Audit on Current State of Development and Practice & The Role of TVNI

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Introduction

In the last twenty years there have been very significant developments and applications at scale of a relatively little-known technology that provides simple, effective, efficient, low-cost solutions to a broad range of environmental management issues. Known as "Vetiver Grass Technology" (VGT), researchers and end-users have developed and widely demonstrated its utility in the tropics and sub-tropics (to 30 degrees north and south) for bioengineering, phytoremediation, watershed protection, disaster risk mitigation, soil and moisture conservation and community development. Collectively, all of these applications are known as the "Vetiver System". Despite this strong track record of success, VGT is virtually ignored by those global and regional agencies charged with providing financing, research and technical assistance for achieving rural development, poverty reduction and environmental management objectives. This lack of attention has been a significant impediment to the broader use of VGT by those who would benefit most.

In a world struggling with so many long-term environmental management challenges, it is increasingly important to see VGT broadly placed at the disposal of society. Among others, as a simple multipurpose tool, VGT can provide for increased community and individual resilience and capacity for autonomous adaptation to climate change in the agricultural, rural and urban sectors. It can play a significant role in large-scale, hard adaptation schemes by offering a low cost alternative to engineered works. If global and regional agencies active in combatting climate change impacts in the developing world are to be made aware of this option, systematic efforts will be required to bring to their attention the existing state of knowledge and practice of VGT.

History

The dense planting of perennial plants to form hedges – for field demarcation, containment or exclusion of livestock, control of soil loss, etc. – is a practice that extends back over 2,500 years. Thus it should not have been surprising when, in the mid-1980s, World Bank staff encountered farmers in Mysore and Kerala, India that had been using a perennial clump grass (*Chrysopogon zizanioides,* common name "Vetiver") for centuries for such purposes. What was surprising to many, however, was that the World Bank began to broadly promote the use of Vetiver grass hedges for soil and moisture conservation in India and beyond. The idea was sufficiently noteworthy that Iowa State University's Centre for Indigenous Knowledge for Agriculture and

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Rural Development cited it as a rare example of an international development agency actually taking advantage of indigenous knowledge and practices (Warren, 1992)[3].

The initial impetus for World Bank's interest in Vetiver was the failure of India's large-scale soil and moisture conservation programs to achieve their objectives. Those programs, primarily based on conventional structural and engineered works such as field bunds and terraces, were technically demanding, costly and, ultimately, incompatible with the smallholders systems they were to protect. Replacing them with vegetative and cultural approaches that could be applied and managed by farmers themselves seemed a natural solution. The fact that a World Bank agronomist, John Greenfield, had had successful experiences with Vetiver hedges in sugar cane production in Fiji in the 1950s made that particular alternative seem all the more attractive. To validate the technology, support was provided to state agricultural universities to research the efficacy and utility of Vetiver hedgerows for reducing soil loss and rainfall runoff. Still, many sceptics (many of whom were traditional soil conservation "engineers"), citing the lack of broader research and experience with the plant and its application, questioned the World Bank's actions.

Perceiving the potential value of the technology, in 1989 the US National Research Council (NRC) formed a panel of experts and charged them to conduct a scientific audit of the safety and effectiveness of Vetiver for erosion control. The panel, chaired by Dr. Norman E. Borlaug, a Nobel Prize winning biologist and agronomist, was comprised of scientists with distinguished careers in tropical agricultural systems and soils and soil conservation.[4] The panel's findings and conclusions, all positive, were presented in 1993[5].

The findings and recommendations of the NRC report provided a critical *imprimatur* that opened the door for broader promotion of vetiver grass for soil and moisture conservation and generated interest among grass roots organizations, NGOs and some bi-lateral programs throughout the tropics and sub-tropics. The report and its findings also generated interest in other, alternative applications of Vetiver. Promotion, experimentation and testing was facilitated by a "Vetiver Information Network" established by the World Bank[6] and by Vetiver's pan-tropical distribution[7].

