USDA United States Department of Agriculture

Foreign Agricultural Service
Global Market Analysis
International Production Assessment Division
Web: https://ipad.fas.usda.gov

September 21, 2022

Commodity Intelligence Report

Record Palm Oil Production Forecast for Côte d'Ivoire and Ghana

Palm oil production for marketing year (MY) 2022/23 is forecast at a record 600,000 metric tons (mt) for Côte d'Ivoire, and a record 300,000 mt for Ghana. Harvested area for Côte d'Ivoire is forecast at a record 300,000 hectares (ha), while harvested area for Ghana is forecast at 360,000 ha. Record palm oil yields are forecast for Côte d'Ivoire at 2.00 metric tons per hectare (t/ha) and for Ghana at 0.83 t/ha (Figures 1 and 2). Yields for small-scale landholders are less than large-scale industrial plantations because small landholders often lack access to high yielding hybrid varieties or they cannot afford fertilizers to boost yields. USDA Foreign Agricultural Service (FAS) personnel from Washington DC, Accra, and Abidjan, travelled in major palm oil producing areas in Ghana and Côte d'Ivoire in July 2022 (Figure 3).

Trends in area, yield, and production continue to increase for both countries from gradual area increases by small landholders; improved agronomic management practices; greater availability of high-yielding *Tenera* varieties; and improved crop extension activities promoted by small landholder cooperatives and by large-scale commercial plantations that often support out-grower programs. Replanting trees every 25 years with improved hybrid varieties is the best method to increase yields because high-yielding hybrid varieties have improved from recent research. Palm oil treees also should be replanted every 25 years because palm oil yields become economically unproductive after 25 years of tree growth.

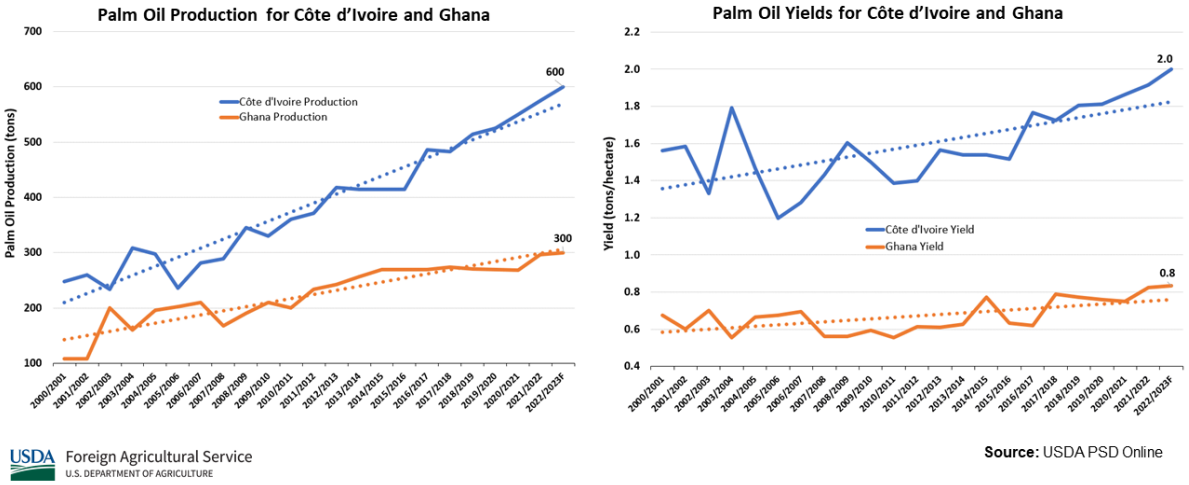


Figure 1. Palm oil production and yield charts for Côte d'Ivoire and Ghana.

