

# Precision Agriculture Technology Adoption in U.S. Crop Production

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# Precision Ag Technology

- Precision agriculture technologies have evolved significantly over the last two decades
  - new products
  - improved older products
- Widespread adoption was expected resulting from
  - Productivity increases
  - Cost reductions
- Adoption in the U.S. has lagged behind expectations, rarely eclipsing 50% of farms or even 50% of planted acres (Erickson and Widmar, 2016; Schimmelpfennig, 2016; Torrez et al., 2016; Zhou et al., 2017)
- Adoption pace has been slower than for other new ag technologies in the U.S.
  - Example: genetically engineered crops in the United States, over roughly the same period, were adopted on about 90% of corn and soybean acres (Mintert, 2016; Wechsler, 2017))

# Key Factors Influencing Adoption of Precision Ag

- Adoption rates are generally higher among larger farms (Fernandez-Cornejo et al., 2001; Schimmelpfennig, 2016)
- Just 12% of the smallest farms (less than 243 hectares) reported using at least one precision agriculture technology (Schimmelpfennig, 2016, data collected in 2010)
- Farms over 1,538 hectares reported adoption rates of 80%, 84%, and 40% for GPS soil/yield mapping, guidance systems, and variable rate technology, respectively (Schimmelpfennig, 2016, data collected in 2010)
- Implication: evaluating adoption rates of all farms might not adequately characterize precision agriculture technology's adoption by the industry

# Filling the Information Gap

## *Precision Ag Adoption By Farmers Who Provide Most of U.S. Crop Production*

- Assess adoption of key precision agriculture technologies by the larger scale U.S. crop farms that produce the majority of U.S. corn, soybeans, wheat and cotton
- Producers of these crops were selected because these four crops collectively accounted for approximately 70 percent of 2017 U.S. planted crop acreage
- Focusing on these crops provides a more accurate picture of how widespread usage of key precision agriculture technologies is on the majority of U.S. crop acreage

# Focused on Adoption of Key Ag Technologies

Key precision agriculture technologies suitable for use in the four principal crops of corn, soybeans, wheat and cotton dominating U.S. planted acreage that have been widely available for many years

1. Yield monitoring
2. Guidance and auto-steer for tractors and harvesters
3. Precision soil sampling
4. Variable rate fertilizer application
5. Variable rate seeding

