

Louis Koko, Addressing the Challenges of Cocoa Beans Supply in Côte d'Ivoire (Speaker #13)

Wednesday, April 15, 2015 8:15 a.m.

Questions

1. You talked about farm finance. Is there a mechanism for a small farmer who is *not* in a co-op to get financing?

It is true that in the framework of initiatives implemented by the cocoa industry to improve farmers' access to fertilizers, the partnership is to support small farmers grouped in cooperatives. Working with cooperatives is an approach that reduces the risks. So really, there is no direct mechanism of access to finance to support the individual farmer. However, in terms of supports (not only finance support), there are many indirect mechanisms. For example, in the context of the *Cocoa Livelihood Program (CLP)* of World Cocoa Foundation (WCF), "innovative Farmer Business Schools train farmers and integrate a farm management approach, increasing profit from cocoa and other diversified crops, and teach annual budgetary planning for household expenditures and nutritional needs. Business Service Centers (BSC) serve as a hub of services including credit and market information; BSCs have been established to date through public-private partnerships, and are hosted by agro-dealers & microfinance institutions to improve access to quality inputs." Finally, there is also the direct support provided by *Le Conseil du Café-Cacao* to individual farmers through the free distribution of pesticides products and cocoa seeds.

(See answer of question N° 8 for additional information).

2. How does fertilizer and improved yield impact disease?

The boron calcium nitrate fertilizer has an impact on the rate of black pod diseases. This also results in improved production. Through its nutritional value, this fertilizer increases the vigor of cocoa trees by providing a better integrity of the cell wall and a potential barrier effect.

3. When is fertilizer applied to cocoa trees?

Fertilizers are applied at the beginning of the rainy season. In Côte d'Ivoire, for the cocoa area, there are two rainy seasons: from March to June and from August to September. The fertilizer is applied twice a year, in early March and early August (See answer of question N° 37 for additional information).

4. What percent of cocoa farmers are using fertilizer?

It is not easy to talk about official statistics because there are no detailed and completed surveys. However, sectoral studies allow us to get some statistics. For example, between 2012 and 2015, our survey indicates an increase in the consumption of fertilizers in the cocoa sector (from 45 000 to 90 000 tones metric). Overall nationally, 10 to 15% of cocoa farmers use fertilizers. There is mainly a regional variability of this statistics. For example, in the western and the southwest regions of Côte d'Ivoire, where 35% of cocoa is produced, 50% of farmers use the fertilizer because of low soil fertility. Farmers say that they use fertilizers to avoid the

early mortality of cocoa trees while in the eastern region (former first cocoa region). Less than 5% of farmers apply fertilizers because of the good quality of soils and long tradition of cocoa growing without fertilizers.

5. Does fertilizer also increase quality of cocoa beans – fat or bean size?

The amount of nutrients provided by fertilizers can increase or decrease some physiological characteristics of the pods and beans.

About number of pods per tree :

- Nitrogen (N) has a positive effect on the number of pods per tree only when soil phosphorus (P) and potassium (K) are both present.
- P has a significant negative effect in the absence of K.
- K has a positive effect. The effect is increased (2.7-fold) when N is supplied at the same time.
- Calcium (Ca) and magnesium (Mg) deficient pods are susceptible to black pod, thus reducing the pod number per tree. This can also be observed with boron deficiency.
- Acid soils are often linked with higher black pod disease. But this might be due to the lower Ca level also observed in acid soil.
- The pod index (number of pods for 1 kg of dry beans or beans per pod) is not nutrient dependant, but only a genetic trait.

About bean size :

- P and K have a significant effect on the bean size. The effect is negative when both P and K fertilizers are applied separately, but it is positive when they are supplied together.
- The individual effects of P and K are roughly the same, which explains why the main effects of either P or K are not significant.

About the weight of beans per pod :

- Fertilizers have no significant influence on the weight of fresh beans per pod or on the average weight of a bean. The number of beans per pods and their weight are also influenced by the location of the pod on the cacao (the biggest pods are those at the base of the trunk).

6. Do the cocoa trees absorb fertilizer into the actual cocoa? What actually is absorbed – any risks to the cocoa bean quality?

About the mineral composition of bean or bean quality, in Côte d'Ivoire, no significant effect of fertilizer on the mineral composition of cocoa beans was found. The average mineral composition of the dry matter of a cocoa bean is 2.34% N; 0.41% P; 0.97% K; 0.08% Ca; 0.15% Mg. Mg improves the chocolate taste by increasing the polyphenol and sugar contents in the beans. Zn can contribute to an improvement of the fermentation through producing enzymes that can help cocoa bean fermentation. The taste of chocolate was found correlated to the terroir; this includes many factors of which are the environment and varieties, and the type of soil.

