Chapter 14
Socio-economic Determinants and Trends on Fertilizer Use in West Africa

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Abstract A large number of people in Africa continue to grapple with food and nutrition insecurity largely due to insufficient food availability, inadequate incomes coupled with high rates of unemployment, risk and vulnerability as well as inadequate access to basic services. The situation has been exacerbated by emerging global socio-economic trends, population increase, land degradation, climate change and an undeveloped agricultural sector among many other causes (Bationo and Egulu, Status of implementation of Abuja declaration, 2013). It is estimated that Africa's 226.4 million people are chronically hungry (FAO 2012).

Food security has been threatened in African countries since the past decades due to the decrease in soil fertility, poor use of improved technology and low investment in agriculture. These had impacted negatively on crop yields, overall agricultural production and development of African countries. The situation has been a concern to African leaders who converged to the Africa Fertilizer Summit of Abuja in 2006 to discuss and prescribe some solutions to remedy the issues. At this meeting, it was noted that Africa has the lowest rate of fertilizer application. The continent has a fertilizer application rate of about 8 kilograms per hectare, which is far below the global average of 50 kilograms per hectare.

A 12-point resolution was therefore developed at the end of the summit that was aimed at achieving the global average of fertilizer use by 2015. The resolution, which was known as the Abuja Declaration on Fertilizer for an African Green Revolution spells out measures and actions that must be taken to accelerate the accessibility, availability and affordability of fertilizers in the region.

On the production side, the average annual increase of cereal yield in Africa is about 10 kg ha^{-1}, corresponding to extensive agriculture neglecting external inputs like improved seeds and plant nutrients (Bationo et al. 2004). Due to a high population growth rate (3%) compared to cereal grain yield (<1%) (Gruhn et al. 2000), cereal production per capita has decreased from 150 kg/person to 130 kg/ person over the last 35 years, whereas Asia and Latin America realized per capita food increase from 200 kg/person to 250 kg/ person during the same period.

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Although some effort are underway to improve agricultural productivity in West Africa through the increased use of improved inputs including fertilizers, it is important to notice that food insecurity is still threatening many African countries. Some scientists support that the increase in yields of the food crops has been largely due to land expansion rather than crop productivity improvement potential. There is ample evidence that increased use of inorganic fertilizers has been responsible for an important share of world-wide agricultural productivity growth. Efficient fertilizer use can stimulate production growth, improve food and nutrition security and reduce poverty through income growth for farmers and lower food costs for consumers. Nevertheless production increase in Africa is mainly attributed to area increase than productivity increase (Table 14.1).

Fertilizer was as important as seed in the Green Revolution contributing as much as 50% of the yield growth in Asia (Wigg and Hopper 1993). Several studies have found that one-third of the cereal production worldwide is due to the use of fertilizer and related factors of production (Bumb 1995, citing FAO and Van Keulen and Breman 1990). A diagnosis analysis of fertilizer demand in West Africa showed some level of improvement since the Abuja Summit and more specifically after the food crisis of 2008. For instance, fertilizer consumption in the 15 ECOWAS countries was 1,020,000 tons with an average rate of 9 kg/ha in 2006, while it was estimated in the 8 WAEMU countries plus Chad at 1,025,000 tons with an average rate of 15 kg/ha in 2012 (Mando 2013).

On 30 June–1 July 2013, the Food and Agriculture Organization in collaboration with the African Union Commission, and the Institute Lula convened a high level meeting in Ethiopia, Addis Ababa. The meeting put together African and International Leaders to deliberate and endorse a radical approach to end hunger in Africa by 2025 building on renewed partnerships within the CAADP Framework. The present paper is an attempt to analyze the socio economic determinants of fertilizer use in West Africa since the declaration of Abuja. It will also point out progress made and their impact on agricultural outputs and people livelihood in West Africa. It will be based on recent studies conducted on fertilizer and agricultural outputs in Africa. Some indicators like fertilizer use rate and consumption, economic return of fertilizer use, effect of fertilizer use on natural resources and livelihood, and new trends in fertilizer use will be developed to show progress achieved since the Abuja Summit.

Keywords Fertilizer use • Determinants • Statistics and trends

Contents

14.1 Introduction

According to The Fertilizer Institute (TFI 2002), fertilizers account for more than 50% in the increase of productivity. It contributes to farmers' welfare through the generation of additional incomes. Efficient use of fertilizers can stimulate production growth, improve food and nutrition security and reduce poverty through income growth for farmers and lower food costs for consumers. Fertilizer was as important as seed in the Green Revolution contributing as much as 50% of the yield growth in Asia (Wigg and Hopper 1993). Several studies have found that one-third of the cereal production worldwide is due to the use of fertilizer and related factors of production (Bumb 1995, citing FAO and Van Keulen and Breman 1990). In most part of the word, the average use of fertilizer ranges from 73 kg of nutrients per hectare of arable land in Latin America to 135 kg/ha in East Asia. In West Africa the rate is it recently estimated at only 12 kg/ha (IFDC 2015). Table 14.1 shows some figures and selected African countries.

Sub-Saharan African countries count among the most affected in the world by food shortage and growing poverty. Although the conditions of high demand for fertilizer exist, yields remain low to meet the intensification of agriculture. At the same time, the agricultural yields of major crops have stagnated or declined in Sub-Saharan Africa but it continues growing in other parts of the world.

Some evident factors hinder the effective growth of fertilizer demand and the organization of fertilizer industry. This situation does not facilitate the creation of favorable conditions to supply the fertilizer market effectively. Nevertheless trends in fertilizer use especially in fertilizer consumption and fertilizer use rate have been increasing in West Africa during the last decade.

Many studies have shown the positive correlation between the growth of agricultural productivity and the use of fertilizers (TFI 2002). The situation of low productivity of agriculture in the SSA could have led to increased use of fertilizer. Unfortunately, the market is not properly supplied with required fertilizers and farmers' needs are not fulfilled.

