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the pulse of global agriculture

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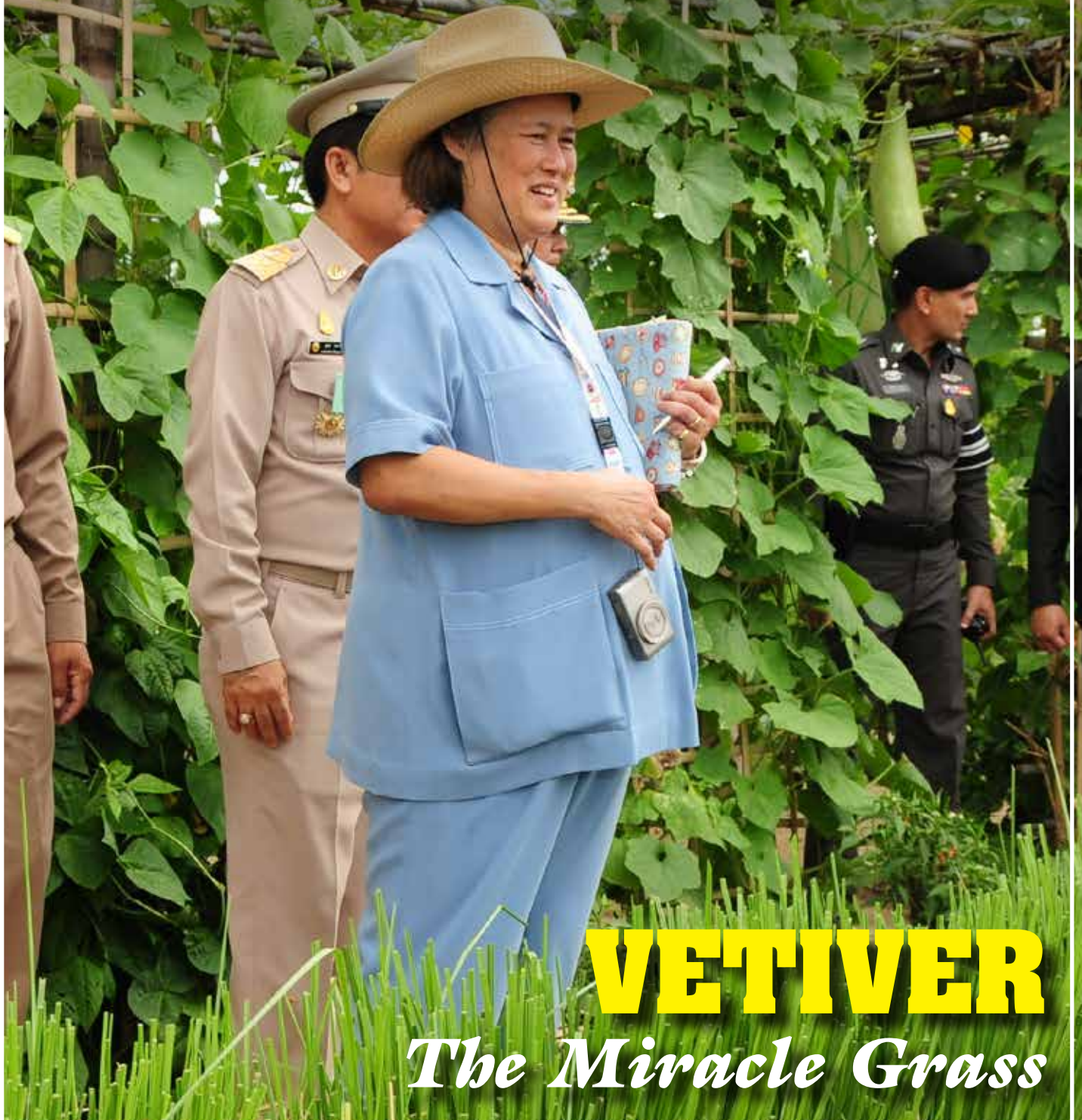


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THE VISION

Agriculture World Global Vetiver Awards, International Year Of Vetiver The Journey Begins

Millets have been part of the Indian civilization for ages. Extensive reference to millets can be found in India's ancient texts. But in these contemporary times, their goodness had been forgotten. Hon'ble Prime Minister Shri Narendra Modi brought millets on the global high table by persuading the United Nations to announce 2023 as the International Year of Millets. With this initiative, the world woke up to the amazing potential of millets and their role in addressing multiple challenges faced by humanity and environment.

It is time for India, in its role as *Vishwaguru*, to spearhead a similar initiative again. At multiple forums including the hugely popular 'Mann Ki Baat', Hon'ble PM Shri Modi has reiterated the nation's commitment to combat climate change and to work for UN Sustainable Development Goals. After the stupendous success of the global millets initiative, it is time for India to call upon the United Nations to bring another initiative under the international spot light.

VETIVER, the miracle grass which originated in India, has the amazing potential to mitigate and even reverse several global concerns like climate change, environmental pollution, rapidly deteriorating soil health, land erosion, contamination of water bodies and the like. The wise have said that nothing can stop an idea whose time has come. **It is time now for Vetiver.**

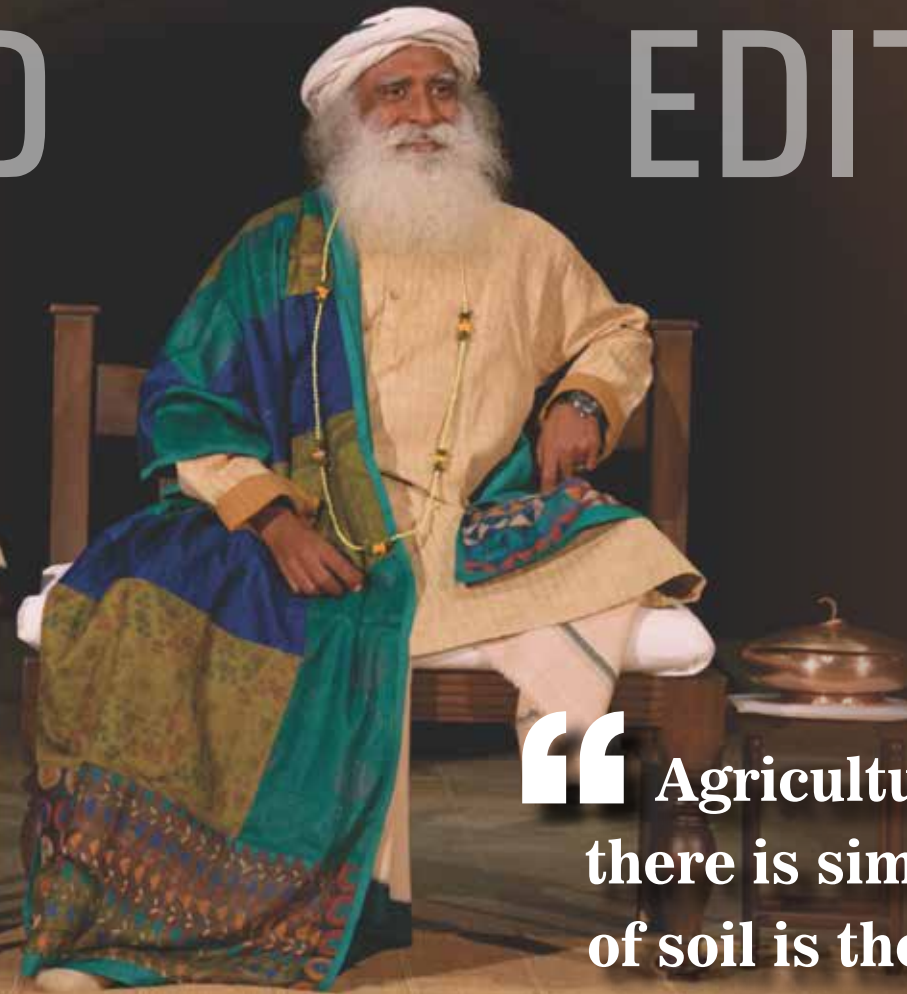
Krishi Jagran – the media house with the largest global presence in the agriculture sector, proposes to partner with **The International Vetiver Network (TVNI)** and all Vetiver enthusiasts around the world to announce the **Agriculture World Global Vetiver Awards**. The purpose of the awards is to bring global focus on the amazing potential of this wonder grass, create awareness about its advantages and honour those individuals and institutions who have played a seminal role in the Vetiver sector.

We also urge our Hon'ble Prime Minister Shri Narendra Modi to initiate the move and call upon the UN to declare **2024 as The International Year Of Vetiver**. In fact, the ability of Vetiver to address global concerns is so astounding and all-encompassing that perhaps the UN should declare a whole decade as the Decade of Vetiver. **Let a new future dawn!**

MC Dominic
Founder & Editor-in-Chief



Krishi Jagran The Pride of Agriculture



“Agriculture can only thrive on rich soil – there is simply no other way. Regeneration of soil is the invigoration of life - **Sadhguru**”

It is with pride and a deep sense of honour that we bring to you the global edition on the miracle grass Vetiver.

It is time for Vetiver to claim its space in the global arena. It is highly suitable that the Krishi Jagran Group should be part of this wonderful, inspiring movement.

Known for its forte in agriculture journalism in the last three decades, Krishi Jagran continues to occupy pride of place in various formats from print to digital to social media.

Krishi Jagran Group of Publications has been featured in the 'Limca Book of Records' for being the largest circulating, with the maximum languages and highest readership in the agriculture sector, serving the Indian rural and farming community for the last 26 years.

All this has been possible because of our visionary leadership and the remarkable work of our team over the years. It is the result of the sustained, devoted efforts of our team that the Krishi Jagran Group has excelled in services via digital and social media platforms in connecting with the vast rural and farming community. We have been recently awarded the Krishi Udyami Krishak Ratan Puraskar in the category of 'Excellence in Digital Media.'

We have 23 editions in 12 languages in the print and digital media, with a reach across all states and are considered the largest circulated agri-rural magazine in the country. Krishi Jagran acts as an exclusive platform for knowledge sharing and networking with farmers, scientists, business groups and administrators.

The overall reach of Krishi Jagran Group is 15cr+ across the country with a combined readership of 1.2cr+ through the magazines. Along with this, the Krishi Jagran Media Group has a wide follower base and active presence on multiple social media platforms with 23 lakh+ followers on Facebook itself, 13 lakh+ push notifications subscribers and nearly 1.5 Cr+ average monthly portal visitors.

The efforts of our team for nearly three decades have connected us with a wide network of KVKs and NGOs across the country along with a maximum number of FPOs, dealers, and distributors at the ground level.

We acknowledge with pride and a sense of deep responsibility and shall continue to work always with dedication and commitment.

Shiny Dominic
Managing Director

Every year around April, the Great Indian Summer arrives and the country gradually transforms into a furnace. The gentle morning sunshine of winter is replaced with a sweltering heat that sends mankind scurrying for shade. In such times, a cooling drink is almost like manna from heaven. A refresher, very common in Indian homes is the KHUS sherbet, made from Vetiver grass leaves (*Chrysopogon zizanioides*). Vetiver is known to bring down body heat and is packed with natural antioxidants that reduce inflammation in the body.

As for the roots, the essential oil extracted from them via steam distillation is an important base ingredient in perfumery. Ancient Sangam literature, written more than 2,000 years ago, also mentions Vetiver as an 'omaligai' ingredient used to enhance the bathing experience.

Indian city Kannauj's Vetiver 'ROOH' is today prized in the world of international perfume business and is the base for iconic perfumes, Armani's 'Vetiver Babylone' and Tom Ford's 'Grey Vetiver'. Interestingly, 'In The Scent Trail', artist-journalist Celia Lyttelton writes that "Scientists have isolated 150 molecules from Vetiver, and there are still more mysteries to be unearthed from its roots."

But Vetiver's story in India goes beyond its earthy perfume. It has roots in something that many Indians will find very familiar...

Coolers! The relief brought by this sweet-smelling air is best summed up by these (translated) lines written by poet Bihari Lal Chaubey:

*"As Vetiver blinds, that lend
To burning summer noons
The scented chill... Of winter nights."*

So the next time you are looking for an antidote to the heat of summers, return to the roots (literally) and try this multi-faceted 'wonder' grass!

As we are aware, along with several health benefits, Vetiver, also known as Khus, has been used for degraded land rehabilitation, erosion control and slope stabilization due to its unique massive root system. Its tolerance to high levels of toxicities makes the grass an economical solution for sustainable carbon sequestration and mitigation of climate change.

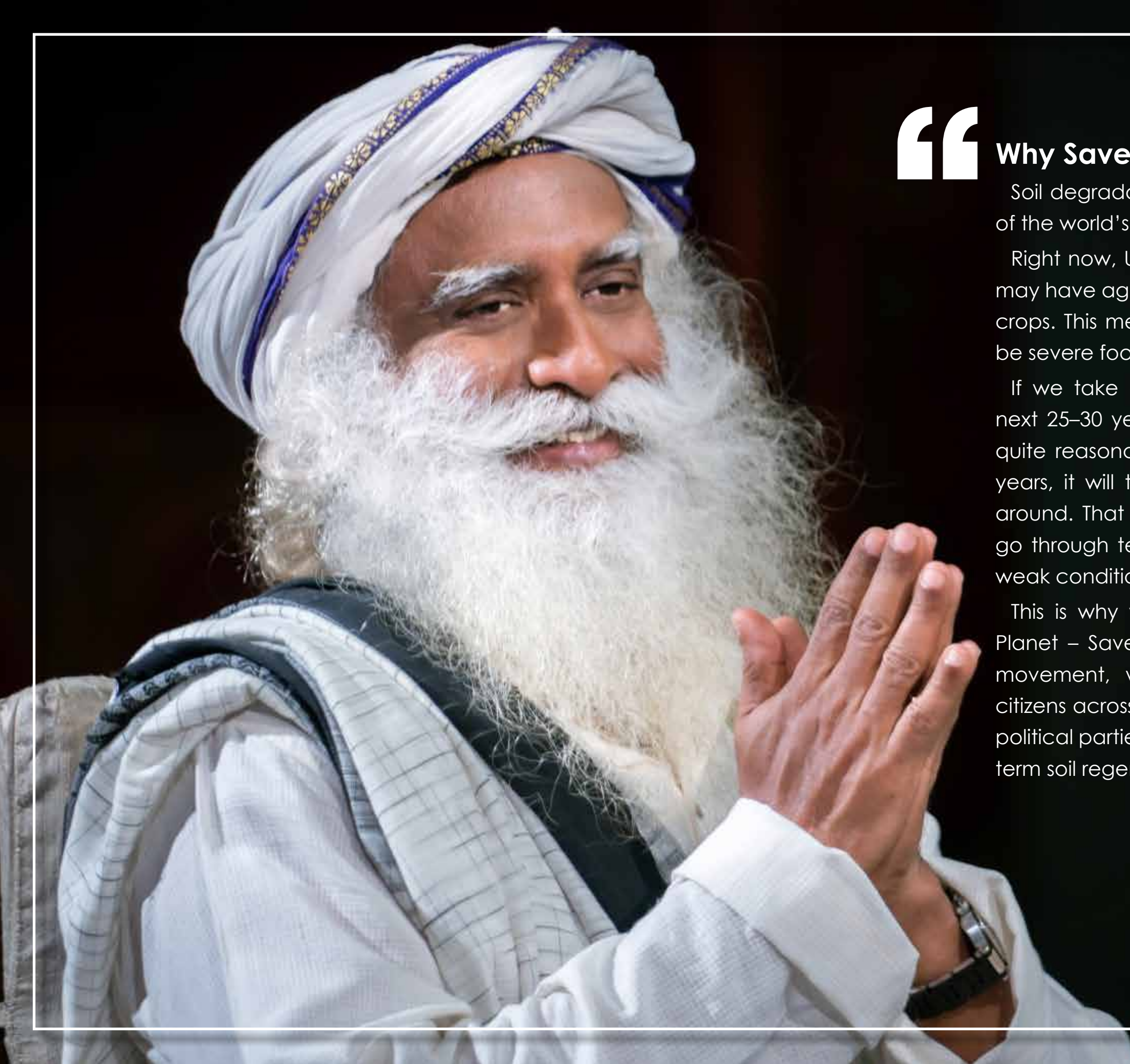
Inspired by Mr Dick Grimshaw, Founder, TVNI and Dr CK Ashok, Chairman, First World Community, this edition of Agriculture World is our tribute to this WONDER GRASS and will proudly be launched at the 7th International Conference on Vetiver (ICV-7) at Thailand in the gracious presence of Her Royal Highness, Princess Maha Chakri Sirindhorn among more than 120 participating Nations.