7. If we fertilize with compost and mineral how many years can we farm a cocoa farm? Ten,

20, 50, 100 years?

The duration of a cocoa farm depends on many factors such as soil fertility, climate condition, plant material and the use of good agricultural practices. In reality, this period may be shortened or lengthened by the effect of one factor or combination of some factors. When the producer fertilizes his plantation with compost and mineral fertilizers, it extends the life of cocoa through good management of soil fertility. In practice, the plantation can produce cocoa for at least 25 to 30 years because of the restoration of nutrients.

8. Is banking – mobile or other – available to farmers and does it participates in fertilizer financing?

The financing of fertilizer in a context of limited income and limited assets of the cocoa farmers are not encouraging the banks to take risk on small holders. Without financial support, farmers themselves have limited direct investments capacities, and in most of the cases the lack of prices visibility is not helping the farmers to risk shifting production modes.

About the banking, there is one exception. In Côte d'Ivoire since 2012 a microfinance institution called Advans is involved in many fertilizer financing programs, a pioneer in this field.

9. Please explain again why the fertilizer gain is so much more on the very small farms.

Small areas are better managed in terms of respect of the fertilizer dose for each cocoa tree. There is also the fact that the producer has the ability to apply good agricultural practices on a small area. When the producer has more than one hectare of cocoa farm, he tends to want to apply the fertilizer on all the cocoa trees of this surface by under-dosing while there is only enough for 1 ha. In this case, the gain of the fertilizer depends on the mode of application. This is one of the reasons why farmers are encouraged to practice the scheme of gradual fertilization: apply the fertilizer on 1/4 ha of plantations in the first year, tree by tree, to gradually reach 1 ha fertilized in the following year.

10. When you fertilize do you fertilize every tree the same or do you give priority to specific trees?

Each cocoa must receive the same amount of fertilizer. However, ill or less vigorous cocoa will not have the same performance as the healthy cocoa tree which received good agricultural practices. Besides, in an optimal approach, fertilizers do not need to be applied to all cacao trees at cocoa farm level. According to many surveys, indeed, only a portion of the cacao trees are producing. For example, It has found that, in a cacao plot, 7.9% of the trees are unproductive, 34.5% produce little yields (< 12 pods/tree), 27.2% produce average yields (12 to 20 pods/tree), 21.7% produce good yields (20 to 50 pods/tree), and the remaining 8.7% produce high yields (>50 pods/tree).

11. Will compost plus mineral fertilizer avoid soil acidification?

Indeed, compost plus mineral fertilizer optimizes nutrition of cocoa trees. Organic acids contained in the compost also improve the structure and the soil pH. Yes, compost plus mineral fertilizer can avoid soil acidification.

12. When you use mineral fertilizer does that promote soil acidification?

The dissolution of mineral fertilizers in cocoa soil has several effects on soil properties, including salinity and soil pH which are the most apparent. These effects vary with fertilizer. The effect of fertilizer on the soil pH is determined by the ability of this fertilizer to generate H⁺ or OH⁻ ions by their reactions in the soil. The acidifying effect can reduce the productivity of the cocoa tree in acid soils. To avoid acidification of soils under cocoa, application of compost more right mineral fertilizer is a sustainable solution.

To avoid a toxic salt concentration, chemical fertilizers should not be applied to young cacao until at least three to four weeks after field planting.

13. Why is the fertilizer applied in a ring one meter from the trunk? Why not further out?

To reduce the fertilization cost, it is recommended not to fertilize the entire plot, but rather to apply the fertilizers either in a ring or a crown around the base of the trunk, as roots are mainly growing under the cacao tree canopy or in strips (alleys) along the rows. On big farms, mechanization of fertilizer application can be done on alleys in a 0.8 m band in the middle of cacao rows planted at 3 m spacing. The area corrected with fertilizers represents about 27% of the total surface. Application in a ring around the base of the trunk is preferred for young trees. The diameter of the ring should be similar to that of the tree canopy. Fertilizer applied in strips along rows is a method generally used for high-density adult plantations.

14. Last year Ivory Coast had the largest cocoa crop ever. How much of this is due to GAP or fertilizer use? Is it sustainable – will it happen again this year?

