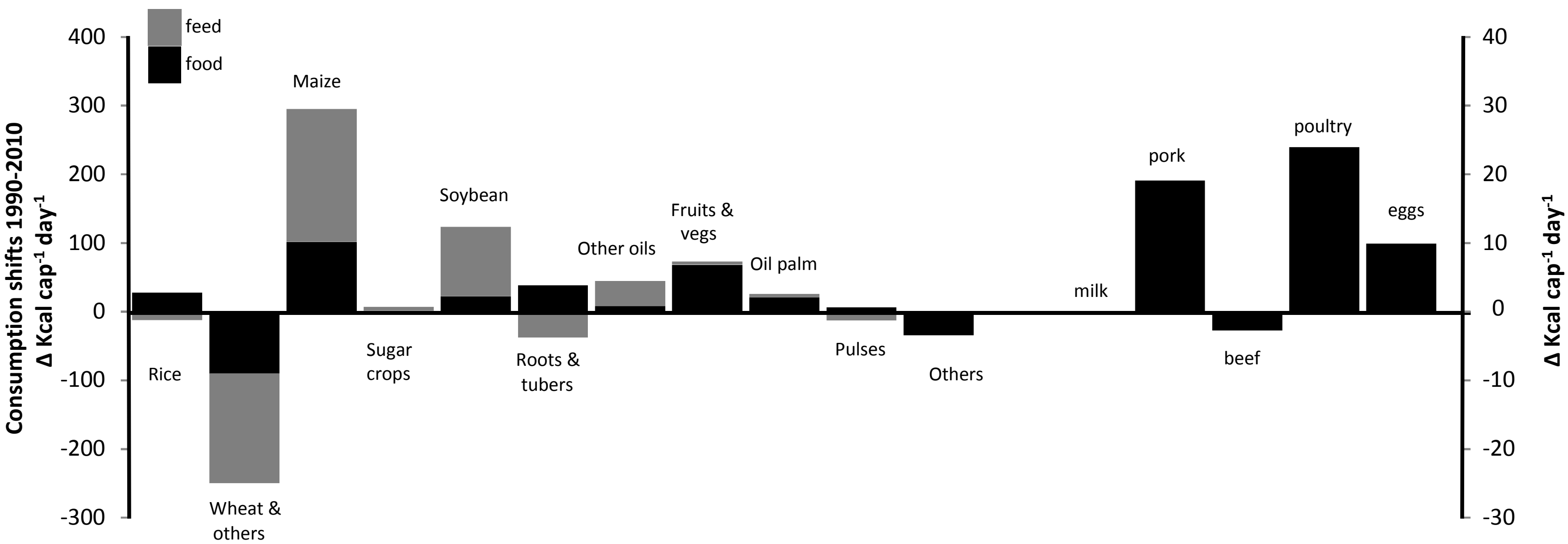
**Supplementary figure 1-** Food and feed consumption shifts over the last 20 years. Global shifts of calories consumed per capita and per day for the major plant and animal products examined in this study between 1988-1990 and 2008-2010. There is a net increase in total plant and animal food calories of 168.3 and 50.1 Kcal $cap^{-1}$ $day^{-1}$ or +38.9 and +47.7%, respectively. In the same period feed use increased by 121.3 Kcal $cap^{-1}$ $day^{-1}$ or +41.1%. Global population increased by 31.8% during the same period. Note 10X change in Y axis scale for animal products.



