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sharing knowledge, improving rural livelihoods

Information support for sustainable soil fertility management (CTA Seminar 2003): highlights

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Preface

Soil fertility degradation constitutes one of the most important constraints to sustainable food production. Poor soils are widespread although by no means universal throughout the ACP states. While some areas are endowed with inherently fertile volcanic soils that require little or no amendments, most soils in ACP countries are poor and degraded, and oftentimes highly fragile. As a result, most smallholder farmers in ACP states are forced to eke out a living on impoverished soils with little or no access to fertilisers and appropriate information on sustainable soil fertility management.

Not surprisingly, emphasis has been placed on technical solutions to the problem of soil fertility management, largely through the application of organic and inorganic amendments. However, experience shows that a narrow focus on the technical aspects of sustainable soil fertility management alone has failed to achieve improvements in productivity, economic growth and food security because soil fertility management is greatly affected by social, economic and political factors. With a view to providing a platform for wide-ranging discussions on a more holistic approach to soil fertility management, CTA, in cooperation with ISRIC-World Soil Information, organised a seminar on Information Support for Sustainable Soil Fertility Management in Arnhem, The Netherlands in October 2003. More than 70 participants from African, Caribbean and Pacific States and from the EU attended the seminar. They included policy-makers, farmers' organisations, NGOs, training institutes, researchers, extensionists, ACP regional organisations and networks, private sector and civil society groups, and bilateral and international organisations. The aim of the seminar was to examine the broader non-technical issues that impinge upon sustainable soil fertility management and, more specifically, to: briefly review the state of technical knowledge on soil fertility management; examine the policy issues and strategies that are required to improve soil fertility management at national and regional level; and to identify the information and communication requirements to support identified policies and strategies.

We believe that the deliberations of this seminar will provide valuable insights into the all important issue of sustainable soil fertility management and hope that the ideas and recommendations will be considered by all stakeholders who have a genuine interest in improving the productivity of smallholder farmers throughout the ACP states. At the very least, we believe that the ideas and arguments articulated herein will serve to convince stakeholders about the merits of adopting a more holistic approach to soil fertility management.

Introduction

'Poor soils make poor people, and poor people make soils worse'. This is a situation that can be seen in many African, Caribbean and Pacific (ACP) countries. What information support can be offered – to farmers, policy-makers, researchers and civil society – to break this vicious cycle of increasing poverty? How can aspiring entrepreneurs in agriculture acquire the information they need to maximise the potential of one of their most important natural resources – their soils? Where, for whom, and what type of information is required? And where are the bottlenecks in communication that inhibit information flow and the incentive to take action? What could, or should, be done – and by whom? A discussion of these issues was the objective of CTA's 2003 seminar: 'Information support for sustainable soil fertility management'. Attended by more than 70 participants from ACP states and from the European Union (EU), the seminar was held from 21–24 October 2003 in Arnhem, the Netherlands. It was sponsored by CTA (www.cta.int), and co-organised by CTA and ISRIC – World Soil Information (www.isric.org).

A range of definitions

Different disciplines tend to take a differing view on how 'sustainable soil fertility' should be defined. These range from a relatively narrow to a broad focus. The narrow focus includes soil chemistry, in particular the major elements (nitrogen, phosphorus, potassium) and the equally important trace elements (magnesium, sulphur, zinc, molybdenum, calcium, etc.) that are essential for healthy plant growth. Adequate carbon content, and freedom from potentially polluting elements such as sodium and aluminium, also form part of the chemical approach to soil fertility.

The broad focus is on the plant and its environment. Plants require a soil with good physical structure that has adequate water-retaining and drainage properties. Soil biology and soil health may also be properly considered an essential aspect of fertility. One gram of soil contains millions of organisms and thousands of species of bacteria. It is the richest terrestrial habitat that exists, and it can be argued that for good soil fertility the soil's biological health should be nurtured.

A definition of soil health

Soil health is the continued capacity of soil to function as a vital living system within an ecosystem and land-use boundaries, to sustain biological productivity, to promote the quality of the air and water environments, and to maintain plant, animal and human health.
John Duran, Soil Scientist, USDA, and President of the Soil Society

The human factor

To discuss definitions of sustainable soil fertility without recognising the human factor may be akin to hiding one's head in the sand. For many, the ability of the soil to meet the productive requirements of a farm household is a more comprehensive and realistic definition that is helpful when considering long-term sustainability and use. If one considers soil resources as a public good, the definition should also include the management of soil fertility as part of an ecosystem, sustaining or improving the quality of the land, air and water environments, and of plant, animal and human health. Such an apparently all-embracing, holistic view is still limited, however. Soil fertility management is greatly affected by social, economic and political factors, and much of the seminar debate focused on these issues.

Poor soils, poor people

Food insecurity

To deny that ACP countries are among the poorest in the world would be naive. About half (all in Africa) are in the lowest 10% of the UN classification system of poverty (http://hdr.undp.org). Over the past two decades the world has made remarkable progress in increasing food production and reducing food insecurity. Yet in sub-Saharan Africa, despite slight increases in *per capita* food production in the past ten years, the population living in hunger jumped nearly 20%, with 30 million more food-insecure people by the end of the 1990s (von Braun, 2003). In the 1970s, 170 g cereals per person was produced in Africa, and 230 kg in Asia. Twenty-five years later *per capita* production has dropped in Africa, whereas it has risen in Asia. Food insecurity is triggered by a variety of often interrelated factors including conflicts, drought, floods or other natural or man-made disasters. A feature of poor countries is that they do not have the resources to recover without external support. Africa's average cereal yield stagnated at 1.2 t/ha during the 1990s. By 2020, even assuming that average cereal yields increase to 1.8 t/ha, Africa will need to import between 25 and 32% of its cereal demand to remain at present nutritional levels (FAO, 2001, p. 7). Another feature of the poorer developing countries is that they are all heavily dependent on agriculture.

An agricultural economy

Agriculture is the economic and social mainstay of most ACP countries. In Africa it accounts for a third of gross domestic product (GDP) and represents up to 40% of exports. It employs more than 75% of the working population, and is the sole source of income for many families. If agriculture fails, people suffer. Furthermore, agriculture is the only realistic basis for economic growth in most ACP countries. This cannot be achieved on soils that become increasingly degraded by, for example, wind or water erosion, nutrient mining or pollution. Poor soils produce weak plants that are more susceptible to attack by pests and diseases. In poor soils, higher-yielding crop varieties can never reach their potential and, in effect, will waste money spent on seed and on crop-breeding efforts. Two years ago, between 30 and 40% of food production in Africa was based on new varieties, but production was in decline. Productive agriculture depends on productive, fertile soils. If people are to eat, soils must be fed.

The issues

Experience shows that a narrow focus on the technical aspects of sustainable soil fertility management alone fails to achieve improvements in productivity, economic growth and food security. For this reason, the 2003 CTA Seminar was structured to include presentations and discussion not only on technical issues, but also on policies that influence, or could influence, how farmers manage their soils and what information and communication support may be appropriate.

Technical

The technical factors that constrain or promote good soil fertility management were discussed, including:

- Relative importance of soil nutrients and water
- Relative benefits of organic and chemical inputs, including the practicalities of their availability, access and application in the various ACP regions
- Tillage systems
- Erosion

- Pollution
- Integrated crop nutrient management – this recognises that management of soil fertility cannot be considered in isolation from the marketing of farm produce or the policies that govern the economic environment in which the farming community/industry operates.

Policy

The policy issues that affect soil fertility were discussed, including:

- Factors that determine farmers' investment in soil fertility, including their expectation of return, security of land tenure, availability of labour, and access to credit – and knowledge
- Factors affecting farmers' use of fertilisers, including the actual cost, the cost relative to output prices, and issues relating to distribution and marketing
- Achieving higher priority for soil fertility by governments
- Encouraging the establishment of policies for sustainable soil fertility management that are coherent in the context of agriculture generally
- Benefits of regional collaboration.

Information support

Factors that influence access to and the use of information were discussed, including:

- What information is needed by farmers, researchers, non-governmental organisations (NGOs), policy-makers, etc. in order to improve soil fertility management?
- Access to information and communication technologies (ICTs)
- How to achieve effective two-way dialogue between farmers' groups, NGOs, extension, research, local and national policy and institutions
- Market information systems for fertiliser inputs
- Integrated information and communication management support, including recommendations to CTA for a variety of activities considered helpful within the overall context of promoting sustainable soil fertility management.

Four years after the start of this millennium, the internationally agreed Millennium Development Goals (www.developmentgoals.org) to cut poverty levels are looking over-ambitious. Greater efforts must be made – somehow – and one way would be to pay much more attention to the basic medium in which food crops are grown: the soil.

Chapter 1: Technical Aspects of Soil Fertility Management

This chapter highlights some of the principal constraints to good soil fertility management in ACP countries, and focuses on the technical options that were discussed at the seminar.

ACP regions and soil fertility status

Naturally there is huge variation not only between, but within, ACP countries. It is not practical to present the current situation regarding soil fertility status in any detail here. Sweeping generalisations quoting shock and horror statistics are unfair and may be misleading, as they have often been extrapolated from a small plot to a regional scale (Scoones and Toulmin, 1999, p. 15). Nevertheless, through long-term research (see Scoones and Toulmin, 1999, p. 32) and day-to-day experience, there are clear indicators that major problems exist and should be addressed.

Africa

Poor soils are widespread, although by no means universal. There are well documented examples (e.g. Machakos, Kenya) where poor soils have been restored and are now well maintained, yielding good farming income on a sustainable basis. And in many areas of Africa, particularly on flood plains and in coastal humid zones, the inherent fertility of the soil, coupled with a favourable climate, allows high yields on a continuous basis, and sufficient profit to purchase fertilisers to replace the nutrients lost with harvests, maintaining productivity. Elsewhere, crop-growing soils have been improved by adding manure, fertilisers and lime, providing irrigation and improving drainage. In less favourable crop-growing areas, appropriate farming systems (for example keeping livestock on rangelands) allow farming communities to live securely within the carrying capacity of the land, without major problems of land degradation. But the majority of Africa's subsistence farmers eke out a precarious living on soils that have always been poor (more than 50% of Africans live on less than $1 a day, and the rural population makes up nearly 70% of the population in general). Not only do they have few options for improving fertility, but external factors are putting more pressure on the system.

Land degradation

In general, the three major categories of land degradation are:

- Physical degradation – including water and wind erosion, crusting and sealing, compaction, waterlogging, and reduced infiltration
- Chemical degradation – including acidification, nutrient depletion, pollution from industrial or mining waste, and excessive or inappropriate application of pesticides or fertilisers
- Biological degradation – including soil organic mater decline, biomass burning, and depletion of vegetation cover and soil fauna.
  (Source: FAO, 2001)

Wind, water, and the working man or woman

It is now firmly believed by many that rainfall is becoming increasingly unreliable and its distribution more erratic. This leads to chronic water shortage. Because plants can only take up nutrients in water-soluble form, the effect of nutrients is reduced, and the crop may be damaged by scorching. Water shortages also have other, perhaps more damaging aspects, in blunting people's perception of the importance of maintaining soil fertility. Although this may be an irrational view, it is widespread both within and outside the farming community. Farmers may hesitate to purchase fertilisers, or to invest the labour in improving soil fertility through organic means, if they fear the rains may fail and leave them with low yields. Policy-makers are under pressure from the entire drought-affected population to invest in the water supply, and from farmers to invest in irrigation. Which policy-maker will turn from a popular strategy of improving access to water in order to favour soil fertility improvement, particularly as his/her own perception of greatest need probably agrees with the popular view?

Inadequate soil cover is an increasing problem which exacerbates the effect of flash floods, scouring tonnes of topsoil from higher to lower ground. Wind erosion is equally dramatic. Many tonnes of the most fertile topsoil can be lost as the Harmattan wind blows across the Sahel. (Although one farmer's loss may be another's gain if blown soil can be trapped downwind.)

The availability of labour in rural areas is declining as farm incomes fall and the younger generation seek employment in towns and cities. Although there are signs that urban migration is slowing, shortage of labour – family labour, or labour for hire – is becoming a major problem that is made much worse where HIV/AIDS is seriously affecting the region. A shortage of labour means that more has to be done by fewer people in the often short season for land preparation. Labour-intensive strategies for improving soil fertility – maintaining stone bunds and collecting sufficient organic material to spread on the land, for example – are giving way to less labour-intensive strategies.

<u>Population and other pressures</u>

Although the population growth rate is declining, in terms of absolute numbers the population in much of Africa is rising. In some countries farm plots are necessarily becoming smaller, and marginal, inherently infertile land is being brought into production by people who have no means to improve its fertility. The time that land is allowed to lie fallow is shorter and therefore less effective, and less attention is given to growing rotation crops such as legumes or green manures that could improve fertility. Nutrients are therefore being continuously mined from the soil in the harvested crops and are not being replaced by fertilisers. At a time when food production needs to increase to meet growing demand, farming is becoming less, rather than more, intensive. According to Sasakawa Global 2000 (www.saa-tokyo.org/english/sg2000/index.html), on about 100,000 million ha of land the estimated per hectare net nutrient loss over the past 30 years is 700 kg of nitrogen, 200 kg of phosphorus and 450 kg of potassium. A downward spiral of lower income, less investment in fertility improvement leading to lower yields and yet lower income is leading, inexorably, to greater poverty – of people and soils.

