POLICY BRIEF

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Controlling Erosion and Increasing Crop Yields in Slope Farming: A Vetiver Technology

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INTRODUCTION

Soil erosion has been identified as a major environmental problem worldwide. It is estimated that about seven million hectares of arable land is rendered unproductive annually due to soil erosion, resulting in a loss of $400 million per year. According to the Food and Agriculture Organisation (FAO) of the United Nations, about 60% of Africa's land is vulnerable to erosion.

In Nigeria, cultivation of sloppy landscapes is predominant in the southeastern region of the country, which is the forest zone. The region has spectacular steep land but it is common to see many areas of the slope land gullied few years after they have been converted to farmland.

Out of the total number of gullied land identified in the region, about 70% was as a result of unprotected steep land farming. Traditional Farming Practice (TFP) in the region seems not to be offering adequate protection of the soil, but rather exposes it to erosion. Once a slope is cleared for cultivation - without adequate soil protective measures (as in the picture below), erosion sets in.

Steep land cultivation in Southeastern Nigeria (Field work)

Dissection of land by active gullies continues in farming areas, leading to loss of fertile soils and reduction in crop yields. Poverty, malnutrition and food insecurity are but few consequences of soil erosion on farmers, hence the need for innovative intervention measures to control erosion, rehabilitate the soil and increase crop yields so as to improve livelihoods.

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CONTEXT

In recognition of the enormity of the challenges associated with cultivating steep land, some countries have put in place laws to limit the level of slope land cultivation. For instance, in parts of central Africa, if the degree of slope is 12%, the country law prohibits cultivation on such land. Similarly, there are country laws that prohibit slope farming, for example, in Philippines, if the slope is 25%, in Israel if the degree is 35%, and in Ethiopia, if it is 30%.

However, cultivators of steep lands do not observe these slope regulations and it is often difficult for governments in these countries to strictly adhere to the implementation of such policies due to scarcity of arable land as a result of population pressure (Grimshaw and Larisa, 1995). Moving farmers away from slopes where there are no flat lands to resettle them, means moving millions of people and their families away from their source of livelihoods. This therefore calls for the need to ensure productivity of steep lands to improve the lives of peasant farmers.

APPROACH

Plate 1: Vetiver strip on the contour of a high slope (source: www.vetiver.org)

The search for solutions to restore the productivity of slope lands led to the development of a green farming practice that involves installing Vetiver Buffer Strip (VBS) as a bio-engineering structure on contour. This technology has been found to be cheap, effective and user-friendly. This policy brief is based on a study that used *Chrosopogon nigritana*, as green technology in farmers' steep land fields (45% slope) in Southeastern Nigeria, so as to investigate the optimal spacing for conserving soil and water in staple food crop fields and also to assess the impact on crop yields. *Chrosopogon nigritana* is a vetiver grass species native to South and West Africa.

The project adopted different Vetiver Buffer Strip spacing (VBS) at 5m, 15m and 25m as treatment and compared it with the traditional farming practice (TFP) where farmers cultivated slope without any soil erosion control measure. Erosion plots were constructed on the slope, to capture soil and water losses under the various treatments.

Sedimentation drums installed in the ground in a trench dug at the lower end (down slope) of the erosion plot, with vetiver buffer serving as erosion control measure.

In addition, a mixture of maize and cassava were planted on the erosion plots - using the traditional mound tillage system. Rainfall of 1200mm and 710mm were recorded in 2010 and 2011 respectively. Water and soil losses were monitored and crop yields recorded. Carbon, nitrogen (greenhouse elements), phosphorus and other major nutrients lost in eroded sediments from the farmers' fields were collected and quantified.

RESULT

The absence of erosion control measures in the study area resulted in severe loss of soil, ranging from 138 t ha^{-1} yr^{-1} to 829 t ha^{-1} yr^{-1}. These figures far exceeded the Food and Agriculture Organisation's (FAO) soil loss acceptable limit of 12 t ha^{-1} yr^{-1}. This level of soil loss was also much higher than the level recorded under vetiver intervention, which was between 6 t ha^{-1} and 14 t ha^{-1} or about 1%, as presented in Chart 1 below.

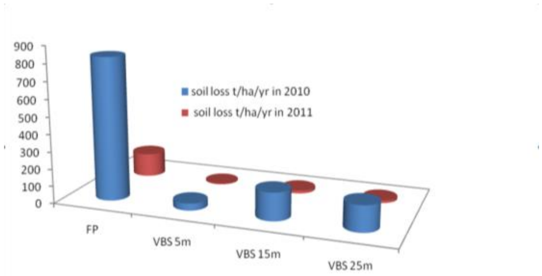

Chart 1: Soil loss under Farmer Practice as against Vetiver Buffer Strip (VBS) intervention on a 45% slope in Southeastern Nigeria

Similarly, rainfall loss under Farmer Practice (FP) ranged from 21% to 29%. This resulted in carbon, nitrogen and phosphorous losses in the soil. Carbon loss under the Framer Practice was 90kg ha^{-1} yr^{-1} and 94kg ha^{-1} yr^{-1} in 2010 and 2011, respectively. Also, nitrogen loss was 9kg ha^{-1} yr^{-1} and 11kg ha^{-1} yr^{-1}, and phosphorous loss was 62 kg ha^{-1} yr^{-1} and 33kg ha^{-1}yr^{-1} in the two years respectively, as represented in Chart 2.

