

GROWING YOUR DIGITAL AGRICULTURE STRATEGY

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TRENDS IN DIGITAL AGRICULTURE



“BIG DATA” IN AGRICULTURE

- Growth of sensors, GPS guidance, equipment telematics, and drones.
- Terabytes of farm data can now be collected and stored in the cloud.
- How “big” is farm data if it remains siloed on the farm?

INVESTMENT IN AG-TECH IS GROWING

- Investment in agri-food tech startups grew to \$17 billion in 2018 (43% increase from 2017).
- Of this, \$7 billion was in “upstream” startups working close to the farm.
- Climate Corp sale to Monsanto for \$930 million indicates optimism.

TRENDS IN DIGITAL AGRICULTURE

QUESTIONS REMAIN...

- Data **collection** does not imply data **action**.
 - 61% of corn growers used a yield monitor in 2010 but only 34% generated a yield map (USDA ARMS survey).
- How do producers use their data to make management **decisions**?
- What **hardware** and **software** tools do farmers use to store/manage/analyze their data?
- How do producers **evaluate** their data-driven decisions?

PURDUE CENTER FOR COMMERCIAL AGRICULTURE

WORKING TO ANSWER IMPORTANT QUESTIONS IN DIGITAL AGRICULTURE

1. Farmer Perceptions of Precision Agriculture Technology Benefits (Thompson et al., 2018)
 - ~65% of farms adopt for **yield improvement/cost reduction** (variable rate technology)
 - ~35% adopt for **convenience** (GPS guidance/auto-steer, yield monitors)
 - There is a tradeoff between financial benefits and convenience conferred by PA technologies.
 - Profitability requires translation of farm information into yield enhancing or cost reducing actions.
2. Farm Data Usage in Commercial Agriculture (Delay et al., 2019)
 - Active farm data management and engagement makes data more actionable and improves perceptions of yield outcomes.

FARM DATA USAGE

FARM DATA USE SURVEY

- Focused on commercial scale operations (1,000 acres +)
- Corn and soybean producers
- 800 farm respondents
- 32 questions covering:
 - Farm demographics
 - Types of data collected
 - Data-driven decisions
 - Data management
 - Data sharing

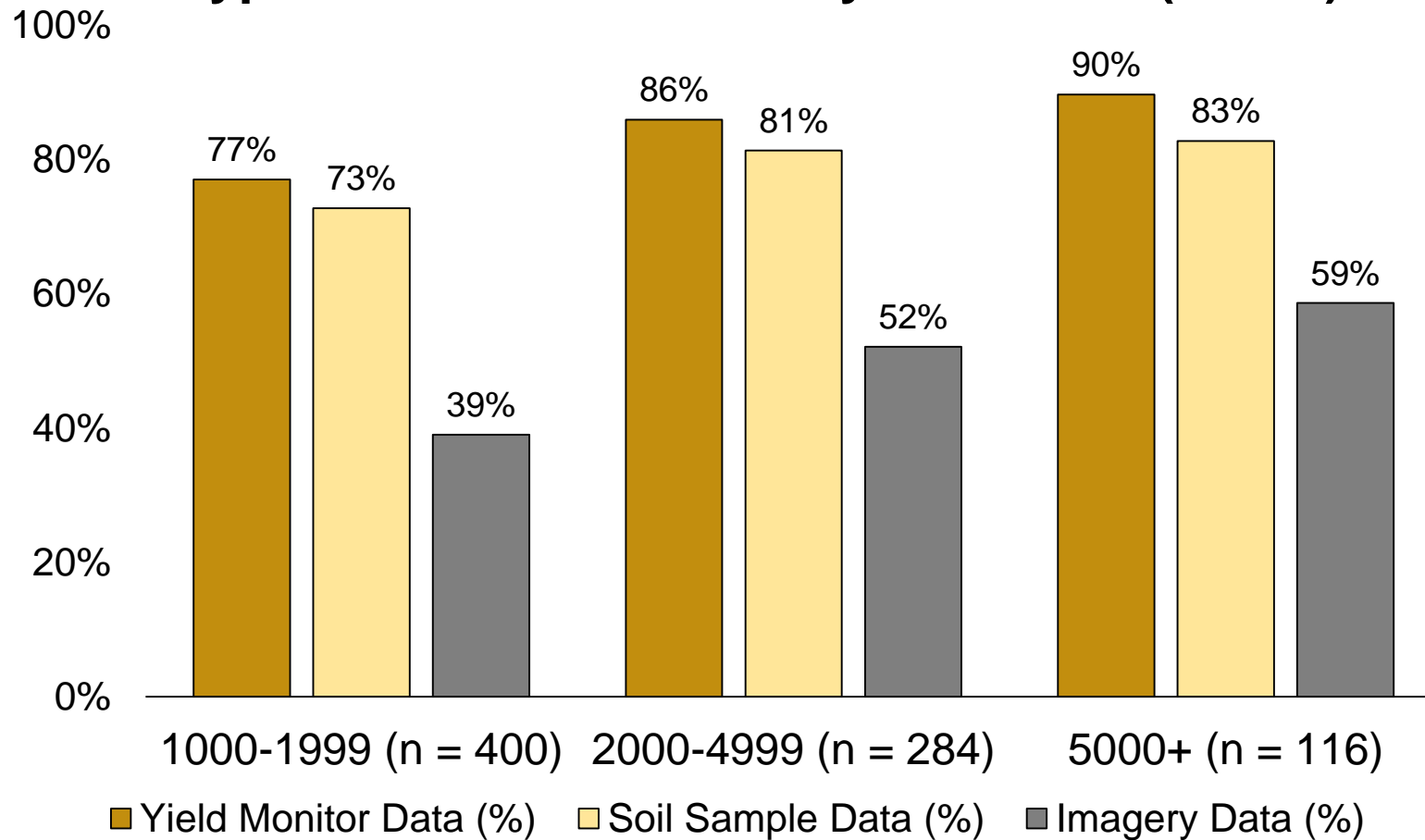
PRECISION AGRICULTURE ADOPTION

ADOPTION RATES OF PRECISION AGRICULTURE & DATA COLLECTION

	Percent of survey respondents
GPS guidance/auto-steer	92%
Yield monitor data	82%
High-speed internet access	80%
Soil sampling data	77%
Variable rate fertilizer application	71%
GPS mapping	67%
Variable rate seed application	59%
Drone or satellite imagery data	47%
Drone/UAV	26%