The traditional subsistence agriculture that is widespread in much of sub-Saharan Africa cannot feed present, let alone future, generations. And prices for cash crops are falling. Oxfam estimates that coffee farmers now receive, in real terms, much the same price for their coffee as they did 100 years ago. As actual costs for inputs such as fertilisers have increased with the removal of subsidies, and earnings from crops have failed to keep pace, certainly in relative terms, many millions of farmers have no choice but to abandon any thought of applying inorganic fertilisers to their land, despite an understanding of the inevitable impact. In the North-West Province of Cameroon, for example, ten women will buy and share between them one bag of fertiliser – the most they can afford. Lack of opportunities to obtain credit, and lack of collateral with which to secure it, compound an already difficult situation.

Good soil fertility management is a long-term strategy, but many millions of farmers in Africa have no choice but to work to a short-term horizon. Feeding the family in this season must take priority over unseen seasons to come.

Caribbean

The situation in the Caribbean islands is very different from the vast continental land mass of Africa. In the volcanic islands, the soil is inherently fertile. Indigenous food production has never been the primary focus of agriculture; rather the islands have been used to grow crops for export to the colonising countries in Europe. These primary products are produced mainly on large farms which occupy the flatter areas and leave only steeply sloping land for the small farmer. For most of these small farmers, shifting cultivation and fallow remain important ways of maintaining soil fertility. For the plantation crops, inorganic fertilisers, as well as crop protection chemicals, have been extensively used with, in some places, devastating impact on wildlife. Pollution is a major feature of much of the lowland area, whereas erosion is the principal constraint to soil fertility on the hillsides.

<u>Too much rather than too little</u>

Trinidad is the world's largest exporter of nitrogen fertilisers, but there is no shortage in the home territories. Compound fertilisers are, however, imported. Farmers in Barbados and Dominica apply, on average, 100 kg of fertilisers per ha, whereas in St Lucia and St Vincent the rate is nearer 300 kg/ha. In the banana industry, for example, the industry itself imports fertilisers which are supplied to farmers on credit, the cost being deducted on sale of the crop. Government support to soil research has declined in recent years, and farmers are now more likely to be influenced by the persuasive marketing skills of the sellers of fertilisers. Over-use and misuse are therefore widespread.

Agriculture in the Caribbean is, however, undergoing massive change. The trade preferences that guaranteed high price levels in EU markets are being eroded as a result of the Common Agricultural Policy (CAP) reform process triggered by world trade rules. The Caribbean's traditional crops – bananas, sugar, coffee, cocoa and rice – are under threat, and current agricultural production systems are no longer sustainable. The result is that large tracts of land are being abandoned and farming must change dramatically if it is to have a future.

Pacific

The larger islands of the Pacific, including Papua New Guinea, the Solomon Islands, Vanuatu and Fiji, are mainly volcanic and have fertile soils as well as being generally rich in biological and other physical resources. In contrast, the small islands, mainly atolls with elevations that are less than a few metres above sea level, are characterised by poor quality soils. The percentage of land under cultivation varies considerably from island to island, but has generally increased in recent years. Tonga has the highest percentage of its territory under cultivation (80%). In Papua New Guinea the steep slopes are cultivated for food and oil palm, whereas ginger and sugar are the predominant crops grown on steep land in Fiji. Land degradation is becoming more obvious, and it is estimated that about 10% of land has severe fertility problems. As a result, yields of taro have fallen in Tonga and Samoa, and in Papua New Guinea coffee is becoming less productive.

<u>Intensification</u>

Traditionally, farmers used minimum tillage systems, shifting cultivation and few fertilisers and could nevertheless obtain domestic and even export quality crops of, for example, taro or yam. With an increasing population has come the need for more intensive agricultural production and greater commercialisation. The effect has been a trend towards deforestation, monocropping and much more intensive use of fertilisers. Land clearance and ploughing have left land vulnerable to erosion, and excessive use of fertilisers has resulted in pollution. Where traditional slash-and-burn practices remain, the fallow period is now much shorter and soil fertility is therefore threatened.

Constraints

Although varying greatly in degree, it is an inescapable fact that wherever one may look – in an ACP country or elsewhere – if farmers are poor their investment in soil fertility is, at best, limited to what they have in hand – and to what they can do by hand in the time available. Sub-Saharan Africa uses less than 1.8% of global fertiliser production, even though it has 9% of the world population. This gap is not due to a failure to understand the benefits of fertilisers, but reflects the poverty inherent within the continent. With money, farmers can buy fertilisers or buy labour. Without it, they can buy neither.

A woman's work is never done

Where farm work is done principally by hand – a characteristic of poor farmers in most ACP countries – low productivity per unit of labour is a major constraint to improved incomes, and therefore to the improvement of soil fertility. The problem is not simply one of cash. In subsistence agriculture, labour is often the limiting factor, defining how much land can be cultivated and to what extent 'cash-free' resources, such as crop residues, can be incorporated. There is, after all, only so much one human being can do in a day. This is particularly so in households headed by women, where childbearing and family care, including fetching water and firewood, eat into the time available for land preparation. When that person is already overburdened with other work, possibly malnourished, and perhaps hindered by social or cultural practices, or lack of knowledge, changing the ways things have always been done is virtually impossible. The practice of burning grasslands, crop residues, home sweepings and livestock manure is one example that a soil fertility advisor would deplore, but may be able to do little to change in the short term.

HIV/AIDS and soil fertility

Subsistence agriculture is dependent on the timely availability of competent labour. Illness and death force farming families to simplify their farming systems, cutting back on the number of crops as well as the area of land under cultivation. Less attention will be paid to managing the soil. Livestock are less well protected from hazards such as straying and theft, or from insect pests and predators, and in time will diminish in quantity and quality, or be sold to finance medical care. Opportunities for using manure are reduced. Terraces, bunds, irrigation and drainage channels are likely to fall into disrepair, and defences against erosion to be abandoned. The effect on soil fertility is insidious and persistent. Shortage of farm labour also has an effect on the transmission of HIV. When money is short, transactional sex may be the only means by which a woman can pay for land preparation. In such circumstances, 'safe' sex is probably unrealistic.
(Source: Barnett and Whiteside, 2002)

Soil fertility – from where?

In more populated areas the size of farm plots has become smaller, often to the point where it is no longer viable to keep large livestock. With their loss goes the opportunity to incorporate manure, a valuable asset not only for the nutrients, but also for the improved structure it brings to the soil. The slow but insidious effect of HIV/AIDS is also taking its toll because affected families cut back wherever they can on the amount of farm work that has to be done. A strategy that many adopt in the early stages is to sell their livestock.

For most farmers the labour burden of applying adequate amounts of manure to replenish soil nutrients would be too great, even if sufficient quantities were available – which they are not. Up to 40 ha of dry-season grazing land is required to maintain the yield on 1 ha of crop land. If the soils in West Africa were to be fertilised solely with manure, it would be possible to apply only 2.5 kg of nitrogen and 0.6 kg of phosphorus per ha, quantities that are totally inadequate.

Fertilisers – price and distribution

No-one should be surprised that soil fertility in much of Africa is declining. Africa's consumption of fertilisers is the lowest in the world. If South Africa is excluded, fertiliser use in sub-Saharan Africa averages 9 kg/ha. The global average is 100 kg/ha; China uses 250 kg/ha. Perhaps this is to be expected: an African farmer pays, on average, two to three times more for a bag of fertiliser than do farmers in Asia. There are many reasons, but among them are the poor road and rail networks on the continent; it costs as much to transport 1 t of fertiliser from Europe or North America to the port of an African country as it does to transport the same volume 100 km inland. Not only do farmers in Africa have to pay much more for fertilisers, they have to do so at a cash-short season. Another common experience is to find that fertilisers are not available at regional dealerships at the time they are needed. In these respects, organisations such as parastatals can be helpful in supplying fertilisers, the cost of which is deducted at harvest.

Soil fertility in Africa suffers not only because fertilisers are expensive, but because the price a farmer receives for his crop is so low, especially for a staple such as maize (see Box: Value–cost ratio) The unsatisfactory input–output ratio discourages farmers from investing, particularly when credit is difficult to obtain or is expensive, and security of land tenure is uncertain. In any case, soil fertility improvement is a slow process with little sign of reward in the early seasons. Furthermore, it is more expensive and less rewarding to attempt to restore already degraded soils than to maintain existing fertility. If the land is in reasonable condition, a farmer can expect a harvest of about 15 kg of cereal grain per additional kilogram of nitrogen applied. If the land is already degraded, that same kilogram of nitrogen will only supply about 9 kg of cereal grain.

Value–cost ratio (VCR)

The VCR is a ratio of value of increased yield to the cost of fertiliser per unit. A VCR of 2 is usually considered the absolute minimum for fertiliser use to be efficient, while ratios in excess of 3 are needed if farmers are to have much incentive to risk investment. VCRs are useful for comparing the profitability of fertiliser use on crops across countries and/or over time. A function of yields, prices and cost, the ratio varies in time and space depending on the variables. For example, evidence for Mali and Ghana shows a VCR for maize and fertiliser of less than 2 in 1997 (Köning et al 1997. Integrated Soil Improvement and Agricultural Developments in West Africa: Why current policy approaches fail. ISRIC Report 97/11), whereas in Burkina Faso the VCR for sorghum and millet fell from 5.3 in 1981 to 2.9 in 1996.

Globalisation and getting together

If the price of agricultural commodities is partly to blame for farmers' low incomes (and therefore their inability to afford fertilisers), what room do farmers have for manoeuvre? Subsidies in countries of the Organisation for Economic Co-operation and Development (OECD) affect world commodity prices and, despite the Doha Development Agenda and an apparent commitment by the international community to work towards the Millennium Development Goals, the richer countries continue to apply brakes to the process of agricultural reform. Furthermore, prices of inputs have risen over the past two decades because subsidies have been cut, largely in response to external pressure from institutions such as the World Bank and the International Monetary Fund (IMF). The policies of liberalisation that have been pursued by these institutions have often failed to achieve the market-led growth that was their objective. Not only are farmers in most ACP countries now experiencing high-input/low-output prices, they also have to contend with a poorly functioning public sector that does not have the resources necessary to support its farming sector adequately. In contrast to the industrialised countries, where the farming industry is tiny in terms of its percentage contribution to GDP compared with the ACP states, farmers' organisations in Africa are either too weak to apply the pressure required for change – or fail to represent their members' interests.

Taking a look at some technical options

Much research has been carried out and many books written on the technical options available for maintaining or restoring soil fertility (see Bibliography). In very general terms, seminar participants discussed soil analysis; the relative benefits of organic and inorganic inputs; the value of low-tillage systems; maintaining soil health; and farmers' field schools as a means of developing and transferring technology.

The hole in the ground goes airborne

If soil fertility is to be maintained or improved, a useful starting point is an analysis of what already exists. Soil mapping has changed dramatically in recent years. Whereas at one time the standard practice was to dig 1.5 m^2 holes every 20 m and deduce from the excavated rocks the nature of the soil's parent material, it is now possible to obtain remote sensing imagery using satellites and geographic information systems (GIS) and models. Airborne surveys are particularly useful, and both quick and relatively inexpensive compared with ground testing. The information obtained can be used to guide decisions on land use, or whether agricultural production has potential and is therefore worth investment.

Airborne soil surveys

Airborne surveys may use, among other devices, gamma ray spectrometry. This picks up radioactive elements – for example potassium, thorium and uranium – indicating the presence of each at a given depth by a different colour. Each colour can then be investigated by ground analysis. The soil surveyor can be confident that the chemical analysis holds true wherever that same colour appears on the spectrometry map. Salinity can be detected by aircraft travelling over the ground at about 200 mph (300 km/h) generating its own electromagnetic field. When the aircraft passes over an area of high conductivity – for example saline water, which may be several metres below the surface – a secondary electromagnetic field is generated and is detected by the instrumentation aboard the aircraft. Freshwater, which is not such a good conductor, is indicated by the patterns that emerge.

For small-scale, non-commercial farmers in ACP countries, obtaining a diagnosis of their soil must be done by means that many would consider no less sophisticated than remote sensing from aircraft. By understanding the relationship between certain indicator plants and the soil, farmers can make reasonable assumptions about the soil's fertility and take appropriate steps to improve it where necessary.

Between remote sensing and on-farm plant indicators are standard, laboratory-based soil-testing services, which are now severely curtailed in many countries. (see Box: Soil testing services)

Soil testing services run by NGOs and fertiliser associations

State-operated regional soil laboratories (funded by the Danish government) were eventually closed down in Bangladesh because they became unsustainable. A low-budget system of soil-testing services run by NGOs and fertiliser associations was subsequently established with the help of a World Bank loan. They produced fertiliser recommendations for about 10,000 farmers in the first year, about five times higher than the state-operated services. However, quality control became a problem. It seems that national laboratories can most usefully play a supervisory and technical support role for small soil-testing laboratories run by NGOs and fertiliser associations.

Organic options

Few would argue against making the best use of readily available organic materials for improving soil fertility. Not only do they provide some of the nutrients that plants need but, very importantly, they improve the soil's structure, its carbon content and its biodiversity. Indeed, some would argue that it is very difficult to increase long-term soil fertility at economically viable levels if external inputs such as fertilisers are constantly introduced. Others argue that failure to use inorganic fertilisers is, in effect, putting poverty into the system. Where soils are already impoverished and where over-exploitation means there are no resources, external inputs of some kind are necessary. Nevertheless, for 20 years 'low-external-input' agriculture has been promoted throughout Africa. Are organic materials alone sufficient for sustainable soil fertility management?

