Supporting information for Food waste and its associated environmental impacts of workplace buffet-style canteens in Beijing, China

**Table. S1. Parameters of cooked food to agricultural products**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Item**  **(kg/kg)** | **Staple food** | **vegetable** | **meat** | **Sea**  **food** | **eggs** | **soy food** | **nuts** | **fruits** | **Data**  **sources** |
| P1 | 1.50 | 0.93 | 0.73 | 0.85 | 1 | 5 | 1 | 1 | [1-2]; Own estimation |
| P2 | 1.40 | 1.5 | 1.87 | 1.18 | 1.18 | 0.75 | 1 | 1 | [3] |

**Note:** P1 is the conversion factor of cooked food to raw food. P2 is the conversion factor of the raw food equivalent to agricultural products.

**Table. S2. Parameters about ecological footprint of food waste in Beijing** [4]

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Average productivity of land used to produce *i* food Y*i* /(kg/hm2)** | **Land type** | **equivalence factor of *j* productive land R*j*** |
| Rice | 7133.91 | farmland | 1.32 |
| Wheat | 5957.41 | farmland | 1.49 |
| Other cereals | 6697.70 | farmland | 1.32 |
| Beans | 1600.19 | farmland | 0.83 |
| Vegetables | 58756.01 | farmland | 1.38 |
| Pork | 2992.82 | farmland | 1.59 |
| Beef | 11613.66 | farmland | 1.59 |
| 39.14 | grassland | 0.71 |
| Mutton | 16017.37 | farmland | 1.59 |
| 33.58 | grassland | 0.71 |
| Poultry | 3869.26 | farmland | 1.59 |
| Other meats | 3431.04 | farmland | 1.59 |
| Seafood | 9651.33 | Water | 0.48 |
| Eggs | 3531.92 | farmland | 1.59 |
| Nuts | 1044.91 | Forest | 2.36 |
| Fruits | 16757.19 | Forest | 0.74 |

Notes: In our research, we aggregated the 14 categories of food into 8 categories: staple food, vegetables, meats, sea food, eggs, soy food, nuts and fruits. The Y*i* and R*j* of staple food is the average of rice, wheat and other cereals; The Y*i* and R*j* of meats is the average of pork, beef, mutton, poultry and other meats.

**Table. S3. Water footprint of food waste per unit in Beijing (m3/kg)** [5]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Cereals** | **Beans** | **Vegetables** | **Pork/ Beef/ Mutton** | **Poultry** |
| 1.19 | 2.20 | 0.19 | 14.37 | 3.50 |
| **Egg** | **Seafood** | **Fruits** | **Tea-leaves** |  |
| 2.90 | 5.00 | 0.51 | 1.81 |  |

Notes: In our research, we aggregated the 9 categories of food into 8 categories: staple food, vegetables, meats, sea food, eggs, soy food, nuts and fruits. The carbon footprint of staple food is the cereals; the carbon footprint of meats is the average of pork/beef/mutton and poultry; the carbon footprint of nuts is the carbon footprint of tea-leaves.

**Table. S4. Carbon footprint of food waste per unit in Beijing (kgCO2eq/kg)** [6]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Rice** | **Wheat** | **Other Cereals** | **Beans** | **Vegetables** | **Pork** |
| 3.56/3.98 | 2.87/3.30 | 2.88/3.30 | 3.22/3.64 | 2.65/3.04 | 7.30/7.70 |
| **Beef** | **Mutton** | **Poultry** | **Other meat** | **Seafood** | **Egg** |
| 26.22/26.62 | 32.12/32.52 | 6.55/6.95 | 25.62/26.03 | 3.45/3.83 | 4.97/5.38 |

Notes: In our research, we aggregated the 12 categories of food into 8 categories: staple food, vegetables, meats, sea food, eggs, soy food, nuts and fruits. The carbon footprint of staple food is the average of rice, wheat and other cereals; the carbon footprint of meats is the average of pork, beef, mutton, poultry and other meat; the carbon footprint of nuts and fruits is the carbon footprint of all plant food.

