Africa's fertilizer and soil health action plan: An African green revolution

Written by

Henk Breman, *Agrobiologist and former director IFDC-Africa,* ***AgroBioAfrica, The Netherlands***

During Abuja 2006, the first African Fertilizer Summit, it was clear Africa lagging as far as agricultural development concerns and the African Union decided that a 'Fertilizer Action Plan' had to be developed.

Using the average national cereal yield as a measure for agricultural development, Africa had an overall average of 1.4 t/ha of cereals - the world average in those days was 3.3 t/ha. The average global use of artificial fertilizers was 120kg/ha, against 35kg/ha for Africa. However, the average fertilizer use in Sub-Saharan Africa (SSA) was only 8kg/ha/year.

The product of the Abuja summit was 'The Abuja declaration on fertilizers'. A useful source for knowing more about the declaration and its effects is 'Feeding Africa's soils. Fertilizers to support Africa's agricultural transformation' (AGRA, 2019). The book looks at the Abuja declaration and the disappointing fertilizer use in SSA. Instead of increasing the fertilizer consumption to 50kg/ha/year in 2015, only 15kg/ha/year was reached and Africa was spending annually more than USD35 bn on importing food. These imports were far from sufficient - Africa only accounted for 1.5% of world's consumption, but 20% of the world's population.

Fertilizer consumption

To explain the lack of progress in fertilizer use, AGRA's book presents the status of implementation of Abuja recommendations, stating there is a need to harmonize policies for quality control and cut taxes. Most countries in SSA have a wide range of policy and regulatory policies, but two-thirds of them do not have coherent fertilizer policies. About one-third of countries in SSA still have import duties on fertilizers and half still have taxes on fertilizers.

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There is also need to improve agrodealer networks. In most countries there are still too few agrodealers to serve the needs of smallholders.

Improving infrastructure and output marketing would help. Progress has been limited because port and transport infrastructures are still inadequate. In terms of fertilizer output marketing, non-tariff barriers tend to raise costs of doing business.

In addition, no regional procurement and distribution facilities have been established.

The overall use of fertilizer, improved seeds and crop protection products remains low. Extension services in many countries are defunct and most countries lack soil mapping and testing facilities.

Nevertheless, fertilizer consumption continues increasing slowly. After the increase in consumption between 2006 and 2015 from 8kg/ha to 15 kg/ha, an uptake of 20 kg/ha/year was reached in 2018. One has to realize that in the same period the area of arable land in SSA increased from 196 mn to 212 mn ha. Consequently, between 2006 and 2019 the consumption of fertilizers increased from 1.6 mn t to 4.3 mn t. But the reclamation of arable land is still a stronger tool for increasing food production than the increase in fertilizer use. Hence the decision to organize a second African Union summit in 2023, focusing on fertilizers and soil health. For a sustainable African food security, mistakes made elsewhere in the world should be avoided. Think about over-dosing and misuse of fertilizers, causing pollution of soil, water and air, and unbalanced fertilizer use, causing in term soil exhaustion.

(left) Preparing a common field; *(above)* Agricultural inputs shop in DRC, where there is a lack of fertilizer use

Fertilizers and soil health

In Nairobi on 20-22 June 2022, a brainstorming event was organized by the African Union and partners as the start of a process that will lead to the second African action plan with the flowing goals:

- Reaching the average annual fertilizer consumption of 50 kg/ha/year or more
- Ensuring that this will not degrade but will improve and maintain soil health

About 90 people were involved in the brainstorming event. Representatives from African and international institutes, some politicians, but mainly scientists, and also representatives from a number of fertilizer producers which are already active on the African market. The Melinda and Bill Gates Foundation agreed to finance both the brainstorming as well as the follow-up: the formulation of an action plan proposal to be submitted to the 2023 summit.

The participants were members of one of the five working groups, treating the fertilizer market development and shocks (such as the Russian-Ukraine war), fertilizer finance, soil health and on farm fertilizer economics. Plenary sessions were alternated by breakout sessions of these workings groups. Two panels opened the first plenary session. Their members informed the participants about the 2030 outlook on agricultural development in Africa, and reflected on progress and nuances across contexts.

