

MALAWI

Strategy Support Program



THE CHALLENGE OF AFRICA'S NITROGEN DROUGHT: SOME INDICATORS FROM MALAWIAN EXPERIENCE

STEPHEN CARR

Years of continuous cultivation with little or no use of external inputs to restore soil nutrients has resulted in a situation in which crop production in a number of African countries is now limited by nutrient deficiencies and in particular nitrogen and phosphorus which are crucial to healthy plant growth. This widespread problem has been described as a “nitrogen drought”. Attempts to remedy this situation using only organic inputs have largely failed to keep up with the rate of nutrient loss. This policy note uses Malawi as an example of a country facing these conditions and in which the level of household food production is largely determined by the availability of nitrogen in the soil. Years of efforts to ameliorate this situation with organic initiatives have elicited little farmer support because of their lack of impact. Elsewhere in the world these deficiencies are made good with inorganic fertilizer and in Malawi small scale farmers have seen the benefits of these and are anxious to obtain them. With limited opportunities for generating income either on or off the farm the majority of farmers cannot afford to purchase inorganic fertilizer at commercial prices. This article describes unsuccessful efforts by donors to address this situation. Finally a year of severe hunger led the government to initiate a fertilizer subsidy programme. The article gives a brief outline of both the successes and challenges of this strategy and its current parlous situation. Despite its weaknesses the subsidy has led to improved household food availability for millions of people and its withdrawal would result in serious hunger and hardship as crop yields would decline in the face of major nutrient deficiencies. At present the country faces a clear option between importing and subsidizing inorganic fertilizer or importing and subsidizing higher cost grain.

BACKGROUND

For increasing numbers of small scale farmers in Africa the dominant factor which limits their yields is a deficiency of plant nutrients in their soils and in particular nitrogen and phosphorus which are crucial to healthy plant growth (Stocking 1987; Cleaver and Schreiber 1992; CIMMYT 1990). This is a result of years of continuous cropping with little, if any restoration of the nutrients removed by crops, erosion and leaching. It is claimed that “inadequate soil fertility now poses the single most important constraint on maize production in Africa” (Smaling 1993).

Malawi provides an example of such a situation in which an estimated 66 kilogram of plant nutrients are lost from each hectare of land each year through the removal of crops and residues (World Bank 2004) whilst a further 14 kilogram is lost through erosion (Elwell and Rook 1996). The result is average unfertilized maize yields of 800 kilogram per hectare (University of Malawi 2000) with many farmers on the most vulnerable soils achieving little more than half this level. As 72 percent of farmers have less than one hectare, with 38 percent having less than 0.5 hectares (National Statistics Office 2007), such yields cannot meet the family's food needs. The country is fortunate in receiving adequate rainfall over a four month period to produce good yields of appropriate crops with 96 percent of meteorological stations receiving a long term average of more than 800 millimeters of rain per season (see Department of Climate Change and Meteorological Services 2014).

The dominant limitation on yields is what has been described as a “nitrogen drought”. This is clearly indicated by the fact that there is little correlation between rainfall and maize production over time because of the adequacy of the rainfall, but there is a close match between grain production and the use of nitrogenous fertilizer. It

has proved possible over a number of years to accurately estimate the total maize crop in advance once the figure for nitrogenous fertilizer available to farmers is known.

Elsewhere small scale farmers replace these lost nutrients through the use of inorganic fertilizer by applying 548 kilogram of nutrients per hectare of arable land per year in China, 310 kilogram in Vietnam and 178 kilogram in India (World Bank 2012). The figure for Sub-Saharan Africa is 4 kilogram, which is quite inadequate to replace nutrient losses let alone lead to an increase in yields.

Farmers in Malawi are all too well aware of the challenge posed by declining soil productivity and the demand for access to inorganic fertilizer comes out all too clearly in any encounter with them (Conroy 1993). The only reason that they do not buy it is because they do not have available cash: 78 percent of farmers



Africa's “nitrogen drought”: lack of nitrogen affects plant growth and crop yield as demonstrated in this “Improved Maize for African Soils” maize trial led by CIMMYT. Photo credit: F. Sipalla/CIMMYT at Flickr.

do not have a surplus of food and so do not sell any significant amount of their staples (NSO 2007). The 15 percent of the population who live in urban areas provide an inadequate internal market for horticultural produce while high transport costs make low value annual export crops economically unattractive. The rainfall pattern, with a long dry season, precludes the growing of perennial cash crops for 98 percent of smallholders. Years of intensive effort have failed to identify a suitable high value annual crop. Currently only 5 percent of farm plots are allocated to non-food crops for sale (NSO 2007). In consequence fertilizer at commercial prices is out of the reach of the majority of farm families in Malawi.

