EROSION CONTROL IN AGRICULTURAL AREAS: AN ETHIOPIAN PERSPECTIVE

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Abstract

Ethiopia experiences extreme rural poverty and some of the worst land degradation in the world (1 900 million tons of soil per year), yet the program response for conservation has demonstrated considerable weakness. The main development effort implemented since the mid 1970s is based on food for work (FFW), at a huge per hectare cost. Symptoms of erosion have been tackled by physical engineering, the construction of terraces and bunds, the plugging of gullies and the planting of woodlands. Every year over 30 million farmers' working days are mobilized for soil and water conservation (SWC) activities.

The results achieved by these massive campaigns are subjected to critical revision. Many FFW programs are poorly executed, have a low cost-benefit ratio, are expensive, largely dependent on external inputs and generally not supportive of self-help efforts. It appears that Ethiopia is entering into the dangerous stage known in other countries with prolonged FFW activities (20 years or longer) at which people are unable or unwilling to do anything to better their livelihood without being rewarded in FFW.

Engineered conservation provides a measure of land protection, but a terrace brings no reward to the farmer if he cannot plough it, if it nests mice that damage standing crops and if this is compounded by the failure to extend an adaptable package to promote soil fertility and plant growth on that terrace. New ways have to be found to mobilize farming families in voluntary self-help conservation if degradation problems are to be tackled in a national context. Development organizations are now aware of the need for change and some have started to move in new directions.

Vetiver grass technology (VGT) in Ethiopia is low cost, achievable, gender sensitive and capable of producing real benefits for farmers involved in SWC with very limited technical and input support. It was introduced for SWC in 1991 and its dissemination has taken various forms, which are examined here. It has shown that there are socio-economic benefits to be gained from it for soil conservation and that the technology can be expanded to other uses beside arable land.

Introduction

Ethiopia, with an estimated area of 1.12 million km^2 and close to 60 million inhabitants, is one of the largest and most populous countries in Africa. Agriculture is the mainstay of the economy; it contributes 57% of GDP and 85% of employment (UNCTAD 1997). With a per-capita GDP of US$150 in 1995, Ethiopia is among the poorest countries in the world (World Bank 1997). Most of the agricultural land is located in the highlands and is operated by farming households. Smallholders cultivating fragmented micro holdings (0.075-1.000 ha) produce more than 90% of the annual agricultural output. Despite its pivotal role, the performance of the sector has remained largely unsatisfactory. Food self-sufficiency remains an unattained objective, and per-capita food production has been falling over the decades. In 1993/94 production grew by 0.5% per year while the population grew by 3%, implying a per-capita food production decline of 2.5%.

This is constrained by the country's deteriorating natural resource base and environment. Degradation of the resource base mainly due to soil erosion and nutrient depletion has continued at an alarming rate. The national soil erosion hazard assessment, which is based on soil erosion trends and land cover use data for 1994, indicates that over the whole country, up to 3 500 million tons of top soil is eroded every year, mainly from farmlands through the process of sheet erosion. Because of this, it is estimated that 20 000-30 000 ha of cropland is abandoned every year because the land can no longer assist cropping. Consequently, it is expected that by the year 2000 about 2.8 million highlanders will be affected.

Soil erosion is greatest on arable land where the average annual loss is estimated to be 42 t/ha, but may even reach 300 t/ha/year in some fields. This is six times the rate of soil formation and it probably causes an average annual reduction in soil depth of 4mm. FAO in 1986 estimated that 50% of the highlands are significantly eroded, 25% of which seriously and 4% beyond the point of no return.

Various approaches, mainly based on mandatory policies, have been tried unsuccessfully in the past to encourage adoption of erosion control practices by the farming sector. A soil and water conservation program, mainly of engineering, was implemented with a large investment input from the government, international organizations and the local people. About US$20 million was disbursed annually during the 1980s and 1990s in the form of FFW. Farmers' labour involvement amounted to 30 million person-days per year. With the available resources, 25% of the targeted areas were rehabilitated. A recent study of FFW areas indicates, however, that structures were dismantled from 53% of the plots and partly removed from 31% once the incentive to keep this up was lifted. More land becomes exhausted than is recovered. The success of the effort, as witnessed in recent years, has been limited. One wonders what prompts farmers to destroy vital resource-improving investments of high value to society.

