Adapting to Increasing Variability: Climate Change and Agriculture

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Adapting to Increasing Variability

CLIMATE CHANGE AND AGRICULTURE
AGRICULTURAL ADAPTATION

- Longer season cultivars
- Supply irrigation water
- Drain soil to reduce water logging
- Larger planting equipment
- Modify housing for animals
- Provide alternative water sources for animals
- Perennial crops - modify pruning, fruit load
- Specialty crops - modify environment to protect against extremes (temperature, wind)
# South Dakota Crop Distribution

## South Dakota Crop Area Harvested

<table>
<thead>
<tr>
<th>Year</th>
<th>Wheat</th>
<th>Corn</th>
<th>Soybean</th>
<th>Sunflower</th>
</tr>
</thead>
<tbody>
<tr>
<td>1860</td>
<td></td>
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<tr>
<td>1880</td>
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<tr>
<td>1900</td>
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<tr>
<td>1920</td>
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<td>1940</td>
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<td>1960</td>
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<td>1980</td>
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<tr>
<td>2000</td>
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<tr>
<td>2020</td>
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</tbody>
</table>

*Note: The exact data values are not provided in the table.*

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![Graph showing South Dakota Crop Area Harvested](chart.png)

**South Dakota Crop Area Harvested**

- **Wheat**
- **Corn**
- **Soybean**
- **Sunflower**

*Graph showing the area harvested for different crops from 1860 to 2020.*
IMPROVED AGRONOMIC SYSTEMS

Iowa Maize Production

<table>
<thead>
<tr>
<th>Year</th>
<th>Planted Area (ha x 10^6)</th>
<th>Harvested Area (ha x 10^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td>5.0</td>
<td></td>
</tr>
</tbody>
</table>

Year
SOIL EROSION
SPRING PRECIPITATION (AMES)

Ames Spring Precipitation

Year
1880 1900 1920 1940 1960 1980 2000 2020

Precipitation (inches)
0 2 4 6 8 10 12 14 16 18 20 22

Spring Precip (March-May)
Mean Spring Precip
INCREASED SUBSURFACE DRAINAGE
Des Moines Precipitation
Days per Year with More than 1.25 inches

Years having more than 8 days

2

350% Increase

2010 through Sept 27

7

41% Increase

3.7

5.2
SOYBEAN YIELD DEVIATIONS

Kentucky Soybean Yield

Year
Fraction Deviation from Potential Yield
-0.2 0.0 0.2 0.4 0.6
VARIATION IN YIELDS

The majority of the yield losses due to the weather are short-term stresses.
WATER REQUIREMENTS

Corn Water Use Efficiency

Water Use (mm)
200 300 400 500 600 700 800 900
Yield (kg ha\(^{-1}\))
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
28000

Water Deficit need 120 mm more water to grow 300 bu corn
ADAPTATION STRATEGIES

- Role of proper soil management has been overlooked as a reservoir of water to meet plant needs
- Adaptive strategies will have to ensure that soil is a foundational piece of the process
TEMPERATURE RESPONSE IN ANIMALS
PRACTICES

- Changes in crop rotations
- Changes in water management (irrigation and drainage)
- Changes in fertilizer management
- Changes in crop management
- Changes in animal management
- Ultimately we are going to have to quantify G x E x M interactions to develop effective adaptive strategies
AGRICULTURAL ADAPTATION

- Agriculture has adapted to climate change and will continue to adapt
- Practices will have to cope with larger extremes in temperature and precipitation