Mamta Jain
Group Editor & CEO

“Today vetiver has turned from an ordinary grass into a ‘miracle grass’. It has been proved worldwide that vetiver can conserve all types of soil and water.” - **Her Royal Highness Princess Maha Chakri Sirindhorn**







Why Save Soil?

Soil degradation is a global phenomenon. Half of the world's topsoil has been lost.

Right now, United Nations statistics say that we may have agricultural soil only for another 80–100 crops. This means after 45–60 years, there could be severe food shortages.

If we take concrete action now, then in the next 25–30 years, we could turn the soil around quite reasonably. But if we wait to act after 50 years, it will take 100–150 years to turn the soil around. That means four or five generations will go through terrible states of life because of the weak condition of soil.

This is why we have taken up the Conscious Planet – Save Soil movement. As a part of the movement, we have reached over 4 billion citizens across the world, and impressed upon all political parties and governments to take to long-term soil regeneration policies.

SADHGURU

Saviour Of Mother Earth



When the World Bank intervention for the vetiver project in India finished, the government did not continue the expansion of the vetiver grass project. But I was very impressed with this highly effective low cost technology. Vetiver is now being used for many other amazing applications apart from soil conservation



Mr Dick Grimshaw
Agriculturist
Founded The Vetiver Network

Traditionally, vetiver has been used mainly in the perfume industry and for medicinal purposes. But over the over the last 40 years, we have observed the many new benefits of this unique plant. Vetiver reduces soil erosion, reduces rainfall run-off, improves soil moisture reduces soil toxins, and benefits soil microorganisms.

Vetiver has very strong and deep roots. When grown as a dense, narrow hedge, vetiver can prevent erosion and soil loss from farms. These hedgerows when correctly designed will also improve groundwater recharge and provide habitat for wildlife.

Vetiver is equally effective on hills slopes and flat land creating at low cost living bandhs.

Soil Conservation, Soil Rejuvenation

My work with vetiver started around 1980s when I was working with World Bank in India. I was in Delhi for 5-6 years. One of the programs that we supported were initially four watershed development projects in south and central India. The system involving constructed graded bandhs was not very effective, costs were high, and high maintenance was required. We looked for alternative methods

We examined the work being done in Fiji and other countries. We found that biological vetiver barriers were being used for soil and water conservation and were effective even after 50 years since establishment. We also found that farmers in Kerala had been using vetiver for erosion control, livestock forage, and farm boundary demarcation for many centuries.

Sadly, nobody was interested in what these farmers were doing. Their work carried immense value, but it was being ignored by government officials. Wherever they planted vetiver ground water recharge improved (Village well water levels were higher).

In this way, our work with vetiver started and the program expanded.

For various reasons, when the World Bank intervention finished, the government did not continue the promotion of vetiver grass but the private sector and NGOs did.

While we were in India, one of the key members of my team was John Greenfield. He wrote a farmer's guide booklet on the many uses of vetiver. The book was published around 1987-88. It was translated in as many as 13 Indian languages.

Immense Environmental Benefits

Vetiver hedgerows reduce erosion up to 90 percent. They reduce rainfall run off by as much as 70 percent. They are highly effective in recharging ground water.

When I went back to Washington DC, I was Head of the Agriculture Technical department for Asia. I used the opportunity to spread information about this technology in China, Malaysia,

Indonesia, Philippines, Vietnam and also in countries in South America and Africa.

In fact some very good vetiver research was carried out in Nigeria confirming earlier some excellent Indian research that set out benefits from growing vetiver hedgerows.

Research in Thailand, Malaysia, China found that the root strength of vetiver is equivalent to one-sixth of mild steel and significantly improves soil shear strength. In different countries, vetiver started getting used for stabilizing highways, river banks, dykes, dams, drains. It turned out to be very effective, often 90% less costly than "hard" structures, and is now widely used for such purposes.

Vetiver is tolerant to most heavy metals. It reduces contamination of water and land. It removes excess pesticides and herbicides in the soil. Mining industries started using it. It is also used for treatment of contaminated wastewater and tertiary sewage effluent. Vetiver on floating pontoons can clean polluted ponds. It should be used on the many village and temple tanks in India. In China it is being used to treat the waste from pig and fish farms.

In Ethiopia it is used to treat effluent from coffee pulping mills. All these applications help to keep river water cleaner.

Multiple Uses In Agriculture

Research done in South Africa shows that vetiver can be used to reduce the incidence of agriculture pests such as stem borer of maize sorghum. Very good research in China supports the control of the striped stem borer of rice by as little as 80 vetiver plants /ha planted on paddy field bunds.

With the use of vetiver, there has been major reduction in pesticide use by farmers covering 275,000 ha (2019) of rice in south China. Vetiver provides very good habitat for beneficial insects.

Vetiver is used for regenerative agriculture. Appropriate use of vetiver can effectively stop the overuse of fertilizers, herbicides, pesticides.

Countering The Impact Of Climate Change

The health of the soil and the microbes which live in the soil, both severely depleted over the last 50 years, can be restored by combining vetiver with other practices.

Vetiver has major benefits for soil conservation purposes. Vetiver mulch is highly effective. It improves soil moisture and reduces soil temperature. The use of vetiver is very important to counter the impact of climate change.

Need To Make Farmers Aware

The use of vetiver by the farming community has been limited because of lack of awareness, inadequate user training, and availability of quality vetiver plants.

I have also observed (not just in India) that there are extension workers and even officers of various departments who do not want to promote it.

Their personal interests related to the sale of pesticides, herbicides and other products is hit by the use of vetiver.

The problem is also because of tunnel vision and personal agendas. Some people are not interested in holistic benefits that come from vetiver. What we have found is that wherever farmers have been made aware of and have understood the whole range of vetiver applications and benefits, they have adopted it fast.

Farmers should have access to good quality vetiver planting material. Vetiver that is used for commercial vetiver oil industry can be used for other agricultural and engineering benefits.

Governments, Policy Makers Need To Promote Vetiver Use

Unfortunately, we have found that many governments and politicians are not interested in the promotion of vetiver, a highly effective low-cost technology.

This unique plant offers multiple benefits across a range of sectors. It can help countries meet UN goals to achieve net zero on carbon emission.

Out of ignorance, some people consider any grass including vetiver is a weed. It is not so. Vetiver (that originating from south India) is not invasive. On social media platforms some farmers said they thought it was weed and got rid of it.

They did not know that it is wonder grass. Farmers should be given incentives to use it.

For 40 years, I have observed that vetiver is used for improving soil, improving groundwater, for dealing with floods, and for reducing landslides. It is amazing that vetiver can be used for practically anything. It can grow in a very wide range of soil and climatic conditions.

The private sector is expanding ways of commercially benefiting from vetiver - from pharmaceutical and cosmetic uses to waste water treatment, stabilizing landfills, and treating effluents. In the US, vetiver, planted on landfills, is irrigated with landfill effluent saving local authorities thousands of dollars in alternative costly disposal

With more realization among governments to do something about climate change, there will be discussion on using low-cost and effective technologies. Vetiver fits in very well with this.

Future Roadmap For Global Vetiver Sector

We have to get everybody working together on this. We have to get governments and policy makers involved. Vetiver can significantly support biological (ecoengineering) systems for soil and water conservation. It can help nations across the world deal with soil health problems.



The benefits are so humungous that the governments can give incentives to farmers who grow vetiver. Vetiver plantations shall impact communities beneficially. Communities share the same water table, the same river streams which may be contaminated. Vetiver can reverse the negatives

The cross sector benefits are so large and widespread that the governments should provide incentives to farmers who grow vetiver. Vetiver plantations impact communities beneficially. Communities share the same water table, the same river streams which may be contaminated. Vetiver can reverse the negatives.

The real strength of this technology is for rural communities, at village level. Many of these rural communities get very few services from the government, and when they do they often are often poor

Rural communities can be taught this technology. They can apply it without having to rely on unreliable or inadequate government services. This has been proven time and again by the experience of communities worldwide.

The Kenya Experiment

In East Africa the technology has worked very well for Kenyan farmers. All this is being achieved by work in the non-government sector. These initiatives involve local farmers, NGOs, private companies and community activists.

Vetiver systems act as insurance technology for farmers. Take the case of Malawi, that recently suffered a devastating cyclone. There was tremendous flooding. Many crops were wiped out. Farmers were in difficult situation and had to find ways to pay back debt.

But the farmers who had planted vetiver did not lose their crops. In these extreme weather events, vetiver plays a very important role for the farmer. There are many other examples in Central America. In 1999, there was a major hurricane where farmers lost their crop. Here again vetiver hedgerows protected their crops. The farmers did not reel under losses.

Vetiver - The Insurance Policy For Farmers

It is important that international development agencies like World Bank, Asian Development Bank etc play a stronger role in supporting this bio-engineering technology.

The Vetiver System (the name for the collective range of vetiver applications) can achieve a lot more and solve many problems.

The adoption of the Vetiver System may take some time. It may take a lot of work. When farmers come to know of a highly remunerative variety of rice, they grab it. When it comes to soil conservation, adoption is a slow process. This has to change.

There is much higher interest in vetiver now because of the challenges posed by climate change.

Even now, across India and in many nations, farmers don't know about vetiver. Wherever this knowledge has been disseminated, farmers have adopted it and most of them like it.

Vetiver can clean up excess elements in the soil. This has been established globally and is also very well researched. A study on vetiver grass will throw up thousands of references for diverse kinds of environmental research.

Concerns Over Climate Change Shall Boost Vetiver Use

When we started work in the 1980s there was hardly any research on vetiver. Slowly research has expanded and in the last three years alone some 3000 papers focus on or cite papers on vetiver.

The interest in vetiver will grow in the soil health sector. Additionally, vetiver can help mitigate some of the extreme aspects of climate change. It is extremely interesting that vetiver roots have a very strong positive association with soil micro flora, micro fauna. There is immense activity around the roots.

With the aid of these microbes Vetiver captures and processes soil nutrients that are often unavailable to plants. These are then recycled for further plant/crop growth and to the benefit of other fauna and flora in the environment. We need more focus on the the large and broad range of vetiver benefits for agriculture, and how it can support the farmers. Once the farmers understand the Vetiver System and start using the different applications they will understand the benefits, and vetiver usage will expand.



MANAGING SOIL HEALTH WITH VETIVER FOR CLIMATE AND FOOD SECURITY

Important among global issues of the 21st century are: population prone to undernutrition estimated at 1200 million and that to malnutrition at 2000 million, soil degradation affecting 2 billion hectare (B ha) of which that prone to water erosion at 1.1 B ha and that by wind erosion at 0.56 B ha, anthropogenic global warming at 1.1 OC since the Industrial Revolution and occurring at the rate of 0.2 OC/decade, the urgency to identify and implement no-carbon fuel sources viz. bioenergy, and put Sustainable Development Goals of the Agenda 2030 of the United Nations on track. An appropriate strategy to address these and other global issues is protection, restoration and sustainable management of soil health in agro-ecosystems.

Adoption of effective measures of soil and water conservation, especially in fragile landscapes under harsh climates and on agriculturally marginal and degraded ecosystems, is critical to sustainable management of soil health. It is precisely in these eco-regions that establishment of contour hedges of Vetiver (khus) has proven effective.

Vetivers' Root System, Physiological Characteristics

It is a perennial grass of the family Poaceae, native of South Asia, and has traditionally been grown for oil content contained in its roots and used in perfumes and traditional medicine. While closely related to sorghum (*Sorghum bicolor*), Vetivers' root system and physiological characteristics are even better than other perennial grasses such as lemon grass (*Cymbopogon citratus*), citronella (*Cymbopogon nardus*), and palmarosa (*Cymbopogon martinii*).

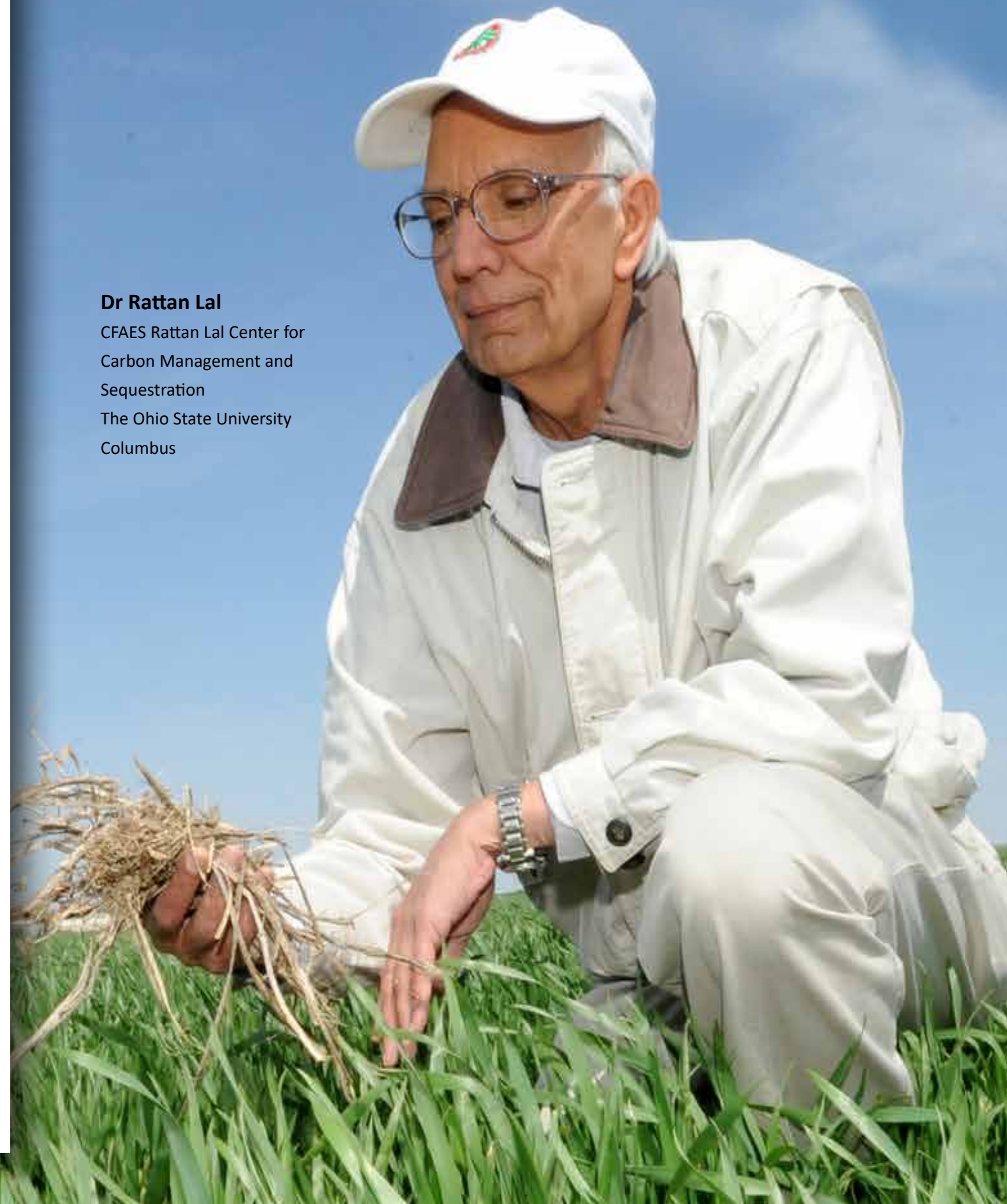
Specifically, Vetiver is characterized by a fibrous, massive, and deep root system which binds soil particles and resists the high erosivity of tropical raindrop impact and large kinetic energy of surface runoff on sloping lands. The high root: shoot ratio of 1:1, the highest among grass species, creates an extremely effective barrier against erosivity of tropical rains on sloping lands. Because of its versatility and adaptability to harsh environments, Vetiver has multiple applications to agriculture, industry, climate change and water quality and renewability, among others (Gnansounou et al., 2017; Oshunsanya & Aliku, 2017).

