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The palm oil dilemma

Policy tensions among higher productivity, rising demand, and deforestation

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Palm oil production has increased rapidly over the past two decades in response to rising demand for its use in food, energy, and industrial applications.[1] In an era of increasing pressure on natural resources, however, expansion of oil palm plantations presents a dilemma: On the one hand, oil palm is the most productive oil crop in the world; on the other hand, in some areas, oil palm plantations can displace forests and peatlands, leading to biodiversity losses and increased greenhouse gas emissions.[2] Recent experience has varied widely by region; forest clearing is estimated to have accounted for 45 percent of oil palm area expansion in Southeast Asia since 1989 and 31 percent in South America, but only 7 percent in Africa and 2 percent in Mesoamerica.[3]

Technological innovations that increase yields, such as improved seeds and better management practices, could mitigate the trade-off between rising demand and environmental costs. But opinions are divided as to whether higher palm oil yields will decrease or increase pressure to clear more land.[4] This is a critical policy issue for producer countries and the global community, as global demand and production of palm oil for food, feed, and fuel are projected to rise rapidly in the coming decades.[5] Appropriate policy responses will depend on the changing dynamics of global markets as well as the differing historical and environmental contexts of particular palm-oil-producing countries.

Using an integrated system of economic and biophysical models, we find that increased palm oil yields will reduce pressure on land resources in the long run. In the near term, however, yield-increasing innovations must be accompanied by policy measures to discourage oil palm expansion that results in forest and peatland conversion, and by effective enforcement and careful monitoring to prevent environmental damage.

POLICY TAKEAWAYS

- In the long run, higher palm oil yields are projected to reduce pressure on land resources.
- Yield-increasing innovations must be accompanied by careful monitoring and regulation of land conversion to prevent environmental damage.
- Policies to clarify land rights and improve smallholders' access to resources, technologies, and markets will help small farmers to innovate more quickly.
- Sustainability criteria, certification, and other environmental protection measures are especially relevant in areas where oil palm expansion has involved clearing of forests and peatlands.

EFFECTS OF HIGHER PALM OIL YIELDS

The argument that agricultural intensification and increased yields reduce tropical deforestation was first made by Norman Borlaug in 1983. Whether the "Borlaug hypothesis" proves true in any particular context depends on the nature of the specific technology, farmers, scale of production, input and output markets, property rights, and agroecological conditions.[6] For example, if only a few farmers adopt a new technology, or if changes in local production do not affect output prices, higher yields will increase returns for those who adopt the new technology and provide them with incentives to clear more land for crop production.[7] In contrast, if increased production reduces palm oil prices, incentives to expand oil palm area will be reduced. Changes in oil palm productivity will also trigger adjustments in markets for other commodities, such as soybean and groundnut oil, for which palm oil is a substitute, and for other crops that compete with oil palm for land, labor, and other inputs.[8]

As a result, questions about the effects of increased productivity in oil palm cultivation cannot be answered *a priori*. They require empirical analysis of the complex biophysical and economic interactions among multiple resources, producers, commodities, and countries. We explored these questions using IFPRI's International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT), a global multimarket economic model of agricultural production and trade, linked to climate, water, and crop models, which addresses such complex interactions.[9]

With standard assumptions about changes in population, income, and climate,[10] we project that total global oilseed demand and production will increase by about 85 percent between 2010 and 2050.[11] Rising demand for both food and industrial uses (of which biofuels represent a relatively small share) will drive growth, although growth rates are expected to slow in comparison with rates of the recent past.

