

*The availability of mineral fertilizers is often a political issue. In Mali, a large country in the sahelian zone of Africa, the Dutch government has been providing fertilizer 'aid' over a long period. But what is the final impact of this 'aid' for the different parties and to what extent does it enhance sustainable development? Report on an evaluation study.*

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**M**ore than 80% of Mali's population depends on agriculture. Agricultural potential is highest in the South with an annual rainfall from 600 to 1200 mm/year, but rainfall is irregular and soil fertility moderate to low. Sorghum and millet, followed by maize and rice are the most important food crops, but cotton is by far the most important cash crop. It provides almost 40% of export earnings and consumes 80% of all mineral fertilizers.

The total economic production, the Gross Interior Produce per capita grew slowly over the last 10 years. And so did agricultural production, but this is mostly due to increase in cultivated area. One third of the population lives in the so called 'cotton area', where cotton is the main crop of mostly small holder farmers. Another 2% lives in irrigated rice areas and more than half in other rural areas. Farmers' income is highest in rice, medium in cotton and low in the dry cereal and peanut areas.

#### Agricultural 'account'

Although agriculture as a whole forms the bulk export earnings, the total 'agricultural account' (the agricultural part of the balance of payments) has shown a permanent deficit over the last 10 years (table 1). In other words, the import of inputs necessary to produce agricultural export crops together with that of foodstuffs exceeds the export earnings of agriculture.

In addition to this, there is also production loss due to soil erosion. Although it is not easy to determine this in exact financial terms, it can be estimated to equal harvest losses due to soil erosion. For Mali this leads to losses equal to 0.6% of Gross Agricultural Produce (Bishop & Allen,

# HOW FERTILE IS FERTILIZER USE?



Photo: Henk Kieft

1989). This approximately equals total amount of average annual Dutch fertilizer aid to Mali.

#### Fertilizer aid

Of all mineral fertilizers used in Mali, the largest part is imported through development cooperation programmes. The Dutch government has been the main supplier, contributing between 30 and 100% of total consumption, depending on the type of fertilizer and the year. Fertilizer aid is for the Netherlands often an 'end-of-the-year' issue. Total amount supplied depends on the budgetary situation at the end of the year.

The Malian government has delegated all her activities for development of cash crops to so-called 'Offices de Developpement Rural' (ODR), parastatals with a high degree of autonomy. These ODRs are involved in input supply of seed, fertilizer and pesticides, in research and extension, in organizing village coopera-

tives, in monitoring production and in buying and processing output. Farmers have no choice but to buy their inputs from the ODR. A typical example is the 'Compagnie Malienne pour le Developpement des Textiles' (CMDT), the well-organised ODR for cotton. It has kept prices of fertilizers at farm level above levels in surrounding countries and has only reached competitive levels after donor pressure in 1991. CMDT determines demand and imports directly without any government intervention, taxes or control.

#### Who benefits?

The main bulk of fertilizer supply goes to the most productive crops and areas, i.e. cotton, rice and sugarcane. In other words only little more than one third of the agrarian population is reached. These are the 'better-off' farmers with revenues 2 to 3 times the country average. Within these areas, strong income differences exist as well. Several studies indicate that differences between the richer and poorer sections are increasing (e.g. Marijsse and Renard, 1992).

The impact of fertilizer aid and supply on the position of women is of special concern. Due to lack of in-depth studies we had to rely on information from more general studies and from interviews during the evaluation study. In general, women are rarely reached by the extension services promoting crop intensification. Their access to fertilizer is limited as they have difficulties in obtaining credit which is relat-

Elements of balance (billions FCFA)	1987	1990
1 Export Agriculture total	59	78
2 Import Food products	15	17
3 Import fertilizer, pesticides, machinery	60	73
4 Import agriculture total	94	90
5 Balance of agric. commerce (1)-(4)	-16	-12

Table 1. Agricultural products and the balance of payments, of Mali, 1987 and 1990. (MAEE,1992)

*Village waste, a source of nutrients, is actively collected and applied. Some families 'produce' and use 6 tons per year. Its nutrient value compares to that of 'dried dung'.*

ed to land-ownership. Women often buy fertilizer in small quantities of 5-10 kg at a relatively high price, 50-80% above the average price. On the other hand women do use left-overs of their husband's fertilizer of whatever type for their own crops.