In 2013-2014, cocoa production in Côte d'Ivoire has increased dramatically to reach 1.7 million tons of cocoa beans. This result can be explained by the impact of many initiatives that have been launched to boost cocoa production in Côte d'Ivoire since 2000. For example, 20 000 to 40 000 ha of plantations are regularly created each year by Le Conseil du Café-Cacao since ten years with both the support of research (CNRA) and extension agency. Today, it is obvious that these orchard renewal initiatives have an impact on improving cocoa production. Ongoing studies should provide more accurate information on the impact of the renewal of the orchard on production. But in addition, rehabilitation of existing plantations significantly improves yields and implicitly contributes to improving national cocoa production. Indeed, cocoa yields are significantly improved with the use of fertilizers and pesticides. So there is a close relationship between the largest cocoa crop and extension of fertilizers and pesticides at farm level. Increasingly, farmers themselves adopt fertilizers to address the decline in the fertility of their soils. Since 2012, we find that the cocoa sector is the largest consumer of fertilizers with an average of 45 000 tons per year. This trend will be sustainable if efforts are maintained by all the stakeholders, including the guarantee of good cocoa prices for the small farmer.

15. About how many years of cocoa growing does it take before the land is degraded?

Within an intensive system, a cocoa plantation can produce for at least 25 to 30 years. Generally speaking, the land degradation is influenced by many factors such as agricultural practices without fertilizers, intensive production or not, etc.

16. Do cocoa farmers ever use crop rotation to replenish nutrients in the soil?

Crop rotation is not used in the cocoa growing system in Côte d'Ivoire. But there are many fallow lands after old cocoa plantations that can be used to replant cocoa.

17. Fertilizers cost money. Does the increase yield offset the cost of fertilizer? What is the impact on farm profit?

According to some recent studies, to profit from the use of fertilizers, a cocoa plantation must produce at least 500 to 650 kg of beans per hectare before applying the fertilizer. And after using fertilizers with an improvement of at least 30% yield, the farmer can profit from the application of this input.

18. Is the use of nitrogen fixing legumes a solution? Either as a ground cover crop or as shade trees?

Intercropped trees can affect potential soil fertility, either by providing external nutrients, or on the contrary, by competing for nutrients. For example, legume crops can provide N to associated cacao via their ability to fix atmospheric N thus making it available for the cacao. A 16% increase in the litter N level was observed in cacao associated with *Erythrina* sp. compared to cacao associated with *Cordia* sp., a non-leguminous shade tree. However, legume intercropping does not systematically benefit the cacao as it depends on the levels of associated nutrients that may have limiting effects if their levels are low compared to that of N. Conversely, the availability of certain nutrients for cacao may be reduced due to competition with associated trees. For example, competition for phosphorus between cacao and shade trees such as iroko (*Milicia* sp.) was observed in some cocoa farms.

19. Pruning is commonly used to increase the quality of fruits and vegetables. Does increasing the yield have an effect on the quality of the cocoa pods/beans?

See detailed answers for the question N°5 about relation between yield, fertilizer and quality of the cocoa pods/beans.

20. Is there a similar program to fight against diseases?

There are many programs against the diseases of cocoa in Côte d'Ivoire. Primarily, there is the national program to fight against the swollen shoot disease (CSSV) that is implemented by Le Conseil du Café-Cacao. Recently, through Cocoa Action of World Cocoa Foundation (WCF), the cocoa industry also launched some projects with the objectives to reduce diseases impact.

21. I have heard that some fertilizers can cause cadmium problems. What causes this? Do all fertilizers do this? If not all, what controls this?

Generally, there is cadmium in two sources: soil and phosphate fertilizers. However, in general, soils in West Africa, particularly in Côte d'Ivoire, do not contain cadmium. For fertilizers, cadmium level is dependent on the source of the phosphate fertilizers. Some phosphate fertilizers have high levels of cadmium. There are no confirmed cases in Ivory Coast but we must remain vigilant. We must therefore monitor the quality of the fertilizer used in cocoa production to avoid this problem.

22. What is the average income of a cocoa bean farmer with and without fertilizer?

The average income of a cocoa bean farmer with fertilizers varies depending on factors including the age and the size of the plantation. The cost value ratio that determines the impact of inputs on producer income was positive only for plantations of less than 1 ha whose age is between 10 and 15 years (See Tables in full paper for more details). The impact of the application of fertilizer on gross revenues and net profits of farmers were also demonstrated by the NGO TechnoServe on behalf of Cocoa Livelihoods Program (CLP). In fact, the farmers who have received fertilizers have seen their net profits increase by 35-50% in 2 years.

