EROSION CONTROL IN AGRICULTURAL AREAS:

AN ETHIOPIAN PERSPECTIVE

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Introduction

Ethiopia, with an estimated area 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 as it contributes 57% of the GDP and 85% of the employment (UNCTAD 1997). With GDP $150 per capita in 1995, Ethiopia is among the poorest country in the world (World Bank 1997). Most of the agricultural land is located in the highlands and is operated by Peasant Households. Smallholders cultivating fragmented micro holding (0.075 -1 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 objectives, and per capital food, production has been falling over the decades. In 1993/94 production grew by 0.05% per year while population grew by 3% implying a per capita food production declined by 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 alarming rate. The national soil erosion hazard assessment which is based on soil erosivity and erodibility and land cover land use data of 1994 indicates that over the whole country, up to 3.5 billion tons of top soil is eroded every year mainly from farm lands through the process of sheet erosion. Because of this, annually it is estimated that 20,000 - 30,000 ha of cropland is abandoned because the land could no longer assist cropping. Consequently, by the year 2010 it is expected that about 2.8 million highlanders would 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 to 300 t/ha/year on some fields. This is six times the rate of soil formation and probably causes an average annual reduction in soil depth of 4 mm. FAO (1986) estimated 50% of the highlands are significantly eroded, of which are seriously eroded and have reached a point of no return.

Various approaches, mainly based on mandatory policies, have been unsuccessfully tried in the past to encourage adoption of erosion control practices by the peasant sector. Soil and water conservation (SWC) program, mainly engineering based, was implemented with large investment input from the government, generous international organizations and the local people. Around $ 20 million was disbursed annually during 1980s and 1990s in the form of FFW. Farmers' labor involvement amounted 30 million person days per year. With available resources 25% of the targeted areas were rehabilitated and most of the physical measures constructed. Recent study in Food For Work (FFW) areas indicate that structures were dismantled from 53% of the plots and partly removed from 31% once the coercion to keep them is lifted. Faster than the degraded land recover, more land became exhausted. The success of the effort, as witness in recent years, has however been limited. One wonders what prompts peasants to destroy vital resource - improving investments of high value to the society. Several factors may be mentioned for failure of the past conservation program. The most significant are:

1. Lack of participation / top down approaches.

2. In appropriate technology / blanket recommendation: No attempt was made to involve the end users in adoption the technologies to the local conditions. Soil or stone bunds are not equally effective in high and low-rainfall areas. The productivity impacts of the structural measures were not considered, as the focus was only to curb the loss of soil.

3. Takes scarce productive lands out of production thus yield falls at least in the short-term.

4. Structures also created a breeding ground for noxious weeds and rodents.

5. Focus on quantity rather than quality: Apart from 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 emphasis quantity rather than quality.

6. Today, many development based organizations have brought the 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 a need to move away from pure engineering approaches for SWC.

Introduction of Vetiver Grass

In 1970, for the first time, the grass was introduced to the country by the State Coffee sector. It was imported from India. The purpose of its introduction was mainly to demarcate the different coffee estates and to control the expansion of noxious grass called Cynodon dactylon. A few years later, some NGOs also reputedly introduced the grass to the peasant sector. It is probably after the commencement of the Vetiver Newsletter in 1989, and the First National Workshop in 1991, most people become aware of the wonder grass as the cheapest means of erosion control in croplands.

Barriers to the Technology

Like any other introduced technology, the vetiver grass faced a considerable resistance from the professionals and farmers side. The major reasons were:

- Farmers were reluctant to use because they considered the grass as a noxious, invasive grass that occupies and abandons their croplands.

- Farmers also doubted about its different uses advocated by the extension agents.

- Professional, starting from the top policy makers down to the development worker, who were geared to physical SWC measures and used to work under FFW program were not convinced at all and did not even allowed the introduction of the grass to FFW areas. They said "It is the grass of the World Bank and the Bank may have its own hidden mission".

- Another reason they raised was that the grass has not been researched under our condition in any of the SWC research centers. That at least needs 6 -10 years before the research result officially comes out.

Because of the above stated obstacles and until end 1989, the usage of grass was limited and localized only in the State Coffee sector and in non-FFW areas. It was in 1991 that an Ethiopian based NGO called Menschen fur Menschen (MfM) for the first time broke the barrier and introduced the grass to the peasant sector particularly to its project areas. This NGO promoted the grass mainly for its SWC using the following approaches:

- Creating Awareness. The first and the most important entry point was creating awareness for its own development agents.