<u>How good is organic?</u>

One of the major drawbacks to an 'organic only' strategy – unless growing for a high-value organic market – is that organic materials are unlikely to be available in sufficient quantities fully to restore lost nutrients. Even if sufficient biomass is available, or can be increased by growing green manures, can farmers afford to wait for the many seasons it will take to restore fertility by organic means alone? Adding fertility by organic means is also an imprecise science. Nutrient levels are usually (although not always) unknown, and will vary widely. Furthermore, applying organic materials is much harder work than applying inorganic fertilisers, which are far more concentrated and much easier to handle. Nevertheless, there are a very wide range of ingenious soil- and water-conservation strategies that farmers have been using – in some cases perhaps for millennia. Obvious examples are stone bunds, terracing, planting pits such as *zaï* and *demi-lunes*, ridging, grass barriers, grass mulching, etc. Mulching not only helps to fertilise the soil as the mulch breaks down, but encourages termites that create passages in the soil, destroying surface crust and increasing porosity and permeability. For many farmers, stone bunds and mulching are complementary measures –once the investment is made in stone bunding, mulching brings added benefits thereby increasing the return (Reij *et al.*, 1996).

Controlling erosion on steep slopes

The system developed by farmers in the Matengo highlands of Tanzania, known as *ingolu* or *ngoro*, controls erosion as well as helping to conserve fertility. The overall effect is a honeycomb pattern dug on sloping land that captures soil and water, and makes use of grass and weeds to build up soil fertility with organic content and nutrients, supplemented by the growing of beans. It is very labour intensive, with the hardest work being done by women. Grass is cut in the field to be pitted. Men lay the grass out in a grid pattern of approximately 1 m squares. Women dig out the centre of the grid square and place the soil on the grass grid. The depth of the pit is usually between 15 and 60 cm. Crop planting varies, but often beans are planted first, with the seed placed on the soil above the grass grid and covered by subsoil from the pit. During weeding, all weeds are thrown into the pit where they are left to form compost. In the following season the same pits are used for maize. When the maize is harvested the ridges are split; new pits are formed in place of the former ridges, and new ridges in place of the old pits.
(Source: Reij *et al*., 1996, p. 145)

A way with waste

Most people pick their path through roadside rubbish with a certain degree of distaste. Some may feel the city authorities should do a better job of clearing away the waste. Few would have the foresight to see that the unwanted vegetable waste that piles up around market places and even in people's backyards has the potential to enrich impoverished soil. Recycling rubbish may not be to everyone's taste but, as one scheme in Nairobi has shown, urban gardeners and vegetable producers need and value the soil-restoring properties of the end product. To do the job well, and produce a safe compost of acceptable quality, good management and resolve in the face of scepticism and disbelief are essential. Nairobi City Garbage Recyclers was set up in the poor, eastern estates area of Nairobi, where a team of young, previously unemployed youths sorts organic from inorganic waste, turning the former into compost. It is then put into bags and sold to urban farmers, and to the city authorities for municipal tree planting, for example. It is also being sold to farmers in rural areas, helping to return the nutrients that usually make only a one-way journey into town.
Unlike a factory product, compost made from household and market waste cannot, by its nature, be totally standardised. This has to be accepted by the buyer, and is reflected in the price. Nairobi City Garbage Recyclers has been working with the University of Nairobi's Department of Agriculture to ensure the compost does meet certain standards, including those of safety and nutrient content. The composting method takes the soil temperature to 80°C, at which most pathogens, and eggs of enteric worms, for example, are killed. Analysis of compost samples reveals satisfactory levels of nitrogen and phosphorus, the two nutrients that are most likely to be deficient in urban soils. Many urban soils are also very low in carbon, and recycled organic waste helps restore carbon to the soil. Heavy metals are a common problem with recycled materials – batteries, the main source, are removed before composting, together with all plastics, metals and other inorganic materials, and so present no problems in the finished product.

As stated above, if the soils in West Africa were to be fertilised solely with manure it would be possible to apply only 2.5 kg of nitrogen and 0.6 kg of phosphorus. Set against the average for sub-Saharan Africa as a whole (excluding South Africa) of 9 kg/ha, and the global average of 100 kg/ha, applying manure is a poor substitute when considered solely in terms of nutrient supply. However, it is a great deal better than nothing. If manure, crop residues and composted organic materials from household waste or other sources are ploughed back into crop-growing areas, instead of being burnt, the need for inorganic fertilisers will at least be reduced.

A belief in burning

In the North West Province of Cameroon, farmers prepare their plots by cutting grasses and other vegetation, covering them with soil and then setting fire to them, letting them burn for one or two days. Crop yields are good in the first season after burning, but after that yields drop quickly. By the third season maize is stunted and produces few usable cobs, and beans are weak and spindly. Farmers, working on the principle that 'seeing is believing', think their only recourse is to burn again, and that the more they burn the more productive the soil will be. Little do they realise that the heat generated by burning grass below the surface kills organisms in the soil to 2 m depth and effectively destroys its fertility for many years.
(Source: radio interview recorded by Martha Chindong with Athanasius Monju, director of a local NGO, 'Livelihoods', in CTA Rural Radio Resource Pack 00/2, *Sustainable Soil Fertility*, p.16. Martha Chindong works for the Agricultural Information Service of the Ministry of Agriculture in Yaoundé and is responsible for the AIS's radio programmes in English.)

Crop rotation

At the Kenya Institute of Organic Farming extension staff are taught how to encourage farmers to practice crop rotation as a means of managing the fertility of their soils, as well as breaking the pest and disease cycle that can build up quickly if the same crops are grown on the same ground in repeated seasons. A 'hungry' crop such as maize, cabbage or kale begins the cycle, followed by a legume crop such as beans to fix nitrogen (and perhaps provide feed for livestock as well as the household). Legumes will be followed by a moderately hungry crop such as tomato, eggplant or peppers and, for the final crop of the rotation, a less hungry crop such as carrot or sweet potato.

Crop–livestock integration in North West Province, Cameroon

A farmer concerned that his yields were tumbling recognised that the falling fertility of his soil was the probable cause. He also noticed that where cattle had strayed onto his land, the fertility improved. Every evening at dusk, and again at dawn, cattle herders would pass by from daytime to the night-time grazing. Cattle herders and farmers had a history of conflict followed by uneasy truce, but here was an opportunity to – as it were – mend fences. The farmer fenced in part of his field (100 m2) and persuaded one of the cattle owners to allow his cattle to be confined overnight within it. The livestock had good grazing, the herder had a shorter distance to move his animals, and the farmer had his plot manured. The farmer concerned was of a scientific turn of mind and wanted to know the optimum number of weeks the cattle would need to spend on the plot. Too long would waste good cropping time, but too short a time would lessen the fertilising effect of the manure. He therefore fenced in five 100 m2 plots. He used one as a control in which no cattle were kept, and the rest had 12 cattle 'night-paddocked' for between one and six weeks. Others adopted the idea and the village became something of a *cause célèbre*, the farmer being a good publicist as well as a good scientist. Not only was the farmer's soil improved, but the relationship between farmers and herders improved. Crop yields improved, and this stimulated more efficient marketing and greater profits. Furthermore, it helped to show development workers, researchers and others that farmers should be respected for their ability to solve problems with innovative ideas.

Cutting down on cultivation with conservation farming

Another means of improving soil fertility through organic means are no-tillage or low-tillage systems of land preparation. Conservation farming maximises the use of ground cover to reduce water run-off and wind erosion, and allows huge savings in terms of labour because land is not ploughed before planting. This is a major consideration where ill-health reduces the availability and/or increases the cost of hired labour. Conservation farming does not exclude the use of fertilisers, but experiments in Samoa demonstrated that no-tillage systems with low inputs produced better yields at lower cost than tillage systems with high inputs.

Furthermore, weed control, which is often expected to be a shortcoming in no-tillage systems requiring high inputs of herbicides, proved less of a problem than in places where the land had been cleared for cultivation.

Conservation farming – a commercial decision

There has been a major trend towards conservation agriculture in South Africa in recent years. A number of very successful commercial farmers have adopted the practice, growing principally maize, soya and wheat, but also sunflower and cotton. Conservation agriculture does not necessarily increase yields, but it reduces costs, especially for farm fuel, and conserves resources, most importantly water.

Agroforestry

Trees can be an important asset to a farm and, if leguminous, can improve the fertility of the soil. However, many species have an extensive root system and the minerals and water they take up can deprive other plants, particularly crops planted near trees, of the nutrients they need (see Box: Advantages and disadvantages of the alley-cropping system). Deep-rooting trees may therefore be preferable to laterally, shallow-rooted species, as deep roots do not compete for nutrients within the crop root zone, but can pump up nutrients from lower strata which are then added to surface soil fertility via leaf fall (Scoones and Toulmin, 1999, p. 47). Careful choice of species is therefore important. Trials at Niaouli in 1996 (Bationo) show that adding leucaena to fertilised maize more than doubled yields (from under 1.5 to over 3 t/ha). Senna was marginally less effective than leucaena, but gliricidia had little effect.

Advantages and disadvantages of the alley-cropping system in subhumid zones

Advantages of the alley-cropping system are:
- Erosion protection
- High returns of fixed nitrogen in tree loppings used as mulch
- Substantial additions of organic matter to the soil and hence significant improvement of soil properties
- Availability of wood for fuel and building poles.

Disadvantages are:
- A higher labour requirement to manage trees
- Competition for space, light, water and nutrients between trees and crops grown in the alleys
- An inadequate return from trees compared with the labour involved in their establishment and maintenance.

(Source: FAO, 2001)

Recommending fertilisers

The majority of participants at the seminar accepted that the increased use of inorganic fertilisers, especially in Africa, is essential if agricultural productivity is to improve. The question is not: ‘Can farmers afford to use fertilisers?’ but rather: ‘Can farmers afford not to use fertilisers?’ Technical specifications of type, application rates, placement, timing, etc. were not discussed, beyond pointing out that balanced fertilisation is important and that this includes the use of trace elements. The discussions centred on policy aspects of fertiliser supply (see Chapter 2). One aspect that stimulated much discussion was whether, in low-rainfall areas, it is lack of water or lack of soil nutrients that limits yields. As discussed above, it seems counter-intuitive to suggest that soil fertility is more important, but work in the Sahel has shown that improved soil fertility enhances the water-use efficiency of crops. A technical solution that could prove useful would be to ensure measures to improve the levels of soil nutrients are incorporated in any irrigation or water-conservation scheme, thereby adding value to the considerable investment such schemes demand, not least in terms of the labour required for initial construction and subsequent maintenance.

Achieving the maximum efficiency in terms of response from the crop per unit of fertiliser should go hand-in-hand with soil- and water-conservation measures.

<u>Balanced nutrition</u>

It is important that crops are supplied with all the nutrients they need, and in the correct proportion for the specific crop, taking into account the extent to which crop residues are returned to the soil. The tendency is for nitrogen to be favoured above other, equally critical nutrients. Plants supplied with excessive nitrogen have soft tissue that has little resistance to penetration by fungal attack, or to sucking and chewing insects. Lack of potassium, calcium and boron leads to the development of lesions and other injuries through which pests and diseases can invade plant tissue. Plants suffering from magnesium or potassium deficiency become yellowish in colour, and more attractive to aphids which compete for assimilates and transmit viruses at the same time.

Cereals remove from the field as much potassium as they do nitrogen (approximately 30 kg/t K_2O in grains and straw produced in high-input systems). For cauliflower and tomato, the ratio of nitrogen to potassium is 1 : 1.4; for Irish potato it is 1 : 1.8; for banana it is 1 : 4. As more farmers in developing countries turn to vegetable production to provide a high-income crop that fits in well with traditional cereals, balanced fertiliser application becomes critical. Cabbage, for example, can remove four times as much K_2O from the soil as rice. Generally, vegetables have a short growing season, partly because they are harvested before producing seed. This means that nutrients must be in the ground and available for uptake by the plant during the high demand period of growth. Major growth in vegetable production has taken place in recent years, and for exporters for whom consistent high quality is paramount, balanced soil fertilisation is critical.

The K in cotton

Potassium deficiency in cotton is commonly called 'cotton rust' because leaves become reddish-brown and dry, shedding prematurely. These symptoms seldom appear on the older leaves at the bottom of the plant, but rather on the young leaves at the top. If there is insufficient potassium supply from the soil, these 'rusty' young leaves are the source of the nutrient for the rapidly growing bolls.
(Source: *International Fertiliser Correspondent*, the newsletter of the International Potash Institute, www.ipipotash.org)

Coca Cola – the cap fits

Phosphorus deficiency is a major constraint to crop production in West Africa, and response to nitrogen is substantial when both moisture and phosphorus are non-limiting. For many years research has been undertaken to assess the extent of soil phosphorus deficiency, to estimate the phosphorus requirement of major crops, and to evaluate the agronomic potential of various phosphate fertilisers including phosphate rocks indigenous to the region, such as those found in Tahoua in Niger and Tilemsi in Mali. Despite the widespread and acute phosphate deficiencies in West African soils, very little phosphorus fertiliser is used by local farmers, partly because of the high cost of imported fertilisers. However farmers who leave their crop residues on their land and use the 'Coca Cola cap technology' of applying a capful of phosphorus at the rate of about 4 kg/ha have found that their profits have risen, with yields up from 200–300 kg/ha to almost 1 t/ha.

