Data Article

Datasets of mass of phosphorus flows in Zhangzhou city in China

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Abstract

Compared to currency data which tends to fluctuate with the market and cannot accurately reflect the effects of human activities on resources use efficiency and environmental sustainability, the assessment accuracy of the effects can be further improved by constant mass data of elements contained in materials and products within socioeconomic system, e.g. phosphorus mass data for its use efficiency assessment in the case of Zhangzhou city in China Huang et al., 2019. Firstly, the mass data of products and raw materials were sourced or assessed mainly from government statistical year books or bulletins. Secondly, the phosphorus contents in materials were derived mainly from literature. Finally, the mass of phosphorus flows throughout food production-consumption system in Zhangzhou prefecture, Fujian province, China was accounted by mass balance accounting based on substance flow analysis. These data include the following parts: input/output phosphorus flows across the jurisdiction boundary of Zhangzhou city; phosphorus flows into or out of agricultural production subsystems such as crop farming, livestock, and aquaculture; phosphorus flows into or out of human consumption subsystems.

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phosphorus flows across subsystems. Part of reference data related to phosphorus mass balance accounting was also presented.

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### 1. Data

The datasets of this article provide information on the phosphorus use of agricultural food production subsystems and urban/rural food consumption subsystems and the phosphorus emission from these subsystems. Tables 1–4 showed the input/output phosphorus flows of each subsystem. Table 5 showed the import/export phosphorus flows across the boundary of the whole system.

These datasets were based on the use of phosphorus-containing products, including products for the purposes of production or consumption, and the phosphorus content in the products. The detailed calculation methods can be seen in the Appendix A. Supplementary data for Huang et al. (2019) [1]. Based on these datasets, phosphorus flow chart for each year can be drawn, e.g. the year 1995 and 2014 in Huang et al. (2019) [1].

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**Specifications table**

| Subject area                  | Environmental management. |
|------------------------------|---------------------------|
| More specific subject area    | Environmental system analysis, element metabolism in socioeconomic system. |
| Type of data                  | Table.                   |
| How data was acquired         | Survey by local governmental agencies, literature, reports, yearbooks, etc.; Mass balance modeling by substance flow analysis. |
| Data format                   | Raw, filtered, analyzed, extrapolated. |
| Experimental factors          | The mass of phosphorus flows throughout food production-consumption system in Zhangzhou prefecture were assessed. |
| Experimental features         | Mass balance thinking and bottom-up assessment method were applied. |
| Data source location          | Yearbooks, reports, interviews across the jurisdiction of Zhangzhou City in China and global literature. |
| Data accessibility            | The phosphorus mass data is with this article. |
| Related research article      | [1]Huang, C.L., Gao, B., Xu, S., Huang, Y.F., Yan, X.M., Cui, S.H., 2019. Changing phosphorus metabolism of a global aquaculture city. Journal of Cleaner Production, 225: p.1118–1133. |

**Value of the data**

- Mass data of phosphorus element flows across regional socioeconomic system can be an integrated part of global map of element biogeochemical cycle.
- Mass data within socioeconomic system is more valuable and convincing for global sustainability assessment, compared to currency data.
- Analysis of systematic data derived from substance flow analysis of element flows in the interaction between human and the environment will provide viable approach for getting a solution for the dilemma between economic development and environmental protection.
- Compared with other element data in this city or the same element in other cities, effects of urbanization or industrial structure on element metabolism efficiencies can be verified.
2. Experimental design, materials, and methods

2.1. Analytical framework and data sources

We applied a coupled system approach, i.e. Substance Flow Analysis (SFA), to account for the phosphorus flows through regional food production and consumption system and its subsystems. Analytical framework and data sources can be seen in Huang et al. (2019) [1].