Soil Health Improvement Under Vetiver-Based Farming Systems

The tufted vertically growing and deep root system of Vetiver has restorative effects on soil health (Holanda et al., 2022). The latter refers to biophysical and biochemical properties of soil as a



Vetiver has multiple benefits of enhancing agronomic productivity on marginal, degraded and polluted lands while conserving soil, recharging ground water, purifying wastewater, sequestering carbon in biomass and soil for adaptation and mitigation of climate change, improving productivity and advancing Sustainable Development Goals of the United Nations of the Agenda 2030



Dr Rattan Lal

CFAES Rattan Lal Center for
Carbon Management and
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living entity to generate numerous ecosystem services essential for human wellbeing and nature conservancy. Important among these ecosystem services are sequestration of carbon for adaptation and mitigation of climate change, improvement of soil structure and hydrological properties, and increase in eco-efficiency of finite resources including green water reserve and plant available nutrients.

The massive root system of Vetiver improves soil biological properties (Maddhesiya et al., 2021), increases green water supply in the root zone, enhances shear strength, and provides an effective control of accelerated soil erosion (Kebede & Yaekob, 2009; Jotisankasa, 2015; Prakasa Rao et al., 2015; Niu & Nan, 2017; Amiri et al., 2017, 2019; Mondal & Patel, 2020; Badhon et al., 2021; Ewetola et al., 2021; Holanda et al., 2022). Vetiver has a high biomass production ranging from 22.8 to 27.5 Mg/ha in monoculture stand on marginal lands in India (Maddhesiya et al., 2021) to 67.7 Mg/ha on a good soil in Australia (Tessema et al., 2022). Under favorable conditions, the shoot and root production can be as high as 161 and 107 Mg/ha (fresh) and 67.7 and 52.5 Mg/ha (dry) biomass, respectively with 1:1.143 (fresh) and 1:1.125 (dry) production ratio (Tessema et al., 2022). Tomar and Minhas (2004) reported total mean biomass production of 30 Mg/ha. yr. in India and Thailand. In Texas, USA, Meki et al. (2020) reported biomass yield of 18.4 Mg/ha.

The high shoot biomass has multiple functions including the production of cellulosic ethanol or bioenergy feedstock (Meki et al., 2020; Kumar et al., 2023). Retention of biomass as mulch can conserve soil and water and lead to sequestration of soil organic carbon (SOC) stock in the surface and sub-soil layers. Biomass can also be used for industrial purposes.

Carbon Sequestration In Biomass And Soil

Because of its large biomass production potential, Vetiver has a high capacity to sequester atmospheric CO₂ in biomass and soil. Furthermore, Vetiver can be grown on marginal or non-agricultural lands, where it has potential to photosynthesize as much as 20 Mg C/ha-yr. In comparison with biomass production of 25 Mg/ha by Miscanthus, Vetiver can produce 100 Mg/ha of biomass under favorable conditions (Pinners, 2014). Root biomass production of Vetiver is more than that of Miscanthus.

The biomass production capacity of Vetiver has been reported to be as much as 3-9 kg/m² depending on soil and rainfall (Pinners, 2014). Vetiver can produce high biomass even on degraded or agriculturally marginal lands, mine lands, steep road banks, along highways or on urban lands. In some marginal soils of India, Singh et al. (2014) documented that SOC concentration increased from 0.64-0.7% in croplands to 1.12-1.3% under Vetiver over a 5-year period. In Ethiopia, Hailu et al. (2020) reported that SOC concentration in 0-30cm layer under hedges was 1.61% compared with 0.19% on land farther away or without hedges.



Agronomic productivity can be enhanced to advance food and nutritional security by establishing contour hedges, mulching and with other Vetiver-based farming systems

Deposition of surface soil under Vetiver hedges may be the cause of a high SOC content. Therefore, C sequestration in terrestrial biosphere by Vetiver is a natural approach to offset some of the anthropogenic emissions. Lavania & Seshu (2009) reported that Vetiver, with fast-growing tufted root system, that can reach 3-m depth in one year, has a potential to sequester 1 kg C/m²-yr (10 Mg C/ha-yr.).

Agronomic Production In Vetiver-Based Systems

Vetiver, being tolerant to drought and able to grow on contaminated soils, is a versatile tool to enhance agronomic productivity even on marginal and degraded soils. Indeed, Vetiver is a cost-effective technology for soil and water conservation, integrated pest control, phytoremediation of polluted soils, improvement of water quality and renewability, bio-energy feedstocks production, and improving eco-efficiency of agronomic systems.

Global Experiences With Vetiver

Vetiver is a tool for sustainable agricultural production even under marginal conditions (Oshunsanya & Aliku, 2017). In Nigeria, Babalola et al. (2003) reported increase in crop yield by 11-26% for cowpeas and 50% for maize by installation of Vetiver hedges

at 20-m spacing on land with 6% slope. Oshunsanya et al. (2010) reported increase in maize yield by 13.5 to 26.6% and cassava yield by 7.9 to 11.2% with Vetiver hedges at 5, 10 and 20 m spacing. Combining Vetiver hedges with Vetiver mulch can enhance productivity even more than that by hedges alone. For example, based on a study in Nigeria, Babalola et al. (2007) reported that use of Vetiver grass mulch increased yield of maize by as much as 47.7% than that from un-mulched plots.

Similarly, in Colombia, Laing (1992) reported higher productivity by combining Vetiver hedges with vetiver mulch because of increase in eco-efficiency. Inter-cropping with Vetiver, while reducing oil yield by 16.7% and also reducing crop yield, increased land equivalent ratio (1.54), land use efficiency (130%), relative net return (1.35) and total net returns of US \$4802/ha. Intercropping enhanced profit by 35% over the sole cropping (Yaseem et al., 2014).

In Ethiopia, Hailu et al. (2020) observed that yield of teff was 851 kg/ha with vetiver hedges compared with 660 kg/ha without, an increase of 29%. Branca et al. (2013) reviewed 160 studies on the effects of grasses (including Vetiver) on productivity. They concluded that Vetiver is a sustainable land management (SLM)

system with multiple benefits such as food security, adaptation/mitigation of climate change, ground water recharge, and remediation of polluted soils.

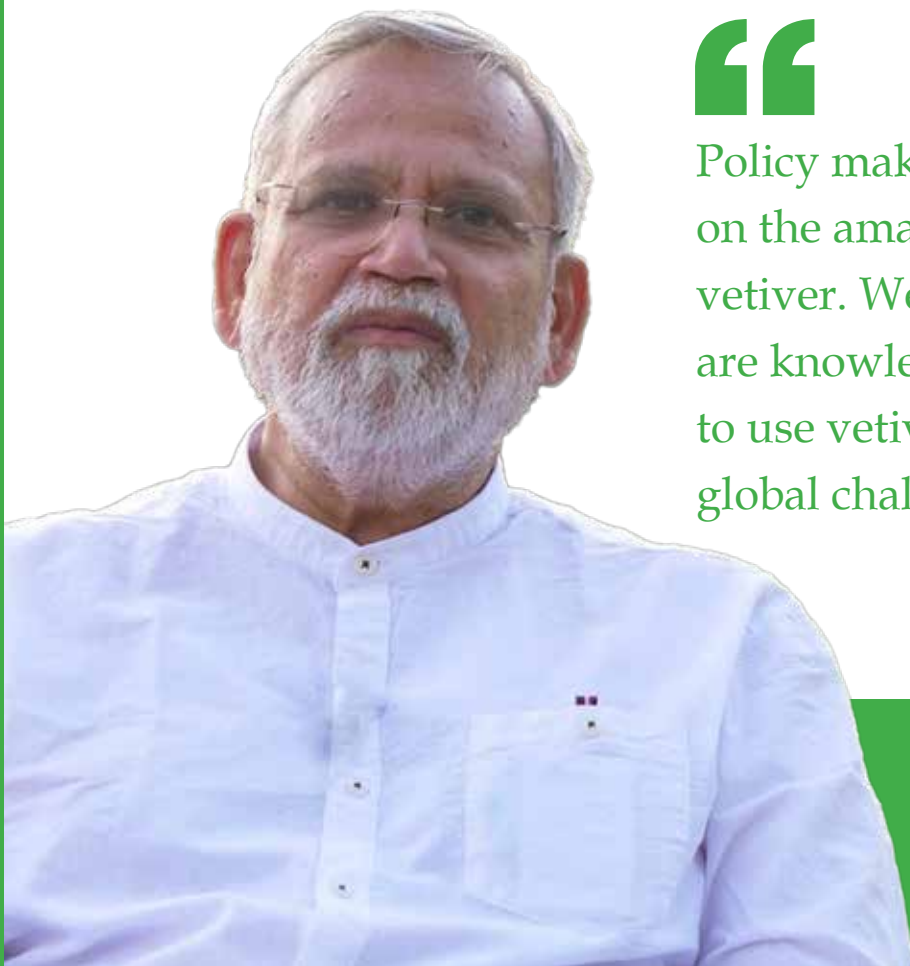
Vetiver Can Enhance Farm Income, Alleviate Poverty

Use of Vetiver is a SLM system, especially for degraded soils, drought prone and erosion-susceptible environments, marginal lands and polluted soils. In addition to being a high-value essential oil crop, Vetiver has multiple benefits of enhancing agronomic productivity on marginal, degraded and polluted lands while conserving soil, recharging ground water, purifying wastewater, sequestering carbon in biomass and soil for adaptation and mitigation of climate change, improving productivity and advancing Sustainable Development Goals of the United Nations of the Agenda 2030.

High biomass production can also be a feedstock for bio-energy production. Agronomic productivity can be enhanced to advance food and nutritional security by establishing contour hedges, mulching and with other Vetiver-based farming systems. It is a multiple-purpose grass which can enhance farm income and alleviate poverty.

Wonder Grass

The Magnitude Of Vetiver's Uses And Applications



Policy makers need to be informed on the amazing properties of vetiver. We need people who are knowledgeable about how to use vetiver to address the global challenges

Dr C K Ashok Kumar

Innovator, Co-Founder of the sachet revolution in India by pioneering efforts of Velvette, the first sachet shampoo of India. He is also the founder of First World Community

The amazing properties of vetiver have been known to the Indian civilization for long. Vetiver grass is believed to have originated in Tamil Nadu, perhaps on the banks of Cauvery river. Its many benefits have been mentioned in ancient Tamil scriptures. The historical texts reveal that King Raja Raja Chola used vetiver for its erosion-resistant properties.

The agricultural and environmental benefits of vetiver were known to farmers in south India. The knowledge of vetiver reached globally through the efforts of Dick Grimshaw and John Greenfield when the duo was part of the World Bank team in India.

Vetiver has immense medicinal value. In a temple in Tamil Nadu, even now people cue up for vetiver water to cure them of kidney-related health issues.

I had been associated with the FMCG sector. The company that I was working in developed a mix of shikakai and vetiver powder for hair health. Hence we had asked some farmers to grow vetiver to supply the raw material. This is how I connected with other stakeholders in the vetiver sector some years ago.

I learnt of the magnitude of vetiver's uses and applications, its impact on society and environment. This was highly fascinating for me, and I was drawn more and more to Vetiver Grass Technology. We have now realized that every farmer all over the world must know and benefit from the greatness of vetiver.

France is the major user of vetiver. The major suppliers include Haiti, India and Indonesia. Our farmers and other suppliers in the vetiver sector need to be more stringent about quality control. Purity of vetiver oil is a major consideration.

Our farmers and suppliers must always offer good quality vetiver essential oil. This can be done by promoting more land for vetiver cultivation. The challenge is that a large number of farmers do not know about vetiver, and of its benefit for issues related to agriculture, environment or the industry.

I persuaded Six engineering graduates led by Inbarasan to take up Vetiver farming. About 700 acres came under Vetiver cultivation. This is perhaps the largest in India for commercial farming.

Vetiver For Carbon Sequestration

Vetiver plays a very important role for carbon sequestration. Bamboo and vetiver are the two most important crops which generate oxygen. Their benefits can be maximized through more and more research, and generating higher awareness about its uses.

The government can provide some kind of support for farmers to incentivize the cultivation of vetiver. The bio-engineering aspects of vetiver are of immense importance. The government can purchase vetiver from farmer for bund restoration for rivers or lakes.

The government can also promote collective farming of vetiver. In coastal zones where other crops do not grow, we have used hundreds of acres of such land for vetiver cultivation.

I live in Tamil Nadu. I found that the graduates of CK engineering college near where I live did not have jobs. I asked them to grow vetiver and persuaded six engineering graduates to take up vetiver farming. We also found them the market for vetiver oil.

We Need More R&D To Maximize Vetiver Use

There should be more research on increasing the product line based on vetiver. It has traditionally been used in Ayurveda, by the perfumery industry, as a lifestyle product. Vetiver grass technology (VGT) can flourish if the government provides support for vetiver start-ups. There is a huge international market for vetiver.

Vetiver works like magic for soil restoration. Most farmers are ignorant about this, and they can be educated. To remove the toxins in the soil, we can plant vetiver so that soil health can be revived.

Vetiver has the property of absorbing heavy metals. It can detoxify the land. More in-depth studies should be done on the soil rejuvenation properties of vetiver and disseminate awareness.

Policy Measures To Promote Vetiver

We have specific boards like Coffee Board, Tea Board, Coir Board, Coconut Board etc. In the same way, Vetiver Board should be created so that the right policy decisions are taken, and the

government can provide support to the farmers. Marketing assistance can be provided to the farmers to promote vetiver cultivation. NABARD can help in awareness generation and also provide training. Dissemination of knowledge is very important.

The bio-engineering properties of vetiver are so immense that it can minimize the losses caused by natural calamities. This grass can even combat climate change. Knowledge dissemination can happen effectively if the government takes on this role, and also encourages start-ups in the vetiver sector.

The government can support veti-preneurs across India in diverse sectors like environment, agriculture, bio engineering, infrastructure, ayurveda, wellness, pharmaceutical industry, perfume industry etc. Vetiver can offer livelihood for so many start-ups.

There is need to further strengthen the global vetiver sector. Engineering colleges can focus on the existing product range. Through research, innovative products can be introduced.

Global Roadmap

AI can be used to disseminate the knowledge of vetiver. Specific problems of different countries can be addressed. Countries must also share their knowledge and experiences. Global warming is a burning issue we are facing today. Carbon mitigation is a major concern.

In Ayurveda, vetiver is mentioned as medicine. It is used for various purposes including the cure for impotency and build vitality. Vetiver offers a good solution for fertility-related issues. Vetiver can cure lifestyle diseases.

Policy makers need to be informed on the amazing properties of vetiver. We need people who are knowledgeable about how to use vetiver to address the global challenges.

Carbon sequestration is the need of the hour. Through overuse of chemicals, our soil has become sick. From sick soil, we shall produce sick people. We must plant vetiver to improve soil health. By improving the quality of soil, we shall improve the quality of health of human beings.



Dr CK Ashok Kumar and Inbarasan



Dr CK Ashok Kumar in vetiver garland crown and sword



Dr Umesh Chandra Lavania
INSA Senior Scientist
CSIR-National Botanical Research
Institute, Lucknow, India

“ An important and preferred requirement for optimal utilization of this grass in ecological plantations is that the plant type used in plantation should be non-seed forming / low seed forming so that it does not become weedy

VETIVER GRASS MODEL

Then and Now

From Industrial And Environmental Perspective

Vetiver grass, *Chrysopogon zizanioides* Roberty, popularly known as 'Khus' in India, is native to India, said to have its primary centre of origin in peninsular India, from where it is dispersed to northern plains and terai regions. It has been transported to South-East Asia, and subsequently to other regions all across to globe (Lavania 2002, 2008). This grass sports fast growing deep penetrating roots, known to form strong mesh of tufted roots.