**Supplementary table 1** – Sources of information used in this study. Main variables, units and time period of the data are indicated. Sources correspond to official on-line databases in the case of FAO and USDA and to references from the literature. Important adjustments applied to the data are indicated.

| # | Variable | Unit | Period | Data Source | Adjustments | Notes |
|---|---|---|---|---|---|---|
| 1 | Production | Tg yr-1 | 2008-2010 for global analysis, 2007 for crop specific balance, 1988-1990 for analysis of trends | Production, Crops + Livestock Primary (FAO, 2012) | Transformation to total dry mass using databases #9 and #10 | Accessed in November 2012 |
| 2 | Harvested area | M ha yr-1 | 2008-2010 for global analysis, 2007 for crop specific balance | Production, Crops + Livestock Primary (FAO, 2012) | None | Accessed in November 2012 |
| 3 | Farm gate value | USD Mg-1 | 2008-2010 for global analysis, 2007 for crop specific balance | Prices, Producer Price (FAO, 2012) | None | Accessed in November 2012 |
| 4 | Allocation | % | 2008-2009 for global analysis, 1988-1990 for analysis of trends | Food Balance Sheets, Commodity Balances (FAO, 2012) | Estimated for all subrpoducts after considering seed, food, feed, processed, other uses and waste to be 100% | Accessed in November 2012 |
| 5 | Allocation others | % | various dates | (Shapouri et al., 2002, Njie, 2007, Balat and Balat, 2009, Licht, 2010, Rangnekar, 1988, Morand et al., 2004) | Bioenergy absolute values discounted from other uses in #5, if not enough, also from processed | |
| 6 | Total fertilizer use | Tg yr-1 | 2008-2009 for global analysis, 1988-1990 for analysis of trends | Resources, Fertilizers (FAO, 2012) | Consumption values adjusted for pure element mass | Accessed in November 2012 |
| 7 | Fertilizer use by crop | kg ha-1 yr-1 | 2007 | (Heffer, 2009) | Estimates for 2008-2010 assumed same fertilizer allocation reported in 2007 | |
| 8 | Mineral Supplementation | Tg yr-1 | 2009 | (International, 2008) | reported feed allocation applied to total P production from database #6 | Report indicates 80 vs. 5% allocation of total mineral P to fertilizer vs. animal feed |
| 9 | Composition edible part | Mass fraction of moisture, fat, protein and carbohydrates, N, P and K, and caloric content | not applied | (USDA, 2011) | reported for edible sub-components | Accessed in November 2012 |
| 10 | Composition others | Mass fraction of moisture, N, P and K, and caloric content | not applied | (USDA, 2011) and references in supplementary table 2 | reported for non-edible crops and sub-components | Accessed in November 2012 |

**Supplementary table 2** – Major plant and animal products and subproducts and their dietary and N, P, K composition. Each group can include one species (single species) or more, in which case a set of representative species was selected to characterize the composition of the whole group. The share in terms of dry mass accounted for by the representative species is indicated as a percentage in brackets. Components or subproducts and their dry matter content and fraction of the total product in terms of dry mass are indicated. Energy, protein, fat and carbohydrate contents correspond to the food+feed usable fraction. C, N, P and K contents correspond to the total mass of each subrpduct regardless of its use.  Source references from which data was obtained are shown.

