Sharing the burden of producing sustainable biofuels

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Palm oil is one of the world's most traded and versatile agricultural commodities. It can be used as edible vegetable oil, industrial lubricant, raw material in cosmetic and skincare products and feedstock for biofuel production. Growing global demand for palm oil and the ensuing cropland expansion has been blamed for a wide range of environmental ills, including tropical deforestation, peatland degradation, biodiversity loss and CO_2 emissions (Koh & Wilcove 2008; Butler & Laurance 2009; Danielsen et al. 2009). In response to these concerns, a group of stakeholders—including activists, investors, producers and retailers—formed the Roundtable on Sustainable Palm Oil (RSPO; www.rspo.org) to develop a certification scheme for palm oil produced through environmentally- and socially-responsible ways. It is widely anticipated that the creation of a premium market for RSPO-certified sustainable palm oil (CSPO) would incentivize palm oil producers to improve their management practices.

However, the RSPO faces several challenges (Laurance et al. 2009), including the high cost of undergoing certification that currently is entirely borne by producers, and a lackluster demand for CSPO. Following the first shipment of CSPO to Europe in November 2008, less than 3% of the total volume of CSPO produced (~1.05 million tons) had been sold (Butler 2009a). Even after a year, in October 2009, only ~200,000 tons of CSPO (~19%) had been purchased by manufacturers of palm oil products (Butler 2009b). The reason for the slow demand for CSPO is unclear, but is likely due to the global financial downturn causing buyers and manufacturers to be less willing to switch to premium palm oil. The economic crisis may have also affected efforts to promote sustainable consumerism in countries, such as China and India, which are the world's largest importers of palm oil. A further factor could be a lack of consumer confidence in

RSPO's credibility, stoked by activists' accusations that certification is the industry's attempt at greenwashing to mislead consumers (Koh et al. 2009). On the other hand, other environmental groups warn that if the RSPO should fail in its endeavor, the palm oil industry will likely revert to business-as-usual practices that will continue to harm the environment (Butler 2009a).

Here, we argue that the financial burden and risk of producing sustainable palm oil should not fall solely on producers; instead these costs should be shared among key actors along the palm oil supply chain that includes both traders and buyers. We further argue that at the national level some countries may be more financially capable than others in creating a stronger demand for premium palm oil.

We therefore propose an "ability-to-pay" index that identifies the richest and largest palm oil importing countries as those that are most morally obligated to contribute to developing a successful CSPO market to raise the environmental performance of the palm oil industry. In its simplest formulation, this ability-to-pay index could be a multiplier function of two metrics—a country's per capita import volume of palm oil and its per capita Gross Domestic Product (GDP). Import is a more appropriate metric to consider than consumption because countries that benefit from importing and re-exporting palm oil (i.e., traders) are also obligated to reduce the environmental impacts of their profiteering activities.

Based on 2007 values of these two metrics (FAO 2009; World Bank 2009), we calculated the ability-to-pay index for 156 countries (Table 1; Appendix S1). The top 10 countries on this list are: the Netherlands, Germany, United States, United Kingdom, Japan, Italy, Belgium, China, France and Spain. The Netherlands justifiably tops the list,

being both the second largest importer (1.24 million tons) and the largest exporter (1.25 million tons) of palm oil; and ranks among the richest industrialized nations in the world (per capita GDP: US$46,750). Indeed, six of the “Group of Eight” or G8 nations are represented in this list (i.e., Germany, United States, United Kingdom, Japan, Italy and France). In contrast, although China is the world's largest importer of palm oil (5.4 million tons), by virtue of it being significantly less affluent (per capita GDP: US$2,575) than other major palm oil importers, it is ranked eighth on our list. China also happens to be the only developing country in this group.

What are the financial implications of switching from uncertified to certified palm oil for the country and individual consumer? We based our estimates of the cost of large-scale adoption of CSPO on a palm oil price of US$781/ton (2006-08 average; USDA-FAS 2009) and an estimated 15% price differential between uncertified and certified palm oil (RSPO 2009). We found that Indonesia—the world’s largest palm oil producer—which consumes 4.9 million tons of palm oil annually (2008 values; USDA-FAS 2009), would incur an additional cost of US$571 million by switching from consuming uncertified to certified palm oil; whereas for the United States, which consumes 960,000 tons of palm oil annually (and is experiencing rising palm oil demand), the added cost would be US$112 million. For the individual consumer in Indonesia, he or she would need to spend an additional US$2.50, which represents 0.13% of his or her annual income (per capita GDP); whereas an American consumer would only need to spend an extra US$0.40, equivalent to 0.0008% of his or her yearly income. Thus, an individual in a developing country such as Indonesia not only has to shoulder the cost of producing sustainable palm oil, but he or she would also be much heavily

burdened by switching to *using* sustainable palm oil, compared to a consumer in a richer nation such as the United States.

