Trends in Fertilizer Consumption in Cameroon: Implications for Sustainable Agricultural Development

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Abstract

Intensification of smallholder agriculture is critical to future economic development in most developing countries, including Cameroon. With current population of about 16 million projected to reach 20 million by 2020, the task for Cameroonian agriculture will be to meet the ever-increasing demand for food and fibre in a sustainable way. Current agricultural practices mine soil nutrients, with annual average removal of more than 60 kg/ha ($N+P_20_5+K_20$). Organic sources are not sufficient to replace these nutrients. This paper attempts to examine trends in fertilizer consumption in Cameroon over the 1961-2001 period. Compound growth rates for fertilizer consumption are estimated. Preliminary analysis of the data suggests that fertilizer consumption in the post- reform period (1995-2001) has recovered to the immediate pre-reform (1980-1988) period after incurring sharp drops following the elimination of subsidies and consequent fertilizer price increases.

Key Words: Fertilizer consumption trends, nutrient use efficiency, sustainable agriculture, Cameroon.

Introduction

The benefits of fertilizer use in developing countries are well documented (Baanante et al., 1989). Intensification of smallholder agriculture is critical to future economic development in most developing countries. Therefore, like most developing countries, Cameroon is making efforts to increase agricultural production by increasing productivity. In modern agriculture special emphasis is placed on improved techniques of crop production. Improved varieties play a prominent role in increasing per hectare yield. However, full potential of the improved varieties can be realized only if essential inputs, particularly fertilizers are applied both in requisite quantities and in a timely manner.

Agriculture in Cameroon is dominated by small farmers who intercrop their production of cash crops and food crops on average farm size of about 2 hectares (MINAGRI, 1993). Irrespective of the zone, most production, whether of food crops or cash crops, comes from small farmers.

Good genetic plant material and sound agronomic practices, water and soil fertility are the keys to high crop production levels. The agricultural future of Cameroon lies in the rainfed areas and improvements in soil fertility at the farm level is a key element for maintaining and improving crop yields. Throughout Cameroon, low-fertility soils are a major constraint on crop production (IFDC, 1986). Under these conditions, an increasingly important impact of fertilizer on food-crop yields can be expected with the cereal crops and particularly with maize, which requires a high level of soil fertility for good yields (IFDC, 1986).

The population of Cameroon grew from 7.7 million in 1976 to about 15.3 million in 2000, reflecting an annual growth rate of 2.8 percent (Institut National de la Statistique, 2001). The population is projected to attain 20 million by 2020 (FAO, 2004). The task for Cameroonian agriculture during the coming decades will be to meet the ever-increasing demand for food and fibre in a sustainable way. Current agricultural practices mine soil nutrients, with average removal of more than 60 kg per hectare over the 1993-95 period in over 18 African countries, including Cameroon (Map1 in Appendix). Organic sources are not sufficient to replace these nutrients. Declining soil fertility and mismanagement of plant nutrients have made the job of satisfying food and fibre need more difficult. Increasing inorganic fertilizer use, consistent with agronomic recommendations will have few, if any undesirable environmental impacts, and many positive impacts. For example, increased inorganic fertilizer use would benefit the environment by reducing the pressure to convert forests and other fragile lands to agricultural uses and, by increasing biomass production, help increase the organic matter content of African soils. This organic material supplies and helps retain soil nutrients.

Without proper use of fertilizers the sustainability of yields of improved varieties at high levels cannot be achieved. To quote the Food and Agriculture Organization of the United Nations (FAO) on this issue: “Attempts to increase productivity without adding nutrients to the soil will ultimately fail, especially when soils are already on the verge of degradation. Technologies that use minimum inputs are unlikely either to increase yields significantly or to prevent further degradation in adverse seasons. Therefore, technologies of the future must continue to use fertilizers or relatively large dressings of organic manure in order to restore soil structure and fertility” (FAO, 1987).

