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# Overview of Ghana's Fertilizer Sector

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## Abstract

Historically using extensive rather than intensive agricultural systems, Ghana's—crop yields have remained low. With this trend gradually changing, yields of some crops such as cassava, cocoa, maize and oil palm recently registered annual growth rates higher than the increase in cultivated areas. However, there is still a significant gap between the current and the potential yield of the main food or cash crops—a situation that could change with the appropriate usage of fertilizer.

Despite the government's efforts to boost fertilizer adoption and increase crop yields, through the Plating for Food and Jobs program, the adoption of fertilizer remains limited, still below the Abuja target of 50 kilograms per hectare.

This report provides an overview of the fertilizer sector in Ghana, focusing on understanding the underlying reasons for the low application rates and finally exploring potential solutions to some of the issues identified.

In addition to the limited usage of fertilizers, authors found out the other important reasons behind the low yields are the use of inappropriate fertilizers for Ghanaian soils and crops, reliance on imports instead of producing more country-specific blends, lack of availability of fertilizers in some localities, no access to credit to the down payment required to buy the fertilizers and a complex land tenure system that hinders access to land.


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Furthermore, fertilizer consumption varies considerably from year to year, in response to the quantities subsidized by national subsidy programs (in place since 2008). Around 70% to 80% of the fertilizer market is subsidized not only creating a significant dependence on the public budget but also limiting the development of a purely private market.

These gaps in the agricultural system present opportunities to promote specific fertilizer recommendations for all the main crops, produce and commercialize organic fertilizer, improve subsidy programs and use mobile-money to help smallholder farmers to finance fertilizers.

Keywords: Fertilizers; Ghana; Agriculture

# Contents

# 1. Agriculture Overview

Ghana's economy is based mainly on services and industry, with services having a 46.3% share of GDP in 2018 and industry 34%. Agriculture accounted for 19.7%, of which 73% came from crop production and the remainder from livestock, forestry and logging, and fishing activities (Ghana Statistical Service 2019). Between 2014 and 2018, agricultural GDP grew by an annual average of 3.4%, below the 6% target.[1]

In 2018, Ghana's agricultural sector employed 33% of the labor force, as estimated by the International Labour Organization (World Bank 2019). Although there is a pronounced downward trend in the share of the population working in this sector, it is still the backbone of Ghana's development. The World Bank described agriculture as "the main source of livelihood for the majority of the country's poorest households" (2017, 5). In 2012/2013, 82.5% of households in rural areas owned or operated a farm, along with 26.6% of those in urban areas, making a total of 3.4 million farms (Ghana Statistical Service 2014).

Ghana is divided in six agro-ecological zones (see Exhibit 1), with different climates, vegetation and soil properties. In general, the regions in the north of Ghana (containing the Sudan and Guinea savanna zones) have more challenging conditions for crop production, with limited rainfall (with only one rainy season, while the southern regions have two), higher dry temperatures and poorer soils. The north is also less economically developed, with a higher level of poverty and limited infrastructure.

More than 80% of agriculture is done by smallholder farmers, for subsistence or small-scale trading, in slots with parcels of less than 2 hectares of land.[2] Farming households consume around 65% of the crops they produce.[3]

The levels of natural organic carbon, nitrogen and phosphorus in the soil are generally very low although the southern regions, which have more forests and high humidity levels, perform better (Food and Agriculture Organization 2005).

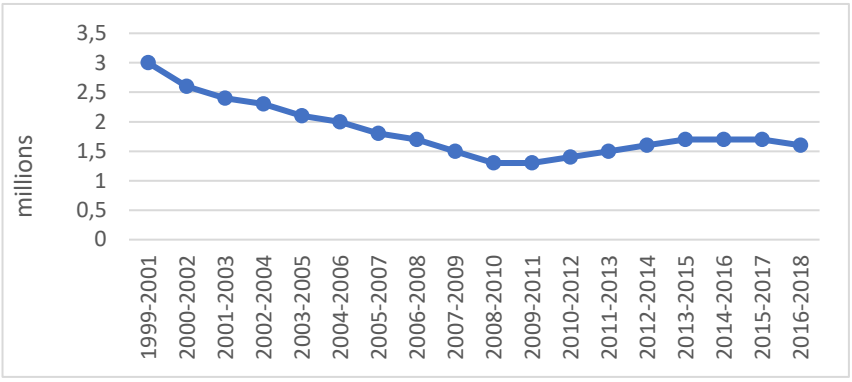
Between 2000 and 2015, the rate of undernourishment in Ghana declined from 15.6% to 5.5%, making it well below the 22.5% average rate for sub-Saharan Africa (FAOSTAT 2018). However, the absolute number of undernourished people slightly increased between 2008 and 2013, stagnating at around 1.6 million (see Figure 1), showing that Ghana's improved agricultural output (see Figure 3) has been an insufficient counterbalance to the growth in population.

[1] The 6% target was one of the goals established by the Comprehensive Africa Agriculture Development Programme, to which Ghana signed up in 2009, based on information from "Comprehensive Africa Agriculture Development Programme (CAADP)," Peace, Security and Development, Office of the Special Adviser on Africa, accessed April 8, 2019, https://www.un.org/en/africa/osaa/peace/caadp.shtml; "Comprehensive Africa Agriculture Development Programme (CAADP) –Ghana," Home, African Union Development Agency, accessed May 20, 2019, https://www.nepad.org/nepad-oncontinent/comprehensive-africa-agriculture-development-programme-caadp-ghana.

[2] Daniel Sarpong, "Policy options for smallholders and trade liberalization in Ghana," accessed May 29, 2019, http://www.fao.org/docrep/007/y5784e/y5784e04.htm.

[3] Calculated by the authors based on data from tables 8.6 and 8.14 of the *Ghana Living Standards Survey Round 6* (Ghana Statistical Service 2014), excluding the value of the production of cocoa (the main cash crop).

**Figure 1**
**Number of Undernourished People (Millions) (Three-Year Average)**

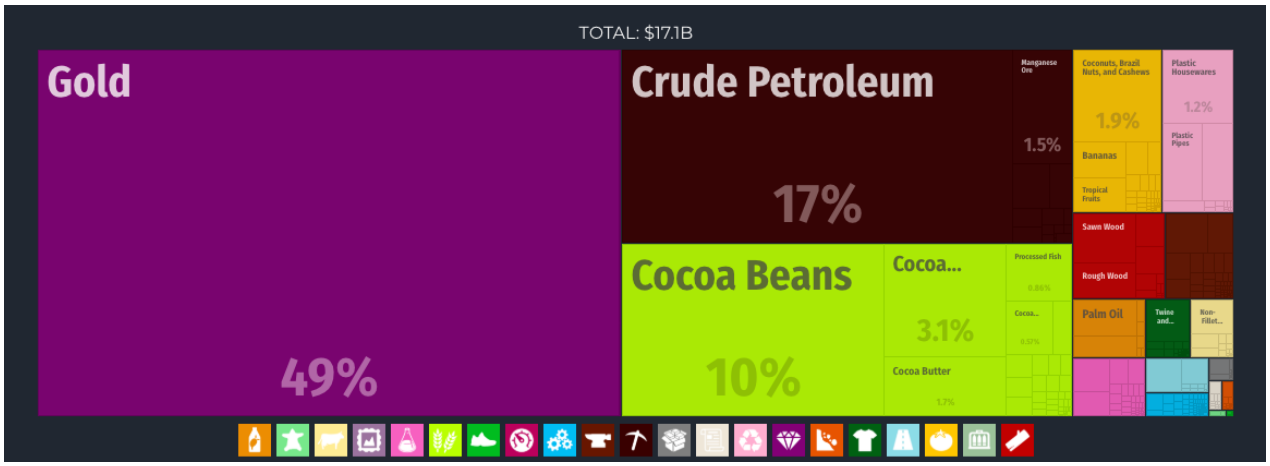



Source: Prepared by the authors, based on data from the Food and Agriculture Organization (2018).

## 2. Crops and Productivity

Cocoa is Ghana's most important agricultural export commodity, accounting for around 15% of exports (in the form of beans, paste, butter and powder), as shown in Figure 2. With annual production of 883,652 tonnes of cocoa beans (in 2017), almost all of this destined to help meet international demand, Ghana is the world's second-biggest producer and accounts for approximately 20% of the global market. In 2018, cocoa accounted for 1.6% of the country's GDP. Cashew nuts are the second main commercial crop for export (1.9% of exports), followed far behind by vegetal oils and tropical fruit.