The Role Of The World Bank Project

Traditionally this grass has been valued for its perfumery grade essential oil extracted from aromatic roots, and for mesh forming roots for soil and bund stabilization. With the implementation of World Bank Project in 1980s in India, there has been resurgence of interest on the application of Vetiver Grass Technology (VGT) for soil conservation and watershed management. VGT is a practical, simple and low-cost technology for environmental protection employing live vetiver plant for conservation of soil and water. Now, the Vetiver System has been successfully implemented in different countries across the globe.

Two diverse morphotypes of Vetiver are known to be naturally occurring in India i.e. (i) North Indian Type – a tall plant type with thicker roots, profuse flowering, high seed set and superior perfumery grade laevorotatory essential oil rich in ketones, and South Indian type – a short plant type with profuse tillering and thinner roots, but low and late flowering

with low seed set, higher concentration of dextrorotatory essential oil of lower perfumery value. Besides, huge diversity is known to be occurring in root-morphology – from thick to thin, smooth without secondary roots to with secondary and tertiary roots, facilitating identification of ideal root type for specific applications (Lavania 2019).

Over the years vetiver grass has been used for various industrial and environmental applications. The pre-requisites for various applications could be briefly defined as follows to meet the specific applications.

Vetiver Grass Model for Industrial Applications

The aromatic oil extracted from the aromatic roots is highly valued in perfumery industry. Quality of the essential oil remains an important consideration. For vetiver as a perfume, it is desirable that the oil contains a reasonable amount of vetiver ketones to add specific perfumery 'notes'. However, for utilization of vetiver in perfumery for its fixation property, the specific content of vetiver alcohols - vetiverol(s) is preferable.

Both Khusimol and Khushinol rich varieties are now available, at the CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow, India. Further, another requirement from cultivator's view point is to have a variety that could produce desirable quantities of essential oil in short duration cultivation, as well as reduction in distillation time. The above said institute in Lucknow has also developed vetiver varieties to meet such objectives.

Vetiver Grass Model for Environmental Applications

The deep penetrating and prominent web forming tufted root system is the primary candidate for utilization of vetiver grass for its multifarious environmental applications, including enhancement of soil health, disaster management of landslides, river banks stabilization of degraded soil, carbon sequestration in sub-soil horizon and pollution mitigation. However, an important and preferred requirement for optimal utilization of this grass in ecological plantations is that the plant type used in plantation should be non-seed forming / low seed forming so that it does not become weedy. The much-utilized applications of the Vetiver System Technology are on account of the following.

Soil Stabilization And Conservation

It is the physical properties of tufted roots and root-web that enables soil binding. This facilitates soil conservation of degraded soil, stabilization of slopes, degraded soil pans and disaster management of flood prone areas. These aspects have been extensively discussed elsewhere, and are hugely available at www.vetiver.com, hence not discussed here further.

Rehabilitation Of Contaminated Sites Through Phytoremediation

Phytoremediation is an eco-friendly, cost-effective and sustainable green technology to clean up polluted soil and water bodies. There are different phytoremediation strategies like - phytoextraction, phytostabilization, phytodegradation, phytovolatilization, rhizofiltration and rhizodegradation, that can be applied to remediate the contaminated sites based on the properties and chemical nature of the contaminant and characteristics of the plant species.

Of these, Phytostabilization could be considered most ideal when it comes to utilization of plants for remediation purpose such that toxic metals and metalloids do not enter into the main body of the plants thereby excluding entry of the toxic residues in the food chain.

Extensive studies conducted by our group on mine spoil dumps (Banerjee et al. 2019) have shown that heavy metals although absorbed by the roots of vetiver, but they remain largely confined to root zone and do not enter or have only little translocation to the shoot zone.

Observations from these findings evinced that iron deposition was high in hypodermal and cortical tissues of root cell wall and a few iron depositions were observed in the vascular bundle region of the leaves. Such localized deposition of metal in the cell wall is a protective measure to lower the toxicity within cell and can be the reason for the survival of the plants.

The presence of metal content in plant tissues is generally associated with metal-induced stress that affects their survival. Despite having high metal concentration in their tissue, vetiver plants survived successfully in iron mine spoil dump soil due to the increased enzymatic and non-enzymatic antioxidant activities of vetiver genotypes through chelation of metals by phytochelatins, and such response was even more in certain specific genotypes (Banerjee et al 2019). Such phytoremediation potential of vetiver has also been tested at the iron ore spoil dump site by establishing the vetiver plantations (Banerjee et al 2019, Vimala et al 2022).

Vetiver As Forage Crop

While screening of vetiver genotypes for various applications, it has been found that certain genotypes offer forage quality shoots having good nutritional value and palatable forage (Lavana et al 2021). An environmental model depicting rehabilitation of contaminated soil by absorption of heavy metals by roots, and utilization of shoots as fodder and other uses is depicted through Fig. 2 (reproduced from Vimala et al 2022), as an ecosystem service approach.

Vetiver For Carbon Sequestration

Owing to deep penetrating roots, vetiver is considered a prospective candidate for sequestration of atmospheric carbon deep into soil. This is suggested as a quick, simple and reasonable alternative to tree plantations (Lavana and Lavana 2009).

Vetiver Model for Industrial Utilization and Environmental Applications

Till 1980, Vetiver grass was largely used for extraction of essential oil from roots for perfumery applications and at a limited scale for soil conservation. But huge strides have since been achieved on both fronts.

While roots collected from wild were used for extraction of oil through hydro-distillation yielding oil concentration of more than 0.2 % from fresh roots, requiring distillation time of 18-24 hrs, from about 18-month-old plants, but with the development of improved varieties we are now able to obtain more than 2.0% oil (i.e., a ten-time jump). Further, varieties are also avail producing more than 1.0% oil from 8-month crop and on 8 hours of distillation.

On environmental application front we now have varieties that are suitable as Forage, as well improved soil binding potential on account secondary and tertiary roots (Lavana et al 2021), and for carbon sequestration capable of sequestering ~ 900 g of atmospheric carbon in one year from one squire land with vetiver plantations. Further, details about such designer varieties shall be presented by the present author during the ICV-7 at Chiang Mai on 30th May 2023.



Enhance Your Tractor's Performance With Savsol Lubricants

In the modern agricultural industry, tractors and other farming machinery are essential for productivity and efficiency. These machines require proper maintenance to ensure that they operate at their best and last for many years.

One of the most crucial components of maintenance for these machines is using high-quality lubricants. Savsol Lubricants is a reputable manufacturer of lubricants, and their products are among the best fit for tractors and other agricultural machinery. In this article, we will delve into the reasons why Savsol Lubricants is the best choice for maintaining your farming machinery.

Why Lubrication is Essential for Tractors and Agricultural Machinery?

Tractors, combine harvesters, silage harvesters, and grape harvesting machines are powered by high-performance engines that operate with different types of gearboxes. These machines are often exposed to extreme conditions such as heavy loads and high-pressure environments, which can cause significant wear and tear on their components. Lubricants such as engine oil, gear oil, hydraulic oils, and greases play a crucial role in reducing friction, heat, and wear and tear on these components, ensuring smooth and efficient operation.

Savsol Lubricants: The Best Choice for Tractors

Savsol Lubricants is a reputable and reliable lubricant manufacturer that has been serving the agricultural sector for many years. The company offers a wide range of lubricants, including engine oils, gear oils, hydraulic oils, and greases, that are designed to provide constant protection and extend the service life of farming machinery.

High-Performance and Efficient

Savsol lubricants are formulated to provide high performance and efficiency, ensuring that your machinery operates at its best. The lubricants are designed to increase equipment reliability, boost performance, and improve efficiency. Using Savsol lubricants can result in increased resistance of your machinery to heavy loads and high pressure, minimizing downtime, and maximizing operational abilities.

Savsol Lubricants provides constant protection and extends the service life of your farming machinery. By using these lubricants, you can maintain your agricultural equipment efficiently and minimize its downtime. As a result, you can experience maximum performance and smooth operation, which can lead to greater yield and higher profits.

Increased Uptime and Operational Reliability

Using Savsol Lubricants can increase equipment uptime and ensure operational reliability, no matter the weather conditions or terrain. These lubricants have been tested under different weather conditions, and they have proven to provide constant protection, even under extreme temperatures. They are also designed to provide excellent oxidation stability, which means that they can maintain their performance for an extended period, reducing the need for frequent oil changes.

Environmentally Friendly

Savsol Lubricants are environmentally friendly and comply with environmental regulations. They are formulated with high-quality base oils and additives that meet or exceed industry standards, ensuring that they have minimal impact on the environment.

Wide Range of Products

Savsol Lubricants offers a wide range of lubricants that are designed to cater to the needs of different types of farming machinery. Their range of products includes engine oils, gear oils, hydraulic oils, and greases, all of which are formulated to provide the best performance and efficiency.

In conclusion, lubricants are an essential component of the maintenance of tractors and other agricultural machinery. Using high-quality lubricants such as Savsol Lubricants can significantly enhance the performance, efficiency, and longevity of these machines. Savsol Lubricants is a reputable manufacturer of lubricants, and their products are among the best fit for tractors and other agricultural machinery.

To learn more about Savsol and its range of products, please visit their official website at – www.savsol.com.



Comprehensive Range of Tractor Engine Oils



Dr Paul Truong

Technical Director
The Vetiver Network International,
Director for Asia and Oceania. He is a
leading global scientist and practitioner for
Vetiver application in phytoremediation of
wastewater and contaminated land

VETIVER PHYTOREMEDIATION TECHNOLOGY (VPT)

For Improved Water Quality & Pollution Control

“ The study conducted by Michigan State University identified the biochemical pathways associated with tetracycline (TC) transformation/ degradation in vetiver grass. Vetiver has the potential to be used as a biological remediation system in TC contaminated water sources.

In the last 30 years, VPT has been widely studied and proven to be an effective, low cost and sustainable method for cleaning up municipal and industrial wastewater. Vetiver grass was shown to lower BOD and COD. VPT has demonstrated that in four weeks Vetiver reduced organic matter of 96% for BOD and 94% for COD. Normal biological treatment using ponds requires at least two to three months of detention time, so the success of obtaining acceptable results in less than a month represents a significant breakthrough.

Why Vetiver Is Ideal For Environment Protection

The following characteristics demonstrate why vetiver is an ideal plant for environmental protection:

- Vetiver grass has neither stolons nor rhizomes, but rather a massive, finely structured root system that reaches 3 to 4 meters in its first year. This extraordinarily dense root system reinforces the soil and makes it extremely difficult to be displaced by high-velocity flows.
- When planted in close proximity, the upright stems to create a dense hedge. These hedges can withstand moderately deep-water flow, slow the water down, and collect sediment.
- Extremely resistant to insects, disease, and fire.
- Tolerance for extreme climatic variations such as extreme temperatures from -15° C to 60° C.
- Tolerance for prolonged drought, flooding, and submersion.
- Highly tolerant of high acidity, alkalinity, salinity, sodicity, and magnesium in the growing medium.
- Highly tolerant to soils containing Al, Mn, As, Cd, Cr, Ni, Pb, Hg, Se, and Zn.
- High level of herbicide and pesticide tolerance
- Extremely tolerant and efficient at absorbing nutrients, especially nitrogen and phosphorus
- Highly efficient at absorbing dissolved Hg, Cd, and Pb from polluted water.
- Quick recovery from damage caused by the aforementioned stresses.

Dealing With Water Contamination

The “International Conference on Water” held in Singapore in 2001 concluded that billions of people throughout the world are facing the problem of fresh water shortage. This includes water for agricultural uses, for everyday household uses, and even for consumption and drinking.

The goal of the International Fresh Water Conference held in Bonn, Germany in December 2001, was to develop solutions to global water problems. One fifth of the world’s population do not have access to sufficient clean drinking water. Wastewater from around 2.5 billion people cannot be disposed of hygienically. Polluted drinking water is the number one cause of disease around the world. At the same time, poor water supply reinforces poverty and gender inequality.

The presence of veterinary and human antibiotics in soil and surface water is an emerging environmental concern. Environmental

contamination by antibiotics perturbs the ecological balance. It also poses a risk to human health by promoting the development of multiantibiotic-resistant bacteria.

The study conducted by Michigan State University identified the biochemical pathways associated with tetracycline (TC) transformation/degradation in vetiver grass. Vetiver has the potential to be used as a biological remediation system in TC contaminated water sources.

A hydroponic experimental setup was used with four initial TC concentrations (0, 5, 35, 75 ppm), and TC uptake was monitored over a 30-day period. Results show that TC transformation in the media occurred during the first 5 days.

A decrease in the parent compound and an increase in the concentration of the isomers such as epitetracycline (ETC) and anhyrotetracycline (ATC) occurred, and TC disappeared in 20 days in tanks with vetiver grass. Transformation products of TC in plant tissue were analyzed by using ultra HPLC high-resolution Orbitrap mass spectrometry (HRMS/MS).

This indicates amide hydrolysis of TC in vetiver roots. Metabolic profiling revealed that glyoxylate metabolism, TCA cycle, biosynthesis of secondary metabolites, tryptophan metabolism, and inositol phosphate metabolism were impacted in vetiver root by TC treatment.

Case Study In Australia

The disposal of industrial wastewater in Queensland state of Australia is subjected to the strict environmental guidelines enforced by the Environmental Protection Authority. The most common method of treating industrial wastewater in Queensland is by land irrigation, which is presently based on tropical and subtropical pasture plants. However with limited land area available for irrigation, these plants are not efficient enough to sustainably dispose of all the effluent produced by the industries. Therefore to comply with the new standards, most industries are now under strong pressure to upgrade their treatment processes.

Over the past two years a series of research projects conducted at GELITA Australia gelatine factory in Beaudesert, Queensland and at Teys Bros. abattoir in Beenleigh to determine a viable means to achieve these goals. The VPT has been identified as having the potential to meet all the criteria:

- Vetiver has the potential of producing up to 132t/ha/year of dry matter yield as compared to 23 and 20t/ha/year for Kikuyu and Rhodes grass respectively
- With this production vetiver planting has the potential of exporting up to 1920kg/ha/year of N and 198kg/ha/year of P as compared to 687 of N and 77kg/ha/year of P for Kikuyu and 399 of N and 26 of P for Rhodes grass respectively.
- Vetiver growth can respond positively to N supply up to 6000kg/ha/year and to ensure this extraordinary growth and N uptake, P supply level should be at 250/ha/year.

Based on the above results the two companies have developed long term implementation plans for effluent and other solid waste product disposal.

VETIVER

The Miracle Grass

Mr P Haridas

Thiruvalli, Alappuram District, Kerala



Knowledge Of Vetiver In Ancient Indian Texts

Vetiver is mentioned in the ancient Sanskrit writing and is part of mythology. The earlier generic name Vetiveria comes from "Vettiver", its name in Tamil meaning 'root that is dug up'. It has been used in India since ancient times and is recorded as a medicinal plant Hindi Ayurvedic science.

Its common name in other languages are Vettiver, Ilamichamver (Tamil), Ramacham (Malayalam), Vattiveeru, Lavancha (Kannada), Birina (Assamese), Khus (Bengali), Bala, Bena, Panni (Hindi)

“

World Bank agriculturists Richard Grimshaw and John Greenfield had an entrancing vision. A little known grass called Vetiver, they proposed, could provide answer to soil erosion, and it could do so in a way that would appeal to millions of farmers, land owners, politicians and administrators

Vetiver grass is a tropical plant known botanically as *Chrysopogon zizanioides*. It belongs to the same family, Gramineae as rice, wheat, maize, sugarcane etc. It is no exaggeration that in Plant kingdom few existing plants have the unique attributes of multiple uses, environmental friendly, effective and simple use as Vetiver. Fewer plants have been idolized as "Miracle Grass", "wonder grass" with capacity to create a living wall, a living filter strip and 'live nail' reinforcement.

This plant can be grown over a very wide range of climatic and soil conditions. If planted correctly it can be virtually grown anywhere under tropical, semi tropical and Mediterranean climates. When Vetiver is grown in the form of a narrow self sustaining hedge row, it exhibits special characteristics that are essential to many of different applications that comprise the Vetiver System.

This plant, *Chrysopogon zizanioides* is promoted in nearly 100 countries for VS applications. It originated in South India, is sterile, non invasive and has to be propagated vegetatively by its tillers (slips). The specific name "zizanioides" means river side which reflects the fact that in the remote past the plant was commonly found in the river banks along the water ways in India where it is known as Vetiver, Vetivert or khus.