PREPAC

In an attempt to restore highly depleted soils in western Kenya, scientists at Moi University developed PREPAC – the phosphate rock exploratory project – using low-cost inputs. Packs were developed for use on 25 m2 plots growing intercropped maize and soybeans. The PREPAC contained 2 kg biogenic Minjingu phosphate rock, 0.2 kg urea, *Rhizobium* inoculant (Biofix) for 125 kg food grain legume seed, and lime pellets. Instructions for use in English, Kiswahili and some local languages were also enclosed within the PREPAC. Initially the pack was distributed to 52 farmers who were asked to do the trials themselves, in order to get a realistic on-farm response. Positive returns on investment were in the ratio of about 1.6 : 3. Where the scheme foundered was on the issue of marketing. The packs were distributed to 42 agricultural suppliers in western Kenya, who were asked to sell them on at a price of their choosing. But farmers were not prepared to pay for the PREPAC, expecting to have it as a free gift. It seems that farmers are unlikely to be interested in a new technology without a very good information system to support it.

Maintaining soil health

Few farmers understand the interaction between a plant's roots and the soil in which it is growing, but a better understanding would lead to more respect for soil health. Too many of today's normal farming practices are highly damaging, yet it is extremely difficult to put the message across that a healthy, living soil is essential if crops are to grow well. Cultivation every year on the same land without adding fertilisers or organic matter, and often burning crop residues in a misguided attempt to deter pests and diseases, has a very damaging effect, also preventing natural organisms in the soil from performing their function of biological tillage. Avoiding burning, using minimum tillage and applying mulches are the best routes to protecting the soil and its biodiversity/biota/fauna.

Root architecture

Most nutrients reach plant roots by diffusion, a slow process which controls nutrient supply at the root surface. Generally speaking, the total amount of nutrients reaching the root surface is related to the root-length density, soil moisture and texture, and the concentration of the particular nutrient in solution. By absorbing nutrients from the soil solution, the plant root creates a diffusion gradient causing the nutrient to move towards the root. The rate of this movement, or flux, is dependent on the nutrient concentration in the soil solution as well as on the root system itself. Root-length density is genetically controlled. Cereals usually have a higher root-length density than potatoes or beans. The lower the root-length density, the greater the required nutrient concentration in solution.

Integrated soil fertility management

The concept of integrated soil fertility management is wider than a simple 'best-bet' combination of organic and inorganic inputs. The essence of the approach is the emphasis on context-specific and adaptive responses. It takes the local context into account, builds on local knowledge, and is a finely tuned approach to nutrient management that includes timing and placement of inputs so that nutrient release and plant uptake are synchronised. It may include resource-flow mapping to link an analysis of nutrient flows to farmers' practices and conditions. Training in the use of basic soil-testing equipment may be considered, and also simple limiting-factor experiments to define what intervention options are appropriate to a particular setting (Scoones and Toulmin, 1999, p. 76). The concept of integrated nutrient management also takes markets into account, and recognises the importance of linking to markets, institutions, and policy and broader environmental issues.

Management of soil fertility cannot be seen in isolation from other aspects of farm work, nor from the many other non-farm factors that affect farmers. This is apparent from work with farmers' field schools, for example by InMasp. [1] Recognising that falling soil fertility could account for falling yields, the 30 or so farmers at each of 11 farmers' field schools in Kenya began studying the soils on their farms. The plan was to identify soil fertility constraints and to generate appropriate and effective integrated nutrient management technologies to increase long-term productivity and profitability. Socio-economic and environmental concerns complemented the agronomic factors. More ambitiously, the idea has been to work with farmers to formulate appropriate district policy recommendations.

Farmers' field schools for integrated nutrient management

Farmers begin the season's work by undertaking an agro-ecosystem analysis which will include mapping their water catchment area and different land-use systems. Problems are identified, and a programme of field experiments and practical exercises is devised with the help of the group's facilitator to test a variety of possibly helpful technologies. An experiment might include, for example, treating one plot with a handful of farmyard manure at each planting hole (16 t/ha); applying diammonia phosphate to another plot at the rate of a teaspoonful per planting hole (216 kg/ha); combining the two treatments on one plot; and combining both treatments plus tithonia at the rate of 3.5 t/ha on a further plot. During and at the end of every season, farmers evaluate the trials not only for the effect of the different treatments on crop yield and health, but for return against labour and financial cost, incidence of weeds, soil moisture retention, etc. Building on this information, further trials are developed for the subsequent season. Of course, interest will eventually wane if the work does not, at some stage, result in greater productivity and profitability. Furthermore, initial commitment to the farmers' field school will very largely depend on the interpersonal skills of the facilitators as well as the training they have received. (Source - InMasp)

The advantage of farmers' field schools is that the agenda is set by farmers, not by extension officers, NGOs or researchers, who may have their own ideas as to what is important. It quickly becomes apparent that technical options are only one aspect of farming. Decisions must be based on economic factors, where risks and costs play an important part and where policy decisions by others affect the options open to farmers. Soil fertility management is no exception.

[1] InMasp (Integrated nutrient management to attain sustainable productivity increases in East African farming systems; www.inmasp.nl) is a multi-institutional initiative of six partners in East Africa (ETC-East Africa; Kenya Agricultural Research Institute (KARI); Makerere University, Uganda; Environmental Alert; Awassa College of Agriculture, Ethiopia; SoS Sahel) and three in Europe (Agricultural Economics Research Institute = Landbouw Economisch Instituut, LEI, the Netherlands; Research Institute for Animal Husbandry, the Netherlands; National Agricultural Research Foundation, Greece).

Chapter 2: Policy Aspects of Soil Fertility Management

Technology adoption

Technologies for improved soil fertility management are of no use to farmers unless the economic, social, institutional and political environment is favourable.

Economic considerations

Farmers all over the world are interested in making money – if they can make money by using fertilisers, whether they are in Africa, the Caribbean or the Pacific, they will use them. In Africa, farmers' produce has increased little in price, if at all, over the past 20 years, in sharp contrast to fertilisers – and in many cases it has declined. If farmers do not get enough return on the cost of their inputs, they will cease to purchase them. In the Caribbean, where farmers do achieve a worthwhile return on their investment, the profit motive is a powerful incentive and farmers need to be discouraged from applying fertilisers at excessive rates. In the Pacific, where agricultural intensification is the trend, farmers are happy to use fertilisers in the expectation of increased yields for which there is a growing market.

The fertiliser market in Africa

In Africa, the agriculture input/output ratio is the worst in the world. Poor infrastructure within the continent is one reason. In a typical example, it costs as much to transport 1 tonne of fertiliser from Ghana's port at Tema to the country's northern city of Tamale as it does to transport that same tonne from Europe. Fertilisers are heavy and bulky and transport by rail, if the rail networks were adequate, would be more efficient than road. As it is, fertilisers are transported by truck and all the handling costs along the way are added to the final price that the farmer has to pay.

Two or three companies control about 70% of the market in Africa, with one company having, by far, the majority share. High market concentration and lack of competition always have an impact on price and, because the market in Africa is small, it does not attract new companies. It is a vicious circle: high fertiliser prices discourage fertiliser use, and a small market for fertilisers increases their price. Obtaining credit is another economic factor that inhibits the expansion of the fertiliser market. Dealers need working capital to operate and expand their networks, but credit is difficult to obtain and is expensive. Farmers need credit to buy fertilisers – they face the same challenge. In some areas farmers have been willing to buy fertilisers in smaller than the average 25 or 50 kg bags, and this has encouraged greater use once farmers have been able to see the benefits for themselves (Scoones and Toulmin, 1999, p. 47). For example, fertiliser use in Kisii, western Kenya has been accelerated by packing in small sacks of 10 kg. Nevertheless, without a market for their products, farmers have no incentive to invest. It is a market that makes soil and water conservation worthwhile.

Big companies = bigger profits for small farmers

It is not often that farmers working small plots of land have the chance to supply to big multinational companies such as Guinness or Nestlé. Under the Rural Sector Enhancement Programme (managed by the International Institute of Tropical Agriculture with funding from the US Agency for International Development, USAID), farmers in Nigeria are grouping together to meet the demands of quantity and quality that such companies require. Soil fertility management is part of this process. Farmers are linked to the private sector for the purchase of fertilisers, seed and other inputs, and to banks for the purchase of credit. Farmers are given training to improve production quality and product marketing. By supplying directly to the big companies, farmers are receiving a greater share of the consumer naira and an incentive to continue investing in soil fertility management.

Institutional inadequacies

The effect of structural adjustment and privatisation programmes has been to leave extension services in disarray in much of sub-Saharan Africa. Extension officers are usually paid very little and have areas to serve – in theory – that are too large to cover with the few resources at their disposal. Soil fertility management is unlikely to seem pressing in comparison with, say, livestock health or crop protection. Furthermore, farmers' organisations are often weak and are not able, or willing, to exert pressure for change.

The lament that farmers will not adopt proven technologies has echoed around research establishments for decades, with an answering echo: 'whose fault is that?' Despite the best endeavours of many committed individuals, it is undoubtedly true that inadequate institutional mechanisms exist for transferring technologies from research to the farm or, indeed, for transferring farmers' concerns to research, extension and policy-makers. Small pockets of success are greatly to be admired, but the problem always lies in scaling up to meaningful size. The persuasive enthusiasm of a small group of individuals can work wonders, but the effect falls off rapidly as the targeted group gets bigger. Farmers' field schools demonstrate this perfectly. Anyone who has watched a farmers' field school in session is likely to have been deeply impressed by the commitment of all present, stimulated by the usually excellent interpersonal skills of the trained facilitator. But success depends on face-to-face contact – undoubtedly the most effective yet most expensive form of technology transfer. Realism is essential. A donor may be prepared to put $200,000 into a specific country, sufficient to target perhaps ten different farmers' groups in ten districts, but how can this be scaled up to meet not just 1000 farmers' groups but 100,000? No doubt it is true that good news travels fast, but it is equally true that it does not travel fast enough.

Many scientists do not feel it is within their responsibility to concern themselves about transferring technology to farmers. They believe time spent on communication wastes time that could be spent doing worthwhile research. It is also true that some scientists fear, perhaps correctly, that they are poor communicators. They prefer to hide behind their information and press officers, and see no reason to improve their own communication skills. Most research institutions depend on outside funding, and donors expect to see a return in terms of benefits accruing to those for whom the research programme has been devised. To have to admit that farmers are not taking up the technologies, and that no effort is being made by the research institution to encourage them to do so – because that is the job of others – could lead to a very rapid fall-off in funding. And however hard information officers work, their efforts can never be as effective as those of the enthusiastic scientist explaining why he/she is doing the work in hand and the benefits the work will bring to others.

Again, for decades the complaint has been that the approach of advisors and researchers to farmers has been top-down, and that decisions are made *for* farmers rather than *by* them. One can hardly blame farmers for being disinterested in advice that appears to take little account of the reality of their complex social and economic situation. Often that advice is conflicting, as each message reflects the views, or the mandate, of the institution presenting it. Farmers are not fools, and will not be persuaded against their better judgement to a course of action that risks what they cannot afford to lose.

Political priorities

Agriculture does not receive high government priority in most ACP countries. This is perhaps surprising in agriculture-dependent economies. An analysis of Poverty Reduction Strategy Papers – the means by which least developed countries may apply for financial assistance from the World Bank and the IMF, makes this clear. Governments are more interested in seeking assistance for establishing new technologies that provide high income for a few elite, but which do nothing for the vast majority. Even where agriculture is given some attention, soil fertility management is not.

Whether or not land tenure systems discourage investment in soil fertility management is open to debate. Certainly many people believe that farmers are unwilling to make efforts to improve their soils over the longer term if they are unsure of being able to reap the rewards. This is particularly the case with potassium and rock phosphate, which do not have such an immediately visible effect on plant growth as nitrogen. Whether soil fertility management is likely to provide the incentive to governments to create systems of more secure land tenure for impoverished farmers is also open to debate.

One feature of governments throughout the world – industrialised and developing – is that land-use planning, land tenure, finance, trade, exports, agriculture, etc. are handled by different ministerial departments. Forming a coherent strategy on sustainable land management is extremely difficult, especially as final decisions are usually made within departments of finance, or indeed the presidential office, where soil fertility management is unlikely to rank highly.

Government policies have had a major impact on the fertiliser market, especially in the past when subsidies and other schemes encouraged political interference. Six years ago governments in West Africa were buying urea at twice the price of that on the world market. By the time it reached farmers, it was three to seven times higher than in the rest of the world. And today a farmer in Kenya still pays seven times what a farmer in Europe pays for a similar bag of fertiliser. Around 30–50 years ago, the government of South Africa invested in phosphate rock and lime and made it possible for white settlers to develop intensive agriculture and to adopt 'green revolution' technologies. Today neither African governments, nor their donors, are interested in doing so.

Perhaps the overriding constraint to soil fertility is the weak price farmers obtain for their produce. There must be an incentive for farmers to commercialise their production and increase yields through the use of fertilisers. Strengthening the output market is essential.

Emergency aid to agriculture

Agricultural aid following natural or man-made disasters often includes fertilisers. In many cases the fertilisers are donated directly to farmers without the involvement of the local fertiliser dealers' distribution network. This distribution network of very small dealers is usually weak and can be hard-hit if ignored. To sustain the distribution network, these dealers should be involved in distributing the donated fertiliser.