THE ORGANIC ALTERNATIVE

In the late 1980s it became apparent that the ongoing credit program to provide fertilizer and seed for maize production was only assisting a small fraction of the farming community and that there was an urgent need to address the challenge of soil productivity facing the great majority of farmers who could not gain access to fertilizer (World Bank 1989). Four major donors put funds into a national initiative to popularize low cost methods for restoring soil productivity. There was adequate funding and an experienced group of senior agriculturalists to train and supervise a field team of 3,000 extension workers. In addition the Rockefeller Foundation supplied a group of scientists to provide excellent research support to the initiative. The strategy was based on limiting nutrient loss by getting farms worked on the contour, using homemade A-frames for marking out the farms. In order to restore the levels of nitrogen in the soil farmers were helped to combine agroforestry with a promiscuous soya bean (which does not need inoculation) with an excellent reputation for nitrogen fixation.

The agroforestry technology was based on the use of a quick growing leguminous shrub, *Tephrosia voglii* and an indigenous tree, *Faidherbia albida*. The former had given outstanding results used in a two and a half year fallow in neighboring Zambia and years of research on the latter tree in the wild had shown its beneficial impact over a life span of more than 100 years. In Malawi there was no possibility of having a fallow of more than six months but research had shown benefits from *Tephrosia* from even such a short break. Tons of *Tephrosia* seed were produced and distributed to tens of thousands of farmers with instructions as to its use. It was widely planted but within a few years it became quite clear that it was not being adopted and today it would be difficult to find it being used on a smallholding. It did benefit the following maize crop but farmers did not consider the benefit adequate to compensate for the loss of intercrops in the maize nor for the substantial amount of extra work involved. Farmers in direct contact with extension staff planted *Faidherbia* but the ten year wait for initial benefits discouraged others from adopting the technology. The soya proved quite popular but, with no local market and no traditional use in the diet the area grown was confined to a small fraction of the farm and therefore could play no significant role in restoring soil nitrogen levels. With no other technology available which was suited to farmers with less than a hectare of land the “organic” initiative was closed down after eight years.

There are small, closely managed efforts by NGO’s to help farmers with labor-intensive methods of restoring soil fertility but they show no signs of spreading across the general farm population and currently it is estimated that all organic sources are replacing 10 percent of the nutrients being lost from Malawian

farms each year (World Bank 2004). This may seem low but compares with India in which it is estimated that 15 percent of the 30 million tons of nutrients lost each year are replaced from all organic sources (Government of India 2009). This is in a country with a substantially higher proportion of leguminous crops and livestock ownership per head of rural population than Malawi.

THE FOCUS ON FERTILIZERS

The failure of the “organic” initiative to identify technologies which were suited to Malawian smallholders and which could keep up with the country’s rates of nutrient depletion and population growth led to a surge of activity in the later 1990s to provide more farmers with access to inorganic fertilizer. This took the form of free handouts under the heading of “drought relief”, the provision of small highly subsidized credit schemes for fertilizer and a nationwide initiative to provide all farming families with a small pack of free fertilizer and hybrid seed “to demonstrate the value of these inputs”. In fact the great majority of farmers were aware of the value of fertilizer and hybrid seed which had been used by the most prosperous members of the rural community since the 1960s and survey data showed that only 6 percent of those not using fertilizer did not want it (Conroy 1993). In a situation where nutrients are the dominant constraint on crop production the impact of fertilizer can treble yields of maize with no other change in management of the crop, making its benefits more than obvious to the general farming population. The challenge was not the ignorance of farmers but their inability to access what they needed and wanted in quantities adequate to offset nutrient loss and to provide them with sufficient staple food. As the inadequacy of free handouts of small quantities of fertilizer became more obvious the support of donors declined and in the 2004/05 season little free fertilizer was available from any source at the time of planting and there was a disastrous drop in maize production leading to widespread hunger and hardship. As a result of this experience the Malawia President announced that the government would assist farmers with subsidized fertilizer in quantities adequate to provide them with household food security. In doing this he was emulating the government policy of the two main smallholder farming populations in the world, India and China, which have been heavily subsidizing fertilizer for their farmers for many years. Despite strong opposition from the major donors the government went ahead with the subsidy and maize production immediately increased at the household level and widespread hunger was eliminated.