The current study is a compilation of some facts and evidence on improvement in fertilizer use determinants in West Africa and progress made on fertilizer consumption indicators since the Abuja declaration. Statistics on fertilizer use in Africa compared to other parts in Africa and the World have been presented to support the concepts developed. The study also provides with some tracks to improve fertilizer supply and use in Africa.

Table 14.1 Fertilizer use in selected African countries 2006–2011

Country	Area cultivated in 2006 (1000 Hectare)	Total nutrient used (+) in 2006	Nutrient used per ha (kg/ha) in 2006	Area cultivated in 2011 (1000 hectare)	Increase in cultivated land 2006–2011 (%)	Nutrient used in 2012(−) in 2011	Nutrient used per ha (kg/ha) in 2011	Increase in fertilizer used per ha 2006–2011 (%)	Cost of imported fertilizers in 2006 (1000 USD)	Cost of imported fertilizers in 2011 (1000 USD)	Increased in cost of fertilizer 2006–2011 (%)
Algeria	7470	99,172	13	7510	0.53	127,033	17	30.7	33,073	66,137	99.9
Egypt	2605	1,283,931	493	2870	10.2	1,686,880	588	19.2	29,543	81,613	176.25
Morocco	8064	482,639	60	7944	−1.5	577,416	73	21	119,791	150,701	25.8
Ethiopia	12,923	149,111	12	14,565	12.7	316,308	22	83	45,671	75,544	65.4
Kenya	5310	182,489	34	5500	3.67	152,529	28	−17.6	2040	NA	NA
Tanzania	9700	57,115	6	11,600	19.68	102,998	9	50	70,862	129,767	83.1
Zambia	3013	77,372	26	3400	12.8	186,132	48	84.6	79,482	166,745	109.7
Madagascar	3000	7399	2	3500	16.6	11,058	3	50	2113	4498	112.8
South Africa	12,600	818,271	67	12,033	−4.5	748,010	62	−7.4	585,010	725,831	24
Burkina Faso	4700	63,000	13	5700	21.3	61,004	11	−15.3	20,336	48,272	137.3
Ghana	4200	84,251	18	4860	15.71	137,533	28	55.5	NA	NA	NA
Mali	5677	99,355	18	6860	20.8	174,437	25	38.8	73,522	174,437	137.2
Nigeria	37,000	369,431	10	36,000	−2.7	151,999	4	−60	247,424	71,018	−71.2
Malawi	3300	117,657	36	3600	9.1	107,435	30	−16.6	35,622	209,179	487.2
Total	**119,562**	**3,891,193**	**32.5**	**125,942**	**5.3**	**4540,772**	**36.1**	**11.4**	**1,344,489**	**1,903,742**	**41.5**

Source: From FAO and from various countries' studies; data compiled by Bationo and Klutse

14.2 Facts on Fertilizer Use in West Africa

14.2.1 Economic Return of Fertilizer Use

Widespread adoption of fertilizer depends on its profitability, which depends on input and output prices as well as on the strength of the fertilizer response.

Pieri (1989) reporting on fertilizer research conducted from 1960–1985, confirmed that inorganic fertilizers, in combination with other intensification practices, had tripled cotton yields in West Africa from 310 to 970 kg ha^{-1}. Table 14.2 summarizes historical data on the yield potential associated with fertilizer use for the main food crops in different agro-ecological zones of Africa, comparing results from (1) on-station trials representing maximum fertilizer response, (2) on farm trials representing intermediate results, and (3) farmers traditional practices using no fertilizers.

From the above, it appeared that maize can increase by 650% over control in farms conditions without fertilizers compared to yield in research station and by 340% in farmers' field conditions with fertilizer use. Other crops' yield like rice can increase from two to four folds over control in farmers without fertilizer compared to fertilizer use in farmers' field using fertilizers and on research station. Increase with cassava using fertilizers is also high as illustrated in the mentioned table.

In a comprehensive review of fertilizer response and profitability research in Africa, Yanngen et al. (1998) found that contrary to conventional wisdom, there

Table 14.2 Yield potential with fertilizer use in West Africa

Crop	Actual yields in farms without fertilizer (Control)	Yield on-station with fertilizer (Kg/ha)	Increase over control (%)	Yield in farmers' field with fertilizer(Kg/ha)	Increase over control (%)
Irrigated rice West Africa (kg/ha)	3000	8000	167	6000	100
Upland rice West Africa	1000	4000	500	2500	150
Low land rice West Africa	1500	5000	233	3000	100
Cassava West Africa	8000	47,000	487	35,000	337
Maize West Africa	800	6000	650	3500	337
Sorghum West Africa	600	3000	400	1800	200
Cowpea-West Africa	300	2000	567	1000	233

Source: Bationo et al. (2013)

Table 14.3 Percentage annual increase in crop yields of selected food crops due to land expansion and crop improvement potential in West Africa

Crops	Area (%)/year	Productivity (%)/year	Production (%)/Year
Cassava	2.6	0.7	3.3
Maize	0.8	0.2	1.0
Yam	7.2	0.4	7.6
Cowpea	7.6	−1.1	6.5
Soybean	−0.1	4.8	4.7
Plantain	1.9	0.0	2.0

Source: www.fao.org

Table 14.4 Fertilizer incentives; Summary of key indicators by crop and region

		Kg of output/kg of nutrient use (Agronomic Efficiency)			Profit Incentives (V/C Ratio)	
Type of crop	Region	Typical	Min	Max	Min	Max
Maize	East & Southern Africa	17	2	52	1	15
	West Africa	15	0	54	0.69	26
	Latin America	10	5	18	1.2	5.3
Cotton	East & Southern Africa	5.8	0	7	0.00	3.1
	West Africa	5	2	12	0.61	3.7
Rice (irrigated)	West Africa	12	7	16	1.6	3.97
	Asia	11	7.7	33.6	1.5	3.1
Sorghum	East & Southern Africa	10	4	21	1.5	2.6
	West Africa	7	3	14	1	18
	Latin America	7	2.8	21		

Source: Adapted from Yanngen et al. (1998)

were numerous examples of fertilizer response and profitability in Africa that compared favorably to those in other parts of the world. The typical and maximum kilograms of output per kilogram of fertilizer (a measure of agronomic efficiency) for rice and maize research reviewed by Yanngen et al. (1998) were frequently equal to or higher than responses obtained in Latin America and Asia respectively. But production increase was largely due to land increase rather than yield increase as shown in Table 14.3.