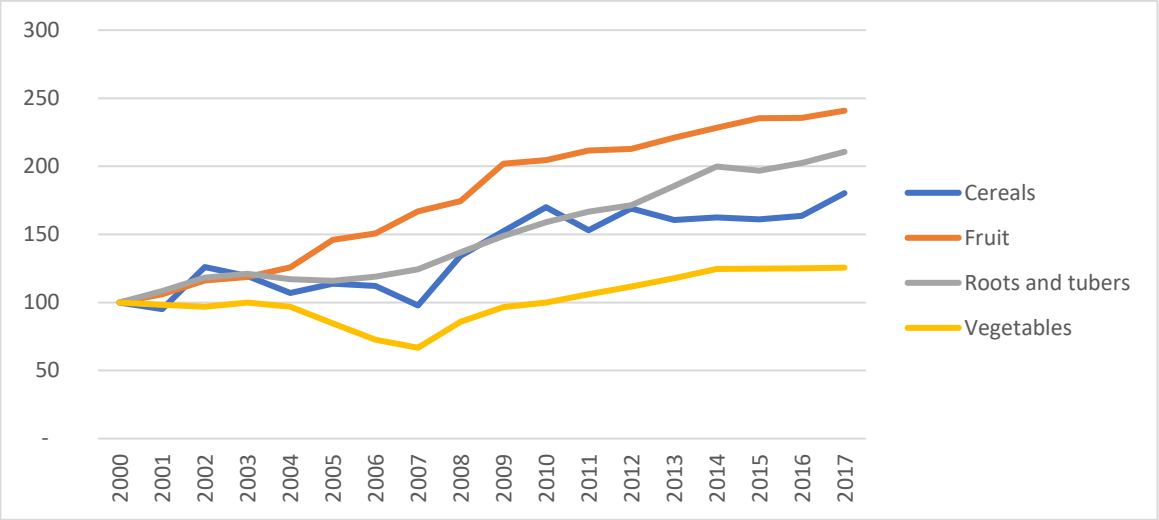
**Figure 2**
**Visualization of Ghana's Exports in 2017**




Source: "Ghana," Countries, Observatory of Economic Complexity, accessed June 7, 2019, https://oec.world/en/profile/country/gha/.

The agricultural output of food crops has increased moderately since 2000. (See Figure 3.) The compound annual growth rate (CAGR) ranged from 1.35% for vegetables to 5.35% for fruit, driven by a modest yearly increase of both the yield and the harvested area.

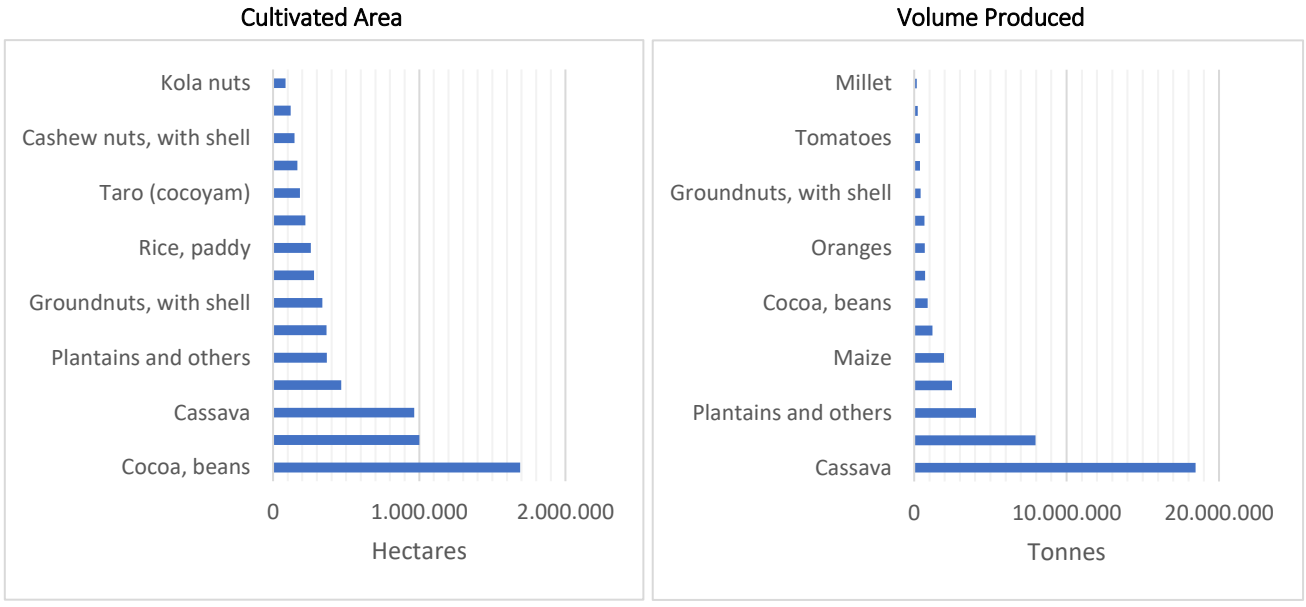
**Figure 3**
**Evolution of Production per Category of Food Crop, 2000-2017: Indexed to the Year 2000**




Source: Prepared by the authors based on data from the Food and Agriculture Organization (2017).

The main food crops are cassava, yams, plantains, oil palm, maize and taro (cocoyam). Figure 4 shows the top 15 crops by cultivated area and volume produced.

**Figure 4**
**Top 15 Crops by Cultivated Area and Volume Produced, 2017**

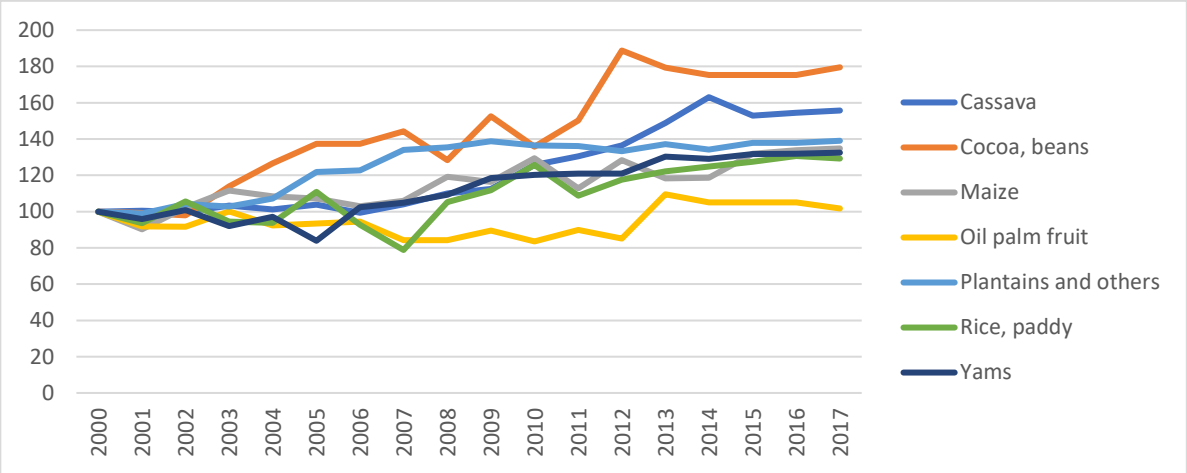



Source: Prepared by the authors based on data from the Food and Agriculture Organization (2017).
Note: "nes" means "not elsewhere specified."

Ghana's agricultural trade balance is positive, mainly due to the impact of cocoa exports. If the $1.8 billion of cocoa exports are excluded, the import and export values for agricultural products are virtually the same: around $1.3 billion (Food and Agriculture Organization 2016). The main imported products are rice, wheat, palm oil, sugar, chicken meat and tomatoes.

The yield of most of the important crops began to increase in 2000 (as shown in Figure 5), with the exception of palm oil. However, since 2013, the previously upward trend has stagnated, with little or no growth.

**Figure 5**
**Yield (Kilograms per Hectare) of Main Crops, Indexed to 2000 Levels**




Source: Prepared by the authors based on data from the Food and Agriculture Organization (2017).

The yields of some indigenous crops—such as cassava, cocoa, plantains and yams—are higher than the world average. Conversely, the yields of several other important products—such as maize, oil palm, rice and tomatoes—is considerably lower. (See Table 1.)