### Effects

The policy decision to allow distribution of fertilizer aid through ODRs has strengthened them at the expense of the farmers cooperatives. The monopoly position of ODRs has in fact kept farmers rather dependant on them. Although in practice distribution has been done effectively, this effect goes against the Malian policy of decentralisation, privatisation and 'responsibilisation' of rural population. Effects of fertilizer on farmers' income are difficult to 'distil' from those of the broader package of agricultural inputs and extension, mechanisation and infrastructure. But the doses farmers use, when compared to doses advised by extension services, give an indication of how farmers perceive the effects in terms of additional production and income. Cotton-farmers generally use less per hectare than recommended and in irrigated rice more, indicating that intensification of fertilizer use is more profitable for rice farmers. Cotton farmers seem to prefer to open up additional land rather than intensify production in existing plots. With still access to 'easy land', farmers rather optimize per active family member than per hectare. Fertilizer promotion does therefore not prevent cultivation of newly opened lands as farmers generally apply the amount of fertilizer they can afford on the maximum area that can be managed with available labour.

### Assessing sustainability

The issue of 'sustainability of mineral fertilizer use' can be operationalized at three levels, each with a specific indicator. Ecological sustainability has been focused at field level with nutrient balances as the principle indicator; economic sustainability at farm level with cost-benefit ratio of fertilizer use as an indicator. At policy level we assessed the governmental support to sustainable soil management by farmers.

In nutrient balances one compares the amount of nutrients brought to the field in the form of e.g. recycling of crop residues, manure and mineral fertilizer, with the amount removed through harvesting of products and erosion. In cotton these balances appear, as an average, negative in Nitrogen (N;25kg/ha) and Potash (K;20kg/ha), current doses of mineral fertilizer being included (van der Pol, 1992).

Van der Pol estimates that with current practices the soil productivity in the cotton area will collapse in 30 years. Erosion losses are a very important part of this negative picture. Without attending to this, higher levels of mineral nutrients will not guarantee a more closed nutrient balance or a higher level of sustainability.

There are important other problems. Soils in the northern cotton zone are getting too acid due to inequibrated nitrogen fertilization with ureum. Harvest levels drop and farmers try to grow other crops and/or to improve the soil with organic matter. Environmental effects can be expected at current doses of nutrient application.

### The organic alternative?

In general, there is a structural shortage of organic matter. Even with strong efforts to improve dung production and its quality, only around 30-40% of present nutrient need would be available. There seems therefore no other way than to optimize its use in relation to mineral fertilizer.

Another potential source of nutrients is village waste, which is actively collected and applied. Some families 'produce' and use 6 tons per year. Its nutrient value compares to that of 'dried dung'.

A sustainable alternative at field level should combine at least a three year rotation of crops, application of locally available rock phosphate, cultivation of legumes and erosion control for N and organic matter, and recycling of crop residues and increased use of compost and dung. Additional nutrients could then be supplied through mineral fertilizer. A limiting factor in obtaining manure is the grazing area for cattle. This could, partly, be

solved by making protein-rich cattle feed from the cotton seed pulp feed currently 'exported' to the capital.

### Economic sustainability

To estimate rentability of use of mineral fertilizer as well as animal dung, costs of these inputs can be compared with the income increase obtained by applying them. It appears that use of both mineral and organic fertilizer is feasible at present price levels of cotton (Kieft et al, 1993). Higher doses of mineral fertilizer than presently used are available but are not economically feasible for the farmer, given his/her access to additional land. For organic fertilizer higher doses are also feasible and necessary but not available in sufficient quantities.

From a similar exercise on soil and water conservation techniques, one could conclude that these are only paying off in about 10 years. Of course paying off is quicker if cash crops with a reasonable price are included in the rotation.

### Sustainable policy?

Policy support is urgently needed to encourage farmers to develop more sustainable ways of farming. Presently support for this is mostly found within research circles. From the national governmental level there are only initiatives on issues like the use of local rock phosphate, bush-fire regulations, and local involvement in the management of natural resources. A very urgent challenge is to stop the enormous losses due to erosion. In our opinion, subsidizing erosion control measures needs to be seriously considered.

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## OUR VIEW

In principle a 3 year rotation of cotton-maize-sorghum could be sustainable at current levels of production, if sufficient organic manure would be available. But manure at current practices is available only for at most 30% of the fields. Improvements on production of more dung of better quality are possible if enough cattle feed and straw is available. This is a limiting factor. But without organic fertilizer, production of cotton would fall in the long run. Hence the most feasible option for sustainable cotton production in Mali seems to be a combination of local rock phosphate and LEISA techniques to enable efficient application of low to medium levels of additional mineral fertilizer.