Maximum value/cost ratios (an indicator of potential profitability) for maize were as high as 26 and those for rice were 4; both were well above a value/cost ratio of 2 used as a threshold level of profitability thought to stimulate on-farm fertilizer adoption. The column 6 in Table 14.4 showing the minimum value/cost ratios obtained for different crops illustrates, however, one of the key fertilizer adoption challenges for Africa that is the risk factor. The low level of minimum VCR explains in some extends farmers' aversion for fertilizer use. This is mainly due to the non mastery of climate conditions in agriculture that limits farmers' investments in any production system without water control.

Some key indicators are used to measure the profitability of fertilizer use:

- the input/output ratio assesses the agronomic efficiency of fertilizer;
- the value/cost ratio uses only the cost of fertilizer that enables an increase of a certain amount of yield, and
- the benefit/cost ratio uses fertilizer and associated costs such as application labor, transport, and additional harvest labor. It is calculated by dividing the total discounted *value* of the benefits by the total discounted value of the costs.

The Tables 14.5 and 14.6 show that agronomic efficiency is two folds higher at research station than on farm level for all cultivated types of rice. The VCR ranges from a minimum amount of 2 at harvest in farm conditions to a maximum value of 6 on station at the highest market price for all cultivated categories of rice. These values express low risk in using fertilizer for all cultivated rice and emphasize on the profitability of fertilizers use on rice. For the BCR that ranges from 0.9 to 5.4 there is very little risk to lose money but high opportunity to get profit by using fertilizer on all categories of cultivated rice. For cassava the three indicators show some high return potentials through the use of appropriate fertilizers. In microdosing conditions where little fertilizers are used, the three indicators point out profit by using fertilizers but with low returns showed by the BCR values and high potential profit with VCR on all types of crops.

14.2.2 Environmental Analysis of Fertilizer Use

Soil nutrient depletion is a major bottleneck in increasing land productivity in the region and has largely contributed to poverty and food insecurity. Soil nutrient depletion occurs when nutrient inflows are less than outflows. Nutrient balances are negative for many cropping systems indicating that farmers are mining their soils of nutrient reserves. The negative effects of nutrient outputs exceeding inputs, manifested in negative nutrient balances and the deficiencies of major nutrients are attributed primarily to non-useful outflows such as burning/removal of biomass, leaching, volatilization, erosion losses of nutrients and the lack of water and waste recycling in agricultural systems.

Considerable export of nutrients is through harvestable products that are the goal and objective of agricultural production. Results from Nutrient Monitoring (NUTMON) (Gachimbi et al. 2002) studies demonstrate that for efficient return to increased agricultural production, enhanced nutrient availability will have to initially depend on the extent to which farmers minimize or eliminate non-useful outflows including residue burning, the loss of nutrients especially N through leaching, volatilization and denitrification and through loss of nutrients by erosion.

Nitrogen is commonly deficient and limits crop production in cultivated soils of the tropics (Sanchez 1976). For most farmers in SSA, the use of mineral N fertilizers is limited due to the high prices and low profitability (McIntire and Fussel 1986). One of the options is to source N from organic inputs, intercropping and

Table 14.5 Yield response and profitability indicators for rice and cassava in West Africa

Variables	Irrigated rice	Upland rice	Lowland rice	Cassava West Africa
1. Crop Yield Without Fertilizer (Kg/ha)	3000	1000	1500	8000
2. Crop Yield With Fertilizer: - On-Station (Kg/ha)	8000	4000	5000	47,000
3. Crop Yield With Fertilizer: - On-Farm (Kg/ha)	6000	2500	3000	35,000
4. Quantity of N, P205, K20 Applied (Kg/ha)	120 N, 60P205, 0 K20	60 N, 69P205, 36 K20	60 N, 69P205, 36 K20	60 N, 92P205, 48 K20
5. Total Nutrients (Kg)	180	165	165	200
6. Type of fertilizers (e.g. urea, DAP etc.. . .)	Urea, Dap	Urea, NPK (15-15-15)	Urea, NPK (15-15-15)	Urea, TSP, KCL
7. Agronomic Efficiency:- On-Station (Kg/Kg)	27.8	18.2	21.2	195.0
8. Agronomic Efficiency:- On-Farm (Kg/Kg)	16.7	9.1	9.1	135.0
9. Cost of Fertilizer Applied ($/ha)	225	186	186	300
10. Other cost associated with fertilizer used ($/ha)	9	9	9	20
12. Price of Crop at Harvest ($/Kg)	0.2	0.3	0.3	0.2
13. Price of Crop at the highest market price ($/Kg)	0.3	0.4	0.4	0.3
14. Value cost ratio:- On-station at harvest	4.3	3.8	4.5	24.4
15. Value cost ratio:- On-station at the highest market price	6.4	5.4	6.3	36.6
16. Value cost ratio:- On-farm at harvest	2.6	1.9	1.9	16.9
17. Value cost ratio:- On-farm at the highest market price	3.8	2.7	2.7	25.3
18. Benefit cost ratio on station at harvest	3.3	2.8	3.5	23.4
19. Benefit cost ratio on station at the highest market price.	5.4	4.4	5.3	35.6
20. Benefit cost ratio on farm at harvest	1.6	0.9	0.9	15.9
21. Benefit cost ratio on farm at the highest market price.	2.8	1.7	1.7	24.3
22. Scientist providing the data	Bado	Bado	Bado	Fening

Source: Adapted from Bationo and Egulu (2013), Tabo et al. (2006), Tabo et al. (2007)

rotations with N fixing crops and through managed fallows using improved leguminous fallows (Tian et al. 2001). It is also often reported that the inadequate use of mineral sources of nitrogen adversely affects soil structure (Klutse 2008).

