A New Approach to Fertilizer Use and Food Production in Less Developed Countries

A.C. Ackello-Ogutu

Abstract: After explaining why so many developing countries are facing food production problems, this paper proceeds to give a brief outline of alternative options for raising soil fertility and food crop production in the less developed countries (LDCs). The underlying hypothesis is that government policies concerning prices, trade, infrastructure, and literacy of the millions of rural people in LDCs impose serious constraints on efficient distribution and use of manufactured fertilizers. The paper emphasizes the fact that there are still vast potentials for increasing food production in the LDCs that cannot be afforded on a regular basis by the small scale farmers. There is an urgent need for the LDC governments to institute specific policies favouring the production of food crops. LDCs are also urged to strengthen their agricultural and extension services so as to facilitate effective use of organic fertilizers at the farm level.

Introduction

This paper examines alternative possibilities for increasing soil fertility and food production in the less developed countries (LDCs). The underlying hypothesis is that, in many of the LDCs, government policies on prices and trade, poor infrastructure, and illiteracy of the rural people impose severe constraints on the efficient distribution and use of manufactured fertilizers necessary for increasing food production.

The options suggested in this paper are by no means new but should, nevertheless, be accorded a renewed emphasis because the cost of manufactured fertilizers is expected to continue rising, thereby working against the small-scale farmers’ efforts to increase food crop productivity.

Production and Consumption of Fertilizers in the LDCs

The consumption of fertilizers in the LDCs has increased significantly over the last three decades. Consumption of the commonly used macronutrients—nitrogen (N), phosphorus (P), and potassium (K)—in 1982/83 was about 40 Mt (FAO, 1983b) compared to only one Mt in 1950 (IFDC, 1979).

Per capita consumption is, however, relatively low compared to the developed countries (DCs), thus indicating a potential for increased consumption in the future. In 1974, fertilizer use per capita in the LDCs was only 6.7 kg compared to 58 kg in the DCs, with projections of 18.7 kg and 130 kg respectively by the year 2000 (IFDC, 1979).

The distribution among LDCs of the raw materials needed in fertilizer manufacture and the cost of energy are such that many LDCs have to import large amounts of fertilizer.

The experiences of the oil crisis of the early and mid-1970s that led to unprecedentedly high fertilizer prices have emphasized the need for the LDCs to strive for self-sufficient production, especially of N. However, the current trends in the costs of plant construction and raw materials are such that individual ownership of fertilizer manufacturing plants will continue to be an illusive dream of many LDCs.

Regional cooperation among LDCs for purposes of fertilizer production and trade is a theoretically feasible and often discussed alternative to self-sufficiency but one fraught with inherently serious political and economic difficulties.

In the meantime, the pressure on agricultural land is growing more intense. In Kenya, for example, where the population growth rate is estimated to be 4 percent per year, agricultural land per capita ranges from 0.3 ha to 1.8 ha (Government of Kenya, 1983b) and is projected to average about 0.2 ha by the year 2000 (McCarthy and Mwangi, 1982).

The declining trend in land availability, reinforced by inadequate irrigation facilities, is forcing farmers to cultivate marginal land, which requires not only special soil conservation techniques but also large applications of expensive fertilizers in order to maintain crop productivity.

The Need for Increased Efficiency in Fertilizer Use

Due to the finite nature of raw materials used in the manufacture of fertilizers, and in view of their rapidly escalating costs, more emphasis should be placed on increasing fertilizer use efficiency. Efficient fertilizer use should also be encouraged to prevent environmental pollution due to excessive
application.

It is estimated that only about 50-60 percent of $N$, 10-15 percent of $P$, and 20-25 percent of $K$ is recovered by the crop to which they are applied (IFDC, 1979; FAO, 1975a). The remainder enters the soil nutrient bank or is washed away into the rivers, lakes, and ground water, often with deleterious consequences to aquatic and human life.

Nutrient loss can be accelerated by inappropriate soil management practices, especially those encouraging erosion of the topsoil. Poor soil management is often prevalent in low income farming communities where short-term subsistence requirements are heavily weighted against the environmental and long-term issues.

Food Production and Availability

The LDCs need to apply measures aimed not only at increasing food crop production but also at ensuring that food reaches the consumer at affordable prices. Such prices must also leave a fair economic return to the factors of production in order to avoid their relocation to other activities. In that respect, a fundamental objective is that of food self-sufficiency. In itself, increased use of fertilizer should be seen only as part of the basic objective of increasing food availability.

If the LDCs’ small-scale farmer is to be the target and the basic objective is to increase food crop production, then an expectation of a sudden technological leap into the use of manufactured fertilizers and hybrid seeds does not constitute a viable long-term proposition.

One of the major weaknesses of placing too much emphasis on adoption of improved seed varieties and fertilizers is that timely distribution of those inputs to a large number of farmers requires a well-organized marketing infrastructure, adequate storage and transport facilities, together with large sums of money in the form of credit to producers, local stockists, or both. These are usually lacking in LDCs or operational only for cash crops.

Another weakness of overemphasizing the use of manufactured fertilizers is that, in an attempt to keep the consumer food prices low (especially in the urban areas), and in the absence of credit and subsidies favouring food crops, only a few of the low-income farmers find it economically worthwhile to increase food crop production beyond their own subsistence requirements.

Finally, many of the farmers in the LDCs are illiterate and, with the inadequately staffed and poorly funded agricultural extension systems, they cannot be expected to follow the constantly changing instructions necessary for effective use of fertilizers and new seed varieties. When price incentives and the requisite literacy are lacking, recurrent expenditures on fertilizer and new seed varieties can easily be viewed by poor farmers as unnecessary.

