

Supplemental Material

Table S1. Main biological production data for Guyuan that were used to calculate the equivalence factors in 1998.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	248,131	16,139	400,458,1246	Cultivated land
Barley	2916	16,206	47,256,288	Cultivated land
Other grains	3760	15,800	59,409,504	Cultivated land
Legumes	27,577	17,138	472,614,626	Cultivated land
Rice	1908	15934	30,402,377	Cultivated land
Maize	163,480	16,444	2,688,284,738	Cultivated land
Millet	5089	15,800	80,408,236	Cultivated land
Sorghum	540	15,800	8,532,216	Cultivated land
Buckwheat	5343	15,800	84,421,537	Cultivated land
Millet	17,012	15,800	268,796,405	Cultivated land
Soybean	1760	21,025	3,7004,704	Cultivated land
Potato	172,571	5710	985,359,702	Cultivated land
Oilseed rape	185	26,334	4,871,790	Cultivated land
Flax	36,056	15,906	573,515,389	Cultivated land
Hemp	180	21,766	3,917,957	Cultivated land
Sunflower (<i>Helianthus</i>) seeds	5439	41,859	227,668,490	Cultivated land
Hemp	305	14,463	4,411,154	Cultivated land
Sugar beet	109,858	2792	306,749,902	Cultivated land
Tobacco leaf	485	15,926	7,7240,13	Cultivated land
Medicinal herbs	327	17263	5,645,132	Cultivated land
Vegetables	144,824	1463	211,877,512	Cultivated land
Melons	85,514	1062	90,791,924	Cultivated land
Pork	12,914	25,038	323,343,315	Cultivated land
Beef	6238	13,731	85,655,849	Grassland
Mutton	3011	13,731	41,344,944	Grassland
Poultry meat	1250	6864	8,579,450	Cultivated land
Rabbit meat	15	5196	77,936	Grassland
Goat wool	73	5016	366,168	Grassland
Sheep wool	1032	5016	5,176,512	Grassland
Cashmere	21	5016	105,336	Grassland
Honey	158	20,959	3,311,446	Cultivated land
Eggs	4506	8791	39,610,173	Cultivated land
Bean pods	312	15,926	4,968,850	Cultivated land
Milk	138	2842	392,251	Grassland
Aquaculture products	630	5450	3,433,500	Water body
Apple	9847	1842	18,135,909	Forest
Pear	2100	2061	4,327,554	Forest
Chinese date (jujube)	17	5107	86,815	Forest
Grape	456	2260	1,030,724	Forest
Other fruits	9507	2203	20,942,590	Forest
Chinese wolfberry	489	18,360	8,978,040	Forest
Nuts	85	31,254	2,656,578	Forest
Pepper (spice)	26	10,800	280,787	Forest

Nursery stock	45,140	16,744	755,826,337	Forest
Wood	7.2003	12,310	88,636	Forest

Table S2. Local productivity and equivalence factors for land in Guyuan in 1998.

Land category	Total energy (GJ)	Total land area (ha)	Energy per unit area (GJ/ha)	Equivalence factor
Cultivated land	10,584,058	648,781	16.31376085	1.89
Grassland	133,119	514,779	0.258594459	0.03
Forest	812,354	169,183	4.801628829	0.56
Water body	3434	1247	2.75340818	0.32
Total land	11,532,965	1,333,990	8.645465515	1.00

Table S3. Main biological production data for Guyuan that were used to calculate the equivalence factors in 2013.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	153,081	16,139	2,470,571,197	Cultivated land
Other grains	285	15,800	4,503,114	Cultivated land
Maize	325,927	16,444	5,359,582,699	Cultivated land
Millet	869	15,800	13,730,548	Cultivated land
Oat	2435	15,800	38,473,974	Cultivated land
Buckwheat	5278	15,800	83,394,511	Cultivated land
Millet	2277	15,800	35,977,511	Cultivated land
Other legumes	8259	16,700	137,925,300	Cultivated land
Legumes	6880	16,700	114,896,000	Cultivated land
Soybean	195	21,025	4,099,953	Cultivated land
Potato	293,070	5710	1,673,394,532	Cultivated land
Flax	40604	15,906	645,856,969	Cultivated land
Sunflower (<i>Helianthus</i>) seeds	17410	41,859	728,756,833	Cultivated land
Tobacco leaf	1960	15,926	31,214,568	Cultivated land
Medicinal herbs	24,116	17,263	416,324,154	Cultivated land
Vegetables	1,656,142	1463	2,422,935,746	Cultivated land
Melons	41,299	1062	43,847,974	Cultivated land
Alfalfa	282,774	16,943	4,791,052,324	Cultivated land
Dogtail grass (<i>Cynosurus</i> spp.)	71,975	16,283	1,171,966,046	Cultivated land
Pork	14,783	25,038	370,139,711	Cultivated land
Poultry meat	4518	6864	31,009,564	Cultivated land
Eggs	5523	8791	48,550,152	Cultivated land
Beef	39,294	13,731	539,557,702	Grassland
Mutton	15,456	13,731	212,230,973	Grassland
Horse meat	11	13,731	151,044	Grassland
Mule meat	185	13,731	2,540,291	Grassland
Rabbit meat	431	6864	2,958,194	Grassland
Donkey meat	1421	13,731	19,512,177	Grassland
Milk	2826	2842	8,032,622	Grassland
Sheep wool	1599	5016	8,020,584	Grassland
Goat wool	86	5016	431,376	Grassland
Rabbit fur	1.89	5016	9480	Grassland
Honey	854	20,959	17,898,576	Cultivated land
Grapes	13	2260	29,385	Forest
Apple	9292	1842	17,113,727	Forest
Pear	2448	2061	5,044,692	Forest
Chinese date (jujube)	15	5107	76,601	Forest
Peach	3880	2153	8,352,476	Forest