| Item | representative species (share) | components | dry matter | fraction | energy | protein | fat | carbohydrates | C | N | P | K | Sources |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % total weight | in dry weight | kcal / 100 g | % | % | % | % | mg / Kg | mg / Kg | mg / Kg | |
| Wheat & other fine grains | wheat (76.4%) | whole grain | 0.89 | 1.00 | 378 | 13.7 | 2.0 | 82.6 | 41.7 | 23449 | 4236 | 4456 | (USDA, 2011) |
| Maize | single species | whole grain | 0.90 | 1.00 | 407 | 10.5 | 5.3 | 82.9 | 42.6 | 16816 | 2343 | 3202 | (USDA, 2011) |
| Rice | single species | whole grain + husk | 0.88 | 1.00 | 390 | 7.3 | 1.9 | 88.0 | 41.2 | 11200 | 2862 | 4532 | (USDA, 2012) |
| | | whole grain | 0.83 | 0.63 | 413 | 8.6 | 3.1 | 86.9 | 41.7 | 13694 | 3013 | 3058 | (USDA, 2011) |
| | | husk | 0.96 | 0.37 | 350 | 5.0 | 0.0 | 90.0 | 40.3 | 6865 | 2600 | 7093 | (Houston and Kohler, 1970) |
| Sugar crops | sugar cane (88.2%) | whole stem | 0.34 | 1.00 | 310 | 1.2 | 0.0 | 78.4 | 40.1 | 2557 | 601 | 6636 | (USDA, 2012) |
| | | sugar | 1.00 | 0.29 | 389 | 0.0 | 0.0 | 95.0 | 40.0 | 0 | 0 | 20 | (USDA, 2011) |
| | | bagasse | 0.55 | 0.48 | 233 | 2.4 | 0.0 | 60.0 | 40.3 | 3840 | 900 | 8000 | (Mena, 1987) |
| | | others | 0.13 | 0.23 | 372 | 0.0 | 0.0 | 96.2 | 40.0 | 3121 | 739 | 12231 | (Mena, 1987, Pate et al., 1984) |
| Fruits & vegetables | onion + tomato + melon + apple + orange (30.0%) | whole fruit/bulb | 0.11 | 1.00 | 354 | 8.2 | 1.6 | 86.3 | 41.2 | 9743 | 2008 | 17526 | (USDA, 2011) |
| Soybean | single species | whole grain | 0.91 | 1.00 | 488 | 39.9 | 21.8 | 33.0 | 51.0 | 69873 | 7697 | 19648 | (USDA, 2011) |
| | | oil | 1.00 | 0.21 | 884 | 0.0 | 100.0 | 0.0 | 75.0 | 0 | 0 | 0 | (USDA, 2011) |
| | | cake | 0.89 | 0.79 | 382 | 50.5 | 1.0 | 41.7 | 44.6 | 88446 | 9743 | 24871 | (USDA, 2011) |
| Roots & tubers | potato + cassava (64.6%) | whole tuber/root | 0.32 | 1.00 | 387 | 6.1 | 0.6 | 90.3 | 40.6 | 7208 | 1546 | 12450 | (USDA, 2011) |
| Oil palm | single species | whole fruit | 0.60 | 1.00 | 345 | 2.4 | 37.8 | 8.1 | 53.0 | 9260 | 1386 | 11685 | (Fairhurst and Hardter, 2003) |
| | | fruit oil | 1.00 | 0.33 | 884 | 0.0 | 100.0 | 0.0 | 75.0 | 0 | 0 | 0 | (USDA, 2011) |
| | | kernel oil | 1.00 | 0.04 | 884 | 0.0 | 100.0 | 0.0 | 75.0 | 0 | 0 | 0 | (USDA, 2011) |
| | | kernel cake | 0.90 | 0.04 | 355 | 62.8 | 7.4 | 8.1 | 48.9 | 113289 | 19514 | 26455 | (Fairhurst and Hardter, 2003) |
| | | others | 0.47 | 0.59 | 0 | 0.0 | 0.0 | 0.0 | 39.2 | 8530 | 1113 | 18201 | (Fairhurst and Hardter, 2003) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other oils | rapeseed + sunflower (82.6%) | whole grains | 0.90 | 1.00 | 537 | 18.2 | 47.7 | 8.8 | 60.4 | 38920 | 6791 | 9669 | (USDA, 2012, Assadi et al., 2011, Earle et al., 1968, Newkirk, 2009) |