Several factors may be mentioned for the failure of the past conservation program. The most significant are:

- The lack of participation and the top-down approach.
- Inappropriate technology and blanket recommendations: No attempt was made to involve the end users in adapting the technology to the local conditions. Soil or stone bunds are not equally effective in high and low-rainfall areas. The productivity impact of the structural measures was not considered, as the focus was only to curb the loss of soil. Structures also created a breeding ground for noxious weeds and rodents.
- Focus on quantity rather than quality: Apart from the failure to involve land users in the design, implementation and management of conservation works, the FFW approach of remunerating the workers according to the quantity of work accomplished led workers constrained to meet their subsistence needs to emphasize quantity rather than quality.

Today, many development-based organizations have brought a new approach into the main steam of thinking and have highlighted particularly the potential use of biological soil conservation in general and the use of vetiver grass in particular, and the need to move away from the pure engineering approaches for SWC.

Introduction of Vetiver Grass to Ethiopia

The grass was introduced to the country by the state coffee sector in 1970. It was imported from India. The purpose of its introduction was mainly to demarcate the different coffee estates and to control the expansion of a noxious grass called *Cynodon dactylon.* A few years later, some NGOs introduced the grass into the farming sector. It was probably after the *Vetiver Newsletter* started in 1989 and the first national workshop was held in 1991 that most people become aware of the wonder grass as the cheapest means of erosion control in croplands.

Barrier to the Technology

Like any other newly introduced technology, vetiver grass faced considerable resistance from professionals and farmers alike. The main reasons were:

- Farmers were reluctant to use it because they considered the grass as a noxious and invasive grass that took over their croplands.

- Farmers also doubted its different uses as advocated by the extension agents.
- Professionals, from top policymakers down to development workers, favoured physical SWC measures and were used to work under the FFW program, so they were not convinced at all and did not even allow the introduction of the grass in FFW areas. They said, “It is the grass of the World Bank and the bank may have its own hidden purpose.” Another reason they raised was that the grass had not been researched under our conditions in any of the SWC research centres, and that six to ten years would be needed before the research result came out officially.

Because of the above-stated obstacles and until the end of 1989, the use of grass was limited to the state coffee sector and non-FFW areas.

It was in 1991 that an Ethiopia-based NGO called Menschen für Menschen (MfM) for the first time broke the barrier and introduced the grass to the farming sector through its project areas. That NGO promoted the grass mainly for SWC using the following approach: the first and most important entry point was creating awareness for its own development agents; it would establish the first vetiver nursery in the country for SWC purposes, with strict management at the nursery level; in the same year, it would demonstrate the application of the grass for farmland SWC. For the first time in the country, in 1991, the grass was planted on ten hectares of cropland owned by five farmers. One of them won the 1993 farmer’s award arranged by The Vetiver Network in Washington.

After two years of progress, the project organized training. This training was the first of its kind in the region and it brought together all non-governmental as well as governmental organizations working in the SWC projects to discuss the potential of the grass for SWC and its promotion in the region. Local-level officials and influential farmers were invited to attend the handing over of the TVN award to the farmer, Mr Walelege. This was the occasion for most people to become enthusiastic about the grass.

The majority of schoolboys and girls in Ethiopia come from rural areas. They spent their time after school hours and during school vacations assisting their families in their farming activities. Taking this as an advantage, the NGO has helped establish environmental clubs in five school grounds in order to disseminate the technology at a fast rate through students to parents. Vetiver was one of the main components included for SWC purposes. This played an essential role in the expansion of the technology to the majority of the beneficiaries without any additional cost or labour (extension staff).

Since the introduction of the grass to the area, there have been five press releases about the grass in the main newsletters and more than ten radio interviews made by the staff of the project, government officials and the beneficiaries. The progress of the project was reported on Ethiopian television every year during the main rainy season. This approach contributed much to introduce the technology throughout the country.

Translation of the “green book” into local languages and making those translations available to extension workers and farmers was one means of technology transfer used by the NGO. Besides, video and slide shows contributed a lot to the program. Flyers on the technology were prepared and distributed during the training of specialists and farmers.

In 1995, when all concerned bodies accepted and started applying the grass for their SWC program, the project handed over partially the production centres to interested farmers’ groups. This created confidence among the groups about the technology because it helped to generate income for the owners of the nurseries.

Besides assisting farmers’ groups in establishing their nurseries, the project also technically and materially assisted almost all governmental and non-governmental organizations in the region during the establishment of nurseries.

Farmers’ groups are the main targets for the enabling roles of the development support services. A principle of enablement is minimum input for maximum output. This implies that the support services have to promote self-help, local-level initiative and farmer-to-farmer interaction. The network, though not officially established, helps farmers to share resources and skills. It helps in marketing the grass to needy organizations.