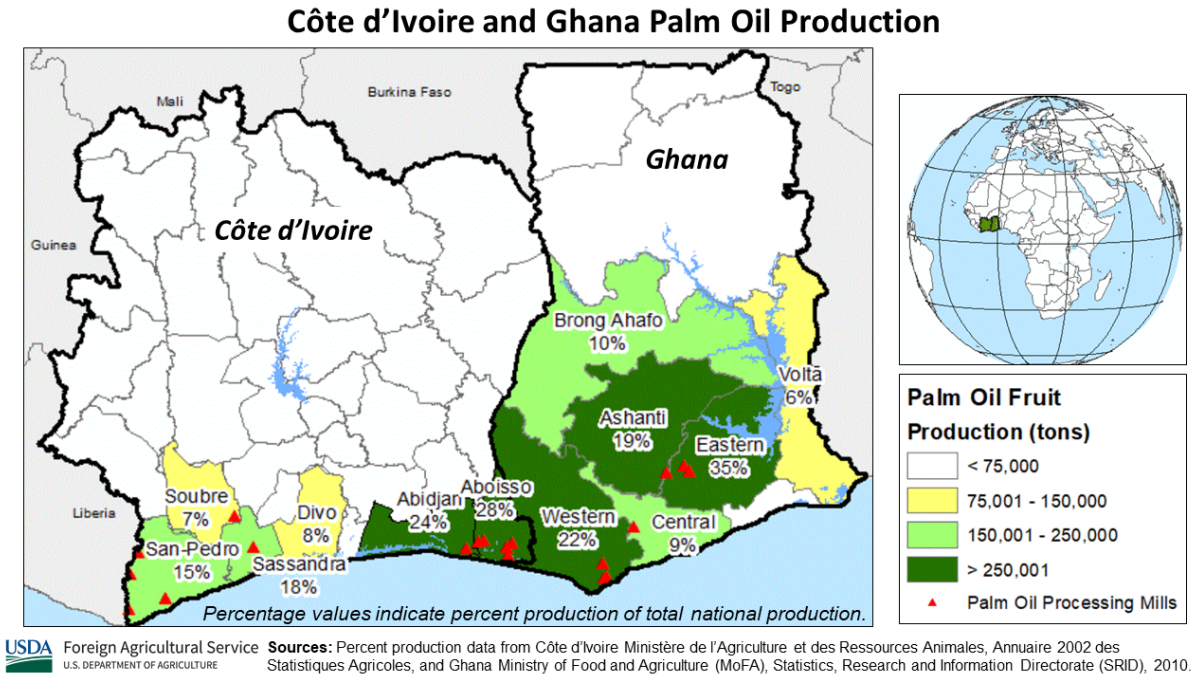


Figure 2. Palm oil production maps for Côte d'Ivoire and Ghana.

Palm Oil Area Mapping for Small-scale Landholders and Large-scale Industrial Estates

USDA/FAS personnel visited major palm oil producing regions in Côte d'Ivoire from July 18 to 22, 2022, and Ghana from July 25 to 29, 2022 (Figure 3). The FAS survey team interviewed several palm oil cooperatives, producers, and processors, ranging from large-scale to small-scale.The survey team also validated a global palm oil area map derived from 10-meter resolution Sentinel-2 imagery, and processed by machine-learning algorithms on Google Earth Engine (Figure 3 and Descals, et al., 2021).

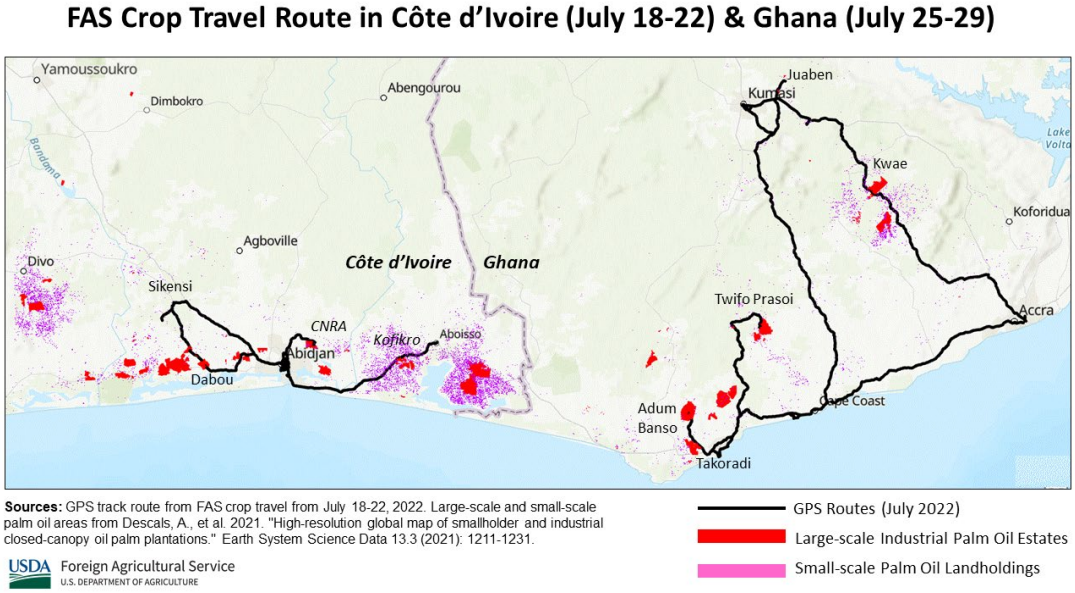


Figure 3. USDA/FAS Crop Tour Route in Côte d'Ivoire and Ghana in late July 2022.