Soon a handful of researcher-practitioners in countries like Malaysia, Australia and Thailand[8] were expanding the knowledge base and the range of applications to, among others, bioengineering, slope stabilization, waste water treatment and, phytoremediation for soil and

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[3] Warren, D. M. 1992. Indigenous knowledge, biodiversity conservation and development. Keynote address at the International Conference on Conservation of Biodiversity in Africa: Local Initiatives and Institutional Roles, 30 August-3 September 1992, Nairobi, Kenya

[4] The Panel's other members were Dr. Rattan Lal, then of Ohio State University, Columbus; Dr. David Pimental, then of Cornell University and; Dr. Hugh Popenoe, then of the University of Florida.

[5] National Research Council. 1993. *Vetiver Grass: A Thin Green Line Against Erosion.* National Academy Press, Washington, D.C.

[6] In 1995 The Vetiver Network was formally established as a non-profit organization; it was later renamed The Vetiver Network International.

[7] Vetiver grass was moved around the world, among others, in the nineteenth and early twentieth centuries by colonial powers for essential oil production and, with some plantation crops such as sugar cane and coffee, for soil conservation.

[8] For example, see: Yoon, P.K. 1991 and 1993. A Look See at Vetiver Grass in Malaysia, Vols 1 & 2. (www.vetiver.org/MAL_PK.Yoon%20Look%20see/START.HTM); Hengchaovanich, Diti. 1999. 15 years of bio engineering in the wet tropics. (www.vetiver.org/ENG_bioengineeringmal.htm; Troung, Paul. 2013. Vetiver system for prevention and treatment of polluted water and contaminated land. (www.vetiver.org/LAICV2F/0%20Plenary/P3Truong_TE.pdf)

water contamination. His Majesty the King of Thailand, an early advocate for Vetiver, directed comprehensive, systematic and sustained efforts for Vetiver research and development in Thailand. Within the decade following the release of the NRC report, a critical mass of end-users – many of whom were loosely connected through The Vetiver Network International as well as national and regional Vetiver networks that had sprung up – could be found in dozens of countries. Private sector companies, specializing in bioengineering with Vetiver for slope stabilization and infrastructure protection and, reclamation of mined areas began to appear in Latin America, Africa and Asia. These were successful to the point that in 2003 private firms in China sponsored the Third International Conference on VGT to showcase their work in bioengineering and phytoremediation. Then, in 2006, the largest private beverage company in Venezuela sponsored the Fourth International Conference on VGT to exhibit its work in watershed and water quality protection and community development. Most recently (2013), private sector interests organized the Second Latin-American Conference on VGT in Colombia to share knowledge and experiences with other companies and individuals from all over Latin America.

The Evolution of VGT

A simple metric for looking at how interests and end uses (applications) have been evolving since those early days in the 1990s is to look at the thematic distribution of the papers that have been presented in the International Vetiver Conferences during the 20 year period between ICV-1 in 1996 and ICV-6 in 2015. Table 1 provides some insights into how VGT interests and applications have evolved over the last 2 decades. Initially, interest was strong in VGT for soil and water conservation and agricultural applications, but it has since declined greatly. Today the focus is now on broader bioengineering and environmental management research and applications. The only thematic areas that have remained fairly constant are basic and applied research on Vetiver itself and VGT for community development. Research on the Vetiver plant has been both a response to and driver of the continued expansion of use of VGT in areas such as phytoremediation, disturbed land reclamation and bioengineering. As such, over the years there have been continued efforts and attention invested into better understanding Vetiver's biology, genetics, performance, environmental tolerances, physical characteristics, and root/soil interactions, phytoremediation abilities, etc. On the other hand, VGT and its potential role within overall community development has sparked relatively little interest. This, along with declining attention overall to Vetiver in agricultural systems, are worth noting for a number of reasons.