Whenever there was the possibility of participating in workshops, conferences and seminars, papers on vetiver were presented, in particular for officials and policymakers at federal or national level. This contributed very much to change the attitude to officially accept the grass as one of the potential plants for SWC programs in the country.

Every year in December the project organizes an award ceremony for outstanding farmers and field workers, to which representatives of governmental and non-governmental organizations and other influential people such as farmers, religious, and youth groups are invited.

Vetiver Today

Beneficiaries and Organizations Involved

Currently, the grass is used by the majority of farmers, rural road experts, urban dwellers, small-scale cottage industries and wetland development projects. There are 250 NGOs in the country working in different programs. Of these, 110 are working in the field of natural conservation. By 1999, 80% of them (88) were using the grass for their SWC programs.

The country is administratively divided into 12 regions. According to the latest survey made by the Ministry of Agriculture in 1998, the majority of the regions now are using the grass for their various programs. Other than these, bilateral organizations such as GTZ, SIDA and CIDA and multilateral organizations such as FAO, UNCDF, UNDP and the World Bank are willing to finance projects to promote the technology. Consequently, today one of the biggest vetiver promotion projects has been launched by financial assistance from two bilateral organizations, GTZ and SIDA, in the northern part of the country.

Number of Nurseries, Production and Total Area Treated

As stated above, the first nursery was established in 1991 by MfM in the southwest part of the country. In the same year, more than 50 000 clumps were produced and about 10 ha of farmland were planted for SWC purpose. Since 1991, much progress has been observed in the development of nurseries in the country.

Table 1. Nurseries established by governmental and non-governmental organizations till end 1999

Year	Nursery			Total (No)	Production (million)	Area treated (ha)	Beneficiaries (H.H.)
	NGO (No)	GO (No)	Private (No)				
1991	1			1	0.05	10	5
1992	5	2		7	0.75	60	80
1993	17	5		22	7.20	258	2500
1994	27	19	3	49	50.80	1821	10 760
1995	35	34	5	74	657.00	11 073	68 494
1996	58	54	13	125	763.00	22 846	76 890
1997	69	70	17	156	844.00	34 215	134 162
1998	80	73	22	175	965.00	38 720	256 196
1999	89	101	31	221	1 300.00	41 890	450 161
Total	381	358	91	830	4 587.80	150 894	999 348

Application

Agro-ecology

Slope: The grass is grown on a variety of slopes, up to 40-45 gradient. The planting procedures should be followed strictly; otherwise the damage will be enormous. For very steep slopes, containerized plants are used for better and quick effect.

Vertical interval: The applied vertical interval in the country varies from one slope class to another. The interval recommended in the country for slopes of 3-15, 16-25, and 25% and above is 1, 1.5 and 2 m respectively. For very steep slopes, it is advisable to plant splits closer and just after the first shower. In our case, we also use containerized plants for better survival and effect.

Altitude: Most of the highlands in Ethiopia are above 1800 m. They are highly populated and experience severe land degradation. The upper altitudinal limit where the grass has been tested is 3100 m. Even when it freezes, the plant survives, more or less. However, the optimal, effective limit is 2800 m.

Area of application

Apart from farmland conservation, the grass is used for the following areas:

- *Plantation:* the main use of the grass is to replace stone-made micro basins by vetiver- made micro basins. This is now becoming a famous undertaking in coffee-growing areas.
- *Gully:* Together with physical measures, the grass is widely applied to control the gully sides and head.
- *Waterways*: Mainly used to stabilize the sides of the channels from sliding and falling. It is used mainly to protect the drains along the roadside
- *Irrigation canals and riverbank control*: The walls of irrigation canals that have a low angle of repose are better protected by planting vetiver along both sides of the canals. In the same way riverbanks that have undercut/scoring effect are protected by planting bigger-size plants without splitting into smaller tillers.
- *Dam catchment protection*: It is the only grass family that has proven to be effective in controlling sediments from silting dams. Today, the domestic water-supply and hydroelectric authorities involved in dam construction are convinced of the advantages of using the grass to treat the catchment before a dam is built. Good examples and experiences are the dam built by one NGO called the Amahara Relief and Development Organization in the northern part of the country and the Fincha hydroelectric power plant in the south, which used vetiver to treat the whole catchment.

Other Benefits

Besides the different uses stated above, the grass has other economic and social advantages that should be indicated here.