FARM DATA USAGE

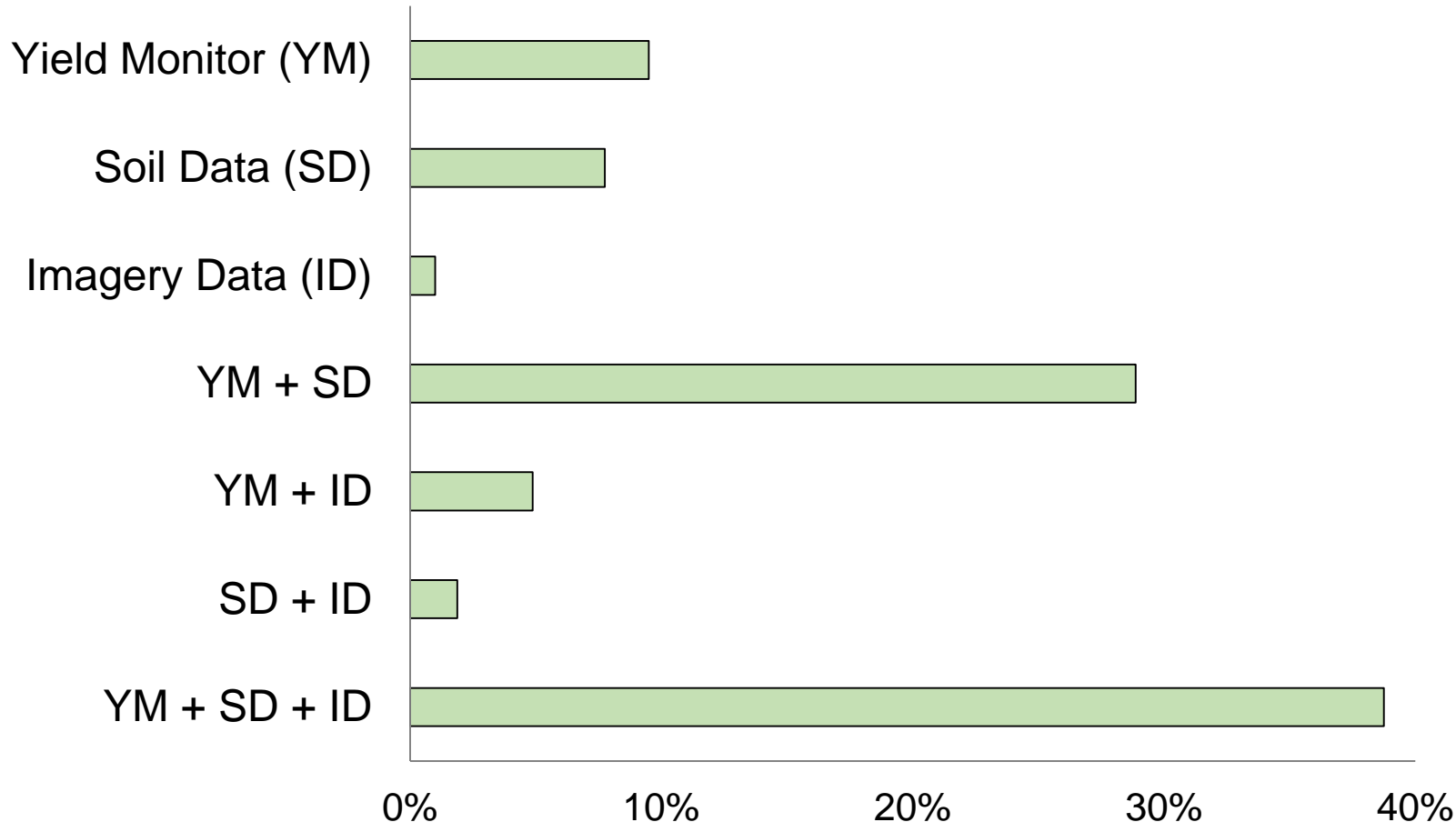
Types of Data Collected by Farm Size (Acres)



- Collection of yield monitor and soil data is common across all farms.
- Large operations are more likely to collect data – particularly imagery data.
- Younger operators and farms with higher educational attainment are also more likely to collect farm data – again, differences are largest for imagery data.
- Differences in collection of yield monitor and soil data between farm sizes are less pronounced.

FARM DATA USAGE

Farms Tend to Bundle Data Sources



- Most farms collect multiple types of farm data.
- The most common “data bundles” are:
 - YM + SD + ID
 - YM + SD
- Among those only collecting one data type, YM data is the most common.
- Drone/satellite imagery data is rarely collected on its own – if collected, it is typically paired with YM and SD.
- Implies that data is more valuable when combined with other data sources.