For Ghana, smallholders palm oil area is approximately 290,000 hectares (81 percent of total area) and large-scale industrial estates is about 70,000 hectares (19 percent of total). Harvested area reportedly includes about 150,000 ha on wild oil palm groves with low yielding *Dura* palms; 140,000 ha on independent small to medium-scale farms; and the remaining 70,000 ha managed by oil palm plantations (Ofosu-Budu and Sarpong, 2013). Average palm oil farm size in Ghana is approximately 2.7 hectares (MASDAR, 2011).

Côte d'Ivoire's small landholders palm oil area is approximately 220,000 hectares (73 percent of total) and large-scale industrial estates area is about 80,000 hectares (27 percent of total). Average farm size is 3 to 5 hectares for 45,000 small landholders, and some farms are greater than 100 hectares. A global palm oil area product derived from satellite imagery mapped large-scale estates and small-scale landholdings for all palm oil producing countries (Descals, et al., 2021), but under-estimated palm oil area for Côte d'Ivoire and Ghana in comparison to published national palm oil area estimates (AIPH, 2022 and MASDAR, 2011). It was noticed that the machine-learning crop classification algortihms could be improved for Côte d'Ivoire and Ghana because palm oil fields located near field edges were often excluded and this could be the source for palm oil area being underestimated by the 2019 global palm area product.

The FAS team also visited the *Centre National de Recherche Agronomique* (CNRA or National Center for Agricultural Research) research station at La Mé, Côte d'Ivoire. The CNRA research station develops high-yielding and disease resistance varieties which are distributed as germinated seeds or tree seedlings to large-scale industrial estates and to small-scale landholders in Côte d'Ivoire and surrounding countries. CNRA distributes approximately 12 million seeds per year and the germinated seeds can be purchased on-line at the CNRA web site (Figures 4 and 5).

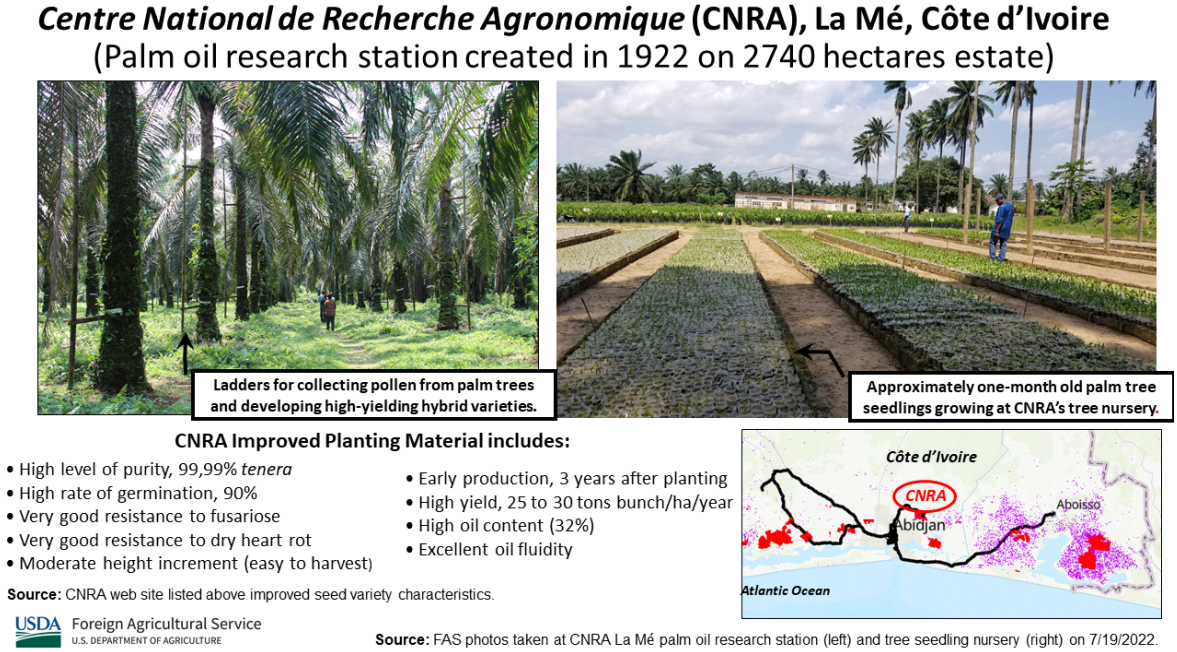
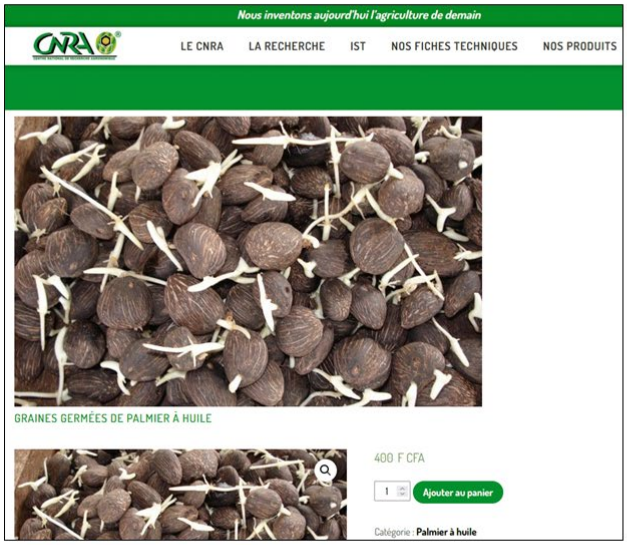