The focus of the subsidy is on fertilizer for maize. This is the natural crop of choice for the majority of smallholders

Despite strong opposition from the major donors the government went ahead with the subsidy. Maize production immediately increased and widespread hunger was eliminated.

and occupies 86 percent of the land allocated to staple food crops (NSO 2007). With small plots of land and four months of dependable rain per year maize is the grain crop which offers the greatest potential yield of reasonable quality calories per unit area. The crop was introduced by the Portuguese some four hundred years ago and farmers have adopted it in favor of the lower yielding sorghum and millets brought in earlier from Ethiopia and the Sudan. While root crops have the potential to produce more calories per hectare their inferior food quality has led farmers to confine them to a small fraction of the national cropped area. A further attraction of maize is its responsiveness to fertilizer as compared to sorghum and millets with their far lower grain indices. A series of 1,670 well-managed fertilizer trials on farmers’

fields showed that smallholders could expect to obtain 17 kilogram of maize for each kilogram nitrogen applied under Malawian conditions (Benson 1996). Subsequent surveys of the much larger number and broader variety of farmers involved in the fertilizer subsidy has identified an average figure of 15 kilogram of grain as the most likely response being achieved by the population as a whole to the application of one kilogram nitrogen on maize in the presence of adequate phosphorus (Dorward and Chirwa 2010). This is a much higher figure than can be obtained from the tall stemmed sorghums and bulrush millet grown in Malawi with grain indices as low as 18 percent. Farmers in Malawi have chosen maize as their dominant staple because of its yield potential, freedom from bird damage, palatability and responsiveness to improved plant nutrition. There is little sign of their making any change in this decision in the near future so that maize needs to be the focus of strategies aimed at improving household food security in Malawi. There are understandable concerns in some quarters with regard to the environmental impact of extensive fertilizer use but as Dudal and Byrnes (1993) have put it “the environmental consequences of the continued low use of fertilizer combined with persistent nutrient mining are more inevitable and devastating than those anticipated from increased fertilizer use”.

THE FARM INPUT SUBSIDY PROGRAM

Following on the Malawian President’s announcement that it was now government policy to subsidize inorganic fertilizer, fundamental decisions had to be made as how this policy would be implemented. There were three major issues which required decisions before the program could be initiated. The first was whether the subsidy would be available to all or would be targeted. If targeted then who would be the beneficiaries and thirdly how much fertilizer and of what type would be covered. It was recognized that there was a serious danger that if there was a general subsidy then traders would take advantage of Malawi’s long and porous international borders and substantial quantities of fertilizer would be lost to the country and sold to neighboring states with no subsidy. It was therefore decided to target individual smallholders who would be far less likely to export the fertilizer. There were insufficient funds available to offer a meaningful amount of fertilizer to every farming family so the decision was made to target 60 percent of the smallholder sector. There was plenty of survey evidence to show that the 20 percent of wealthiest families had been purchasing fertilizer with cash for a number of years and so that group was left out. It was considered that many of the poorest 20 percent lacked the means to make the best use of an expensive input and so they were also excluded. They were expected to benefit from the greater availability of grain in the community and the lower prices that would result from increased production. Their social welfare needs could be better met from more appropriate interventions than giving them expensive fertilizer. Finally it was calculated that to move large numbers of people out of food insecurity would require an allocation of 100 kilogram of fertilizer per beneficiary containing a balance of nitrogen and phosphate based on experimental evidence. This issue gave rise to a good deal of controversy as not all Malawi’s soils are in need of phosphatic fertilizer. Unfortunately a close study of the distribution of the areas with and without phosphate deficiency showed no clear geographic boundaries and the distribution of millions of bags of fertilizer with different constituents being allocated to neighboring villages was rightly considered too complex a challenge. All recipients therefore received a standard fertilizer package which included 34 kilogram nitrogen, 10kg phosphorus, and

4 kilogram sulphur (of which there was sound evidence of a widespread deficiency). It was expected that this would supply a family with an extra half a ton of grain which would close the food gap for a large proportion of recipients.

2005 saw the launch of FISP with 132,000 tons of subsidized fertilizer which was estimated to have produced an estimated 660,000 metric tons of maize. The pre-harvest price of maize in real terms in 2006 was just 39 percent of what it had been in 2005. With the great majority of rural people being net purchasers of maize this was a major benefit. In the following year the amount of subsidized fertilizer rose to 179,000 tons providing an estimated 900,000 tons of grain and a further improvement in household food security. The program reached its peak in 2008/09 when 202,000 tons of fertilizer were subsidized. The impact was a reduction of 23.2 percent in the proportion of persons classified as “very poor” between 2007 and 2009 (Dorward and Chirwa 2010). Pressure then started to mount on the government to reduce the amount of subsidized fertilizer. The per capita quantity of subsidized fertilizer steadily declined and by 2012/03 allocation was only 60 percent of the 2008/09 figure. The result, as expected, has been a sharp drop in maize supply, a corresponding marked rise in maize prices and the need for a World Food Program distribution of emergency rations of grain to 1.8 million people facing severe hunger. Had the subsidy been maintained at its original level an extra 400,000 tons of maize would have been produced and this hardship avoided.