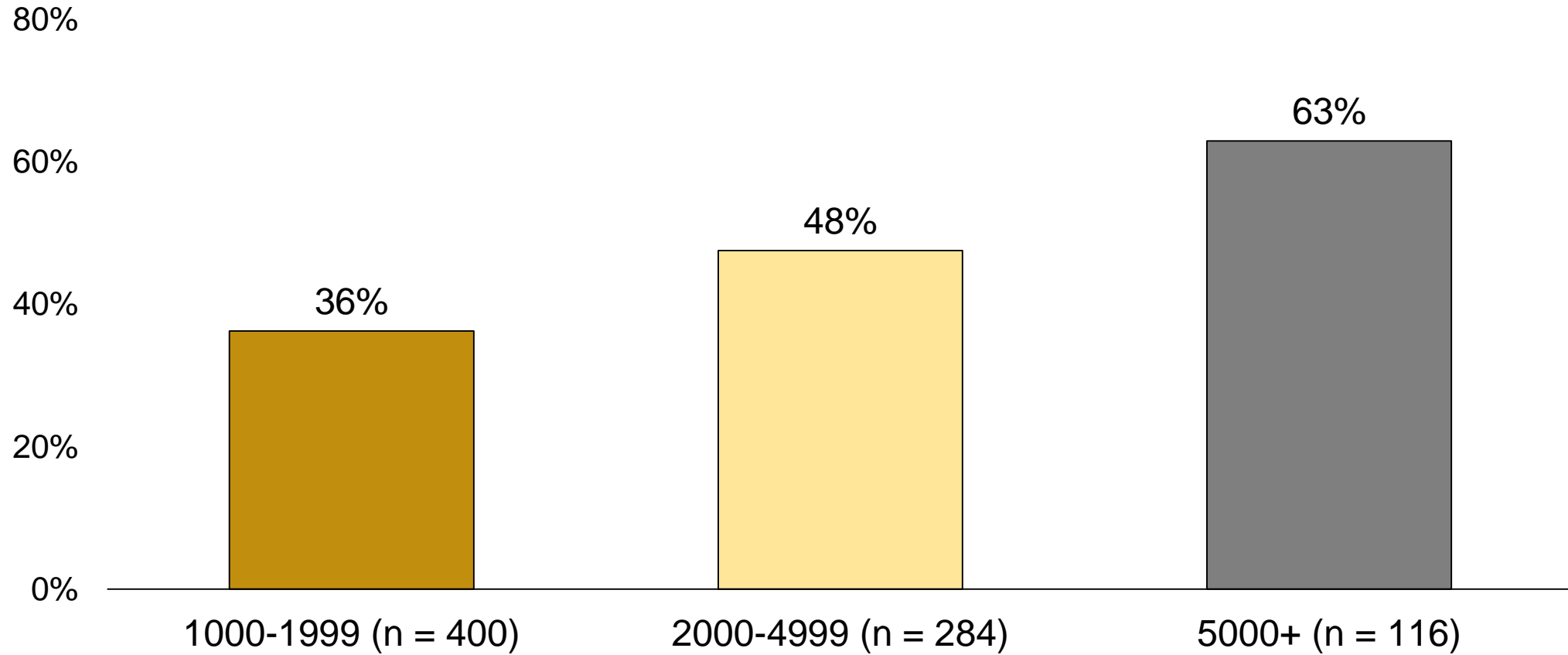
FARM DATA USAGE

CHARACTERISTICS OF FARM OPERATIONS THAT DO NOT COLLECT DATA

- Demographics of non-collectors:
 - Smaller operations - 75% operate less than 2,000 acres vs. 48% of data collectors.
 - Farms have fewer employees.
 - Operators tend to be older with fewer years of formal education.
- Primary reasons for not collecting farm data:
 - Weak value proposition (too expensive or unclear benefits).
 - Uncertainty in how data can be used to improve profitability.
- Non-collectors are unlikely to begin collecting in the future
 - e.g. 76% of non-collectors say it is unlikely that they will begin collecting imagery data in the future.