Given the anticipated growth in global demand for edible vegetable oils and biofuels, a certification scheme could prove to be an attractive financial incentive—a key "pressure point" of the industry (Wilcove & Koh 2009)—for farmers to improve their environmental performance. However, for any certification scheme to be credible and feasible, its financial burden would have to be appropriately shared among different stakeholders. In particular, as suggested by our analysis, the richer buyers and traders of palm oil have a moral obligation to ensure the success of certification.

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Supporting Information

Appendix S1 is available online. The authors are solely responsible for the content and functionality of this material. Queries (other than absence of the material) should be directed to the corresponding author.

Table 1. Top ten countries ranked by the "ability-to-pay" index.

		Palm oil statistics (tons)			GDP		
Rank	Country Name	Production	Import	Export	(million current US$)	Population	Ability-to-pay
1	Netherlands	0	1,237,817	1,251,807	765,818	16,381,137	57,868
2	Germany	0	1,076,393	185,089	3,317,365	82,268,357	43,404
3	United States	0	787,825	51,553	13,751,400	301,621,000	35,918
4	United Kingdom	0	491,944	21,374	2,772,024	61,001,341	22,355
5	Japan	0	532,209	437	4,384,255	127,770,750	18,262
6	Italy	0	507,622	59,123	2,101,637	59,374,701	17,968
7	Belgium	0	384,574	29,687	452,754	10,625,700	16,386
8	China	221,000	5,415,067	20,237	3,412,676	1,325,235,624	13,945
9	France	0	312,253	11,438	2,589,839	61,707,072	13,105
10	Spain	0	316,159	49,289	1,436,891	44,878,945	10,122

Note: All values are for the year 2007. Values for China include Hong Kong. The ability-to-pay index is calculated as the product of per capita palm oil import and per capita Gross Domestic Product (GDP). For some countries, export volume may be larger than the sum of production and import volume because of cumulative palm oil stocks produced or imported in previous years. Data on palm oil statistics were obtained from the Food and Agriculture Organization of the United Nations (2009), and data on GDP and population were obtained from the World Bank (2009). See Appendix S1 for full list of 156 countries.

Supporting Information

Appendix S1. Summary statistics used in the calculation of the "ability-to-pay" index for 156 countries engaged in the production, import and export of palm oil. All values are for the year 2007. Values for China include Hong Kong. The ability-to-pay index is calculated as the product of per capita palm oil import and per capita Gross Domestic Product (GDP). For some countries, export volume may be larger than the sum of production and import volume because of cumulative palm oil stocks produced or imported in previous years. Data on palm oil statistics were obtained from the Food and Agriculture Organization of the United Nations (2009), and data on GDP and population were obtained from the World Bank (2009).

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11	Denmark	0	168,846	21,122	311,580	5,461,438	9,633
12	Sweden	0	133,524	24,298	454,310	9,148,092	6,631
13	Russia	0	575,605	750	1,290,082	142,100,000	5,226
14	Australia	0	128,335	87	820,974	21,015,000	5,014
15	Saudi Arabia	0	280,426	4,990	381,683	24,157,431	4,431
16	Korea	0	187,564	39	969,795	48,456,000	3,754
17	India	0	3,514,900	805	1,176,890	1,124,786,997	3,678
18	Turkey	0	365,629	6	655,881	73,885,055	3,246
19	Malaysia	15,823,200	435,845	13,011,131	186,719	26,549,518	3,065
20	Ireland	0	51,024	1,789	259,018	4,366,193	3,027