| | | oil | 1.00 | 0.47 | 884 | 0.0 | 100.0 | 0.0 | 75.0 | 0 | 0 | 0 | (USDA, 2011) |
| | | cake | 0.80 | 0.44 | 277 | 41.4 | 1.6 | 19.9 | 48.9 | 87821 | 15189 | 20645 | (Earle et al., 1968, Newkirk, 2009) |
| | | others | 0.90 | 0.09 | 0 | 0.0 | 0.0 | 0.0 | 40.3 | 3100 | 1200 | 6500 | (USDA, 2012) |
| Pulses | groundnut + beans (58.2%) | whole grains (no shells for GN) | 0.90 | 1.00 | 486 | 24.2 | 31.6 | 33.2 | 54.3 | 42507 | 3891 | 9586 | (USDA, 2011) |
| Poultry & other birds | chicken (88.0%) | whole body | 0.39 | 1.00 | 412 | 43 | 31 | 2 | 62 | 88367 | 22282 | 5541 | (USDA, 2011, Hurwitz and Plavnik, 1986, Field et al., 1974) |
| | | carcass w/o bones | 0.34 | 0.48 | 623 | 54.7 | 44.3 | 0.0 | 59.5 | 87504 | 4322 | 5557 | (USDA, 2011) |
| | | ophal | 0.25 | 0.23 | 487 | 71.2 | 17.8 | 7.2 | 51.7 | 113840 | 9073 | 7839 | (USDA, 2011) |
| | | bones+feathers | 0.60 | 0.29 | 0 | 0.0 | 18.0 | 0.0 | 75.0 | 69864 | 62534 | 3716 | (Field et al., 1974) |
| Eggs | hen eggs (92.4%) | whole egg | 0.31 | 1.00 | 528 | 46 | 35 | 3 | 56 | 74630 | 7486 | 5103 | (USDA, 2011, Schaafsma et al., 2000) |
| | | fill | 0.24 | 0.88 | 600 | 52.7 | 39.9 | 3.0 | 58.5 | 84260 | 8302 | 5786 | (USDA, 2011) |
| | | shell | 0.85 | 0.12 | 0 | 0.0 | 0.0 | 0.0 | 34.7 | 4010 | 1500 | 90 | (USDA, 2011, Schaafsma et al., 2000) |
| Pork meat | single species | whole body | 0.51 | 1.00 | 604 | 24 | 60 | 0 | 58 | 48230 | 13821 | 5212 | (USDA, 2011, Field et al., 1974) |
| | | carcass w/o bones | 0.50 | 0.59 | 749 | 27.7 | 69.9 | 0.0 | 67.0 | 44361 | 3089 | 5043 | (USDA, 2011) |
| | | ophal+blood | 0.43 | 0.23 | 705 | 34.8 | 61.5 | 0.0 | 64.9 | 55757 | 4637 | 6909 | (USDA, 2011) |
| | | bones | 0.63 | 0.18 | 0 | 0.0 | 27.6 | 0.0 | 20.7 | 51292 | 60729 | 3600 | (Field et al., 1974) |
| Beef, mutton, goat | cattle (73.2%) | whole body | 0.46 | 1.00 | 395 | 30 | 40 | 0 | 46 | 56720 | 16367 | 3761 | (Warriss, 2010) |
| | | carcass w/o bones | 0.44 | 0.34 | 681 | 40.5 | 56.3 | 0.0 | 63.3 | 64839 | 3603 | 6247 | (USDA, 2011, Warriss, 2010) |
| | | ophal+blood | 0.41 | 0.24 | 680 | 36.9 | 57.9 | 0.0 | 64.1 | 58981 | 7978 | 6821 | (USDA, 2011, Warriss, 2010) |
| | | hide | 0.63 | 0.10 | 0 | 71.4 | 28.6 | 0.0 | 55.0 | 114286 | 0 | 0 | (USDA, 2011, Warriss, 2010) |
| | | bones | 0.68 | 0.19 | 0 | 0.0 | 22.9 | 0.0 | 17.2 | 47849 | 69615 | 0 | (Field et al., 1974) |
| | | gut content (waste) | 0.20 | 0.13 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0 | 0 | (USDA, 2011, Warriss, 2010) |
| Milk all species | cow milk (83.5%) | whole milk | 0.13 | 1.00 | 514 | 26.5 | 27.5 | 40.3 | 52.2 | 4246 | 708 | 1112 | (USDA, 2011) |