### Table 1

**Phosphorus flows for crop farming subsystems**

| Year | Fertilizers | Pesticides | Seeds | FP | F | TS | RS | Stubble | RM | RRE | RUE |
|------|-------------|------------|-------|----|---|----|----|---------|----|-----|-----|
| 2014 | 33023       | 194        | 55    | 12193 | 212 | 1123 | 178 | 321     | 3818| 863 | 144 |
| 2013 | 31090       | 196        | 56    | 11585 | 214 | 1135 | 186 | 315     | 4532| 856 | 147 |
| 2012 | 31673       | 193        | 55    | 11095 | 215 | 1114 | 187 | 308     | 4577| 849 | 149 |
| 2011 | 31782       | 198        | 56    | 10793 | 222 | 1099 | 187 | 301     | 4582| 848 | 142 |
| 2010 | 31874       | 198        | 56    | 10441 | 223 | 1124 | 196 | 299     | 4231| 848 | 141 |
| 2009 | 31590       | 195        | 55    | 10236 | 228 | 1132 | 200 | 295     | 3820| 837 | 143 |
| 2008 | 29434       | 190        | 51    | 10270 | 240 | 1139 | 205 | 295     | 3797| 850 | 137 |
| 2007 | 28664       | 178        | 47    | 9721  | 252 | 1208 | 218 | 298     | 3602| 844 | 134 |
| 2006 | 29544       | 182        | 50    | 9434  | 266 | 1222 | 223 | 300     | 3583| 844 | 128 |
| 2005 | 30373       | 185        | 73    | 10883 | 267 | 1474 | 281 | 362     | 4502| 841 | 119 |
| 2004 | 30028       | 172        | 74    | 10753 | 253 | 1526 | 291 | 371     | 4588| 840 | 118 |
| 2003 | 29393       | 177        | 75    | 10427 | 274 | 1591 | 306 | 372     | 4366| 842 | 105 |
| 2002 | 29133       | 175        | 78    | 10337 | 263 | 1598 | 307 | 374     | 4343| 802 | 120 |
| 2001 | 29188       | 178        | 87    | 11147 | 291 | 1681 | 337 | 389     | 4443| 995 | 72  |
| 2000 | 32232       | 147        | 96    | 11280 | 290 | 1669 | 342 | 388     | 4359| 1029| 76  |
| 1999 | 33825       | 165        | 113   | 11686 | 282 | 2178 | 471 | 442     | 4275| 1041| 75  |
| 1998 | 31473       | 142        | 116   | 11715 | 296 | 2697 | 594 | 498     | 4375| 1052| 79  |
| 1997 | 30739       | 1218       | 119   | 11335 | 285 | 2729 | 612 | 491     | 4177| 1084| 82  |
| 1996 | 28267       | 686        | 120   | 11125 | 317 | 2674 | 599 | 480     | 4236| 1100| 92  |
| 1995 | 25788       | 153        | 117   | 10401 | 310 | 2557 | 582 | 448     | 4036| 1113| 98  |

Notes: FP, food products from crop farming; F, green fodder; TS, total straw output; RS, recycled straw; RM, recycled livestock manure applied to the field; RRE/RUE, recycled rural/urban residents’ excreta applied to the field.

### Table 2

**Phosphorus flows for livestock subsystems**

| Year | IFL | S | F | G | LP | LL | RM |
|------|-----|---|---|---|----|----|----|
| 2014 | 3734| 317| 212| 935| 588| 793| 3818|
| 2013 | 4638| 310| 214| 927| 674| 883| 4532|
| 2012 | 4653| 304| 215| 931| 665| 862| 4577|
| 2011 | 4538| 298| 222| 914| 640| 750| 4582|
| 2010 | 4270| 294| 223| 896| 611| 842| 4231|
| 2009 | 3991| 288| 228| 865| 586| 967| 3820|
| 2008 | 3914| 286| 240| 841| 573| 910| 3797|
| 2007 | 3564| 284| 252| 760| 559| 700| 3602|
| 2006 | 3785| 284| 266| 749| 579| 922| 3583|
| 2005 | 4427| 347| 267| 1157| 748| 948| 4502|
| 2004 | 4476| 354| 253| 1152| 755| 893| 4588|
| 2003 | 4128| 346| 274| 1085| 730| 737| 4366|
| 2002 | 4066| 346| 263| 1080| 715| 697| 4343|
| 2001 | 3877| 376| 291| 1285| 722| 663| 4443|
| 2000 | 3653| 381| 290| 1378| 710| 634| 4359|
| 1999 | 3029| 425| 282| 1574| 647| 388| 4275|
| 1998 | 3011| 458| 296| 1635| 648| 376| 4375|
| 1997 | 3340| 451| 285| 1023| 594| 328| 4177|
| 1996 | 2573| 442| 317| 1558| 540| 114| 4236|
| 1995 | 2342| 411| 310| 1457| 474| 9| 4036|