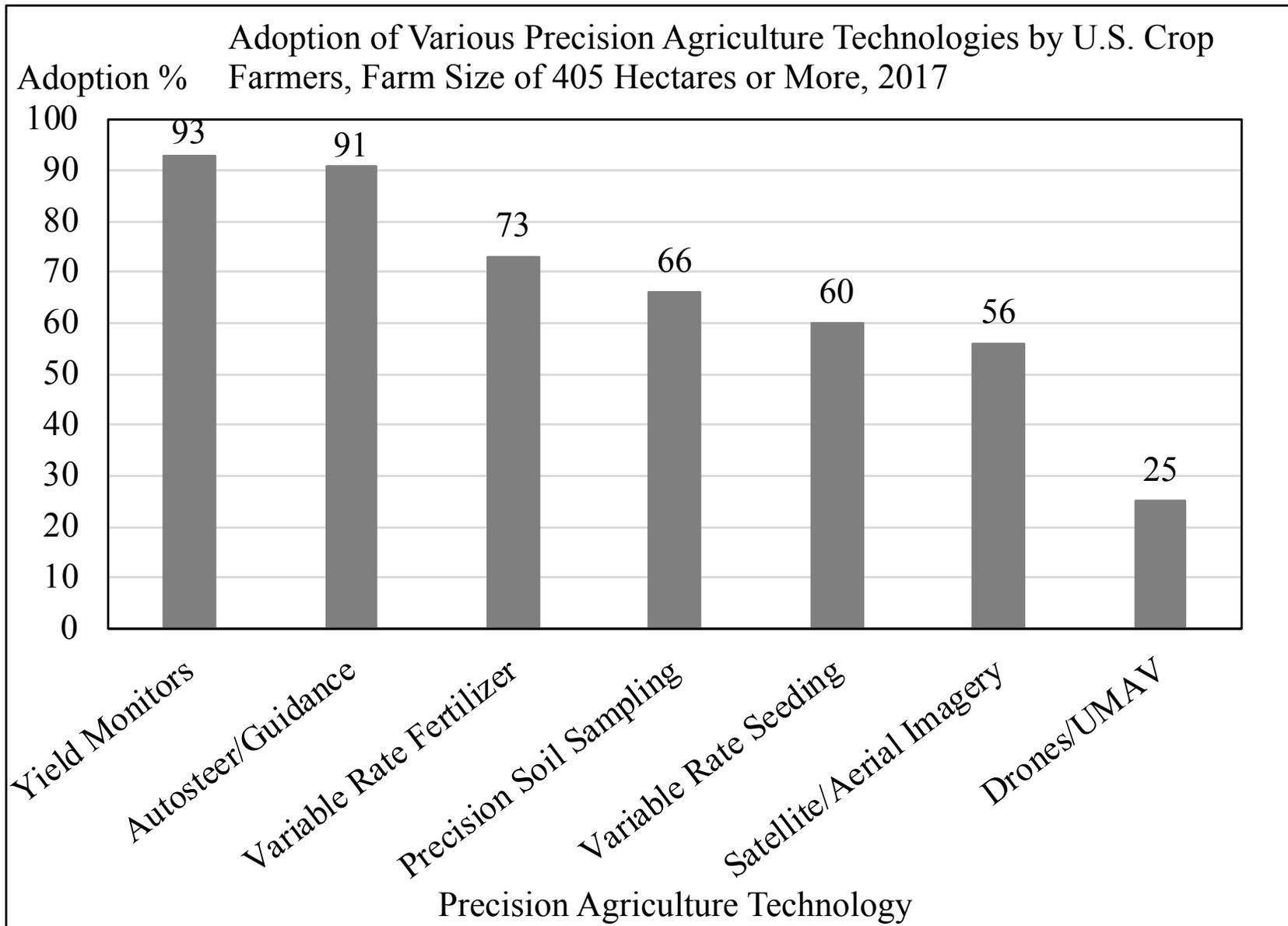
PLUS

- ✓ use of drones or unmanned aerial vehicles (UMAV)
- ✓ satellite/aerial imagery

# How Did We Gather Data on Precision Ag Adoption Rates?

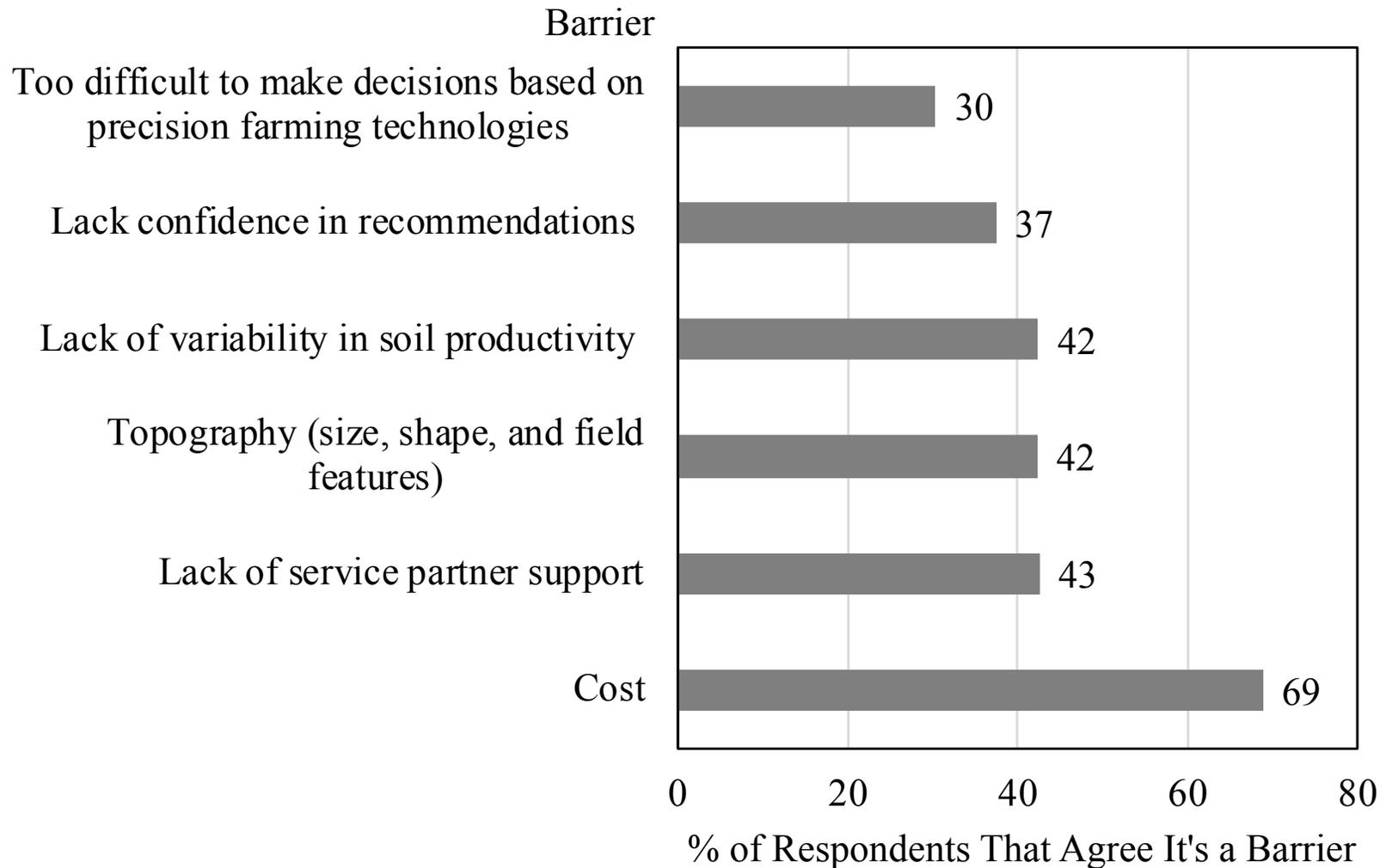
- Phone survey of U.S. farmers that produce corn, soybeans, wheat and cotton was conducted from early June to early July 2017
- Survey sample was stratified to only survey farms that had total planted crop acreage of 405 or more hectares. For accuracy, at least 400 responses needed out of this farm population. We chose to oversample as follows:
  - 400 responses sought from farms operating between 405 and 810 hectares
  - 400 responses sought from farms operating 810 hectares or more
- Enterprise quotas were derived from the distribution of corn, soybean, wheat and cotton acres reported by USDA in the 2012 Census of Agriculture (USDA, 2014)
- 25 percent of the sample was comprised of farms with wheat (20.5%) and cotton enterprises (4.5%)
- 75 percent of the sample comprised of farms with corn or soybean enterprises
- Ultimately, the survey yielded 837 usable responses.