**Supplementary table 3.** Geographical variability of nutrient:energy and nutrient:protein ratios for maize, wheat, rice, soybean and hen eggs based on existing nutritional reports (Argentina: Closa & Landeta, 2010; East Asia: Leung et al., 1972; Brazil: NEPA-UNICAMP, 2011; Canada: Health Canada, 2010; Africa: Leung et al. 1968; Denmark: National Food Institute, 2009, US: USDA, 2011). Note that all values correspond to the edible fraction of the products, which is the most commonly reported figure in nutritional surveys (i.e. rice hulls or egg shells are not considered). Values used in this study correspond to the US.

| | | energy mg Kcal-1 | | | protein mg g-1 | |
|---|---|---|---|---|---|---|
| | | **N** | **P** | **K** | **P** | **K** |
| Maize | Argentina | 4.39 | 0.81 | 0.92 | 29.5 | 33.5 |
| | East Asia | 4.17 | 0.70 | 0.81 | 26.9 | 31.2 |
| | Brazil | 3.26 | 0.31 | 0.48 | 15.0 | 23.3 |
| | Canada | 4.12 | 0.58 | 0.79 | 22.3 | 30.5 |
| | Africa | 4.40 | 0.60 | NA | 21.9 | NA |
| | US | 4.10 | 0.58 | 0.79 | 22.0 | 30.0 |
| | **Mean** | **4.07** | **0.60** | **0.76** | **22.9** | **29.7** |
| | **SD** | **0.42** | **0.17** | **0.17** | **5.0** | **3.8** |
| Wheat | Argentina | 5.72 | 0.96 | 1.02 | 26.9 | 28.6 |
| | East Asia | 5.62 | 1.16 | 1.52 | 32.9 | 43.1 |
| | Canada | 6.17 | 0.88 | 1.11 | 22.9 | 28.8 |
| | Denmark | 4.98 | 0.79 | 1.12 | 25.4 | 35.9 |
| | US | 6.20 | 1.12 | 1.18 | 31.0 | 33.0 |
| | **Mean** | **5.74** | **0.98** | **1.19** | **27.81** | **33.89** |
| | **SD** | **0.50** | **0.16** | **0.19** | **4.11** | **5.98** |
| Rice | Mexico | 3.24 | 0.62 | 0.58 | 30.8 | 28.5 |
| | East Asia | 3.44 | 0.69 | 0.57 | 32.4 | 26.6 |
| | Brazil | 3.24 | 0.70 | 0.48 | 34.4 | 23.7 |
| | Canada | 3.42 | 0.90 | 0.60 | 42.2 | 28.2 |
| | Denmark | 3.91 | 1.01 | 0.68 | 41.1 | 27.9 |
| | Africa | 3.63 | 0.70 | NA | 30.9 | NA |
| | US | 3.31 | 0.73 | 0.66 | 35.2 | 35.7 |
| | **Mean** | **3.46** | **0.76** | **0.60** | **35.27** | **28.44** |
| | **SD** | **0.24** | **0.14** | **0.07** | **4.66** | **3.99** |
| Soybean | Argentina | 13.81 | 1.24 | 5.01 | 14.4 | 58.0 |
| | East Asia | 14.04 | 1.37 | 3.76 | 15.6 | 42.8 |
| | Brazil | 13.39 | 1.25 | 2.63 | 14.9 | 31.4 |
| | Canada | 13.09 | 1.58 | 4.03 | 19.3 | 49.2 |
| | Denmark | 13.94 | 1.14 | 4.07 | 13.0 | 46.8 |
| | US | 14.00 | 1.58 | 4.03 | 19.0 | 49.0 |
| | **Mean** | **13.71** | **1.36** | **3.92** | **16.0** | **46.2** |
| | **SD** | **0.38** | **0.19** | **0.76** | **2.5** | **8.8** |
| Hen egg | Argentina | 12.31 | 1.37 | 0.88 | 17.8 | 11.5 |
| | East Asia | 12.66 | 1.36 | 1.08 | 17.2 | 13.6 |
| | Brazil | 14.55 | 1.15 | 1.05 | 12.6 | 11.5 |
| | Canada | 13.02 | 0.87 | 0.79 | 10.7 | 9.7 |
| | Denmark | 14.20 | 1.48 | 0.92 | 16.7 | 10.3 |
| | Africa | 13.49 | 1.43 | NA | 16.9 | 0.0 |
| | US | 14.10 | 1.38 | 0.96 | 15.7 | 11.0 |
| | **Mean** | **13.47** | **1.29** | **0.95** | **15.37** | **9.67** |
| | **SD** | **0.85** | **0.21** | **0.11** | **2.68** | **4.44** |