The present food shortages risk causing almost 100 mn extra hungry people in SSA. Since early February, millions of people dropped under the extreme poverty criteria of USD2.20/day.

Soil depletion, caused by lack of fertilizer use, leads to soil degradation

The Russian-Ukraine war causes a serious world fertilizer shortage, representing the food for almost 60 mn people. At least 13 African countries suffer by the restrictions of the Western world regarding the fertilizer trade of Russia and Belarus.

The Abuja goal of 50 kg/ha fertilizer use has been reached by 10 countries. Only seven countries reached the required level of investments in agriculture.

Mega trends and challenges for African agriculture include population growth, climate change and a growing middle-class, requesting more and better (protein rich) food.

Less land will be available and its price will increase. Inherently, land productivity has to increase. More fertilizer has to be used, while the risk of using it increases.

Soil depletion, caused by lack of fertilizer use, leads to soil degradation that can be expressed by an annual decrease of soil value equal to about USD70 bn.

In regions with a relatively high soil organic matter content, such as the Ethiopian mountains, fertilizer shows a dominant nitrogen response, while in most of Africa, the soil organic matter content is very low. Consequently, fertilizer shows a multiple nutrient response. An increase of the nitrogen dose from 0kg/ha to 100 kg/ha, will increase the cereal yield from 0.8 t/ha to 5.0 t/ha in case of soils with enough soil organic matter. On the dominant soils being poor in soil organic matter, the yield increase will reach an average level of 2.5 t/ha.

Scarecrows in ripening rice fields

A representative of the fertilizer producers insisted that Africa's fertilizer stakeholders are competing in an unfair battle. He stressed that it would be a shame to see a crisis go to waste! The huge food shortages on the world market should be considered as a challenge to organize a more general agricultural development, using increase of the fertilizer consumption as trigger.

Since the end of 2021, the price of nitrogen, phosphorus and potassium fertilizers on the global market increased at average about three times: from USD300-400/t to USD800-1200/t.

Rapid increase of fertilizer imports by countries is often followed by an even faster decrease. Within these fluctuations of imports, an even more serious fluctuation occurs for the different types of fertilizer. It is rare to experience timely buying strategies. One observes the lack or limited storage of forward supply. Offtake agreements are rare, as are buyers buying together in bulk.

Fertilizer tenders, that should have low prices as result, have in general the opposite effect. Purchase prices become high by lack of knowledge and/or corruption.

In general, besides lack of knowledge and experience as well as corruption, the crippling finance 'ecosystem' is a key cause of slow and limited growth of national fertilizer markets.

Government responsibility

In many countries series of challenges exists. Too often, participants expressed the need to train farmers. However, in view of the challenges, the training of government officials and input market business operators would achieve more. Farmers all over Africa would be happy to produce more when an enabling environment ensures that their income will increase. Politicians and business operators are responsible for this enabling.

Soil health has been the goal provoking the most discussions. The required investments only pay-off in mid- or long term, while the use of fertilizer as such is often already too expensive for farmers. The working group 'Soil health and fertility' proposed i) promoting the use of fertilizers only in combination with the use of organic soil amendments and ii) convincing farmers to use the increased availability of crop byproducts such as straw for improving the soil organic matter content. Besides, the maintenance of soil health is not only the task of farmers. The costs involved should be shared with the society as a whole - food should not become as cheap as possible!

Other important factors for concern are:

- The extreme present fertilizer and food prices - a result of the covid-epidemic and the Russian-Ukrainian war
- Climate change and the inherent higher risk for farmers of using expensive external inputs such as fertilizers, improved crop varieties and plant protection products
- Ensuring that the increased adoption of fertilizer use by farmers will cause a growth in food production higher than the present and the expected population growth

The best fertilizer for a crop is a market

At present, fertilizer promotion in Africa is an uphill battle. The public attitude regarding chemicals such as fertilizers and plant protection products is increasingly negative.