The wider picture

Policies for soil fertility management should form part of a holistic approach to agricultural development. Not only does this make sense because it accords with the reality of people’s lives – in which soil fertility cannot be seen in isolation from the many other factors affecting their livelihoods – but because, frankly, there is no other way to ensure it receives the necessary attention. Proposals at policy level that relate to soil fertility management alone will probably be ignored. As noted earlier, national funds are more likely to be made available for water supply or irrigation schemes. These have an indirect bearing on soil fertility management, but will be much more effective if a consideration of nutrient balances within the soil is incorporated within the programme of work. Those concerned about soil fertility management should make efforts to ensure that policies relating to land use, water conservation, erosion control, markets, advisory services, etc. are, at the very least, coherent with the needs of soil fertility management on-farm – and preferably take direct account of them.

Policies for the input market: towards a greater coherence?

Achieving higher priority for soil fertility management by governments will be an uphill task. One aspect that must be considered is that there is little point in designing policies for the input market that are not consistent with the state of the output market. If, for example, regulations have the effect of increasing the cost of fertilisers, yet farm-gate prices for produce are low because of cheap foreign imports, there is little prospect for improved soil fertility.

International dimension

Imports of cheap food, grown by subsidised farmers in the West and sold way below cost in developing countries (sacks of US rice sold on the streets of Ouagadougou, for example) are counter-productive to the aims of good soil fertility management. Westerners may be affected by heartrending pictures of hungry children in Africa, but have little comprehension that the policies that secure the livelihoods of their own farmers may be contributing to the sorry state of agriculture in the developing countries accepting their exports.

Policies that have an effect on the price of fertilisers should be coherent with policies that affect other agricultural inputs, for example the price of seeds, crop protection products and irrigation. The availability and cost of credit should also be consistent with the needs of agricultural input dealers, those involved in buying and selling farm produce, processors and other entrepreneurs and, of course, cooperatives or individual farmers.

Aside from credit, policies are needed to encourage small entrepreneurs to set up in business, selling agricultural inputs in small quantities to small farmers. Better road and rail networks would bring far wider benefits to society than simply improving fertiliser distribution and, by extension, farm incomes. Associations of agricultural input dealers are necessary on the one hand to exert some control over the standards of their members, and on the other to represent the industry at government level (see Box: When farmers are in business).

When farmers are in business, so are the fertiliser dealers

Why is it that farmers in much of Africa find they have to pay five to seven times the price for fertilisers than farmers in the rest of the world? It is certainly not because they are the most affluent. In an attempt to overcome some of the problems associated with the marketing of fertilisers and other inputs in Ghana, an association of private sector dealers has been formed. Called the Ghana Agri-Inputs Dealers Association, the executive secretariat is based in Accra and its members range from small to very large. The objective is to achieve a fairer, more competitive and trusted market, offering goods at prices that are more consistent across the country. Ensuring that supplies are available in time for the planting season is another objective, something that has proved problematic in the past for a variety of reasons. Regional branches of the association have been set up to try and ensure local dealers have stocks of urea, etc. ready for sale to farmers before the beginning of the rains. The association liaises with the big importers to ensure there are buffer stocks in place, especially at regional warehouses. Association members are expected to follow agreed guidelines, drawn up in conjunction with the Ministry of Agriculture and other government organisations, and defaulters can be banned.

Another aspect that would greatly enhance the prospects for improved access to fertilisers at reasonable cost would be to create regional markets (see Box: A regional fertiliser market for inputs in West Africa). A larger market, and harmonised import regulations across the region, would encourage more fertiliser companies to enter what would be a more open, transparently operated market (by lessening interference from those with powerful interests), and should drive down prices through increased competition.

Policies for balanced nutrition

It is important that policies should promote balanced fertilisation in order to achieve economic benefit for farmers and reduce losses of nutrients to the environment. The tendency is for governments to favour nitrogen as the fertiliser of choice. It is usually available more locally and is less expensive than, for example, potassium, which is mined from relatively few deposits worldwide and therefore has to be imported. Farmers are usually unaware of the importance of nutrients other than nitrogen. Nitrogen promotes lush, soft, green growth, but plants can absorb only so much, and excess is not only a waste of money but can be environmentally damaging if leached into watercourses.

Associations for added strength

Policies that encourage the establishment of truly representative farmers' associations are essential if farmers generally are to achieve a better deal. Partnerships between farmers' and industry associations would be a more powerful lobby at government level than either interest group working alone. It should also help to achieve greater priority for agriculture at national and district level. Policy-makers should expect to design policies in close cooperation with farmers' organisations, NGOs, research institutes and private sector associations.

Farmers' organisations

After independence, governments took over control of the cooperatives that had been established during colonial times to ensure that production of crops destined for the world market met requirements. The managers were civil servants, membership was mandatory, and farmers had no influence over the organisation's activities. Today, village-level groups, producer groups, federations of groups, national and even regional organisations abound and – in theory at least – management is under the democratic control of the membership. Whatever the size, in order to operate as a separate legal entity a farmers' organisation must have legal status. Without this it will not be recognised by public authorities or NGOs as a valid negotiating partner.

In order to operate effectively, farmers' organisations must have a sound financial base. This will usually be based on a membership subscription, or commission charged on cooperative marketing of produce. Farmers' organisations act as an intermediary between the state and individuals, and may have strong economic and political influence on rural development. They may also act as a partner institution in a three-way arrangement by which an external donor makes funds available indirectly, using the services of a local institution which acts as advisor to the farmers' organisation and as comptroller of the donor's funds. Farmers' organisations should be offering members the advantages of bulk-bought fertilisers as well as other inputs, and assistance with marketing and access to credit.

Always recommended, but rarely achieved, are effective task forces or committees linking government departments that have, or should have, a common interest – in this case the management of soil fertility. Provisions and policies for improving soil fertility management should be included – in conjunction with other land-use measures – in national development plans. Most countries have natural resource management policies, on paper at least, but policy-makers will not think to include soil fertility measures unless considerable pressure is applied by the agriculture lobby. This could have an important bearing when national governments apply for funding through such institutions as the African Development Bank, the Global Environmental Facility (GEF) and the World Bank. Although GEF funds are tied to biodiversity, soil is the richest terrestrial habitat for biodiversity that exists on earth. If agriculture and soil fertility management in particular can be incorporated within environmental projects, the opportunities for funding and action are greatly increased.

Policies for soil fertility management in ACP regions

Africa

The most widely recognised international soil fertility management policy for Africa is the Soil Fertility Initiative (SFI), launched during the World Food Summit in 1996 as a result of consultations between development agencies and donors including the World Bank, the Food and Agriculture Organization (FAO), International Fertilizer Development Center (IFDC), International Fertilizer Industry Association (IFA), Consultative Group on International Agricultural Research (CGIAR) with International Center for Research in Agroforestry (ICRAF) as the leading Centre, USAID, and a number of NGOs. The goal was to promote investment in soil fertility and land management in order to combat land degradation and achieve sustainable agricultural productivity growth and food security in sub-Saharan Africa.

A framework for designing national action plans was developed and an international facilitation group comprising FAO, ICRAF, IFDC and the World Bank was established to support and guide this process and the follow-up programme. In the five years between 1996 and 2001, 20 countries in sub-Saharan Africa received some form of financial and technical assistance to help them develop their national action plans. Of these, approximately a dozen plans have been completed, including those for Ghana and Mali (see Annexes 2 and 3).

Implementation of the national action plans has proved somewhat problematic, and disappointing to those who were expecting stand-alone projects in soil fertility management. The World Bank's policy is to avoid such projects on the basis that soil fertility is a cross-sectoral issue. Therefore actions proposed in the plan can be supported where they fit into an existing project already being supported by the Bank in that country. For example, if the national action plan of the SFI proposes support to the agricultural input industry, then it can be implemented through existing Bank projects designed to support private sector development. An enabling environment component may be implemented within a poverty reduction strategy credit, or institutional capacity building within the national institutional capacity building operations. The difficulty has been that in many of the Bank's existing projects there is very little latitude to mobilise resources to fund specific actions.

Secondly, the SFI team in each country was set up to develop the action plan, for which adequate resources were provided by the Bank. Once developed, the plan was submitted to government for approval, after which the government would appoint one institution to coordinate implementation. However, thereafter it seems that the appointed institutions received no funds that they could use to carry out their task of finding projects through which the action plan could be implemented.

Despite these difficulties and disappointments, a number of financial instruments can be explored to source funding for the national action plans (see Box: Financial instruments).

Financial instruments for implementing SFI national action plans

The GEF has offered windows to funding through a variety of structures. One is the rural community development operation by which GEF resources are made available in an earmarked fund that communities can access for any issue related to soil fertility or land management. These grants are mobilised through the World Bank's Operational Program 12 (OP12) (Integrated Ecosystem Management Program), which provides US$4–5 million over four to five years. Countries for which such plans are already prepared are Niger, Burkina Faso and Chad. Under preparation are plans for Guinea, where the programme of work includes soil management and biodiversity; and Senegal, where a grant is being made available for land management in the groundnut basin.

Community-driven development operations focusing on increasing agricultural productivity are typically in the order of US$30 million, and may also provide opportunities to include soil fertility management issues, as in Tanzania through the Agricultural Development and Empowerment Project (PADEP). Ghana and Mali have been able to source funding of about US$1 million through the Bank's window in Agricultural Services Operations.

It may be possible to prepare under OP12 stand-alone, full-size projects with a focus on soil fertility and land management in conjunction with traditional GEF focal areas. Kenya is in the process of preparing its Western Kenya Integrated Ecosystem Management Project under this financial instrument. Stand-alone GEF medium-sized projects provide a maximum grant of US$1 million and can be processed more quickly than a full-size GEF project. Zambia's project on Sustainable Land Management in the Miombo Woodland Ecosystem is being financed through this arrangement.

In order to overcome the funding constraint to getting the SFI national action plans under way, it is proposed that resources be made available to the institutions charged with coordinating and overseeing implementation through a National Action Plan Coordination and Catalytic Fund. Extra funds may be made available that can be used on a matching grant basis. For example, a project working on agricultural extension may be offered funds to include a soil fertility component, provided the original project matches the funds being offered. Global Environmental Facility funds may also be made available to provide an incentive to governments to make policy reforms. Above all, those who want to champion the cause of sustainable soil fertility management must make their voices heard above competing interests, especially in such as arenas as discussions on Poverty Reduction Strategy Papers.

A regional fertiliser market for inputs in West Africa

The official launch of 'Marketing Inputs Regionally' (MIR), [2] a project aimed at promoting agricultural development through the creation of a favourable environment for a regional agricultural inputs market in West Africa, took place in early November 2003, within a few weeks of the CTA Seminar at which many participants called for policies to facilitate farmers' access to fertilisers at realistic prices.

The MIR project is intended to promote a market that functions well, both upstream and downstream of the production chain, without which it is difficult to see how agricultural production can improve in the light of deteriorating soil fertility. Harmonised policies and regulations and effective information systems should set the stage for market transparency and competitiveness in fertilisers and facilitate free movement of goods.

Caribbean

Covering a string of islands, from Venezuela to Florida, of 20 or more nations where none (except for Guyana, Suriname and Belize) has an indigenous population, the Caribbean has unusual characteristics of agricultural production. Growing crops for the ex-colonising countries of Europe, agriculture is in serious disarray now that preferential trade access to Europe is being eroded. As agriculture becomes less profitable, large tracts of land are being abandoned and left open to alternative use. This is pushing up land prices and raises doubts as to whether it can ever be returned to agriculture. The high cost of land makes agricultural production prohibitive, certainly if used for growing primary products. In any case, local products are not competitive with imports. Generally there is no clear-cut and definitive policy on land use, and thus no framework for sustainable soil fertility management.

Soil research in the region has been sporadic, and much of it is now outdated. Commodity-driven research was driven by the demands of the export market rather than in response to national needs. Such research is no longer being undertaken and, in many instances, the information that was produced is not available. The individual territories have had little direct involvement with research that has been coordinated by external agencies and, again, this has been cut back in recent years. This has meant that the research support system has broken down and others – notably fertiliser dealers – have been influential in persuading farmers to purchase fertilisers in the expectation of higher yields and greater profits. Regrettably, this has led to over-use or indiscriminate use of fertilisers, bringing hazards of pollution as well as wasting farmers' money. The quantity of fertiliser used per hectare varies dramatically from a high of nearly 300 kg/ha in St Lucia to a low of 25 kg/ha in Guyana and 12 kg/ha in Haiti. No subsidies or other forms of assistance are given to encourage fertiliser use.

If agriculture in the region is to survive, policies that encourage diversification and adding value will be essential. Policies to address land use, soil fertility maintenance, and support services such as soil and plant analysis laboratories, are also necessary, as is the need to fill the large information gaps that remain. This should include a reassessment of the fertility of all soils using modern and

[2] MIR is a five-year project implemented by IFDC and funded by the Netherlands Ministry for Development Cooperation. It supports the efforts of Union Économique et Monétaire Ouest Africaine and the Economic Community of West African States toward common agricultural policies. Other partners include: the Network of Farmer Organizations and Agricultural Producers of West Africa (ROPPA); the Network of Chambers of Agriculture (RECAO); the Conference of Ministers of Agriculture of West and Central Africa (CMA/WCA); private input importers and dealers; and sector ministries. With headquarters in Burkina Faso, the project also has offices in Benin, Ghana, Mali, Nigeria and Togo.

reliable methods and, from this, develop a framework for soil rehabilitation including recommendations for appropriate fertiliser use. Furthermore, fertiliser use must, in future, be closely monitored in order to avoid past mistakes of misuse.