21	Singapore	0	85,443	175,789	161,347	4,588,600	3,004
22	Mexico	57,000	302,411	636	1,022,815	105,280,515	2,938
23	Greece	0	81,381	13,691	313,354	11,193,366	2,278
24	Austria	0	48,236	613	373,192	8,315,427	2,165
25	Poland	0	164,547	167	422,090	38,120,560	1,822
26	Iran	0	448,057	929	286,058	71,021,039	1,805
27	South Africa	0	299,092	1,001	283,007	47,850,700	1,769
28	Switzerland	0	28,248	15	424,367	7,550,077	1,588
29	Pakistan	0	1,710,437	0	142,893	162,481,399	1,504
30	Ukraine	0	476,809	155,967	141,177	46,509,350	1,447
31	Norway	0	15,672	17	388,413	4,709,153	1,293
32	Canada	0	28,905	882	1,329,885	32,976,000	1,166
33	Namibia	0	305,845	2	7,015	2,080,083	1,031
34	Kuwait	0	23,156	0	112,116	2,662,966	975
35	Portugal	0	41,116	109	222,758	10,608,335	863
36	Bangladesh	0	1,728,006	744	68,415	158,571,814	746
37	New Zealand	0	21,958	8	135,667	4,228,300	705
38	Brazil	190,000	98,607	2,403	1,313,361	191,601,284	676
39	Israel	0	24,563	56	163,957	7,180,100	561
40	Sri Lanka	0	332,855	9,064	32,346	20,010,000	538
41	Finland	0	10,455	14	244,661	5,288,720	484
42	Czech Republic	0	27,195	542	174,998	10,334,160	461
43	Egypt	0	260,667	444	130,476	75,466,539	451
44	Venezuela, RB	70,000	53,385	15	228,071	27,483,000	443
45	Romania	0	51,769	1	165,976	21,546,873	399
46	Vietnam	0	457,616	6,187	68,643	85,154,900	369
47	Philippines	62,000	185,400	8,188	144,062	87,892,094	304
48	Algeria	0	73,474	0	135,285	33,852,676	294
49	Kenya	0	415,970	34,565	24,190	37,530,726	268
50	Angola	55,000	64,100	12,000	61,403	16,948,673	232

51	El Salvador	0	73,711	2,387	20,373	6,853,143	219
52	Tunisia	0	60,289	55	35,020	10,225,400	206
53	Hungary	0	14,577	0	138,429	10,055,579	201
54	Benin	40,000	291,500	236	5,428	9,025,402	175
55	Croatia	0	14,679	226	51,278	4,435,982	170
56	Yemen	0	149,743	746	22,523	22,383,108	151
57	Syria	0	69,893	0	37,745	19,890,585	133
58	Tanzania	6,200	323,226	16,341	16,181	40,432,163	129
59	Lithuania	0	11,226	525	38,332	3,375,618	127
60	Jordan	0	42,509	2,876	15,833	5,718,855	118
61	Sudan	0	92,900	0	46,228	38,555,569	111
62	Trinidad & Tobago	0	6,747	0	20,886	1,333,050	106
63	Azerbaijan	0	28,806	0	31,248	8,556,379	105
64	Bulgaria	0	19,928	2,147	39,549	7,659,764	103
65	Lebanon	0	17,080	315	24,352	4,097,076	102
66	Ghana	109,000	150,900	92,000	15,147	23,461,523	97
67	Peru	34,000	24,031	745	107,297	27,898,182	92
68	Slovak Republic	0	5,846	3	74,972	5,397,318	81
69	Djibouti	0	76,663	1,124	830	832,992	76
70	Kazakhstan	0	11,001	1	104,853	15,484,200	74
71	Serbia	0	12,961	57	40,122	7,381,579	70
72	Colombia	780,000	14,617	315,575	207,786	43,987,000	69
73	Congo	25,000	31,559	30	7,646	3,766,751	64
74	Guatemala	130,000	24,754	110,186	33,855	13,348,222	63
75	Uganda	0	143,703	19,586	11,771	30,916,072	55
76	Chile	0	5,512	4	163,913	16,594,596	54
77	Dominican Republic	32,000	13,132	0	36,686	9,725,569	50
78	Slovenia	0	2,005	36	47,182	2,018,122	47
79	Mauritius	0	8,326	0	6,786	1,260,692	45
80	Mauritania	0	52,308	0	2,644	3,120,981	44