Apricot	25,662	2203	56,529,793	Forest
Other fruits	1639	2203	3,610,488	Forest
Walnut	240	31,254	7,500,926	Forest
Wood	511,675	16,744	8,567,486,200	Forest
Aquaculture products	460	5450	2,507,000	Water body

Table S4. Local productivity and equivalence factors for the land in Guyuan in 2013.

Land category	Total energy (GJ)	Total land area (ha)	Energy per unit area (GJ/ha)	Equivalence factor
Cultivated land	20,656,102	355 100	58.16981683	1.72
Grassland	793,444	221 300	3.585379323	0.11
Forest	8,665,744	311 000	27.86412954	0.82
Water body	2507	458	5.47379913	0.16
Total land	30,117,798	887 858	33.92186328	1.00

Table S5. Main biological production data for Yuanzhou County of Guyuan that were used to calculate the yield factors in 2013.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	26183	16139	422566913	Cultivated land
Other grains	270	15800	4266108	Cultivated land
Maize	91007	16444	1496530029	Cultivated land
Millet	173	15800	2733469	Cultivated land
Buckwheat	631	15800	9970052	Cultivated land
Proso millet	213	15800	3365485	Cultivated land
Pea	1719	16700	28707300	Cultivated land
Potato	67512	5710	385485419	Cultivated land
Flaxseed	13012	15906	206971995	Cultivated land
Sunflower (<i>Helianthus</i>) seed	17005	41859	711804133	Cultivated land
Medical herbs	7600	17263	131201840	Cultivated land
Vegetables	852123	1463	1246655949	Cultivated land
Melon	16619	1062	17644725	Cultivated land
Alfalfa	61196	16943	1036846521	Cultivated land
Dogtail grass (<i>Cynosurus</i> spp.)	49875	16283	812112630	Cultivated land
Pork	2682	25038	67152452	Cultivated land
Poultry meat	2149	6864	14749790	Cultivated land
Egg	4079	8791	35856613	Cultivated land
Beef	7623	13731	104673610	Grassland
Mutton	5147	13731	70675001	Grassland
Horse meat	3	13731	41194	Grassland
Mule meat	30	13731	411939	Grassland
Rabbit meat	40	6864	274542	Grassland
Donkey meat	65	13731	892534	Grassland
Milk	2783	2842	7910399	Grassland
Sheep wool	591	5016	2964456	Grassland
Goat wool	21	5016	105336	Grassland
Honey	12	20959	251502	Cultivated land
Apple	3900	1842	7182903	Forest
Pear	246	2061	506942	Forest

Peach	270	2153	581229	Forest
Apricot	2022	2203	4454183	Forest
Wood	181700	16744	3042384800	Forest

Table S6. Local productivity and yield factors for the land in Yuanzhou County in 2013.