Table 1. VGT Research/Applications: Change in Relative Importance From ICV-1 to ICV-6

	International Vetiver Conferences					
Thematic Area	**I - 1996**	**II - 2000**	**III - 2003**	**IV - 2006**	**V - 2011**	**VI - 2015**
Soil & Water/Agriculture	55%	42%	11%	19%	14%	15%
The Plant	29%	17%	11%	26%	15%	16%
Alternative/Innovative Uses	7%	0%	5%	7%	10%	7%

Environmental Management & Protection	5%	25%	54%	27%	27%	22%
Community Development	3%	3%	0%	12%	7%	7%
Bioengineering/ Infrastructure Protection	2%	12%	19%	9%	27%	32%

One, our interest in Vetiver today was first motivated by its great promise and potential for improving the lives and livelihoods of the world's poorest and most economically marginalized populations: communities and households that rely upon rainfed agriculture. Poverty is primarily a rural phenomenon and, in rural areas, it is most prevalent among households reliant on rainfed agriculture. Rainfed agriculture accounts for more than 95% of farmed land in sub-Saharan Africa, 90% in Latin America, 75% in the Near East and North Africa; 65% in East Asia and 60% in South Asia.[9]

The potential of Vetiver to improve and sustain rainfed agriculture stood out to the distinguished panel of experts who led the US National Research Council's scientific audit of Vetiver:

> *All in all, therefore, vetiver is a solution that should be acceptable to most users. It seems promising as a way for local people to involve themselves naturally in erosion-control activities - something that national planners have long dreamed of. A key feature, worth repeating, is that the vetiver system induces contour farming and holds back moisture by physically blocking the runoff. Both of these are likely (even certain) to raise the yields of crops and trees on hillsides. Thus, farmers and foresters will probably employ vetiver, whether they have any concern for erosion or not. Self-interest should drive them.* (NRC, 1993)

Yet, with some very noteworthy exceptions (e.g., in Ethiopia), VGT has not been deployed at scale to benefit poor rural communities reliant on rainfed farming. This declining interest in VGT for soil and water conservation and agriculture and the limited interest in VGT for community development seem to go hand-in-hand. What we have seen through the ICVs over the years appears to be a reflection of what is also happening more broadly with VGT applications throughout the majority of developing countries in the tropics and subtropics.

Two, climate change. With the world on track to ensure that the worst case scenarios for climate change impacts actually come to pass, issues of building capacity for climate change adaptation and community resilience are all too real and immediate. In a 2011 World Bank publication[10], the authors present a series of case studies in which the main, cross-cutting concerns of the communities studied were issues of water quantity and quality; control of soil erosion and maintenance of fertility and; vulnerability to extreme weather events. Overall, the

[9] IWMI. 2010. *Managing water for rainfed agriculture* Water Issue Brief, Issue 10. International Water Management Institute.

[10] Ashwill, M.; Flora, C. and Flora, J. 2011 *Building Community Resilience to Climate Change – Testing the Adaptation Coalition Framework in Latin America*. The International Bank for Reconstruction and Development. NW Washington, DC 20433, USA

communities' concerns ran the gamut from water-related health issues, sedimentation of rivers, flooding, droughts, desiccation of wetlands, landslides, and damages to infrastructure. To address these issues and concerns, the authors emphasized the need for effective, cross sectoral responses.

Examples from all over the world demonstrate that the Vetiver System is a viable alternative for managing many of these problems and mitigating them to a significant degree. As importantly, the Vetiver System can be managed by the communities themselves with relatively little external support, offering a scalable option for supporting community resilience and autonomous adaptation.

Often the installation of Vetiver hedgerows results in mitigating more than one problem. For example, in Ethiopia the use of the Vetiver System on-farm enhanced soil fertility and soil moisture, resulting in significant gains in crop yield while improving groundwater recharge to the extent that nearby wetlands that had dried up were restored and, wells and springs became more reliable, even during drought years.

An example of this is the work by Alois Kennerknecht, with communities in Lima, Peru. His example is one a cross sectoral approach and, while it is in an urban rather than rural area, it is particularly instructive on how Vetiver can contribute to the mitigation of climate-induced problems. Vetiver is utilized for waste water treatment (a disease control intervention) and for the control of erosion and dust. Vetiver is even used in landscaping to enhance quality of life. Much of Alois' work came about in reaction to costly, high tech solutions for waste water treatment that have been funded previously by the development banks. Many have not worked well and, if they do, are too costly for government to extend them to the thousands of communities that need them. The same is true for most other countries.