81	Morocco	0	17,440	341	75,119	30,860,595	42
82	Bermuda	0	441	0	5,855	64,000	40
83	Haiti	0	53,757	0	6,715	9,611,554	38
84	Uruguay	0	4,884	163	23,136	3,323,906	34
85	Nicaragua	8,800	32,102	1,092	5,726	5,604,596	33
86	Senegal	6,100	34,885	1,459	11,165	12,411,094	31
87	Cameroon	172,000	27,355	68	20,686	18,532,799	31
88	Gabon	6,400	3,089	997	11,568	1,330,182	27
89	Panama	14,000	4,286	2,674	19,485	3,340,605	25
90	Cyprus	0	990	0	21,277	854,673	25
91	Mozambique	0	55,200	0	7,790	21,372,202	20
92	Mali	0	34,600	94	6,863	12,334,168	19
93	Costa Rica	185,600	3,252	144,339	26,267	4,462,193	19
94	Ethiopia	0	69,585	0	19,395	79,086,894	17
95	Jamaica	0	3,832	2	11,430	2,675,800	16
96	Malta	0	844	0	7,449	409,197	15
97	Guinea	50,000	26,700	280	4,564	9,380,197	13
98	Gambia	2,550	34,000	1	644	1,706,767	13
99	Fiji	0	3,098	0	3,431	834,278	13
100	Latvia	0	1,029	16	27,155	2,276,100	12
101	Kiribati	0	13,413	0	78	95,067	11
102	Niger	0	29,326	2,299	4,170	14,195,085	8.62
103	Argentina	0	1,267	0	262,451	39,503,466	8.42
104	Uzbekistan	0	9,800	0	22,308	26,867,800	8.14
105	Bosnia & Herzegovina	0	1,957	13	15,144	3,772,964	7.86
106	D.R. Congo	104,000	47,353	652	8,953	62,399,224	6.79
107	Belarus	0	1,400	0	44,773	9,702,000	6.46
108	Libya	0	681	0	58,333	6,156,488	6.45
109	Burkina Faso	0	13,800	484	6,767	14,777,431	6.32
110	Estonia	0	381	2	20,901	1,341,672	5.94

111	Togo	7,000	14,635	2,226	2,499	6,580,669	5.56
112	Thailand	965,000	1,407	283,065	245,351	63,832,135	5.41
113	Rwanda	0	15,691	0	3,339	9,735,541	5.38
114	Cote d'Ivoire	288,819	5,021	89,381	19,796	19,268,303	5.16
115	Madagascar	3,500	13,623	308	7,382	19,669,953	5.11
116	Mongolia	0	3,368	0	3,930	2,608,412	5.07
117	Guyana	0	3,150	0	1,080	738,548	4.61
118	Cambodia	0	7,185	2,546	8,350	14,446,056	4.15
119	Macedonia	0	1,037	10	7,674	2,037,032	3.91
120	Botswana	0	513	0	12,311	1,881,432	3.36
121	Liberia	34,800	16,581	638	735	3,713,868	3.28
122	Moldova	0	2,717	0	4,396	3,803,704	3.14
123	Honduras	175,000	1,728	178,047	12,234	7,103,786	2.98
124	Papua New Guinea	395,000	3,000	368,300	6,259	6,324,097	2.97
125	Zambia	0	2,863	0	11,363	11,919,870	2.73
126	Seychelles	0	310	0	728	85,032	2.65
127	Sierra Leone	36,000	8,964	152	1,664	5,848,320	2.55
128	Samoa	0	870	0	525	181,293	2.52
129	Albania	0	708	0	10,831	3,181,326	2.41
130	Indonesia	16,900,000	1,154	8,875,419	432,817	225,630,065	2.21
131	Malawi	0	8,632	0	3,563	13,920,062	2.21
132	Iceland	0	28	0	19,963	310,997	1.80
133	Kyrgyz Republic	0	2,374	0	3,745	5,234,800	1.70
134	Comoros	0	2,246	0	449	628,410	1.60
135	Guinea-Bissau	6,350	6,942	9	357	1,694,653	1.46
136	Georgia	0	537	0	10,175	4,398,588	1.24
137	Armenia	0	390	0	9,204	3,009,162	1.19
138	Nigeria	1,300,000	726	157	165,469	147,982,941	0.81
139	Bahamas	0	37	0	6,571	331,140	0.73
140	Bolivia	0	420		13,120	9,517,537	0.58

141	Central African Republic	1,700	1,352	0	1,712	4,343,405	0.53
142	Turkmenistan	0	100		12,933	4,963,332	0.26
143	St. Lucia	0	44	0	980	167,975	0.26
144	Ecuador	295,000	76	171,638	44,490	13,339,580	0.25
145	Montenegro	0	41		3,477	599,006	0.24
146	St. Kitts & Nevis	0	20		527	48,790	0.22
147	Bhutan	0	79		1,096	657,401	0.13
148	Cape Verde	0	48		1,434	530,269	0.13
149	St. Vincent & the Grenadines	0	26		553	120,325	0.12
150	Vanuatu	0	57	1	452	225,898	0.11
151	Luxembourg	0	1	0	49,460	479,993	0.10
152	Swaziland	0	30	0	2,894	1,147,616	0.08
153	Solomon Islands	35,800	34	19,745	388	495,362	0.03
154	Tonga	0	10		253	102,214	0.02
155	Burundi	1,800	167	98	974	8,495,915	0.02
156	Nepal	0	36	1,753	10,315	28,107,592	0.01

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