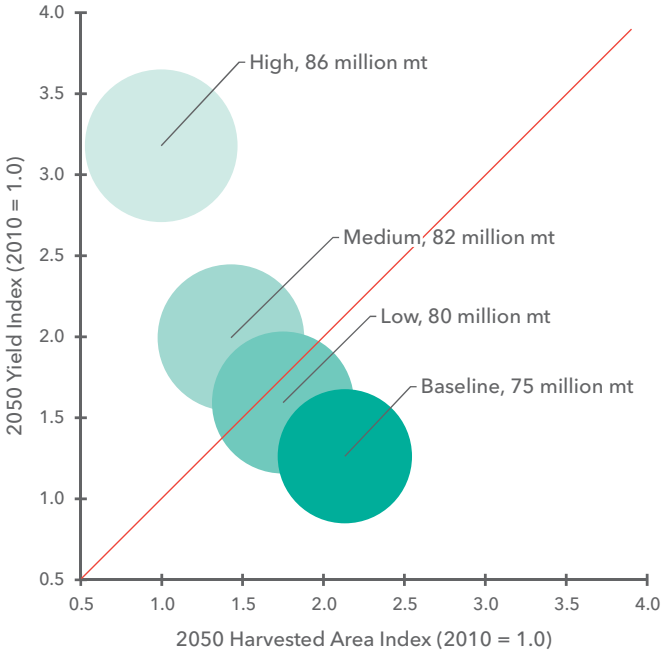
Palm oil production is projected to grow nearly twice as fast, with most of that growth coming from an increase in harvested area (Figure 1, baseline scenario). Global average palm oil yields are projected to increase by 24 percent to around 4 metric tons per hectare (mt/ha) and harvested area by more than 110 percent, with most of the growth taking place in Indonesia and Malaysia. Nevertheless, the projected area expansion of 16.5 million hectares (Mha) is less than the 19.3 Mha estimated to be "very suitable land which could be available for sustainable oil palm cultivation," and projected oil yields remain well below potential ceilings of 12 to 18 mt/ha, depending on technology, management, and agroecological conditions.[12]

WHAT WOULD FASTER YIELD GROWTH MEAN?

According to our projections, if palm oil yields increase more rapidly than in the baseline scenario (while holding yield growth rates for all other crops at levels assumed in the baseline scenario), harvested area will expand more slowly. In scenarios in which yields increase by an additional 25 to 100 percent, global prices for palm oil drop by 10 to 21 percent in 2050 (relative to baseline levels in 2050), thereby reducing incentives for expansion of oil palm area (Figure 1, alternative scenarios). In a high-yield growth scenario in which average yields in 2050 increase to roughly 9 mt/ha, total global oil palm harvested area remains at 2010 levels (Table 1 and Figure 1). Prices for other crops also drop, though not as much (generally by less than 2 percent), leading to a shift from oil palm to other crops in some areas. Faster growth in palm oil yields slows net growth in total harvested area across all crops (including oil palm) in all regions.

Absolute reductions in oil palm harvested area (relative to baseline projections in 2050) are greatest in East Asia and the Pacific (including Indonesia and Malaysia), where most palm oil production takes place (Table 1 and Figure 2), though other regions also see reductions. This is an important consideration in the formulation of land-use policy.

FIGURE 1 Scenarios of projected increases in global palm oil production, area, and yield in 2050



Note: The circles show a baseline scenario and low, medium, and high growth scenarios that simulate yield growth resulting in global average palm oil yields in 2050 of approximately 4, 5, 6, and 9 mt/ha, respectively. The size of each circle indicates the increase in annual production in 2050 relative to 2010 (75, 80, 82, and 86 million mt for each of the scenarios). The location of each circle indicates the change in harvested area (x-axis) and yield (y-axis) in 2050 relative to 2010.

Source: Analysis by the authors, using the IMPACT model.

Under the high-yield growth scenario in Figure 2, which projects a doubling of average palm oil yields, Indonesia and Malaysia would reduce oil palm harvested area (relative to baseline levels in 2050) by almost 8 and 4 million hectares (63 and 40 percent of projected 2050 levels), respectively. Under the same scenario, the countries of West Africa, dominated by Nigeria, would reduce harvested area by between 44 and 63 percent (for a total of 3.7 million hectares) compared with the baseline scenario, while countries in Latin America and the Caribbean would reduce harvested area by 53 to 66 percent (for a total of 0.5 million hectares).

POLICY IMPLICATIONS

Although our projections show that expansion of oil palm area will slow with faster yield growth, important concerns remain that require careful attention from policymakers. The processes of innovation, adoption, and market adjustment are not instantaneous or uniform across farmers or regions. During the period of transition, early adopters of yield-enhancing technologies will gain a competitive advantage over late adopters and non-adopters, and thus have an incentive to expand their area under production—potentially at the expense of forest, peatlands, and other environmentally sensitive land—before palm oil prices begin to decline.