The Use Of Vetiver In Rural Households

For several centuries Vetiver has been commercially cultivated for the scented oil that is distilled from its roots. Villages weave these roots into mats, baskets, fans and ornaments. They also weave them in to window covering that freshen the air of homes with a penetrating scent. The roots and oil are known to repel insects. People in India and elsewhere have long used Vetiver roots among their cloths to keep insects away.

Vetiver Effectively Combats Soil Erosion

Soil erosion is a quiet crisis, largely manmade disaster that is unfolded in many parts of the world. The changes it brings are chronic and irreversible: lost land, reduced productivity of farms, plantations and forests, silted rivers, canals and irrigation works, washed out roads, bridges and destroyed agricultural land where myriad valuable micro organisms would normally breed and prosper.

Soil erosion is getting worse in warmer parts of the world. The world's forests are disappearing 30 times faster than they are being re-established. Such immediate and far reaching consequences have led to its recognition as one the most serious agricultural problems of the world.

Suffice to say, soil erosion is literally costing the earth. It is with this scenario in mind that many people around the world who were concerned about the environmental problem became intrigued by the ideas of two World Bank Agriculturists, Richard Grimshaw and John Greenfield. These two had an entrancing vision: a little known grass called Vetiver, they proposed, could provide answer to soil erosion and it could do so in a way that would appeal to millions of farmers, land owners, politicians and administrators.

Many studies all over the world have shown that Vetiver as a hedge is the ideal plant to conserve soil and rehabilitate eroded land. This grass has been used for soil and water conservation in agricultural land for many years but its related impact on land stabilization, soil erosion and sediment control only started in the late 1980s following its promotion by the World Bank.

Vetiver Combines Several Characteristics That Make It Special

- When planted correctly, Vetiver will quickly form a dense, permanent hedge, which will reduce water flow velocity, divert runoff water and form a very effective filter.

- It has strong fibrous root system that penetrates and binds the soil to a depth of 3 meters and can withstand the effects of tunneling and cracking.
- It is perennial and requires minimal maintenance.
- It is practically sterile and because it produces no stolons or rhizomes it will not become a weed. It will not compete with the crop plants it is used to protect.
- It has stiff and erect stems which can stand up to relatively deep water flow. As its crown is below the surface it protects the plant against fire and overgrazing.
- Its sharp leaves and aromatic roots repel rodents, snakes and similar pests.
- Its leaves and roots have demonstrated a resistance to most diseases.
- Once established, it is generally unpalatable to livestock. The tender leaves, however, are palatable.
- It is both xerophytes and hydrophyte and once established it can withstand drought, flood and long period of water logging.
- It is cheap and easy to establish as a hedge and to maintain as well as to remove if it is not wanted.
- It will grow in all types of soil regardless of fertility, pH or salinity. It is highly tolerant to toxic levels of aluminium, manganese, arsenic, cadmium, chromium, nickel, copper, mercury, lead, selenium and zinc.
- It will grow in a wide range of climates. It is known to grow in areas with average annual rainfall between 200 and 6000 millimeters and with temperatures ranging from 10 to 45 C.
- It is a climax plant and therefore even all surrounding plants are destroyed by drought, flood, pests, diseases, fire or other adversity, Vetiver will remain to protect the ground from the onslaught of next rains.
- Vetiver roots are very strong with average tensile strength of 75 Mpa (1/6th of the strength of mild steel).

All these may seem strange but there is more! Vetiver grass grows so densely that it can block the spread of other grasses including some of the world's worst creeping grasses. In Zimbabwe tobacco farmers plant Vetiver around their fields to prevent Bermuda grass from penetrating their fields from adjacent road sides.



SCL India Leads the Way in Enhancing Indian Farmers' Productivity and Quality

SCL India (SCL Commercial India Pvt Ltd), a fully-owned subsidiary of SCL Italia, was established in 2022, with Mr Tanveer leading the company in India and Dr Rajesh Kumar Sharma providing guidance to the technical team. Currently, SCL India employs a team of nine individuals. Their representatives are located in Karnal, Lucknow, Vadodara, Nashik, Hyderabad, and Coimbatore, with their headquarters situated in New Delhi.

Through successful collaborations with their partners (importers), SCL India has introduced cutting-edge and revolutionary plant nutrition technologies in nearly 14 states. Notably, they recently had the privilege of hosting Dr Matthias Griesbach (Global Sales Director-FertiGlobal), Mr Claus Brakemeier (Business Development Manager-FertiGlobal), and Ms Margareth (Global Coordinator-Technical Activities) during their visit to the Indian market from March 18th to 26th, 2023.

On March 18th, an interactive session took place between Team SCL India and the global delegation. Mr Matthias provided valuable guidance and motivation to their team, emphasizing the challenges faced by Indian agriculture in terms of low productivity and occasional issues with yield quality.

He emphasized that yield and quality are crucial factors influencing farmers' profitability and expressed confidence in FertiGlobal technologies. These technologies are poised to play a vital role in enhancing the happiness of Indian farmers by ensuring better productivity and improved quality.

In his address, Mr Claus Brakemeier highlighted the achievements of Indian agriculture in terms of grain self-sufficiency. However, he acknowledged that the industry's production methods are resource-intensive, focused primarily on cereals, and biased towards certain regions. These resource-intensive practices have led to significant sustainability concerns, including increased stress on water resources, desertification, and land degradation. FertiGlobal's central focus is protection, encompassing various aspects such as soil, seed, plant, yield, and the farmer. Their unique approach places nutrition as a pivotal factor in plant protection.

During their visit, the global team had the opportunity to meet with their partners in various locations across the country, including Srinagar, Nashik, Hyderabad, Mumbai, and Coimbatore.

Additionally, they organized a large-scale gathering in Coimbatore, South India, where leading farmers, distributors, and retailers came together. This event served as a platform for productive discussions and educational sessions, highlighting the advanced technologies offered by SCL India to all their stakeholders.



“ The VS toolkit has evolved over thirty years of continuous innovation and experience with development, application, and adoption. It offers some thirty different eco-engineering applications for agriculture, the environment and more ”

VETIVER TOOLKIT

The Climate Smart Technology



Mr Jim Smyle
President/Chairman, Board
TheVetiverNetworkInternational

Communities in the Global South urgently need practical and affordable means to adapt and prosper in face of climate change. Public sector-driven, “planned adaptation” initiatives simply will not reach most of them in time. The scale of the problem is too big. India and Sub-Saharan Africa alone have some 2.4 million villages, and Pacific Islanders occupy 15% of the earth’s surface. Approaches and tools to empower communities to take the lead in overcoming their priority adaptation challenges are needed now! This is especially true for the most vulnerable communities on the frontlines of climate change: poor, rural communities dependent upon smallholder agriculture. The Vetiver System (VS) – with its broad range of applications proven effective across a wide range of soil/climatic conditions – offers them a multipurpose “toolkit” that is available right now.

Urgency Of The Vetiver Toolkit

The urgency of getting the Vetiver toolkit into the hands of communities is underscored by the IPCC’s Climate Change 2022 report that tells us that “...despite progress, adaptation gaps exist between current levels of adaptation and [what is] needed to respond to impacts and reduce climate risks...[Existing efforts are] fragmented, small in scale...and focused more on planning rather than implementation [with] the largest adaptation gaps among lower income groups”.

What progress is seen amongst rural, smallholder farming households is primarily through their own efforts, and not as a result of public sector support or programs. This was the conclusion of another recent study that reviewed hundreds of major adaptation support programs in Asia, Africa, and Latin America.

Worrisome Adaptation Gaps

The authors found worrisome “adaptation gaps” and noted that local efforts fall short due to the lack of focus on implementation and capacity building, and the bureaucratized approaches of public programs that should be supporting them. In short, government and donor-dependent support for climate change adaptation suffers from too little financing, and too little on-the-ground action.

This is where the Vetiver toolkit – a practical and affordable package that rural households/communities in the Global South can manage themselves to adapt to climate change – offers great promise for community-led climate change adaptation.

The VS toolkit has evolved over thirty years of continuous innovation and experience with development, application, and adoption. It offers some thirty different eco-engineering applications for making agriculture climate-smart, sustaining soil and water resources, and improving soil health; stabilizing and protecting infrastructure and watersheds; decontaminating land and water; preventing and mitigating natural disasters; enhancing livelihoods (e.g., fodder, handicrafts, roofing thatch, essential



oil, medicines); and effectively sequestering and conserving soil organic carbon. The table below summarizes the range of benefits that farmers, communities, and societies will perceive from taking advantage of the Vetiver toolkit.

VS Toolkit: The One-Stop Alternative

The VS toolkit for community-led climate change adaptation can be effectively applied across almost the entire range of soil and climatic conditions found in the tropics and sub-tropics. It is a “one-stop” alternative for many of the challenges faced by rural agricultural communities.

All applications are based on the plant *Chrysopogon zizanioides* (Vetiver grass), which is well-known to science and backed by extensive research. It is found in over 120 countries and is already familiar to many rural populations. No other simple system offers such an array of applications nor is any other individual alternative as institutionally simple, low cost, or technically straightforward to apply.

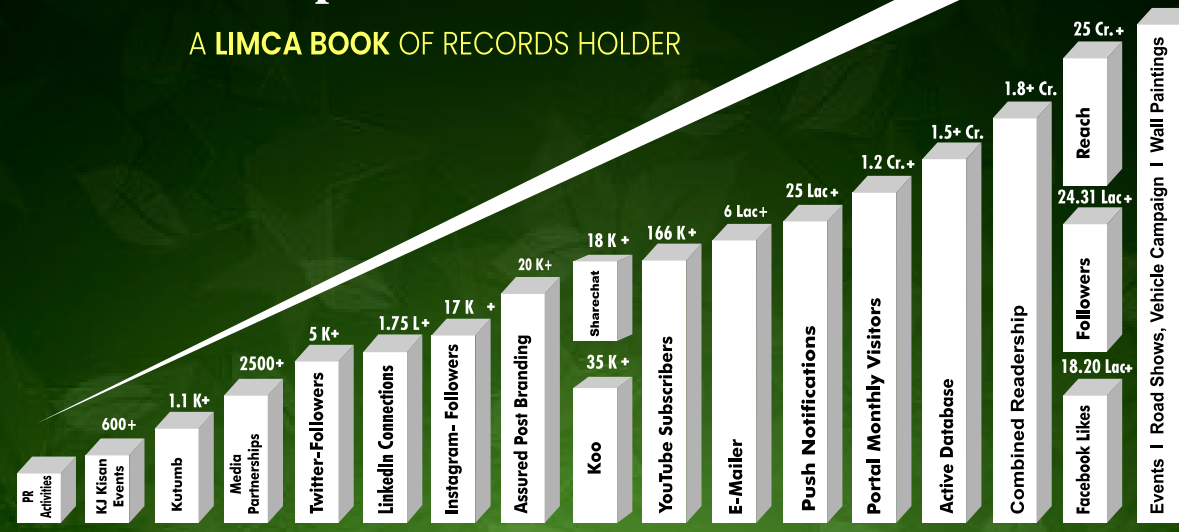
There are other alternatives for soil conservation under non-critical conditions, but under extreme rainfall/flood events, drought, and on steeper slopes none have the all-in-one, multi-protection that VS provides. All-in-all, the VS toolkit is cheaper, more effective, more user friendly for poor rural communities, better quality and more easily scaled.

The proof of this lies in the fact that the VS is now found in so many countries around the world because people searching for a solution to a problem learned about Vetiver Grass, tried it, and found that it worked. There are millions more communities in the Global South which, given the option, would find that VS supplies many of the solutions they are looking for. Let’s get the VS toolkit into their hands.



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THE VETIVER MAGIC

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**Permanent
Multilayer Food Forest**



Mr Patanjali Jha

former Principal Chief Commissioner of Income Tax Mumbai, has created Vanya Natural Farms, a food forest spread across 100 acres of land in Madhya Pradesh and Bihar, with a range of trees having commercial and medical value.

Mr. Jha has been awarded the Governor's Environmental Award, Finance Minister's Award and was recognized as one of the Heroes of Sustainability in 2020



“

The temperature in Vanya on any given day is 15° C less than in neighbouring areas. With Vetiver, Subabool and certain types of bamboos, huge carbon sequestration can be achieved. Soil fertility is restored and poison free medicinal food products are made available

Vetiver along with no till, no poison, permanent multilayer multi-species food forest can be beneficial in increasing biodiversity, reducing temperatures and global warming, carbon sequestering, controlling cancer incidence, water harvesting, rejuvenation of rivers and underground water recharge, and increasing farm incomes.

The Amazing Benefits Offered By Vetiver Systems

Vetiver can be said to have the potential of being the ‘Saviour of Mother Earth’. All of these beneficial effects can be had by practising all of the following:

- Setting up of food forests with multi-layers and no tilling, no chemicals, no pesticides, including Moringa as one of the trees amongst others, and use of Vetiver and seedballs;
- Use of Vetiver grass for afforestation of wasteland, slope stabilisation, carbon sequestration, groundwater recharge, reversing soil degradation, and biomass; and
- Riparian buffers with Vetiver grass and trees along riversides for river water regeneration and purification and preventing riverbed silting and riverbank soil erosion;
- Setting up of Compressed Bio Gas (CBG) production plants to produce biofuels from biomass;
- Substitution of CBG for Compressed Natural Gas (CNG) and second generation (2G) biofuels.

Food Forests In Bihar And Madhya Pradesh

Our on-ground experience and experiments provide the basis for this conclusion. We have successfully set up food forests in the states of Bihar and Madhya Pradesh in India on over 100 acres of land. Afforestation work taken up by the Eco-Task Force (ETF) of the Indian Army using Vetiver grass gifted by us in the Marathwada region of Maharashtra and also banks of river Ganga between Allahabad and Varanasi in association with us is also a proof of concept.

Vanya: A Food Forest

Vanya Organic farm is situated on the banks of the Narmada River in the state of Madhya Pradesh in India. Creating food forest is a method of replicating Nature as far as possible, with human interventions restricted to filling the gap of natural resources of that particular area. An important component is the introduction of Vetiver and nitrogen fixing plants to fill the existing gaps of that area's ecosystem and to continue supporting it. The core principles behind the no-till natural food forests, such as Vanya, are:

- Soil fertility is derived from the microbe ecosystem of the top soil.
- Any exposure to harsh sunlight is extremely harmful to the microbe ecosystem of the top soil, hence no-tilling is adopted. No tilling leads to less greenhouse gas (GHG) emissions

as compared to the conventional system of agriculture with tilling. No-till farming reduces nitrous oxide (N₂O) emissions by 40-70%, depending on rotation. Nitrous oxide is a potent GHG, 300 times stronger than CO₂, and stays in the atmosphere for 120 years.

- Microbes flourish under damp condition, hence mulching and covering every inch of soil is important. This in turn preserves the moisture content of the soil, retains water in the topsoil and recovers groundwater levels, leading to less need of irrigation, and provides advantageous conditions for microbial growth. In our farms, almost every inch of soil is covered by live mulch. The thick cover of Vetiver mulch increases water infiltration and reduces evaporation, particularly important under the hot, dry conditions. It also protects the soil surface from the impact of raindrops, a major cause of soil erosion. The mulch on the ground makes the sunlight that does reach through the trees on the ground lose its harshness that could destroy the living organisms feeding on the mulch from trees.
- Mix of native plants and remunerative plants are sown with gay abandon and Nature is allowed to decide what is best for that area. The perennial trees and plants are carefully selected from locally adapted or ‘desi’ (local) species, some with leaves (e.g., Moringa) small enough to allow sunlight to filter through to the lower layers. This bio-diverse tree growth forms the biomass that enriches the soil and feeds the numerous microorganisms and animal life that thrive on decaying plant matter.

- Application of seed balls.
- Trees, shrubs, creepers, tubers, Vetiver are grown together. Being multi-layer, the farm productivity is greater than in conventional agriculture techniques.
- Pollination is done by birds, bees, monkeys, so there is arrangement of their food in the food forest. Flowers like pink pepper and water are ensured for the bees the year round. Bee boxes are also used.
- No man-made chemicals of any kind such as pesticides, fertilizers, growth boosters etc. are used. Vanya does not use cattle manure, as the vast quantities of varied biomass from the trees are sufficient food for the soil. Neither are any organic or natural pest repellent sprays used, as healthy soil creates healthy plant life – and if there are insects that eat some fruits or leaves, let them too live.

