The Future of Autonomy in Agricultural Production and Marketing

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Why the interest in Ground Autonomy?

- Efficiency--Autonomous vehicles can perform tasks more efficiently than humans
- Sustainability--Autonomous vehicles can help conserve natural resources and improve sustainability
- Labor shortages--Autonomous vehicles can help address labor shortages
- Safety--Autonomous vehicles can make farming safer
- Productivity--Autonomous vehicles can increase yield land unit (more precise management)
- Real-time data--Autonomous vehicles can collect real-time data that farmers can use to make adjustments

Trends Driving Change in North Dakota Agriculture

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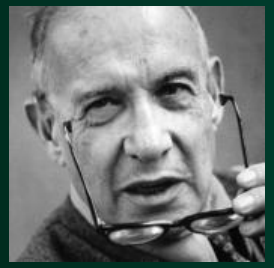
Peter Drucker

- Management guru, consultant, academic
- “Forecasting future trends is a futile exercise. The best we can do is extrapolate trends that are already in place into the future.”



1. Artificial Intelligence

- Artificial intelligence (AI) is a branch of computer science that allows machines to perform tasks that usually require human intelligence. AI systems can mimic human cognitive functions like learning, problem-solving, and pattern recognition. They can also understand and translate spoken and written language, analyze data, and make recommendations.

Artificial Intelligence

- Ground and air autonomy
- Data is increasingly the currency by which technology will drive agriculture
  - Allows machines to make decisions in real time
- https://www.youtube.com/watch?v=g4Sfnmfw8o0
- Predictive features
  - E.g. Genomic enhanced EPD's
- Like any tool, can be used or misused