In 1999, the intensity of fertilizer use (i.e., kg per hectare of cropland) was 7 kg in Cameroon. This is just over half the average of 12 kg for sub-Saharan Africa and far below the world average of 94 kg. There are many reasons for low fertilizer use. These include unfavorable input and output prices, limited access to credit, infrastructural constraints, and the nonconductive policy environment. Concerns about the decline in fertilizer use following the implementation of structural adjustment and agricultural reform programmes in the 1990s have led many analysts to question the premises and effectiveness of the reforms and to suggest alternative approaches for promoting agricultural intensification in developing countries (Jayne et al., 2003). Inorganic fertilizer use must be combined with other agronomic management practices. That is, for efficient nutrient utilization, inorganic fertilizer must be combined with organic matter, water harvesting, and controlling soil erosion in site-specific integrated soil fertility management strategies.

This paper attempts to examine the trends in fertilizer consumption in Cameroon during the four decades from 1961 to 2001. Specific objectives are:

1. To examine trends in consumption of inorganic fertilizers from 1961 to 2001; and
2. To estimate compound growth rates of fertilizer consumption for selected sub-periods.

To enable the reader have a clear perspective of what is meant by the term “fertilizer”, the author briefly defines the term “fertilizer”, clarifies some distinctions between organic and inorganic fertilizers and briefly discusses the importance of nutrient use efficiency and balanced fertilization and the need for soil testing. Next, the data and the procedure used in this study are discussed. This is followed by analysis of the data. Lastly, the study conclusions and implications for policy are presented.

What is a fertilizer?

A fertilizer is a material that furnishes one or more of the chemical elements necessary for the proper development and growth of plants. These elements include the major nutrients such as nitrogen, phosphorus, potassium, and sulfur, as well as the trace elements such as iron, zinc, and magnesium. The most important fertilizers are fertilizer products (also called chemical or mineral fertilizers), manures, and plant residues. A fertilizer product is a material produced by industrial processes with the specific purpose of being used as a fertilizer. Fertilizers are essential in today’s agricultural system to replace the elements extracted from the soil in the form of food and other agricultural products (UNIDO/IFDC, 1998).

Frequently Misunderstood Fertilizer Distinctions: Organic vs Inorganic

There has been much controversy over organic versus inorganic fertilizers. It is important to know that plants do not recognize the difference between organic and inorganic fertilizers. Their tiny root hairs can absorb only nutrients that have been broken down into inorganic, water-soluble forms. It makes no difference to a maize plant or to a tomato plant if the atom of nitrogen it is absorbing has come from a compost pile or a fertilizer factory. Organic fertilizers are made from materials derived from living things and include such things as cow, sheep, goat, poultry and horse manure. (Farmers should avoid using pig, dog or cat faeces because of the problems involved with internal parasitic worms which may be transferred to humans.) Bonemeal, bloodmeal, compost, and green manures will also provide nutrients for plants. Chemical fertilizers are manufactured from nonliving materials. Rock phosphate, for example, is a common source of phosphorus in chemical fertilizers. There are, however, advantages and disadvantages to each form of fertilizer, organic and inorganic (Table 1 in Appendix).

It is important to reiterate that there is no fundamental difference in nutritional quality between organic and inorganic fertilizers. It makes no difference to the beet root if the atoms of potassium it absorbs are from an organic fertilizer such as wood ash or an inorganic one such as muriate of potash. Similarly, “it makes no difference to a plant whether the nitrate ion it consumes comes from a bag of urea or from decomposing organic matter” (Dr. Norman E. Borlaug, 2003). Whether a farmer chooses to use organic, inorganic or a combination of both types of fertilizers, it is important to follow research and extension guidelines regarding timing of application, placement of the fertilizer, and the proper amount of fertilizer to be used. All the same, if organic materials are readily available and cheap, the expense of the commercial fertilizers should also be considered, bearing in mind that organic fertilizers are complements, not substitutes for inorganic fertilizers.

Nutrient Use Efficiency and Balanced Fertilization

One of the most important reasons for low fertilizer use efficiency is the imbalanced application of fertilizers. For best results from fertilizers all the nutrients must be available in sufficient quantities. The target in the application of fertilizers should therefore, be two-fold – first to obtain reasonable yields and second to build the soil fertility reserves back to sufficiency levels. The best way to achieve this is the use of organic residues and manures in conjunction with inorganic fertilizers, which can help in lowering the production costs by supplying plant nutrients on the one hand and by improving the soil health and properties on the other.