Table 1. A differentiated effect of triggering agricultural development in three neighboring African countries, comparing the main indicators for development from this study

Indicators agricultural development	Burundi		DR Congo*		Rwanda	
	2005	2014	2005	2014	2005	2014
Fertilizer use (kg/ha)	3	11	0	3	3	13
Average fertilizer price ($/kg)**		0.9		1.2		0.7
Average CBR ($/$)***		0.21		0.38		0.22
Cereal yield (t/ha)	1.3	1.2	0.8	0.8	1.2	2.0

**Only two provinces, both Kivu's. **Average of most used types. ***Average cost : benefit ratio for main crops.*

Food production is more competitive in regions and countries where fertilizer use was adopted long ago

Fertilizer use risks being more costly and agriculture less competitive: More fertilizer and/or more complicated formula are required. And in many regions Africa's population density is still low. Consequently the road density is low and the transport infrastructure badly developed, causing high transport costs.

Food production is more competitive in regions and countries where fertilizer use was adopted long ago. The potential extra yield that can be obtained using 1kg of nitrogen (N) from fertilizer when all other factors, nutrients included, are optimal, is 60-65kg of cereal grain. Good farmers reach as average about 25kg/1kg N in rainfed farming or 30kg/1kg N from well managed irrigated rice 30 kg/1kg N. Unexperienced farmers start by obtaining about 10-15kg/1kg N, while on sub-optimal soils even experienced farmers may not produce more.

Approaches have been formulated leading to optimal fertilizer use efficiency, while avoiding soil health problems. Losses of fertilizer nutrients to soil, water and air are restricted:

'site-specific' fertilizer recommendations and using them in an integrated soil fertility management context are suggested. However, the recommended formula and their doses may have to be different in terms of geography, farming systems, production systems, soils and climates. And also functionally, SDG's to be achieved, levels of commercialization, national policies, availability and affordability of fertilizers.

Another approach is to increase the soil organic matter content through enhancing grasslands in mixed production systems, using the intensification of human food crop production to improve livestock productivity. And also introducing 'intensive agroforestry', using trees on cropland for optimizing fertilizer use. Respecting soil and water conservation for enhanced nutrient use efficiency is also important.

The main interventions concerned the question how high such fertilizer recommendations should be on the agenda for agricultural development under the different conditions of individual African countries (see table 1).

Taking a look at table 1, all three countries (Burundi, Democratic Republic of the Congo (DRC) and

Table 2. Agricultural challenges tackled differently, barely or not at all

Average values 2018, based on country averages	I. Developed or developing agriculture	II. No or barely agricultural development	
	(n = 22)	II.a Food import (n = 5)	II.b Others (n = 19
Arable land (x 10^6 ha)	107 (59% cereals	4 (18% cereals)	143 (55% cereals)
Fertilizer use (kg/ha arable land)	59	35	12
Cereal yield (Mt/ha)	2.1	0.8	1.0
Natural production potential (Mt/ha)	1.1	1.5	1.2
Fertilizer use efficiency (kg/kg)	19	<< 0**	< 0
Food security index	39	50	31
Gross national income ($/cap./year)	4,000	12,700	2,000
Fragile state ranking	88	77	97
Corruption perception index*	36	38	25

**1–100; the lower the number the higher the corruption! **Fertilizers presumably mainly used for cash crops.*

Well organized agricultural development can lead to socio-economic development

Rwanda) have a shared history of colonization, and two of them have a similar population and agro-ecology. During the period from 1960 to 2020, DRC showed no increase in cereal yield, so no agricultural development. Yields increased in both Burundi and Rwanda, the increase being somewhat higher in Rwanda during the last 15 years. The table presents the evolution of key indicators for agricultural development for the period 2005 – 2014, a period during which an external project supported agricultural development efforts in the three countries.