TABLE 1 Harvested area for oil palm and other crops in 2010 and 2050 under alternative assumptions about yield growth

	Area (million hectares)					Change in area in 2050 due to yield growth					
	Baseline		2050 + Yield growth			Million hectares			Percent (%)		
	2010	2050	Low	Med	High	Low	Med	High	Low	Med	High
OIL PALM											
World	**14.6**	**31.1**	**25.5**	**20.8**	**14.5**	**-5.6**	**-10.3**	**-16.5**	**-17.9**	**-33.0**	**-53.3**
East Asia and Pacific	9.3	23.2	19.2	15.6	11.1	-4.1	-7.7	-12.2	-17.5	-33.0	-52.4
Africa south of the Sahara	4.7	6.9	5.6	4.6	3.0	-1.3	-2.3	-3.8	-19.2	-33.1	-55.7
Latin America and the Caribbean	0.6	1.0	0.8	0.6	0.4	-0.2	-0.3	-0.5	-19.4	-33.3	-55.9
ALL OTHER OILSEEDS											
World	**211.6**	**275.0**	**274.9**	**274.9**	**275.0**	**-0.0**	**-0.0**	**-0.0**	**-0.0**	**-0.0**	**-0.0**
East Asia and Pacific	39.5	45.9	46.2	46.5	46.8	0.3	0.5	0.9	0.6	1.2	2.0
South Asia	32.5	40.4	40.3	40.3	40.2	-0.1	-0.1	-0.2	-0.1	-0.3	-0.4
Former Soviet Union	12.6	14.6	14.6	14.6	14.6	-0.0	-0.0	-0.0	-0.1	-0.1	-0.2
Middle East and North Africa	6.3	8.7	8.7	8.6	8.5	-0.1	-0.1	-0.2	-0.7	-1.4	-2.2
Africa south of the Sahara	18.9	28.9	28.9	28.8	28.7	-0.1	-0.1	-0.2	-0.2	-0.4	-0.6
Latin America and the Caribbean	46.5	68.2	68.1	68.1	68.1	0.0	-0.1	-0.1	0.0	-0.1	-0.1
North America	39.9	50.4	50.3	50.3	50.3	0.0	0.0	-0.1	-0.1	-0.1	-0.1
Europe	15.6	17.8	17.8	17.7	17.6	-0.1	-0.1	-0.2	-0.4	-0.7	-1.2
ALL CROPS											
World	**1265.7**	**1494.5**	**1491.2**	**1488.4**	**1484.9**	**-3.3**	**-6.1**	**-9.6**	**-0.2**	**-0.4**	**-0.6**
East Asia and Pacific	303.3	342.2	340.3	338.5	336.5	-2.0	-3.7	-5.8	-0.6	-1.1	-1.7
South Asia	227.5	243.4	243.2	243.0	242.8	-0.2	-0.3	-0.5	-0.1	-0.1	-0.2
Former Soviet Union	107.0	116.8	116.7	116.6	116.6	-0.1	-0.1	-0.2	-0.1	-0.1	-0.2
Middle East and North Africa	69.4	80.8	80.7	80.6	80.6	-0.1	-0.1	-0.2	-0.1	-0.2	-0.2
Africa south of the Sahara	193.9	278.0	277.3	276.8	276.0	-0.7	-1.2	-2.0	-0.2	-0.4	-0.7
Latin America and the Caribbean	142.5	198.1	197.9	197.8	197.6	-0.2	-0.3	-0.5	-0.1	-0.2	-0.3
North America	125.7	141.1	141.0	141.0	140.9	-0.1	-0.1	-0.2	0.0	-0.1	-0.1
Europe	96.5	94.2	94.1	94.0	93.9	-0.1	-0.1	-0.2	-0.1	-0.1	-0.2

Note: Low, Medium, and High scenarios simulate yield growth resulting in global average palm oil yields in 2050 of approximately 5, 6, and 9 mt/ha, respectively (compared with 4 mt/ha in the baseline scenario in 2050).