How did we get here?

Interestingly, the development of the Vetiver System and its multiple applications has come about primarily through the efforts and work of relatively few committed individuals and the free sharing of information between them. For more than 15 years, with the exception of Thailand – which has been a global leader in VGT research, development and, applications – there has been little government or other formal public institutional backing for the promotion and application of VGT. Rather, private individuals, companies, foundations and local organizations have invested millions of dollars in time and resources to develop the technology and the capacity to provide services in areas such as reclamation of mined lands in Africa and South America; in the stabilization of major public and private infrastructure in Africa, Asia and South America and; in phytoremediation on all continents (including the USA with a recent, award-winning, installation for remediation of land fill leachate in Mississippi). Despite these significant advances and many successes, the lack of broader institutional support from the formal systems of government and international development, research and technical assistance agencies (e.g., CGIAR, FAO) remains as a major bottleneck to the diffusion of the technology on a global scale. This institutional neglect has additional consequences. Multilateral (and, to a lesser extent, bilateral) development institutions that rely to a great

extent for technical guidance from these international institutions thus fail to consider VGT as an alternative when and where it is appropriate. IFAD, for example, produces no technical publications on agriculture of any kind. It uses FAO and CGIAR material, having no capacity to do this type of research itself. Similarly the World Bank's capacity, though better than IFAD's, is limited in this area. For both of these institutions, it is wiser to make use of research coming out of FAO and CGIAR. [11]

To get some insight into the scope of the institutional neglect by international research and technical assistance agencies and its consequences among the multilateral development agencies, one need look no farther than the scientific literature and research publications accessible online. Table 1 and Figure 2 (below) present the results of an analysis that sampled primary references (i.e., excluding citations) found online. Over 7,000 references were sampled from: (i) academic and technical websites (AGRIS, Springer) and search engines (Google Scholar); (ii) CGIAR affiliates and FAO, the principal international research and technical assistance agencies and; (iii) IFAD and World Bank, the main multilaterals engaged in agricultural and rural development lending globally. The results demonstrate the extent to which VGT has been largely ignored.

Table 2. Meta-Analysis of Vetiver References (Research & Applications) by Source

Source	Number of References by Thematic Area			
	Essential Oil	Agriculture Productivity	Socially Sound Development	Infrastructure
Pre-1985				
Academic & Technical[12]	629	4	4	0
Int'l Research & Technical Assistance Agencies[2]	0	0	0	0
Multilateral Development Agencies[3]	0	0	0	0
1985 to 1993				
Academic & Technical	288	113	2	2
Int'l Research & Technical Assistance Agencies	0	1	0	0
Multilateral Development Agencies	0	0	0	0
1994 to 2003				
Academic & Technical	436	1,340	459	148
Int'l Research & Technical Assistance Agencies	16	98	5	1
Multilateral Development Agencies	0	7	4	2
2004 to 2013				
Academic & Technical	1,462	3,564	714	608
Int'l Research & Technical Assistance Agencies	5	105	2	0
Multilateral Development Agencies	2	18	5	3