Figure 4. Tree nursery at the *Centre National de Recherche Agronomique* (CNRA), La Mé, Côte d'Ivoire.

***High-yielding* germinated hybrid seeds developed at CNRA's palm oil research station.**
(It's very important to replant palm trees with the best available planting material because productivity declines after 25-years.)



Source: *Centre National de Recherche Agronomique (CNRA)* shopping cart web site

Source: FAS photo taken at CNRA's La Mé palm oil research station on 7/19/2022.

Figure 5. Improved hybrid seed varieties are sold at the *Centre National de Recherche Agronomique* (CNRA), La Mé, Côte d'Ivoire.

Annual Rainfall Suitability and Palm Oil Yield Reductions from Drought

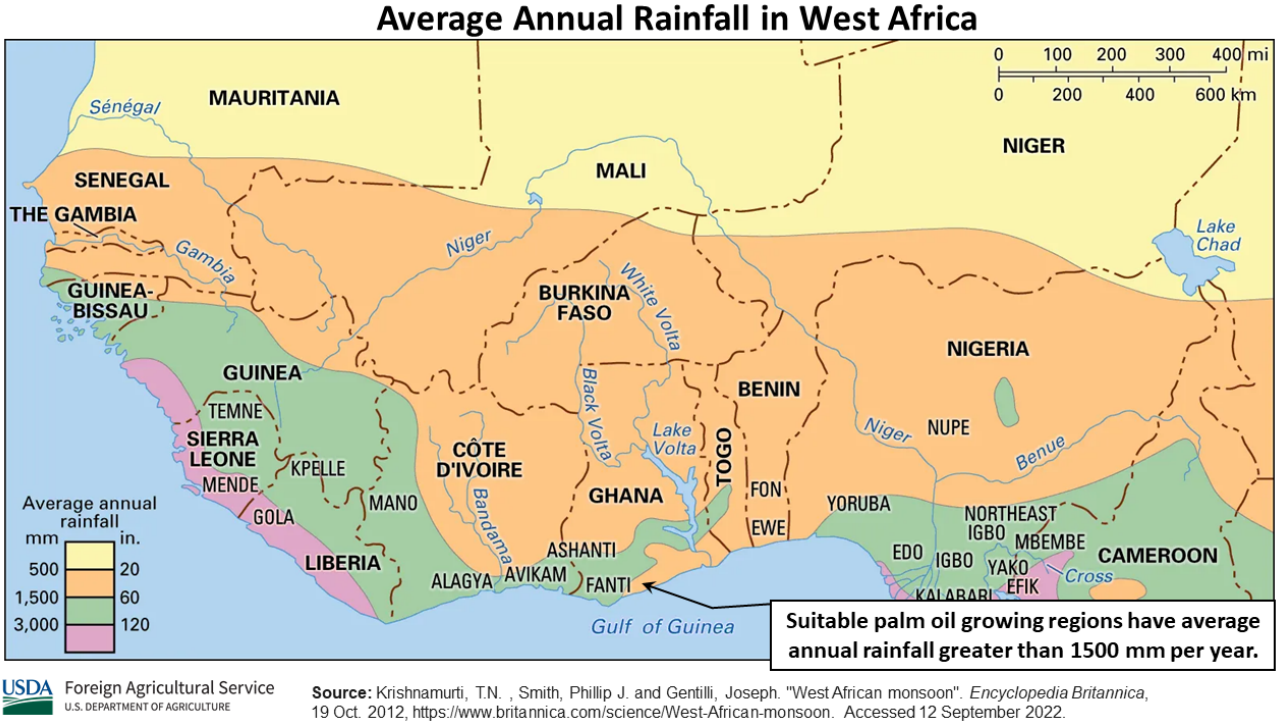
The most critical climate factor used to assess land suitability for commercial cultivation of oil palm is daily, monthly, and annual rainfall. Other important climatic elements that help to determine palm oil production performance are: a) Solar radiation intensity and duration; b) Air temperature (mean, maximum, and minimum temperature); c) Relative Humidity and Vapor Pressure Deficit; d) Evaporation; and e) Wind (Goh, et al., 2011). A minimum annual rainfall of 1,500 millimeters (mm) is required to ensure Fresh Fruit Bunches (FFB) yields of 15 to 30 t/ha per year on large-scale industrial plantations in Ghana (MASDAR, 2011 and Figure 6).