St Vincent

Other Caribbean territories will be interested in the policy development process that has been occurring in St Vincent with respect to the improvement of arrowroot production. This has included a review of previous research on soils and soil fertility maintenance, a presentation of the current status, an assessment of fertility levels of all soils through soil analysis, proposed recommendations for fertiliser use in the short and medium term, and field trials to adjust recommendations in the longer term.

Pacific

Much work has been done in the past to formulate policies on sustainable land management, but implementation of those policies has been limited. Decentralisation has been a feature of many Pacific island states, and land management now falls under the responsibility of district and village authorities and, eventually, individual farmers. Here support for soil fertility programmes is almost non-existent. As noted earlier, population pressure is seen as one of the factors contributing to soil degradation, with continuous cropping taking over from shifting cultivation. Although policies to encourage internal or outward migration from smaller to bigger islands are seen as one way to alleviate the situation, policies that support more sustainable agricultural intensification are essential. As part of this policy of intensification, farmers need guidelines for farming activities or specific crops that relate to specific soil types and situations.

It is felt to be important to create awareness among farmers that, unless they take greater responsibility for soil fertility, their incomes will suffer through falling yields. But to be able to establish appropriate education programmes – or any promotion of soil fertility issues – especially at government level, it is essential that proposals for policy reform are seen as relevant to the individual nation's overall framework for development.

Chapter 3: Information and Communication Support

The paradox – introduction

Scientists are burning to impart information. Decision-makers want to be better informed. Farmers are thirsty for knowledge. All are frustrated. Why is this, at a time when information overload can be a very real block to taking any action, let alone wise action? The answer must surely lie not so much in terms of the availability of information, but in its quality, appropriateness for the given context and, above all, the effectiveness of its communication.

There needs to be far more effective communication than is currently the case between policy-makers who select priorities and allocate resources, and farmers' groups, industry associations, scientists and NGOs who recognise the constraints and can offer solutions. It is essential to an effective communications strategy to ensure information has been generated in response to demand. If the information 'product' is right, the task of communication becomes far more manageable.

Policy-makers

For soil fertility management to move up – or even onto – the political agenda, those who champion its cause need to communicate to policy-makers the relationship between soil fertility, agricultural productivity and future economic prosperity. They also need to emphasise the relationship between agricultural productivity and the environment – land degradation, biodiversity and water conservation, carbon sequestration, desertification and climate change. Recognition of the links between such issues and soil fertility management will not only help create greater awareness of its importance, but may open windows to funding opportunities that have an environmental bias, such as GEF funds. Policy-makers should also be made aware of the link between improved soil management, reducing rural exodus and other similar socio-economic benefits.

Farmers

Few farmers – or indeed anyone else – really understand what is happening with the roots of their plants in the richest terrestrial habitat that exists, invisible, below their feet. With better knowledge, at least of basic principles of good soil fertility management, farmers could do much to improve farm productivity. They could, for example, avoid damaging practices such as unnecessary burning of organic matter (especially underground); avoid over-exposure to wind and rain; and ensure that fertilisers, where used, are applied economically and effectively.

The success of farmers' field schools points to the importance of providing farmers with information on which to base their own decisions, rather than continuing the out-dated tendency (still prevalent in some countries) of government advisors and scientists trying to tell farmers what they should be doing. It is impossible to understand all the elements that contribute to a farmer's situation, and inappropriate advice has always been worse than useless because it discourages farmers from recognising and considering the adoption of good advice they may hear in future.

Communication – the language, the message

The very nature of farmers' field schools encourages good communication in language all can understand. The barrier of technical jargon, which those who believe themselves knowledgeable raise against those they consider inferior, cannot survive in such surroundings. However hard it may be to achieve in a technical setting, words should be chosen on the basis of clarity to all parties in any exchange, at any level.

The jointly considered trials conducted by farmers' field schools also mean that everyone takes home the same message, even if the decision is to continue, or modify, the trial until a clear outcome is apparent. Participants at the CTA Seminar felt that a major constraint to the adoption of new technologies for soil fertility management is that different parties communicate very different messages according to their own firmly held beliefs – the relative benefits of organic and inorganic nutrients being the most obvious example.

Information

Often scattered, fragmented and inappropriate for the given context, information – and the means of acquiring it – may be difficult to obtain in many ACP countries, despite the massive growth and spread of ICT in recent years. Soil data, for example, are often missing altogether, or are decades out of date. Market information systems are improving dramatically but many remain unconnected to such networks.

The distribution of information – on paper, through meetings, using electronic media, etc. – goes some way to fill gaps, but the real challenge is to ensure that information leads to knowledge and, in turn, to wisdom. One route to this objective is to improve knowledge of soil fertility management within the mainstream agricultural colleges that train future extension and advisory officers.

Working out information needs

Seminar participants formed six working groups, two groups considering the information needs of each of the following: policy-makers; farmers' groups, NGOs and the private sector; and researchers. Although by no means exhaustive, given the time constraints, participants identified the following needs.

Policy-makers

It was felt that policy-makers require information concerning:

- The environmental resource base, its current status, trends, potential and constraints
- The socio-economic structure, both demographic and macro-economic
- Policies, institutions and procedures, including land tenure, market infrastructure and services and the regulatory framework across all relevant sectors
- Interventions by other development partners at national and regional levels
- Useful, proven soil fertility management technologies
- Input markets and level of distribution to producers.

Farmers' groups, NGOs and the private sector

Some of the identified information needs are exclusive to each of these sectors, but there are also many areas of overlap. For example, all sectors need information about new technologies and access to credit but, for the private sector and NGOs, it is important to acquire information about farmers' needs for inputs. Farmers' groups, NGOs and the private sector require information concerning:

- New technologies for soil and water management
- Fertiliser (and other inputs) market, including availability, prices and delivery
- Fertiliser quality and application rates in specific conditions
- Soil types and fertility status, and other relevant environmental information

- Credit and means of securing funds
- Changes in policies and regional initiatives
- Opportunities offered by development partners and eligibility criteria (NGOs)
- Market opportunities, including the fair-trade market for organic products
- Opportunities for adding value through processing, etc.
- Land tenure issues
- Farmers' needs concerning inputs
- Regulations and standards, customs and tariffs, subsidies and taxes
- Results from research – in an accessible format.

Researchers

These working groups were able to produce a long list of information needs, which included:

- An understanding of the needs of other groups, e.g. farmers and policy-makers
- Socio-economics
- Research management
- Decision-support systems and models
- Agro-enterprises, markets and rural information
- Potential of different land-use types, e.g. carbon sequestration, organic farming
- Synthesis of existing information on different farming systems
- Validated information collected informally, e.g. through farmers' field schools
- Updated spatial soil database at various scales for process modelling, result extrapolation, etc.
- Soil biology of different land-use types
- Technical options
- Laboratory techniques and models
- Sources of equipment (reagents, laboratory equipment)
- Participatory research
- Literature and publications
- Soil scientists, areas of work and contact information
- Sources of funding
- Project monitoring, evaluation and impact assessment.

Existing sources of information – international, regional, national

The Working Groups were asked to identify available sources of information.

For policy-makers these included:

- Research institutes
- Agricultural ministries
- Universities
- Private sector institutions
- Producers' associations
- Parastatals
- Farmers' associations
- Development partners (NGOs, bilateral agencies, etc.)
- National archives.

For farmers' organisations these included:

- Research institutions
- Local market information
- Contact with other farmers' groups
- Local media
- Publications, including technical information from ministries
- Communications through telephone, Internet, mobile phones
- Direct contact – meetings, training, seminars, field days
- Extension.

For NGOs, the above, including international NGO meetings, workshops, study visits etc.; and for the private sector their Chambers of Commerce, industry and affiliated organisations, and information from government sources.

There are, of course, sources of information at regional and international level, and selected institutions were invited to share their experiences with seminar participants (see the following boxes on FAO, ILEIA, ISRIC, AFAMIN, AfNet and CTA). There are specialised agencies providing information on a wide range of agriculture-related issues, including soil fertility management. They include the CGIAR system-wide soil and water programme; the FAO digital soil database (SOTER); the ECOPORT web portal for ecological information; and CABI (BIONET International). Other sources of information include the conference proceedings of soil science societies, relevant networks and other soil scientists.

Technical Centre for Agricultural and Rural Co-operation (CTA)

CTA's two principal objectives are to improve availability and access to information in ACP states, and to improve ACP capacity to manage information and communication. Its focus for information support is on small-scale, resource-poor farmers, especially women and youth; emerging issues; and information and communication management (ICM) strategies. The Centre achieves this through support to information generation, including repackaging, and preferential treatment of ACP authorship of publications on its catalogue, ensuring that the information offered is coherent, relevant and understandable.
Information is made available through a range of services that include: a publications distribution service; a bimonthly magazine, *Spore* (printed in three languages with a total print run of 40,000); a question-and-answer service (provided through 10 centres in ACP countries); the provision of bibliographic references and abstracts to researchers (Selective Dissemination of Information, SDI); provision of reference books published by third parties (Dissemination of Reference Books on Agriculture, DORA); ready-to-broadcast radio material; and face-to-face exchanges (seminars, workshops, study visits, etc.). In terms of capacity development, CTA offers training courses in the management of information, including scientific data, scientific writing and report writing.
CTA's website provides thematic gateways to information sources on the use of ICT in African agriculture and natural resource management ('ICT Update'); on Agricultural trade issues in current and future ACP–EU relations ('Agritrade'); and on science and technology for agricultural and rural development in ACP countries ('Knowledge for Development'). *Spore* online, an e-publications catalogue, seminar reports and a wide range of other sources of information are also accessible through the CTA website.
www.cta.int

ISRIC – World Soil Information

The mandate of ISRIC – World Soil Information is to increase knowledge of the land, and in particular its soils, and to support the sustainable use of land resources. Its objectives are (i) to inform and educate, through the World Soil Museum, public information, education, discussion and publications; (ii) as World Data Centre for Soils, to serve the scientific community as custodian of world soil information, collecting, scrutinising and analysing data and making them freely available; and (iii) applied research to support policy-making and management.
The unique World Soil Museum holds representative monoliths, fully analysed samples and documentation of the soils of the world; a Virtual Soil Museum is under development for delivery of this information through the Internet. Global soil and terrain data are available online and on CD-ROM; the ISIS and WISE soil profile databases of geo-located, validated, standardised data are available online. Country-specific information is available in the form of reports, maps, soil materials, etc.
ISRIC provides a range of short courses; training and technical backstopping for the development of national and regional soil information systems; and capacity building for natural resource institutions at national and international levels. ISRIC facilitates interaction between users and producers of soil information.
www.isric.org

Information Centre for Low External Input and Sustainable Agriculture (ILEIA)

ILEIA was established in 1984 in response to a concern that mainstream agricultural development – particularly the green revolution – was bypassing small and marginal farmers in the South, eroding their livelihoods, affecting the environment adversely, and leading to widespread losses of agrobiodiversity. Its main activities are the documentation, analysis and publication of successful experiences in low external input and sustainable agriculture. ILEIA identifies promising technologies involving no or only marginal external inputs, which build on local knowledge and traditional technologies, and where farmers themselves have been involved in development. ILEIA's target groups are field-level development workers, academics and researchers, and policy-makers of national governmental organisations, of private, voluntary organisations and NGOs, and of bi- and multilateral donor organisations. The principal means of outreach is *LEISA*, the organisation's magazine, which documents low external input sustainable agriculture techniques, many of which would otherwise go unreported yet are worth sharing. *LEISA* has readers in 120 countries and is produced in six editions: French, Spanish and English, and as regional editions for India, Brazil and Indonesia.
www.ileia.org

African Network for Soil Biology and Fertility (AfNet)

Established in 1988, AfNet is the single most important implementing agent of the Tropical Soil Biology and Fertility programme of Centro Internacional de Agricultura Tropical (CIAT). It is a network of scientists collaborating with NGOs and the private sector throughout sub-Saharan Africa. The overall purpose is to generate, share and apply soil fertility knowledge to enhance the welfare of farming communities. The network allows its members (currently from 23 different countries in east, central, west and southern Africa) to exchange information, achieve economies of scale, minimise duplication, and provide increased bargaining power with external partners.
Activities include research, training and capacity building, information and documentation. Research activities in 2003 included soil organic matter dynamics in Kenya, Ghana and Zimbabwe; combining organic and inorganic nutrient sources in Mali and Niger; fertiliser equivalency values of legume–cereal cropping systems in Tanzania, Kenya, Ghana, Nigeria and Togo; on-farm testing of cost-effective soil fertility management technologies in Kenya; screening green manure legume species in Uganda; and combining water and nutrients in Kenya, Burkina Faso, Zimbabwe, South Africa, Botswana, Mali and Niger. AfNet's information support activities include, among other publications, textbooks to support the soil biology curriculum in African universities.
www.ciat.cgiar.org/tsbf_institute/africa.htm

FAO Gateway to Land and Water Information

This is a web-based portal forming part of FAO's information system, which serves a wide range of users from senior policy-makers to students. The overall objective is to promote improved decision-making for the sustainable use of agriculture and natural resources worldwide.