Vanya Organic: Bio-Diverse Food Forest

At Vanya Organic, of the total 40 acres, planting of the bio-diverse food forest continues apace on 20 acres, while the rest is already well forested. There are tens of thousands of trees, with heights varying from 15–50 feet and lower—a huge biodiversity of hundreds of varieties: 400 mango trees, 5,000 drumstick (Moringa), 5,000 citrus (rangpur lime, mausambi, kaffir lime, grapefruit, kagzi



lemon), 7,000 papaya, 5,000 Subabool, 500 Neem, and thousands more of perennial Arhar, Amla, Guava, Kathal (Jackfruit), Ber, Pink Pepper, Jamun, Banana, Babool, Glyricidea, Teak, Phalsa, Sharifa, pomegranate, Bel, Wisdom Tree, Swarn Champa, Khajoor and Coconut; and finally the understory of thousands of plants of Ginger, Turmeric, Aloe Vera and millions of slips of Vetiver. Flax seeds, fenugreek seeds, bhui amla, sweet potato, yam, tamarind, insulin plants, and Shatavari are also grown in abundance.

Temperature Control In Vanya

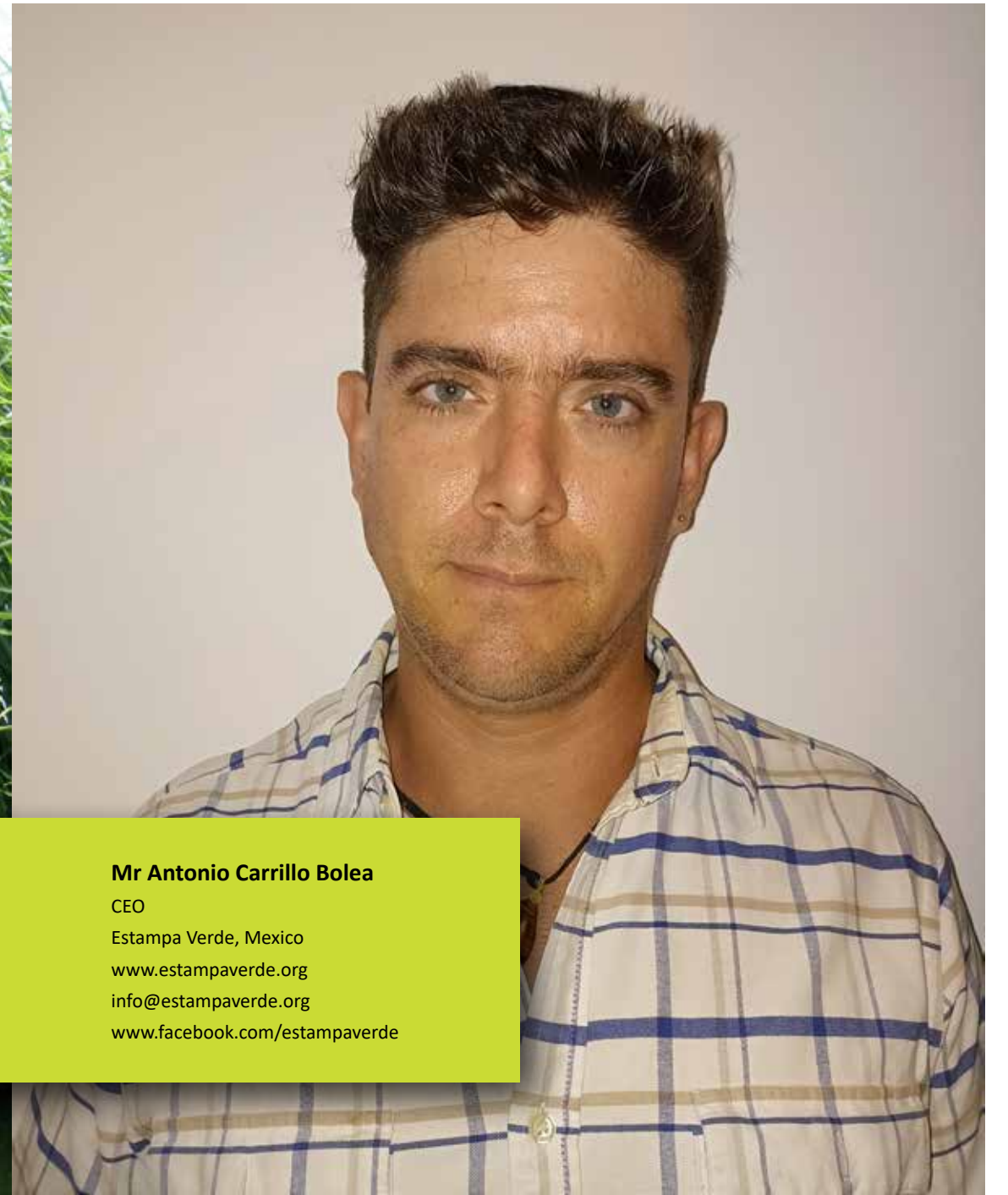
The temperature in Vanya on any given day is 15 degree Centigrade less than in neighbouring areas. Many plants grown at Vanya Organic, especially guduchi, turmeric, aloe vera, Vetiver, and moringa, have been found to be very medicinally effective. In Ayurveda, Vetiver has multiple uses due to its cooling and alkaline properties, reduces stress and anxiety, amongst other uses.

With Vetiver, Subabool and certain types of bamboos, huge carbon sequestration can be achieved. Soil fertility is restored and poison free medicinal food products are made available.

Vetiver can be used along with Nitrogen-fixing plants and dense food forests created in which plants for biofuels and biomass for ethanol can be included, which would provide cleaner environment and enhanced incomes along with chemical free food.



Vetiver can be used along with Nitrogen-fixing plants and dense food forests created in which plants for biofuels and biomass for ethanol can be included, which would provide cleaner environment and enhanced incomes along with chemical free food



THE DEVELOPMENT GLUE

Mr Antonio Carrillo Bolea
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“ Vetiver system is a great open-source solution that can be adapted to many different conditions. It can serve as a “development glue” that can help bind different components of sustainable or regenerative projects, in agriculture and beyond

In Mexico, as in most of other countries, agriculture is facing great challenges derived from climate change – extreme weather, droughts, heavy precipitation events, and other issues that are major drivers of adaptation and mitigation strategies.

Our organization is focused on helping farmers to implement nature based solutions based on agro-forestry. We want to deliver solutions that are effective, both at cost and opportunity level. These solutions should generate results in the short and long term. They should allow farmers to further implement agro-ecological strategies that can help them adapt to a changing environment. These solutions must also be of benefit for the people and planet.

Why We Chose The Vetiver System As An Entry Point

We chose the Vetiver System as an entry point since we consider this technology as a great open-source solution that can be adapted to many different conditions. It can serve as a “development glue” that can help bind different components of sustainable or regenerative projects, in agriculture and beyond.

We have been collaborating since 2019 with a major agricultural company that exports prime quality tobacco wrapper for the international cigar industry. This company is located in the Maticapan Valley, a very important production zone that has more than 3000 years of agricultural history.

With climate change, the Maticapan valley has lost vital tons of soil due to heavy precipitation events. For tobacco farming this can mean total crop loss and low-quality yields. The Vetiver System on Keyline was suggested in 2019 by Estampa Verde as the main project that would provide a starting point for other risk management strategies. The project has matured enough to be organized into a set of good practices that we are expecting to validate and scale in other agricultural contexts worldwide.

Nature-Based Solution

This nature-based solution provides a basic framework for further intensification of agroecological and/or agroforestry practices, and requires to be implemented following a due diligence process for the following:

- a) Deliver all the vetiver plant material in the required quantities
- b) Have all the vetiver grass established in the correct places for soil and water quality restoration
- c) Avoid being too disruptive of the main cash crop cultivation that is actually under management.

This solution delivers better results when combined with perennial trees and shrubs, which increase soil and water conservation potential and overall yields. It can be adopted in mixed crop rotations of up to 25-30 year cycles in humid tropics, which include harvesting high-quality timber.

With these statements under consideration, we must consider Keyline Vetiver Hedges as the foundation for the further development of regenerative agriculture practices, which must be the result of a well-planned, thoroughly implemented and monitored project.

Implementation Checklist

We have generated an implementation checklist of the Vetiver System on Keyline that follows the structure of USDA agricultural standards. We consider that the due diligence process suggested will provide any farming operation project with a crop management base map which will define the number and scale of Keyline Vetiver Hedges.

These hedges must be planted to mitigate climate risks and adapt the productive unit for further agroecological intensification. Vetiver grass hedges must be considered a multipurpose nature-based solution, and when correctly applied, the practice supports one or more of the following purposes:

- Reduce erosion from wind and water, especially extreme precipitation events and unexpected droughts.
- Reduce soil and water quality degradation due to conventional agricultural practices such as excessive agrochemicals or increased tractor machinery intensity.
- Increase soil organic matter content and overall microbiological health.
- Suppress excessive weed pressures and break pest cycles.
- Improve soil moisture use efficiency with a watershed restoration approach.
- Decompaction of soils.
- Provide a template for agroecological intensification, which must include mixed agroforestry systems suitable for the main cash crop at hand.
- Provide additional soil erosion control for other farm features such as roads, streams, wetlands, and farm infrastructure.

Standardized Checklist

For this practice to be successful, we have created a checklist to determine a standard process. It should include the following.

- Geographical analysis for the farms under management with a watershed and biodiversity assessment: this will provide a detailed base map that will guide all present and future interventions.
- Hydrological design of main farm features for the Vetiver System implementation: this includes all the different layers of information that respond to the time and motion workflows of the agricultural enterprise, including roads, water distribution, and any other farm infrastructure.
- Plant nursery and vetiver grass plantation models which will allow the agricultural enterprise to be sustainable regarding quality vetiver materials.
- Keyline earthworks: which must be considered at the beginning of the project as this becomes an important investment. Terra-forming becomes the starting point for repairing existing soil damage and prevent future erosion events.

We are now scaling this solution to other agricultural endeavors in Mexico, such as cattle farming, coffee, and cacao agro-forestry systems. We still need more institutions to get involved to generate more scientific data that validates important indicators such as carbon sequestration, soil microbiological health, soil erosion control, etc. Any further information regarding this standard or other applications of the Keyline Scale of Permanence, please contact us in our website and social media networks.

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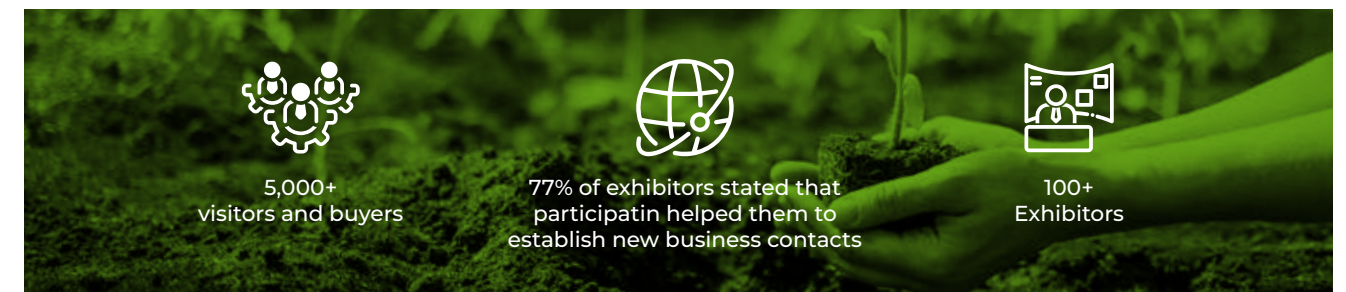


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River Embankment Protection by Vetiver System Nadia District, West Bengal



River embankment protection through vetiver system has been tried throughout the state of West Bengal after successful implementation in the Nadia district. Vetiver system is one of the most powerful technique/systems to make the world safer environmentally and increase the income for rural people by means of soil reclamation, soil conservation and agriculture productivity



Dr Babul Mahato

WBCS (Executive), is presently posted as Sub-Divisional Officer & Sub-Divisional Magistrate, Jhargram, WB. Academically, he is an agriculturist with PhD in Horticulture. He conceptualized the project Sabujayan and implemented the scheme during his posting in Nadia district as District Panchayat & Rural Development Officer and District Nodal Officer, MGNREGA

Vetiver grass is native to India and there are 12 known species. It is called wonder grass of the world as it can be used in different purpose from soil reclamation to producing essential oils for economic development and environmental protection.

Vetiver grass principally has genotype diversity in Central and Southern India. It was used extensively for essential oil extraction from roots throughout the country.

Deep Vertical Penetration Of Vetiver Roots

Vetiveria zizanioides species, out of known 12 species of Vetiveria, is the best suitable for its root structure. The species Vetiveria zizanioides has two types of cultivars. Of this, the North Indian types are best suitable for essential oil extraction. The South Indian types are best suitable for controlling soil erosion and river embankment stabilization because of the fibrous long root structure.

The roots of Vetiver are the most useful and important part. Most grasses have fibrous root system, which spread out from the underground part of the culm and chold soil in a horizontal pattern. The roots that penetrate vertically into the soil are not deep. In contrast, the root system of vetiver grass does not expand much more horizontally but penetrate vertically deep into the soil. The horizontal expansion of the vetiver root system is limited upto only 50 cm whereas it vertically penetrates up to 5 metres.

Nadia is a rural flood prone district of West Bengal around 150 km north-east of Kolkata having around 224 km of international boundary with Bangladesh. Nadia district witnessed devastating flood in 2000 and 2015. Most parts of the district were waterlogged. It led to extensive human resource loss, and also heavy economic loss.

How Vetiver Helped Nadia

People of Nadia have to bear with such horrifying situations. This is because of water flow from the rivers like Bhagirathi, Jalangi, Padma, Ichhamati, Churni and Mathabhanga with total river length of 553.31 km in the district and water used to be inundated in the different parts of the district, which leads to flood like situation very often in the district.



This is a regular phenomenon during monsoon times in the district. River streams capture many land parts of the district every year. From the Engineers' perspective sustainable asset management has posed as a gargantuan task because of soil erosion.

Traditional hard engineering is now found to be inconsistent with the three pillars of sustainability- economy, social and environmental. Hard engineering interventions with rock-boulders and concrete to prevent river embankment erosion have been attempted over decades in the region incurring large financial and environmental costs and with limited success.

Bio-Engineering Through Vetiver System

This in combination with limited state budgets makes vetiver bio-engineering an alternative, low cost, environmentally sustainable solution imperative. The Vetiver System shows considerable promise. Project Sabujayan makes the hope by using the Vetiver System by using Mahatma Gandhi NREGA fund in Nadia district to protect river embankments, arresting soil erosion. The bio-engineering tool through Vetiver System led to many successes in the district.

Project Sabujayan had been planned to protect the river embankments through vetiver system by using its root system. It has been divided into three parts.

- 1) Vetiver Nursery Development and multiplication of vetiver slips
- 2) Vetiver slips plantation along the river embankments in the district
- 3) Nurturing of vetiver and handicrafts making by using vetiver upper parts for additional income of the SHG members of the district.

Green Technology

Sabujayan project started in the Nadia district during September, 2015. The nomenclature of the project has been given the Chief Minister, West Bengal, Smt. Mamata Banerjee during her visit to the district in September, 2015. It means plantation/green technology.

Selection of proper species was the first step of Sabujayan.

South Indian types of *Vetiveria zizanioides* have been identified for the project. Accordingly, vetiver slips have been procured from Tamilnadu and vetiver personality of south India, Mr P Vincent. He assisted to procure as well as imparted initial training to the nurseries selected in the district.

Nurseries have been raised in different blocks of four subdivisions of the district. Initially four nurseries have been developed with fifty thousand vetiver slips in each nursery during November, 2015. Vetiver slips grow profusely and multiplied into 30-50 times in 4-6 months.