Agricultural policies

In spite of recommendations for optimum fertilizer use among thousands and thousands of farmers, fertilizer use barely increased in both Kivu provinces, while the adoption rate was the highest in Rwanda. In DRC agricultural policies were not developed or appeared being ineffective. Input and output market development received no attention - fertilizer was smuggled into the country. The Abuja summit recommendations had not been put into effect and peace and stability were a far cry. Rwanda, however developed an effective agricultural policy. Subsidizing fertilizer use was one of the components and fertilizer use recommendations appeared to be useful.

Using the book from Breman, Schut and Seligman (2019), I insisted that different action plans are required for different countries. In the book, the African countries are classified in six groups, based on the degree of agricultural development. As measure for 'agricultural development' the speed of increase of crop productivity is applied, a factor having a direct link with fertilizer use. In class 1 countries, the average speed is equal to that elsewhere in the world where farmers use fertilizers, improved crop varieties and pesticides. In class 2 and 3 countries, the adoption of these products is lower, but the productivity of arable farming is significantly increasing. In class 4 countries some increase is measurable over the past 10-15 years, in class 5 countries crop yields have stagnated since 1960, in class 6 countries yields are even lower.

Three groups out of these six classes can be seen in table 2. Group i concerns the countries of the classes 1-3, countries with agricultural development. Group ii concerned the classes 4-6, countries with (barely) no agricultural development. This group is divided in two sub-groups:

- (II.a) rich countries with mining industries, ensuring food security through import
- (II.b) much poorer countries not importing enough food

This focusses on the differences in fertilizer use and presents a socio-economic and agronomic comparison of 46 of the 54 African countries.

With better soils, we see better fertilizer recommendations adopted

Confronting cereal yields with fertilizer use, it becomes clear that fertilizers in group II.a countries are not applied on cereals. Presumable the attention given to agriculture is going to cash crops. Thanks to food imports, the average food security of group II.a is the highest of the three groups. Group I countries are more food secure than group II.b countries (see food security indices). In group I countries, 15% of the population knows regularly what hunger is, against 30% for group II.b.

Group II.a, importing an important part of food consumed, are countries with an average gross income of USD12,700/capita/year. This figure is USD4,000/capita/year and USD2,000/capita/year respectively for group I and II.b. Useful for understanding these differences is the fact that the agricultural added value for group II.a is only 4% of the gross national product, against respectively 23% and 30% for group I and II.b.

Group II.a countries make their money out of mining. A limited fraction of its land is cultivated and only 18% of it is used for cereal production, against more that 50% for both other groups.

‹INSERT TABLE 2›

One other difference, not presented in the table is that in the group I countries, the price of fertilizer nitrogen is 3.2 times higher than the price of paddy rice, and 5.5 times higher than the price of maize. The averages for the group II countries are respectively 5.8 and 7.1. The absence of an effective agricultural policy cannot be better illustrated.

Struggle against poverty through integrated soil fertility management

Fertilizer recommendations will influence fertilizer use adoption when improving the cost/benefit ratio sufficiently.

The above analyses helps to answer the question when and where optimizing fertilizer use will trigger fertilizer adoption.

Key recommendations

Agronomy is a useful tool in a fertilizer action plan, when it improves the costs/benefit ratio of fertilizer use. This opportunity is weakening when the distance to the cities and markets increases. The greater the distance, the more agriculture serves food self-sufficiency of farmers. However, when farmers with increasing distance go for crops with a good shelf life, they create their own opportunity.

The better the soils, the more chance that fertilizer recommendations are adopted. Therefore, maintenance and/or improvement of soil qualities has to be a key component of the recommendations.

One may wonder why curing the fragility of the countries of group II.b, while tackling the negative role of corruption should not have the highest priority. Such efforts risk not being meaningful in countries where the gross national income per capita is only USD2,000/year. As shown in table 2, for the group I countries, those with agricultural development, the average income has been already doubled.

Well organized agricultural development can lead to socio-economic development and their is hope that economic development will go hand in hand with increase of the wages.

However, the opposite - cheap labour - is required to enable Africa to industrialize and to produce for itself and for more developed countries in Europe and in America, in the same way as some Asian countries are doing. To realize this, food has to become much cheaper, allowing for less labour to feed the family, while having more money left for other expenditures. ■