Notes: IFL, imported feed for livestock; S, straw feed; F, green fodder; G, grain feed; LP, livestock products; LL, Loss from livestock; RM, recycled livestock manure applied to the field.
2.2. Mass balance modeling

The equations of all phosphorus inputs and outputs during production, consumption, and discharge were constructed based on the mass balance principle, see Huang et al. (2019) [1].

Table 3
Phosphorus flows for aquaculture subsystems Unit: tonnes.

| Year | IFSF | IFFF | MFP | APU | APR | LSA | LFA | FAP | SP | SAP | SAPF |
|------|------|------|-----|-----|-----|-----|-----|-----|----|-----|------|
| 2014 | 3358 | 29882 | 5236 | 103 | 179 | 2567 | 27733 | 2149 | 6028 | 3579 | 791 |
| 2013 | 3016 | 28180 | 4773 | 83  | 144 | 2173 | 24961 | 1935 | 5473 | 3170 | 701 |
| 2012 | 2874 | 26896 | 4773 | 83  | 144 | 2173 | 24961 | 1935 | 5473 | 3170 | 701 |
| 2011 | 2423 | 25283 | 103  | 179 | 2567 | 27733 | 2149 | 6028 | 3579 | 791 |
| 2010 | 2282 | 24116 | 103  | 179 | 2567 | 27733 | 2149 | 6028 | 3579 | 791 |
| 2009 | 2301 | 23473 | 103  | 179 | 2567 | 27733 | 2149 | 6028 | 3579 | 791 |
| 2008 | 2188 | 22535 | 103  | 179 | 2567 | 27733 | 2149 | 6028 | 3579 | 791 |
| 2007 | 2041 | 21074 | 103  | 179 | 2567 | 27733 | 2149 | 6028 | 3579 | 791 |

Notes: IFSF/IFFF, imported feed for seawater/freshwater fauna; MFP, marine fishing products; APR/APU, aquaculture products for rural/urban residents; LFA/LSA, loss from freshwater/seawater aquaculture; LP, livestock products; FAP, freshwater aquaculture products; SP, seawater products; SAP, seawater aquaculture products; SAPF, seawater aquaculture products on feed.

Table 4
Phosphorus flows for human consumption subsystems Unit: tonnes.

| Year | CU | CR | LPR | LPU | APU | APR | SF | RRE | RUE | LR | LU | UFI |
|------|----|----|-----|-----|-----|-----|----|-----|-----|----|----|-----|
| 2014 | 446 | 1040 | 378 | 247 | 103 | 179 | 126 | 863 | 144 | 1252 | 703 | 480 |
| 2013 | 370 | 1067 | 349 | 273 | 92  | 158 | 135 | 856 | 147 | 1226 | 716 | 500 |
| 2012 | 383 | 1117 | 358 | 306 | 83  | 144 | 129 | 849 | 149 | 1200 | 729 | 407 |
| 2011 | 343 | 1140 | 345 | 275 | 83  | 144 | 129 | 849 | 149 | 1200 | 729 | 407 |
| 2010 | 326 | 1149 | 289 | 249 | 65  | 143 | 141 | 848 | 141 | 1169 | 715 | 424 |
| 2009 | 328 | 1087 | 273 | 248 | 72  | 153 | 150 | 837 | 143 | 1139 | 749 | 556 |
| 2008 | 352 | 1120 | 266 | 278 | 75  | 131 | 189 | 844 | 134 | 1120 | 733 | 420 |
| 2007 | 370 | 1094 | 269 | 285 | 65  | 122 | 194 | 848 | 142 | 1184 | 717 | 442 |
| 2006 | 324 | 1140 | 345 | 275 | 77  | 140 | 129 | 848 | 142 | 1184 | 717 | 442 |
| 2005 | 309 | 1140 | 289 | 249 | 65  | 143 | 141 | 848 | 141 | 1169 | 715 | 424 |
| 2004 | 326 | 1149 | 289 | 249 | 65  | 143 | 141 | 848 | 141 | 1169 | 715 | 424 |

