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Assessment of past and present soil conservation initiatives in Nigeria, West Africa

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Abstract

Soil conservation has a long tradition in West Africa and various on-farm and off-farm soil conservation technologies already exist. An extensive literature review has shown that mulching, crop management and conservation tillage are adequate measures for combating soil degradative processes such as soil loss in the savanna of Nigeria. Most farmers are in general aware of environmental problems but adopt only technologies which are compatible with the present farming system and whose costs of installation and maintenance are low. As education and training on soil conservation seem to increase the adoption of appropriate technologies, the work of extension agencies is important.

1. Background and aim of study

Soil erosion has been recognized for a long time as a serious problem in Nigeria (Stamp 1938) which has several environmental and economic impacts, especially in West Africa where the resilience ability of the soil is limited (Lal 1995). Hence, the avoidance of soil loss by improved management and conservation of the natural resource is important to combat low agricultural production, food insecurity, and the rapid increase in levels of poverty (Ehui and Pender 2005). Research on soil conservation has already been done for many years in different parts of Nigeria. The existing initiatives have resulted in a range of on-farm and off-farm technologies. But up till now, an extensive review of initiatives has been done only for single erosion control measures. The initiatives also raise questions about their effectiveness and adoption by farmers. The objective of this study was to assess past and present on-farm soil conservation initiatives by reviewing appropriate literature and interviewing farmers on their experiences with soil conservation technologies (SCTs).

2. Methodology

Literature review: In 2006 and 2007, an extensive literature review was conducted by visiting selected scientific, governmental, and non-governmental institutions working on soil conservation in Nigeria. For example, the universities at Abeokuta, Ile-Ife, Nsukka, Maiduguri, and Zaria, the Agricultural Development Program (ADP), Kaduna, were contacted to collect appropriate documents. In addition, national and international journals were reviewed.

Questionnaire: The farm settlement Esa Oke (7°44' N 4°50' E) and the neighboring communities Elwure and Owode-Ede (7°42' N 4°29' E) in southwest Nigeria were selected. Sheet erosion is a common problem in the area and the farmers had been trained on soil conservation by the Rural Development Project (RUDEP) since 1996. A total of 40 farmers were purposively sampled in May 2007. A structured questionnaire was used to elicit information from farmers on their personal and socio-economic characteristics and their experiences in practicing SCTs.

3. Results and Discussion

Literature review:

Performance: Most of the literature on soil conservation was found in research institutions and on the Internet. Appropriate records were rare in different governmental institutions, even if staff members described the implementation of initiatives. Most of the soil conservation projects were performed on-station, only a few on-farm including the participation of farmers.

History: In SSA, many indigenous soil and water conservation such as ridging, terracing, multiple cropping, and fallowing were used in the pre-colonial era (Igbokwe 1996). In colonial times, the British Government conducted large-scale projects on soil conservation but many failed as imported technologies were inadequate. After independence, more emphasis was put on soil fertility issues. Decreasing funds at the end of the oil boom in the 1980s additionally restricted soil conservation schemes (Slaymaker and Blench 2002).

Strategy: The impact of mulching has been demonstrated in many field experiments (Lal 1993). Investigations on the beneficial effects were made by Hulugalle et al. (1985). Crop residues generally reduce soil erosion and enhance the structure and productivity of the soil. Limitations are the large quantity of material required, the risk of carryover of pests and diseases from the previous crop, difficulties in controlling weeds (Lal 2000).

Multiple cropping has been traditionally practiced and is still very common in Nigeria (Olukosi et al. 1991). Research preferentially focused on increasing soil productivity. For example, Carsky et al. (2001) investigated the intercropping of cereals with legumes. Agroforestry is another erosion control technology. Field trials with *Leucaena* were made by Lal (1989), and Kang et al. (1990). The results show that trees improve the soil structure and maintain a high infiltration rate which reduces runoff. The investigations on cover crops, such as *Pueraria*, made by Tian et al. (1999) show that cover crops improve the structure, increase nitrogen levels and suppress weeds. Research on improved fallows were made by Tarawali et al. (1999). The benefits of multiple cropping are various, as erosion is reduced, soil properties are improved, and the risk of total crop failure is decreased. But reduced crops yields when grown in combination with trees were also observed, possibly caused by competition for light, water, and nutrients.

Soil management by minimum tillage or zero-tillage is emphasized as an appropriate soil conserving technology in Nigeria as the erodibility is reduced (Braide 1986). Adequate field trials were made by Takken et al. (2001). The results show the benefits of conservation tillage through the long-term maintenance of the soil structure and an increase in water retention and hydraulic conductivity. Problematic is that reduced or no-tillage is not applicable to stem tubers and root crops which are usually planted on ridges.