**Supplementary table 4**. Global nutrient fluxes associated with food production in croplands. Nutrients withdrawn by crops considered the elemental pools embedded in harvested plant materials and divided them into food and non-food (e.g. energy, wastes) supply to human and feed supply to livestock. The total flux of nutrients withdrawn from livestock systems are divided into food and non-food (e.g. bones, leather) supply and the fraction of the withdrawal coming from landless systems is indicated. Total additions of mineral nutrients to the food system are divided into fertilizer for crops that supply humans or livestock and direct mineral supplementation of livestock. Three levels of recycling of nutrients from the livestock production system back to croplands are assumed based on the fraction of feed entering landless vs. land based systems and the relative rate of recycling of each system. A global balance (fertilization – harvest + recycling) considering each recycling assumption is presented. In the case of N, crop withdrawals including biological fixation contributions are presented in brackets.

| Component | | N | P | K |
|---|---|---|---|---|
| | | (Tg yr-1) | | |
| Crop withdrawal | Total | 53.7 (69.6) | 11.6 | 28.0 |
| | human supply (non-food) | 7.7 (8.3) | 1.8 | 8.2 |
| | human supply (food) | 24.7 (27.0) | 4.9 | 10.1 |
| | livestock supply | 21.2 (34.2) | 5.0 | 9.7 |
| Livestock withdrawal | Total | 13.6 | 3.6 | 1.7 |
| | human supply (non-food) | 2.9 | 2.4 | 0.1 |
| | human supply (food) | 10.8 | 1.2 | 1.6 |
| | fraction from landless systems | 0.3 | 0.3 | 0.2 |
| Additions | Total | 103.5 | 18.8 | 21.3 |
| | fertilization | 103.5 | 17.4 | 21.3 |
| | livestock supplementation | <0.1 | 1.4 | 0.0 |
| Livestock to crop recycling | Low | 0.0 | 0.0 | 0.0 |
| | Medium | 6.8 | 0.9 | 2.1 |
| | High | 22.6 | 3.4 | 7.4 |
| Balance | Low | 49.8 | 7.2 | -6.7 |
| | Medium | 56.6 | 8.1 | -4.6 |
| | High | 72.4 | 10.6 | 0.7 |

**Supplementary information**

**Geographical variation of nutritional and elemental composition -** In order to explore the variability of the nutritional and elemental composition of crops across the globe and their potential influence on our calculations, we compared the values reported by the USDA Nutrient Database for Standard Reference with data reported by different national and regional initiatives for Argentina, Brazil, Canada, Denmark, Mexico, East Asia and Africa (see supplementary information table 3). We focused on four dominant crops (wheat, maize, rice and soybean) and one animal item (chicken eggs) in order to describe the range of variation within species and compare it with the values applied to our analysis. The majority of the databases report only edible components and this is what we compared in this section as opposed to the rest of our analysis (see supplementary information table 3). This analysis revealed larger differences across than within crop species and showed that the values reported by the USDA offered a good representation of the values reported in other countries. Based on these findings we focused our work on the USDA database, which is the most complete of all the international databases that we examined.

