PREINDUSTRIAL GLOBAL TERRESTRIAL P FLUX

Change in storage = 1-6 Tg P/yr

Freshwater and terrestrial ecosystems combined

Change in storage = 10 – (1 + 8) = 1
to
15 – (1 + 8) = 6

Bennett et al. 2001
Current global terrestrial P flux

\[ \text{Change in storage} = (15 + 18.5) - (1 + 22) = 10.5 \to (20 + 18.5) - (1 + 22) = 15.5 \]

Bennett et al. 2001
Figure 8. The pools and flows of phosphorus in the CENTURY model
P FERTILIZER (ORGANIC OR INORGANIC)

SOIL

CROP
% of applied nutrients captured by crops
30-50% of N
≈45% of P
P FERTILIZER (ORGANIC OR INORGANIC)

SOIL

Crop

Clay mineralogy

High sorption capacity:
Amorphous aluminosilicates
Fe oxides
Al oxides

Moderate sorption capacity:
Crystalline aluminosilicates
Humic compounds
Figure 2. Examples of P sorption isotherms determined by the method of Fox and Kamprath (1970). Source: Sanchez and Uehara (1980).
Cumulative P additions as Farm Yard Manure (FYM) or P fertilizer by 1903
And P removal in wheat, potato and barley harvests to present at Exhaustion
P FERTILIZER
(ORGANIC OR INORGANIC)

SOIL

P-enriched organic and inorganic particles
Water and wind erosion

Leaching of Dissolved Po or Pi

CROP

wetland
river
lake
estuary
Coastal marine
P FERTILIZER (ORGANIC OR INORGANIC)

SOIL

P-enriched organic and inorganic particles

Water and wind erosion

Leaching of Dissolved Po or Pi

FACTORS AFFECTING P LOSS TO WATER AND WIND

Tillage practices
Slope
SOM content
Soil texture
Duration of time without vegetative cover
Intensity of rainfall events

wetland
river
lake
estuary
Coastal marine
Table 5. Effect of fertilizer P application on the loss of P in surface runoff.

<table>
<thead>
<tr>
<th>Land use</th>
<th>Fert. Appld.</th>
<th>P losses</th>
<th>Fert. loss</th>
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<tbody>
<tr>
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<tr>
<td>Contour corn 1</td>
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<td>0.45</td>
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<td></td>
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<td>0.76</td>
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<tr>
<td>Grass 2</td>
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<td>0.01</td>
<td>0.20</td>
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<td>No till corn for silage 3</td>
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<td>0.70</td>
<td>1.30</td>
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<td>30</td>
<td>0.80</td>
<td>1.00</td>
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<tr>
<td>No till corn for grain 3</td>
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<td>1.10</td>
<td>2.20</td>
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<tr>
<td></td>
<td>30</td>
<td>1.80</td>
<td>1.60</td>
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<tr>
<td>Conventional corn 3</td>
<td>15</td>
<td>0.30</td>
<td>15.10</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.20</td>
<td>17.50</td>
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<td>Wheat/fallow 4</td>
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<td>54</td>
<td>1.20</td>
<td>2.90</td>
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<td>Grass 5</td>
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<tr>
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<td>50</td>
<td>2.80</td>
<td>2.74</td>
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</tbody>
</table>

* Percent decrease in P loss from fertilised compared to check treatment


**P FERTILIZER (ORGANIC OR INORGANIC)**

- **Ag SOIL storage ~8 Tg/yr**

  - P-enriched organic and inorganic particles

  - Water and wind erosion

    - Leaching of Dissolved Po or Pi

    - Wetland/riparian
      - freshwater
      - Sediment Storage 3.1 Tg/yr
      - river
      - lake
      - estuary
      - Coastal marine

  - Crop
Global ocean P fluxes—(Tg/yr)

River  22

Continental Shelf Estuarine/Deltaic  6.9

Fish  0.3

Atmospheric  0.95

Pelagic deep ocean  1.3

(Howarth et al. 1995)
Imbalances in the budget reflect the uncertainty and are most likely due to underestimating burial, with riverine input being the second largest uncertainty.

(Howarth et al. 1995)
P FERTILIZER (ORGANIC OR INORGANIC)

SOIL

CROP

10-90 % of applied P might be taken up by the crop

Average ~45%

MANAGEMENT FACTORS
Crop selection
Crop deployment in time and space
Soil pH management (lime)
Alleviation of other crop limiting factors
Mycorrhizal colonization (?)
P FERTILIZER
(ORGANIC OR INORGANIC)

SOIL

CROP

Concentrated Animal Production

Rural to urban food shipments

Beaton et al. 1995
Optimize the utility of P fertilizers, a scarce, non-renewable, non-substitutable and highly valuable resource, rather than simply try to find the most effective sinks.