**Table. S5. The nitrogen contents of different food ((N*i*，kg/kg)** [7]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rice** | **Wheat** | **Other Cereals** | **Beans** | **Vegetables** | **Nuts** | **Fruit** |
| 0.0124 | 0.0215 | 0.0188 | 0.0586 | 0.0043 | 0.027 | 0.0017 |
| **Pork** | **Beef** | **Mutton** | **Poultry** | **Other Meat** | **Seafood** | **Egg** |
| 0.0240 | 0.0250 | 0.0230 | 0.0240 | 0.0240 | 0.0218 | 0.0168 |

Notes: In our research, we aggregated the 12 categories of food into 8 categories: staple food, vegetables, meats, sea food, eggs, soy food, nuts and fruits. The nitrogen content of staple food is the average of rice, wheat and other cereals; The nitrogen contents of meats is the average of pork, beef, mutton, poultry and other meat.

**Table. S6. The N budget and use efficiencies for different processes of food waste chain** [7]

|  |  |  |  |
| --- | --- | --- | --- |
| **Processes** | **N budgets** | **Methods** | **Parameters** |
| Final Disposal | The nitrogen contents of food *N* *food* | *Wfood waste×Ni* | See Table.S5. |
| Food Processing | The nitrogen loss during food processing *N**w-processing* | *N* *food*k1 | k1 = 0.36 |
| Food Production | The nitrogen loss related to farmland runoff *N**runoff* | *N* *crop-food* k2 | k2 =2.86 |
| The nitrogen loss related to farmland erosion *N**erosion* | *N* *crop-food* k3 | k3 =0.14 |
| The nitrogen accumulation in farmland *N**accumulation* | *N* *crop-food* k4 | k4 =0.14 |
| NH3 emissions from farmland | *N* *crop-food* k5 | k5 =2.71 |
| N2O emissions from farmland | *N* *crop-food* k6 | k6 =0.14 |
| N2 emissions from farmland | *N* *crop-food* k7 | k7 =2.29 |
| NH3 emissions from livestock | *N* *livestock* k8 | k8 =5.50 |
| N2O emissions from livestock | *N* *livestock* k9 | k9 =0.25 |
| N2 emissions from livestock | *N* *livestock* k10 | k10 =1.00 |
| N emissions from livestock’s manure waste *N**manure-waste* | *N* *livestock* k11 | k11 =7.50 |
| The usage of fertilizer *N**u-fertilizer* | *N* *crop-food* k12 | k12 =8.71 |
| Fertilizer Production | The nitrogen loss related to fertilizer production *N**w-fertilizer* | *N* *u-fertilizer* k13 | k13 =0.15 |

Notes: In our research, the crop food include staple food, vegetables, soy food, nuts and fruits; the livestock include meats, eggs and sea food.

**Table. S7. The phosphorus contents of different food (P*i*，kg/kg)** [8]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Rice** | **Wheat** | **Other Cereals** | **Beans** | **Vegetables** | **Nut** | **Fruit** |
| 0.00254 | 0.00381 | 0.00314 | 0.00605 | 0.00063 | 0.00414 | 0.00025 |
| **Pork** | **Beef** | **Mutton** | **Poultry** | **Other Meat** | **Seafood** | **Egg** |
| 0.00560 | 0.0021 | 0.0016 | 0.00150 | 0.00176 | 0.00256 | 0.00260 |

Notes: In our research, we aggregated the 12 categories of food into 8 categories: staple food, vegetables, meats, sea food, eggs, soy food, nuts and fruits. The phosphorus content of staple food is the average of rice, wheat and other cereals; The phosphorus contents of meats is the average of pork, beef, mutton, poultry and other meat.