**Table 1**
**Comparison of Yield (Kilograms per Hectare) in Selected Territories, 2017**

| | Ivory Coast | Ghana | Kenya | World | Africa | West Africa |
|---|---|---|---|---|---|---|
| Cassava | 6,139 | 19,131 | 12,302 | 11,085 | 8,794 | 9,749 |
| Cocoa, beans | 490 | 523 | — | 443 | 454 | 461 |
| **Maize** | **1,958** | **1,965** | **1,523** | **5,755** | **2,073** | **1,639** |
| **Oil palm fruit** | **6,287** | **6,774** | **—** | **14,872** | **4,291** | **3,522** |
| Plantains and others | 3,731 | 10,992 | 12,145 | 7,105 | 5,759 | 6,601 |
| **Rice, paddy** | **2,557** | **2,790** | **2,718** | **4,602** | **2,444** | **2,128** |
| **Tomatoes** | **10,244** | **7,757** | **19,390** | **37,600** | **16,488** | **7,653** |
| Yams | 5,768 | 17,069 | 9,772 | 8,530 | 8,495 | 8,456 |

Source: Prepared by the authors based on data from the Food and Agriculture Organization (2017).

However, there is a significant gap between the current (2017) and the potential yields of all these crops, as shown in Table 2.

**Table 2**
**Current (2017) and Potential Yields of Selected Crops in Ghana, in Kilograms per Hectare**

| | Current | Potential | Gap (%) |
|---|---|---|---|
| Cassava | 19,131 | 45,000 | 135 |
| Cocoa, beans | 523 | 1,000 | 91 |
| Maize | 1,965 | 5,500–14,730 | 180–650 |
| Plantains and others | 10,992 | 38,000 | 246 |
| Rice, paddy | 2,790 | 8,290 | 197 |
| Tomatoes | 7,757 | 20,000–25,480 | 158–228 |
| Yams | 17,069 | 52,000 | 205 |

Source: Prepared by the authors based on data from the Food and Agriculture Organization (2017) for the current yields, and data from the Ministry of Food and Agriculture ("Planting for Food and Jobs," 2017) and the Ministry of Food and Agriculture ("Agriculture in Ghana," 2017) for potential yields.

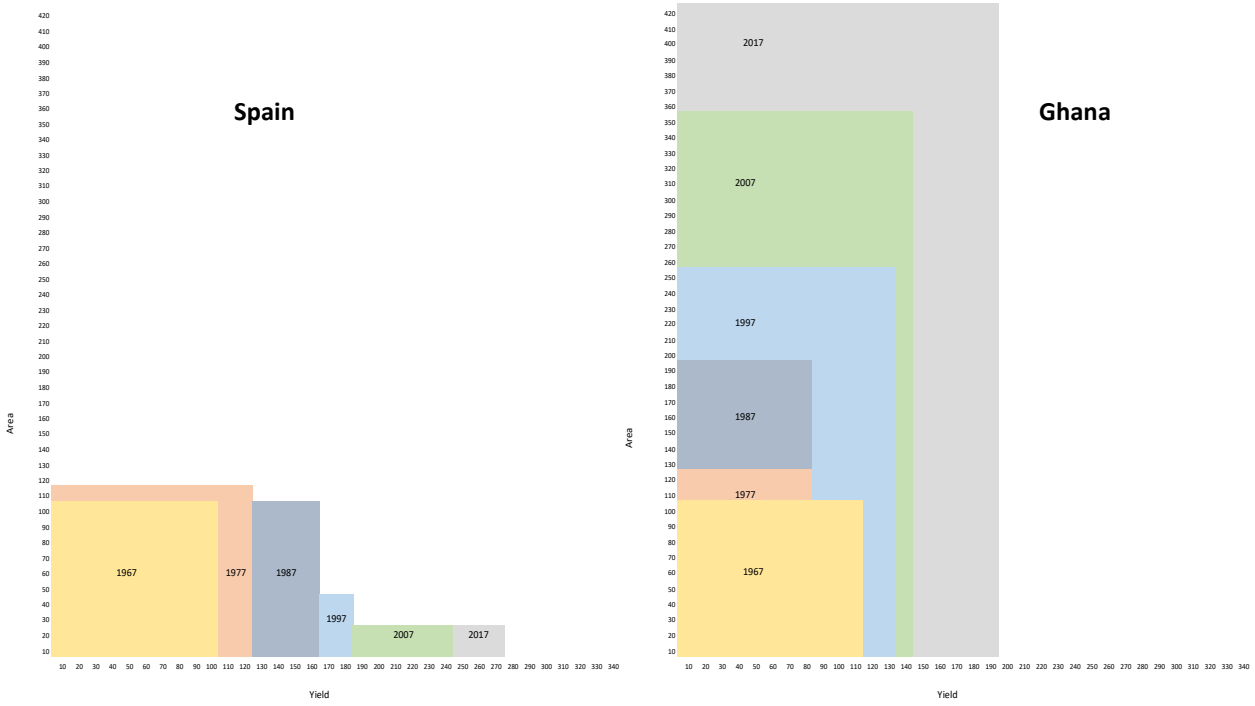
Note: Potential yields (also referred to as "achievable yields") are yields that have been achieved in benchmark cases, where there has been more effective extension and where recommended technologies have been used.

Several factors contribute to low crop productivity such as poor soil, low rainfall levels, limited availability of water or irrigation, adverse climatic conditions, inadequate agricultural techniques, little or no mechanization, the farmers being insufficiently educated or knowledgeable, lack of quality inputs such as seeds, pesticides and fertilizers, no access to organized output markets, and low crop prices.

Although all these factors play a role, in the case of Ghana one of the main causes of low yields is the historically used system of extensive agriculture, where farmers seek to produce greater volumes by increasing the harvested area, rather than intensifying productivity through mechanization, irrigation and the application of fertilizers.

A comparison of trends in the production of roots and tubers in Ghana and Spain provides a good example. In Spain, the yield (in hectograms per hectare) in 2017 was 2.6 times the yield in 1966, while the cultivated area was five times smaller. In Ghana in the same period, productivity increased by 1.8 times, while the cultivated area was 4.2 times bigger. Over those 50 years, the growth in production was mainly a result of intensification in Spain, while in Ghana the main driver was the expansion of the cultivated area. (See Figure 6.)

**Figure 6**
**Cultivated Area and Yield of Roots and Tubers in Ghana and Spain, 1966-2017**




Source: Prepared by the authors, based on data from the Food and Agriculture Organization (2017).

Between 1990 and 2017, the cultivated area of all the main crops increased by several times more than the yields (Table 3), overrunning other indigenous types of land cover, such as savannas, forests and woodlands.

Nevertheless, the trend is gradually changing. As shown in Table 4, from 2010 to 2017, for the first time the yields of crops such as cassava, cocoa, maize and oil palm registered annual growth rates higher than the rates of growth in cultivated areas.

Another issue affecting the sustainability of Ghana's agriculture in general, and the cocoa sector in particular, is the land-tenure system. In a 2017 publication about Ghana, the World Bank (2017) said:

> "Indigenous norms that regulate land ownership differ among communities and are usually associated with many shortcomings including undefined boundaries, unclear rights and titles, undocumented transactions and disputes which sometimes escalate into full-fledged conflicts." (10)

Later in the same publication, the World Bank emphasized that a "critical, but often neglected factor is that Ghana's largely traditional land-tenure system is not conducive to agricultural investment. Formal land registration processes remain highly inefficient, and landowners often lack enforceable titles, especially in rural areas." (33)

Therefore, farmers could face a double challenge: an inability to expand the cultivated area, and a lack of incentives to invest in fertilizers or irrigation systems for land over which they have no long-term guarantees.

Although an estimated 40% to 50% of Ghana's arable area is not under cultivation (Ministry of Food and Agriculture, *Agriculture in Ghana*, 2017), the increasing population density in rural areas, combined with a complex land-tenure system that hinders access to land, will prompt the country to use more intensive production methods and to achieve its full productivity potential. The greater adoption of appropriate fertilizers is fundamental to accelerating this change.

