



United States Department of Agriculture

# Small Farm Use of Precision Technologies for Row Crop Production in the U.S.

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# How small is a small farm?

1. Small U.S. farms are usually defined as those with less than \$350,000 in gross cash farm income. A quarter of U.S. ag production comes from small farms.
2. For this analysis of precision technology use, small farms are defined by total acreage planted to a particular crop. These farms have the smallest 10 to 15 percent of U.S. planted acres for each crop.
3. Small U.S. rice and wheat farms tend to be larger than small maize and soybean farms. The smallest rice and wheat farms fall between 75-200 planted acres, while the smallest maize and soybean farms between 20-70 planted acres.

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# Categories of small U.S. farms, by crop



Farm size Categories	1	2	3	4
	acres/hectares			
Soybeans 2018/12 and Maize 2016	Up to 20/ Up to 8	20-40/ 8-16	40-60/ 16-24	60-70/ 24-28
Wheat 2017 and Rice 2013	Up to 75/ Up to 30	75-125/ 30-51	125-150/ 51-61	150-200/ 61-81

**HEADLINE:**  
Small rice and wheat farms are over twice the size of small maize and soybean farms.

Source: USDA Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.

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# How is technology use counted on small farms with several crops?

1. Some farms may have several crops, and farm size for technology use is planted acres of one crop.
2. About half of all U.S. soybean farms also grow maize. This analysis asks about acres of soybeans using the technologies.
3. The same question is asked for maize, so some of the maize farms may also be soybean farms. Few farms have both maize and soybeans in a single year.
4. Differences in number of fields, and field sizes, between crops on small farms are dramatic – shown on the next slide.

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# Total number of fields and average size (acres), within each size category

Number of fields/ Average field size (in acres, by farm sizes 1-4)	1	2	3	4
Soybeans – 2018 – 2012	37,400/6.0 32,300/7.0	59,800/15.3 67,500/15.1	65,200/17.1 72,000/18.9	25,900/21.1 57,500/28.2
Wheat - 2017	58,600/27.7	34,600/52.0	8,100/62.4	15,900/67.9
Maize - 2016	64,300/5.2	107,200/10.6	105,100/14.8	37,600/18.7
Rice - 2013	66/54.8	494/58.2	314/51.4	1,070/44.3

## HEADLINES:

Field sizes on maize and soybean farms are much smaller than on rice farms, but they have many more fields.

Soybean fields tend to be larger than maize fields on small farms.

This means that small maize farms may have many more small fields to manage using precision technologies.

Source: USDA Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.

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# Four precision technologies in common use by farmers

(not including custom applicator's use of PrecAg)

## Yield maps

Harvester yield-data with Global Positioning System (GPS) co-ordinates are mapped to inform a wide-range of production management decisions

## Soil properties maps

Soil-test data (nitrogen, phosphorous, potassium, and soil organic matter) are GPS mapped showing zones of field soil conditions

## Guidance systems

Tractors and combine harvesters are programmed to self-steer farm machinery with an operator in the cab

## Variable rate input applications (VRT)

Crop production input levels for seeds, fertilizer, and chemicals (pesticides and herbicides) are programmed using GPS maps

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# Yield and soil properties mapping on small U.S. farms

Percent of farms in each category (1-4) of planted acres

Yield map/ Soil properties mapping, percent adoption	1	2	3	4
Soybeans – 2018 – 2012	10%/none 1%/none	3%/3% 3%/3%	1%/<1% 6%/9%	6%/none 6%/9%
Wheat - 2017	5%/1%	10%/4%	19%/7%	8%/2%
Maize - 2016	none/none	9%/<1%	5%/6%	none/none
Rice - 2013	none/none	2%/9%	11%/18%	14%/none

## HEADLINE:

Soil mapping adoption higher on category 3 farms for most crops, and yield mapping for wheat and rice (40-60 and 125-150 acres).



Source: USDA Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.

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# Guidance system adoption on small U.S. farms



Percent of farms in each category (1-4) of planted acres



Auto-steering of either tractors or combines, percent adoption	1	2	3	4
Soybeans – 2018 – 2012	4% 3%	8% 18%	5% 7%	14% 15%
Wheat - 2017	12%	19%	28%	16%
Maize - 2016	none	4%	6%	3%
Rice - 2013	19%	71%	44%	30%

**HEADLINE:**  
Guidance use more widespread on wheat and rice farms.  
  
These farms have the largest average field sizes

Source: USDA Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.

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# VRT seed and chemical adoption on small U.S. farms



Percent of farms in each category (1-4) of planted acres



Variable rate seed/chemical applications percent adoption	1	2	3	4
Soybeans – 2018 – 2012	<1%/none 2%/11%	1%/1% 4%/7%	4%/4% 1%/4%	3%/<1% 2%/1%
Wheat - 2017	1%/<1%	2%/<1%	9%/6%	1%/1%
Maize - 2016	none/none	4%/2%	2%/<1%	2%/9%
Rice - 2013	5%/none	none/none	none/7%	14%/19%

**HEADLINE:**  
VRT seed and chemical use more popular on larger wheat and rice farms

Also VRT chemicals for maize. Nationally favored by both soybean and maize growers.

Source: USDA Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.

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# VRT fertilizer adoption on small U.S. farms



Percent of farms in each category (1-4) of planted acres

Variable rate fertilizer applications, percent adoption	1	2	3	4
Soybeans – 2018 – 2012	<1% 8%	5% 7%	5% 9%	3% 4%
Wheat - 2017	4%	5%	11%	2%
Maize - 2016	none	3%	5%	9%
Rice - 2013	11%	6%	7%	16%

**HEADLINE:**  
Wheat and rice also figure prominently for VRT fertilization.

Source: USDA Economic Research Service estimates using data from the Agricultural Resource Management Survey (ARMS) Phase II.

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# Result Synopsis and an Interpretation

1. Small rice and wheat farms are over twice the size of small maize and soybean farms, and field sizes even more so. This means that small maize and soybean farms have many more fields. Soybean fields tend to be larger than maize fields on small farms.
2. Soil mapping adoption is higher on mid-sized small farms for most crops. Guidance is more widespread on all sizes of small wheat and rice farms, and they have the largest average field sizes.
3. VRT seed, chemical, and fertilization are likewise more popular on larger small wheat and rice farms.
4. **The result tables indicate** that there is some use of each technology on small farms at the national level. This is despite the fact that adoption increases with farm size for all row crops examined at the national level.
5. **Upshot #2.** The left-tail, small farm adoption of PrecAg only goes to zero for one crop – maize. This is the crop with the highest national adoption levels.

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