Mechanical measures such as contour ridging are common all over Nigeria while ridge tying is primarily conducted in the north (Malgwi 1992). Permanent erosion control technologies such as terraces were built in Maku near Udi-Nsukka (Igbokwe 1996). There is little research on these issues nowadays as implementation and maintenance are often low due to the high labour and material costs (Lal 1995). Waterways, such as cut-off drainage, are primarily installed in areas with high rainfall rates. Literature on investigations into drainage systems is rare in Nigeria.

Studies focusing on better land use planning and proper soil management by using modern technologies such as the Geographic Information System is another approach to improve soil conservation. For example, Igwe (1998) made an assessment of soil degradation and risk modeling and suggested appropriate measures for land use.

Questionnaire:

Personal and socio-economic characters of the respondents (only majorities): Most of the farmers were male (57.5 %) and between the ages of 46 and 65 years. Thirty percent of the respondents had no formal education, 35 % had post-secondary education. Households are often large: 65 % had between 7 and 12 persons. In the area, 50 % of the farms had about 6 to 10 ha

whereas 35 % are smaller than 2 ha. Farmers acquired land most often by leasing (52.5 %), followed by inheritance (35 %). Families were the major source for credit (97.5 %), as cooperative societies that lend money are rare. Half of the interviewed farmers were also occupied in trading. Almost all respondents had traveled within the country (55 %) or within the State (25 %). Nearly all farmers of the villages were members of agricultural associations to receive more knowledge on farming issues. Sixty percent of the respondents had an average annual income of less than US\$400, 37.5 % earned US\$400 to US\$800. The majority of the respondents (40 %) spent less than US\$40 on inputs per year.

Awareness of environmental problems: Most of the respondents (62.5 %) acknowledged the presence of environmental problems in their community, while 37.5 % did not believe in their existence. Soil erosion (42.5 %) and deforestation (10.0 %) were indicated as the most prevalent problems. Some of the respondents (30.0 %) indicated that sheet erosion dominated, while a few (12.5%) indicated rill erosion as prevalent.

SCTs performed and adopted: Mulching, cover cropping, contour tillage, and cut off drainage were the SCTs performed in the study area. Mulching, cover cropping, and contour tillage were well accepted as they are regarded as not labor-intensive, highly cost-effective, compatible with the existing farming system, and easy and cheap to adopt. Cut-off drainage was rarely adopted due to high labour-intensity and incompatibility with the culture. Agroforestry was not popular. The major sources of information were forefathers, schools, and RUDEP. Many farmers said that agroforestry, mulching, and contour tillage were some of the indigenous farming practices which were not used any more but disseminated as on-farm soil erosion control technologies through RUDEP again. Most of the respondents first heard about cut-off drainage through RUDEP. About 45,0 % generally adopted SCTs, while the remaining 55,0 % rejected all of them. About half of the farmers (51.4 %) who adopted one or more of the introduced SCTs consequently rejected them later. Some (37.8 %) adopted only one of the SCTs, while the remainder adopted two and three. Most adopters (72.2 %) were at the first stage in the adoption of the technology (first instalment) while 11.1 % had completed the installation of the SCT. Another 11.1 % discontinued implementation, while 5.6 % were at the maintenance level of adoption. Most adopters (66.7 %) were in continuous adoption of the SCT for 1 to 5 years, some had adopted the SCT for more than 10 years. Very few were in continuous adoption for between 6 and 10 years.

Relationship between personal, socio-economic characteristics and number of SCT adopted: Education, membership of agricultural organizations, and the number of labourers on the farms had a positive influence on the adoption of SCTs. (Table 1).

Table 1: Correlation between characteristics and the number of SCT adopted
(* significant at 0.05 level)

Characteristic	r _{Sp}
Age	- 0.08
Level of education	0.13
No. of years in farming	0.08
No. of labourer on the farm	0.36*
No. of membership in agricultural associations	0.39*
No. of SCTs aware	0.32*
Total annual income	0.06

4. Summary and Conclusion

The literature review and the interviews both show that mulching, crop management, and conservation tillage are appropriate technologies for conserving the soil in the savanna of Nigeria.

They are practiced and generally adopted by farmers as they are compatible with the existing farming system, cheap and easy to install and maintain. Education and training on soil conservation seems to increase the adoption rate of technologies which highlights the importance of agricultural extension agencies in the country.

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