Key





*Intro to Agriscience*  
**Precision Ag - Lesson 1 Quiz ANSWER KEY**

13. Differences within an area of interest is called \_\_\_\_\_.
- a. discrepancy **b. variability**  
c. variety d. diversity
14. Seed, fertilizer, herbicide and irrigation water are examples of \_\_\_\_\_ used to produce a crop.
- a. inputs** b. chemicals  
c. compounds d. expanses
15. A \_\_\_\_\_ is an example of an UAV.
- a. ray of sun b. GMC Acadia  
c. seedling **d. drone**

---

**Short Answer/Fill-in-the-Blank Section - Read each statement or question carefully. Fill in the blanks with the correct answers or write the correct response in the space provided below each question.**

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16. The primary goal of Precision Ag is to identify **variability** in the field.
17. Name the 5 components of Precision Agriculture.
- GPS Receiver, Sensors, Meters, Monitors, and Software***
18. Advanced **sensors** allow us to track things and drive our tractors straight while advanced **meters** allow us to vary the rate of delivery of seed, fertilizer, pesticides and water “on the run.”
19. Explain why is it important for an Agricultural Producer to know the moisture of grain.
- If a producer is purchasing grain to feed to livestock, he or she does not want to pay for the extra water if it contains a high amount of moisture. If the producer is selling grain, he or she will want to know how much the income from the crop will be discounted due to the moisture content. Etc.***



*Intro to Agriscience*  
*Precision Ag - Lesson 1 Quiz ANSWER KEY*

20. Give two examples of how Precision Agriculture can be used in animal production.

*To determine range condition, to help rotate pastures, act as virtual fences, etc.*

21. Precision Ag and management is used to manage resources.

22. What does it mean to manage on a “granular” scale?

*It allows you to manage on a smaller, more precise scale to manage its unique characteristics and thereby place inputs accordingly for that portion. Etc.*

23. With Precision Ag, operators aim to add the right inputs at the right time at the right place at the right rate.

24. Name one way an Ag producer can increase profitability using Precision Ag.

*Add fewer inputs where the field is less productive, apply the most and best product to the most productive area, be more precise with input placement, etc.*

25. The concept of one seed in one spot every time is called singulation.