The most favorable annual average rainfall for optimal FFB yields ranges from 2,000 to 3,000 mm per year, and approximately 150 to 200 mm per month (Figure 7). Case studies show that yield reductions are expected when annual rainfall is less than 2000 mm per year or monthly rainfall totals are less than 100 mm per month (Figure 5 and Woittiez, et al., 2017). Other important climatic factors for favorable yields include more than 200 rainy days per year, relative humidity ranging between 75 and 80 percent, and mean air temperatures ranging from 22 to 32°C.

The major climatic constraint for West Africa is a prolonged dry season of 4 to 5 months. The dry season can cause water deficit stress from November through March, and water stress is considered the main determining factor for seasonal yield reductions in West Africa palm oil (Figure 8 and Van Der Vossen,1974). Drought stress lasting more than 8 weeks usually results in reduced flowering and fruit production during the

following 12-month period. Annual yields can be reduced by 40 to 50 percent below average following a very severe drought (IPNI, 2015).

Peak harvest months in Côte d'Ivoire and Ghana range from February through June when nearly 60 percent of the annual harvest is milled. For Ghana, average FFB yields range from 1 to 3 t/ha in wild groves of *Dura* oil palm; private small landholdings yields are about 3 t/ha; and large-scale industrial estates yields range from 10 to 15 t/ha (Ofosu-Budu and Sarpong, 2013). Yields for small landholder producers supported by out-grower schemes tend to be higher than independent smallholders because the parent large-scale company provides out-growers with high-yielding hybrid varieties, fertilizer inputs, and other agronomic extension services that contribute towards higher yields.



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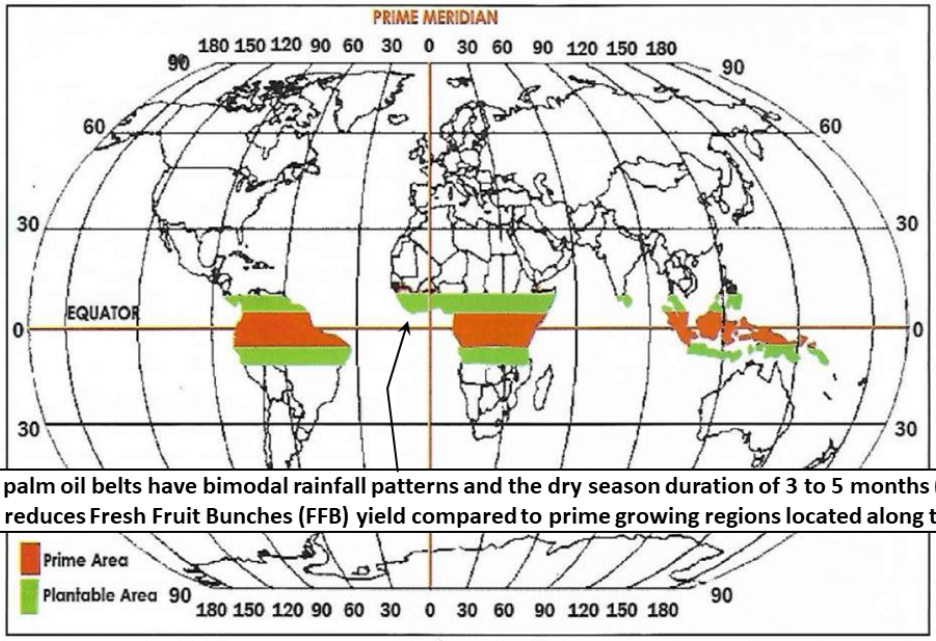
Source: Krishnamurti, T.N. , Smith, Phillip J. and Gentilli, Joseph. "West African monsoon". *Encyclopedia Britannica*, 19 Oct. 2012, https://www.britannica.com/science/West-African-monsoon. Accessed 12 September 2022.

