Global innovation in corn and food security

How can technology help to make our world more food secure?

Background

Corn is the most widely grown crop in the world—found in our food, fuel, livestock feed, and even packaging—but not everyone is food secure (having reliable access to a sufficient quantity of affordable, nutritious food). As the global population rises toward 10 billion and climate change disrupts traditional farming, the pressure to grow more food using fewer resources is urgent. Precision agriculture, using tools like drones, satellites, soil sensors, and mobile apps, offers powerful ways to improve corn yields and reduce waste. But access to these tools is not equal, and many farmers around the world still lack the resources or infrastructure to benefit from them. In this activity, you'll become an expert on how one region uses technology to tackle food insecurity through corn, compare your findings with peers, and work together to imagine global strategies that are not only innovative but fair. This isn't just about farming—it's about the future of food, equity, and our planet.

Materials

- Six case study handouts: Iowa, Kenya, India, Nigeria, Guatemala, Brazil
- Comparative case study organizer

Instructions

Expert groups

1. Divide students into 6 expert groups and assign one case study to each group.
2. Each expert group will analyze their case study and complete the comparative case study organizer for their assigned region.
3. Have each group discuss key takeaways about their region to share with others.

Home groups

4. Regroup students with peers who studied different regions.
5. Each student teaches their case study to their peers.
6. All group members complete the comparative case study organizer.

Whole-class synthesis

7. Regroup as a class to discuss patterns, innovations, and equity challenges across regions.
8. Optional: Students create a hybrid food security proposal to improve food security in a food-insecure region.

Reflection

9. Which case study best reflects food justice and equity in practice?
10. Which case study best reflects inequity in food justice and practice?
11. What do these case studies show about the role of technology in sustainable agriculture?
12. Which solution do you think is most scalable to other regions, and why?
13. Design your own solution: which elements from these cases would you combine to provide food equity, access, and environmental sustainability in corn production?

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Comparative case study organizer

	Iowa	Kenya	India	Nigeria	Guatemala	Brazil
Technology						
Purpose/problem solved						
Results						
Challenges						
Equity/justice issues						

CASE STUDY 1

Drones and data: precision corn farming

Farm profile

Northwest Iowa, United States

- 1,200-acre family-owned corn and soybean farm
- Operated by the Martin family for three generations
- Focused on increasing yield while reducing input costs

Technology used

- Multispectral drones to scan crop health and detect stress
- GPS-guided tractors for precise planting and spraying
- Yield mapping software to analyze harvest data

Goals

- Identify the underperforming areas of the field quickly
- Use less fertilizer and water where not needed
- Improve corn yield across variable field conditions
- Save money on fuel, chemicals, and labor

Results

- Corn yield increased by 12% in one growing season
- Fertilizer use was reduced by 18%, lowering runoff risks
- The farm saved approximately $22,000 annually on inputs
- Drones detected a fungal infection early, preventing major crop loss

Challenges

- High up-front cost: Drone and software package cost $15,000
- Requires technical training to operate and interpret data
- Reliable internet access is needed for software updates and data uploads
- Not feasible yet for many small farms or low-income regions

Discussion questions

1. What problem did the drone technology help solve for this farm?
2. How did the Martins balance cost and benefit?
3. Could this solution be used in a developing country with fewer resources? Why or why not?

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Smartphone Agriculture: empowering corn farmers in Kenya

Farm profile

Bungoma County, Western Kenya

- Smallholder maize (corn) farmers with 1–3 acre plots
- Rain-fed farming, minimal access to modern equipment
- Average annual income: less than USD $1,000

Technology used

- Mobile app: “PlantVillage Nuru”
    - Free app developed by Penn State and FAO
    - Uses smartphone camera and AI to detect corn pests/diseases
- SMS planting alerts: Farmers receive text-based weather and planting updates
- Solar-powered smartphones provided through a non-profit partnership

Goals

- Detect and manage fall armyworm infestations that threaten corn harvests
- Empower farmers with real-time planting advice
- Improve maize (corn) yields and food security in a high-poverty region

Results

- Farmers using the app saw 30–40% decreased crop loss due to early pest detection
- SMS planting advice led to improved planting times, increasing yields by up to 25%
- Community-level training allowed hundreds of farmers to adopt the tool
- Local youth trained as “digital extension agents,” creating jobs and support networks

Challenges

- Literacy barrier: App use requires some reading and tech familiarity
- Phone coverage and solar charging access are still inconsistent in remote areas
- Success depends on strong community outreach and training programs
- App focuses on diagnostics—still needs integration with long-term soil and water management tools

Discussion questions

1. What made this technology accessible for low-income farmers?
2. What barriers still exist despite the success of the program?
3. How might this model be expanded or improved in similar regions?