Fertilizer use efficiency (FUE) and nutrient use efficiency (NUE) is perceived and determined differently by agronomists, physiologists, soil scientists, and even economists. The common denominator in different approaches is crop yield. An increase in FUE or NUE generally leads to an increase in crop yield, which is a reflection of a greater output per unit input. Though approaches towards FUE or NUE are interrelated, the corresponding agro-economic definition is of paramount importance in practical farming. It relates the input directly to the output and does not provide credit for luxury consumption or other avenues of nutrient loss.

Efficient nutrient use results from balanced fertilization and sound management practices and decisions. Balanced fertilizer use is not only the first requirement; it is a pre-requisite since no amount of agronomic manipulation can produce high efficiency out of imbalanced nutrient application. When balanced fertilization is practiced, one nutrient increases the efficiency of others through a synergistic effect. Of critical importance is the need to determine the fertility status of soils before embarking on fertilization. This can be accomplished through appropriate soil testing.

The Need for Soil Testing

Would you add oil to your car's engine without checking the level on the dipstick first? Of course not! However, many farmers do something similar every year when they apply fertilizer to their soil without getting a soil test. By soil sampling, farmers can potentially save money that might otherwise be spent on unneeded fertilizer and other chemicals. Farmers who do not sample may penalize themselves by having to replant or replace their crops later due to either inadequate or excessive nutrients.

In industrialized countries like the United States of America, soil sampling analysis is a free service for residents in many States. But in most developing countries in Sub-Saharan Africa in general the situation is different. In Cameroon, for example, soil testing is rarely done by small farmers who produce over 80 percent of the food supplies on farms averaging 1.8 hectares. The reason is that small farmers cannot afford the cost of reagents used in soil tests and so must rely on government institutions to conduct such tests. Given the severe budgetary constraints faced by the Government of Cameroon, soil testing is not high on the list of priorities for agricultural sector development. This is a serious mistake considering that applying unneeded fertilizer is becoming more and more costly. And its purchase price is just part of that cost. Over-fertilizing also can lead to important environmental concerns, such as runoff from farms. Summaries of soil tests carried out by research institutions in Cameroon over the past 15-20 years may show little change in the level of some nutrients. But, an isolated incident within the context of increasing changes in world atmospheric conditions can have a big impact on policy. At the same time, planting choices based on soil tests are more than an ecologically sound practice.

Data and Procedure

The study was based on time series data on fertilizer consumption from the year 1961 to 2001 obtained from FAO database. Data from other sources were of poor quality and often incomplete and contradictory. At the time of this writing, 2001 is the most recent year for which data is available from the FAOStat web site (http://apps.fao.org/.[1] The data on fertilizer consumption were analyzed and compared for five sub-periods characterized by different stages in the fertilizer sector and development policy environment in Cameroon. The first two sub-periods, 1961-1970

[1] FAO is the only consistent source of fertilizer use information for African countries.

and 1971-1980 represent the pre-reform period when fertilizer use development was in its infancy. The sub-period 1980-1988 represents the period when FONADER[2] was exclusively responsible for procurement and distribution of subsidized fertilizers. The sub-period 1988-1994 represents the period when the Fertilizer Sub-Sector Reform Programme (FSSRP)[3] was implemented. Finally, the sub-period 1995-2001 represents the period of complete privatization of the fertilizer sector. Because data were not available on organic fertilizer consumption, the analysis in section concerns the use of inorganic (or chemical) fertilizers only. Growth rates were estimated using ordinary least squares (OLS) regression with the dependent variable expressed as the logarithm of the series and the independent variable time. Descriptive statistics and estimated compound growth rates are reported.

Data Analysis

Major trends in fertilizer consumption are depicted in Figure 1. In the early 1960s, the Food and Agricultural Organization (FAO) of the United Nations launched a worldwide campaign against hunger. Cameroon adhered and put in place a fertilizer sector. At this initial stage in fertilizer use development it was necessary to create an awareness of the benefits of their use. Heavily subsidized fertilizers were distributed by government agencies and extension services advised farmers on their use.