2. Shifting Acreage of Principal Crops

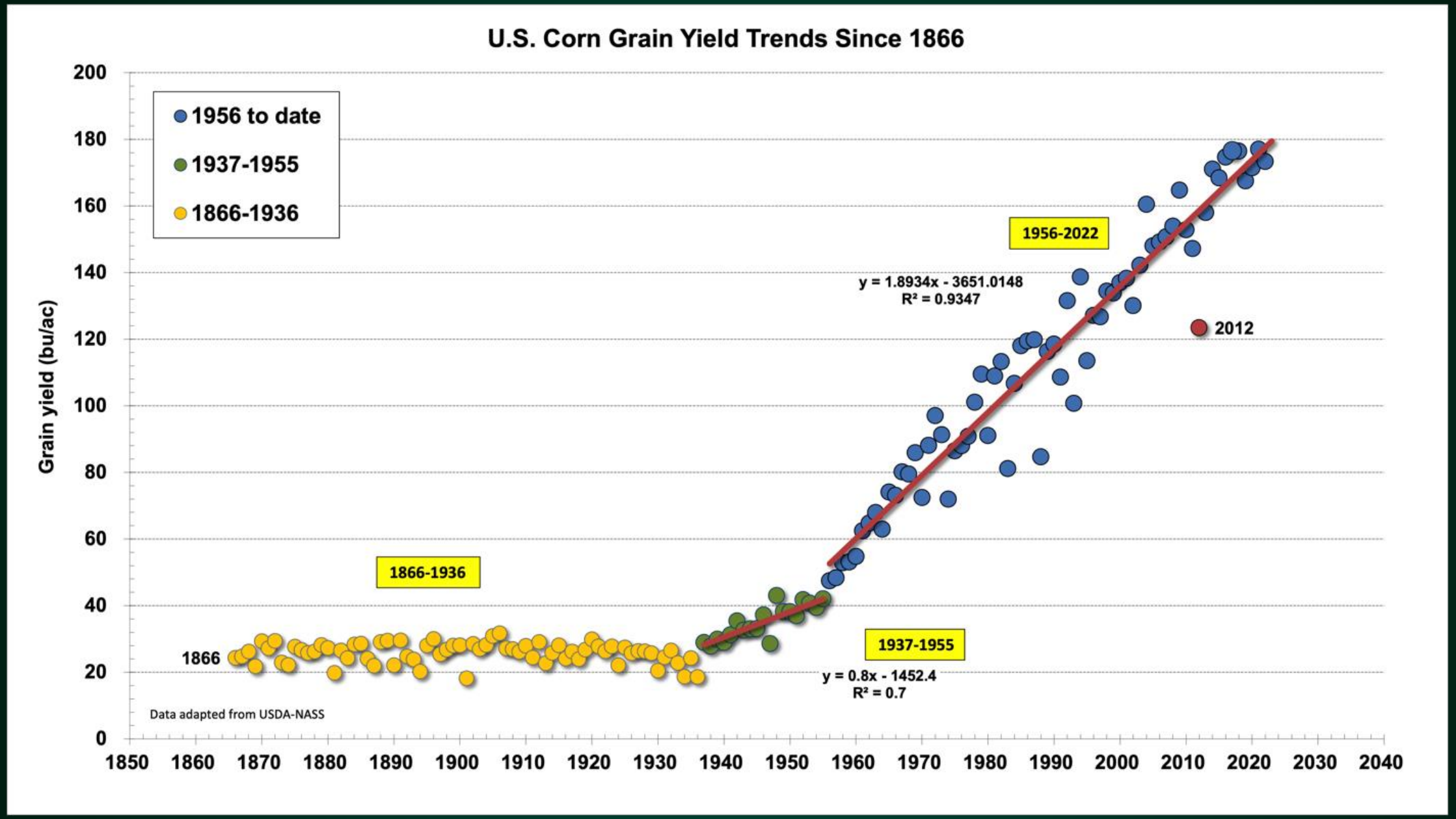


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Figure 1. Change in Harvested Acres, Corn, 2004-05 to 2014-15