- Establish Vetiver Nursery. Establish the first vetiver nursery in the country for SWC purposes. In addition, very strictly follow the management at nursery level.

- Demonstrate the Application. In the same year, demonstrate the application of the grass for farmland SWC. For the first time in the country, 1991, the grass was planted on ten-ha cropland owned by five farmers. One of them won the 1993 Farmers Award arranged by The Vetiver Network in Washington

- Organize Training. After two years of progress, the Project organized training. This training was the first of its kind in the region that brought together all organizations (NGOs, GOs) working in the SWC projects to discuss the potential of the grass for SWC and its promotion in the region.

- Handing Over the Award. Invite local level officials and influential farmers during the handing over the award to the farmer, Mr. Walelege, the winner of Farmers Award. This was the occasion for most people to become enthusiastic about the grass.

- Environmental Clubs: The majority of the schoolboys and girls in Ethiopia come from rural areas. They spent their time after school hours and school vacations assisting their families in their day today farming activities. Taking this as an advantage, the NGO has assisted the establishment of environmental clubs at five school grounds in order to disseminate the technology at faster rate through students to parents. Vetiver was one of major components included for SWC purposes. This principle played an essential role in the expansion of the technology to the majority of the beneficiaries with out any additional cost and labor (extension staff).

- Media and Press: Since the introduction of the grass to the area, there were five press releases about the grass in the major news letters and more than ten radio interviews made by the staff of project and government and the beneficiaries. On top of this, the progress of the project was on air in Ethiopian Television every year during the main rainy season. This approach contributed much to introduce the technology through out the country.

- Training Supports: Translation the Green Book into local languages and making available to extension workers and farmers was one means of technology transfer used by the NGO. Beside, video and slide show contributed a lot to programme. Flyers on the technology is prepared and distributed during Subject Matter Specialist and farmers training.

- Farmers Self-Help Groups: In 1995, when all concerned bodies accepted and started applying the grass for their SWC program, the project handed over partially the production centers to interested farmers groups. This created confidence among the groups about the technology because it helps to generate income to the owners of the nurseries.

- Assisting the Establishment of Nurseries: Besides assisting farmers groups in establishing their nurseries, the Project also technically and materially assisted almost all GOs and NGOs in the region during the initial establishment of nurseries.

- Farmers to Farmers Networks: Farmers groups are the main targets for the enabling roles

of the development support services. A principle of ennoblement is minimum input for maximum out put. 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.

- Paper Presentation: Whenever there is possibility of participating in workshops, conferences and seminars, papers on vetiver were presented in particular for officials and policy makers at federal or national level This has contributed very much in changing the attitude to officially accept the grass as one of potential plants for on going SWC programs in the country.

- Awards: Every year in the month of December, the project organizes an award ceremony for outstanding farmers and field workers. On the occasion, invited people from GOs, NGOs and influential people such as farmers, religious organization and youth groups.

Vetiver Today

Beneficiaries and Organizations Involved

Unlike those initial years, the vetiver grass is being used by a majority of the farmers, rural road experts, urban dwellers, small-scale cottage industries and Wet Lands Development Project. There are 250 NGOs in the country working in different program. Of these, 110 are working in the field of natural conservation. 80% of them are now using the grass for their SWC program. This has brought the number of NGOs involved from one in 1991 to 88 in 1999.

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 vetiver grass for their different program.

Other than these, the bilateral organizations like GTZ, SIDA, CIDA; and multilateral organizations such as FAO, UNCDF, IJNDP, World Bank, etc. have fully accepted and willing to finance projects that are interested to promote the technology. Consequently, today one the biggest vetiver promotion projects has been launched by financial assistance of two bilateral organizations, GTZ and SIDA, in the northern part of the country.

Number of Nurseries, Production, Total Area Treated

As stated above, the first nursery was established in 1991 by MfM in southwest part of the country. In the same year, more than 50,000 clumps were produced and about 10 ha of farmland was planted for SWC purpose. Since 1991, great progress has been observed in the development of nurseries in the country. Table 1 shows the nurseries established by government agencies and non-government organization until end of 1999.

Application

Agro-Ecology:

- Slope: The grass is practiced on different slope classes. The upper slope limit ranges between 40-45%. Still at this slope class, it effectively holds the sediments. The planting procedures should strictly be applied otherwise, the cause of the damage will be enormous. For very steep slope, containerized plants are used for better and quick effect.