How The Vetiver System Grew In Nadia

The number of nurseries have been increased to 76 by one year and able to make more than two crores slips. Training to the SHG members for nursery raising, plantation along the river embankments and nurturing of vetiver plants simultaneously have been undertaken to make the project Sabujayan success.

Dr. Paul Truong, Technical Director of TVNI has visited India during first fortnight of April, 2016 and he visited the project sites of Sabujayan in Nadia district. He also participated in a workshop on Sabujayan project held at Bidhan Chandra Krishi Viswavidyalaya during 14-15, April, 2016.

Awards And Accolades

Vetiver plantation along the river embankments in Sabujayan project gives hope for river embankment stabilization specially where toe-erosion of rivers is not so active. The project earned lots of praise at state and national level. It bagged the Chief Minister's Best Project Award on 03-02-2017 and National Award in Mahatma Gandhi NREGA scheme by Ministry of Rural Development, Government of India in 2017. SHG members are earning additional income by making handicrafts through vetiver upper parts.

River embankment protection through vetiver system has been tried throughout the state of West Bengal after successful implementation in the Nadia district. Vetiver system is one of the most powerful technique/systems to make the world safer environmentally and increase the income for rural people by means of soil reclamation, soil conservation and agriculture productivity.

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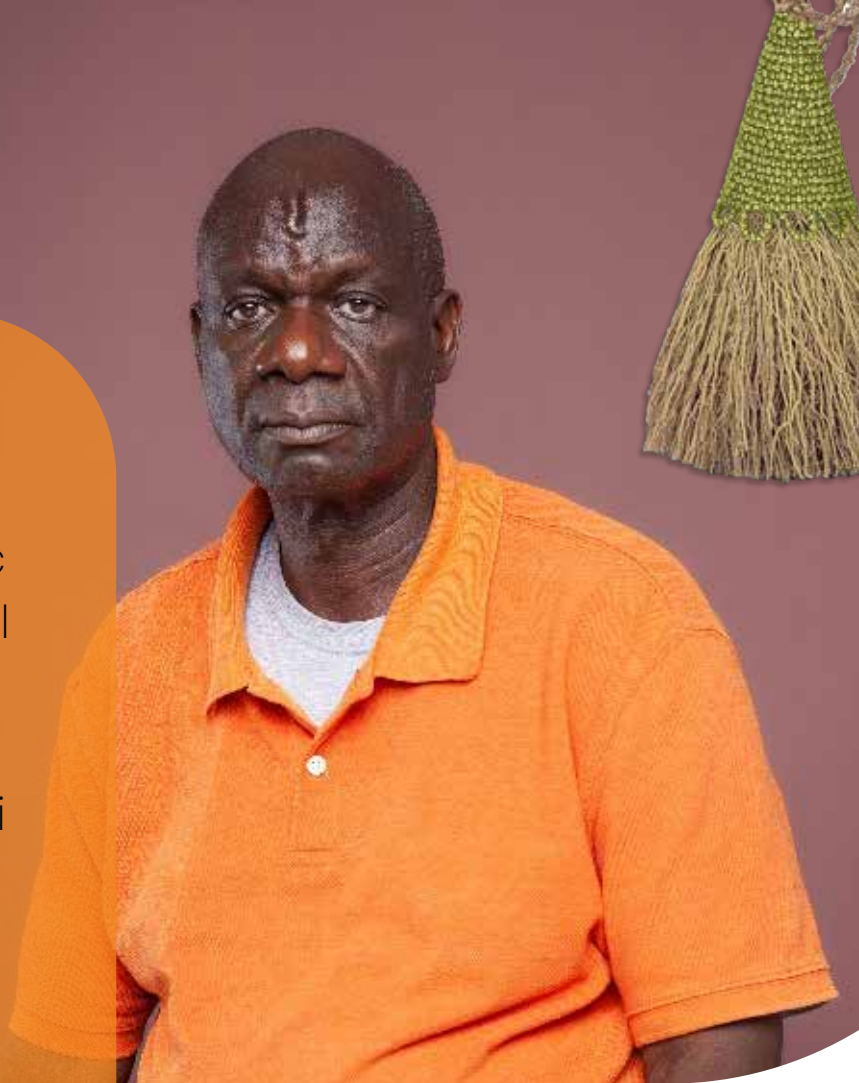
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“

Vetiver builds soil organic carbon and improves soil moisture. It plays a major role in enhancing the development of soil fungi and bacteria especially in the creation of food forests from degraded land



REGENERATIVE FARMING WITH VETIVER

Low Cost, High Returns

Mr Caleb Omolo
environmentalist and farmer
Kenya

I have been using Vetiver grass since 2009. I work with Vetiver grass as pioneer grass to help me create sustainable nature related farms.

I have learned that the heat waves, droughts, floods, wild fires and dust storms are man-made. It is possible to turn these extreme weather patterns around if we study the way nature works by embracing regenerative farming systems.

I was introduced to Vetiver grass by Elise Pinner (TVNI) in 2009. Farms in Rongo (Kisii County – western Kenya), including my ancestral land, were highly degraded.

I started using vetiver grass to solve the soil erosion and wind erosion problems on my land.

The Amazing Uses of Vetiver

For the last 13 years I have learned so many other uses of vetiver grass in its relation to soil, and the functions of the vetiver roots and leaves. Vetiver builds soil organic carbon and improves soil moisture. It plays a major role in enhancing the development of soil fungi and bacteria especially in the creation of food forests from degraded land.

I learned that vetiver helps to change soil biology by enhancing the dominance of fungi over bacteria under forest conditions. I also learnt that once the forest has reached maturity, the fungi start working against vetiver. I have also learned that vetiver is eventually shaded out by tree growth and denser leaf canopy, the mycorrhiza turn their attention from the dying vetiver to the trees, supplying them with nutrients. This interaction between vetiver and other plants, as well as trees, is important, and should be a key component of regenerative agriculture.

Why Regenerative Farming Is Important

Regenerative farming is a farming system which has been practiced in many parts of the world. The Europeans and Americans learned it from Asian countries. The name “Regenerative Farming” was coined by Gerome Rodale in the 1930s. In Asia it is called “natural farming”. Many farmers in India, Japan and South Korea are practicing regenerative farming. Regenerative farming is a farming system that is cheap to implement because it uses locally available bio-degradable materials (mainly plant residues), that most farmers see as a problem, recycling them back into the soil.

Regenerative farming is able to turn bio-degradable waste into productive plant-based nutrients that in turn helps to increase crop yield, in contrast to synthetic conventional farming which has high input and lowering yields in the long term. Regenerative farming is able to maintain and often increase farm net incomes due to reduced expenses in input and labor (particularly weeding). What used to be seen as waste is, under regenerative farming, transformed into bio-complete compost, rich in plant nutrients that do no harm to the environment. The object is to mimic nature in the way forest system works where all the elements are balanced enabling farmers multiple benefits through bio-diversity. Plant nutrients are plentiful but mostly unavailable, especially phosphorous, as well as potassium, calcium and iron. Regenerative farming, through enhanced fungal activity, enables these nutrients to be available to plants.

How Vetiver Aids Regenerative Farming

The most effective plant to enable the “mining” of these minerals is vetiver grass together with other cover crops that in a regenerative system are found in early stages of forest formation. They are known as pioneer plants or cover crops.

Vetiver, works with microbes, converts, through photosynthesis, atmospheric carbon dioxide to carbohydrates, feeding mycorrhizal fungi with carbon that in return produces an enzyme that breaks the bonds of different minerals making them available to plants. As the vetiver root goes deeper, mycorrhizal fungi continue feeding the roots with the nutrients while leaves and stem feeds with carbon. The process is called photosynthesis.

We have been working with farmers using vetiver grass in all types of soil, including degraded land, and we came to the same conclusion of its ability to build soil and develop available nutrients to plants. This system is environmentally friendly and is entirely organic with no dependence on agrochemicals.

I encourage small scale marginalized farmers, such as the group I am working with in Lela, Siaya County – Kenya, to embrace ‘Regenerative Farming with Vetiver’ (RAV). It is low cost and yields high returns, with minimum risk compared to conventional farming where fertilizer and other chemicals are very expensive for the average small farmer.



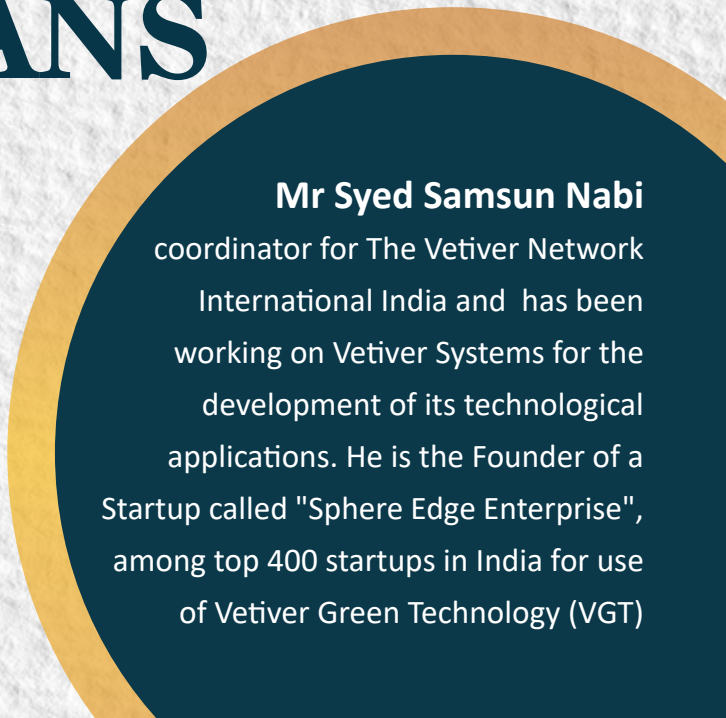


The sinking Sundarbans islands are one of the first climate hotspots in India. At this critical juncture, where we only have a few years to act according to scientists and adopt strong and time bound mitigation measures

PROMOTING VETIVER GREEN TECHNOLOGY IN THE SUNDARBANS



Majority of ongoing normal developmental and restoration activities including protection work of the embankments, the most important lifeline of people living on the islands, are proving to be unsustainable and leading to increasing vulnerability



Mr Syed Samsun Nabi
coordinator for The Vetiver Network International India and has been working on Vetiver Systems for the development of its technological applications. He is the Founder of a Startup called "Sphere Edge Enterprise", among top 400 startups in India for use of Vetiver Green Technology (VGT)

Sundarbans in West Bengal is one of the most vulnerable and threatened eco-systems due to climate change impact, human intervention, faulty developmental policies and priorities. Most of such planned interventions do not take into account the restoration and conservation needs of this unique ecosystem.

Highly Fragile Ecosystem

Sundarbans is an extremely fragile ecosystem affected by sea level rise @ 3.14 mm per year and in some places as high as 5.22 mm per year which is much higher than the global average. This has led to massive soil erosion and submergence of a few islands resulting in a few thousands climate / environmental refugees. Between 86-90 sq. kms of land has been lost in the last 30 years and scientific data & field observation shows that the rate of loss is increasing. There is a 26% increase in severe cyclones during the last 120 years in the Bay of Bengal and the Sundarbans.

Increasing salinity over the years has reduced crop productivity & fish catch, the main livelihoods of the people, as well as posing an increasing threat to the bio-diversity. During the May 2009 Cyclone Aila in which more than 2.5 million persons & 194,000 families were affected, embankments were breached and the tidal surge made most of the cultivable land saline and destroyed most assets, all livelihoods equipment, fish & prawn farms, livestock, boats and most personal belongings. Most of the land continues to be unfit for agriculture & there are very little, alternative livelihoods options left. Majority of ongoing normal developmental and restoration activities including protection work of the embankments, the most important lifeline of people living on the islands, are proving to be unsustainable and leading to increasing vulnerability.

UNESCO Heritage Site

Sundarbans is part of the world's largest active Delta having a network of tidal rivers, channels, creeks, islands, mudflats, coastal dunes with hydrodynamic uncertainties, changing geomorphology and climatic hazards, a vast area of mangrove forests with rich variety of flora and diverse fauna in a unique but extremely fragile ecosystem. It is also a UNESCO Heritage Site.

The type of development which has disregarded the fragile ecosystem has made the Sundarbans and its hinterland, including the city of Kolkata, extremely high risk and vulnerable to cyclones and tidal surges. Global warming has further exacerbated this vulnerability with scientists predicting higher frequency and intensity of cyclones and other extreme climatic occurrences. Bay of Bengal has a history of having the highest frequencies of major cyclones in the world. In recent times, especially after 1992, the sea level started rising at an average rate of 3 mm per year.

Strong And Time Bound Mitigation Measures Needed

The sinking Sundarbans islands are one of the first climate hotspots in India. At this critical juncture, where we only have a

few years to act according to scientists, strong and time bound mitigation measures must accompany measures for adaptation with a focus on vulnerability reduction should be given the utmost priority & integrated with all sustainable developmental interventions. The delta land being relatively flat means larger losses of coastal land and greater losses of lives and property during natural calamities. Vulnerabilities and risks reduction are the main thrust areas for project design.

Cyclone Aila and the consecutive cyclones like the Bulbul and Amphan has left in its wake questions that are extremely important and needs to be addressed with utmost urgency. The bigger issue for deltas like the Sundarbans is not just better relief and rehabilitation but its very survival.

It is also not simply a matter of building a permanent network of coastal embankments and inland dykes. The hydrology of the Sundarbans is immensely complex, with huge rivers, immense flood plains, and the Bay of Bengal forming and re-forming it all the time.

The challenge here is not to secure it for human activities alone, but also to preserve and strengthen it as a natural buffer between invasions of nature and human habitations further inland. Today, there is an urgent need to determine the safe limit for human activities and interventions in places like the Sundarbans. Any long-term intervention in the Sundarbans should take into account various aspects of its entire ecosystem and address it holistically. Focusing on a few aspects will only lead to further damage to the ecosystem and further increasing the risks and vulnerabilities.

The Ongoing Dynamism Of Sundarbans

Sundarbans is the world's largest mangrove delta which shares its geographical boundary with India and Bangladesh, India holding 9630 sq km of area. The entire area is marked with rivers and rivulets with numerous tidal creeks and channels forming a criss-cross network.

This complex network of the riverine system with freshwater from the perennial rivers and salt water inflow from the sea tides create an ongoing dynamism that justifies the rich biodiversity of the area for the lush growth of mangroves - home to 70% of all species of mangroves in the world.

Human settlements with 5.1 million (approx.) people living in Sundarbans are integrated with this dynamic ecosystem for their lives and livelihoods. Communities have settled in 54 islands out of 102 islands in the Sundarbans, the rest 48 are uninhabited and protected forests where no human activities except forest patrols are allowed. The inhabited islands are protected from tidal flows, by embankments, twice each day. The embankment is by 3500 km long which forms the lifeline of the people of Sunderbans.



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How Vetiver Helped Restore A Damaged Ecosystem

Shyha mountain range stands tall all along Kerala's eastern border like the Great wall of China. Surrounded by thick rain forests, the 'high range' kept the organic equilibrium of the state. At a certain stage of history, badly in need of more food, the government encouraged people to deforest and cultivate. Within a few decades, the devastating effects of 'grow more food revolution' in the environmentally sensitive Western Ghats became visible. Youth slowly became more concerned about the environment and organic farming.

The Cardamom Plantation That Suffered

That is how we decided to take over an abandoned estate in Munnar in the Western Ghats which existed since colonial times. Few plants of Agave Sisal, Coffee and a patch of tea remained in the estate in addition to Cardamom which was the latest and major cultivation.

We decided to focus on the latest addition, cardamom. Naturally our immediate action was to stop chemical fertilizers and application of pesticides. Quite naturally, within a few months, there was a collective attack of various pests and the plants lost their vigour and caterpillars left no leaf to see. That's when we consulted K V Dayal, a known organic farmer and environmentalist who visited Blackberry Estate and suggested methods to save the plantation. According to him, Cardamom being a wild plant, needs a forest like environment to survive. Yes, we were ready to make a forest to save our dream.