Another negative effect often pointed out by agricultural products are health issues. Although fertilizers can modify the structure of agricultural products, there is no tangible study that reveals the direct negative effect of nutrients on human health. Nevertheless some literatures emphasized on the heavy metal residues from fertilizers in soils and products that have negative effect on human health. There is need to enhance quality control mechanism in the region to check the level of any negative item in fertilizers that can affect human being (Klutse et al. 2012).

14.2.3 Gender Issue in Fertilizer Use

The *State of Food and Agriculture 2010–2011* estimates the female share of the agricultural labor force at almost 50%. Prospects for increasing agricultural productivity require taking into account needs of women not least productive inputs namely, fertilizer, land and labor, credit and information services. Considering that women farmers are still vulnerable in farming as in other labor markets, it would be strategic for Member States to address the fertilizer needs of women, for example by special packaging in smaller affordable bags, targeted vouchers or even credit.

Similarly, other specific categories such as youth, vulnerable groups and civil society organizations requirements should be considered. Another aspect of fertilizer use in West Africa is cultural behavior linked to risk aversion for failure in using fertilizers (Klutse 2013). Risk aversion is a threat that is often viewed by small scale farmers as too great to take without some type of insurance or risk mitigation assistance. This social attitude is in link with a low level of control on production conditions like rainfall, floods, drought, and plant diseases. This attitude limits the use of fertilizers and is correlated with low purchase power of the majority of producers in SSA.

14.3 Trends in Fertilizer Use in West Africa

In 2006, The Abuja Summit stated that Africa's fertilizer use averaged only 8 kilograms per hectare, that was only 10% of the world's average. To improve the situation, the African Union Member States resolve 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. Since the end of the Summit, fertilizer consumption indicators have recorded some changes. Through the concepts of availability, accessibility and affordability, various indicators that characterizing trends in fertilizer use will be presented in West Africa.

14.3.1 Availability

The concept availability determines the amount of fertilizers that is physically supplied in a geographical coverage for the need of an intended users. It can be captured through the importation and the balance of previous agricultural campaigns.

Most West African countries are net importers of fertilizers. Apart Senegal and Nigeria who produce part of their fertilizer needs, West African countries import fertilizers for their agricultural production needs. Yearly imports are based on the estimate of needs. Recent assessment on fertilizer subsector in West Africa revealed that the imported volumes are almost below the potential demand of the users. This is expressed in the Table 14.7 where less than 50% of fertilizer requirements are covered in some countries. Another study on fertilizers demand and supply showed that in 2012/2013, total consumption in eight West African countries and Tchad on cotton and cereals is about 769,500 metric tons. Total demand was estimated at 2,219,000 in 2015 metric tons based on area cultivated and was covered at about 31% by the supplied quantities. These examples illustrate that there are enough gaps not covered by fertilizers available in many West African countries. (Table 14.8)

Although the current available quantities do not meet users entire needs, it is useful to mention that there are enough progress in the quantities made available at country level through importation. Table 14.9 shows that many countries have progressed in their quantities made available within 5 years. In Ghana for instance average increase rate is 140% between 2005 and 2010 while it is 98% in Mali (Klutse et al. 2012).

14.3.2 Accessibility

Fertilizer consumption is still low in West Africa. This is due to financial weakness of major producers that are smallholder farmers, climatic risks, economic instability of producers due producer price volatility, and lack of conducive politic incentives (Doumbia et al. 2005; Tabo et al. 2005; Zoundi and Hitimana 2007). Furthermore, the unequal distribution of available fertilizers in the country reduces access to smallholder farmers. In these countries, almost all the major importers and distributors are based in large urban centers or areas of agricultural production.

It is also observed the supply is closely linked to seasons of production (dry season versus rainy season, small versus large agricultural seasons) and to post raining season program of production. The preference of some importers and distributors for some specific geographical zones for their cash crop activities limit access of fertilizers to other users. In general, rural infrastructures like road qualities and warehouses availability are key to fertilizer accessibility in various

Table 14.7 Key indicators of fertilizer availability in West African selected countries

Items	Countries							
	Benin	Burkina Faso	Côte d'Ivoire	Ghana	Mali	Nigeria	Senegal	Togo
Import/Consumption	70,000	150,000	450,000	380,000/200,000	300,000	1,015,400	95,000	70,000
Country fertilizer demand	250,000	300,000	–	400,000	730,000	1,667,000	500,000	200,000
Potential Gaps	180,000	150,000	–	200,000	430,000	652,000	405,000	130,000

Sources: Benin: AIC et CAI. In Rapport Etude Engrais UEMOA, 2012 / Côte d'Ivoire: Komena Boniface, Etude engrais UEMOA, 2012 / Ghana: PPRSD and CRS, 2014 / Mali: DNA, 2014 / Nigeria: FFD, 2013 / Sénégal: Etude de faisabilité de l'UEMOA, 2012 / Togo: Etude UEMOA, 2013 /Nigeria potential needs 4,871,580 mt - APMEU, 1990.Expressed total fertilizer requirement in 2013 is 1,667,243 mt

Note: Consumptions are not well defined in countries. Volumes recorded are most of the time related to import in countries or are trough estimates

Table 14.8 Quantity of fertilizers imported and average needs coverage rate

Country	Import (Average 2010–2012) (Tons)	Distribution by crops (%)		Demand yearly (2015) (Tons)	Coverage rate of demand (%)
cotton + cereals			Non cotton value chain		
Bénin	45,000	95	5	210,000	21.4
Burkina Faso	160,000	78	22	414,000	38.6
Côte-d'Ivoire	63,000	NA	NA	NA	NA
Guinée Bissau	4000	0	100	23,000	17.4
Mali	310,000	52	48	724,000	42.8
Niger	40,000	0	100	198,000	20.2
Sénégal	54,000	72	28	70,000	77.1
Togo	46,000	80	20	250,000	18.4
Tchad	47,500	84	16	330,000	14.4