The gateway gives access to the land and water database. This provides information at global, regional and national scales on the status and trends of land, water and plant nutrition management, and is intended to promote sustainable agricultural land practices. Information is derived from FAO-identified regional and national institutions which, ideally, post reports directly to the FAO server by link from their own servers, following agreed guidelines on content and format. Information is regularly updated by the participating institution. FAO gateway users are also given links to sites on similar subjects to broaden the range of information sources offered.

At each level – global, regional and national – users can find information under the following headings: overview, land resources, water resources (AQUASTAT), plant nutrient resources, hot spots, bright spots, challenges and viewpoints. There are currently 50 countries featured, but new countries are gradually being added. Content varies according to the specific agro-ecological conditions of the country concerned.

www.fao.org/waicent/faoinfo/agricult/agl/swlwpnr/swlwpnr.htm

World Overview of Conservation Approaches and Technologies (WOCAT)

WOCAT is a worldwide network of soil and water conservation experts, technicians, extension workers, planners and decision-makers who believe that experiences and lessons learned at global, regional and national levels can help to achieve better soil and water conservation. Much of that experience is currently not documented in a manner that allows easy access and comparison; better information management is required for both specialists and decision-makers.

Information about experiences at field level is gathered through detailed questionnaires. This is entered in a database, and can be analysed, evaluated and reproduced as reports, maps, CD-ROMs and for the WOCAT website. Information goes either directly back to users at field level, or for the planning and implementation of projects.

For soil and water conservation specialists, extension workers and technicians, WOCAT offers a method of documenting, evaluating and monitoring their own experience; access to information on soil and water conservation approaches and technologies worldwide – in books, maps and digital format; comprehensive information about the biophysical and socio-economic context of soil and water conservation, options and contacts; and worldwide information exchange. For planners and decision-makers, WOCAT offers a tool to learn from existing experiences and avoid mistakes and duplications.

www.wocat.net

African Agricultural Market Information Network (AFAMIN)

On the premise that markets and market information can be a springboard for sustainable agricultural intensification, the web-based AFAMIN links participants within and between countries in West Africa and with the international community. Although other market information systems exist, AFAMIN is currently the only comprehensive site in the region that monitors prices of inputs.

Markets are monitored on a monthly basis to collect prices on a number of agricultural inputs. This information is transferred to the country focal point, where it is available for use by television, radio, print and website. Information that is pertinent on a regional basis is analysed at that level, in conjunction with other sources such as FAO and IFDC. AFAMIN provides a means of linking producers, buyers and importers in the South to those in the North. In addition to the web-based information, printed newsletters are published monthly at country level. The objectives are: to provide relevant, reliable and current market information to the agricultural sector; to analyse information to compare trade trends, productivity and profitability across countries in the sub-region and others; to share information pertinent to stakeholders to help them make informed decisions about their businesses; and to provide a medium for information exchange.

www.afamin.net

Gaps in content and constraints to information and communication

Despite the seeming surfeit of information, often leading to a feeling of overload, dissatisfaction remains with both content, in terms of breadth and quality of information, and the management tools that should ensure that people can easily access what they need. The ICTs should be able to channel information to users in a format that they find appropriate to their needs, but they are some way from achieving this.

In terms of soil fertility management, there is a danger that the technical messages NGOs, farmers' groups, researchers and others hope farmers will adopt will fail to have an impact because they are confusing. On one hand, there is the problem of apparently contradictory information; on the other, the jargon-filled language that is often adopted. Where traditional lines of communication to farmers through government extension services have broken down, researchers face a dilemma. Should they undertake 'extension' themselves and communicate directly with farmers? This may, or may not, dilute their effectiveness as researchers, but it certainly absorbs time and funds and will have very limited outreach. But if they take no responsibility for disseminating the information they generate in an accessible form to end users – the farmers – they run the risk that they will be unable to respond positively when their donors ask what impact their funded research has had in the field. Without a positive response, future funding is jeopardised.

The Working Groups at the seminar pointed to the following gaps in and constraints to information:

- Incompleteness of information held at national level, including on soil biology, physics and ecology
- Inadequate communication
- Lack of, or weak, capacity in specialised agencies for generating information
- Insufficient support for extension
- Limited human resources and financial constraints among farmers' groups
- Financial constraints and lack of knowledge of where to source finance among NGOs

- Lack of infrastructure and lack of collaboration within the private sector
- Farmers' limited exposure to information
- Limited Internet resources and other ICTs
- Lack of ICT and ICM skills, and inadequate infrastructure and equipment
- Insufficient information exchange between policy-makers
- Lack of favourable and encouraging policies
- Lack of transparency; censorship
- Limited communication skills
- Few channels of communication
- Inadequate access to scientific journals
- Weak links between researchers, extension, farmers' groups, NGOs and policy-makers
- Short-term expectations of donors and policy-makers.

Recommendations – which ICM strategies should be developed?

Working Groups were asked to identify strategies by which ICM could be improved. Among the responses was a call for good governance and stability, without which the necessary investment is unlikely to be forthcoming. It is also considered important to ascertain how farmers themselves receive information; how they communicate among themselves; and who influences whom in the adoption of technologies. Emphasis should be placed on the processes by which decisions are reached. All relevant parties should be involved, including policy-makers, who should have an opportunity to both listen and contribute. Other ideas offered included:

- An integrated approach to ICM
- Better involvement of all stakeholders in the design and implementation of strategies for soil fertility management
- Establish clearer links between improved soil fertility management and the multiple benefits that result
- Develop representative structures in different interest groups able to negotiate with policy-makers
- Greater investment in developing ICM skills
- Greater investment in ICTs
- Strengthen ICM capacities of the private sector
- Improved coordination, collaboration and communication
- Training
- Enhance research to improve understanding of soil fertility issues and management.

Recommendations – what activities should be planned within the strategies?

Among the activities that could be planned within the overall strategies are:

- Establish a network or platform for exchanges between policy-makers on soil fertility, for example a network between national SFI teams
- Develop policy briefs on soil fertility management in order to sensitise policy-makers to the importance of investing in land management
- Organise meetings to facilitate information exchange between policy-makers and researchers
- Develop improved data collection, transmission and storage
- Translation of scientific information into simple messages
- Economic analysis of scientific findings
- Develop a system for weighing data generated through informal methods, e.g. farmers' field schools
- Make existing databases compatible
- Develop user-friendly databases dedicated to farming systems
- Training in IT skills, communication and ICM.

Recommendations – role for CTA

Some of the Working Groups ventured to recommend ways in which they felt CTA could play a role in strengthening ICM. These included:

- Training in ICTs and ICM
- Facilitation the coordination, collaboration and communication of networks
- Sensitising policy-makers to the importance of investing in land management by supporting the writing of policy briefs
- Supporting the publication of successful case studies for extension training on soil fertility management
- Undertaking a coordinating/broker role between various stakeholders
- Conduct training workshops, e.g. in proposal writing
- Fund workshops, symposia, exchange visits
- Assist scientists to publish scientific materials
- Create and manage databases
- Set up a virtual library.

Working Groups were asked to devise a communication strategy. With very little time allotted to this activity, nevertheless interesting ideas were put forward.

Communication strategies – some ideas

Group 1 (policy-makers)

- It was felt that a committee of representatives of stakeholders should be established to hold periodic meetings, to ensure accurate and timely information exchange.
- A focal point should be established for this communication group to give the communication flow a centre.
- Links with research, extension and farmers' groups should be established or strengthened to ensure the information needed and the information provided are compatible, with a view to helping farmers achieve a better performance.
- A feedback mechanism for evaluating and revising policies should be set up.
- Improved databases are required, and better access to multimedia tools.

Group 2 (policy-makers)

It was felt important to consider an overall communication strategy that could subsequently be adapted to suit the needs of certain target groups.

- A specialised communication unit should be established at a central point, with a national technical coordinator.
- Decentralised communication units should be established at regional, departmental or district levels.
- The national coordinator should have technical knowledge of land and soil fertility management.
- The national coordinator and the staff in the decentralised units should be trained in communication skills.
- Specialised skills will be necessary in order to target certain groups – e.g. researchers or donors.

Group 3 (farmers' groups, NGOs and the private sector)

- It was felt important to identify and strengthen existing professional organisations in each country that have links with the various stakeholders in soil fertility management. This would provide a means of strengthening communication.
- These groups, acting as a focal point for communicating and sharing information, would have links with the public sector and a reputation for good governance and good management.
- The quality and consistency of information need to be assured; professionalism should also be taken into account; communication, to be effective, needs to be a two-way process.
- There should be a way of standardising language when transferring information.
- The groups need to be willing to share information with various stakeholders, and this should happen at regional and subregional levels.
- Communication tools could include TV, field visits, exhibitions etc.; farmer-to-farmer interaction was underscored as being an important means of communicating information.

Group 4 (farmers' groups, NGOs and the private sector)

It was felt that a communication strategy should address four principal areas of concern to these groups.

- Market information on agricultural inputs and products, giving attention to information coming from local, regional and global sources.
- Information on production technologies, including best practice in integrated soil fertility management.
- Information on soil characteristics and nutrient content. This should identify deficiencies in specific soils so that input dealers can blend appropriate fertilisers.
- Information on financing.
- In the case of market information, in particular, intermediaries such as input dealers or farmers' organisations should be responsible for collecting information from various sources and ensuring its accuracy, and packaging it in such a way as to meet the needs of the various target groups.
- Communication tools will include the media (radio, TV, newsletters, etc.), new ICTs such as the Internet (beware of unsubstantiated information), email, cellular phones, etc., workshops, seminars and consultations.
- Farmers' field schools, workshops, etc. are the most effective way of disseminating information on production techniques.
- For information on finance, it is important to formulate groups who can lobby those with funds to distribute for the generation and dissemination of production technologies, market information, etc.

Group 5 (researchers)

This group recognised that research exists to satisfy different clients. For this reason it is important to ensure information is disseminated to those clients in a manner that makes them use that information effectively to improve their livelihoods. Research is probably not doing enough to communicate this output to the client, whether farmers or policy-makers.

<u>For farmers</u>

- It is essential for an effective communications strategy to ensure the information generated has been demand-driven. If the 'product' is right, much of the problem of communication is taken care of.
- Remove jargon and 'passion' (intemperate speech) from communication.
- Train in communication skills, and learn to put oneself in the position of the audience.
- Ensure appropriate targeting. This includes the timing, volume and packaging of information.
- Involve farmers in a participatory way from the beginning. Not only does this provide an opportunity to validate research results on-farm but, if they are already involved, communication with farmers happens automatically.
- Use simple, local languages and local means of information dissemination.

<u>For policy-makers</u>

- Produce policy briefs and documents that can be easily and quickly read.
- Promote face-to-face dialogue wherever possible.

- Establish lobby groups to push the interests of soil fertility management, etc.
- Use as many communication channels as possible.

For researchers

- Encourage researchers to publish their work in local journals and magazines where it can be easily accessed by the target groups.
- Train scientists in communication skills. It is not enough to leave everything to the communication intermediary.
- Seek feedback to help maintain the quality of information and identify gaps that should be addressed in future.

Group 6 (researchers)

This group presented the concept of a communication strategy as an 'interactive soup' which has one dominating ingredient: it must be participatory and continually interactive. This means that:

- Farmers must be empowered to demand research
- Farmers must be empowered to make decisions, identify constraints and diagnose problems.

A second component of the strategy is to involve all stakeholders to agree on:

- A research agenda
- A means of disseminating the results. This could include field days, demonstrations, farmers' field schools and training centres.

A third component is to develop a strategy for better information management:

- Of information that is generated – e.g. by publishing agricultural facts in non-technical language
- Of other sources of information – reviewing and disseminating as appropriate
- Of communication with other stakeholders – through basic networking.

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Annex 1: Soil Fertility Initiative prototype national action plan: components and rationale

Institutional capacity building

In many countries there is no land-management policy unit to monitor and evaluate land degradation. It was felt that action to create or support such a unit within the ministry of agriculture or environment would be appropriate, and also to support the establishment of a national soil, land and water monitoring system using public or private teledetection and soil laboratories in conjunction with a GIS database. Information thus obtained can be fed back to the land-management policy unit for appropriate measures to be taken.

Enabling environment

In response to the constraint of inadequate soil and land-management institutions, policies and incentives, one of the first objectives of the Soil Fertility Initiative (SFI) has been to establish in each country a pressure group of those involved in the agricultural inputs market, including farmers and private sector input dealers and importers.[3]

- Governments should make regulatory and fiscal reforms to eliminate or at least reduce inefficient or inequitable taxes, duties and procedures with a view to increasing competition and thus lowering fertiliser prices.
- Plans should also include a reform of the land tenure system, policy and institutions so as to increase land tenure security and thereby investment in land and soil management, including special attention to land rights for women.
- Policies and regulations should be developed to provide incentives for the production and use of biological sources of nutrients, such as legumes, cover crops and agroforestry. As a logical consequence of such measures, policies are also needed to encourage consumption of legumes and to encourage trading in wood derived from sustainable agroforestry practices.
- Action plans should demonstrate a willingness to provide greater market access for farmers' produce, including investment in infrastructure and greater profitability. There is also a need to improve proximity and access to decentralised financial institutions and rural credit.
- Political, administrative and fiscal decentralisation is to be promoted with the empowerment of rural communities, especially of the rural poor, through policies designed to achieve transfer of resources and income to the most vulnerable.
- There is also a need to promote demand-driven research and extension service delivery and local investment. There should be greater diversification and competition in agricultural extension delivery systems (public, private and NGOs).
- Environmental markets, such as for carbon sequestration, should be explored with a view to benefiting soil fertility management.