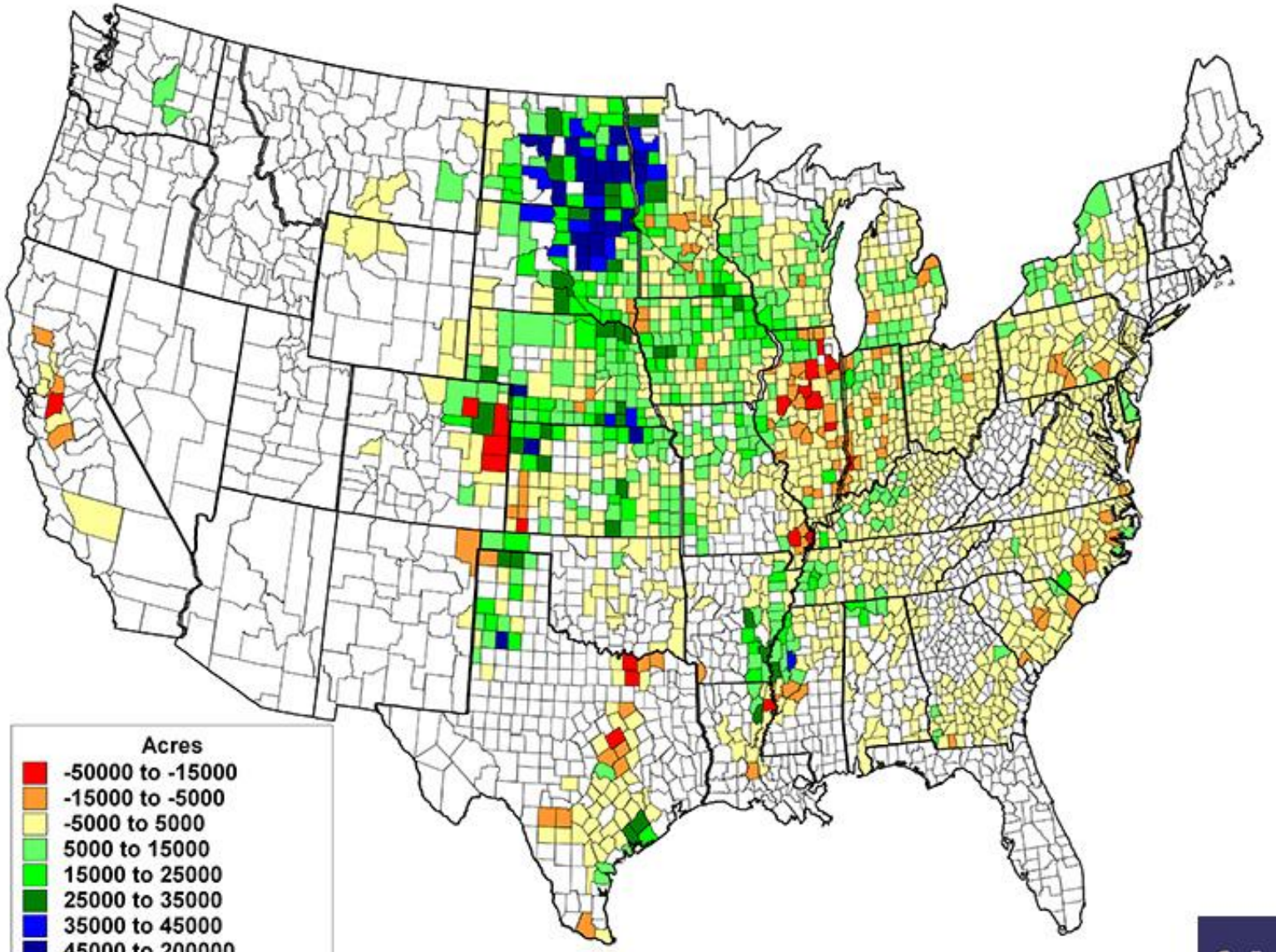

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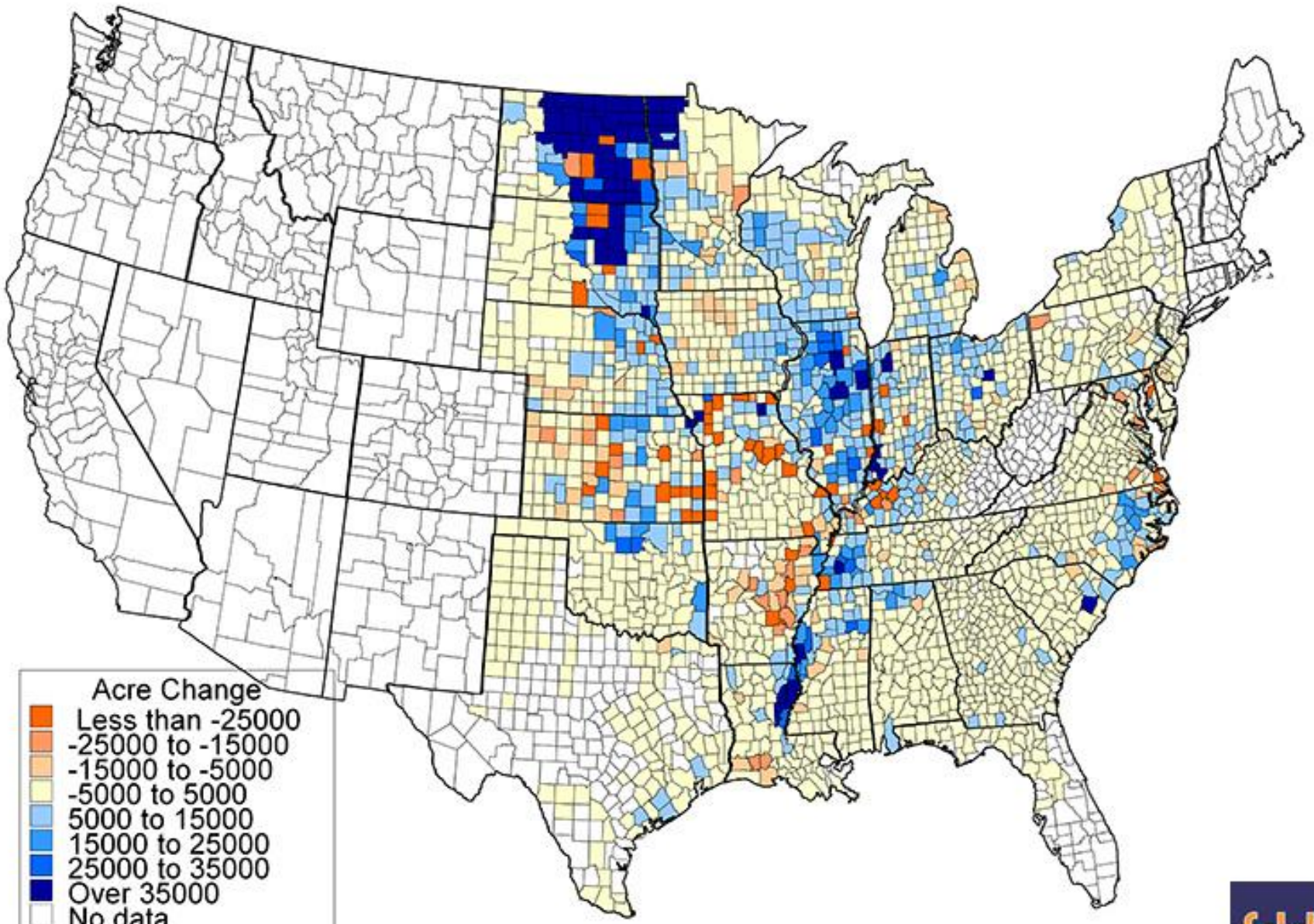
Figure 3. Change in Planted Soybean Acres from 2011 to 2016