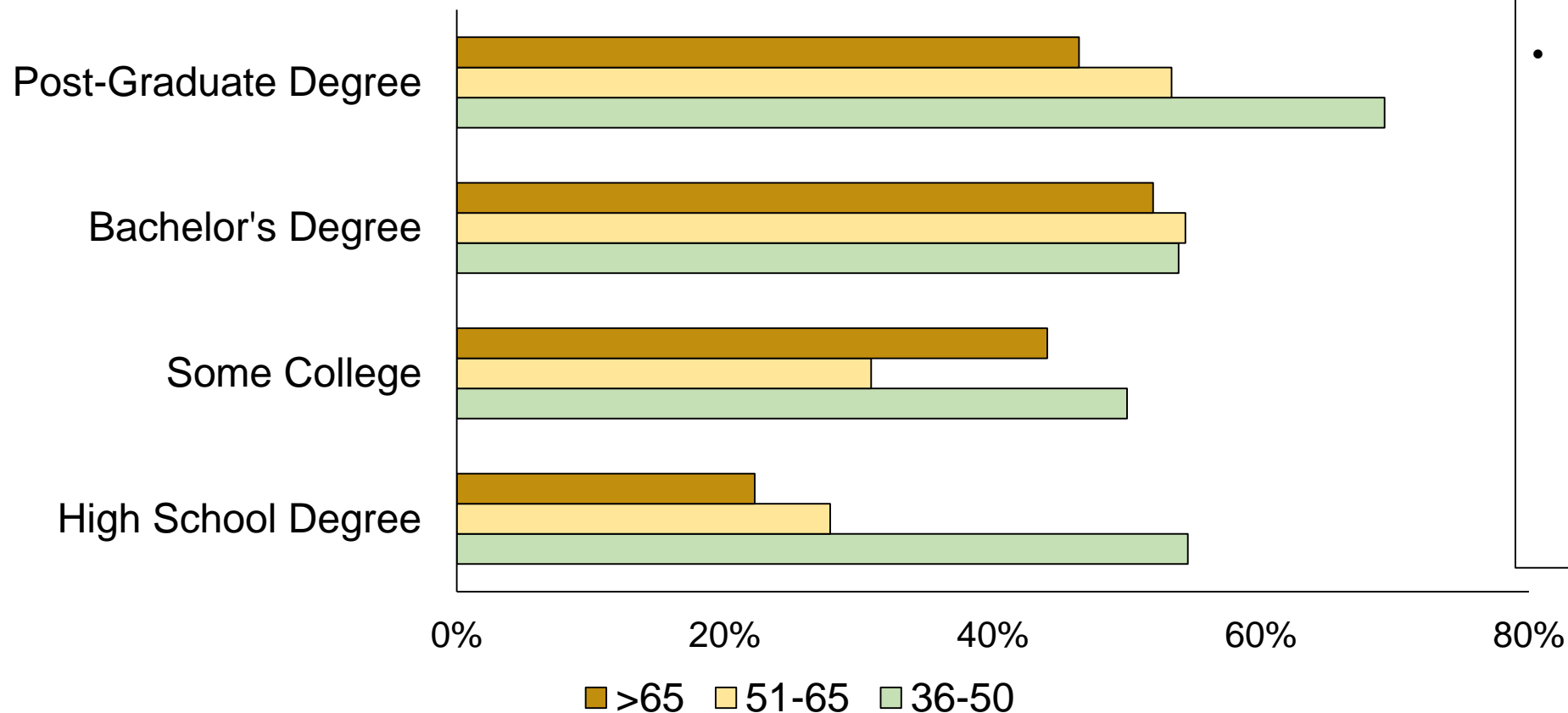
FARM DATA USAGE

Use of Farm Data Software by Farm Size (Acres)



FARM DATA USAGE

Use of Farm Data Software by Education and Operator Age



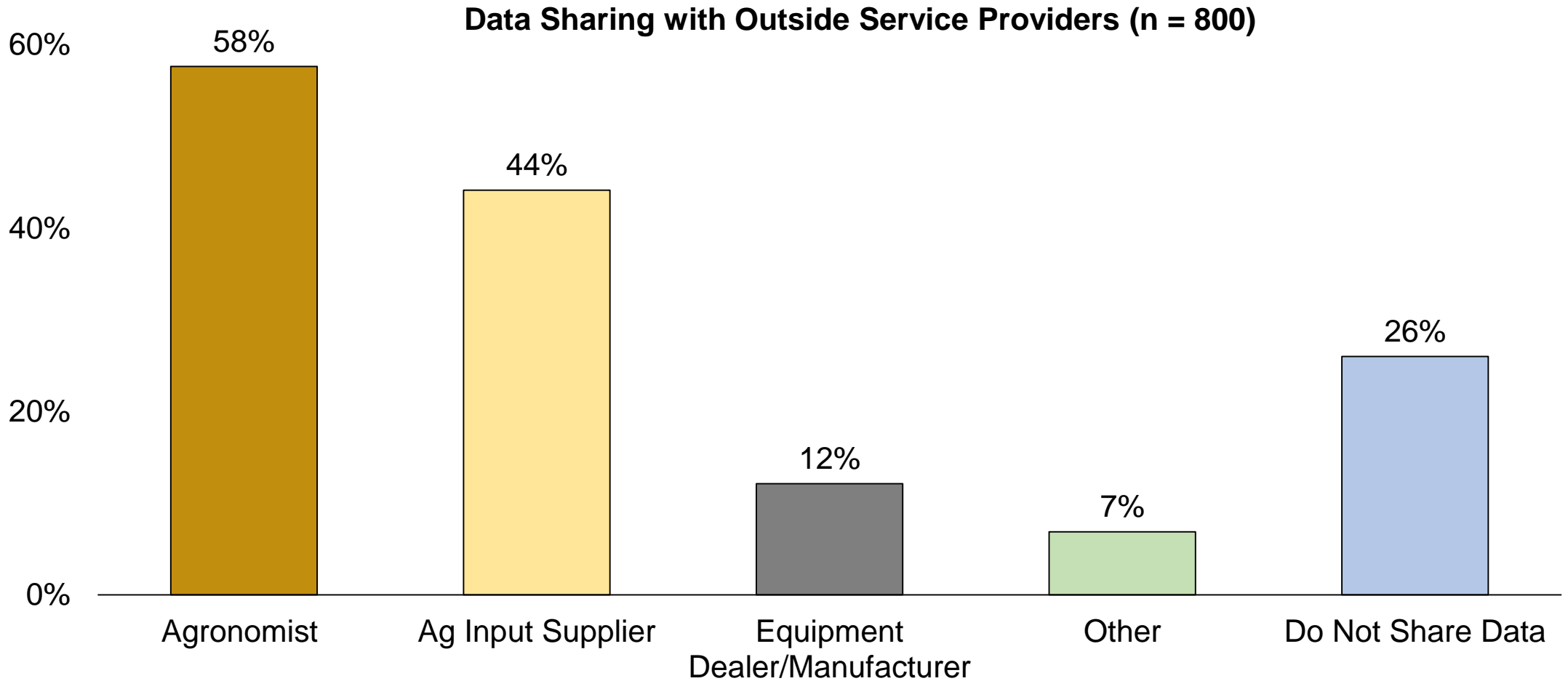
- Software usage among young operators is high – even at lower levels of education.
- The relationship between education and software adoption differs across age groups.
 - 36-50: post-graduate degree raises software adoption rates.
 - 51-65: bachelor's degree raises software adoption.
 - >65: some college raises adoption

FARM DATA USAGE

FARM DATA SOFTWARE

- 44% of surveyed farms use at least one farm data software platform.
- Most popular products:
 - Climate FieldView (52% of software users)
 - John Deere Ops Center (44% of users)
- Software users subscribe to an average of 2 platforms and 70% use more than one—implying there is no “one-stop-shop” for data management solutions.
- 88% of software users subscribe to 3 or fewer platforms.
 - How can new entrants convince farmers to adopt?
- Software usage is related to farm size, operator age, and education.

