Supplemental Fig. S1 The average amount of chemical P fertilizer applied (A, D) and manure P (B, E), crop P uptake (C, F) from 2004 to 2014 in each province of China.
Supplemental Fig. S2 Phosphate rock reserves, P fertilizer production and consumption in China from 1978 to 2017.

Supplemental Table S1. The P loss to the water from agriculture in China (MEP, 2010).

<table>
<thead>
<tr>
<th>Sources</th>
<th>Planting (10^4 tones)</th>
<th>Livestock Husbandry</th>
<th>Aquaculture Industry</th>
<th>The total P loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>amount</td>
<td>10.9</td>
<td>16.0</td>
<td>1.56</td>
<td>42.3</td>
</tr>
<tr>
<td>% of the total P loss</td>
<td>25.1</td>
<td>37.0</td>
<td>3.60</td>
<td>100</td>
</tr>
</tbody>
</table>
**Supplemental Table S2.** The critical level of soil Olsen P (mg kg\(^{-1}\)) for crop yield in each P management zone.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Northwest</th>
<th>Northeast</th>
<th>North</th>
<th>Yangtze River Plain</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major crops(^a)</td>
<td>21</td>
<td>9</td>
<td>18</td>
<td>17</td>
<td>39</td>
</tr>
<tr>
<td>Tomato(^b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amaranth(^c)</td>
<td></td>
<td></td>
<td></td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>Vegetable(^d)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>Leafy vegetable(^e)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>97</td>
</tr>
<tr>
<td>Apple(^f)</td>
<td>&gt;55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pear(^g)</td>
<td>&gt;30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\), Li et al. (2015), including wheat, maize and rice; \(^b\), Zhang et al. (2007); \(^c\), Liang et al. (2009); \(^d\), Zhang et al. (2011); \(^e\), Li et al. (2009); \(^f\), Peng and Jiang. (2006); \(^g\), Personal communication.

**Supplemental Table S3.** Percentages of yield and P uptake for various crop intercropping systems.

<table>
<thead>
<tr>
<th>Cropping system</th>
<th>Locations</th>
<th>Yield (%)</th>
<th>P uptake (%)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize/Wheat</td>
<td>Gansu</td>
<td>37</td>
<td>45</td>
<td>Li et al., 2001</td>
</tr>
<tr>
<td>Wheat/Soybean</td>
<td>Gansu</td>
<td>26</td>
<td>9</td>
<td>Li et al., 2001</td>
</tr>
<tr>
<td>Maize/Fababean</td>
<td>Ningxia</td>
<td>42</td>
<td>15</td>
<td>Mei et al., 2012</td>
</tr>
<tr>
<td>Maize/Soybean</td>
<td>Sichuan</td>
<td>39</td>
<td>112</td>
<td>Xiao et al., 2015</td>
</tr>
<tr>
<td>Maize/Chickpea</td>
<td>Beijing</td>
<td>13</td>
<td>26</td>
<td>Li et al., 2004</td>
</tr>
</tbody>
</table>
Reference list of the 6 publications used in calculation of critical level of soil Olsen P (mg kg\(^{-1}\)) for crop yield in each P management zone in Supplemental Table S1.


Reference list of the 80 publications used in calculation of P use efficiency of different crops in Table 1.


Huang, L.M., Huang, S.W., Han, B.W. 2010. Optimum nitrogen and phosphorus application rate and balanced fertilization effect of winter wheat-summer maize. Soils Fert Sci Chin. 5: 38-44.


Wu, D.W., Dong, Y.D., Suo, B.H., Qiu, B.Y. 1979. $^{32}$P was used to study the effects of soil phosphorus supply and phosphorus application on phosphorus uptake and yield of soybean. J Jilin Agric Univ. 1: 68-75

Wu, J.C., Yang, Y.H., Kang, Y.L., Tian, H.J. 2011. Effects of nitrogen and phosphorus fertilizer on corn