**Global nutrient balances** - We performed N, P and K balances for croplands, excluding nutrient withdrawals from other productive systems such as pastures, rangelands or forests. Global food outputs considered total animal production values regardless of their reliance on crops, yet to estimate livestock to crop recycling, we discriminated the production and nutrient withdrawals derived from landless vs. land-based systems adapting existing global estimates (Steinfeld et al., 2006). We assumed two alternative global energy conversion efficiencies of feed to animal products (feed:food) of 10:1 and 14:1 (Bradford et al., 1999) and assumed that landless systems relied completely on crops, ignoring any hay inputs. After covering landless animal requirements with the fraction of crops allocated to feed, we obtained a leftover that was allocated to land based mixed systems and represented 21 and 47% when the low and high conversion efficiencies were applied. Based on these extreme figures, mixed systems obtain 9.5 or 28% of their energy supply from crops and the rest from stubbles, pastures or rangelands. In the case of P mineral supplements to livestock, we assumed that they were completely allocated to landless systems (half to poultry and half to pork production). With these figures, we were able to estimate the total nutrient intake of animals in landless and land-based mixed systems. By discounting animal-embedded nutrients from this intake, we obtained net excretion fluxes and used alternative criteria to allocate a fraction of those fluxes to recycling. We assumed null recycling as a lowest boundary for our balances. An intermediate recycling criterion assumed that all excretion from land based systems was recycled but none from landless, considering the highest energy efficiency (10:1) and hence the lowest total excretion figures. A high recycling criterion assumed that all land based and half of the landless livestock excretions were recycled, considering the lowest energy efficiency (14:1) and hence the highest total excretion figures. Total balances resulted from the sum of fertilization and recycling (three alternatives) minus crop withdrawals fluxes.

Global nutrient balances for the triennium 2008-2010 were large and positive for N (48 to 70% of fertilizer application after discounting biological fixation), followed by P (38 to 56% of fertilizer application), and K (-31 to 3% of fertilizer)(supplementary table 4). On average across the globe, these figures represent an excess of fertilization over withdrawals of ~38.8-56.4 and ~5.6-8.2 Kg $Ha^{-1}$ $yr^{-1}$ for N and P, respectively, and deficits of ~5.2 up to excess of just 0.6 Kg $Ha^{-1}$ $yr^{-1}$ for K. The exact influence of livestock recycling making these balances more positive is uncertain. The alternative computations of recycling suggested that its overall impact on final nutrient balances is up to 22, 19 and 35% of fertilization for N, P, and K (Supplementary Table 4). Noticeably, the allocation of crop nutrients to livestock (49, 43 and 35 % of harvested N after including biological fixation, P, and K, respectively) exceeded the allocation of crop energy (28%) as a result of a bias towards nutrient-rich items.

We also calculated a range of global feed:livestock nutrient conversion efficiencies, which are of key importance to assess the magnitude of nutrient savings that can be achieved through the reduction of our animal product consumption. If we assume a range of global feed:livestock energy conversion efficiencies of 10:1 to 14:1 (Bradford et al., 1999) and consider the total amount of energy from crops that is used as feed and the amount of energy that is embedded in livestock, we find that 30 to 45% of total livestock outputs should be derived from crops. Based on these figures, feed:livestock nutrient conversion efficiencies would be 5.6:1 to 8.4:1 for N (considering biologically fixed N in feed), 3.9:1 to 5.9:1 for P (considering mineral supplementation in feed), and 12.7:1 to 19.0:1 for K. The fraction of feed nutrients that does not end up embedded in harvested livestock products is, in its majority, lost through urine (most important for N and K) and dung (most important for P) and recycled to croplands only to a partial degree and more intensely in land-based mixed systems than in landless ones.

## References


ASSADI, E., JANMOHAMMADI, H., TAGHIZADEH, A. & ALIJANI, S. 2011. Nutrient composition of different varieties of full-fat canola seed and nitrogen-corrected true metabolizable energy of full-fat canola seed with or without enzyme addition and thermal processing. *The Journal of Applied Poultry Research,* 20**,** 95-101.

BALAT, M. & BALAT, H. 2009. Recent trends in global production and utilization of bio-ethanol fuel. *Applied Energy,* 86**,** 2273-2282.