**Table 3**
**Growth Factor of Cultivated Area and Yield, 1990–2017**

| Ratio of final period/initial period | | |
|---|---|---|
| | Area | Yield |
| Cassava | 2.99 | 2.27 |
| Cocoa, beans | 2.44 | 1.24 |
| Maize | 2.15 | 1.65 |
| Oil palm fruit | 2.80 | 1.04 |
| Plantains and others | 2.85 | 1.78 |
| Rice, paddy | 5.28 | 1.69 |
| Tomatoes | 2.94 | 1.46 |
| Yams | 3.90 | 2.32 |

**Table 4**
**CAGR of Cultivated Area and Yield, 1990–2017**

| | 1990–2000 | | 2000–2010 | | 2010–2017 | |
|---|---|---|---|---|---|---|
| | Area | Yield | Area | Yield | Area | Yield |
| Cassava | 7.4% | 3.9% | 2.9% | 2.3% | 1.4% | **3.1%** |
| Cocoa, beans | 8.0% | −3.7% | 0.6% | 3.1% | 0.8% | **4.1%** |
| Maize | 4.1% | 2.1% | 3.6% | 2.6% | 0.1% | **0.6%** |
| Oil palm fruit | 2.1% | 0.2% | 8.4% | −1.8% | 0.2% | **2.8%** |
| Plantains | 6.6% | 2.5% | 3.0% | 3.2% | 1.7% | 0.3% |
| Rice, paddy | 8.9% | 2.7% | 4.6% | 2.3% | 5.2% | 0.4% |
| Tomatoes | 8.5% | 0.2% | 1.8% | 2.9% | 1.2% | 1.1% |
| Yams | 8.1% | 5.8% | 4.0% | 1.9% | 2.8% | 1.4% |

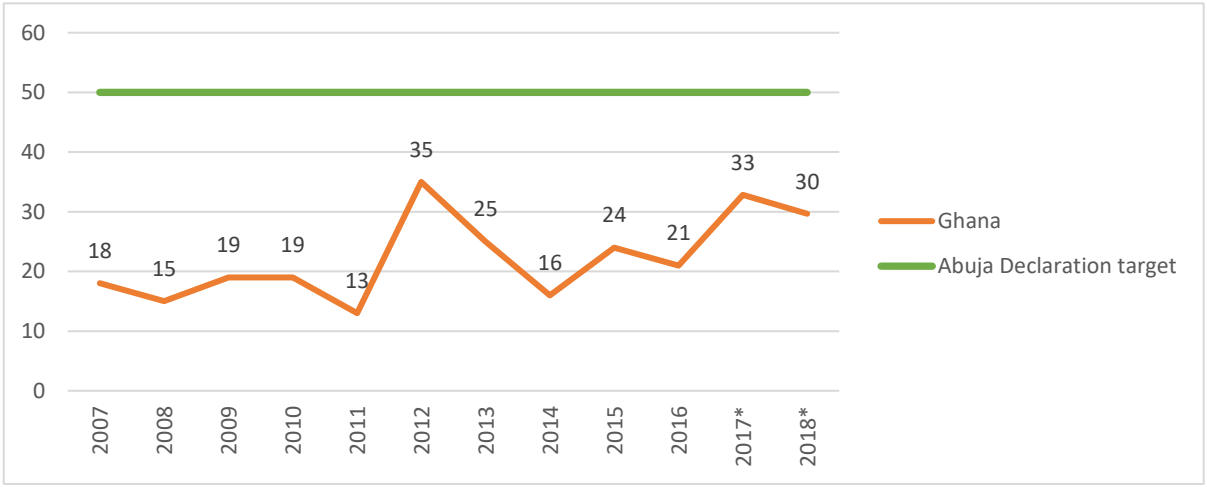
Source: Prepared by the authors based on data from the Food and Agriculture Organization (2017).

## 3. Fertilizer Consumption

Ghana's rate of fertilizer consumption (kilograms of nutrients per hectare of arable land) showed a slight positive trend over a 12-year period, increasing from 18 kilograms per hectare (kg/ha) in 2002 to 30 kilograms in 2018, with significant fluctuations. However, the rate is still lower than the target of 50 kg/ha for 2015 set in the Abuja Declaration[4] in 2006 (see Figure 87.)

[4] "The African Union Ministers of Agriculture convened in Abuja on 12 June 2006 for the Africa Fertilizer Summit," where, "given the strategic importance of fertilizer in achieving the African Green Revolution to end hunger, the African Union Member States resolve[d] to increase the level of use of fertilizer from the current average of 8 kilograms per hectare to an average of at least 50 kilograms per hectare by 2015" (African Development Bank Group, n.d.).

**Figure 7**
**Fertilizer Consumption in Ghana, 2007-2018 (Kilograms of Nutrients per Hectare of Arable Land)**




Source: Prepared by the authors based on data from the World Bank (n.d.).

Notes: The rate for 2017 was calculated by the authors based on the actual total consumption of nutrients of 154,200 tonnes (AfricaFertilizer.org, "Ghana," 2019) divided by 4.7 million hectares of arable land. The rate for 2018 was calculated by the authors based on the estimated consumption of nutrients of 139,319 tonnes divided by 4.7 million hectares of arable land.

Ghana's fertilizer consumption per hectare of arable land is still seven times lower than the world average (see comparison with other countries in Table 5).

**Table 5**
**Fertilizer Consumption in Selected Territories, 2017–2016 (Kilograms of Nutrients per Hectare of Arable Land)**

| Country | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ghana | 18 | 15 | 19 | 19 | 13 | 35 | 25 | 16 | 24 | 21 |
| Ivory Coast | 24 | 18 | 15 | 32 | 19 | 27 | 37 | 42 | 50 | 51 |
| Kenya | 36 | 33 | 32 | 30 | 44 | 34 | 39 | 43 | 29 | 38 |
| Nigeria | 4 | 6 | 5 | 12 | 7 | 9 | 16 | 13 | 8 | 5 |
| Sub-Saharan Africa | 14 | 13 | 13 | 16 | 15 | 15 | 15 | 16 | 15 | 16 |
| World | 124 | 120 | 120 | 129 | 134 | 135 | 137 | 139 | 138 | 140 |

Source: Prepared by authors with data from The World Bank (n.d.).

The total consumption of fertilizer has also varied significantly from year to year (Table 6), responding to changes in subsidy policies. Approximately 70% to 80% of the fertilizers used are subsidized, of which around 30% correspond to the Ghana Cocoa Board and 70% are part of subsidy programs run by the Ministry of Food and Agriculture. Therefore, just 20% to 30% of the fertilizers used are purely market-based and unsubsidized. (See section 5 for more details.)

As an example of the fluctuation in fertilizer consumption, the decrease in consumption in 2014 was due to the interruption of the national subsidy program. The increases in 2017 was mainly due to the introduction of two subsidy programs that were put in place in 2017: the Planting for Food and Jobs program and the normal fertilizer subsidy.

**Table 6**
**Import, Export and Apparent Consumption of Fertilizer in Tonnes, 2010–2018**

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| Consumption | 264,784 | 129,951 | 374,025 | 294,960 | 104,825 | 282,213 | 239,858 | 440,661 | 310,866 |
| Export | 10,967 | 100,639 | 33,274 | 37,740 | 16,203 | 333 | 25 | 3,575 | 4,291 |
| Import | 324,302 | 304,433 | 471,135 | 370,050 | 213,430 | 350,219 | 290,158 | 444,236 | 315,157 |

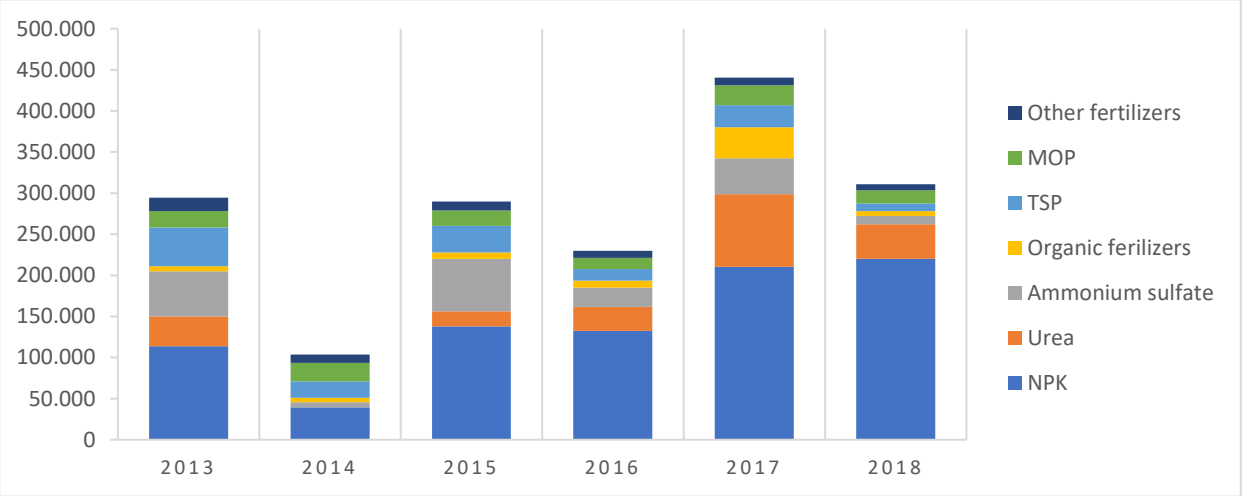
Source: AfricaFertilizer.org ("Ghana," 2019).