23. How is soil fertility measured?

Soil analyses are used to assess the soil fertility (physical, chemical and organic) so as to establish the fertility requirements (formulas and doses). For this, we use the soil diagnosis method described for cocoa growing systems in Côte d'Ivoire. This method has also been validated for the cocoa growing systems in Ghana. Soil nutrition depends on both the nutrients levels and their balances in the soil. Because the actual levels and ratios at a given time are a result of the environment and soil evolution, good correlations are found between the soil diagnostic method and the cocoa yields. Leaf analysis is a good tool to track the evolution of cacao under good agricultural practices such as fertilizer. Nevertheless, foliar diagnosis is insufficient to be used for prospecting to determine fertilizer for cocoa farms already in place and which are not known cropping history; so in these circumstances, the use of soil diagnosis is preferable. In particular, the "Soil Diagnosis," which gives good results for the determination of fertilizer to correct the deficiencies in the soil and to improve cocoa yields. It takes into account both the nitrogen/exchangeable bases depending on the pH, balance K-Ca-Mg and N/P ratio. But after correcting soil, foliar diagnosis might have an important role to play in determining manure maintenance.

24. How do farmers afford to pay for the fertilizer? Please explain "fertilizer to beans" again.

An example of how farmers afford to get the fertilizer is given by The Fertilizer Initiative Program which is lead by IDH The Sustainable Trade Initiative. The key objective is to facilitate farmers access to fertilizer by three ways :

- Farm finance: by this way, the farmer group takes a bank loan for fertilizer for its members, with risk-sharing from the other supply chain agents.
- Fertilizer for beans: the cocoa supplier is partially paid in fertilizer upon delivery of beans to the trader.
- Cash-and-Carry: building on the supply chain infrastructure, fertilizer is made available at selling points close to farmers to buy in cash.

25. Is the fertilizer a concern for organic bean supplies?

To produce organic bean (called also organic cocoa), plantations should not use mineral fertilizers and pesticides. These cocoa plantations must be associated with shade trees. In this case, the production is very low (less than 300 kg/ha) but the cocoa trees can produce for over 30 years.

26. Are there any initiatives to reverse deforestation?

The first initiative is to preserve the remaining 2.5 million ha of forest in Côte d'Ivoire by encouraging farmers to switch cocoa farming system through a new cocoa farm model. For example, there are initiatives to rehabilitate old cocoa plantations by grafting technique with cocoa clones. We must also replant the many fallow lands (8 million ha) by encouraging cocoa replanting with a new, more efficient plant material.

27. What percent yield increase is required to have a net income increase (cover the fertilizer cost)?

To profit from the use of fertilizers, a cocoa plantation must produce at least 500-650 kg of beans per hectare before applying the fertilizer. With an improvement of at least 30% yield, the farmer can profit from the application of fertilizers.

28. Is there a difference of yield between organic and other fertilizers?

The effect of mineral fertilizers on the yield is more significant than the effect of an organic fertilizer because there are many nutrients that go into a mineral fertilizer bag.

On average, the amount of nutrients removed in 1,000 kg of cocoa beans corresponds to 145 kg of nutrients removed from the soil per hectare. Considering that mineral fertilizers contain on average 50% of available nutrients, the amount of nutrients needed to compensate for export of nutrients from harvest should apply in double quantity. This implies that to compensate for a loss of 145 kg of nutrients, farmers must apply at least 300 kg of mineral fertilizers. For example, in Côte d'Ivoire each year for a cocoa hectare (1,333 cacao trees/ha), at least 400 kg of 0-23-19 NPK fertilizer should be applied. This equates to at least 200 kg /ha of nutrients. This quantity of nutrients is rarely achieved in an organic fertilizer, which will match the performance of a mineral fertilizer. However, organic fertilizers have long-term effects on soil fertility (increase of organic matter, improvement of soil structure, etc). The best way is to combine the use of organic and mineral fertilizers in order to optimize yields.

29. Fertilizer use has increased to 10% of farmers – why do you think more have not adopted fertilizer use when it increases yield by 50 %?

Despite its importance in maintaining cocoa yields, smallholder farmers do not use enough fertilizers. Three reasons are often given to explain this phenomenon:

- 1) farmers are not well informed about the correct use of fertilizers;
- 2) access to chemical fertilizers is difficult;
- 3) chemical fertilizers are costly.

However, cocoa growers are aware of the importance of using fertilizers and are buying them as soon as they have access to them. The correlation between fertilizer adoption and cocoa price was clearly demonstrated. That is the reason why it is important that access to fertilizer for smallholders should be made as easy as possible.