Land categories	Total energy (GJ)		Total land area (ha)		Energy per unit area (GJ/ha)		Yield factor
	Yuanzhou	Guyuan	Yuanzhou	Guyuan	Yuanzhou	Guyuan	
Cultivated land	6,634,872.926	20,656,102	123,500	355,100	53.723667	58.16981683	0.92
Grassland	187,949.102	793,444	92,600	221,300	2.0296879	3.585379323	0.57
Forest	3,055,110.057	8,665,744	52,500	311,000	58.192573	27.86412954	2.09

Table S7. Main biological production data for Xiji County of Guyuan that were used to calculate the yield factors in 2013.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	58,843	16,139	949,666,000	Cultivated land
Maize	46,621	16,444	766,641,319	Cultivated land
Millet	690	15,800	10,902,276	Cultivated land
Oat	1940	15,800	30,652,776	Cultivated land
Buckwheat	3842	15,800	60,705,137	Cultivated land
Proso millet	1200	15,800	18,960,480	Cultivated land
Pea	4656	16,700	77,755,200	Cultivated land
Potato	158,597	5710	905,569,838	Cultivated land
Flaxseed	16,959	15,906	269,753,924	Cultivated land
Medical herbs	221	17,263	3,815,211	Cultivated land
Vegetables	510,460	1463	746,802,980	Cultivated land
Alfalfa	183,778	16,943	3,113,758,740	Cultivated land
Pork	4041	25,038	101,179,366	Cultivated land
Poultry meat	511	6864	3,507,279	Cultivated land
Egg	787	8791	6,918,155	Cultivated land
Beef	9385	13,731	128,868,251	Grassland
Mutton	3488	13,731	47,894,774	Grassland
Mule meat	18	13,731	247,163	Grassland
Rabbit meat	338	6864	2,319,883	Grassland
Donkey meat	854	13,731	11,726,530	Grassland
Sheep wool	391	5016	1,961,256	Grassland
Goat wool	6	5016	30,096	Grassland
Honey	140	20,959	2,934,193	Cultivated land
Apple	1195	1842	2,200,915	Forest
Pear	352	2061	725,380	Forest
Peach	270	2153	581,229	Forest
Apricot	2460	2203	5,419,036	Forest
Wood	81,475	16,744	1,364,217,400	Forest
Aquaculture products	460	5450	2,507,000	Water body

Table S8. Local productivity and yield factors for the land in Xiji County in 2013.

Land categories	Total energy (GJ)		Total land area (ha)		Energy per unit area (GJ/ha)		Yield factor
	Xiji	Guyuan	Xiji	Guyuan	Xiji	Guyuan	
Cultivated land	7069523	20656102	115400	355100	61.26103	58.16981683	1.05
Grassland	193048	793444	50300	221300	3.8379315	3.585379323	1.07
Forest	1373144	8665744	91800	311000	14.957995	27.86412954	0.54
Water body	2507	2507	458	458	5.4737991	5.4737991	1

Table S9. Main biological production data for Longde County of Guyuan that were used to calculate the yield factors in 2013.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	19939	16139	321795122	Cultivated land
Other grains	15	15800	237006	Cultivated land
Maize	27247	16444	448052938	Cultivated land
Millet	6	15800	94802	Cultivated land
Buckwheat	185	15800	2923074	Cultivated land
Proso millet	77	15800	1216631	Cultivated land
Other legumes	3874	16700	64695800	Cultivated land
Pea	378	16700	6312600	Cultivated land
Potato	36440	57108	208068027	Cultivated land
Flaxseed	5985	15906	95198846	Cultivated land
Sunflower (<i>Helianthus</i>) seed	75	41859	3139389	Cultivated land
Medical herbs	12400	17263	214066160	Cultivated land
Vegetables	107100	1463	156687300	Cultivated land
Melon	7000	1062	7432040	Cultivated land
Alfalfa	11900	16943	201622224	Cultivated land
Pork	4091	25038	102431276	Cultivated land
Poultry meat	424	6864	2910149	Cultivated land
Egg	263	8791	2311912	Cultivated land
Beef	4691	13731	64413528	Grassland
Mutton	886	13731	12165932	Grassland
Horse meat	3	13731	41194	Grassland
Mule meat	115	13731	15790100	Grassland
Rabbit meat	12	6864	82363	Grassland
Donkey meat	246	13731	3377900	Grassland
Milk	43	2842	122223	Grassland
Sheep wool	60	5016	300960	Grassland
Goat wool	3	5016	15048	Grassland
Honey	2	20959	41917.04	Cultivated land
Apple	700	1842	1289239	Forest
Pear	610	2061	1257051	Forest
Apricot	300	2203	660858	Forest
Walnuts	60	31254	1875232	Forest

Table S10. Local productivity and yield factors for the land in Longde County in 2013.