The increase in corruption and theft associated with FISP is providing an excuse for an exit from support rather as a stimulus to deal with the weaknesses in the program.

The opposition to the subsidy comes from two main quarters. The first is from members of the donor community who

have a long history of high levels of subsidy to their own farmers but are uncomfortable with using their aid money for a long term subsidy to Malawian smallholders. The increase in corruption and theft associated with FISP in recent years is providing an excuse for an exit from support rather as a stimulus to deal with the weaknesses in the program. The second source of opposition is to be found among senior Malawian civil servants. Allocations to a number of departments have been cut in order to fund the subsidy program and the officials resent the cuts.

Two “exit strategies” are being proposed. The first is to turn the subsidy into a loan. The cost in money and manpower of administering small loans to two million widely scattered individuals and collecting the repayment would render such an initiative quite impractical. Of more fundamental importance is the fact that the fertilizer and seed provided under FISP serve to close the household food gap and less than 20 percent of recipients are recorded as selling maize and thereby raising funds which could be used for loan repayment (Jayne et al. 2010). The great majority are unwilling to go hungry in order to repay a loan from a national institution. This is why when even a comparatively small number of better off maize farmers obtained loans from Malawi’s Rural Finance Company for fertilizer the level of repayment was less than 50 percent and the initiative had to be abandoned. Fertilizer prices and interest rates were much lower at that time and today fewer loans would be recouped. The second strategy is to use the FISP funds for improved agricultural research and extension which would raise yields without the need for a subsidy. This flies in the face of the clear historical evidence. Over a period of 15 years the World Bank and other donors provided more than US \$150 million to the Malawian Ministry of Agriculture and Food Security (MoAFS) to strengthen its research and

extension capacity. Project completion reports on the projects all indicated that the investments had no positive impact on yields or national grain production. The final, and largest, investment (Agricultural Services Project) received such a negative Project Completion Report that the World Bank suspended lending to MoAFS for a number of years. This was hardly a surprising outcome. As the dominant constraint on crop production is a shortage of essential plant nutrients, then any strategy which does not provide farmers with those missing nutrients is bound to have little impact. There is nothing to indicate that an expansion of an extension service which is unable to remedy the problem of a "nitrogen drought" will have any more success than its predecessors. The remarkable increase in staple food production in Asia has been the result of giving farmers access to sources of plant nutrients in sufficient quantities both to replace losses and raise yields. Given the relationship between the cost of fertilizer and the value of staple grains, this provision has almost always required the use of subsidies. There seems no reason why the situation in the increasingly densely populated areas of Africa should be different. Countries like Malawi have to face a clear choice between helping their own farmers to be more productive or importing ever more grain which, in its turn, has to be subsidized to

make it accessible to a population with a low purchasing capacity. This latter option is not as straightforward as it might appear. Malawi will not allow the import of GMO maize which cuts it off from the South African market which is itself stretched. Zambia has put a ban on maize exports and Zimbabwe and Mozambique are both importers. Tanzania is expecting to export any surplus to neighboring Kenya which is in deficit. This means that Malawi would have to import bagged white maize from the US at four times the cost of the current government controlled retail price of maize. The current subsidy on the "official" maize price is MK80 per kilogram. The current subsidy on fertilizer is MK300 per kilogram but if the program were to return to its original basis of a 70 percent subsidy the cost would be MK210 per kilogram. One kilogram fertilizer is broadly reckoned to produce 5 kilogram of maize. At the full subsidy this means MK60 subsidy per kilogram of maize. At the 70 percent figure it means MK42 per kilogram maize or half the current government subsidy on the grain. At the cost of imported US bagged maize the subsidy would have to be several times higher to bring the price within the range of the purchasing power of the majority of the population. Judging by the swirl of current comments on the subsidy program in Malawi this choice between subsidizing fertilizer or food is not proving an easy decision to make.