Notes: CR/CU, crop products for rural/urban residents; LPR/LPU, livestock products consumed by rural/urban residents; APU/APR, aquaculture products for urban/rural residents; SF, straw fuel; RRE/RUE, recycled rural/urban residents’ excreta applied to the field; LR/LU, loss from rural/urban residents’ consumption; UFI, Unknown food inflow.
### Table 5
The import/export phosphorus flows across the boundary of the whole system. Unit: tonnes.

| Year | Import flows | Export flows | Total export | Total import |
|------|--------------|--------------|--------------|--------------|
|      | Fertilizers  | Pesticides   | Seeds | IFSF | IFFF | IFL | EC | EL | EA |               |               |
| 2014 | 33023        | 194          | 55    | 3358 | 29882 | 3734 | 9771 | 0  | 7895 | 17629 | 70246         |
| 2013 | 31090        | 196          | 56    | 3016 | 28180 | 4638 | 9221 | 52 | 7475 | 16748 | 67175         |
| 2012 | 31673        | 193          | 55    | 2874 | 26896 | 4653 | 8665 | 0  | 7181 | 15846 | 66344         |
| 2011 | 31782        | 198          | 56    | 2423 | 25283 | 4538 | 8396 | 19 | 6912 | 15327 | 64281         |
| 2010 | 31874        | 198          | 56    | 2282 | 24116 | 4270 | 8069 | 73 | 6691 | 14834 | 62797         |
| 2009 | 31590        | 195          | 55    | 2301 | 23473 | 3991 | 7957 | 64 | 6541 | 14561 | 61604         |
| 2008 | 29434        | 190          | 51    | 2188 | 22535 | 3914 | 8022 | 101| 6277 | 14499 | 58311         |
| 2007 | 28664        | 178          | 47    | 2041 | 21074 | 3564 | 7489 | 14 | 6168 | 13670 | 55569         |
| 2006 | 29544        | 182          | 50    | 1902 | 19431 | 3785 | 7268 | 24 | 5965 | 13257 | 54894         |
| 2005 | 30373        | 185          | 73    | 2165 | 19439 | 4427 | 8245 | 196| 6625 | 15065 | 56661         |
| 2004 | 30028        | 172          | 74    | 2162 | 19516 | 4476 | 7951 | 228| 6453 | 14631 | 54279         |
| 2003 | 29393        | 177          | 75    | 1968 | 17138 | 4128 | 7704 | 217| 6112 | 14033 | 52879         |
| 2002 | 29133        | 175          | 78    | 2047 | 17266 | 4066 | 7485 | 203| 5998 | 13687 | 52766         |
| 2001 | 29188        | 178          | 87    | 1909 | 14821 | 3877 | 7809 | 354| 5784 | 13947 | 50060         |
| 2000 | 32232        | 147          | 96    | 1490 | 13467 | 3653 | 8146 | 358| 5610 | 14114 | 51084         |
| 1999 | 33825        | 165          | 113   | 991  | 12391 | 3029 | 8405 | 320| 5148 | 13874 | 50513         |
| 1998 | 31473        | 142          | 116   | 1131 | 11313 | 3011 | 8422 | 339| 4775 | 13536 | 47185         |
| 1997 | 30739        | 1218         | 119   | 345  | 10539 | 3340 | 8701 | 302| 4309 | 13312 | 46301         |
| 1996 | 28267        | 686          | 120   | 396  | 8645  | 2573 | 7971 | 256| 2550 | 10777 | 40688         |
| 1995 | 25788        | 153          | 117   | 415  | 7401  | 2342 | 7365 | 199| 2281 | 9845  | 36217         |

Notes: IFSF/IFFF, imported feed for seawater/freshwater fauna; IFL, imported feed for livestock; EC, exported crop products; EL, exported livestock products; EA, exported aquaculture products.

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### Conflict of interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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