FARM DATA USAGE



FARM DATA USAGE

DATA SHARING WITH SERVICE PROVIDERS

- 74% of surveyed farms share data with at least one outside service provider (agronomist, input supplier, equipment dealer/manufacturer, or other).
- Farmers are more likely to share data with service providers that are close to crop management decisions.
- Of those that share data, 63% share with 2 or more outside service providers.
- 31% of farms follow recommendations provided by outside service providers “very closely.”

FARM DATA USAGE

WHO DO PRODUCERS TRUST MORE WITH THEIR DATA?

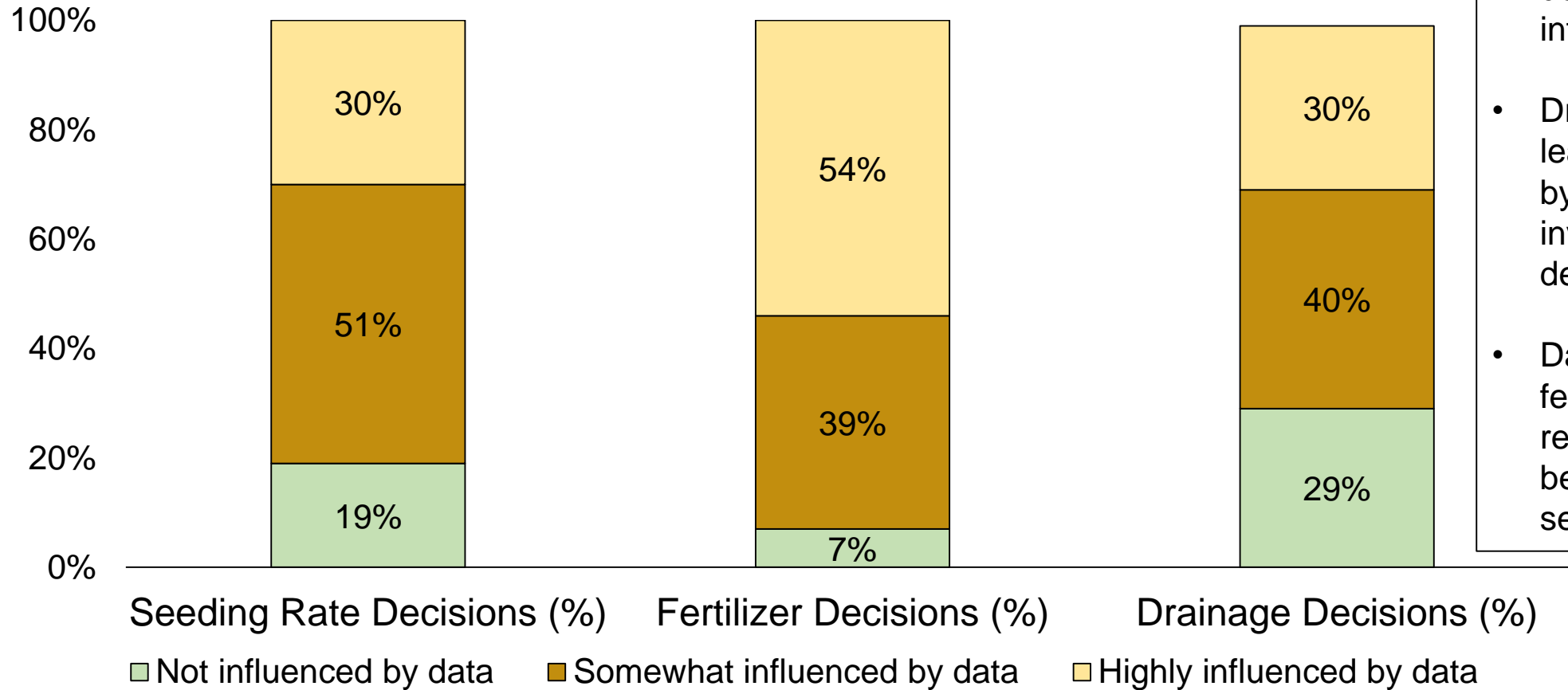
	% of respondents that follow recommendations "very closely"
Farms that share data w/ a service provider (n=592)	31
Share w/ agronomist (n=461)	34
Share w/ input supplier (n=353)	29
Share w/ equipment dealer/manuf. (n=97)	34
Farm software users (n=223)*	44

* Farms that use a farm data software product that provides crop management recommendations/prescriptions.

- Farmers have greater confidence in their software recommendations than those provided by consultants.
- Farmers are more likely to follow their software recommendations if they share data and visa versa.

FARM DATA USAGE

Management Decisions Influenced by Data



- Fertilizer application decisions are the most influenced by data
- Drainage decisions are the least likely to be influenced by farm data – drainage investments are discrete decisions
- Data-informed seeding lags fertilizer decisions – research on VR fertilizer better defined than VR seeding

FARM DATA USAGE

DATA DECISION MAKING

- Farms actively managing their farm data are:
 - (i) more likely to make data-informed decisions, and
 - (ii) more likely to perceive their data-informed decisions as yield improving.
- Fertilizer/nutrient management decisions are the most heavily influenced by farm data.
- Farms that make data-informed decisions are very likely to report a positive yield impact.
 - 72% say data-informed seeding rate decisions increased yields
 - 81% say data-informed fertilizer decisions increased yields
 - 85% say data-informed drainage investment decisions increased yields
- A small number of respondents (2%) collect data but do not use it at all when making seeding rate, fertilizer, or drainage decisions.