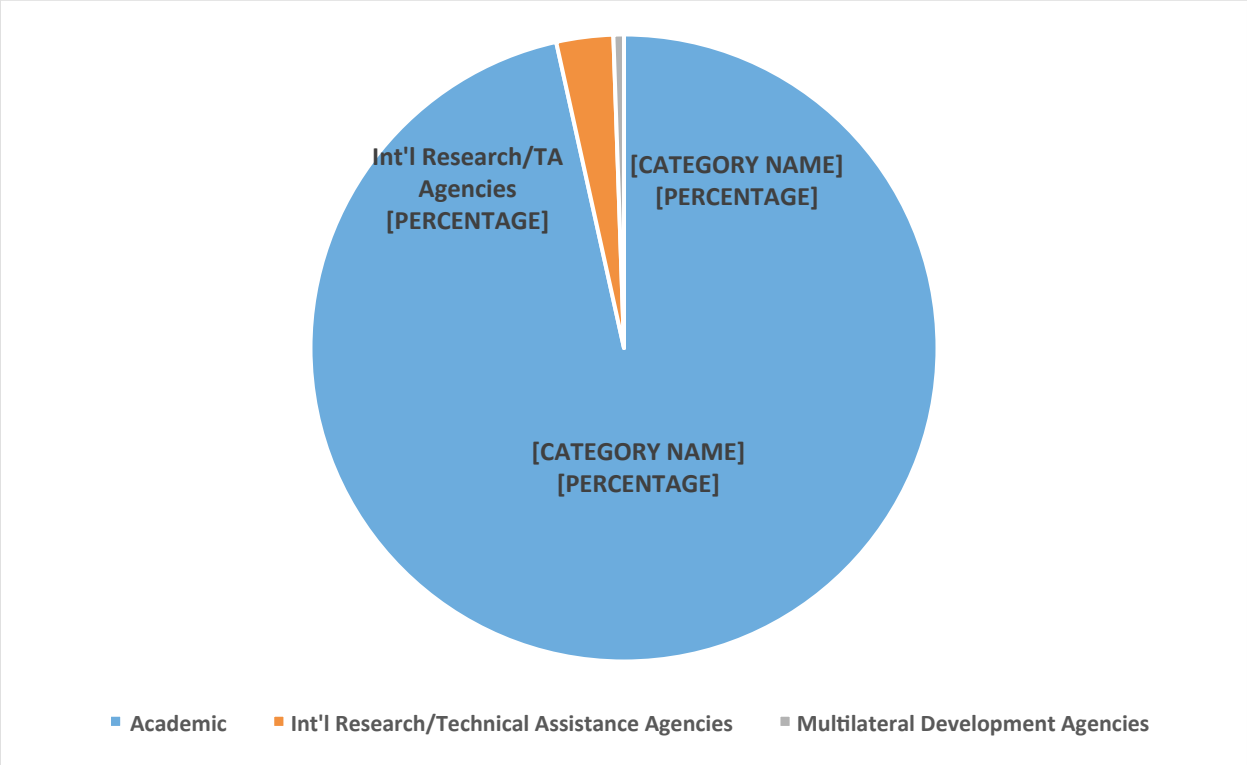
The conclusions from this exercise are quite stark: The very international agencies whose mandate it is to find promising alternatives, such as VGT, and bring them to the attention of

[11] Personal communication, 11/03/2014. Kevin Cleaver, Associate Vice-President, IFAD (2006-2014) and Director of Agriculture, World Bank (2002-2006)

[12] Sources sampled were: International Information System for the Agricultural Science and Technology - agris.fao.org/agris-search/index.do; Springer International Publishers - link.springer.com/ and; Google Scholar - scholar.google.com. [2] Sources sampled were: CGIAR and affiliated institutions (www.cgiar.org/; ICRAF - www.worldagroforestrycentre.org/; CIAT - ciat.cgiar.org/; ICRISAT - www.icrisat.org/; IWMI - www.iwmi.cgiar.org/ and IITA - www.iita.org/home) and FAO (www.fao.org) [3] Sources sampled were: World Bank – www.worldbank.org and; IFAD – www.ifad.org

governments and the international development finance agencies, have singularly failed to give attention to the Vetiver System. Yet, these are the agencies that are to be the lead organizations globally for assisting national governments in, among others, combatting rural poverty; promoting sustainable rural development and; developing and promoting alternatives for "climate smart" agriculture, for "climate proofing" communities and enhancing local capacity for climate change adaptation. That the focus and interests in VGT for sustaining and improving agriculture have declined and that as yet little attention has been given to VGT for community development may be explained to some extent by this state of affairs.

Figure 2. Number of References to Vetiver (Research & Applications) from 1994 to 2014 By Source



Where do we go now?

