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Natural Resources and Pro-Poor Growth: The Economics and Politics

PART II

Chapter 9

Soil Productivity and Pro-Poor Growth

Soil productivity is essential to agricultural growth, food security and support of the livelihoods of the poor. This chapter highlights policies and measures to encourage improved soil management for pro-poor growth and improved food security.

9.1. Overview

This chapter and the next, on water security and pro-poor growth, are fundamentally different from the others in that they do not concern natural resources which can provide direct sources of income, but rather resources that underpin the production of a wide range of agricultural and industrial goods and services. The contribution of soil and water resources to pro-poor growth is indirect. It can only be derived from the importance of the many sectors that rely directly on soil and water productivity as inputs, in particular into agriculture.

Soil productivity is essential to agricultural growth, food security and support of the livelihoods of the poor. Agriculture is the major engine of economic growth in most developing countries (UNDP, 2007), providing incomes and revenues that enable investments in industrialisation and poverty reduction. Developing countries that are classified as low-income have the highest share of agriculture in GDP (typically, around 30%) and of rural labour in total employment (68%). That compares to 4% and 2% in high-income countries (OECD, 2007).

An analysis for the World Development Report 2008 (Ligon and Sadoulet, 2007) shows that a 1% increase in agricultural GDP leads to a 1.6% gain in the per capita income of the poorest fifth of the population. A 10% increase in crop yields leads to a reduction of 6% to 10% of people living on less than a dollar a day. Thus, if land degradation is allowed to continue, major opportunities for the reduction of poverty will be lost (GEF, 2006).

Besides its obvious importance for growth, the agricultural sector faces enormous challenges to meet the food needs of an additional 1.7 billion people over the next 20 years. Soil degradation through erosion, salinisation, and/or loss of minerals can threaten the agriculture sector's contribution to economic growth and to food security.

Assessments of the extent of soil degradation vary, but even based on conservative estimates it ranks among today's greatest environmental challenges, with serious local and global impacts. Soil degradation is reported to affect 30% of the world's irrigated lands, 40% of rained agricultural lands, and 70% of rangelands. This leads to an average annual rate of global productivity loss of 0.4% (World Bank, 2003).

About 2 000 million hectares of soil, equivalent to 15% of the Earth's land area, have been degraded through human activities (ODI, 2006b). Soil degradation appears to be particularly critical to populations in the developing world. The vulnerable soils and harsh climates in most developing countries exacerbate degradation problems. Productivity has declined on 16% of agricultural land in developing countries because of soil degradation. Almost 75% of Central America's agricultural land has been seriously degraded (ODI, 2006b).

The term "soil management" refers specifically to measures to sustain the productive capacity of land. Although this includes agricultural production techniques, this chapter focuses exclusively on measures to control soil erosion, prevent salinisation and pollution

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and maintain soil fertility, as these directly affect soil productivity and its share in agriculture's contribution to growth.

Considering the enormous cost of soil degradation, investment in improving soil fertility is remarkably low, for a variety of reasons related to tenure, access to credit and markets, as well as fiscal and trade policies. Given the growing pressure on land in the developing world, the economic value of soil conservation is likely to increase.

9.2. The contribution of soil management to growth

9.2.1. The costs of poor soil management

Most of the literature on soils and macro-economic growth concentrates on the costs of inaction on soil degradation, rather than on the benefits of action (see next section). In Ghana, for example, it is estimated that soil erosion will cost around 5% of total agricultural GDP over the 10 years from 2006 to 2015 (Diao and Sarpong, 2007). Similar and even higher growth reductions are reported for other countries. Table 9.1 provides a summary of country studies that have estimated the extent to which soil degradation has caused a loss in agricultural incomes and the consequential reductions in economic growth.

Table 9.1. **Analysis of national annual costs of soil degradation in selected countries**

	Gross annual immediate loss (USD million)[1]	% of agricultural GDP[2]
Ethiopia	130	4
Ghana	166.4	5
India		5
Java		3
Madagascar	4.9-7.6	< 1
Malawi	6.6-19.0	3
Mali	2.9-11.6	< 1
Mexico		2.7
Pakistan		5
Zimbabwe	117	9

1. Annual costs of soil degradation arise from water and wind erosion, salinisation, waterlogging and/or fertility decline.
2. Percentages of agricultural GDP are based on World Bank figures for 1992, inflated by 3.9% per year to 1994.