30. How many trees can one farmer manage? How many hectares?

On average, the small farmer has 2-3 ha of cocoa farm. This represents between 1,500 to 2,000

cocoa trees /ha. However, there is a great diversity of size and cocoa trees density at farm level.
31. What farmer's gate price do you think supports turning over old-age trees to develop new trees? The renewal of the orchard is essential for the sustainability of cocoa production. For this purpose, farmers must receive a minimum farm gate price to motivate him to renew the orchard. Since 2010, the reform of the cocoa sector in Côte d'Ivoire (built by Le Conseil du Café-Cacao, the public sustainability cocoa agency) ensures the producer at least 60% of the London CAF price (Cost, Insurance and Freight). On the basis of sales in advance, a guaranteed minimum price of 1 kg of cocoa beans is determined for farmers.
32. What happened in 2009-2010 when the fertilizers were high, but the bean yield was low? In fact, production of beans has not really dropped in 2009-2010. It has been a stabilization of production. However, between 2008 and 2009, there was a decline in production of the beans that can be linked with a decrease in the consumption of fertilizers in the same period.
33. Is cocoa fertilizer the same as is used on all crops – balanced N-P-K, or does it need specific fertilizer? In Côte d'Ivoire, "cocoa fertilizer" is recommended, with 23 % P₂O₅, 19 % K₂O, 10 % CaO, 6 % MgO, and a small amount of S, B and Zn. This is the only fertilizer formula recommended throughout the country, regardless of the type of soil and environment. Nevertheless, on the long term, the use of a single standard formula cannot fulfill the real needs of the cacao in the broad range of different situations because of the many possible interactions between the environment and farming practices. Fertilization must be adapted to the local soil and climate conditions; therefore, the use of more than one formula is encouraged. This is the objective of the international cocoa soil mapping project in Cote d'Ivoire funded by IDH The Sustainable Trade Initiative on behalf of the cocoa Industry partners.
34. You mention that some farmers are planting rubber trees. Is this more profitable or an easier crop to grow? In the recent past, some farmers have converted cocoa lands into rubber plantation because of very good price of rubber farmer's gate price. In five years, from 2009-2012, the area planted with rubber rose from 160 000 to 430 000 ha, an increase of 170%. At this time, the cocoa farmer's gate price was very low. Since 2010, with the reform of the cocoa sector made by Le Conseil du Café-Cacao, there is a stronger dynamic of cocoa than rubber.
35. Where is the fertilizer coming from? Is it produced in Côte d'Ivoire or imported? In Côte d'Ivoire, we have many fertilizer companies (YARA, OCP, Louis Dreyfus Commodities, etc.). Some of them are involved in the Cocoa Fertilizer Program implemented by IDH The Sustainable Trade Initiative on behalf of the cocoa Industry partners.
36. How much fertilizer is optimal for one cocoa tree? Is it applied once per year or several times? Let's consider a one hectare of a cocoa farm with 1,333 cacao/ha. The nutrients exported by

the harvest include nutrient content of the cocoa beans and the nutrient content of the husk, which is also often removed from the cocoa field. The total nutrient removal per hectare depends on the yield of cocoa. So, about nutrient removal of 1 metric ton of dry beans (7% moisture), with the corresponding quantity of 1, 4 MT of husks, more than 300 kg of inorganic fertilizer are needed to compensate for the removal of 145 kg of nutrients with the pod harvest corresponding to one MT of cocoa beans (300 kg versus 145 because in fertilizers the average nutrient concentration is around 50%). Even more could be required if we also consider the fertilizer use efficiency (percentage of uptake versus applied quantity). The nutrient balances at field level depend on the in-flow and out-flow of nutrients.

Mature cacao-producing fruits can be fertilized at the same time as growing trees, but the formulae and fertilizer rates should be tailored to the soil analysis results and expected yields. Fertilizer applications should be split into at least 2 applications per year, with the basal dressing applied at the onset of the rainy season.

(See also answers for the question N°28)

37. On average, how many cocoa trees are on one hectare?

The research recommendation is 1,333 cocoa trees per hectare (3 x 2.5 m).

38. Do we have local chemical industries that produce fertilizers in Côte d'Ivoire?

In Côte d'Ivoire, we have many local chemical industries that produce fertilizers (YARA, OCP, Louis Dreyfus Commodities, etc.).

39. Has using fertilizer and pesticides affected the quality of the bean, e.g. taste?

About nutrients from fertilizer :

- Mg improves the chocolate taste by increasing the polyphenol and sugar contents in the beans.
- Zn can contribute to an improvement of the fermentation through producing enzymes that can help cocoa bean fermentation.
- The taste of chocolate was found correlated to the terroir; this includes many factors of which are the environment and varieties, and the type of soil.