FARM DATA USAGE

PRACTICES THAT MAKE DATA MORE ACTIONABLE

- **Seeding rate decisions:**
 - Collecting yield monitor data
 - Variable rate seeding
 - Sharing data with outside service providers
- **Nutrient management/fertilizer decisions:**
 - Collecting yield monitor data
 - Collecting soil data
 - GPS mapping
 - Variable rate fertilizing
 - Sharing data with outside service providers
- **Drainage investment decisions:**
 - Collecting yield monitor data
 - Collecting drone/satellite data
 - GPS mapping
 - Using UAV/drone
 - Using farm data software

FARM DATA USAGE

COMBINING DATA MANAGEMENT PRACTICES

- Individually, PA technologies, farm data, and data management practices may not increase profitability.
- Layering multiple practices to form an overall farm data strategy makes farm data more actionable and leads to greater satisfaction with yield outcomes.
- Combining farm data software and data sharing is beneficial and the marginal cost low (particularly if you currently subscribe to a software platform).

WHERE DO WE GO FROM HERE?

DOES YOUR FARM HAVE A DATA MANAGEMENT STRATEGY?

- If the answer is **no**:
 - You may not have the time or financial resources to devote to cultivating a data strategy or you do not intend to grow your operation in the future.
 - However, you may be giving something up if you are ignoring the benefits of a well-informed/implemented data strategy. We find evidence that a good data strategy provides a positive payback

WHERE DO WE GO FROM HERE?

DOES YOUR FARM HAVE A DATA MANAGEMENT STRATEGY?

- If the answer is **maybe**:
 - You have adopted some technologies and collected some data but are not engaging with it fully. You are bearing most of the costs, but likely receiving little benefit (beyond convenience). You can either:
 1. Identify the management decisions that could be improved by data.
 2. Get help (software or data sharing) to fully leverage your data's potential.

WHERE DO WE GO FROM HERE?

DOES YOUR FARM HAVE A DATA MANAGEMENT STRATEGY?

- If the answer is **yes**:
 - You may have a well thought out and designed data management strategy.
 - The question for you is, “Are you getting the most out of your data?”
 - Our result suggest there are a number of factors influencing the satisfaction of data-informed decisions.
 - Are you doing these thing? Is there room for you to improve?
 - ❑ Collecting data that complements your management practices - if you perform VR fertilizer, what are your data needs?
 - ❑ Applying multiple “touch points” to your collected data - managing and analyzing with software, sharing with trusted service providers
 - ❑ Evaluating your data-informed decisions - what was the impact of using data in your decisions relative to a no-data baseline?)

Q4 - Does your farm currently use farm data software to store, manage or analyze data?

Answer	%	Count
Yes	75.47%	40
No	24.53%	13
Total	100%	53

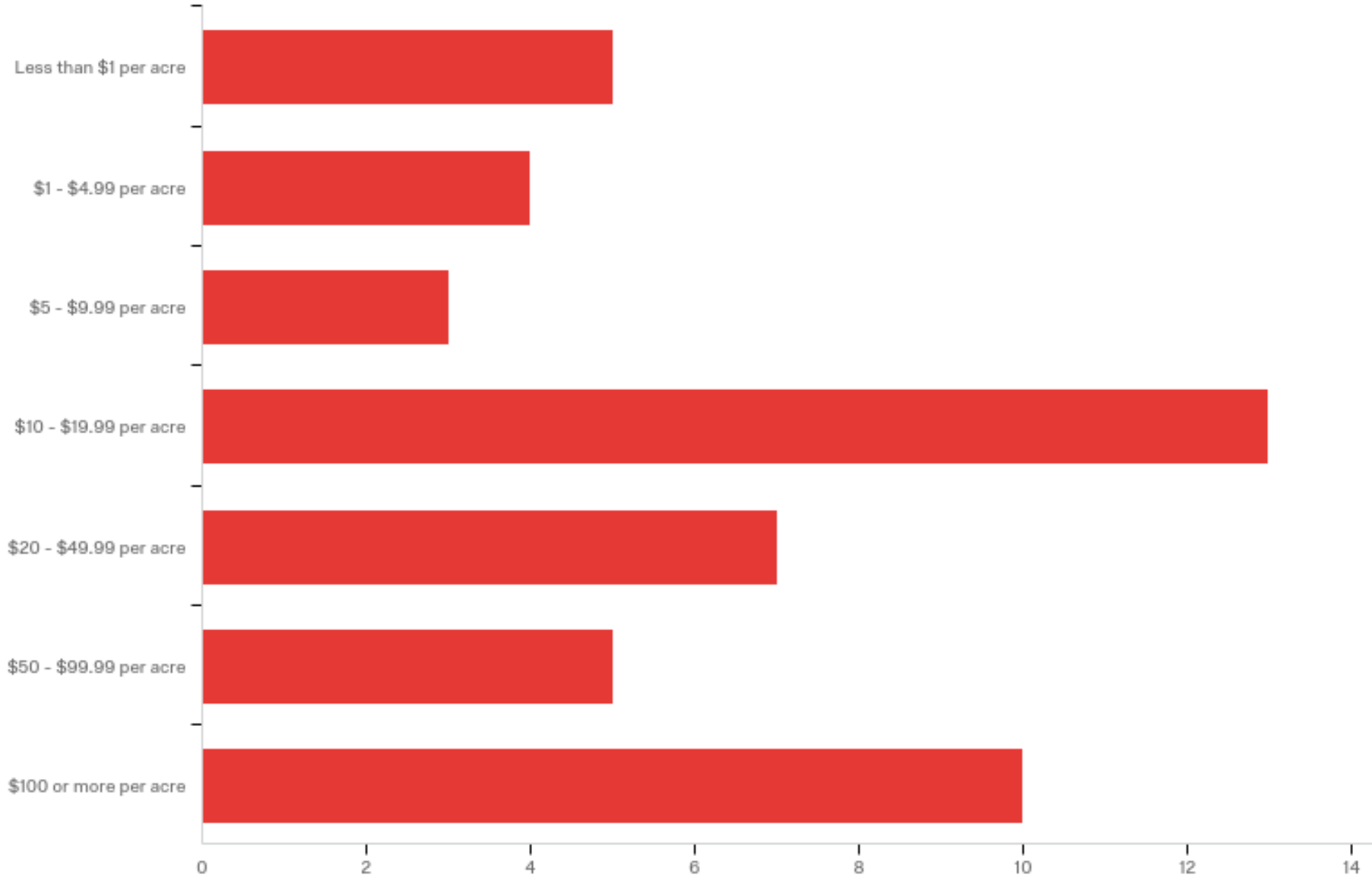
Q5 - Do you share farm data with an outside service provider (agronomist, input supplier, software company, etc.) to generate crop management recommendations?