Source: Scherr, 1999.

9.2.2. The benefits of improved soil management

The link between soil conservation and agricultural productivity serves as the basis for assessing the economic benefits of improved soil management. Although not the only essential input factor, soil does influence to a large extent crop yields and the production of animal fodder, *e.g.* grass.

Investing in soil management is important for poor people, since many of them live on marginal lands with poor quality soils and depend heavily on the quality of the land for survival. Evidence from China, Cambodia, Laos and Vietnam suggests that there is a strong overlap between degradable land and the places where the poor live (World Bank, 2005a).

Conserving soil depth and soil fertility can contribute to growth by sustaining the resource base for crop cultivation and livestock rearing. Soil management actions can address human activities such as overgrazing, overexploitation of plants, trampling of soils, unsustainable irrigation techniques, or unsustainable fertiliser application that exacerbate soil degradation.

Pearce (2005) quotes an econometric study by Wiebe *et al.,* (2001) that shows that soil quality significantly affects the productivity of agricultural labour, with good soils and climate generating an average 13% increase in the output per worker, generating an increase in Africa of even 28%.

Efforts to mitigate the effects of soil degradation through improved soil management can be distinguished into *ex ante* soil conservation and *ex post* soil rehabilitation programmes. Soil conservation is a preventive intervention to limit the extent of soil degradation actually taking place. Soil rehabilitation compensates for previous degradation by restoring the useful capabilities of the soil resource. Obviously, soil rehabilitation is only feasible when degradation is reversible, and it may require extensive resources to restore severely degraded soils. The prevention of soil degradation is generally far more effective and efficient than its *ex post* rehabilitation.

Key preventive measures to protect soil from wind and water erosion include minimum tillage, crop residue mulching, organic matter application and maintenance of vegetative cover. Conservation Agriculture employs many of these approaches; in addition to its economic benefits, it contributes to maintaining or restoring soil biodiversity (Box 9.1). Structural approaches include stone lines, terracing, drainage channels, bund walls, windbreaks and tied ridging. These measures can also indirectly contribute to growth by preventing the silting up of waterways, dams and reservoirs, which can in turn substantially reduce water treatment costs and improve the quality of water.

Box 9.1. **Conservation agriculture**

Conservation agriculture (CA) is a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels. It concurrently conserves the environment and is based on enhancing natural biological processes above and below the ground. Interventions such as mechanical soil tillage are reduced to an absolute minimum, and external inputs such as agrochemicals and nutrients of mineral or organic origin are applied in a way and quantity that does not interfere with, or disrupt, the biological processes. It provides a sustainable production system, without sacrificing yields on high production levels.

Key advantages of CA include:

Labour saving: Soil tillage is of all farming operations the single element that consumes the most energy and labour. By not tilling the soil, farmers can save between 30% and 40% of time and labour. This is of particular importance for farmers who rely fully on family labour.

Erosion reduction: Soils under CA have very high water infiltration capacities, reducing surface runoff and thus soil erosion significantly. This improves the quality of surface water, reducing pollution from soil erosion, and enhances groundwater resources.

Yields: CA allows yields comparable with those of modern intensive agriculture but in a sustainable way. Yields tend to increase over the years with yield variations decreasing. In mechanised systems conservation farming reduces the costs of investment and maintenance of machinery in the long term.

Box 9.1. **Conservation agriculture** *(cont.)*

Carbon sequestration: Non-tilled fields act as a sink for CO_2 and conservation farming applied on a global scale could provide a major contribution to controlling global climate change.

Disadvantages in the short term are the high initial costs of specialised planting equipment and the completely new dynamics of a conservation farming system, requiring high management skills and a learning process by the farmer.

In Brazil the area under conservation farming is now growing exponentially having already reached 10 million hectares. The concept is also widely adopted in North America.