[3] Such a group (APIDIA – Trade Association of the Producers, Importers and Agricultural Distributors Inputs) exists in Guinea and helped to resolve an important issue. The KR2 (Kennedy Round 2) input grants from the Japanese government were being used by the government for political purposes. This was distorting the market, lowering market prices and inhibiting the private sector from intervening. The management of the KR2 was reformed so that now, when inputs arrive, they are handled directly by the private sector for distribution inside the country.

- More holistic, integrated land and water management, focusing on catchment or watershed level, rather than more narrowly, should also be promoted.
- A quality control system for inputs, with the involvement of public and private contractors across the country, should be created.
- Greater emphasis should be given to reducing poverty, especially of those living on marginal lands.

Agricultural research and extension

The perceived constraints are inadequate soil and land-management technologies that are adapted to farmers' circumstances, coupled with insufficient technical knowledge by farmers and insufficient dissemination of technical information.

For research, support is required to develop, adapt, test and evaluate soil and land-management technologies, whereas for extension and training, support is required for the acquisition and dissemination of soil, land and water-management technical knowledge. The focus should be more on the transfer of knowledge of basic principles, as has been achieved through farmers' field schools, rather than simply transferring 'recipes' to farmers.

Support to producers' organisations

Lack of financial resources and credit for acquiring inputs is seen as the principal constraint to more effective producers' organisations, coupled with high transaction costs and poor bargaining power *vis à vis* governments. Actions proposed include financial schemes that would improve producers' organisations access to credit. These could be:

- Revolving or rotation input funds
- Input credit lines
- Food grain credit (the 'warrantage' system being tried in Niger)
- Well targeted credit guarantee funds of subsidies for poor farmer groups
- Input research, development and supply contracts, including supplier credit, with major input manufacturers or suppliers
- Participation in third-party consignment arrangements via commercial bank deposits to allow farmers to have access to these financial resources.

Producers' organisations should also be encouraged to collect and disseminate input and output market information to members.

Support to the private sector

Again, limited access to financial resources to import, produce and market fertilisers is seen as a major constraint to sustainable soil fertility management, as are the inadequate level of policy dialogue with government and the poor bargaining power of private sector organisations. There is an inadequate supply of inputs, exacerbated by poor knowledge of fertiliser input science, handling and safety measures.

Actions envisaged for overcoming these constraints would promote the emergence of private extension and input supply agents. Private 'intensification' agents could operate like stockists, providing advice to farmers in the field about inputs, selling inputs, and perhaps also buying outputs. Action should be taken to support the development of customised fertiliser recommendations and, perhaps, a small-scale bulk blending industry in rural areas.

Community land-management and poverty-reduction sub-projects

Action plans to date have been developed not only at national level, but also in close collaboration with sub-regional agricultural and research authorities and with rural communities. The result has been district- or village-level micro-project ideas to solve local soil fertility issues, and these should be included within the overall plan.

Coordination, monitoring and evaluation

There is poor coordination of donors' and government's interventions in soil and land management, and inadequate support to those championing the cause of soil fertility within the country. In this part of the action plan, therefore, it is proposed that the necessary logistical and financial support be given to the land-management policy unit to enable it to coordinate implementation of the national action plan and undertake monitoring and evaluation of progress.

Annex 2: Ghana's National Soil Fertility Management Action Plan

The government of Ghana, through its Ministry of Food and Agriculture, began developing its Soil Fertility Management Action Plan in 1997, following a World Bank/IFDC-sponsored workshop in 1996. The principles underlying the plan included:

- Importance of agriculture in the national economy
- Need for recapitalisation, maintenance and improvement of soil fertility as a basis for long-term national food security
- Need for sustainable natural resource management in general
- Importance of a competitive agricultural sector and intra-regional cooperation.

Seven national experts were given the task of developing a National Soil Fertility Management Action Plan, with the following objectives:

- To reverse the soil fertility decline in Ghana and ensure a productive soil resource base for sustainable agricultural production
- To promote sound land-management practices necessary for the intensification of agricultural production
- To increase agricultural production by smallholder farmers, thereby improving their quality of life.

It was recognised that soil fertility improvement is a precondition for improved efficiency of inputs such as labour, fertiliser and higher-yielding crop varieties, and that improved soils lead to higher productivity and competitiveness which bring benefits to the farming community and the nation.

The plan includes both policy and technical issues. Policy issues addressed include land tenure, land use and planning, fertiliser planning and infrastructure development. Technical issues include:

- Soil and water management
- Agroforestry
- Soil fertility map
- Economic fertiliser recommendations for food crops
- Integration of crop–livestock systems
- Farm implement development
- Market development
- Credit availability
- Efficient extension services
- Gender issues in soil fertility maintenance.

In all, the plan contains 19 projects under the following headings:

- Soil fertility and management
- Soil and water management
- Crop/livestock integration
- Policy issues and economic considerations

- Gender
- Extension.

Programme implementation is designed to be carried out at three levels: district, regional and national. At the district and regional levels, committees draw up programmes and supervise their implementation. These may include such activities as on-farm trials and farmer education. At the national level, an inter-ministerial/inter-organisational steering committee provides guidelines on the content and implementation of the plan. The Ministry of Food and Agriculture provides a programme coordinator. A number of field programmes include:

- Review and updating of existing fertiliser recommendations
- Detailed characterisation of benchmark soils
- Establishment of long-term integrated plant nutrient management network farms
- Production of a soil fertility map of Ghana
- Assessment and use of manure resources available for soil fertility maintenance
- Assessment of contributions of legumes in the farming system to the nitrogen budget through biological nitrogen fixation
- Production of inoculum
- Impact of organic fertilisation on the economic viability and soil fertility maintenance of small farms
- Development of soil and water packages for various agro-ecological zones in Ghana
- Training and extension programme on technology packages for sustainable soil resource management.

In 1988 the government of Ghana developed the Accelerated Agricultural Growth and Development Strategy, to be implemented by Agricultural Services Sub-Sector Investment Programme, to which the Soil Fertility Initiative (SFI) is linked through one of its key elements – increasing access to improved agricultural technology for natural resource management. The SFI takes into consideration opportunities for building on previous research work in respect of soil fertility, integrated plant nutrient management and agricultural extension, and uses participatory processes to ensure activities are demand-driven. The government will continue to support extension delivery to smallholder farmers. The SFI has two broad components: technology generation and technology dissemination. Technology generation includes:

- Updating fertiliser recommendations
- Integrated nutrient management
- Rock phosphate application
- *Rhizobium* production and use.

Technology dissemination includes:

- On-farm demonstration of proven technologies
- In-service training of subject matter specialists and extension agents
- Fertiliser retailing training
- Curriculum revision for agricultural institutions
- Documentation and information support.

Activities initiated in 2003 include:

- On-farm trials of updated fertiliser recommendations. In the Guinea–savannah zone, 45 farmers in nine districts are participating in on-farm verification of sorghum, and 90 farmers are doing similar work for maize. In the forest–savannah zone, 55 farmers in 11 districts are cooperating on cassava, and 110 farmers on maize.
- Rock phosphate application trials: 14 coconut farmers in two districts, seven small-scale and commercial estate farmers in the forest and semi-deciduous zones, are cooperating with the Oil Palm Research Institute, and 25 farmers in the cocoa-growing areas are cooperating with the Cocoa Research Institute of Ghana.
- *Rhizobium* production and use: *Rhizobium* strains for soybeans are being assessed for viability and purification at the Soil Research Institute in Kumasi.

The SFI plan has been implemented for less than a year, and not all the components have yet become activities. A number of challenges have emerged:

- Selecting and maintaining farmer cooperators for on-farm testing
- Divided opinions on the use of organic and mineral fertilisers
- Procurement for consultancy services and inputs.

Overcoming these challenges will require raising greater awareness of integrated nutrient management among farmers and extension agents, and greater harmonisation of strategies to improve soil fertility. It is felt that despite Ghana's recognition of the impact of declining *soil* fertility on its economy and the wellbeing of its farmers, the pace of progress towards implementation of the SFI has been slow, and should be hastened. Support is sought through collaboration with the international community for technology and information for networking and training.

Annex 3: Mali's National Action Plan for Integrated Soil Fertility Management

Falling or, at best, stagnating crop yields prompted the government of Mali to develop a national action plan to restore soil fertility. Soils in Mali are generally low in nutrients, particularly nitrogen and phosphorus. Climatic conditions make soil fertility management difficult, and farmers do little to improve the situation, either through lack of resources or lack of knowledge. Where production has increased, for example of cotton, this has largely been achieved by increasing the area under cultivation. A general feature is over-exploitation of natural resources and unsustainable crop and livestock production systems, exacerbated by the increase in population.

In the floodplain rice-growing area, three types of soil degradation are causing concern: salinity, alkalinity and acidification. In the wetter zones in the south of the country, acidification and erosion are the main features of soil degradation. Wind erosion is a major factor in the north of the country and water erosion in the south.

The overall objective of the soil fertility management plan is to promote sustainable farming systems and better land management by producers, specifically by:

- Establishing a national policy for soil fertility management
- Promoting sustainable production systems
- Creating marketing systems that favour the supply of inputs
- Fertiliser production
- Training and upgrading of professional skills.

The plan has four major components:

- Support for national institutions for policy formulation – in effect, to ensure soil fertility issues are included in the existing national policy for protection of the environment
- Support for farmers' organisations
- Support for the private sector
- Implementation of regional action plans.

Institutional support

In order to create incentives and an enabling environment, issues that need to be addressed include:

- Security of land tenure
- Reform of fertiliser input grants from donors
- Reform of regulations relating to fertilisers and quality fiscal reform to reduce the cost of fertilisers.

A coordinating unit has been established, which also has responsibility for helping to prepare the programme of activities and to monitor implementation. Responsibility for generating and disseminating soil fertility management techniques also comes under this heading, in particular, support for adaptive research, extension and training of agronomists.

Support to farmers' organisations

Here the principal objective is to improve farmers' access to fertilisers. Activities proposed include:

- Building organisational capacity
- Developing financial measures to improve access to inputs, including fertilisers and agricultural equipment
- Developing markets for certain products
- Promoting small-scale processing and preservation of produce.

Private sector support

Specifically for the supply and distribution of fertilisers, activities under this heading include:

- Building institutional and professional capacity
- Developing financial support measures
- Supporting fertiliser production units based on natural deposits of rock phosphate at Tilemsi
- Developing regional dealerships for fertilisers.

Implementation of regional action plans

These take into account activities of national interest and also activities specific to the three main agricultural regions: cotton, irrigated rice and rainfed cereals.

For the irrigated rice-growing areas, three principal activities are being developed:

- Improving hydraulic infrastructure for more efficient and effective use of irrigation
- Encouraging greater crop diversity to improve incomes
- Training to support the adoption of new technologies.

In the rainfed cereal-growing zone:

- Soil and water conservation and rehabilitation of degraded soils
- Developing and implementing agro-sylvo-pastoral land management
- Boosting and re-equipping organisations involved in soil protection and soil fertility restoration activities
- Promoting the use of rock phosphate
- Encouraging the cultivation of legumes to improve soil nitrogen
- Promoting mineral fertilisers, organic manures and agroforestry
- Developing fertiliser distribution and supplier outlets
- Developing marketing systems for cereals and other crops.

In the cotton-growing zones, activities include:

- Promoting the use of legumes within production systems to improve soil nitrogen
- Promoting livestock
- Improving the quality of manure
- Ensuring fertilisers are used efficiently and effectively

- Promoting measures to control wind and water erosion
- Improving pasture and fallow lands
- Promoting bee-keeping and tree-planting
- Training.

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Annex 5: Abbreviations and acronyms

ACP	African, Caribbean and Pacific
AFAMIN	African Agricultural Market Information Network
AfNet	African Network for Soil Biology and Fertility
CAP	Common Agricultural Policy (EU)
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CMA/WCA	Conference of Ministers of Agriculture of West and Central Africa
CTA	Technical Centre for Agricultural and Rural Co-operation
DORA	Dissemination of Reference Books on Agriculture (CTA programme)
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GEF	Global Environmental Facility
GIS	geographic information system
ICM	information and communication management
ICRAF	International Center for Research in Agroforestry
ICT	information and communication technology
IFA	International Fertilizer Industry Association
IFDC	International Fertilizer Development Center
ILEIA	Information Centre for Low External Input and Sustainable Agriculture
IMF	International Monetary Fund
InMasp	Integrated Nutrient Management to attain Sustainable Productivity Increases in East African Farming Systems
KARI	Kenya Agricultural Research Institute
LEI	Landbouw Economisch Instituut, the Netherlands
MIR	Marketing Inputs Regionally project, West Africa
NGO	non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
PADEP	Agricultural Development and Empowerment Project, Tanzania
PREPAC	Phosphate Rock Exploratory Project, Moi University, Kenya
RECAO	Network of Chambers of Agriculture
ROPPA	Network of Farmer Organizations and Agricultural Producers of West Africa
SDI	Selective Dissemination of Information (CTA programme)
SFI	Soil Fertility Initiative
USAID	US Agency for International Development
VCR	value–cost ratio
WOCAT	World Overview of Conservation Approaches and Technologies