Answer	%	Count
Yes	64.15%	34
No	35.85%	19
Total	100%	53

Q6 - Does your farm collect yield monitor data?

Answer	%	Count
Yes	87.72%	50
No	12.28%	7
Total	100%	57

Q7 - What is the minimum amount of money you would be willing to accept to give up complete ownership of your yield monitor data from last year's harvest (in dollars per acre of data)?



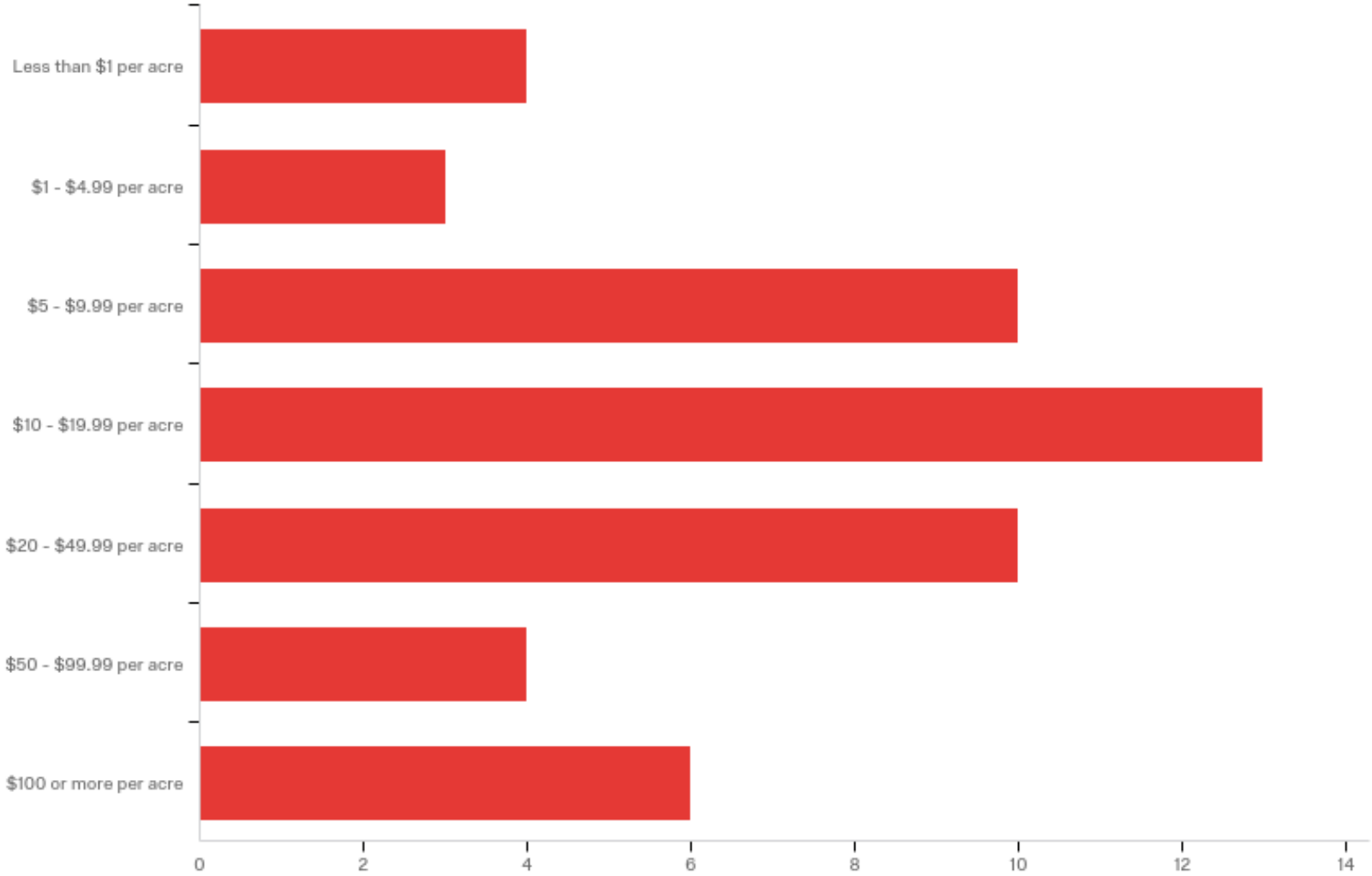
Q7 - What is the minimum amount of money you would be willing to accept to give up complete ownership of your yield monitor data from last year's harvest (in dollars per acre of data)?

Answer	%	Count
Less than \$1 per acre	10.64%	5
\$1 - \$4.99 per acre	8.51%	4
\$5 - \$9.99 per acre	6.38%	3
\$10 - \$19.99 per acre	27.66%	13
\$20 - \$49.99 per acre	14.89%	7
\$50 - \$99.99 per acre	10.64%	5
\$100 or more per acre	21.28%	10
Total	100%	47

Q8 - Does your farm collect soil data using grid or zone soil sampling?

