APPLICATION OF VETIVER IN WESTERN AFRICA

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1. Introduction

"Western Africa" encompasses a broad region stretching from the Atlantic in the West (Mauritania, Senegal/Gambia) to Niger, Nigeria and Chad in the East. It contains three major climatic belts transitioning from Sahelian in the northern third (arid), Soudanian in the middle (semi-arid) and Sub-Guinean along the southern third (tropical). The demarcation is based on soil type and rainfall, the later ranging from 100 mm to 2,500mm. A local species of vetiver (*V .nigritana*) is found predominately in the semi-arid belt where traditionally its roots were prized for its property to give "drinking water a good taste" and for medicinal purposes. *Vetiveria zizanioides* was introduced recently in the mid-20th century as a possible solution to the region's soil erosion problems and lack of its soils to retain scarce rainfall.

This paper explores three aspect of vetiver in the region; the first describes *V.nigritana,* its usage and compares it with *v.zizanioides*; the second describes the introduction of *V. zizanioides* and its newer applications, and lastly we discuss best practices for VS dissemination in areas where the plant is not well known, thus addressing the limitation issue raised in Richard Grimshaw's last presentation; why is VS not more widespread among populations that can benefit from it the most?

2. *V. nigritana* and its usage in Western Africa

Above ground *V. nigritana* is almost undistinguishable from its cousin *V. zizanioides*; leaves are similar in shape and color, and used mostly in handicraft and for fodder. The difference between the two species is below ground in the roots, their size and their performance. The *V.nigritana* root system is dense, hardy but rarely extends beyond 75 cm in length. They are known mostly "to perfume drinking water" and rarely for soil conservation for reasons explained below. The plant is found in areas that were traditionally wetlands, flood plains or

flowing rivers in the mid-section of the above map of West Africa, and also in Central and Southern Africa. There is little evidence the species was cultivated or multiplied, and there is no documentation to indicate the plant is fertile or can reproduce through its seeds. It is widely assumed the present species in Western Africa is sterile, and spread from region to region when tillers from inundated areas detached from larger clumps and floated to other flood plains.

The name of the plant in many local languages of the region attests to the multiple properties attributed to its leaf and root. Names often allude to its "magical" qualities, its longevity and resistance to droughts, inundations, fires and grazing by animals. It has been planted in several areas as "sign posts" to demarcate boundaries between land holdings. Because it is difficult to uproot and move, the plant is referred in those areas (Senegal, Nigeria, Mali) as the "gift of nature" plant, because where planted they reduce land disputes. In parts of Mali the plant is referred to as "Mecca" because of its healing properties, and the hollowed flowering stem, when cut in the form of a writing quilt and dipped in ink, is the only instrument with which one can copy the Holy Koran.

In the northern State of Kano in Nigeria, the plant retains a similar sacredness. It is called "Jema" or Mosque in Arabic, and its root is used as food [1]. In the Senegal River region it is referred as "the plant that never dies" because of its resiliency to drought and flooding cycles. In Western Africa, the leaves are used as thatch, as a composite for adobe mud walls, mats, baskets, beehives and even making rope [2]. Wandering cattle will eat the odorless tender new leaves when there is nothing else to forage in the dry seasons, preferring these leaves to older ones.

Roots of *V.nigritana* are best known in the region for their pleasant scent and their ability to disinfect drinking water. When soaked in storage canaries or water bottles, it is said that they give the water "a better taste." In fact, the root has antibacterial properties as it is the essential oil (vetiverols) in the root that is responsible for its antiseptic and disinfecting qualities [3]. Roots are also used in traditional medicine as a calmer or, when boiled in water, as a disinfectant to eliminate pathogenic bacteria. Women are the principle collectors, sellers and users of the *V. nigritana* roots, particularly for its medicinal applications.

The root is also used as a natural pest control; against termites and as moth repellant. In horticulture it is planted around plots to protect against nematodes. In rice storage granaries, layers of vetiver root are placed intermittently with layers of salt to eliminated losses due to invading pests [4].