Table 2 (in Appendix) presents descriptive statistics for the fertilizer consumption data for the period 1961-2001. Average yearly fertilizer consumption over the 41-year period was 26.7 thousand metric tons of nutrients. Absolute fertilizer use rose from a low of 3.3 thousand metric tons in 1961 to 52.5 thousand metric tons in 2001 with important inter-year variation. Mean annual fertilizer consumption rose from 10.4 thousand metric tons of nutrients in 1961-1979 (when fertilizer use was still in its infancy) to 41.9 thousand metric tons in 1980-87. During these two sub-periods, fertilizer consumption registered compound growth rates of 11.1 and 7 percent, respectively.

The observed upward trend in fertilizer use was due mainly to the existence of fertilizer subsidy administered by FONADER. Additionally, the subsidized fertilizers were sold at uniform prices throughout the Country. Thus, there was no incentive for private economic agents to participate in fertilizer importation and distribution. During the seven years of the FSSRP (1988-1994), absolute fertilizer consumption dropped, averaging 25.5 thousand metric tons per year reflecting a compound growth rate of 9.6 percent over the period. The drop in fertilizer consumption was due

[2] Fonds National du Développement Rural (National Agricultural Development Funds), a state-owned institution responsible for the procurement and distribution of subsidized fertilizer from 1980 to early 1988.

[3] Fertilizer Sub-Sector Reform Programme implemented with support from the United States Agency for International Development (USAID). The programme lasted from 1987/88 (with 70% of delivered fertilizer cost subsidized) to 1993/94 (with 0% subsidy, USAID withdrawal and devaluation of the franc CFA).

mainly to the phasing out of fertilizer subsidy and the consequent increase in fertilizer prices without compensating increases in farm gate crop prices. It is important to recall that both crop and fertilizer prices and non-price variables are important influences on plant nutrient consumption. Fertilizer consumption in the post-reform (1995-2001) period has recovered to the pre-reform levels after incurring sharp drops following the elimination of subsidies. Average yearly consumption was 41.5 thousand nutrient tons reflecting a compound growth of 9.4 percent during the post-reform period.

Fertilizer use in Africa has not developed as many planners hoped it would. If faults are to be identified, then probably the key failing has been the lack of farmer service in terms of guidance and customer service. This points to the critical role of extension in fertilizer use and sustainable agricultural. Perhaps the most informative report on factors affecting fertilizer use growth rates for food-crop production comes from India (Desai, 1982). The following quotation from Desai is particularly apt at this stage in the development of fertilizer use in Cameroon.

> "In India, actual total fertilizer consumption has been substantially less than the economic potential for it; and fertilizer prices have been administratively controlled. Under these circumstances, it would be incorrect to interpret the time series of total fertilizer consumption within the framework of demand analysis only, relating it to the agroeconomic variables behind farmers' demand for fertilizer in order to identify the forces governing it. The pace of growth in total fertilizer consumption would also be governed by the processes that convert the potential into actual farmers' demand. This would include development of an adequate and efficient distribution system, efforts to promote fertilizer use on different crops, and increased availability of fertilizers."

Conclusion and Implications for Policy

It is obvious that national policies can play both a positive as well as negative role in promoting fertilizer use. The challenge lies in identifying an optimum set of policies such that economic benefits generated by these policies are always higher than their costs. With the present low purchasing power of most Cameroonians, agricultural production and productivity can be greatly improved by stimulating a strong increase in fertilizer demand and by simultaneously implementing programmes to improve market efficiency. The focus should be on getting fertilizer prices down and increasing demand in a cost-effective and sustainable manner. A combination of public and private actions is needed, the main objective being not to get government out of the fertilizer sector, but to identify its proper role given the situation prevailing in Cameroon.