CASE STUDY 3

“CropIn” and IoT: data-driven corn farming in India

Farm profile

Andhra Pradesh and Maharashtra, India

- Medium-scale corn farmers (5–10 acres)
- Rain-fed and irrigated plots
- Operating in semi-arid zones prone to drought and erratic rainfall

Technology used

- CropIn SmartFarm platform: Digital dashboard for farm-level data
- IoT-enabled weather stations: Provide hyperlocal weather forecasts
- Field staff app: Allows farmers and agri-advisors to track crop health, soil moisture, and pest alerts in real time
- Machine Learning Models: Predict optimal harvest windows and yield outcomes

Goals

- Help farmers make data-informed decisions about planting, irrigation, and pests.
- Improve crop traceability for market access
- Reduce crop failure due to climate unpredictability
- Support large-scale contract farming networks

Results

- Yield increases of 15–20% on average in participating corn fields
- Reduction in unnecessary pesticide use by 30%
- Improved crop traceability enabled better pricing in domestic and export markets
- Corporate buyers used CropIn’s data to build more resilient supply chains

Challenges

- Internet connectivity remains inconsistent in some rural areas
- Farmers require digital literacy training to use the platform effectively
- Initial adoption is higher among male and better-resourced farmers, raising gender equity concerns
- Requires partnership with field agents or cooperatives for sustainable scale-up

Discussion questions

1. How did CropIn combine hardware (IoT) and software to help farmers?
2. What made this model scalable across different regions?
3. What steps could be taken to make it more equitable for all farmers?

CASE STUDY 4

Satellite alerts for smarter corn farming: Nigeria's Viamo and NASA partnership

Farm profile

Kano and Kaduna states, northern Nigeria

- Smallholder maize farmers managing 1–2 hectares (2.5–5 acres)
- Frequently affected by drought, late rains, and soil nutrient loss
- Farming is mostly manual, with limited market access

Technology used

- NASA-powered satellite weather data integrated with Viamo's communication platform
- SMS alerts and voice messages in local languages (Hausa, Yoruba) deliver:
    - Planting and harvest timing based on satellite rainfall tracking, pest migration alerts, and soil care tips during dry spells
    - Farmers opt into alerts via basic mobile phones—no smartphone required

Goals

- Help farmers adapt to climate variability and reduce weather-related crop loss
- Deliver real-time, hyperlocal farming advice in native languages
- Increase food production and resilience in a food-insecure region

Results

- Participating farmers planted 7–10 days earlier, based on rainfall forecasts
- Reports of 20–30% yield improvements over non-participating farmers
- Soil degradation practices decreased as farmers adopted more sustainable methods
- The platform reached over 250,000 farmers within two years

Challenges

- Reliant on continued funding from the government and NGOs
- Some farmers distrust technology without face-to-face support
- Gender gap in mobile phone access reduces women's participation
- Limited customization for specific crops beyond maize and rice

Discussion questions

1. How did the program overcome the barrier of smartphone access?
2. Why is local language support critical in this model?
3. How could this model be expanded to support gender equity and long-term independence?

CASE STUDY 5

Blending tradition with tech: indigenous corn resilience in Guatemala

Farm profile

Western Highlands, Guatemala

- Indigenous Maya smallholder farmers growing heirloom maize varieties
- Average landholding: 0.5–1.5 hectares (1.2–3.7 acres)
- Farming on steep, erosion-prone hillsides with diverse microclimates

Technology used

- Agroecological mapping tools to identify areas of soil degradation
- An open-source mobile platform developed by local NGOs for:
  - Recording planting and rainfall data, sharing traditional pest remedies, and accessing alerts about weather anomalies (linked to climate projections)
  - Community radio and in-person farmer networks complement mobile outreach

Goals

- Preserve and improve native corn yields in the face of climate change
- Respect and scale indigenous practices like intercropping with beans
- Reduce erosion and improve soil health using no-till and contour farming
- Strengthen food sovereignty while increasing resilience

Results

- Participating farmers reduced post-harvest losses by 25% due to better timing
- Adoption of agroecological practices led to measurable soil improvements
- Farmers reported increased household food supply and less reliance on aid
- Youth participation increased as tech supported cultural pride and modern engagement

Challenges

- Limited internet in mountain regions restricts real-time access
- Need for ongoing translation into multiple Mayan dialects
- National policy often favors industrial corn over indigenous food systems
- Reluctance from some elders toward adopting digital tools

Discussion questions

1. How does this case show using traditional knowledge in addressing food insecurity?
2. What makes this tech culturally appropriate?
3. How could governments better support indigenous-led innovation?

CASE STUDY 6

Remote sensing for smart corn farming: Brazil's Cerrado region

Farm profile

Mato Grosso and Goiás States, Brazil

- Medium-scale farmers growing corn in rotation with soy
- Operate on 10–50 hectare (24–153 acre) plots, often as part of cooperatives
- Facing deforestation pressures and unpredictable rainfall

Technology used

- Satellite remote sensing tools track soil moisture, vegetation health, and land use
- Agrosatélite platform: Integrates satellite data with mobile decision-making tools
- Carbon tracking app: Helps farmers quantify emissions reductions through no-till and cover crops

Goals

- Increase corn yields while maintaining deforestation-free practices
- Enable climate-smart agriculture using data on rainfall, soil, and plant stress
- Support farmers to access a sustainable certification program for corn exports
- Reduce reliance on blanket fertilizer and water applications

Results

- 20–25% average yield gains over two seasons with data-informed planting schedules
- Reduced chemical inputs by 30%, improving soil and water health
- Farmers received bonuses through certified sustainable supply chains
- Satellite data helped cooperatives prove compliance with anti-deforestation pledges

Challenges

- The initial tech literacy gap required extensive farmer training and demo days
- Language barriers for indigenous and Afro-Brazilian farmer communities
- Concerns about data ownership and corporate access to farmer information
- Need for ongoing funding to maintain data platforms and support staff

Discussion questions

1. How does this case show the relationship between environmental protection and food production?
2. What role did the government and research institutions play in this model's impact?
3. How could this approach be adapted for farmers in low-income or remote areas?