Water and Agriculture

ENSC 407 Global Water Issues
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Agriculture is the major water user in the world
• Areas such as the Nile Valley, Central California, Israel could never produce food without irrigation
• Northern China, NW India, US midwest would not produce food without irrigation

How much land is irrigated?
• 267 million hectares worldwide
• 18% of all cropland is irrigated
• Irrigated land is much more productive
• 60% of irrigated land is in Asia (Africa + South America <10%)
• Five-fold increase since 1900 but……
• Rate of irrigated land expansion is slowing
Why?

How much water is needed to grow different crops?

<table>
<thead>
<tr>
<th>Crop/Food</th>
<th>kg water per kg food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>500 to 1500</td>
</tr>
<tr>
<td>Wheat</td>
<td>900 to 2000</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>900 to 2000</td>
</tr>
<tr>
<td>Corn</td>
<td>1000 to 1800</td>
</tr>
<tr>
<td>Rice</td>
<td>1900 to 5000</td>
</tr>
<tr>
<td>Soybeans</td>
<td>1100 to 2000</td>
</tr>
<tr>
<td>Chicken</td>
<td>3500 to 5700</td>
</tr>
<tr>
<td>Beef</td>
<td>15000 to 70000</td>
</tr>
</tbody>
</table>

Water Use by Livestock

<table>
<thead>
<tr>
<th>Animal</th>
<th>Liters per Head per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk cows</td>
<td>154</td>
</tr>
<tr>
<td>Steers</td>
<td>51</td>
</tr>
<tr>
<td>Pigs</td>
<td>9</td>
</tr>
<tr>
<td>Sheep</td>
<td>3</td>
</tr>
<tr>
<td>Horses</td>
<td>68</td>
</tr>
<tr>
<td>Hens/Chickens</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Effect of Diet on Water Use

Gravity Irrigation
- Gravity (30 to 50% efficiency)
  - Furrow
  - Flood

Sprinkler Irrigation
- Lateral, central pivot, high efficient low spray

Drip Irrigation
- Highly efficient (~90%)
- Expensive
- Used extensively in Israel

Water Used for Irrigation and its Subsequent Fate
- Can use surface water (runoff), groundwater, stored (dammed) water, recycled wastewater

Problems with Irrigation
- Problems associated with dams (see list from Hanes lecture)
- Overabstraction of groundwater
- Waterlogging
- Salination – soils become very salty
French fries and depleting aquifers

French fries have become the most widely sold foodservice item in the United States. 

E. Schlosser, Fast Food Nation

Consumers consider both taste and appearance to be important: french fries need to be white, and uniform in length.

Typical potato is 80% water, french frying process replaces this water with fat.

Burbank Russet is best variety but reliance on single variety requires intensive use of insecticides and herbicides.

Growing French Fries

- Potatoes grown without irrigation are knobby
- Potatoes stored at too warm temperatures are flabby, at too cool temperatures result in brown French fries
- Suppliers for fast food restaurants will only contract farmers who can meet strict standards
- Thus growing french fries is a large-scale business requiring irrigation

Straight River, Minnesota

- Premier trout stream located in prime potato-growing area
- Overabstraction of groundwater has reduced flow to stream
- Water returned from irrigation is too warm for fish hatcheries
- Returned irrigation water is contaminated with agricultural chemicals