Note: The table refers to fertilizer as a product, not in terms of quantities of nutrients.

In terms of fertilizer adoption, in 2012/2013, out of a total of about 3.4 million households engaged in agricultural activities, is was estimated only about 991,210 (29%) purchased inorganic fertilizers. This kind of Fertilizer represented 16.3% of the farming households' production costs, second only to hired labor costs (30.9% of the total costs) (Ghana Statistical Service 2014). Considering that fertilizer demand in the years covered by the *Ghana Living Standards Survey Round 6* were similar to 2018 levels, it is likely that the share of farmers using fertilizer is still around 30%. The same survey also contained another interesting fact: 51.9% of the farmers reported that sometimes fertilizers were unavailable to buy, which was the highest percentage among all the inputs.

In terms of macronutrients, the proportion of nitrogen (N), phosphorus (P) and potassium (K) vary, with the share of nitrogen increasing. (See Exhibit 2.) The main fertilizer products consumed in Ghana are the NPK compounds. (See Figure 8.)

**Figure 8**
**Consumption of Different Fertilizer Products in Tonnes, 2013–2018**




Source: AfricaFertilizer.org ("Ghana," 2019).

Notes: The table refers to fertilizer as a product, not in terms of quantities of nutrients.

NPK is a fertilizer whose macronutrients are nitrogen, phosphorus and potassium. Urea and ammonium sulfate are nitrogen-based, while TSP or triple superphosphate fertilizer has a high concentration of phosphorus. MOP (muriate of potash) is also known as potassium chloride and contains concentrated potassium.

One of the main challenges faced by the sector is the adoption of NPK 15-15-15. This is the preferred compound among farmers but it is not the most appropriate formulation for Ghanaian soils and crops. After an attempt to remove it from the list of subsidized products in the 2019 version of the Planning for Food and Jobs program, the Ministry of Food and Agriculture restored its subsidy at the request of farmers and producers.

This preference seems to be a result of the inertia brought about by the fact that, historically, Ghana used blanket fertilizer recommendations. Fixed fertilizer dosages were prescribed for large regions without considering variability in soils, climate, and agricultural techniques. The specific conditions of each subregion or agro-ecological zone was not considered. In addition, the use of micronutrients[5] and inorganic fertilizers continues to be very limited.

This jeopardizing practice—also widely used in other countries in sub-Saharan Africa—is a consequence of a combination of historical factors:

- insufficient research on the specific needs of African soils and crops;
- lack of knowledge and training among farmers;
- high availability of NPK 15-15-15 on international markets (to attend to the high demand of developed countries for which the formulation is appropriate); and
- lower prices of NPK 15-15-15 than other formulations, due to economies of scale.

In the case of Ghana, the government has been working with research institutions to develop improved recommendations, and include these country-tailored formulations in the subsidized Planting for Food and Jobs (PFJ) program, encouraging "local private companies [to blend] micronutrients such as Ca, Mg, S, Fe, Zn, B, Mn, Mo and Cu with major nutrients (N. P and K)"(Ministry of Food and Agriculture, 2017) and educating farmers on its adoption. However, on the supply side, local companies had difficulties blending and providing the aforementioned formulations, while on the demand side, the offtake has also been low.

## 4. Origin of the Fertilizers

Because there is no production of inorganic fertilizer in Ghana, all of the country's fertilizer products are imported—either in bulk or in compounds.

Some of the leading importing companies (Yara Ghana, Chemico Limited, Microfertil, and OmniFert) invested in blending facilities, allowing them to import in bulk and create different formulations adapted to the country's soil needs. However, the five existing blending plants—with a combined capacity of around 700 t—have been operating at very low capacity, an

[5] Micronutrients are usually referred to as "secondary nutrients such as calcium (Ca), magnesium (Mg), sulfur (S), which are required by plants in the range of 5-40 kg/ha, and the true micronutrients zinc (Zn), boron (B), copper (Cu), iron (Fe), manganese (Mn), and molybdenum (Mo), which are required in much smaller quantities of usually less than 1 kg/ha. When micronutrients are lacking, response to the NPKs can be severely restricted. In some cases, yields can be doubled by micronutrient additions." (IFDC 2019)

indication that the consumption of more customized and crop and soil-specific formulations has not yet taken off. In fact, in 2017, virtually all the NPK used was imported already blended.

The countries of origin of fertilizers vary substantially from year to year. In 2017, the top five were Morocco, Finland, Estonia, China, and Italy (AfricaFertilizer.org, "Ghana," 2019).

Nigeria, the closest large nitrogen and urea producer, is not among the main exporters to Ghana. In fact, two thirds of Nigera's production exports go to Brazil. This is due, in part, to the fact that Nigeria produces granular urea (preferred for mechanized applications and usually slightly more expensive), while West African markets are used to prilled urea. Indeed, most of the tenders in the region specify a preference for prilled urea. In addition, the market for nitrogen-based fertilizer is global, with overcapacity and more competitive than phosphate and potash-based products (which production is concentrated over fewer players).

The Ghanaian government is working with OCP Group—the state-run Moroccan company, a leader in phosphate-based fertilizers—in assessing a project for developing a plant, in Ghana, for converting natural gas to urea, thus taking advantage of the country's large natural gas reserves. Should the project be implemented, it will diversify and complement OCP's portfolio, allowing the company to combine the production of urea in Ghana with its Moroccan phosphate products and to commercialize compounds such as DAP (N+P) and NPK. The project also fits in with OCP's strategy to increase its presence in Sub-Saharan Africa, whose market remains underdeveloped and has tremendous growth potential. The Ghanaian economy, on the other hand, could potentially reap several benefits, including: lower and more stable fertilizers costs (by minimizing maritime freight costs and reducing foreign exchange risk), improvement of balance of payments, job creation, and adding value to the country's nascent natural gas industry.

Indeed, a considerable amount of natural gas is still being flared in the country (apparently due to infrastructure bottlenecks). If this wasted natural gas were used, it would be enough to produce 479 thousand tonnes of urea, as shown in Table 7, which represent more than ten times the country's demand for urea in 2018.

**Table 7**
**Potential Production of Urea with Natural Gas Flared in 2018**

| Gas extracted (MMscf) | Gas sold (MMscf) | Gas flared (MMscf) | Potential urea production with flared gas (tonnes) |
|---|---|---|---|
| 108,726 | 34,394 | 7,193 | 479,554 |

Assumptions: 1 MMscf = 1.100 MMbtu; 1 ton of ammonia requires 30 MMbtu of gas; 1 ton of urea requires 0.55 tons of ammonia.

Source: Prepared by the authors using natural gas amount data (amounts extracted, sold, and flared) from (Petroleum Commission, Ghana n.d.).

Such an ambitious project would have to mitigate some important risks, such as:

- Unsteady natural gas supply; due to infrastructure limitations, the natural gas supply in Ghana has been unreliable since extractions began in 2014 and 2015, and it has not been able to meet the needs of the power sector (thus far the main consumer of natural gas). In the event of a disruption in gas supply, power generators could be prioritized over fertilizer plants, given the public and essential nature of electricity.

- Natural gas prices applied in Ghana are relatively high, which could limit the capacity to produce urea at a competitive price.
- The demand for fertilizers in Ghana is not enough to absorb the production of a sizeable urea plant. To achieve a cost-competitive scale, an urea plant should aim for an annual production of between 1 and 1.5 million tonnes, well above the 88,000 tonnes of urea consumed in Ghana in 2017.
- To address the regional market, the plant will have to compete in the global urea market with a overcapacity, and more specifically with the new Nigerian urea plants (Dangote and Indorama) although apparently these companies have not been focusing on African markets.

## 5. Subsidy Programs

Ghana introduced fertilizer subsidies in 2008, as a reaction to increasing food prices. Since then, the programs have been run by the Ministry of Agriculture and Food, generally targeting smallholder farmers that produce food crops—although every year there are changes in terms of quantity of fertilizers subsidized, the value of the subsidies (percentage of the final price to be subsidized), the beneficiaries (number of farmers and criteria to choose them), and the distribution methods. At the same time, the Ghana Cocoa Board (COCOBOD) runs its own fertilizer subsidy program for cocoa producers.