Kelly, et al (1998) observed that to enhance input market efficiency while promoting fertilizer use, consideration should be given to the possibility of some type of fertilizer subsidy as a way of priming the pump to get more efficient private sector involvement in the fertilizer sector. They stress that earlier analyses of fertilizer sector performance has been the failure to consider social costs and benefits. They resolved that as environmental protection becomes increasingly important concern of governments, more attention to fertilizer environmental benefits (e.g., less production moving into marginal lands) and potential inconveniences once high levels of use are attained (e.g., soil acidification, water pollution) will be desired.

Removal of fertilizer subsidy without compensating increases in farm gate prices of crops may jeopardize the achievement of food production targets and fail to realize potential socio-economic benefits. Careful monitoring of the effects of increases in the prices of fertilizers relative to those of crops, whether already implemented or proposed, is essential.

A decline in fertilizer use in Cameroon will result not only in the starvation and malnutrition of millions in Cameroon and the Central African sub-region but also in an increased degradation of the environment through deforestation, soil erosion, and desertification. The certain benefits of fertilizer use to the environment significantly outweigh any of the possible but uncertain detrimental effects. Given that Cameroon lags far behind most developing countries in fertilizer use per hectare, there is wide scope for significant and judicious increases in fertilizer use.

Furthermore, for nutrient use efficiency to be achieved, it is necessary to conduct soil tests of farmers' fields on a fairly regular basis. Soil tests measure the relative nutrient status of soils and are used as a basis for profitable and environmentally responsible fertilizer application. Public and private sector partnerships can be beneficial if fertilizer dealers are encouraged to offer soil testing services to farmers. Extension efforts in educating farmers on integrated soil fertility management practices should be strengthened.

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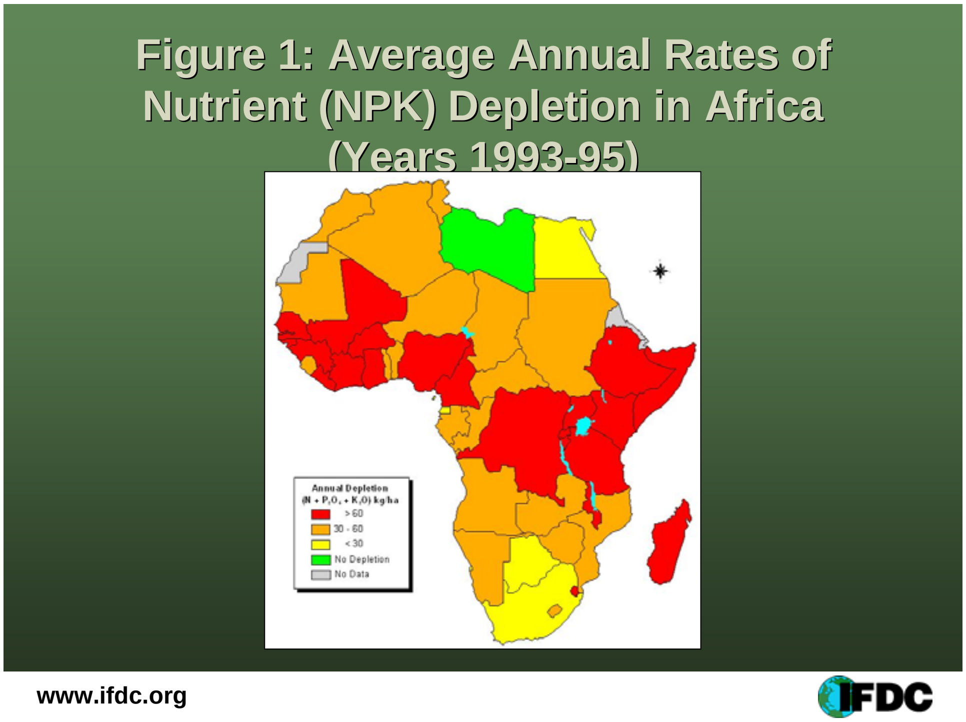
Appendix