BRADFORD, E., BALDWIN, R., BLACKBURN, H., CASSMAN, K., CROSSON, P., DELGADO, C., FADEL, J., FITZHUGH, H., GILL, M. & OLTJEN, J. 1999. Animal agriculture and global food supply. *Task Force Rep.* Ames, IA: Council for Agricultural Science and Technology.

EARLE, F., VANETTEN, C., CLARK, T. & WOLFF, I. 1968. Compositional data on sunflower seed. *Journal of the American Oil Chemists' Society,* 45**,** 876-879.

FAIRHURST, T. & HARDTER, R. 2003. *Oil palm: Management for Large and Sustainable Yields,* Norcorss, GA, Potash and Phosphate Institute.

FAO. 2012. *FAOSTAT database* [Online]. Available: http://faostat.fao.org [Accessed March 2012].

FIELD, R., RILEY, M., MELLO, F., CORBRIDGE, J. & KOTULA, A. 1974. Bone composition in cattle, pigs, sheep and poultry. *Journal of Animal Science,* 39**,** 493-499.

HEFFER, P. 2009. Assessment of fertilizer use by crop at the global level. Paris, France: International Fertilizer Industry Association.

HOUSTON, D. F. & KOHLER, G. 1970. Nutritional properties of rice. Washington DC: National Academy of Sciences.

HURWITZ, S. & PLAVNIK, I. 1986. Carcass minerals in chickens (Gallus domesticus) during growth. *Comparative Biochemistry and Physiology Part A: Physiology,* 83**,** 225-227.

INTERNATIONAL, S. 2008. Animal Feeds: Phosphate Supplements. *Chemical Economics Handbook.* Menlo Park, CA: SRI International.

LICHT, F. O. 2010. World ethanol and biofuels report. Kent, UK: Agra Informa Ltd.

MENA, A. 1987. The utilization of sugar cane by products as substitutes for cereal in Animal Feed. *FAO publications.* Rome, Italy: FAO.

MORAND, A., BROWN, M. & CASTEN, T. 2004. Bagasse Cogeneration--Global Review and Potential. Edinburgh, UK: World alliance for decentralized energy.

NEWKIRK, R. 2009. Canola meal feed industry guide. Winnipeg, Canada: Canadian International Grains Institute.

NJIE, D. 2007. Energy generation from rice residues-a review of technological options, opportunities and challenges. *International Rice Commission Newsletter,* 56**,** 33-43.

PATE, F. M., ALVAREZ, J., PHILLIPS, J. & EILAND, B. 1984. *Sugarcane as a cattle feed: production and utilization*, Florida, US, Agricultural Experiment Stations, Institute of Food and Agricultural Sciences, University of Florida.

RANGNEKAR, D. V. 1988. Integration of sugarcane and milk production in western India. *FAO publications.* Rome, Italy: FAO.

SCHAAFSMA, A., PAKAN, I., HOFSTEDE, G., MUSKIET, F., VAN DER VEER, E. & DE VRIES, P. 2000. Mineral, amino acid, and hormonal composition of chicken eggshell powder and the evaluation of its use in human nutrition. *Poultry Science,* 79**,** 1833-1838.

SHAPOURI, H., DUFFIELD, J. A. & WANG, M. 2002. The energy balance of corn ethanol: an update. *Agricultural Economics Reports*.

STEINFELD, H., GERBER, P., WASSENAAR, T., CASTEL, V., ROSALES, M. & DE HAAN, C. 2006. *Livestock's long shadow: Environmental issues and options,* Rome, Italy, FAO.

USDA. 2011. *USDA National Nutrient Database for Standard Reference* [Online]. Available: http://ndb.nal.usda.gov/ [Accessed March 2012].

USDA. 2012. *USDA plants database* [Online]. Available: http://plants.usda.gov [Accessed March 2012].

WARRISS, P. D. 2010. *The growth and body composition of animals*, Cambridge University Press.