In spite of its multiple uses, little scientific research has been conducted on the performance and behavior of the local *nigritana* variety. In particular, there is no evidence in the literature that it was ever used traditionally for soil erosion or soil conservation purposes [5]. It has been test planted in hedgerows, and compared with other types of grasses. It was shown to trap soil and sand because of its dense leaf system, and will slow rainwater runoffs. In two erosion tests (one Burkina Faso and one in Ghana), it performed better than other local gramineae but not as well as *V.zizanioides* [6 & 7]. One possible explanation is its inability to grow new roots on its leaf stem as does *V. zizanioides*. This lack of new root growth was

observed by the author in field trials where a 20 meter hedge of *V. nigritana* collected, over an 8 month season, approximately 12 cm of eroded sand and soil. The plants survived and continued to grow under the trapped sand, however, there was no sign of new root growth on its leaf stalk as a way to adapt to the "raised" ground level. The submerged parts of the hedges turned white probably due to a lack of sunlight. Under similar conditions, *V. zizanioides* grew new adaptive roots from the leaf stem as soil and sand accumulated above the plant's crown.

Today, the *V. nigritana* root is still collected in the wild, dug up, dried and sold in small bundles, but because of reduced flood plains, lowered water tables, and over-harvesting, the plant's survival is threatened in the region [8]. Only in a few areas are the leaves cut for thatch, adobe and handicraft, but this usage does not destroy the plant. While the supply of plants is dwindling, the author is not aware of any regional effort to propagate the plant commercially or of any program designed to preserve the species from overexploitation. There was an effort in early 1990's in the Anambra State of Nigeria to promote the cultivation and use of the vetiver for erosion control, but after a major push, (even with the help of the Prince of Wales planting vetiver) and good first year, the project did not trigger wide application of vetiver hedges.

3. Introduction of *V.zizanioides*: With increased pressure on the land, recurring droughts and deforestation during the latter part of the last century, much of Africa was confronted with problems related to loss of arable land and soil productivity. Soil erosion, both wind and rain induced became one the most serious constraints to development and food security. As we heard today, it was during the 1980's that the World Bank made significant strides in bringing vetiver to the forefront as a viable vegetative solution to these issues.

In 1993, the US Academy of Science concluded a major study on experiences with vetiver worldwide that became a turning point for environmental application of vetiver. The study focused its research on the Asian variety *V. zizanioides,* which was more widespread globally than Africa's *V. nigritana*. The study's findings and conclusions were that vetiver, when planted in simple hedges across slopes, could be a sustainable solution to tropical and semi arid region's food production and environmental problems; persistent soil erosion and the soil's low moisture retention. Based on experience elsewhere, the study suggested that vetiver could be used in almost every type of climatic and soil-types in Africa. The technology held an "excellent promise" for the continent and elsewhere, but there was a need to conduct regional level testing, experimentation and research. The plant and the technique had to be introduced and disseminated to end-users, particularly farmers and agricultural institutions.

In the process of conducting their study, the Academy of Science established contacts within eleven countries of Western Africa; Benin, Senegal, Sierra Leone, Niger, Nigeria, Mali, Ghana, the Gambia, Ivory Coast, Burkina Faso and Togo. Contacts were with research or academic institutions, development projects, or government departments. Projects were

informed of the Academy's findings, information was disseminated, and *V.zizanioides* plants were made available through government plant protection agencies. Unfortunately not much resulted from these initial contacts.

However, a landmark research on West African soil was conducted over three seasons in the latter 1990s by the Department of Agronomy at Nigeria's University of Ibadan [9]. The study monitored, with scientific rigor, the effect of *V.zizanioides* hedges on soil erosion, soil moisture storage, and crop yield. The results were convincing. On a 6% slope, the study found that three hedges (planted at 20 meters apart) trapped 98% of soil and reduced water runoff up to 130% more than control non-vetiver plots. Crop yields of cowpeas were between 11-26% higher than non-vetiver-managed plots, and maize yield was about 50% higher. The study set the stage for an expanded use of *V.zizanioides*, and the possibility of national or regional promotion and dissemination efforts, which had been lacking to date. There remained a constraint to pushing *V.zizanioides* and that was the readily available plant material; few institutions propagated *V.zizanioides* in sufficient quantities to make the vetiver system available to potential users.