Figure 6. Average Annual Rainfall in West Africa.

Prime Palm Oil Growing Region located within 5-degrees latitude of the Equator



Most West Africa palm oil belts have bimodal rainfall patterns and the dry season duration of 3 to 5 months (<100-mm rainfall per month) reduces Fresh Fruit Bunches (FFB) yield compared to prime growing regions located along the Equator.

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Source: The Philippine Palm Oil Industry Roadmap 2014-2023, https://pca.gov.ph/images/brochure/oilPalms.pdf

Figure 7. Côte d'Ivoire and Ghana have bimodal rainfall patterns and dry season duration ranges from 3 to 5 months.

Climate Suitability Classification for Palm Oil

Proposed climatic suitability classification for oil palm.

Climatic elements	Highly suitable	Suitable	Moderately suitable	Currently	"Permanently unsuitable"
Annual rainfall (mm/year)	2000-2500	2500-3000	3000-4000	4000-5000	>5000
		1700- 2000	1400-1700	1100-1400	<1100
Duration of dry season (month)	0	1	2-4	5-6	>6
Mean annual temperature (°C)	26-29	29-32	32-34	34-36	>36
		23-26	20-23	17-20	<20
Daily solar radiation (MJ/m2)	16-17	17-19	19-21	21-23	>23
		14-16	11-14	8-11	<8
Wind (m/s)	<10	10-15	15-25	25-40	>40

Source: Goh K.J., Chiu S.B. and Paramananthan S. (eds). 2011. Agronomic Principles and Practices of Oil Palm Cultivation. Agricultural Crop Trust, Kuala Lumpur.

Yield-limiting Factors in Oil Palm systems

Yield-limiting factors in oil palm systems: water-limited yield (Yw).

Yield-limiting factors	Range in oil-palm growing areas	Yield effects measured in case studies	Selected references
Total rainfall and distribution	Rainfall (mm year^{-1}) • Malaysia and Indonesia: 1700–4000 • Africa: 1200–3500 • Americas: 1600–3500 Dry months (less than 100 mm rain month^{-1}) • Malaysia and Indonesia: 0–3 • Africa: 3–6 • Americas: 0–5	• Yield reduced if rainfall <2000 mm yr^{-1} or >3500 mm yr^{-1} and/or <100 mm month^{-1} • Yield reductions in relation to water deficit: ○ None if water deficit is less than threshold of 50–200 mm yr^{-1}, depending on local conditions; ○ 10–20% yield loss per 100 mm deficit after the threshold; ○ Exponential decline down to <10 t fruit bunches ha^{-1} yr^{-1} at water deficits of >500 mm • See also: Table 3	(Dufrène et al., 1990) (Hartley, 1988: 98–99) (Paramananthan, 2003) (Goh, 2000) (Olivin, 1986)

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Source: Woittiez, L.S., et al. 2017. Yield gaps in oil palm: A quantitative review of contributing factors, European Journal of Agronomy, Volume 83, 2017, Pages 57-77, https://doi.org/10.1016/j.eja.2016.11.002.

Figure 8. Annual Rainfall Suitability Classification and Palm Oil Yield Reductions from Drought.

Crude Palm Oil (CPO) processing

Palm oil milling capacity exceeds production capacity for Côte d'Ivoire and Ghana. MASDAR (2011) reports there were more than 1,200 small-scale processing mills in Ghana producing approximately 60 percent of the national palm oil output. Côte d'Ivoire has 16 large-scale mills competing with numerous small-scale (artisan) and medium-scale mills (AIPH, 2022).

Fresh Fruit Bunches (FFB) are harvested and weighed at the field, roadside, or palm oil processing mills where farmers are paid based on harvested FFB weight (Figures 9 and 10). The processing mill converts the FFB to crude palm oil (CPO) and palm kernel oil (PKO), if PKO processing is available (Figure 11). CPO processing mills are more common than PKO processing mills because it is much more difficult to extract PKO oil in comparison to CPO oil.