Examples drawn from Kenya—a country often cited as one of the agricultural success stories in Africa—may be used to illustrate those points. In 1963, the area planted to hybrid maize was only 162 ha (FAO, 1975b). Adoption was fairly rapid up to 1972 but levelled off by 1974-76 when the area devoted to hybrid maize averaged about 332,500 ha, or only 22 percent of the total area under maize in the country (Government of Kenya, 1983b; FAO, 1982).

In the field of fertilizers, one study conducted in Kenya’s Central Province revealed that 59 percent of those interviewed did not use fertilizers at all, mainly because they could not afford to do so. Of those who did use them, 68 percent applied inadequate or suboptimal amounts at the prevailing prices (Mwangi, 1978).

In general, it can safely be said that food production in the LDCs has had only nominal benefits from increased fertilizer consumption. Most of the fertilizer is channelled towards the production of high cash value crops rather than food crops whose value-cost ratios, especially following harvest periods, are usually too low. What, then, are the options for increasing soil fertility and food production by small-scale farmers in the LDCs? The next two sections attempt to answer this question.

The Role of Agricultural Research and Extension

An aspect of agricultural research and extension requiring critical evaluation is their role in the development and supply of improved or appropriate varieties of seeds and the design of recommendations that take into account resource constraints.

Many poor farmers living on low potential and very small holdings often fail to get access to nonfarm input loans, or, when they do, the inputs are invariably misallocated due to misleading
advice from the research and extension network. Consequently, repayment of such loans having failed, farmers become reluctant or unable to reapply for additional funds. This adversely affects production continuity.

Cooperative purchase and use of inputs by small-scale farmers is rapidly gaining popularity and should be encouraged by the LDC governments. It should be complemented with adequate extension work, especially in adult education and basic bookkeeping, to avoid the exploitation of illiterate farmers by those motivated by self-interest.

Another area requiring immediate attention is the role of women in food crop production. Although statistical evidence is still lacking, reorganization of the legal and agricultural extension systems in the LDCs could go a long way towards increasing rural incomes and food production (Boserup, 1970; and Buvinic, 1978). This reorganization could be achieved through the liberalization of land ownership, property rights, and credit access policies and by placing greater emphasis on women (rather than household heads, usually men) as a target group in agricultural extension work.

The design of crop production recommendations, including those regarding the use of fertilizers in the LDCs, is ad hoc in nature and is usually developed by research stations having a strong agronomic bias.

The use of socioeconomic models as a basis for constructing farm production plans is almost nonexistent, partly because of lack of qualified staff to deal adequately with the varied socioecological zones and farming conditions and partly due to insufficient government commitment and financial support. Thus the LDC governments should be urged to spend higher proportions of their GNP on the development of research and extension systems. More effort should be aimed at the creation of a lasting awareness among the small-scale farmers of the need for efficient use of resources. Also needed are policies specifically aimed at encouraging internal generation of funds to be invested in the improvement of food production, thus avoiding overreliance on foreign loans.

**Integrated Nutrient Supply Approach**

Minimization of reliance on manufactured fertilizers can be achieved by stressing the integrated nutrient supply approach involving the use of organic fertilizers such as farmyard manure (FYM), biological nitrogen fixation (BNF), sewage effluent, and slurry from biogas plants. Unlike manufactured fertilizers, adoption of those innovations would not impose further strains on existing transport, storage, or credit facilities.

The use of FYM has a big potential in farms with livestock. With the existing pressure on agricultural land and the resulting parcelization of farms, the number of livestock per holding can be expected to decline significantly in the future, thus limiting the accretion of farm organic matter. Efforts should, however, be directed towards the promotion of organic composting techniques that yield high quality manure within short periods of time.

Much work has already been done on BNF, particularly regarding N fixed by symbiotic Rhizobia in the root nodules of leguminous crops and by blue-green algae, especially in flooded rice fields. Some grain legumes are capable of fixing as much as 500 kg of N per ha and experiments of the Indian Agricultural Research Institute have shown that grain cowpeas can provide 12-23 kg of N per ha for the cereal crop that is subsequently planted (FAO, 1983a).

The potential of BNF has not yet been fully tapped, but it is hoped that the LDCs will overcome the expertise and capital constraints in order to take advantage of the current joint efforts of IITA, IRRI and FAO/UNEP aimed at promoting legume inoculation.

Work on the benefits of sewage effluent and slurry from biogas plants is still at its early stages. Nevertheless, the Indian National Dairy Research Institute estimates that 2.5 t of dried biogas slurry is equivalent to 40 kg/ha of fertilizer N (FAO, 1983a).

Finally, educating the farmers on proper crop husbandry, even for traditional food crops, can yield significant dividends. In many LDCs, timeliness in planting and weeding and proper soil conservation have yet to become the modus operandi in agricultural production. A study conducted in Kenya as early as 1968 showed that even without applying fertilizer, good husbandry on local maize could yield 148 percent more grain than poor husbandry on hybrid maize and fertilizer (Allan, 1968).
Conclusions

The options discussed above are by no means exhaustive. It is hoped that further discussions will not only allow exposition of specific country experiences but also the creation of interest among the LDC governments to embark as soon as possible on the promotion of policies and strategies of food production with minimal reliance on external aid in the form of fertilizers.

It is the author’s contention that if such policies were to be pursued, the small-scale farmers in the LDCs would be moved steadily along the technological continuum towards a sustainable improvement in food production.

Notes

1 University of Nairobi.
2 The LDCs are discussed in the paper as a group but it should be noted that some of the statements, especially those referring to the cost of energy, may not be applicable to the oil-producing countries.
3 The term “efficiency” is used rather loosely here in reference to the percentage crop recovery of the applied nutrients and the crop response.
4 The experiences forming the basis of this paper are drawn mostly from Kenya, but it is hoped that the recommendations (options) are equally applicable to other LDCs having similar food production problems.

References