Since 2000, there has been a revival of interest, research and application of the Vetiver System (VS), particularly in three sub-Sahelian countries that border on the Sahara desert; Senegal, Mali and Burkina Faso. Through experience learned in Madagascar on establishing a national vetiver dissemination program, similar initiatives were put into place in these three countries.

4. Elements of vetiver promotion initiative: Innovative technology such as the Vetiver System takes time to be accepted and applied on a broad basis. In order to accelerate the adoption of the technology and newly developed applications, the author proposed and tested a promotion strategy in West Africa while he worked with a donor-supported business development project. The approach consisted of using the private sector in collaboration with public institutions and research centers to establish demonstration sites, produce plant material, generate local information, and create a head of steam to disseminate the diverse application of VS.

The strategy was based on the assumptions that: 1) vetiver had commercial value, thus entrepreneurs were well positioned to market the product; 2) there was sufficient information and experience with VS in other countries to reduce the risk entrepreneurs would take to invest and apply the technology; and 3) with more uses uncovered for vetiver, a promotion program requires the active participation of a more diversified group of stakeholder than the traditional partners targeted in agriculture, water and forestry and research departments. As important to these assumptions, a vetiver initiative has to assure a plentiful supply of vetiver plants at the outset so that as demand expands, the program can rapidly provide plant material without waiting for the next growing cycle.

The initiative began in 2000 by holding information sessions with small groups of driven people showing strong interests in the VS and by providing them with documents and presentations of relevant applications from other parts of the world. The "core groups," sometimes formed under the banner of a "vetiver club," met on a regular basis and each

session focused on a pre-announced VS application. “Meeting” formats were informal, technical documents were distributed and debates ensued on next steps. After 2-3 months of meetings, debates usually focused increasingly on the need for the group to take action and to formulate a vetiver Action plan. These usually included:

- conducting an initial study of existing knowledge, use, distribution and availability of plant material,
- establishing demonstration sites,
- organizing information transfer days and training cycles,
- promoting research,
- encourage private nurseries to multiply vetiver,
- formulate a communication strategy and participate in agriculture and environment fairs,
- assist neighboring countries to develop a vetiver program and
- identify at least one major buyer of the technology.

In Senegal, the group determined that the local species *V. nigritana* should not be abandoned at the outset, but should be comparatively tested, but that there was an immediate need to have certified *V. zizanioides* plant material on hand. The project assisted in the importation of 10,000 slips of the certified species from South Africa. Distribution was made by either selling the slips at cost or given to those who agreed in return for the initial plants to promote VS, and supply plants free of charge to a successive group of beneficiaries as well as for demonstration plots. The majority of the plants fanned out reached institutions and individuals who become familiar with the plant’s performance. Some conducted research, others established demonstration sites, and the balance of plants went to nurseries for testing and multiplication.

A two-part communication strategy was put into place in Senegal, which included the development of visual, written and electronic material adapted to the local context, and an outreach effort that included making presentations and displays for target groups. Target groups included public sector decision makers, pro-active NGOs, professional associations, environmental groups and companies in relevant businesses. The process proved relatively successful, but slow to get traction.

4.1 Paying client: road protection: The first business to “purchase” and apply the Vetiver System in Senegal was SOCOCIM, the country’s largest cement factory that needed to protect its newly built quarry access road from soil erosion. Six kilometers of the asphalt road and bridges (including crossing a railroad track) were threatened by erosion. The core group helped identify a local firm to install the VS, and they also provided overall technical oversight. The installed vegetative protection not only stabilized the road infrastructure, but also contributed to preserving the environment and served as an initial vetiver demonstration site. Subsequent activities and demonstration sites included embankment stabilization, bridge and canal protection, and sand erosion protection.