- *Thatching:* Eighty-three percent of the population of the country live in the rural areas. Only two to four percent of them can afford to build their huts with iron sheets; the majority use grass for roof-making. Farmers who set up vetiver grass hedgerows not only use the grass to build their own huts but also sell it to their neighbours.
- *Feed value*: Though international literature declares vetiver unpalatable to livestock (probably on account of its feed value), it is readily eaten by Ethiopian livestock. Occasional cutting is practiced that stimulates the growth and has livestock fodder as by-product. The year 1999 can be remembered for its long dry season (Oct-July), which caused considerable damage to human and animal lives. The presence of this drought-resistant grass has saved the lives of many head of cattle in the project area.

- *Rodents:* Field rodents reduce crop yield by 10-12%. They damage standing crops. Their main nesting areas are structures built for soil and water conservation and road purposes. Thanks to the introduction of vetiver for SWC, the damage caused by rodents has been minimized by 85%.
- *Obstacles to farming*: One of the complaints of farmers about physical SWC measures is that they hamper the circulation of farm implements and farm animals. The length and of course the height of the structures limit the movements of animals from one terrace to another. In many cases, this problem has been overcome by replacing the structures with vetiver.
- *Mulch*: These days vetiver is the main source of mulching material to cover pre- germination seedbeds and as mulch to conserve moisture for young seedlings.
- *Mattresses:* Mattresses made from vetiver grass are well liked by rural people. Farmers say they are free of bed bugs and fleas.
- *Income:* Schools which have well-established hedgerows get income from the sale of the grass mainly during Ethiopian holidays and wedding ceremonies. Income is also obtained by selling the grass for multiplication purposes. Tillers are sold by dividing the hedgerows into two, leaving major portions on the ground. The income is mainly used to assist students who leave school because of financial problems.
- *Wetland rehabilitation*: Wetlands are our main source of groundwater. They are natural reservoirs of streams and rivers. If disturbed, they cause considerable damage to habitat and biodiversity. There is unlimited exploitation of the grass that grows only in this habitat. Farmers in the area usually live in huts with grass roofs. The main source of grass comes from the wetlands. Every year in November and December, it is a common practice to replace the old roof with a new one. Farmers have to walk a distance to cut and carry the grass. This continuous exploitation of the grass has dried the wetlands by affecting the flow of streams and rivers which have their water source in this ecosystem. Since vetiver planting has expanded in the region, mainly for SWC, farmers use vetiver grass for thatching: it is available near their villages and it lasts longer than the grasses from the wetlands. Moreover, the downstream people can develop their irrigated agriculture and animal husbandry without danger.
- *Cost of the system*: The overall labour cost of establishing a nursery and planting in the field is much smaller than that of using structural measures for SWC. A hectare of nursery can produce about 2.5-3 million splits in five months. The labour requirement to manage this nursery until planting is five PD per day. The daily wage of a labourer in the area is US$0.55. Plants produced on one hectare of nursery can treat 166.5 ha of cropland on 3-percent slopes or 40 ha on 20-percent slopes. Total establishment cost of vetiver hedgerows per ha on 3-percent slopes including production is estimated to be US$3.02, and US$13 for 20-percent slopes. With structural measures, the same slope and area may cost US$119 for 3-percent slopes and US$186 for 20-percent slopes.
- *Spacing*: The space occupied by hedgerows is about one tenth of the equivalent physical structures.
- *Gender sensitivity*: In the country, 25-30% of the farming households are women. The typical households that exercise poor SWC are these disadvantaged groups. The main reason for this is that SWC measures in practice are mainly engineered by nature and usually require more labour and time than women can afford. With the introduction of vetiver in the country, we see more and more women participating in SWC. They view the job as easy and time saving, and they use the grass for spreading on the floor during the coffee ceremony. Traditionally, a coffee ceremony without green grass spread on the floor is not attractive.
- *Organic fertilizer*: In several villages, particularly in the south, it is a common practice to use the grass as litter for the animals in order to collect manure.
- *Locally based development*: Today, where MfM is active, farmers' overall level of continuing innovation is remarkable. Dividing and selling tillers from already established hedges can be cited as the best innovation for sustainable technology. In this area, unless the project wants to introduce some other technique, the farmers are well equipped with the technology and do not need any assistance.
- *Leadership capacity*: Seventy-six well-trained farm extension workers are currently active for vetiver grass promotion in the whole MfM program areas. Farmer-to-farmer extensions trips

and inter-village visits are organized and arranged by these extension workers. They also participate in the selection of the best farmers for annual awards; this has created healthy competition and trust among farmers.