REFERENCES

- Benson, T. 1997. The 1995/96 Fertilizer Verification Trial in Malawi. Economics analyses and results for policy discussion. Lilongwe, Malawi: Ministry of Agriculture and Livestock Development.
- CIMMYT. 1990. World Maize Facts and Trends: Realizing the Potential of Maize in Sub-Saharan Africa. Harare, Zimbabwe: International Maize and Wheat Improvement Centre (CIMMYT).
- Cleaver, K. and Schreiber, G. 1992. The Population, Agriculture and Environment Nexus in Sub-Saharan Africa. *Agriculture and Rural Development Series*, No. 1. Technical Department Africa Region. Washington DC: World Bank.
- Conroy, A. 1993. *Economics of Smallholder Maize Production in Malawi*. PhD thesis, Manchester University, Faculty of Economics.
- Department of Climate Change and Meteorological Services. 2014. Climate of Malawi. Available at <http://www.metmalawi.com/climate/climate.php>.
- Dorward, A. Chirwa, E. and Slater, R. 2010. Evaluation of the 2008/9 Agricultural Input Subsidy Program: Program Impact. Prepared for Malawi Government and Department for International Development (Malawi).
- Dudal, R. and Byrnes, B. 1993. The Effects of Fertilizer Use on the Environment. In Van Reuler, H. and Prins, W. (eds.). *The Role of Plant Nutrients for Sustainable Food Production in Sub-Saharan Africa*, Leidschendam, The Netherlands: VBK Publishing.
- Elwell, H. and Rook, J. 1996. Soil and Water Conservation Technologies in Four Selected Countries Southern Africa (Malawi, Mozambique, Zambia and Zimbabwe). Washington DC: World Bank.
- Government of India. 2009. Economic Survey 2009/10.
- Jayne, T., Sitko, N., Ricker-Gilbert, J. and Mangisoni, J. 2010. Malawi's Maize Marketing System. Prepared for Malawi Government and Department for International Development (Malawi).
- NSO. 2007. National Census of Agriculture and Livestock. Zomba, Malawi: National Statistics Office (NSO).
- Smaling, E. 1993. Nutrient Depletion in Sub-Saharan Africa. In Van Reuler, H. and Prins, W. (eds.), *The Role of Plant Nutrients for Sustainable Food Production in Sub-Saharan Africa*, Leidschendam, The Netherlands: VBK Publishing.
- Stocking, M. 1987. Measuring Land Degradation. In Blackie, P. and Brookfield, H. (eds.) *Land Development and Society*. London: Methuen Publishers.
- University of Malawi. 2000. National Pilot Crop Production Survey 2000. Final Report. Lilongwe: University of Malawi (Bunda College).
- World Bank. 1989. Malawi: National Rural Development Program, Technical Issues Review Report No. 7539-MAI. Washington DC: World Bank.
- World Bank. 2004. Malawi: Country Economic Memorandum, June 2004. Washington DC: World Bank.
- World Bank. 2012. Inorganic Fertilizer Nutrients per Hectare of Cultivated Land, by Country. Available at <http://data.worldbank.org/>.

This Policy Note has been prepared by Stephen Carr as an output for the Malawi Strategy Support Program (MaSSP) of the International Food Policy Research Institute (IFPRI). The note is intended to promote discussion and has not been formally peer reviewed. Any opinions stated herein are those of the authors and do not necessarily reflect the policies or opinions of IFPRI.

MaSSP works closely with the government of Malawi and other development partners to provide information relevant for the design and implementation of Malawi's agricultural and rural development strategies.

Copyright © 2014, International Food Policy Research Institute. All rights reserved. This material may be reproduced for personal and not-for-profit use without permission from but with acknowledgement to IFPRI. For other use, contact ifpri-copyright@cgiar.org.

IFPRI HEADQUARTERS

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

2033 K Street, NW • Washington, DC 20006-1002 USA
Tel: +1-202-862-5600 • Skype: IFPRIhomeoffice
Fax: +1-202-467-4439 • E-mail: ifpri@cgiar.org

IFPRI- LILONGWE

P.O. Box 31666 • Lilongwe 3, Malawi
Tel: +256-1-771780 • E-mail: ifpri-lilongwe@cgiar.org

Contact: Karl Pauw, Country Program Leader (k.pauw@cgiar.org)

MINISTRY OF AGRICULTURE AND FOOD SECURITY

Capital Hill, • Lilongwe, Malawi
P. O. Box 30134 • Lilongwe 3, Malawi
Tel: +265-1-789033 • Fax: +265-1-788003

Contact: Alex Namaona, Director of Agricultural Planning Services (namaonaalex@gmail.com)