Answer	%	Count
Yes	89.29%	50
No	10.71%	6
Total	100%	56

Q9 - What is the minimum amount of money you would be willing to accept to give up complete ownership of your most recent soil sample data (in dollars per acre of data)?



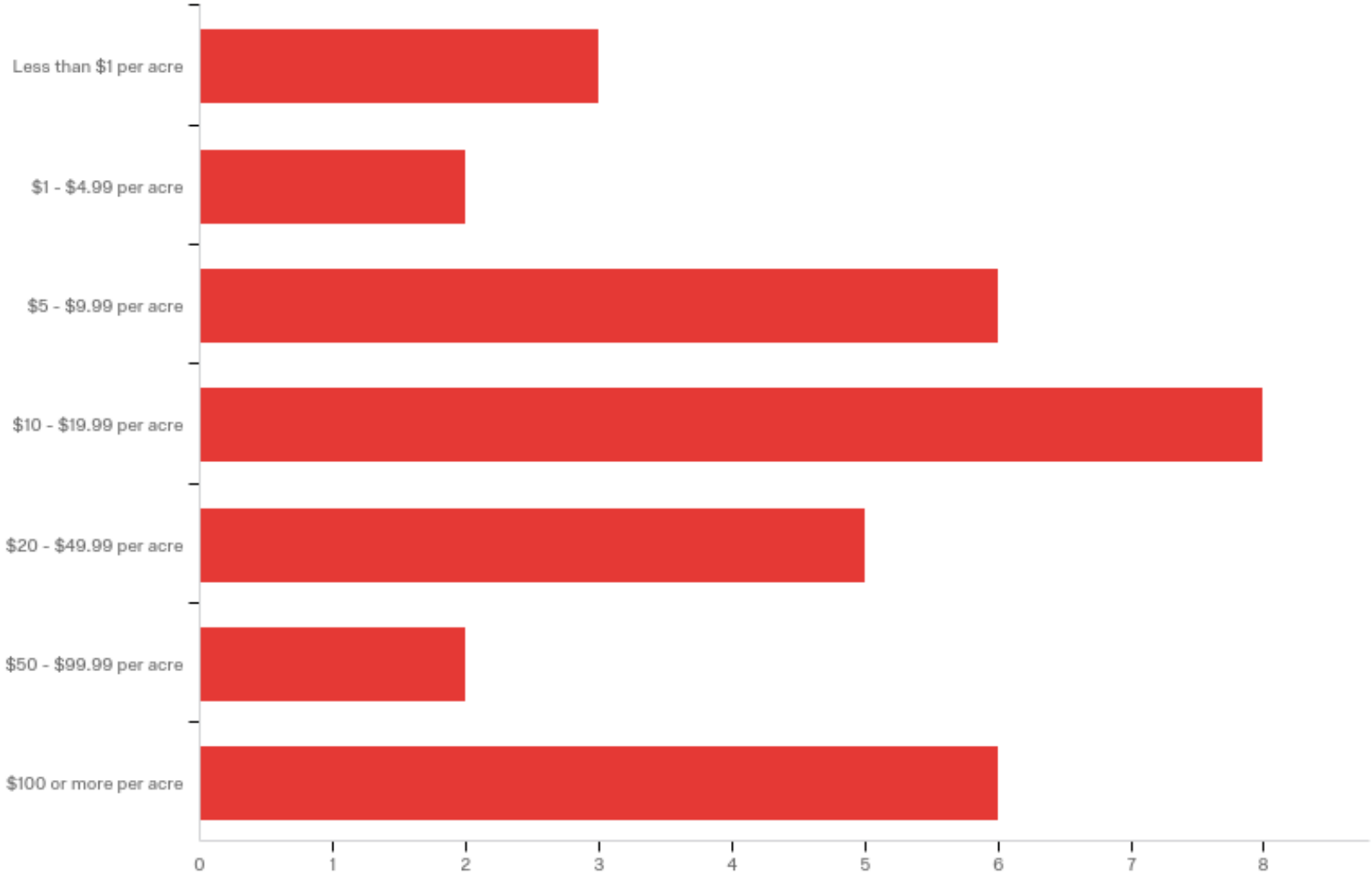
Q9 - What is the minimum amount of money you would be willing to accept to give up complete ownership of your most recent soil sample data (in dollars per acre of data)?

Answer	%	Count
Less than \$1 per acre	8.00%	4
\$1 - \$4.99 per acre	6.00%	3
\$5 - \$9.99 per acre	20.00%	10
\$10 - \$19.99 per acre	26.00%	13
\$20 - \$49.99 per acre	20.00%	10
\$50 - \$99.99 per acre	8.00%	4
\$100 or more per acre	12.00%	6
Total	100%	50

Q10 - Does your farm collect satellite or drone imagery data?

Answer	%	Count
Yes	58.93%	33
No	41.07%	23
Total	100%	56

Q11 - What is the minimum amount of money you would be willing to accept to give up complete ownership of your most recent drone or satellite imagery data (in dollars per acre of data)?



Q11 - What is the minimum amount of money you would be willing to accept to give up complete ownership of your most recent drone or satellite imagery data (in dollars per acre of data)?

Answer	%	Count
Less than \$1 per acre	9.38%	3
\$1 - \$4.99 per acre	6.25%	2
\$5 - \$9.99 per acre	18.75%	6
\$10 - \$19.99 per acre	25.00%	8
\$20 - \$49.99 per acre	15.63%	5
\$50 - \$99.99 per acre	6.25%	2
\$100 or more per acre	18.75%	6
Total	100%	32