The challenge of modern farming

Focus questions	How many people farm in the United States today? What are the methods and technologies employed by modern farmers in the United States?
Vocabulary	Precision technology, infrastructure, commodity farming, climate change, yield, organic, hybrid, genetically modified organism (GMO), Roundup Ready, *Bacillus thuringiensis (Bt)*

Roughly 25% of the world's labor force is employed in agricultural food production, but in the United States this drops significantly to only 2% of its labor force. How can we account for this diminishment in labor required for food production in the US? Infrastructure, mechanization, and technology have accounted for much of the change in the United States, altering farming from a more labor-intensive practice to what we see today.

Modern American farming is a blend of tradition and innovation, requiring farmers to be skilled in science, economics, and technology while adapting to changing environmental and market conditions. Farmers make strategic decisions to maximize productivity while ensuring sustainability and profitability. They choose crops and livestock based on market demand, soil conditions, climate, and government policies. Farmers must decide whether to sell their crops at harvest or to store them to contract sell at a later date. Modern farms use GPS-guided equipment, drones, and data analytics to optimize planting, spraying, and harvest. Farmers make financial decisions on equipment purchases, land investments, and crop insurance to protect against unpredictable weather. Do these farming innovations make food production easier or not?

You will work in groups of 4–6 students, but you will make decisions individually as either a farmer or a sales agronomist. As a farmer, you will make purchasing decisions for inputs such as seed, fertilizer, and pesticides along with additional services that may improve the output of your farm. As a sales agronomist, you will meet with the farmers in your group to offer your products and services. As a farmer, your production will be affected by events that are out of your control, such as weather events. As a sales agronomist, you will make deals with farmers to help them overcome this risk and succeed.

Materials

- Student worksheet
- Event cards
- Products and services cards
- Six-sided die
- Coins

Procedure

Rules for play

- **Players:**
  - 1 Sales agronomist starts with 35 coins.
  - 3–5 Farmers: Each farmer starts with 30 coins and 3 fields.
- **Decision-making per round:**
  - All farmers make decisions simultaneously during the agricultural decisions phase, but they roll dice individually.
- **Starting player rotation:**
  - If you want to rotate turns, the first buyer changes each round for fairness (optional).
- **Negotiation allowed:**
  - Farmers can discuss strategies and sales agronomist can make deals (e.g., discounts for buying in bulk).
- **Buying fields:**
  - Farmers can expand their farms by spending 8 coins per field during the End of Round phase.
- **Event card rules:**
  - Event effects apply before farmers roll dice.

Gameplay

Students should work together in groups of 4–6 to complete the simulation. Each round represents a growing season with these steps:

1. **Event card**
   - The sales agronomist draws an event card and reads it aloud.
2. **Farming decisions**
   - Farmers make decisions and purchase seeds for planting.
   - Farmers record products on chart.
3. **Ag products and service decisions**
   - Sales agronomist meets with farmers to discuss products or services for farmers to buy to increase yield.
   - Farmers decide to purchase or not purchase products or services.
   - Farmers record products or services purchased on chart.
   - Sales agronomist records sales on chart.
4. **Harvest time**
   - Farmers roll a die for each field to see if their crops are successful.
     - Roll a 1 or 2 : The field/crop fails due to drought.
     - Roll a 3, 4, 5, or 6: The field/crop is successful.
5. **End of round**
   - Farmers calculate income and decide about future actions:
     - Whether to expand by buying another field for 8 coins.
     - Whether to purchase product and/or services.
   - Optional: Rotate the starting position for decision-making.
6. **Scoring**
   - At the end of each round, farmers calculate coins as follows:
     - 0 coins earned for failed field.
     - +2 coins for each successful field.
     - −1 to −5 coins for products or services purchased.
     - −8 coins if they buy an extra field.

    - Optional penalty: If you use basic fertilizer in the same field for 3 years in a row you are penalized (−1) coin per round for water quality pollution!
    - Optional penalty: If you use regular irrigation for 3 years in a row you are penalized (−2) coins for high volume water usage!
    - Optional bonus: Farmers who use eco-friendly products (natural fertilizer, biological pest control, cover crops) get +1 bonus coins for 2 or more products used per round!
  - Sales agronomist calculates coins as follows:
    - +1 coin profit for each product sold.
    - −2 coins loss for each crop insurance payout.
    - −1 coin loss for each free product (event card).
    - −5 coins loss for not meeting quota of 12 products or services sold per round.
7. **Success or loss**
    - Farmers are successful if they have 15 coins and 5 fields by the end of the 5th round.
    - Sales agronomist is successful if they have 40 coins at the end of the 5th round.