Source: FAO (n.d.), *Economic aspects of Conservation Agriculture, www.fao.org/ag/ca/5.html, accessed December 2007.*

The economic benefits of investing in soil management can be high. Economic rates of return of 30% have been shown in combined soil and water conservation projects in sub-Saharan Africa (Reij and Steeds, 2003). One of the world's largest soil management investments on China's loess plateau has improved the lives of over 1.2 million farmers (Box 9.2). This project, combined with other initiatives, halved the number of poor living below the poverty line from 59% in 1993 to 27% in 2001 (World Bank, 2003).

Box 9.2. **Investing in soil management in North China and in Niger**

The soils of Quzhou and Nanpi Counties in China were heavily salinated as a result of the poor drainage of irrigated water. Low-cost labour-intensive technologies were employed to reclaim the lands. Over 17 million cubic metres of soil were removed and 11 000 cubic metres levelled to prevent the pooling of stagnant water and improve drainage. The production of wheat, cotton and maize increased, with 23 000 hectares of land being reclaimed and a rise in the incomes of over 35 000 people living in the area as a result.

Source: IFAD (2001).

Between 1984 and 1999 the Keita Valley project in Niger rehabilitated 20 000 hectares of degraded land through a wide range of interventions. Trees were planted, sand dunes were fixed, stream banks were stabilised, dams and wells were built, farmers were trained, credit was extended etc. The pay-off may justify the cost (USD 65 million) over the long term because its results increased incomes in the area by an estimated USD 6 million annually.

Source: Winslow *et al.* (2004).

9.3. Policies and measures to encourage improved soil management

A complete discussion of the policies conducive to pro-poor agriculture is beyond the scope of this chapter, which focuses on the soil management dimension aspects of the issue. Readers are referred to the OECD publication *Promoting Pro-Poor Growth: Agriculture* (2007) for a complete coverage of the issues.

Key elements of a policy environment conducive to improved soil management are outlined below.

Pro-poor land tenure: When farmers and herders do not have long-term security over the land they use, the incentives for environmentally sustainable practices are lost. Defining a system of land rights should reflect suitable patterns of access and land use. The transition to individual land ownership also needs to be accompanied by a legal framework that secures entitlements to land. Security of tenure does not necessarily imply private property rights; collective and community-based soil management can also operate effectively. In successful communal systems, transparency and fairness in the allocation of resources to all stakeholders is essential.

Incentives and credit: Government incentives (*e.g.* in the form of subsidies for soil conservation) can overcome credit constraints that prevent the poor from making up-front investments in soil management with longer pay-back periods. Such schemes require careful design to avoid potential inefficiencies.

Training and knowledge: The poor have limited or no access to conservation technologies or fertilisers, preventing them from fighting soil erosion and fertility decline. Educating poor people in better techniques of farming, diversification and off-farm employment is also vital in land and soil management.

Market-based crop prices: In many developing countries, governments artificially reduce food prices, often in response to pressures from a relatively small, but influential, urban populations. This tends to reduce the profitability of agriculture, undermining incentives to invest in sound soil management.

Other elements that influence soil conservation efforts include investments in rural roads or improved rural infrastructure, as in general these increase market access and strengthen rural-urban links and improve access to credit and financial services. Promoting off-farm activities is important in reducing the dependence of rural people on agriculture alone.

Fertilisers are often used as a response to soil productivity declines and may be financially attractive if the government provides subsidies. However, mismanagement of fertiliser may discourage long-term investment in soil fertility and can lead to air and water pollution. Application of fertilisers should therefore be carefully managed, according to crop needs and soil characteristics. Fertiliser subsidies are often very expensive and their effectiveness in benefiting poor farmers is not always clear. Often the benefits of the subsidy are captured by monopolistic fertiliser importers or larger farmers.

Soil conservation may also require collective action by land-users in the case of clear externalities or open access issues. Institutions are needed to manage collective soil management activities. Local institutions may serve as forums to express local land-users' needs and can facilitate adoption of soil management techniques. Successful soil management programmes have often built on local knowledge and experience. They have also invested in people through training in new technical, organisational and management skills.

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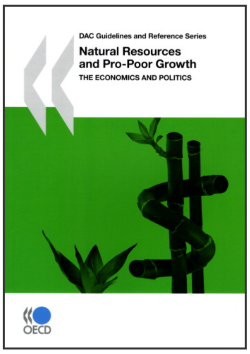

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