Land categories	Total energy (GJ)		Total land area (ha)		Energy per unit area (GJ/ha)		Yield factor
	Longde	Guyuan	Longde	Guyuan	Longde	Guyuan	

Cultivated land	1839237	20656102	30900	355100	59.52224	58.16981683	1.02
Grassland	82098	793444	9300	221300	8.8277685	3.585379323	2.46
Forest	264614	8665744	33900	311000	7.8057339	27.86412954	0.28

Table S11. Main biological production data for Jingyuan County of Guyuan that were used to calculate the yield factors in 2013.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	8772	16139	141571133	Cultivated land
Maize	5234	16444	86068524	Cultivated land
Other legumes	167	16700	2788900	Cultivated land
Soybean	195	21025	4099953	Cultivated land
Potato	11305	5710	64550193	Cultivated land
Flaxseed	1758	15906	27963170	Cultivated land
Medical herbs	1803	17263	31125910	Cultivated land
Vegetables	4512	1463	6601056	Cultivated land
Alfalfa	18300	16943	310057705	Cultivated land
Dogtail grass (<i>Cynosurus</i> spp.)	12300	16283	200280408	Cultivated land
Pork	352	25038	8813446	Cultivated land
Poultry meat	239	6864	1640391	Cultivated land
Beef	8776	13731	120505889	Cultivated land
Mutton	1061	13731	14568909	Grassland
Horse meat	5	13731	68657	Grassland
Mule meat	8	13731	109850	Grassland
Rabbit meat	3	6864	20591	Grassland
Donkey meat	9	13731.3	123582	Grassland
Sheep wool	179	5016	897864	Grassland
Goat wool	6	5016	30096	Grassland
Honey	60	20959	1257511	Cultivated land

Table S12. Local productivity and yield factors for the land in Jingyuan county in 2013.

Land categories	Total energy (GJ)		Total land area (ha)		Energy per unit area (GJ/ha)		Yield factor
	Jingyuan	Guyuan	Jingyuan	Guyuan	Jingyuan	Guyuan	
Cultivated land	88681808	20656102	17300	355100	51.261173	58.16981683	0.88
Grassland	13632574	793444	17500	221300	7.790025	3.585379323	2.17
Forest	552552	8665744	60700	311000	9.1029984	27.86412954	0.33

Table S13. Main biological production data for Pengyang County of Guyuan that were used to calculate the yield factors in 2013.

Agricultural product	Biomass (t)	Energy value (kJ/kg)	Total energy (MJ)	Land category
Wheat	39344	16139	634972029	Cultivated land
Maize	155818	16444	2562289890	Cultivated land
Oat	495	15800	7821198	Cultivated land
Buckwheat	620	15800	9796248	Cultivated land
Proso millet	787	15800	12434915	Cultivated land
Other legumes	4218	16700	70440600	Cultivated land
Pea	127	16700	2120900	Cultivated land

Potato	19216	5710	109721054	Cultivated land
Flaxseed	2890	15906	45969034	Cultivated land
Sunflower (<i>Helianthus</i>) seed	330	41858	13813312	Cultivated land
Tobacco leaf	1960	15926	31214568	Cultivated land
Medical herbs	2092	17263	36115033	Cultivated land
Vegetables	181947	1463	266188461	Cultivated land
Melon	17680	1062	18771210	Cultivated land
Alfalfa	7600	16943	128767134	Cultivated land
Dogtail grass (<i>Cynosurus</i> spp.)	9800	16283	159573008	Cultivated land
Pork	3617	25038	90563169	Cultivated land
Poultry meat	1195	6864	8201954	Cultivated land
Egg	394	8791	3463473	Cultivated land
Beef	8819	13731	121096335	Grassland
Mutton	4874	13731	66926356	Grassland
Mule meat	14	13731	192238.	Grassland
Rabbit meat	38	6864	260815	Grassland
Donkey meat	247	13731	3391631	Grassland
Sheep wool	378	5016	1896048	Grassland
Goat wool	50	5016	250800	Grassland
Rabbit hair	1.89	5016	9480	Grassland
Honey	640	20959	13413453	Cultivated land
Apple	3497	1842	6440670	Forest
Pear	1240	2061	2555318	Forest
Grape	13	2260	29385	Forest
Chinese date (jujube)	15	5107	76601	Forest
Peach	3340	2153	7190018	Forest
Apricot	20880	2203	45995717	Forest
Other fruits	1639	2203	3610488	Forest
Walnuts	180	31254	5625695	Forest
Wood	200000	16744	3348800000	Forest

Table S14. Local productivity and yield factors for the land in Pengyang County in 2013.

Land categories	Total energy (GJ)		Total land area (ha)		Energy per unit area (GJ/ha)		Yield factor
	Pengyang	Guyuan	Pengyang	Guyuan	Pengyang	Guyuan	
Cultivated land	4225651	20656102	68000	355100	62.141921	58.16981683	1.07
Grassland	194024	793444	51600	221300	3.7601493	3.585379323	0.05
Forest	3420324	8665744	72100	311000	47.438612	27.86412954	1.70