The challenges seem to be clear, as TVNI we need to find ways to capture the attention of these global, public sector institutions and encourage them to give the Vetiver System the serious consideration that it deserves. To those ends, several opportunities and initiatives have recently been developing that TVNI believes could offer a coherent strategy and approach, around which TVNI might focus its efforts in promoting the continued expansion and application of the Vetiver System, globally. Specifically:

- **See the Vetiver System internalized by the international research and technical assistance agencies and mainstreamed into the multilateral development agencies**. The NRC's 1993 publication *Vetiver Grass: A Thin Green Line Against Erosion* was of critical importance in its

time for elevating the utilization of Vetiver grass from an unknown technology to the level of a "technology of interest". Since that date, the state of knowledge and of practice of "Vetiver Grass Technology" has expanded exponentially. An updated scientific audit of the type carried out under the auspices of the NRC is needed to provide independent validation and ascertain if VGT should be moved from a "technology of interest" to one that is "accepted and proven". This is a necessity if the technology's potential is to be realized through a programmatic dissemination by and through global institutions and obtain systematic research and technology development backstopping. TVNI is in the process seeking partners and funding to have a global, independent, scientific and technical audit of Vetiver Grass Technology and its applications and impacts carried out. Through the assistance of one of TVNI's board members, we have been in communication the Chief Science Officer for the CGIAR system. He has indicated that the CGIAR would be interested in collaborating on this and providing both an institutional platform/umbrella under which it would be carried out as well as in-kind support. Around $0.5 million is needed still for carrying out a comprehensive audit, and TVNI is actively seeking the funding.

- **Support the development of a web-based, technical training program for VGT.** If the application of the Vetiver System is to scaled up and its use expanded around the world, technical training will have to become widely available. A group of young, entrepreneurial Colombians have come forward with the idea of establishing the Vetiver Institute and developing and offering online courses to educate and certify participants in VGT applications. TVNI plans to do all it can to support them as well as to encourage all of you to find ways to do so as well and to help make this a success. I will say no more as immediately following this talk, Daniel Londoño, the Latin American Vetiver Network Coordinator and one of the principals in this initiative will be presenting it to you.

- **Promote the establishment of a global monitoring and tracking system for VGT applications.** It is absolutely critical to have some form of monitoring and evaluation capacity in order to understand outcomes, set priorities, develop strategies and to be able to make informed and rational judgements for Vetiver System promotion and/or operations. An idea of how this might be accomplished was given to us courtesy of several individuals from the Thai[13] Land Development Department. Their paper (*Management And Monitoring Of Vetiver Grass Plantation In Thailand By Using Vetiver Grass Tracking System*), to be presented here at ICV6, details the development of a Vetiver Grass Tracking System in Thailand. Such a system might be developed globally, based on users taking their smart phones and uploading coordinates, photos and other simple information on their applications to a central database that would then be available to all. Such a system would have great value-added for many aspects of overall promotion, dissemination and, networking as well as begin to fill in our gaps in knowledge of the scope and distribution of VGT applications around the world. The value of having such a system is potentially

[13] Kittima Sivaarthitkul, Chunphen Larpchitr, Pornpat Nopmalai and Weera Pathakheenang.

enormous and it would undoubtedly give rise to many new and innovative opportunities that we might only begin to guess about at this time. TVNI will be seeking interested partners to work on making this system a reality.

Taken together, these three strategic pieces of work are being proposed as where TVNI should focus its efforts in the coming years. If successful, this strategy could make a real contribution to the Vetiver System being scaled up globally. The scientific audit would help to open the door to VGT being scaled up through the interest, attention and efforts of the global institutions whose job it is to be aware of the Vetiver System and its potential. Particularly important will be for the audit to evaluate the Vetiver System's potential as part of the global toolbox for cross-sectoral responses to climate change adaptation, especially for enhancing communities' resilience and autonomous adaptation capacity. The Vetiver Institute could then provide the needed technical foundation (training) upon which a global up scaling could be based. And, finally, the global tracking system would provide the potential both for monitoring the up scaling as well as be a means for strengthening networking at the field-level among interested users, facilitating knowledge sharing, cross-fertilization, and learning.