**Table. S8. The P budget and use efficiencies for different processes of food waste chain** [8]

|  |  |  |  |
| --- | --- | --- | --- |
| **Processes** | **P budgets** | **Methods** | **Parameters** |
| Final Disposal | The phosphorus contents of food *P* *food* | *Wfood waste×Pi* | See Table. S7. |
| Food Processing | The phosphorus loss during food processing *P**w-processing* | *P* *food*k1 | k1 = 0.36 |
| Food Production | The phosphorus loss related to farmland runoff *P**runoff* | *P* *crop-food* k2 | k2 =0.18 |
| The phosphorus loss related to farmland erosion *P**erosion* | *P* *crop-food* k3 | k3 =0.45 |
| The phosphorus accumulation in farmland *P**accumulation* | *P* *crop-food* k4 | k4 =4.15 |
| P emissions from livestock’s manure waste *P**manure-waste* | *P* *livestock* k5 | k11 =18.00 |
| The usage of fertilizer *P**u-fertilizer* | *P crop-food* k6 | k6 =6.23 |
| Fertilizer Production | The phosphorus loss related to fertilizer production *P**w-fertilizer* | *P* *u-fertilizer* k7 | k7 =0.15 |

Notes: In our research, the crop food include staple food, vegetables, soy food, nuts and fruits; the livestock include meats, eggs and sea food.

**Table** **S9 Comparison of food waste between our study and other ones across the world**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Wasted food**  **g/cap/meal** | **consumers** | **Description** | **Source** |
| China | 56 | Cadres and staff | Buffet, a total of 656 samples were surveyed in 4 workplace canteens in Beijing, included breakfast, lunch and dinner, adopted direct weighing | This study |
| China | 61 | University students | Non-buffet, a total of 9192 samples were surveyed in Chinese 29 university canteens across 29 provinces, considered only lunch and dinner, adopted direct weighing | [9] |
| China | 77 | University students | Non-buffet, a total of 1612 samples were surveyed in 7 university canteens in Wuhan, considered only lunch and dinner, adopted direct weighing | [10] |
| China | 74 | University students | Non-buffet, a total of 551 samples were surveyed in 6 university canteens in Beijing, considered only lunch and dinner, adopted direct weighing | [11] |
| China | 130 | Students | Buffet and non-buffet, a total of 998 samples were surveyed at lunch time in 6 schools in Beijing, adopted weighing | [12] |
| China | 116 | Tourists and local residents | Buffet, a total of 360 meals were surveyed in a restaurant in Taiwan, adopted weighing | [13] |
| China | 93 | Tourists and local residents | Non-buffet, a total of 3145 tables were surveyed in 195 restaurants in four cities (Beijing, Shanghai, Lhasa, Chengdu), adopted direct weighing | [14] |
| China | 74 | Tourists and local residents | Non-buffet, a total of 2564 dining-tables were surveyed in 124 restaurants in Beijing, adopted direct weighing | [7] |
| Portugal | 69 | Staff in Municipality | Non-buffet, a total of 160 meals were surveyed at Lunch time in A workplace in North of Portugal, adopted direct weighing | [15] |
| France | 73 | Staff and university students | Buffet, a total of 479 meals were surveyed at Lunch time in a workplace cafeteria, weighing | [16] |
| Portugal | 76.5 | University students | Non-buffet, a total of 2871 meals were surveyed at Lunch time in A university’s canteen in Lisbon, direct weighing | [17] |
| United States | 78 | University students | Buffet, surveyed at lunch time in 2 University’s dining halls in Champaign, adopted direct weighing | [18] |
| United States | 233 | Students and Faculty | Non-buffet, surveyed at Lunch time in a private school located in Columbia, adopted direct weighing | [19] |
| Italy | 141 | Students | Non-buffet, surveyed in 18 school in Cento, Visual assessment | [20] |
| Sweden | 25 | Students | Buffet, a total of 2939 meals were surveyed at Lunch time in 14 schools in Sala, weighing | [21] |
| United Kingdom | 155 | Tourists and local residents | Non-buffet, a total of 4668 guests were surveyed in an ethnic food restaurant in UK, adopted weighing | [22] |
| Iraq | 38 | Tourists and local residents | surveyed in 18 restaurants in four cities（Babel、Tikrit、Mosul and Al-Muthanna, direct weighing | [23] |
| Thailand | 35.1 | Tourists and local residents | Non-buffet, a total of178 guests were surveyed in one restaurant in Chiang Rai, direct weighing | [24] |

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