In 2014, the subsidy program was suspended due to public budget limitations; consumption consequently dropped to one-third of previous year. In 2015, subsidies were restored through the National Fertilizer Subsidy Programme.

In 2017, in addition to the above program, the government launched the Planting for Food and Jobs Programme (PFJ), a flagship project of the new government that aims to increase agricultural production and productivity, adopting “an integrated comprehensive approach that will substantially increase the availability of inputs (seeds and fertilizers) and the accessibility to input and output markets.” (Ministry of Food and Agriculture 2017).

The PFJ Programme not only supplies fertilizer and seeds at highly discounted market prices, but also provides extension services (technical assistance) and aims to create better output markets works (increasing warehousing capacity and market linkages). It is estimated that the fertilizer subsidies supplied through the PFJ will cost about $400 million over the 2017-2020 period (not including subsidies provided to the cocoa sector).

Recently, the National Fertilizer Subsidy Programme was integrated within the PFJ in order to avoid the excessive complexity of running two different subsidy programs. The key aspects of the PFJ are:

- Beneficiaries: smallholders with farms of up to 2 hectares that produce any type of crop. In 2018, 677,000 farmers benefited, and 1 million are to be targeted in 2019
- Crops: food crops such as maize, rice, sorghum, soybeans, groundnut, cassava, cowpea, orange flesh melon, sweet potato, plantain, yam, cabbage, lettuce, carrot, cucumber, tomato, pepper, and onion

- Benefit: farmers can buy up to 10 bags of compound fertilizer (such as NPK) and five bags of urea (for two hectares), at a fixed retail price that is approximately 50% of the market price. The price is the same for all regions. According to the Strategic Plan For Implementation of the PFJ, "the farmer will pay half of the subsidized price (i.e, 25% of the total cost) at the time of collecting the inputs (down payment) and pay the remaining half (i.e, 25% of the total cost) after the crop is harvested." (Ministry of Food and Agriculture, *Planting for Food and Jobs*, 2017).[6]

- Procurement and distribution: the government runs a tender to select the private fertilizer companies that will supply the fertilizers the following year. Companies are selected based on price offered, strength, and distribution network. In 2019, 34 out of 70 bidding companies were selected and each of them was given a quota of fertilizers to supply. The companies are responsible for importing and distributing the fertilizers to the retail shops, where the registered farmers can buy them at the fixed price. A waybill system is used, in which the companies invoice the government for the remaining 50% of the price that is not covered by the farmer.[7]

- To deter smuggling, all fertilizers are packaged with PFJ labels. Fertilizer is sold in 25 kg bags in the northern regions—to make fertilizer more affordable to the smaller and poorest farmers of the northern region—and 50 kg in the southern regions.

- Organic fertilizers are also subsidized.

The effectiveness of agriculture input subsidy programs remains a highly debated and discrepant development topic in sub-Saharan Africa (SSA). The main drawbacks of such programs are usually that:

- it crowds out commercial, non-subsidized, fertilizer demand;

- the yield response to fertilizer is lower than estimated; and

- the programs can become financially unsustainable or limited, as they depend on public expenditure.

In the case of Ghana, although it is difficult to assess if the national fertilizer programs have helped or are instead jeopardizing the development the fertilizer private sector, the truth is that is that approximately 70% of the demand still comes through subsidized programs. Therefore, one of the main challenges that the PFJ should address is using subsidy resources in a way in which beneficiaries perceive the advantages (increased income) of using fertilizers, and keep using them in subsequent years, even without subsidies or with lower ones (also known as an "exit strategy"). Hence, the program could benefit more farmers over the years, without increasing public expenditure and while helping to develop the private market.

[6] Despite this stipulation, the authors were not able to confirm that such methodology (25% down payment and 25% after harvest) is actually being applied.

[7] There have been attempts to introduce voucher/coupon systems in the past. The PFJ implementation document (Ministry of Food and Agriculture, *Planting for Food and Jobs*, 2017) mentions the vouchers as the system to be used, but the attempts to implement it were apparently unsuccessful.

In addition to the lack of an "exit strategy," other issues and complaints regarding the subsidy programs in Ghana in previous years have been:

- untimely distribution of fertilizers (beyond the recommended period of application) and lack of fertilizer in some regions;
- smuggling of subsidized fertilizers to neighboring countries;
- blanket recommendations;
- fertilizer quality issues;
- weak governance and cases of corruption (diversion of fertilizers);
- late payment to importers and distributors, that have to bear with high working capital costs and foreign exchange rate risks.

## 6. Prices

The prices of the fertilizer subsidized through the PFJ are determined at the beginning of the year, in general at 50% of the market price at the time. Table 8 shows the subsidized prices fixed for 2019, and the commercial (non-subsidized) prices observed in July 2019.[8]

**Table 8**
**Subsidized and Commercial Prices of Fertilizer – 2019**

| Fertilizer | Retail price (Subsidized) | COMMERCIAL price |
|---|---|---|
| NPK, all types | GHS 75 per 50 kg bag (approx. $15) | GHS 109 per 50kg bag (approx. $21.80) |
| Urea | GHS 70 per 50 kg bag (approx. $14) | GHS 111 per 50kg bag (approx. $22.20) |
| Organic, granular | GHS 45 per 25 kg bag (approx. $9) | |
| Organic, compost | GHS 20 per 50 kg bag (approx. $4) | |
| Organic, liquid | GHS 19 per liter (approx. $3.80) | |

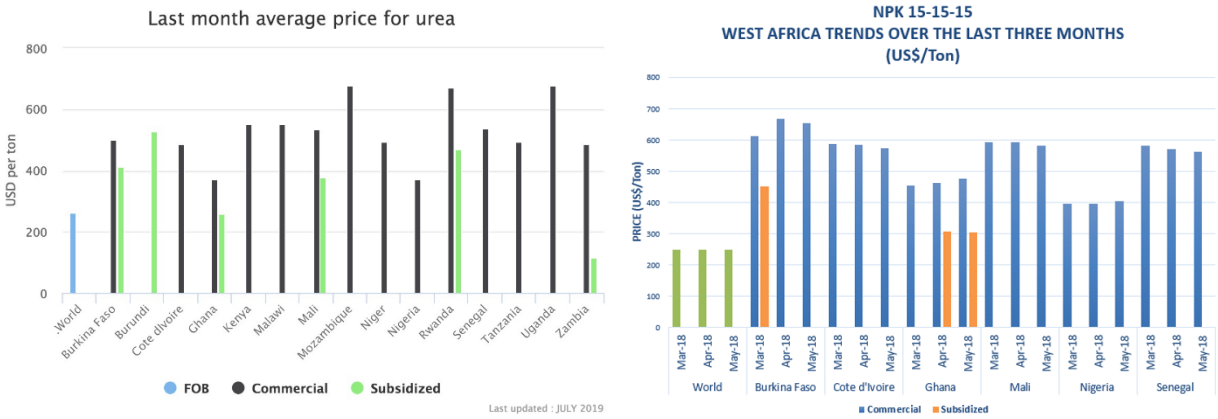
Source: Subsidized prices from the Ministry of Food and Agriculture (2019). Commercial prices: Prepared by the authors; averages calculated using data from July prices from AfricaFertilizer.org ("Retail Fertilizer Prices," 2019).

Note: Exchange rate used: 1 US dollar = 5 Ghanaian cedis.

Retail prices in Ghana are among the lowest in Sub-Saharan Africa; even commercial prices (non-subsidized) are significantly lower than those observed in neighboring countries, with the exception of Nigeria (See Figure 9 and Figure 10.)

[8] Subsidized fertilizer price was set at 50% of the market price (according to the tender results) at the beginning of the year, so in July the commercial price may have varied—the subsidized/market price relationship is therefore not fixed.