# How Widely Are Key Precision Ag Technologies Being Used

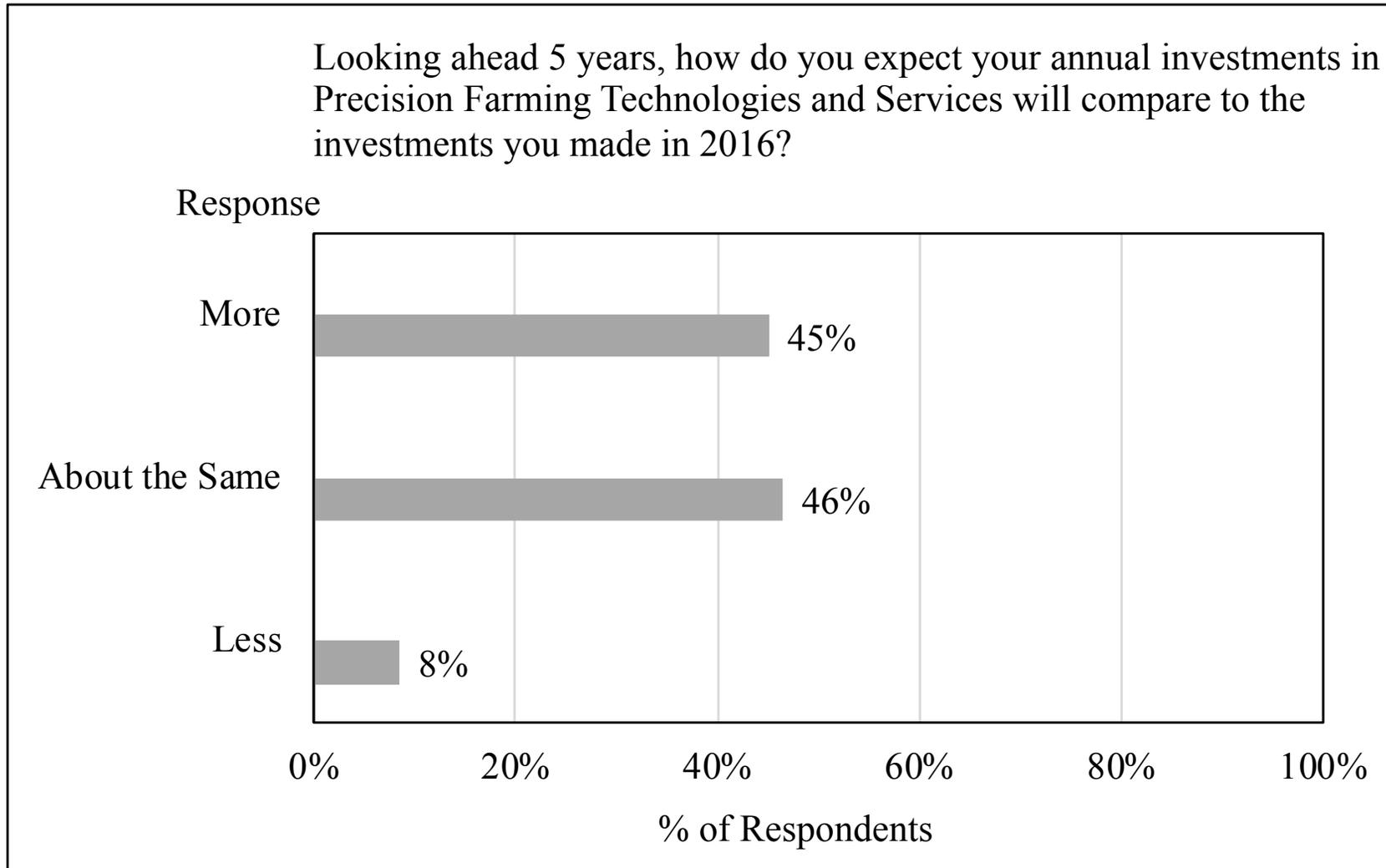


# Barriers to Adoption of Precision Ag by U.S. Farmers

Which of the following are a barrier to your farm's adoption of Precision Ag Technology (Agree or Disagree)?



# U.S. Farmers' Plans for Future Investments in Precision Ag



# Why Are Adoption Rates In This Study Higher Than Reported In Previous Research

- ✓ Small farms are less likely to adopt precision ag
  - Our focus on larger scale farms accounts for some of the difference
  - But even with that adjustment, our adoption rates are higher
- Over time various precision agriculture technologies are simply being more widely adopted by U.S. producers
- But the pace of adoption remains slower than other ag technologies
- Evolving adoption rates could be a function of
  1. Improvements in the technology over time;
  2. Reduced cost as the technologies mature;
  3. Improved understanding of how to implement the technologies in a crop production system providing higher yields, lower costs per hectare or both (e.g., lower costs per unit of output)

# Other Drivers of Precision Ag Adoption Rates

- Better crop production models that underlie some of the technologies
  - especially use of yield mapping
  - variable rate technology
- Time and effort required on the part of producers to fully realize the benefits these technologies offer
  - Stated another way, it is possible that it has simply taken time for farm operators to actually learn how to take advantage of precision agriculture technologies
- Lack of specialization on many smaller farms that might be required to fully capture the benefits of precision agriculture technology could be one reason why precision agriculture technology adoption rates on smaller farms lags behind that of larger farm operations

# Conclusions

1. By 2017, key precision agriculture technologies were being widely used by U.S. commercial scale producers of corn, soybeans, cotton and wheat
2. Over 90 percent of surveyed producers were using auto-steer/guidance technology and yield monitors
3. Nearly three-quarters of producers surveyed were using variable rate fertilizer applications
4. Usage of precision soil sampling, at 66 percent, and variable rate seeding, at 60 percent of respondents were less popular
  - a sizable minority of commercial crop producers remain unconvinced that these technologies can improve their farms' profitability
5. Just one-fourth of the farms in this survey indicated that they had adopted one of the newest precision agriculture technologies, use of drones/UMAV's.

## Conclusions (continued)

6. Most producers did not seem to view using precision ag technology difficult
  - ✓ just 30% of respondents agreed this was a barrier
7. Large number of producers still find precision agriculture's value proposition at least somewhat problematic
  - ✓ 69% of producers identified cost as a major barrier to adoption
8. But producers remain optimistic that precision agriculture's value proposition will improve enough to justify maintaining or actually increasing their precision ag investments in the future

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