Source: National Agricultural Statistical Service, USDA

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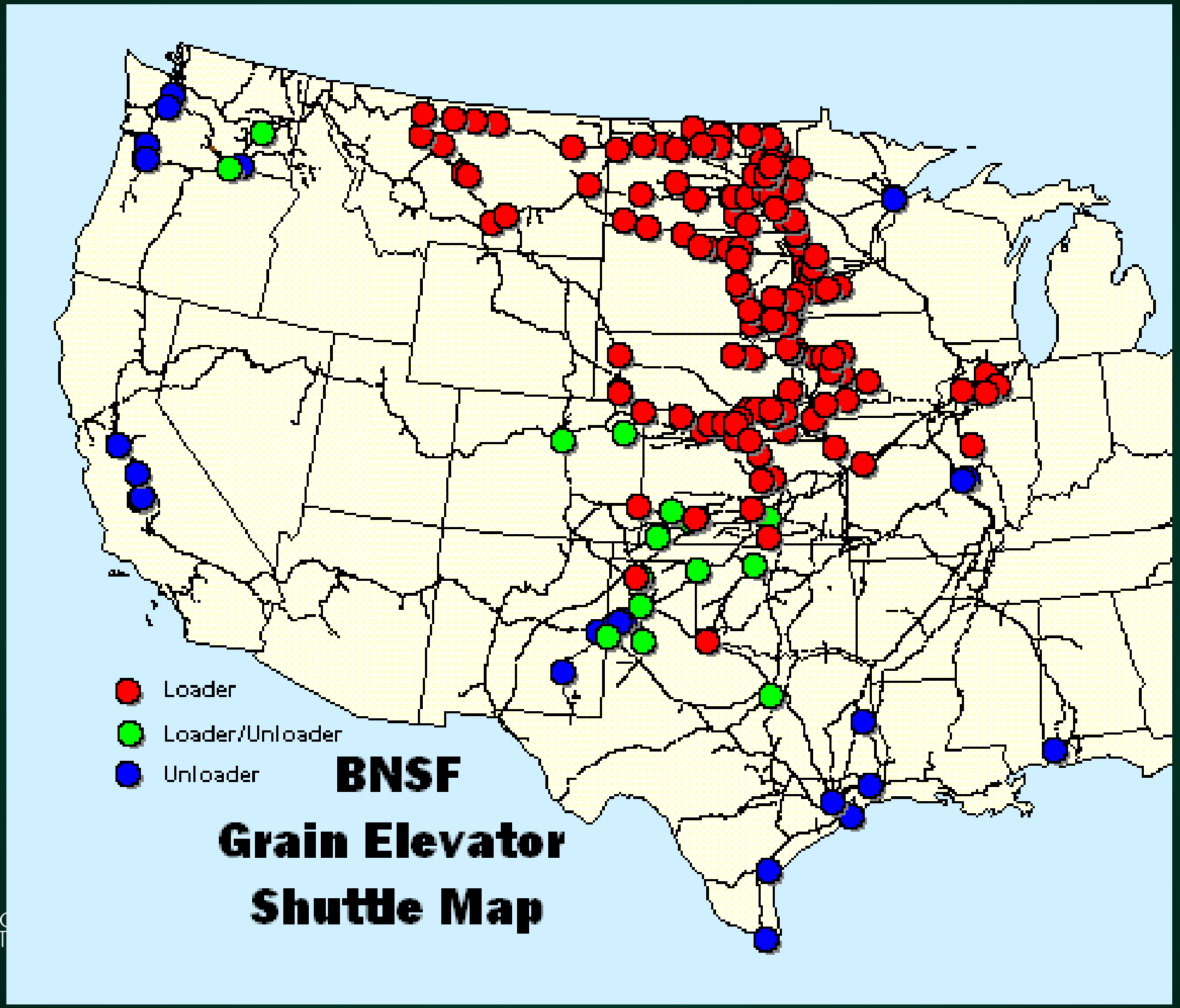
Loader
Loader/Unloader
Unloader
BNSF
Grain Elevator
Shuttle Map

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3. Consolidation (1997 vs 2017)

- Farm size increasing
  - 1227 acres vs 1492 acres
- Number of farms is decreasing
  - 32,348 vs 26,364
- Nearly 28 million acres under cultivation
- 31% hire off farm labor

Source: USDA NASS 2017

Labor Becoming a Larger Issue

- Larger, more complicated equipment
- Less family labor
- More bushels to haul to market/processor
- Low unemployment rates
- Falling rural population
- Aging rural population
- More reliance on H2A

Future of Ground Autonomy for Farmers

- Technology will improve
- Labor shortage will drive trends
- Changing crop mix
  - Higher yield crops (corn)
- Trend line on yield curve means more bushels/greater volumes

Future of Ground Autonomy for Agricultural Supply Chain

- Labor shortage—similar implications
- Technology will improve
- Corn requires larger inputs of fertilizer than other field crops
- Consolidation occurring in supply chain
  - Larger operations

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