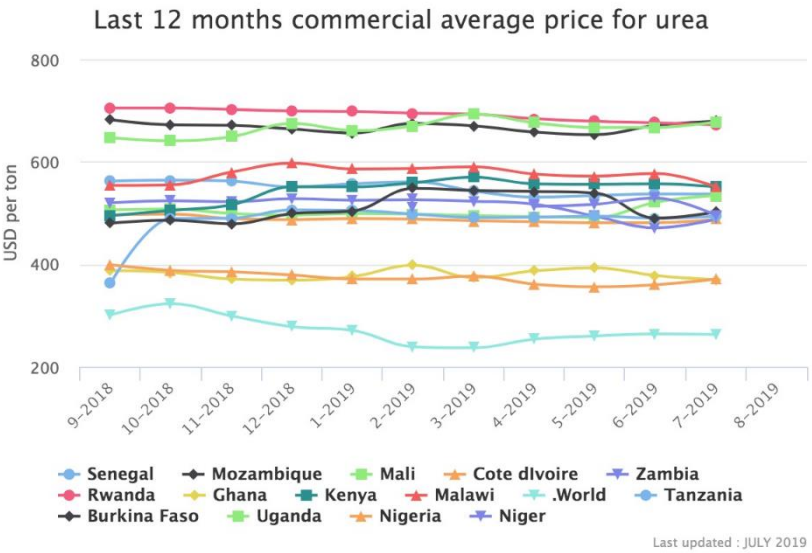
**Figure 9**
**Comparison of Urea and NPK Retail Prices in Selected African Countries**




Source: AfricaFertilizer.org ("National Fertilizer Prices," 2019).

Note: "World" refers to Freight on Board (FOB) prices, not retail prices.

**Figure 10**
**Comparison of Commercial Urea Prices in Selected African Countries in the Last 12 Months**




Source: AfricaFertilizer.org ("National Fertilizer Prices," 2019).

Note: "World"refers to Freight on Board (FOB) prices, not retail prices.

The retail prices of 50 kg non-subsidized bags in Ghana are in line with the prices that can be found in competitive markets in developed countries.

Some of the hypotheses[9] for the reason behind such relatively low retail prices are:

- the prices of subsidized fertilizers are pushing commercial prices down, which could indicate that they are, to some extent, competing;
- non-subsidized fertilizers are somehow benefiting from the import and distribution value-chains of subsidized fertilizers (for example, through economies of scale in transportation); and
- diversion of subsidized fertilizers are still occurring massively, being sold at low commercial prices through illicit markets.

Although fertilizer prices are relatively low, what really determines how affordable fertilizer prices are for a farmer is the relation between their cost and the return obtained by the potential yield increase (and ultimately, revenue increase).

In Table 9, we compare—from the farmers´ perspective—the cost of using fertilizers in one hectare (five bags of NPK and two and a half bags of urea, following the PFJ's recommended dosage) and the potential return (value-cost ratio) for the additional revenues that could be obtained (taking into account that the yield would achieve its maximum potential). We selected three crops whose productivity is lower than world averages.

**Table 9**
**Comparison of Fertilizer Costs and Additional Revenue Obtained When Yield Potential is Achieved (For 1 Hectare)**

With Subsidized Fertilizer Prices:

| | Fertilizers cost - subsidized (A) | Revenue with current yield (B) | Additional revenue with potential yield (C) | Value-cost ratio (=C/A) | % Revenue to cover fertilizer costs (=A/B*100) |
|---|---|---|---|---|---|
| Maize | 550 | 1,376 | 2,475 | 4.5 | 40.0% |
| Rice, paddy | 550 | 2,511 | 4,950 | 9.0 | 21.9% |
| Tomatoes | 550 | 19,393 | 30,608 | 55.7 | 2.8% |

With Non-Subsidized Fertilizer Prices:

| | Fertilizers cost - non-subsidized (A) | Revenue with current yield (B) | Additional revenue with potential yield (C) | Value-cost ratio (=C/A) | % Revenue to cover fertilizer costs (=A/B*100) |
|---|---|---|---|---|---|
| Maize | 800 | 1,376 | 2,475 | 3.1 | 58.1% |
| Rice, paddy | 800 | 2,511 | 4,950 | 6.2 | 31.8% |
| Tomatoes | 800 | 19,393 | 30,608 | 38.3 | 4.1% |

Source: Prepared by the authors. Note: See data and assumptions used in Exhibit 3.

The above tables reveal that, for example, if the potential yield is obtained, farmers planting maize could recover 4.5 times the amount spent on subsidized fertilizers (or 3.1 times if using non-subsidized fertilizers). According to the literature, a return higher than two provides enough

[9] Despite these hypothetical possibilities, the authors did not find evidence that these phenomenon are taking place.

incentive for farmers to use fertilizers. However, the upfront cost to buy fertilizers (the down payment) could require up to 58% of the current revenues.

The above analysis also indicates that, unlike other countries in the region, fertilizer prices per se are probably not the biggest barrier for farmers, as there is a potential attractive return on the investment (although the economics vary depending on the specific crop, season, and fertilizer prices) and ostensibly, there is little room to decrease fertilizer prices further. However, the lack of cash to bear the upfront costs could make fertilizers unaffordable. Therefore, facilitating credit (instead of or in addition to subsidies) could be a powerful tool to boost fertilizer adoption.

## 7. Conclusions and Opportunities

The yield of Ghana's main food products and cash crops remains significantly below the country´s potential, and the production of additional quantities has been primarily driven by extending cultivated areas, rather than intensifying production by using fertilizer and mechanization.

Despite the expenditures in fertilizer subsidy programs (in place since 2008), the adoption of fertilizer remains limited and is still below the Abuja Declaration's target of 50 kg per hectare. Fertilizer consumption varies considerably from year to year, responding to the quantities subsidized.

Through the Planting for Food and Jobs Programme, launched in 2017, smallholder farmers (up to two hectares) planting food crops and vegetables can benefit from fertilizers at 50% off market prices. The program aims to benefit one million farmers in 2019 (out of a total of 3.4 million) and adjustments are being made every year to address issues such as the smuggling or diversion of subsidized fertilizers, cases of corruption, quality of fertilizer, and recommended dosages.

Below, we recap the main challenges that persist through the fertilizer´s value chain, and include some could be are:

### Market primarily driven by public expenditure

Issue: Around 70% to 80% of the market is subsidized, creating a high dependence on public budget and limiting the development of a purely private market.

Opportunity/potential solution: Create exit strategies for the fertilizer subsidy programs. This means that, after receiving subsidized fertilizers for a time, farmers should have increased their revenues and be able to buy fertilizers at market price. Therefore, every year the program should target new farmers who are not using fertilizer yet. This would help to develop the commercial (non-subsidized) fertilizer market, at the same time that the subsidy program could reach more farmers without increasing the public expenditure.

### Products

Issue: Historically, Ghana relied on blanket recommendations of fertilizers; NPK 15-15-15 is the most commonly adopted compound, but it is not the most appropriate for Ghanaian soils and crops. Also, formulations including micronutrients have not traditionally been used. Although the PFJ is trying to address this situation—recommending specific dosages for different regions

and crops and including micronutrients in their formulations—the problem persists. The usage of "inadequate" or non-ideal fertilizer blends and dosages could be one of the reasons behind low yields (in combination with low application rates).

Opportunities/potential solutions:

- Extensive soil analysis is required, to develop and promote specific fertilizer recommendations for all the main crops in Ghana's different regions. Ghana has qualified public institutions and research centers to develop this area. Even so, the private initiative could help to address the problem, harnessing on technology. One example is Zenvus, a Nigerian company that developed a portfolio of technological solutions – using from sensors to drones - to provide farmers with deep insights on soil needs and crops health.
- Building on these bespoke analyses, there will be an opportunity to encourage the use of fertilizers blended in Ghana and tailored to the country's soil and crop formulations, increasing the use of the existing blending facilities.

### Affordability

Fertilizer prices (subsidized and non-subsidized) are relatively low in Ghana, when compared with neighboring countries. In theory, with such prices, farmers could obtain attractive returns on their investment (if higher yields are indeed achieved with the recommended dosages). However, with current low yields, farmers may not have enough revenue to make the required down payment.

Opportunities/potential solutions:

- Facilitate access to credit to farmers who are receiving subsidized fertilizers and also those who are not so they can afford the down payment for fertilizer. A revolving fund could be an interesting tool.
- In terms of access to credit, the gap between smallholder farmers and financial institutions could be bridged by harnessing mobile-money technology and by adopting innovative credit assessment methods, based on the example of what FarmDrive is doing in Kenya.
- Building on the customized, country-tailored recommendations, fertilizer companies can create and market smaller and more affordable fertilizer packages for specific crops, to encourage farmers to try a particular fertilizer in a limited area first. The extra income accrued through the higher yield obtained will finance the purchase of larger quantities of fertilizer later. For example, Yara, one of the leading fertilizer distributors, sells a kit with the recommended amount of all the different fertilizers necessary to fertilize just 100 cocoa trees.

### High dependence on imports

Issues: There is no local production of fertilizers, and most fertilizers are imported from overseas (the intra-African fertilizer market remains very limited).