Source: Mando (2013) – WAEMU, ECOWAS study

Table 14.9 Fertilizer consumption rate by country

Country	Year 2008	Year 2012	Source
Ghana	6 kg per hectare of arable land	Application rate is 12 kg per hectare of arable land	2008 from FAO data and 2012 data from MOFA
Burkina Faso	5 kg per ha of arable land	12 kg per ha	2008 data from FAO and 2012 data from Ministry of agric
Mali	9 kg per hectare of arable land	13 kg/ha in 2012	2008 data from FAO and 2012 data from Ministry of agric
Nigeria	7 kg per hectare of arable land	Not available	From FAO data
Niger	1 kg per hectare of arable land	6 kg per hectare of arable land	From FAO data and 2012 from IFDC

Source: From various sources specified in column 4
NB consumption rate as kg of nutrient per arable land

parts of each country. The network of fertilizer distributors and agrodealers also determines access to smallholder farmers.

Access to fertilizers on time also determines the level of accessibility to farmers. The government subsided fertilizers (prices range between 500 to 600 USD per ton) are available but often come late and are for only a few farmers. Even when they can afford it, they wait to see what they might get from the government The process of distribution is delayed and affects planting on time. Most of the time, agrodealers don't have them on time. Although the subsidy programs seem useful, it usually distorts incentives for farmers to buy fertilizers on time. Table 14.10 shows the level of subsidy in selected countries in West Africa and Tchad (Mando 2013).

Without the subsidies, the cost would all have been borne by the farmers. Nonetheless, the implementation of fertilizer subsidies has been abused. For example, it has been reported that in Senegal and Mali, the implementation was fraught

Table 14.10 Cost of fertilizer, Cost paid by farmers and Subsidy percentage in selected West African Countries 2011/2012

Pays	Cost of fertilizer (FCFA/kg)	Cost to farmers (FCFA/kg)	Level of subsidy (%)
Benin	398	200	50
Cote d'Ivoire	353	265	25
Guinea-Bissau	600	225	62.5
Senegal	506	380	25
Togo	368	184	50
Burkina	509	255	50
Mali	500	250	50
Niger	407	244	40
Chad	500	300	40
Average	441	260	41

Source: GRAD/UEMOA report 2013

with problems of delayed delivery, delayed payments by government to suppliers, non-transparent bidding processes ending with awards granted to firms who were political supporters of those in power, inappropriately large quantities of subsidized fertilizer going to large scale farmers instead of the target group of small scale farmers.

Although the programme had good intentions, the consequences have led a large segment of the farming population in Senegal, particularly in the rice production zones, to advocate for its elimination. This is so because farmers believe they can access fertilizer on the open market at prices equal to or below the "subsidized" prices demanded by the government. Part of the problem is that the government prices are inflated because suppliers must sell to government at a higher price to cover the uncertainties of (i) payments that are delayed more than a year (incurring significant financing charges) and (ii) unreasonably high import and transport costs because the orders are placed so late in the season (Klutse 2013).

14.4 Cost of Fertilizers and Fertilizer Pricing

According to many farmers, the high costs of fertilizers (1000–1200 USD per ton when not subsidized by the government) limit its use. From the time of the Abuja Declaration in 2006 to 2011, the cost of fertilizer increased of 41.5% over a five year period while the cost of imported fertilizers doubled in at least 5 of the selected 14 countries. Whereas farmers in the United States of America (USA) pay USD320/T, the famers in Malawi pay USD1100/T. Whereas the cost of NPK was 250 CFA/kg in 2006 (equivalent of USD 500 per ton), the cost increased up to USD1000 per ton in 2012. It is about 600 USD per ton in 2016 subsequent to severe decrease in oil price. The increase in the cost of raw materials used partly explains

Table 14.11 Farm gate prices of fertilizers in selected African countries as compared to the United States of America (USD/T) 2012

Country	Farm gates prices (USD/T)	Increase (%)
United States	320	–
Benin	507	58
Burkina Faso	735	130
Cote d'Ivoire	801	153
Ghana	577	80
Niger	696	118
Mali	830	159
Kenya	850	166
Malawi	1100	254
Mozambique	1150	254
Rwanda	800	123
Tanzania	1000	212
Uganda	1100	244