8. Once you have completed the simulation, work with your group or as a class to design a solution that reduces the negative effects of human activities on the environment due to modern agriculture in the United States.
    - Evaluate the cost, safety, reliability, and social, cultural, and environmental impacts of the proposed solution for this method of farming.
    - Refine your proposed solution by prioritizing criteria and making tradeoffs as necessary to further reduce environmental impact while addressing human needs.

   Use the questions below to guide your thinking:
    - How does this method of farming meet the needs of the farmer using these methods?
    - How might the methods of modern farming lead to potential problems while addressing the growing human population's need for food security?
    - What alternative methods might be used? How might those methods impact the ecosystem?
    - What are the barriers to using alternative methods?
    - How might the introduction of alternative methods decrease the available food for our growing population?

Negative effects of human activities due to modern farming	**Proposed solution**	**Refined solution**
How do these proposed solutions potentially improve the negative effects of modern farming?		

Example round of gameplay

- **Event card: low prices:** Farmers lose 1 coin total this round.
- **Sales agronomist offers:** Sales agronomist reduces cost of prescription fertilizer to 1 coin per field for this round.
- **Farmer:**
  - Farmer owns three fields.
  - Farmer buys basic GMO technology seeds (+2 coins) for each field.
  - Farmer buys prescription fertilizer (+1 coin) for each field.
- **Roll results:**
  - Farmer rolls 3 separate times (1 time per field).
  - Farmer 1 rolls 4, 5, and 2 (2 successful fields; 1 failed field).
- **Coin updates:**
  - Farmer revenue
    - 2 successful fields (+2 coins × 2 = +4 coins)
    - Basic GMO technology seeds per successful field (+3 coins × 2 = +6 coins)
    - Prescription fertilizer for 2 successful fields (+3 coins × 2 = +6 coins)
  - Farmer input cost for all 3 fields
    - Basic GMO technology seeds for 3 fields (−2 × 3 = −6 coins)
    - Prescription fertilizer (−1 × 3 = −3 coins)
  - Event card low prices = −1 coin
  - Farmer total profit = 6 coins
- Repeat for five rounds.

Farmer data chart

Farmers record total coins spent for each product or service during each round in the chart below and use the chart to determine total revenue and profit before moving on to the next round.

Products and services		**Round**				
		1	**2**	**3**	**4**	**5**
Field purchases	Each farmer starts with 3 free fields.					
Seed choices	Organic					
	Hybrid drought-resistant					
	Basic GMO technology					
	GMO high-yield					
Fertilizer choices	Basic fertilizer					
	Prescription fertilizer					
	Natural fertilizer					
Pesticide choices	Basic herbicide					
	Basic insecticide					
	Biological pest control					
Special products and technologies	Soil testing					
	Microbials					
	Cover crops					
	Tiling					
	Irrigation system					
	Crop insurance					
Starting budget		30				
Total input cost						
Total revenue						
Total profit (starting budget next round)						

Sales agronomist data chart

Famers	**Round** (record profit/loss in each round per farmer)									
	1		**2**		**3**		**4**		**5**	
1										
2										
3										
4										
5										
Starting budget	35									
Total products and services sold										
Total losses										
Total profit (starting budget next round)										

Reflection

1. How successful were you at growing commodity crops on your farm? Were you able to increase your fields from 3 to 5 total fields?

2. How is this simulation realistic? Not realistic?

3. Describe 3 specific differences between this farming simulation and subsistence farming as practiced in small groups within the United States or abroad.

4. How do stability and change within farming practices play a role in modern farming within the US?

Rubric for self-assessment

Skill	Yes	No	Unsure
I participated in the farming simulation with my group and collected data on field success and loss.			
I can suggest a solution for lessening the impact of modern farming on the environment.			
I can suggest a solution for increasing food production efficiency.			
I can prioritize the solution and predict the barriers to implementing my solutions.			