Opportunities potential solutions:

- Increasing the local production and commercialization of organic fertilizer, for use in conjunction with mineral fertilizer, could offer an alternative solution not just to increase domestic supply, but also to reduce the problem of affordability and availability. Lono, for example, is an Ivorian biotechnology start-up company that produces biogas and biofertilizers from raw materials collected by farmers. The company rewards farmers who collect raw materials with points called biocredits, which can be exchanged for cash (mobile money) or products such as compost, biofertilizers and biopesticides. So, Lono has found an innovative way to encourage farmers to collect raw materials, while offering them a financing solution to purchase fertilizers and cooking fuel.
- The OCP Group and Ghanaian government plans to build a natural-gas-to-urea plant, taking advantage of the country's natural gas reserves, can be beneficial for the Ghanaian fertilizer market.
- Encourage the usage of the existent blending facilities, that could provide more country-specific blends.
- Besides, stakeholder of the fertilizer industry should continue to make efforts to create a West African market, to facilitate the trading activities across the region, establish common standards, and create economies of scale. A regional market will generate more opportunities for companies to expand their businesses and revert at lower prices for the end customer.

**Financial constraints**

Issue: Import and distribution activities demand high working capital to finance a lengthy supply chain. The process from importing fertilizers to selling them and receiving the payment can take months. Also, importers participating in the subsidy programs reported delays on the payments. The high dependence of private companies on the subsidy programs to sell their products and a scenario of the devaluation of the Ghanaian cedi makes the fertilizer market risky.

Opportunities/potential solutions: Financial institutions could create credit lines adapted to the fertilizer market - for example accepting the companies' fertilizer stocks as collateral. For that, the bank and the company have to agree upon strict controls to monitor the stocks in the warehouses through the supply chain.

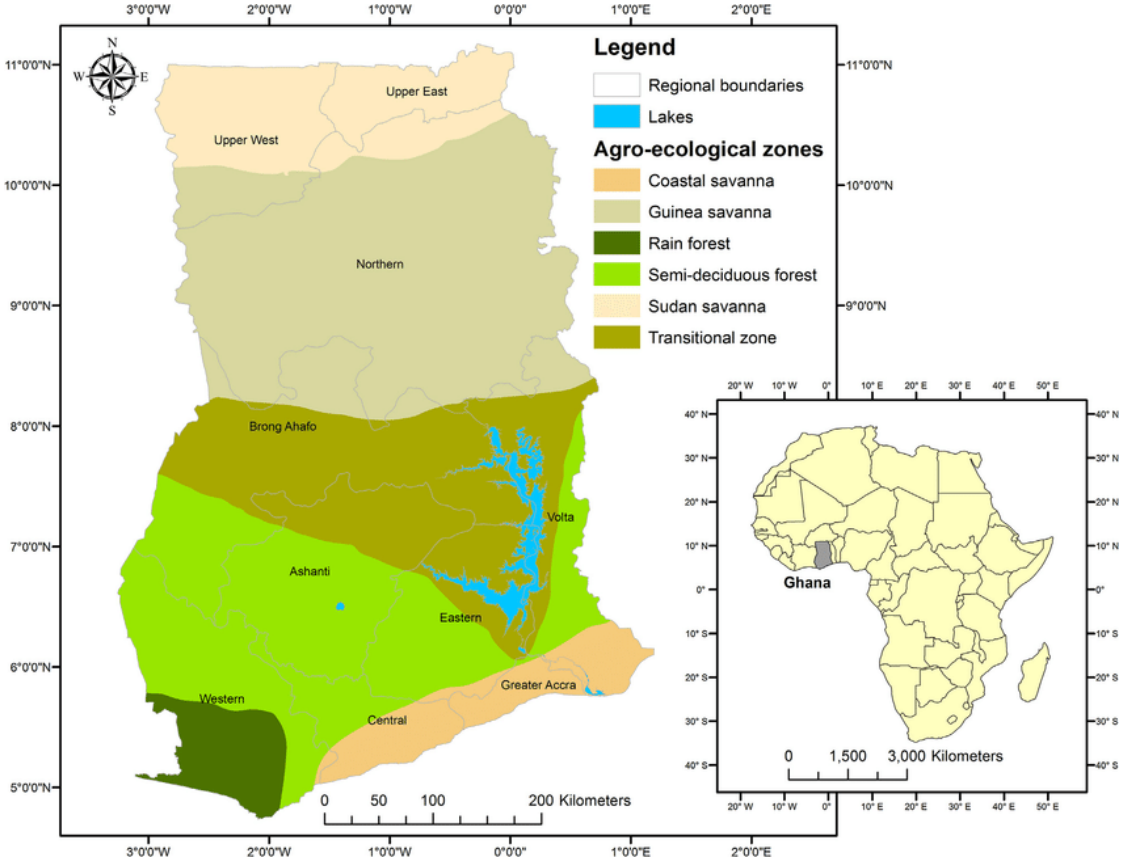
**Distribution and Availability**

Subsidized fertilizers are not always delivered on time. Delays in obtaining and applying fertilizers compromise their effectiveness. Indeed, commercial and/or subsidized fertilizers are not always available in some localities. Smuggling and diversion of subsidized fertilizer also occurs somewhat frequently.

Opportunities/potential solutions: improve tracking and monitoring and payment systems to guarantee that fertilizers are delivered to farmers and that payments are made on time throughout the supply chain. New information and communications technologies, such as e-voucher systems, could help.

# Exhibit 1

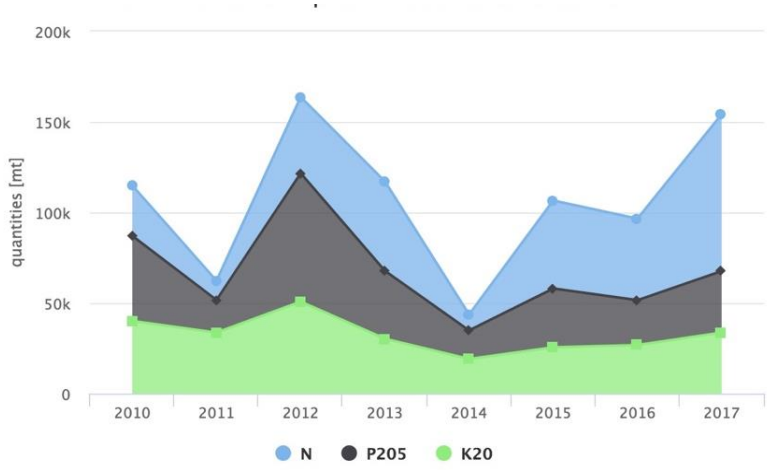
## Map of Agro-Ecological Zones in Ghana




Source: Tiemen Rhebergen et al., "Climate, soil and land-use based land suitability evaluation for oil palm production in Ghana," European Journal of Agronomy 81 (2016): 1-14, https://www.researchgate.net/publication/307569254_Climate_soil_and_land-use_based_land_suitability_evaluation_for_oil_palm_production_in_Ghana.

# Exhibit 2

Fertilizer Consumption by Nutrient, 2010–2017




Source: AfricaFertilizer.org ("Ghana," 2019).

# Exhibit 3
Data Used to Calculate the Results Shown in Table 9

| | Current yield (kg/ha) | Potential yield (kg/ha) | Crop price at farm gate (GHS/kg) | Recom. Fertilizer dosage (bags/Ha) | | Subsidized cost of fertilizer (GHS/bag) | | Non-subsidized cost of fertilizer (GHS/bag) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | NPK | Urea | NPK | Urea | NPK | Urea |
| Maize | 1,965 | 5,500 | 0.7 | 5 | 2.5 | 75 | 70 | 109 | 101 |
| Rice, paddy | 2,790 | 8,290 | 0.9 | 5 | 2.5 | 75 | 70 | 109 | 101 |
| Tomatoes | 7,757 | 20,000 | 2.5 | 5 | 2.5 | 75 | 70 | 109 | 101 |

Sources:

Current yield: Food and Agriculture Organization (2017).

Potential yield: Ministry of Food and Agriculture ("Planting for Food and Jobs," 2017) and the Ministry of Food and Argriculture ("Agriculture in Ghana," 2017).

Crop price at farm gate: Ministry of Food and Agriculture ("Planting for Food and Jobs," 2017).

Recommended fertilizer dosage: Ministry of Food and Agriculture ("Planting for Food and Jobs," 2017).

Subsidized cost of fertilizer: Ministry of Food and Agriculture (2019).

Non-subsidized cost of fertilizer: averages calculated using data from July prices from AfricaFertilizer.org ("Retail Fertilizer Prices," 2019).

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