PRACTICAL ACTION
Technology challenging poverty

INTEGRATED SOIL FERTILITY IMPROVEMENT IN SEMI ARID AREAS

technical brief

Introduction

Moisture stress affects over two thirds of all soils in semi arid areas while soil fertility degradation has been described as the second most important constraint to food security in Africa. Despite proposals for a diversity of solutions and the investment of time and resources by a wide range of institutions it continues to prove a substantially intransigent problem. Inadequate management has exacerbated these problems to an alarming extent. The population is thus trapped in a vicious poverty cycle between land degradation, and the lack of resources or knowledge to generate adequate income and opportunities to overcome the degradation.

Why soil fertility improvement?

- The rural poor cannot expand land holdings because the frontier is limited and the availability of arable land has shrunk dramatically per capita over the past 20 years.
- Compared to other areas, a large proportion of soils in semi arid areas has low inherent fertility and exhibits a variety of constraints, among them: nutrient deficiency, low organic matter, moisture stress, and high erodibility.
- Nutrients are commonly not replaced to the degree that they are removed in crop harvesting and other losses, resulting in high negative nutrient balances e.g. net loss of over 100 kg per hectare per year in south west of Zimbabwe.
- Millions of hectares of land are physically degraded each year, due principally to water and wind erosion. These processes have led to the semi arid areas being characterised by declining per capita food production.

How do farmers lose nutrients

The causes of soil infertility include shortage of manure, tillage practices, continuously cropping the same land, limited crop rotation, indiscriminate cutting of trees, burning of crop residues and bush fires.

Pic. by: Douglas Gumbo: Practical Action

Picture 1: A field in a semi-arid area of Gwanda, Zimbabwe

What are the major constraints

Farmers in semi arid areas are attempting to improve soils, but their efforts are constrained by limited access to knowledge, low resource endowments, and lack of incentives. The high level of poverty lies at the heart of soil fertility degradation problem. Wealthier households, with more options available, are more likely to manage their soils better.

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Poor households lack knowledge of soil management options, the capacity to invest in soils (especially in fertiliser), and have less ability to bear risk and wait for future payoffs from investment.

Farmers have reduced their use of inorganic fertiliser as a consequence of their higher prices, following devaluation, abolition of subsidies and credit systems, and break up of state bodies responsible for marketing and input distribution.

Integrated soil fertility management

The aim of improving soil fertility management is to contribute more broadly to sustainable rural livelihoods. Farmers are usually aware of the need to improve soil fertility and allocate the various sources of nutrients available between crops and soils according to their differing needs and expected returns. There are various pathways which can be followed such choices include: direct interventions to improve soil status, strengthening farmer knowledge and skills, and improving organisational linkages which promote better learning and sharing of ideas. One main strategy that can be adopted in semi arid areas is integrated soil fertility management. The strategy at macro-level is aimed at supporting the evolution of policies bringing greater benefit to the farming sector, while at the same time providing support to networking between various organisations working on soil fertility issues at micro-level.

Integrated soil fertility management combines a mix of organic and inorganic materials, used with close attention to timing and placing of the inputs to maximise nutrient use efficiency. It provides an approach, which needs to be tailored to the characteristics of the site, and constraints faced by the farmer. This approach demands an emphasis on context-specific, adaptive responses based on a new partnership between researchers, farmers and extension workers.

Such skills can be strengthened by farmer field schools, farmer led events such as green fairs, seed fairs, training activities, and action-research approaches which involve, for example, joint elaboration and analysis of resource flow maps. Choice of intervention strategy will be determined by context.

Integrated soil fertility management in practice

There are wide differences in terms of what farmers can do depending on their access to land, labour, livestock, capital and knowledge. Each site presents a diverse array of methods by which people try to maintain the fertility of their soils, such as use of different nutrient sources, choice of crops, and making best use of variability within the landscape with regard to soil type, location, and moisture regime through the development of in-field and out-field systems.

In the South west parts of Zimbabwe (Chivi, Zvishavane, Mberengwa and Gwanda districts) farmers have significantly contributed to the development of sound soil management principles that aim at sustainable crop production without compromising the ecosystem service functions of the soil. These include:
Application of organic resources of animal or plant origin in combination with mineral inputs to maximise input uses efficiencies.

Pict. by: Douglas Gumbo
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Picture 2. Sharing knowledge on integrated soil fertility management

Integration of cover crop and multiple purpose, woody and herbaceous legumes in existing cropping systems to increase the availability of organic resources and consequently to improve crop yields.

Improved sustainability of nutrient cycles through integration of livestock with arable production.

Soil conservation methods to control soil loss and improve water capture and use efficiency

Actually soil fertility is built up by rural communities through progressive and steady modification of the natural resource base (soils, vegetation, slopes, water flows…) by crop fallowing, grazing, selecting crop species, deep ploughing to break the plough pan, sub-soiling, organic fertilising, transferring crop residues and fodder. Soil fertility is also strongly influenced by the accumulation of organic wastes, ashes and various by-products close to living areas and by the long-term rotation of these living areas. Farmers need to be empowered through farmer's organisations and networks which can contribute to the planning and implementation of improved practices, and which are fully involved in bidding for funds and in managing them toward more beneficial land management.

Advantages of integrated soil fertility management

- 'Waste lands' are converted into productive land.
- Allows farmers to continuously achieve high yields on the same land for many years, eliminating the need for clearing new lands, which is rarely available.
- Low external input agriculture is based on making better use of organic materials available on-farm to build up soil organic matter.
- Farmers share knowledge by working in groups
- Improved soil moisture retention

Disadvantages of soil fertility management

- This long term, labour intensive approach is often used to create small plots of high value land, or gardens. However, the low nutrient concentration of many organic materials means that a very large amount of material must be transported and applied to attain any reasonable yield. High levels of labour invested in transport and application are likely only to be feasible where the crops grown can fetch a good price, such as for vegetables around a major town.

Important issue for consideration

The most important thing in soil fertility improvement is to get the plant to use the nutrients that are applied. The key is to ensure that we have good growing conditions so that the crop can take up and make use of the applied nutrients. It means that we must have a productive crop variety suited to that area, planting must be properly done, pests, weeds and diseases must be controlled, in fact, all operations must be done properly. One important aspect of proper conditions is balanced nutrition. There must be an adequate supply of all of the other nutrients if the crop is to make use of the applied nutrients.

Conclusion

Investing in soil fertility management using this method is necessary to help households mitigate many of the characteristics of poverty, for example by improving the quantity and quality of food, income, and resilience of soil productive capacity.

However, there seems to be some confusion as to how this yield increase can be achieved. In many parts of the world, there is an incessant search for new high yielding crop varieties. These new varieties often fail to increase crop production. Why? High crop yields needs the same three things; good crop producing machine (the variety), a good supply of raw materials (nutrients, water, sunlight, air) and a good manager (the farmer) to make sure things run smoothly.

Further information

Dead Level Contours Practical Action Technical Brief
Sand Dams Practical Action Technical Brief
Micro Irrigation Practical Action Technical Brief
http://www.cgiar.org/icrisat/text/news/soilfertilityinitiative
Ian Scoones & Camilla Toulmin "Policies for soil fertility management in Africa" IDS

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