Source: various

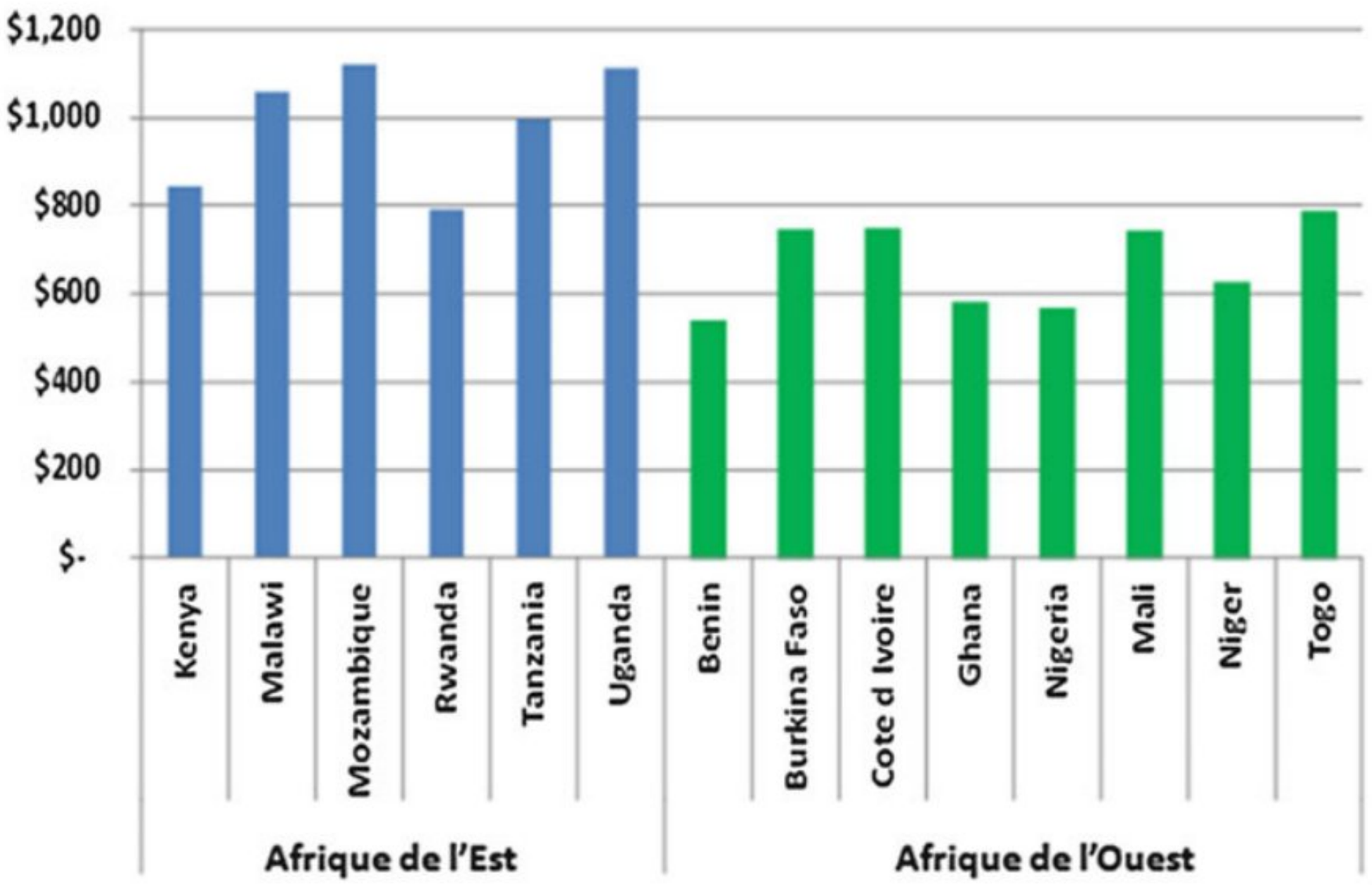

Fig. 14.1 Comparative price of Urea in East and West African countries

the doubling in the cost of NPK in 2011/2012. The percentage price increase as compared to the USA varies from 58 to 254 (as illustrated in Table 14.11).

The price of Urea which is commonly used is equally high. The retail price in April 2012 is between 580 and 800 USD per ton in West African countries against 525 to 1100 USD per ton in East African countries (Fig. 14.1, Table 14.12)

14.5 Fertilizer Cost Structure

In West Africa, CIF (Cost, Insurance and Fret) is the major component of fertilizer price. It range from 50% to 84% of fertilizer price. Table 14.13 and Fig. 14.2 show the main components of fertilizer price in selected West African countries. It is observed that some countries provide fertilizer at better price to farmers but get worst CIF quote on the international market. The figures indicate that some landlocked countries like Burkina Faso and Mali were able to get better CIF quote than those where fertilizers transit from like Togo, Benin and Côte d'Ivoire. This can be explained by the power of negotiation linked to the quantities ordered and the period where fertilizers are ordered. (Fig. 14.2)

Table 14.12 Average price of fertilizers in 8 West African countries and Tchad within the period of 2005 to 2012 (market price in FCFA)

Year	NPK price (FCFA/kg)	UREA (FCFA/kg)	DAP (FCFA/kg)	Average price (FCFA/kg)
2005/06	270	258	235	255
2006/07	276	255	236	255
2007/08	294	326	319	313
2008/09	377	361	429	389
2009/10	402	359	335	365
2010/11	453	463	500	472
2011/12	456	432	500	462
Average price	***361***	***351***	***365***	***359***
Increase rate (%)	***9,5***	***9,8***	***16,2***	***11,8***

Source: GRAD, WAEMU 2013

Table 14.13 Fertilizer price structure in selected West African countries and Tchad

Country	Retailer price (FCFA/kg)	CIF (Price at country gate) (FCFA/kg)	CIF in percent of retail price (%)	Gross margin in percent of retail price (%)
Bénin	398	310	77,9	22,1
Burkina Faso	509	277	54,4	45,6
Mali	500	248	49,6	50,4
Togo	368	309	84,0	16,0
Tchad**	500	323	64,6	35,4
Average	**455**	**293**	64,4	35,6