- Vertical Intervals (VI): The applied VI in the country varies from one slope class to other. The VI recommended in the country for slopes classes between 3-15%, 16-25%, and 25% 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 plant for better survival and effect.

- Altitude: Most of the high lands in Ethiopia are situated above 1800 m a.s.l. These are highly populated and experiencing sever land degradation. The upper altitudinal limit where the grass is tested is 3100 m. a.s.l. Even when it freezes the plant has survived with out big shock. However, the optimal and effective limit is below 2,800 m. a.s.l.

- 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 basin. 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 heads.

- 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 low angle of repose are better protected by planting vetiver along both sides of the canals. In the same way riverbanks that have undercut /scouring effect were 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 the sediment from silting the dam. Today, domestic water supply and hydroelectric authority involved in dam construction area are convinced to use the grass to treat the catchment before any 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 Hydro electric power plant in the south that used vetiver to treat the whole catchment.

- Benefits other than the above: Beside the different uses stated above, the grass has other economic and social advantages that are as follows:

- Thatching. 83% of the population in the country lives in the rural areas, of this 2-4% can only afford to roof their hut with iron sheets while the majority use grass for roof making. Those farmers who established the vetiver grass hedgerows not only use it for their own hut building, but also sell it to neighboring farmers.

- Feed value: Though international literature declares Vetiver as unpalatable for livestock - probably on the account of its feed value - it is readily eaten by livestock here. Occasional cutting is practiced that stimulate the growth and as livestock fodder by-product. The year 1999 can be remembered for its long dry season (Oct-July). This has caused considerable damages to human and animal life. The presence of this drought resistance grass has saved the lives of many

heads of cattle in the project area.

- Rodent. Field rodents reduce crop yield by 10 -12%. They damage standing crop while they are in the field. 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 considerably reduced by 85%.

- Obstacle for farming: One of the complaints of farmers about physical SWC measures is the obstacle to freely move farm implements and farm animals. The continued length and of course the height of the structures limit the movement of animals from one terrace to other. In many cases, this problem has been overcome by replacing vetiver for structures.

- Mulch: Nowadays vetiver is the main source of mulching material to cover pregermination seedbeds and as mulch to conserve moisture for young seedlings.

- Mattress. Mattress made from vetiver grass is most liked by rural people. Farmers say it is completely free of any bed bugs and fleas. Good information and findings.

- Income: Schools who have well-established hedgerows are getting income from the sale of the grass mainly during Ethiopian holy days and weeding ceremonies. On top of this, additional income is also obtained by selling the grass for multiplication purposes. They sell tillers by dividing the hedgerows into two leaving major portions to remain on the ground. The income is mainly used to assist students who quit their education because of financial problems.

Wetlands rehabilitation: Wet lands are our main source of ground water. They are natural reservoir of streams and rivers. If disturbed they cause considerable damages to habitat and bio-diversity. One major cause of this particular ecosystem is the unlimited exploitation of the grass that grows only in this habitat. Farmers in the area usually live in the hut where the roof is made from grass. The main source of the grass comes from the wet lands. Every year in the month of November and December it is a common practice to replace the old roof with new once. Farmers have to walk a distance to cut and carry the grass. This continuous exploitation of the grass has resulted to drying of wet lands there by affecting the continuous flow of stream and rivers that have their water source from this ecosystem. After expansion of the vetiver grass into the region, mainly for SWC, farmers now use vetiver grass for thatching. First, it is available near their villages and secondly it lasts long compared to the grass from wetlands. More over, the downstream people can confidently develop their irrigated agriculture and animal husbandry without any danger.

Cost of the system: The over all labor cost of establishing a nursery and planting in the field is far less than that of using structural measures for SWC. A hectare of nursery can produce about 2.5 - 3 million splits in five months. Labor requirement to mange this nursery until planting out is five PD/day. The daily wage of a laborer in the area is $0.55. Plants produced in one hectare of nursery can treat 166.5 ha cropland on 3% slope or 40 ha on 20% slope. Total establishment cost of vetiver hedgerows/ha on 3% slope including production is estimated to be $ 3.02 and $ 13 for 20% slope. With structural measures the same slope and area may cost $ 119 for 3% and $ 186 for 20% slope.

Spacing: Farmland occupied by hedgerows is about 1/10th of the equivalent physical structures.