Figure 9. Roadside weighing stations in southern Ghana.

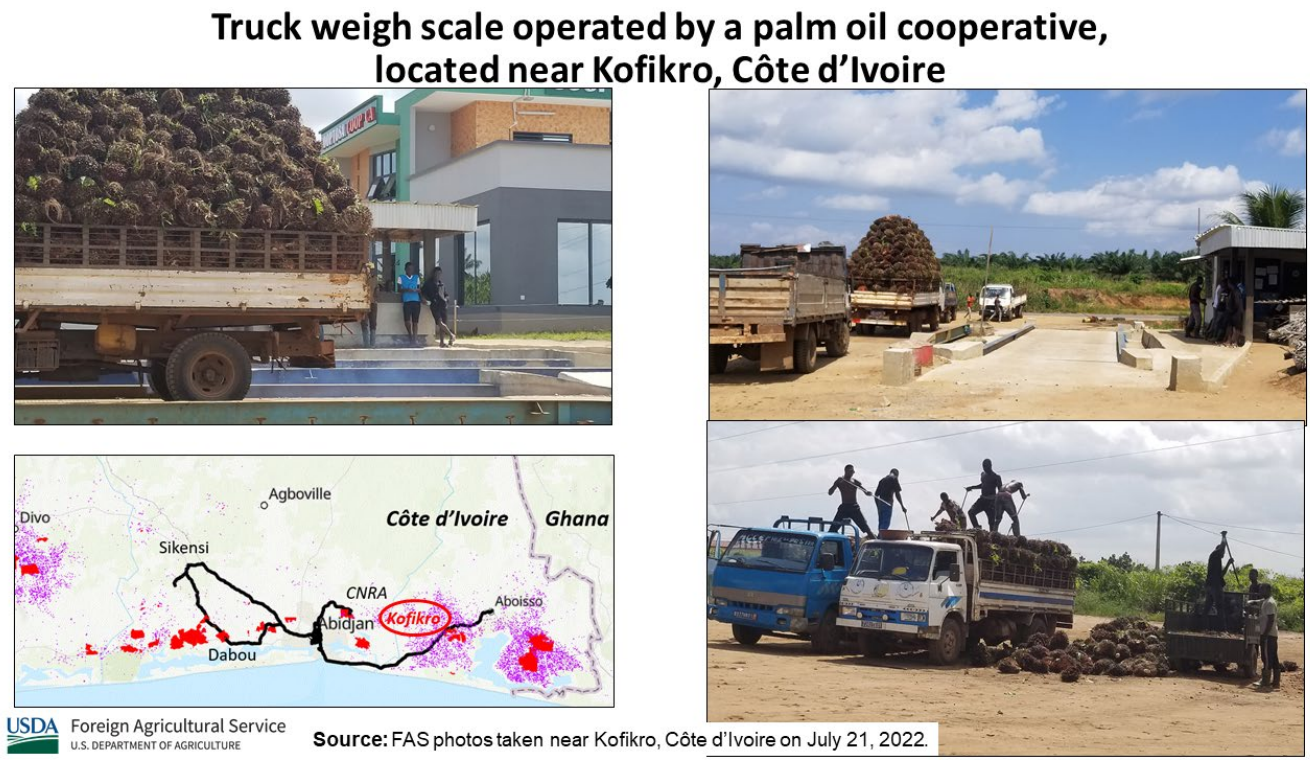

Figure 10.Truck weigh scale located near Kofikro, Côte d'Ivoire.

