SOIL EROSION IS GLOBAL PROBLEM

- 1/3 WORLD’S ARABLE LAND LOST SINCE 1950
- MOST IN ASIA, AFRICA, S. AMERICA
  - 13-18 t/a/yr
- 30% OF US FARMLAND ABANDONED
  - EROSION
  - SALINIZATION
  - WATER-LOGGING
- 90% OF US CROPLAND LOSING SOIL FASTER THAN IT IS REPLACED
  - >1 t/a/yr

PIMENTEL ET AL., 1995
SOIL EROSION

- WATER AND WIND
- LOSSES CAN BE LARGE
  - WATER 3.5 BILLION t/yr
  - WIND 1.5 BILLION t/yr
- TILLAGE TRANSLOCATION
- ENVIRONMENTAL QUALITY ISSUES
- LOSS OF PRODUCTIVITY
- WE’VE BEEN LUCKY UNTIL 2000
WATER EROSION

- Begins with raindrops striking bare soil dislodging particles
- Intense rains seal surface
- When rainfall exceeds infiltration water is stored in small depression
- Once depressions are filled, runoff begins
WATER EROSION

• INITIALLY WATER FLOWS IN A DISCONTINUOUS SHEET

• EVENTUALLY IT CONCENTRATES INTO SMALL CHANNELS OR RILLS. THE RUNOFF NOW HAS ENERGY TO BREAK OFF PARTICLES AND CUT DEEPER

• THE AMOUNT OF EROSION CAUSED BY SHEET AND RILL EROSION INCREASES WITH SLOPE AND DISTANCE

• RILLS MAY EVENTUALLY FORM GULLIES
PREDICTING EROSION - RUSLE

Sheet
Rill
Ephemeral Gully

TYPICAL WATERSHED

SLIDE COURTESY OF JOHN PINGRY, USDA-NRCS
RUSLE - APPLICABLE CROPLAND USES

Where shallow overland flow occurs and erosion rates are high.

- Best: Midwest Corn, Soybean, Wheat
- Mod. Well: Conservation Tillage
- More Variable: Ridge Till, Support Practices
RUSLE - APPLICABLE CONDITIONS

• Slope Length: 50 - 300 feet
• Slope Gradient: 3-20%
• Medium textured soils
• Rainfall predominant precipitation and exceeds 20 inches/yr
WIND EROSION

- Saltation detaches particles
- Smaller particles suspended
- Larger particles creep
- Sandy and silty soils most susceptible
- Soil accumulation in ditches and fence rows
EROSION EFFECTS ON PRODUCTIVITY

- SHALLOW ROOTING ZONE
- LOWER AVAILABLE WATER
- LOSS OF NUTRIENTS AND O.M.
- FARMING THE SUBSOIL
  - POORER TILTH
  - GREATER PENETRATION RESISTANCE
- INCREASED HYDRAULIC COND.
  - “STRONGER” AGGREGATES
- CAN A SOIL BE “REHABILITATED”
TILLAGE TRANSLOCATION

- NET DOWNHILL MOVEMENT BY TILLAGE
- RESULTS IN SMOOTHING OF SURFACE
- WATER EROSION INCREASES RELIEF INTENSITY
- BOUNDARIES STOP MOVEMENT
- NOT ACCOUNTED FOR BY RUSLE
- INCREASES SOIL VARIABILITY
MECHANISM OF TILLAGE TRANSLOCATION
COMPARING WATER EROSION AND TILLAGE TRANSLOCATION

50 YR. SIMULATION OF WATER EROSION AND TILLAGE TRANSLOCATION (SCHUMACHER ET AL., 1999)

ORIGINAL SOIL SURFACE

8 % SLOPE

SUMMIT   SHOULDER   BACKSLOPE   FOOTSLOPE   TOESLOPE
COMPARING WATER EROSION AND TILLAGE TRANSLOCATION

WATER EROSION: EFFECTS PRONOUNCED ON BACKSLOPE. INCREASED CUTTING ALONG SLOPE FACE WITH DEPOSITION ON TOESLOPE.
COMPARING WATER EROSION AND TILLAGE TRANSLOCATION

TILLAGE TRANLOCATION: EFFECTS PRONOUNCED ON CONVEX SHOULDERS. RESULTS IN SMOOTHING OF LANDSCAPE.
## TILLAGE TRANSLOCATION EFFECT ON SOIL PRODUCTIVITY INDEX

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<th>EROSION PROCESS</th>
<th>SUMMIT</th>
<th>SHOULDER</th>
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<td>DISTANCE (m)</td>
<td>10</td>
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*SCHUMACHER ET AL., 1999*
SOIL LOSS AND PRODUCTIVITY

- WESTERN CANADA
- WHEAT
- REMOVED 0, 2, 4, 6, 8 TOPSOIL
- REPLACE NOTHING, N&P, 30 t/a MANURE, AND 2” TOPSOIL
- IRRIGATED AND NON-IRRIGATED
- LARNEY ET AL., 2000
TOPSOIL LOSS AND PRODUCTIVITY

LARNEY ET AL., 2000

IRRIGATED SITE

TOPSOIL REMOVED (in)

WHEAT YIELD (bu/a)

CONTROL  FERTILIZER  MANURE  TOPSOIL
EROSION CLASS EFFECT ON AVAILABLE WATER AND CORN GROWTH

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<th>EROSION CLASS</th>
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<td>0.14</td>
<td>81</td>
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ANDRASKI AND LOWERY, 1992 (LANCASTER, WIS.)
CAN MANURE REHABILITATE AN ERODED SOIL?

<table>
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<th>EROSION CLASS</th>
<th>MANURE</th>
<th>ORG. CARBON</th>
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<td>2.5</td>
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ARRIAGA, 2000 (LANCASTER, WIS.)
CORN YIELD ON A MANURED, ERODED SOIL (12 YEAR AVG.)

ARRIAGA, 2000 (LANCASTER, WIS.)
Cluster #3
(n = 18)

Depth (cm)

Cone Index (kPa)

Cluster #3
(n = 18)

Depth (cm)

Cone Index (kPa)

Ap

Bt1

2Bt2
SUMMARY

- SOIL EROSION IS A SERIOUS PROBLEM
  - ENVIRONMENTAL
  - PRODUCTIVITY
- CONSERVATION PLANNING MUST BE AN INTEGRAL PART OF ALL OPERATIONS
- REDUCED EROSION FROM INCREASED RESIDUE AND CONSERVATION PRACTICES
- PRODUCTIVITY LOSS IS COMPLEX
- POTENTIAL TO QUICKLY RESTORE PRODUCTIVITY IS LIMITED