Source: GRAD, WAEMU 2013

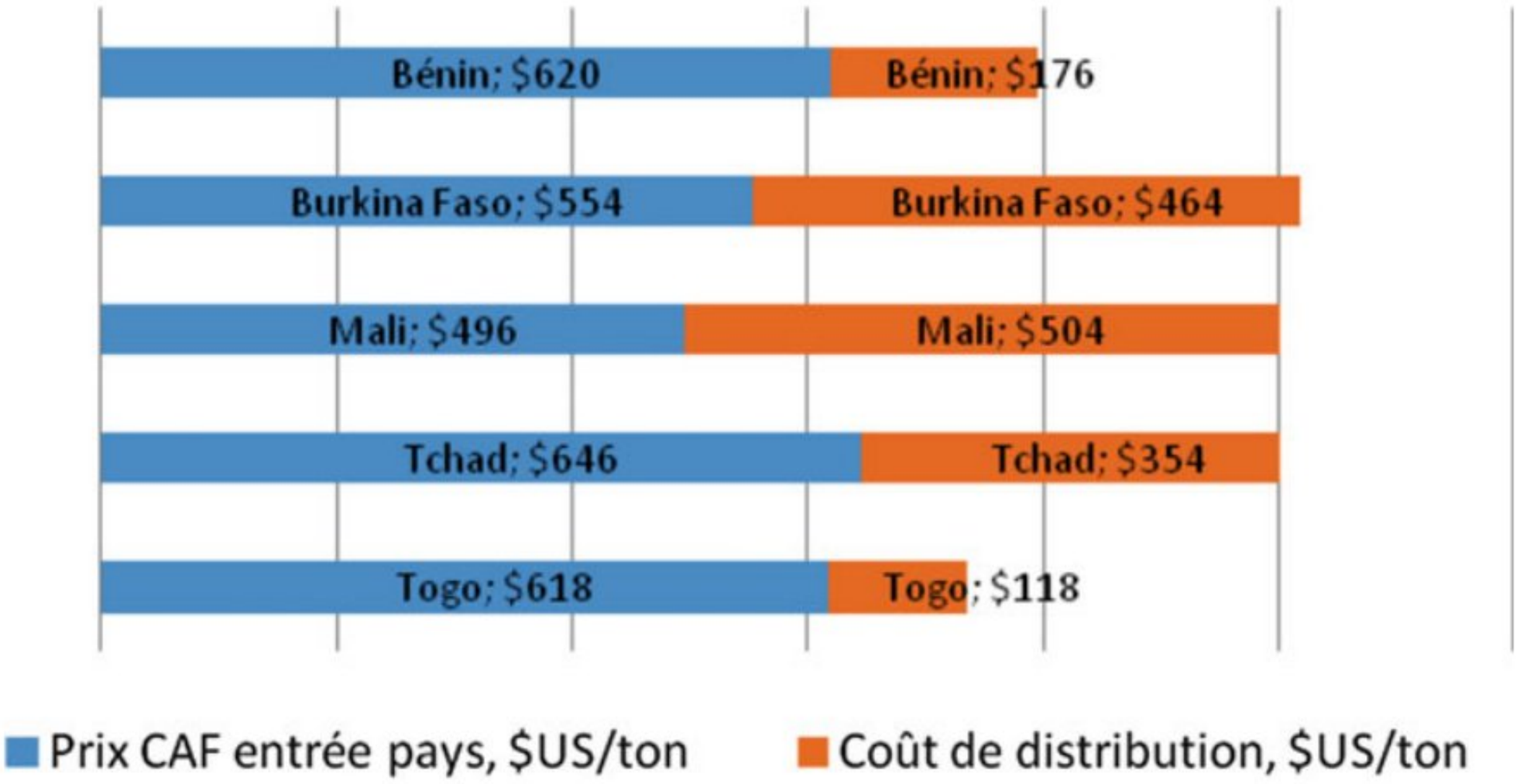

Fig. 14.2 CIF compared to distribution cost in Fertilizer price in West African selected countries

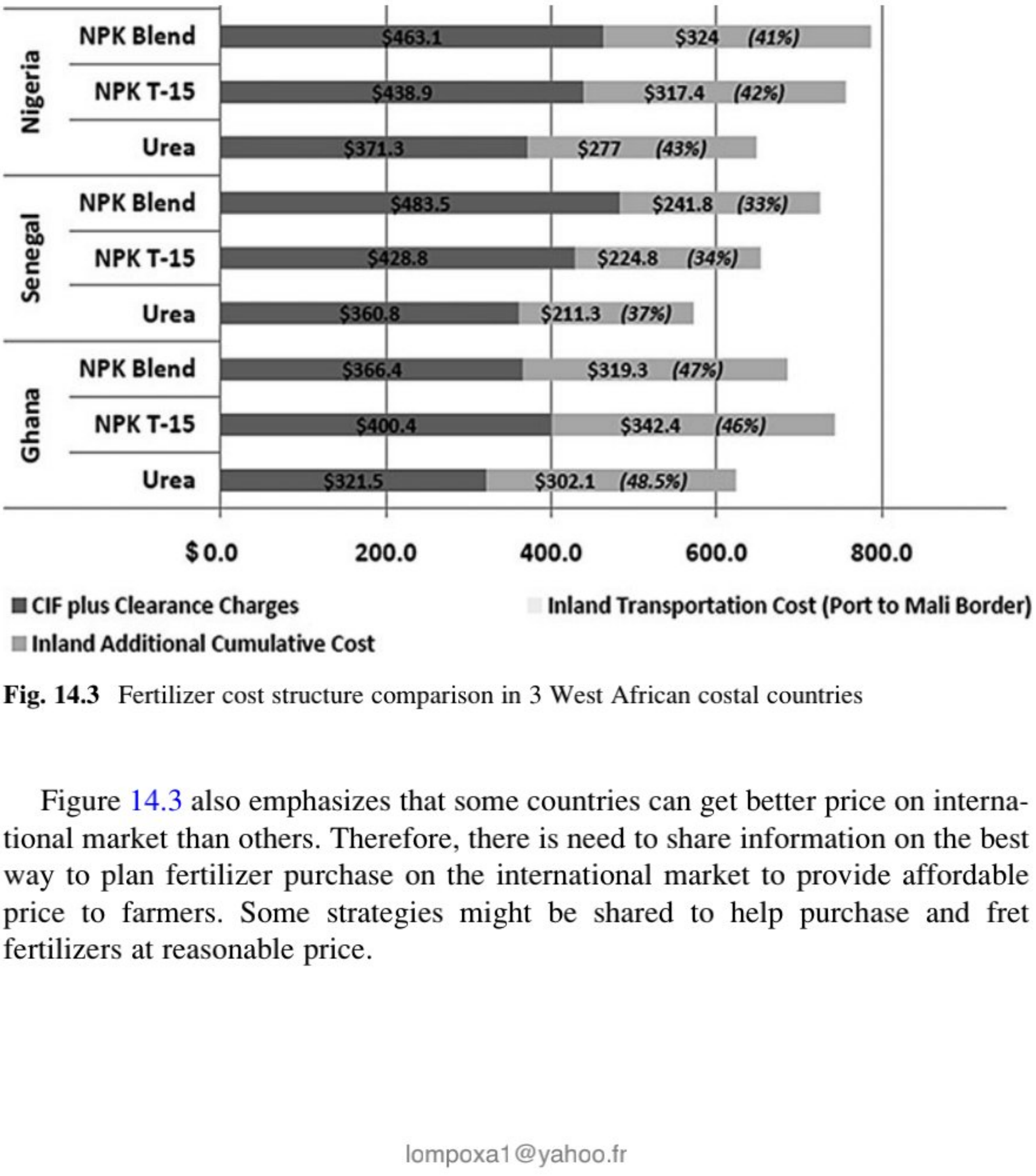

Fig. 14.3 Fertilizer cost structure comparison in 3 West African costal countries

Figure 14.3 also emphasizes that some countries can get better price on international market than others. Therefore, there is need to share information on the best way to plan fertilizer purchase on the international market to provide affordable price to farmers. Some strategies might be shared to help purchase and fret fertilizers at reasonable price.