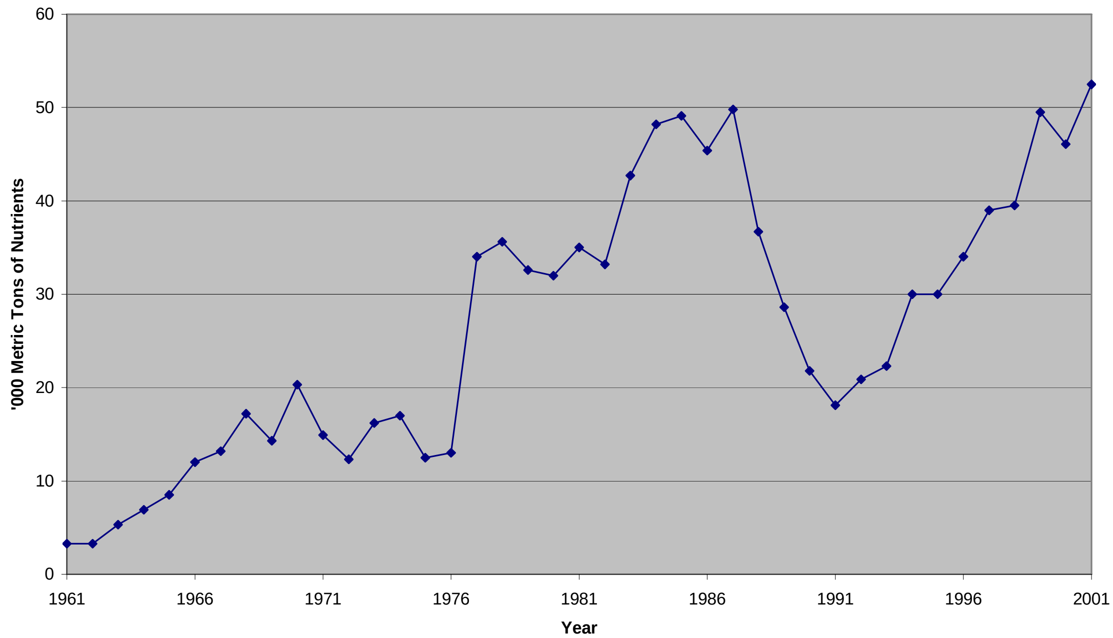
Source: Bumb & Groot, 2004.

Table 1: Some Advantages and Disadvantages of Organic and Inorganic Fertilizers

Organic Fertilizers	**Inorganic Fertilizers**
Advantages: 1. Provides the soil with organic nutrients. 2. Improves the soil structure, or tilth, and increases its ability to hold both water and nutrients. 3. Buildup of toxicity in the soil is unlikely, as long as the amount of organic material incorporated into the soil is fully decomposed. Disadvantages: 1. Not immediately available to plants. This “slow release” feature can be an advantage. However, if there is an immediate need for nutrients, organic fertilizer cannot supply them in a hurry. 2. Less exact way of providing for a plant’s nutritional needs because amount of nutrients and exact type of elements can only be guessed at. 3. Possibility of nitrogen depletion. Because of complex bacterial action, addition of a large amount of organic material can cause a temporary nitrogen depletion in the soil and therefore in the plants.	Advantages: 1. Readily available to plants. 2. A more exact way of providing for a plant’s nutritional needs because type and amount of any given nutritive element in the fertilizer formulation are known. Disadvantages: 1. Subject to leaching when washed by rain or irrigation water down below the level of the plant roots. 2. Can burn seedlings and young plants through process of drying out or desiccation due to presence of chemical salts within the mineral fertilizers. 3. Overly heavy applications can build up toxic concentrations of salts in the soil and create chemical imbalances.

Source: International Fertilizer Development Centre (IFDC).

Figure 2: Fertilizer Consumption in Cameroon, 1961-2001



Source: FAO database.

Table 2: Fertilizer Consumption in Cameroon, 1961-2001

	I 1961-79	II 1980-87	III 1988-94	IV 1995-2001
Mean ('000 mt)	15.3	41.9	25.5	41.5
Standard Deviation	9.5	7.4	6.5	8.2
Minimum ('000 mt)	3.3	32.0	18.1	30.0
Maximum ('000 mt)	35.6	49.8	36.7	52.5
Compound Growth (%)	11.1	7.0	9.6	9.4

Source: Author's computations.