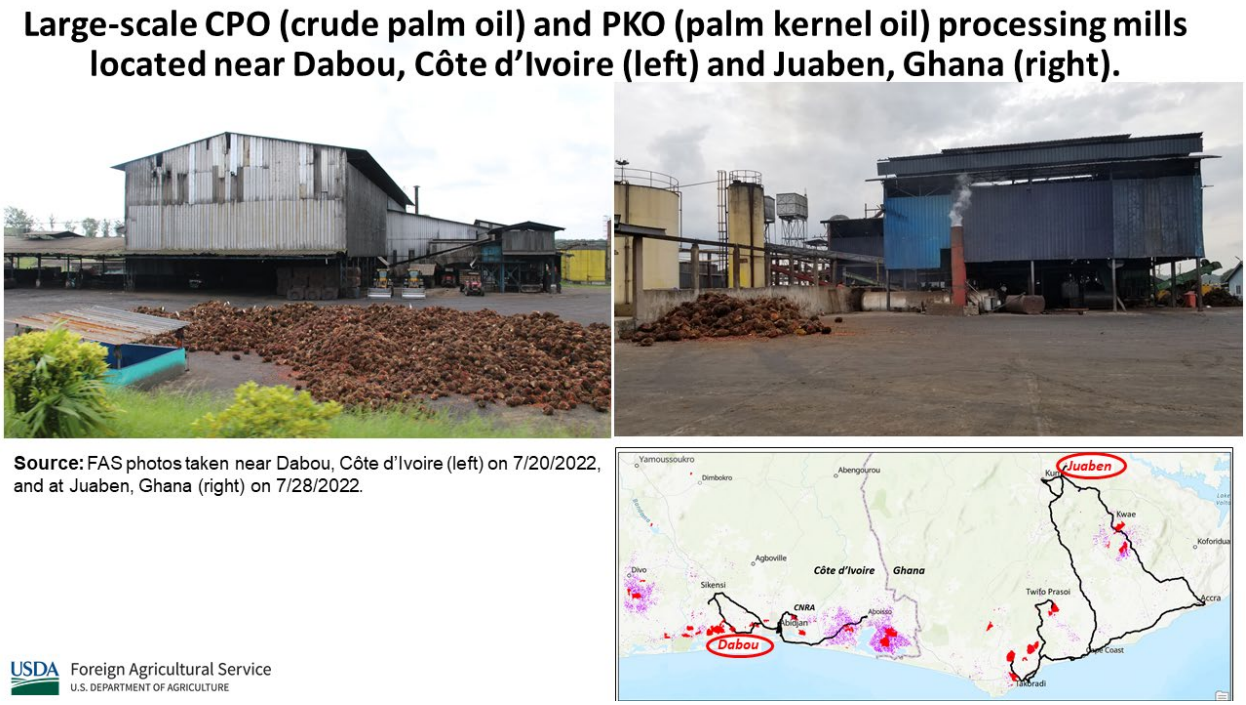

Figure 11. Large-scale CPO and PKO processing mills located near Dabou, Côte d'Ivoire (left) and Juaben, Ghana (right).

The quality of palm oil produced in Ghana is classified by free fatty acid content (FFA) and divided into three main market types (MASDAR, 2011 and Figures 12 to 14):

1. *FFA content from 5-12 percent:*
Accounts for over 90 percent of palm oil produced by village small-scale mills and is processed in the home by women in Ghana. It is the most popular vegetable oil used in preparing food in Ghana and by most people of African descent around the globe.
2. *FFA content greater than 12 percent:*
It is produced in commercial quantities by small-scale producers and is used in manufacturing the local soap. Indigenous soap manufacturers from Burkina Faso and Niger also source this grade of oil because of its relatively low price.
3. *FFA content less than 5%:*
International quality is mainly produced by medium- to large-scale mills which is used by industrial firms to manufacture 3 main products: soap, cooking oil, and margarine.

In summary, major production challenges in Côte d'Ivoire and Ghana include drought during the dry season months from November through March; expensive high-yielding seed varieties and seedlings; high fertilizer costs; high labor costs; high post-harvest losses; sub-optimal fertilizer applications; poor soil moisture conservation practices (i.e., mulching); poor road infrastructure; and low market prices offered at processing mills. Yields can be improved for all small-scale landholders by introducing improved hybrid seed varieties every 25-years when the palm oil tree is replanted.

Medium-scale artisan CPO processing mill located in southern Ghana

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Source: FAS photos taken in southern Ghana on 7/27/2022.

Figure 12. Medium-scale artisan CPO proecssing mill located in southern Ghana.

Medium-scale artisan CPO processing mill located in southern Ghana
(Diesel engine (left) operated by men and other tasks performed by women (right).)

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Source: FAS photos taken in southern Ghana on 7/27/2022.

Figure 13. Medium-scale artisan CPO proecssing mill located in southern Ghana.

Small-scale artisan CPO processing mill located near Sikensi, Côte d'Ivoire
(Operated by a woman and her family on their family house plot.)

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Source: FAS photos taken near Sikensi, Côte d'Ivoire on 7/19/2022.

Figure 14. Small-scale artisan proecssing mill at Sikensi, Côte d'Ivoire.

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Global Agricultural and Disaster Assessment System (GADAS)
https://geo.fas.usda.gov/GADAS/index.html