14.6 Cost Reduction Strategies

14.6.1 Harmonizing Fertilizer Recommendations

As discussed above, cotton fertilizer recommendations really vary from one country to another on some specific elements based on sulfur and boron. Working across agro ecologies can help minimize the differences in fertilizer recommendations and to provide some recommendations that cover many countries. This can enable many countries to order on a large scale and get better price on the international market. Bumb et al. (2011) revealed that this strategy can help gain 8 to 40% of discount on CIF price on the international fertilizer market. The expected profit may be made of formula specificity (30–40%), economy of scale (10–20%), packaging (8–12%), bulk blending (30–35%) and improvement of marketing services (15–20%).

14.6.2 Period of Purchase

Period where fertilizers are ordered is important in price formation. Many buyers from various parts of the world and with different purchase objectives intervene on the fertilizer market. It is useful to know when main suppliers put their bids on the market and to take into account their technical and financial prospects in the negotiations. Many African suppliers arrive late on the market or put their order when big buyers enter in action. It is also advised to avoid going late on the market when the stocks are really low and suppliers are busy for other assignments on the fertilizer value chain.

14.6.3 Volume Ordered, Purchase Modalities and Fret

Many buyers are aware that the quantity of fertilizer ordered at once has significant effect on the price. Moreover, when many cargos are ordered at once, the effect on price reduction is relatively important. To achieve this it is important for West African ports to improve their performance in term of unloading and carrying capacity. It will also be useful that big capacity warehouses are built in entry ports to facilitate fertilizer unloading.

14.6.4 Land Transport

Road harassment which cause incidental expense incurred in fertilizer prices. Fertilizer cost can be reduced by 77USD per ton if road harassment and some

useless components of road transport between Accra and Ouagadougou line are reduced (Annequin 2010). These are related to incidental expense removal and competition improvement on transport market currently controlled by national transport unions.

14.6.5 Financial Expenses

Cost of money is very important in fertilizer pricing. Guaranties requested by financial institutions are high in West Africa and can exceed 12% in francophone West Africa and 25% in Ghana. In addition, the financial costs incurred by providers should be considered. Ogling Europe where the cost of money rent is about 5% (Eyes Dupless 2012. Personal communication), mechanisms should be worked out in Africa to lighten these costs.

14.6.6 Taxes and Tariffs

Tariffs and taxes in many countries add significant costs to fertilizer trade. It was, therefore, resolved to eliminate taxes and tariffs on fertilizer and fertilizer raw materials. Wanzala and Groot (2012) notes that Burundi no longer charges value-added tax (VAT) on fertilizers; Cameroon dropped the common external tariff (CET) on fertilizers; and Seychelles removed the import tariff on fertilizers. Although Mali stopped charging VAT on fertilizers, it imposed a withholding tax while Ghana, imposed an administration fee and an Economic Community of West African States (ECOWAS) levy. In Kenya, importers pay an Importer Declaration Fee at the port.

In ECOWAS region, although fertilizer is exempt from the Common External Tariff, some countries still charge an import duty. According to Bumb et al. (2011), Ghana and Mali charge other small levies such as "shipper and council" taxi which add administrative burdens and rent-seeking opportunities that can lead to costly delays in clearing fertilizer shipments at the port

14.7 Organization in the Fertilizer Subsector

In 2012, ECOWAS passed a Fertilizer Regulation (C/REG.13/12/12). This regulation paves a way for a plausible investment policy and regulatory environment conducive to the supply and use of fertilizers in the region. ECOWAS has also established a West Africa Fertilizer Control Committee, which is led by IFDC, to coordinate the implementation of the Fertilizer Regulation in all the 15 Member States. In this respect Mali increased the number of inspectors from 12 to 31.

Ghana, Burkina Faso, Niger and recently Nigeria are implementing fertilizer regulatory mechanism project that will enable each country to improve fertilizer quality

Industry associations have the potential to improve stakeholders' participation in the conduct of interventions linked to their business. More specifically, fertilizer trade group can play an important role in the management and representation of the industry. When well organized, they can influence public policies and promote members' interest and growth. Convinced with stakeholders choice to form fertilizer trade association in West Africa, AFAP is facilitating their organization into fertilizer trade association. The organization can also promote the efficiency of fertilizer use through technology transfer and rapid dissemination of information using their networks.

14.8 Conclusion

The study shows that fertilizer use indicators have been progressing in West Africa but at slow speed. Some recurring constraints linked to fertilizer recommendations are still hampering this process and need to be tacked at regional level instead of country based interventions. Fertilizer supply challenges in the sub-region should be improved by creating an enabling policy environment, improving access to finance, developing regional trade and output markets, and promoting technology transfer through ISFM and other pathways. Real competition among suppliers should be advised to facilitate pricing that makes fertilizer accessible to smallholder farmers.

Some ongoing initiatives such as the startup objective of the Regional Agricultural Development Fund (FRDA) of WAEMU, the ADB Fertilizer Fund and the Regional Support Fund for Agriculture (FRAA) of the ECOWAS need to be promoted. Initiatives such as the West African fertilizer program funded by USAID provides players a guarantee fund for investments in storage capacity and the development of mixing units. AFAP initiatives that facilitate contracts' partnership in agribusiness, offer local, regional and international operators, grants and assistance for loans at attractive conditions to promote investments in the production, storage capacities and distribution of fertilizers in Africa should be supported.

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