4.2 Water purification trials and installation: A trial project at the capital’s wastewater plant tested, over a 6 month period, the treatment of raw effluent as it passed through tanks into which vetiver floated as in hydroponics. The results showed that vetiver reduced the

Biochemical Oxygen Demand (BOD) level ten fold, reaching acceptable primary effluent standards, reduced the Suspended Solids (SS) close to an accepted level, and while the trial succeeded in reducing significantly the i-Coli count, it did not come close to acceptable level for agricultural use. A community household wastewater treatment facility was also installed using vetiver successfully in a construction absorption tank.

4.3 Agriculture: Initial trials and subsequent application of vetiver to increase water retention was broadly adopted in banana plantations and horticulture production areas by professional organizations. Sections of banana plantations using VS reduce the time from planting to maturity by 13% -15% in part because of the soil's increase capacity to retain humidity. The test site was used extensively to promote vetiver hedging for new and existing plantations.

4.4 Dune stabilization: Coastal hotels in wind swept Cap Skirring and the largest phosphate mining company adopted VS to stabilize dunes, sand infiltration and protect infrastructure. One of the hotel owners whose large waterfront and embankment slope were protected and embellished using VS, initiated a vetiver training sessions for the staff of 16 nearby hotels and resorts as a way to improve the area's ecological and environmental attraction.

Important strides were made in innovative uses of vetiver, such as vetiver scented bottled water, the incorporation of vetiver in Permaculture (dynamic, organic and sustainable agricultural system), and early design of handicraft items. Within four years, vetiver usage, research and application in Senegal reached an acceptable level of penetration and adoption.

A similar approach to vetiver dissemination was tested in Mali, with a focus on protecting the Niger River embankment. The results of the effort were not as positive, in part because the third assumption did not apply – that a core group of broad and diversified individual could launch a national vetiver program. It became evident that the initiative should have been launched with a large number of people and institutions, that more demonstration sites should have been established early on and greater attention given to a communication program. Only one institution, the *Institut Ouest African de Protection de l'Environnement* (IOAPE) took the lead in the initiative and their focus was on protecting the Niger River embankments from erosion. Obtaining approval to install demonstration sites near to or along the river bank proved difficult because local authorities and private land holders had not been made sufficiently aware of vetiver's virtues.

In Burkina Faso, VS was more successful among small farmer and village group, as VS was introduced initially at this level. The movement has not yet reached a take-off point, but the small farmer groups have developed competency in improving soil quality, water retention and multiplying vetiver commercially to be able to scale up and extend vetiver adoption among larger end-users. Ghana's vetiver breakthrough was through the country's gold mines that used the plant to clean-up mine tailings.

Each of these countries where VS has had some traction have been areas where a traditional vetiver existed, but it was never known or used for it soil erosion or waste water characteristics.

Initiatives to introduce VS in Morocco must take a different tack because the country has no experience with a local vetiver variety. A recent initiative to establish a vetiver program has targeted protecting with VS the more than 100 large watershed basins that collect water for the country's extensive irrigation dams. It is estimated that the gradual silting of these water reservoirs is depriving the country of 50 million cubic meters of stockpiling capacity each year. This is has the potential of irrigating 12,000 ha, and is being lost annually [10]. The initiative is using lessons learned from other countries by developing a "systems" approach to inform, sensitize and encourage support for VS. This includes implicating at the outset an array of present and future stakeholder consisting of the media, NGOs, nurseries, projects, investors, researchers, agricultural producers, potential processors, people in the medicinal and aromatic plant sector, engineers, and large and small corporations as well as public agencies and Ministries.

Conclusion

Western Africa has a vetiver knowledge base. It developed application and use of the plant for traditional survival needs – safer drinking water and medicinal support. As fragile lands became more marginalized due to droughts, overuse and deforestation, the region needed to transform traditional practices, and correspondingly adopt new technologies to improve soil conservation, retain soil loss and soil humidity. The VS is one tool that can assist the region to reestablish a better natural balance between land use and land regeneration. Propagating a new plant better adapted to present and future needs, and disseminating the allied technology require knowledge of local practices, and flexible strategies that reach beyond traditional agricultural and forestry extension services. The process must include dedicated public and private individuals and institutions, a focus on a few key applications, yet a communication strategy that sweeps a broad swath of the population.

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