Gender sensitive: In the country, 25 - 30% of the farming households are women. The typical households that exercise poor SWC are these disadvantage group. The main reason for this condition is all SWC measures in practice were mainly engineering by nature and they usually require more labor and time that can not be afforded by women. With vetiver introduction in the country, we see more and more women participating in SWC. On top of their appreciation for its easiness of application and time saving job, they use it for spreading on the floor during coffee ceremony. Traditionally, the coffee ceremony with out 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 bedding for their animals in order to collect manure.

Local based development: To day, where MfM is active, farmers' overall level of continuing innovation is remarkable. Dividing and selling tillers from existing hedges can be cited as the best innovation for sustainability of the technology.

Leadership capacity: Seventy-six well-trained farmer extensionists are presently 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 extensionists. They also participate during the selection the best farmers for annual award this 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 methodologies, as well as technologies, have now spread to all part of the country. In 1996, the presenter of this report has been selected as a resource person by The Vetiver Network, Washington, to share his experiences for Cameroon people. Today the federal government has accepted the grass to be included in its conservation policy and forest action plan. This by itself will assist the wide spread of the technology mainly in the peasant sector.

Discussion

Sustainability of the Technology It is quite clear that a very close inverse correlation exists between the sustainability of SWC technologies and the amount of labor they require. In Ethiopian context, the most long lasting technology is one that:

1. requires the least amount of labor.
2. leads to significant increase in the villagers' well-being, economic as well as social, and
3. can be carried out by villagers themselves. Besides, it should contribute to decrease cost and risk.
4. Vetiver Grass Technology meets these criteria.

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 for the continuation of projects that have been earlier assisted by the governments or others. One of these programs includes the promotion of vetiver grass technology. Experiences from similar projects reveal that by encouraging farmers to produce and sell the grass on their own can also support farmer's own multiplication schemes, and buy from them to distribute to other needy farmers. It can be foreseen that such an approach may increase the participation of farmers even more and more in addition generating income.

Training and visits at all level should be one tool to sustaining 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. Always the expert in charge should practically demonstrate how to plant in the farmers' fields. He/ she should invite all stakeholders like the development agents, the contact farmers and the owners of the farm.

Giving lectures in the agricultural and forestry colleges will be of an advantage to the programme as they are the factories producing young and energetic people that go directly to the field after graduation.

Beside the technical feasibility, which ideally should be further tested for another 2 or 3 seasons, the social dimension should not be overlooked. This is mainly true for countries experiencing free livestock grazing. If farmers are unable or unwilling to curb uncontrolled grazing, the technology most probably may not 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

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 during maintenance of the hedgerows. However, this approach has also been found effective for better growth of vetiver in northern high lands. Good grass growth has been observed in places where leguminous fodder crops are grown along with the vetiver hedgerows. This is because leguminous fodder crop can fix nitrogen, which is required by the grass deficient in the area.

Use simple and cheap means of propagation the grass. It is important not to loose momentum. Soil erosion in most part of the world is so rampant that very little time only is left to halt this trend of degradation. The present need of getting the grass from limited nurseries may not be sufficient to tackle the problem. Another very effective way of propagation the grass should be researched and made available to people at large. The available technique like that of tissue culture should be further promoted.

Maintain flexibility in application of the technology: Giving exact and scientific specifications and making only one recommendation as to how to solve each problem reduces the space the farmers own trials and make the technology theirs. When we recommend, for instance, we should give the farmer a range option for spacing, plant population to experiment with and should encourage him or her to try other grasses for comparison he or she may have seen elsewhere.

Develop closer relationship between the governmental and non-governmental organizations: The mutual learning and sharing resources and experiences between government and non-government organizations, as well as among the non-government agency

Watershed Approach: Another important fact is to apply the Watershed Management Approach. Only if a whole watershed area is treated simultaneously the required impact and effect of the technology can be effected.

Better support to The Vetiver Networks at all level: International organizations and donor

agencies should better support both financially and materially the Vetiver Network. It is because of these networks and the initiatives of few devoted individuals that helped us to be here at this gathering. Even poor countries like Ethiopia should direct some of their funds to assist the international networks in their own countries. Push now and get our respective governments to include the grass in their conservation policy frame works. 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 environment such as the Ethiopian highlands. In this case, it may well pay off to have trodden the path of the last two decades where priority had been given to physical SWC measures. The Vetiver 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 can not be progress without taking (calculated) risk. Therefore, we should not give up if we are confronted with technical and social problems. We have to try repeatedly. Hopefully, we will be successful.

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