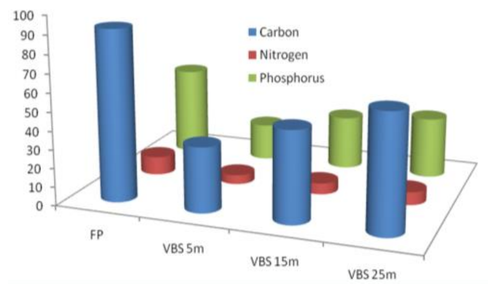

Chart 2: Carbon, nitrogen and phosphorus loss under Farmer Practice (FP) as against Vetiver Buffer Strip (VBS) intervention on a 45% slope in Southeastern Nigeria

The organic carbon and nitrogen contained in eroded sediments are transformed into $C0_2$ and N_20, increasing greenhouse gas emission, rather than being a sink - as expected of a climate smart farming practice. In addition, maize and cassava yields, decreased by 10% and 56%, respectively in the FP field in the second year (Charts 3 and 4).

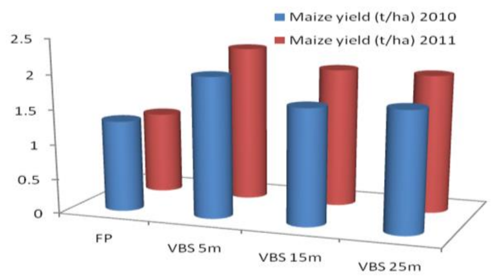

Chart 3: Maize grain yields under Farmer Practice as against Vetiver Buffer Strip (VBS) intervention on a 45% slope in Southeastern Nigeria

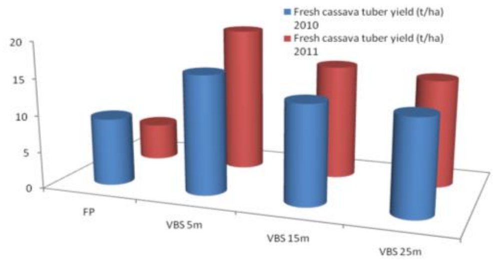

Chart 4: Cassava yields under FP and Vetiver intervention on 45% slope in Southeastern Nigeria

COMPARATIVE ANALYSIS

Findings from the field study revealed that soil loss far exceeded the FAO's standard tolerance level of 12 t ha-^{1} yr^{-1}. The excessive soil loss did not only result in increasing greenhouse gas emission but also led to water pollution. This is because nitrogen and phosphorus transported by the runoff were deposited into water bodies down the slope. This form of pollution (eutrophication) depletes water bodies of oxygen needed by marine organisms. It also impacts negatively on artisanal fishing and aquaculture businesses, raising serious livelihoods concerns for coastal communities who depend on marine resources.

The intervention using vetiver technology at 5m spacing adequately reduced rainfall, soil and carbon losses. Rainfall loss was reduced by 93% and 92% in the two years, respectively. Soil loss was also reduced between 6 and 41 t ha^{-1} yr^{-1}, as against 138 and 829 t ha^{-1} yr^{-1}, under the Farmer Practice. In addition, carbon loss was 23 and 47kg ha^{-1} yr^{-1} in the two year period, as compared to 90 kg ha^{-1} yr^{-1} and 94 kg ha^{-1} yr^{-1} under the Farmer Practice. Moreover, maize yields increased by 71% in the first year and 88% in second year when compared to the Farmer Practice.

Cassava yields also increased by 75% and 295%, respectively.

In effect, the 5m Vetiver Buffer Strip spacing reduced rainfall, soil and carbon losses adequately, as compared to the 15m and 25m vetiver buffer spacing. It can be concluded that vetiver technology leads to high outputs and natural resources conservation. It makes steep land farming contribute to greenhouse gas mitigation and climate change adaptation. Non-use of practices such as vetiver technology means a continuous decline in crop yields, resulting in threat to livelihoods and human security.

In southeastern Nigeria, it is common to hear farmers complain that the soil on steep land farms are stony and thinner and do not yield much gains.

Cassava and maize crop mixture under Farmer Practice (no vetiver)

As climate change intensifies, soil erosion is likely to increase. Unprotected slopes used for cultivation will develop more gullies, and consequently impact negatively on crops, farmlands and livelihoods. Runoff from cleared slopes or unprotected farmlands will increase incidence of flood in communities down the slope. This could also lead to landslide and human insecurity in the country.

IMPLICATIONS FOR POLICY

- **Adoption of Vetiver Technology**. Erosion will occur once slope lands are cultivated. Even the least cultivated or cleared slope needs to be protected with Vetiver Buffer Strip spacing (VBS). Adoption of vetiver technology will ensure natural resources conservation and sustainable management of slope lands.

- **Provision of Vetiver Seedlings**. Adoption of vetiver green farming practice for hillside or slope farming will require provision of enough vetiver seedlings. Local government authorities and state governments could raise vetiver nursery to supply initial seedlings to farmers.

- **Awareness Creation**. There is also the need to create more awareness on the use of the vetiver technology to get farmers to adopt it.

- **Capacity Building**. Extension agents could also improve their knowledge in the use of vetiver technology, so as to best position themselves to support farmers to adopt the technology. This is because research has revealed that the use of vetiver is still at its infancy in Africa, hence the need to enhance capacity in the application of the technology to facilitate adoption.

REFERENCE

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