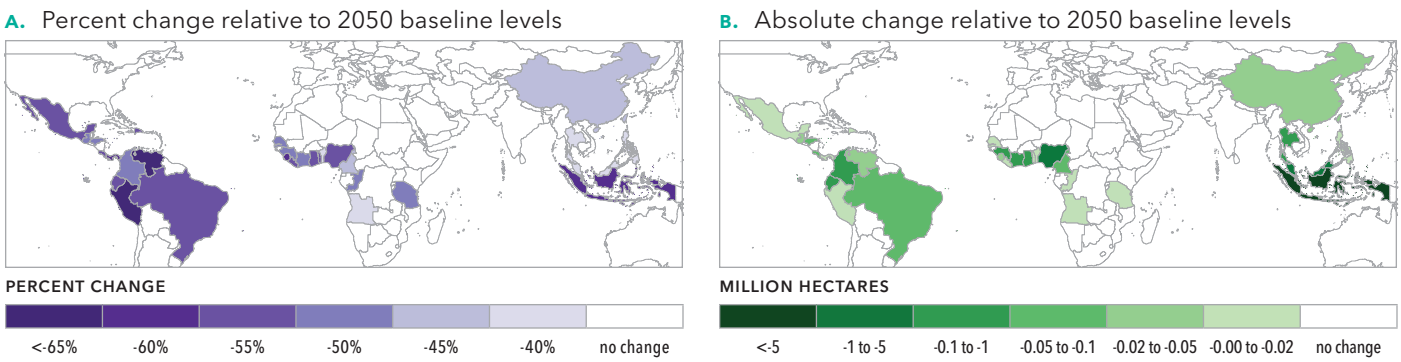
Source: Analysis by the authors, using the IMPACT model.

Subsequent price declines will reduce incentives for all producers to expand further, the net effect of which will be slower growth in area under production (and reductions relative to baseline levels projected in 2050). Therefore, while the long-term effects of increased productivity appear favorable in terms of reduced pressure on land resources, in the short term, to the extent that conversion of environmentally sensitive land is irreversible, yield-increasing innovations must be accompanied by careful monitoring and regulation of land conversion to prevent environmental damage.

These patterns highlight the importance of distinguishing between smallholders and larger-scale producers of palm oil when addressing these challenges. The two groups face different constraints and opportunities in terms of both adopting yield-enhancing technologies and expanding the area for oil palm cultivation.[13] Large producers typically have more secure land tenure and better access to inputs and finance as well as processing facilities and markets, while service delivery to smallholders is more costly.

The ability of large producers to innovate and expand more rapidly than smallholders thus raises distributional as well as environmental concerns. Policy instruments to help smallholders innovate and expand more quickly could include clarification of land rights, organization of smallholders into cooperatives to improve their market access (for example, via Roundtable on Sustainable Palm Oil [RSPO] certification), targeted technology transfer programs, improved access

FIGURE 2 Reduction in oil palm harvested area in 2050, relative to 2050 baseline levels, under a high-yield growth scenario of doubling global average palm oil yields



Note: The high-yield growth scenario simulates yield growth resulting in global average palm oil yields in 2050 of approximately 9 mt/ha (compared with 4 mt/ha in the baseline scenario). International boundaries shown are only representative.

Source: Analysis by the authors, using the IMPACT model.

to finance for adopting higher-productivity seed varieties, improved access to fertilizers and other productive resources, and other complementary options.[14]

Appropriate policy responses will depend on the specific historical and environmental contexts of particular palm-oil-producing countries. Measures to improve smallholders' access to resources, technologies, markets, and opportunities are important in all countries (and not just for oil palm). Measures such as sustainability criteria, certification, land-use monitoring and regulation, and protection of natural areas are most relevant in regions such as Southeast Asia, where oil palm expansion in recent decades has relied to a significant extent on the clearing of forests and peatlands.

While this analysis has focused on palm oil production, demand considerations are also important, as policies play a crucial role on the consumption side. Demand for biodiesel, for example, which is largely determined by government support policy measures, has been a key factor in the rapid increase in palm oil production over the past decade.[15] In light of rising environmental concerns and lower energy prices, those measures are now being reconsidered in some regions, but their impact as well as that of certification requirements in the EU and elsewhere remains an important question.[16] We also need a better understanding of the outlook for demand and policy in large markets, such as China and India, that do not currently impose sustainability requirements. Changes in palm oil demand and production and how they will affect livelihoods, food security, and the environment deserve careful consideration through further research and development of appropriate policy frameworks.

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