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Fertiliser use in semi-arid West Africa: Profitability and supporting policy

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An important debate is currently under way among researchers and policy makers about the relative merits of using organic versus inorganic fertilisers to improve soil fertility in semi-arid areas of sub-Saharan Africa. Environmentalists argue that use of inorganic fertiliser contributes to natural resource degradation and recommend use of organic fertilisers as a means of promoting sustainable agriculture. Opponents of this view maintain that a more rapid introduction of inorganic fertilisers is required in sub-Saharan Africa where current levels of use are extremely low, even when compared with other developing countries.

This debate has important implications for agricultural intensification and sustainable development in the Sudanian and Sahelo-Sudanian agro-ecological zones of semi-arid West Africa. This paper assesses the profitability of using inorganic fertiliser and constraints posed on its use in the semi-arid farming systems of West Africa. It argues that under current conditions in these regions, organic and inorganic fertilisers are complements and not substitutes. The critical requirement for improving food production in these regions is to increase the use of inorganic fertiliser. Government policies need to support fertiliser importation and diffusion with conducive policies.

Are there viable alternatives to inorganic fertilisers?

Most African traditional cropping systems are today under increasing pressure from population growth and use of marginal lands. Levels of fertiliser (organic or inorganic) application are extremely low. This contributes to soil degradation by requiring the extension of cropping onto more marginal lands to maintain output once the fallow system breaks down. As a result, per capita cereal production in the region is declining and traditional sources of organic fertiliser, such as manure and crop residues, are becoming severely limited. In most of semi-arid West Africa, available manure is only sufficient for small areas and crop residues are put to higher economic uses such as livestock feed, fuel and building materials.

Introduction of improved varieties alone does not constitute a sustainable strategy and rather results in the mining of soil nutrients. Furthermore, the fact that both soil fertility and water are limiting agronomic constraints also acts as an obstacle to adequate provision of water when fertiliser is also not applied. Another dimension of the problem relates to the food security risk that inorganic fertiliser purchases pose for vulnerable farm households faced with frequent rain and crop failure.

Notwithstanding the above, under existing farming conditions in the Sudanian and Sahelo-Sudanian zones of semi-arid West Africa, imported inorganic fertilisers are the only technically efficient and economically profitable way to overcome prevailing soil-fertility constraints. Until wider experimentation makes them more successful, alternative soil fertility measures, such as organic fertilisers and natural rock phosphate,

should be seen as complements to not substitutes for imported inorganic fertilisers.

Representative study sites

Field data from a Sudanian site in the Central Plateau of Burkina Faso and a Sahelo-Sudanian site in the Niamey region of Niger serve to evaluate the profitability and potential diffusion of fertiliser technologies in representative sites of semi-arid West Africa.

The site in Burkina Faso is a small farm area where pearl millet and sorghum are principally cultivated. Crop allocation is adjusted to topographical differences in soil fertility and water-retention capacity, with crops tolerant of low soil fertility and drought stress being planted on the sandier, less fertile soils higher in the toposequence. Cereal yields are low because of low fertiliser usage. Population pressure has broken down the traditional bush fallow rotation system in much of the Central Plateau.

The site in Niger is characteristic of a densely populated land-shortage system, with low, variable rainfall, but good market access. Rainfed agriculture with millet/cowpea intercropping predominates in the area though there is some limited irrigation. With the current low-cash-input rainfed practices, wind erosion and increasing population density, rainfed-land quality has been declining and more marginal land has been brought into cultivation. Intensification of irrigated activities has taken place, but not of rainfed activities. Population pressure and increasing profitability of agriculture are pushing for a shift from extensive to intensive production practices.

Options for inorganic fertiliser use in semi-arid West Africa

Whole-farm model results for the two study sites demonstrate that differences in rainfall and soil characteristics in the Sudanian and Sahelo-Sudanian agroclimatic zones require specific technology strategies to overcome the water availability constraint.

In the higher-rainfall Sudanian zone with its heavier soils, the new technologies are tied ridges (water-retention device reducing runoff) and fertiliser use. Fertiliser can be used on sorghum land, but increases in income are not as great as those for tied ridges alone. However, the adoption of tied ridges in the absence of inorganic fertiliser is not a sustainable solution because increasing water use by plants will cause soil nutrients to be mined. It follows that inorganic fertiliser needs to be combined with the water-retention device. In addition, policies are required that moderate cereal price collapses in good-rainfall years so as to maintain the profitability of inorganic fertiliser and encourage its use.

In the Sahelo-Sudanian zone, improved short-cycle cultivars can be adopted profitably, or in combination with phosphorus (P) fertiliser. However, in combination with both nitrogen (N) and P fertiliser adoption of shorter-cycle varieties does not result in increased incomes. Short-cycle early cultivars provide some drought escape and lower production risk, especially in low rainfall years. Without a means of maintaining soil fertility, however, the use of improved cultivars will lead to further mining of soil nutrients. A stepwise approach of P fertiliser adoption with improved short-cycle varieties, is therefore proposed as a first step. Later, both N and P can also be adopted once improved longer-cycle varieties are developed by breeders [this breeding strategy has now been adopted by INRAN (the National Agricultural Research Institute of Niger) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). This approach will contribute to relieving water and soil fertility constraints, while at the same time generating higher incomes and profits.

The model results presented support the importance of the rapid introduction of inorganic fertiliser in

semi-arid West Africa. This could be strengthened by the improvement in the macro-economic environment and liberalisation of domestic economic policies currently under way in the French currency countries. West African governments can facilitate this process by making the importation of inorganic fertilisers easier for the private sector and by enabling, rather than resisting, higher domestic cereal prices for farmers to profit from fertiliser use and intensify their production.

For more information on this issue see: Shapiro B.I. and Sanders J.H. 1998. Fertilizer use in semiarid West Africa: Profitability and supporting policy. *Agricultural Systems* 56(4):467–482.