Replication to Non-program Areas

Replication by other organizations within and outside Ethiopia has been significant. The program methodology and technology have now spread to all parts of the country. In 1996, the presenter of this report was selected as a resource person by The Vetiver Network in Washington to share his experience with people from Cameroon. Today the federal government has accepted to include the grass in its conservation policy and forest action plan. This by itself will help spread the technology mainly in the farming sector.

Discussion

Sustainability of the Technology

It is quite clear that a very close inverse relationship exists between the sustainability of SWC technologies and the amount of labour they require. In the Ethiopian context, the longest lasting technology is that which requires the least amount of labour, leads to a significant increase in the villagers' wellbeing, economic as well as social, and can be carried out by the villagers themselves. Besides, it should contribute to decrease cost and risk.

How to Achieve Sustainability

These days, governments of developing countries are constrained by financial problems. The chance of financing projects with big inputs no longer exists. Beneficiaries should be responsible to continue projects that have been assisted earlier by the government or others. One of these programs includes the promotion of vetiver grass technology. Experience from similar projects shows that by encouraging farmers to produce and sell the grass on their own, they can also support farmers' multiplication schemes and buy from them to distribute to other needy farmers. It can be foreseen that such an approach will increase the participation of farmers as well as generate further income.

Training and visits at all levels should help sustain the technology in the future. Moreover, proper care during propagation will also contribute to the better success of the program. Selecting the proper time for planting will increase survival and easily convince and attract the beneficiaries. The expert in charge should always demonstrate practically how to plant the grass in the fields. He or she should invite all stakeholders, such as the development agents, the contact farmers and the owners of farms.

Giving lectures in agricultural and forestry colleges will benefit the program, as they are the factories producing young and energetic people that go directly into the field after graduation.

Beside the technical feasibility, which ideally should be tested for another two or three seasons, the social dimension should not be overlooked, especially in countries with free grazing. If farmers are unable or unwilling to curb uncontrolled grazing, the technology is unlikely to be as attractive and effective. This will automatically affect the sustainability of the technology. This has been very clear to the farmers and has to be repeated at every possible opportunity.

Recommendations and Policy Implications

Recommendations on Technology and Methodology

- Combine vetiver grass with other compatible leguminous fodder crops. Parallel to planting the grass for SWC purposes, compatible and supplementary fodder crops should be sown or planted along the hedgerows to increase the feed value of the grass. This is advantageous particularly in places where trimmed vetiver is usually wasted when maintaining the strips. However, this approach has been found to improve the growth of vetiver in the northern highlands. Good grass growth has been observed in places where leguminous fodder crops are grown along with the vetiver hedgerows. This is because leguminous fodder crops can fix nitrogen, which is required by the deficient grasses in the area.
- Use simple and cheap means of propagating the grass. It is important not to lose momentum. Soil erosion in most parts of the world is so rampant that very little time is left to halt this trend of degradation. Getting the grass from nurseries may not be sufficient to tackle the problem. Another very effective way of propagating the grass should be researched and made available to people at large. The available technique of tissue culture should be further promoted.
- Maintain flexibility in applying the technology. Giving exact and scientific specifications and making only one recommendation as to how to solve each problem helps the farmers and make the technology theirs. For instance, we should give the farmer a range of options for spacing the plant population to experiment with and we should encourage him to try other grasses he may have seen elsewhere for comparison.
- Develop a closer relationship between governmental and non-governmental organizations. Mutual learning and sharing of resources and experience between governmental and non-governmental organizations has definitely helped make promotion more effective and spread quickly in the country.
- Watershed approach. Another important point is to apply the watershed management approach. Only if a whole watershed area is treated simultaneously can the required impact and effect of the technology be obtained.
- Better support of The Vetiver Network at all levels. International organizations and donor agencies should better support both financially and materially the vetiver network.
- Even poor countries like Ethiopia should direct some of their funds to assist their national networks.
- Push now and then our respective governments to include the grass in their conservation policy frameworks. Never give up until they do so.

Conclusion

It can be seen from the report that vetiver grass has the potential to improve in the medium and long term the natural resource base in fragile and heavily abused environments such as the Ethiopian highlands.

The approach is six to eight years old in some places and in others is just at its initial stage. Future problems and setbacks should not be excluded or minimized.

Yet, there cannot be progress without taking calculated risks. Therefore, we should not give up if we are confronted still with technical and social problems. We have to try repeatedly until we succeed.