By the next monsoon, we realised that every effort to save the plantation in the slope, seriously damaged the ecosystem. Firstly, monsoon after monsoon, the top soil was washed away to the streams ultimately to be ended up in the Arabian Sea. Evidently, neglect was better than care. We had to change our strategy or stop caring about the earth at all.

Mr Haridas To The Rescue

We were searching for a viable organic method to stop sheet erosion. Our search ended up in the office of Mr. Haridas, the R&D GM of KDHP Company. Mr Haridas, a die-hard Vetiverian with a dedicated vetiver research wing, was keen to address our farming issues. By the time I climbed down his office after several hours of audio-visual study class and a bag full of printed matter, I became his first convert – a proud vetiverian.

Vetiver was extensively used in Blackberry Estate for multiple purposes. Vetiver hedges were made in the slope to stop erosion. An ancient trekking path running through the middle of the estate was stabilized planting the grass on both sides. Several ancient farming terraces in the estate were protected with vetiver. This served to control direct sun from damaging the sensitive strawberry plants. Incidentally, a picture of the strawberry plants in a terrace was awarded first in the poster competition in ICV 5 Lucknow in the year 2011. Perhaps due to the water recharging effects of vetiver plants, the only water source in the property which used to get dry during summer became perennial.

How The Vetiver Resort Came Up

Our financial resources dried out and we had to find a source of income to continue with the conservation activities. That's how we added a few cottages and started taking tourists seeking solace from nature. Number of cottages was later increased to 16 and was marketed in the name Blackberry Hills Munnar Nature Resort. (No plans to increase it further) Paul Turong, the great vetiverian from Australia visited Blackberry Hills and named it Vetiver Resort. His video can still be seen on the net.

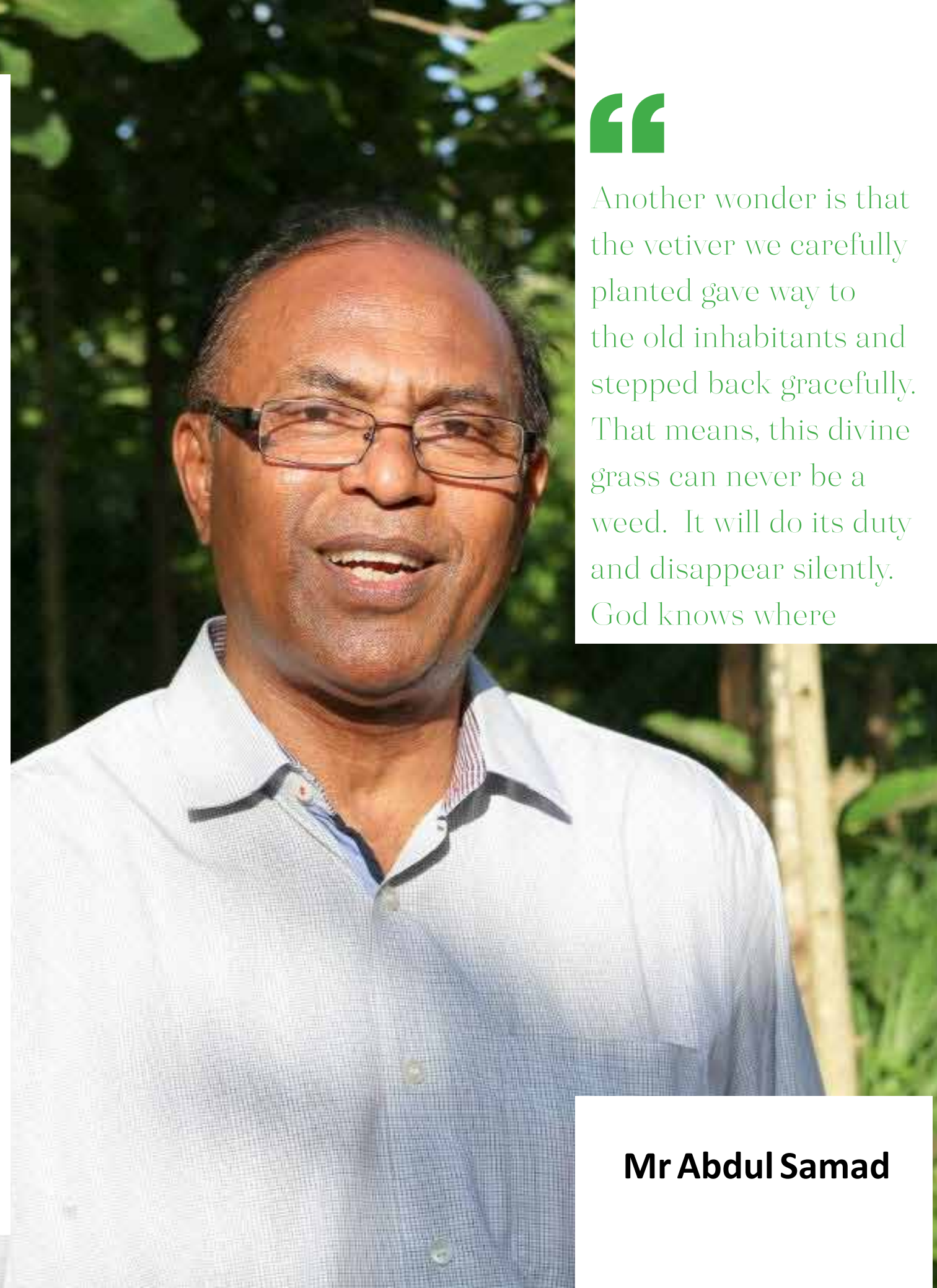
Ethnic Flora And Fauna Made A Comeback

The wonderful part of the vetiver revolution is yet to be reported. We found many ethnic plants and trees exclusive to a Shola Forest sprouting up in the estate. Research revealed that the Blackberry Estate was a Shola Forest in the past which was converted to an Agave Estate. The old inhabitants were recapturing their territory. We simply let it happen.

Many endemic endangered flora and fauna like Tree fern, Atlas Moth, Nilgiri Flying Frog etc returned back to their own territory. Another wonder is that the vetiver we carefully planted gave way to the old inhabitants and stepped back gracefully. That means, this divine grass can never be a weed. It will do its duty and disappear silently. God knows where.

“

Another wonder is that the vetiver we carefully planted gave way to the old inhabitants and stepped back gracefully. That means, this divine grass can never be a weed. It will do its duty and disappear silently. God knows where



Mr Abdul Samad

LAND STABILIZATION AND VETIVER



Prof Devesh Walia

Head of the Geology Department
North-Eastern Hill University, Shillong



Vetiver Grass Technology has gained importance over other land stabilization mitigation and management engineering-based methods become a widely used and acceptable tool for erosion and drainage control and management on slopes and gullies

Since the Industrial Revolution began around 1750s, human activities have contributed substantially to climate change by adding CO₂ and other heat-trapping greenhouse gases to the atmosphere. These greenhouse gas emissions have increased the greenhouse effect and caused Earth's surface temperature to rise.

As the climate changes, sea levels are rising, glaciers are retreating, precipitation patterns are changing, and the world is getting warmer. Recent evidence suggests even more rapid change, which will greatly, and in some cases irreversibly, affect not just people, but also species and ecosystems.

Due to such changes the total available water in the atmosphere will increase and water is the element which promotes landslides so there is an urgent need to think, act to control and utilize the total water available for beneficial use.

Urgent Need For Land Stabilization

North-Eastern region and high-altitude region of India is very fragile due to steeper slopes, high relative relief and presence of weathered, fractured/sheared rocks in addition to unfavorable hydrological conditions posed by intensive high concentrated rainfall events including frequent cloud bursts, periodic flash floods. The landslide hazard has become a common feature in the mountain regions.

Landslide hazard vulnerability is increasing at an alarming rate due to unplanned and uncontrolled constructions and other types of infrastructural development. Hence, there is an urgent need to work for land stabilization for sustainable development in the area. Although the landslide phenomenon is localized, yet, few landslides need attention as these disrupt the road communication, the backbone of life and livelihood.

Valuable Bioengineering Tool

The usage of bioengineering tool for land stabilization is a simple nature-based solution for such a complex problem. Vetiver Grass Technology has gained importance over other land stabilization mitigation and management engineering-based methods become a widely used and acceptable tool for erosion and drainage control and management on slopes and gullies.

Vetiver grass being a perennial with a deep and strong root system binds the soil and resists high water velocity with scouring action. Once the vetiver grass grows it improves the microenvironment of the soil and being non-pervasive in nature allows the other plants to establish. The vetiver planting material can be prepared by splitting the mature plants or propagating from plant parts because of many such pertinent characteristics with other usages the vetiver grass is widely used in many countries for land rehabilitation and landslide hazard mitigation.

How Plantation Of Vetiver Helps

There are different methods of planting vetiver grass on a slope, depending upon the slope angle, soil cover, hydrological condition and planting material. A common method to plant vetiver grass slips (young plants) in trenches (10-12 cm deep and 6-8 cm wide) along the contour line and fill the trenches with vermicompost and cover the roots with soil and press firmly, water the plants within a day if there is no rainfall.

The plantation of vetiver grass along the contour helps in controlling the flow of water along the slopes, and reduces the rainwater velocity along the slopes. Normally, once the grass grows the hedges should be maintained by cutting back to a height of 15 cm once or twice a year, so as to facilitate vetiver roots to grow and firmly bind the soil.

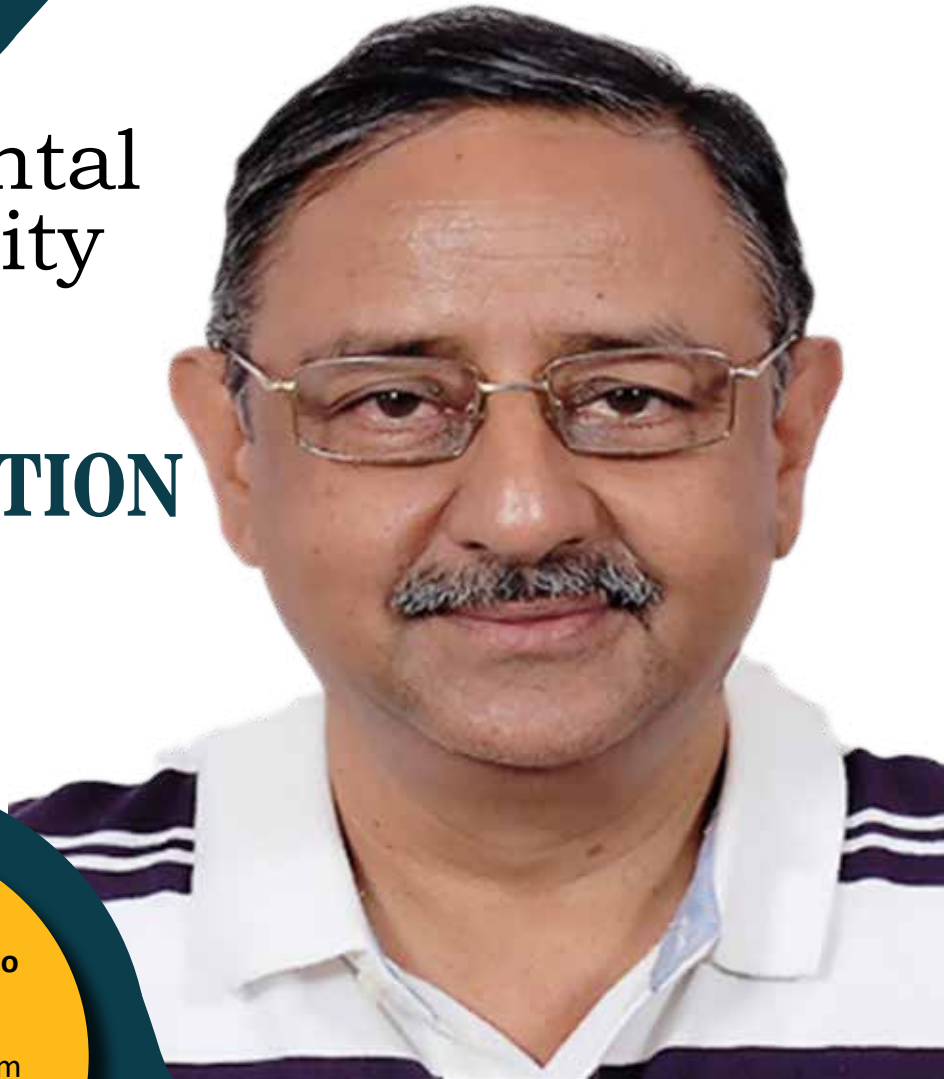
Fastest Growing Technology For Land Stabilization

It has been recorded that even in the most complex scenarios where the soils have been loose with lot of water specially in the moist and humid areas, vetiver grass has absorbed the excess soil water and even utilized the atmospheric water for its faster growth and once the land is stabilized and the water availability reduces, vetiver starts consuming less water as per the water availability. Moreover, the aroma due to the vetiver gives very soothing effect specially during the summers.

The Vetiver Grass Technology is the fastest growing technologies for land stabilization as it not only enhances the soil binding potential but gives good aesthetic looks during any time of the year. We must adopt to such technologies especially in the era of climate variability, before climate change further increases its impact on human life and livelihood. Such a simple method without much expenditure is a boon for humankind.

Environmental Sustainability

CARBON SEQUESTRATION BY VETIVER



Dr E.V.S. Prakasa Rao
Honorary Scientist
CSIR-Fourth Paradigm
Institute, Bengaluru, India



Vetiver is generally recommended as a perennial plant for environmental services such as C sequestration, soil conservation, phytoremediation, protection of embankments of water bodies and slopes among others



The Way forward

- Vetiver can sequester more C than many other plant species
- Evaluation of deeper soil horizons for soil organic C under vetiver in different agro-climatic conditions will throw light on its contribution to C sequestration in soils
- Good agronomy will help to produce large volumes of vetiver roots in deep soil horizons thus contributing to C sequestration.
- An international research programme to combine economic utilization of vetiver and C sequestration is needed to derive benefits from this wonder grass.

Global temperatures could increase by 2-6°C by the end of this century which are caused primarily by anthropogenic activities which release greenhouse gases (GHGs) such as carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O). According to IPCC (2014), the major sectors responsible for GHGs emissions are: power stations (25%), agriculture (24%), industry (10%), transportation (14%), buildings (6%), other energy sectors (10%). In order to contain the rising global temperatures, mitigation of CO₂ emissions has been touted as an important strategy. Land-use systems can significantly influence CO₂ emissions. In agricultural systems, the existing practices mostly increase carbon emissions. Some important strategies to mitigate carbon emissions include no/minimum tillage, conservation agriculture, water management, recycling agri-wastes, incorporation of crop residues, crop rotations to include such plants that enhance soil carbon among others.

What is carbon sequestration?

Carbon sequestration is a method of capturing and storing atmospheric carbon; the methods include: biological carbon sequestration wherein atmospheric CO₂ is captured by photosynthesis by plants such as forests, grasses and other plants, geological carbon sequestration where CO₂ is stored in deep geological formations and industrial sequestration where CO₂ is converted to stable forms.

In agricultural systems, carbon sequestration has been a challenge since the complex carbon cycle releases CO₂ into the atmosphere continuously and the net carbon stored in soil-plant systems remains at levels below desirable levels.

Thus, the existing land use systems need a paradigm shift to make the environment a net storehouse of carbon. It has been suggested that optimized cropping systems have the potential to reduce GHG emissions by 7-16% (Yin et al., 2023). Presently only biological C sequestration is discussed.

Why Vetiver?

Vetiver, a perennial grass with very high biomass and root production has been suggested as a potential candidate for C sequestration (Singh et al., 2014). Vetiver can be incorporated in existing cropping systems in a study conducted in South India (Prakasa Rao et al., 2015). In this study it has been shown that vetiver has the potential to improve the livelihoods of small farmers, besides providing environmental services such as C sequestration.

Not many studies have been done on the C sequestration by vetiver. Our estimates have suggested that vetiver could sequester

nearly 15 t C/ha/year in its roots and shoots in a sub-tropical environment in red soils of south India (Singh et al., 2014). Vetiver sequestered more C than many grasses. Vetiver shoots and roots contain 50.5% and 50.3% C; higher than many plants.

One premise could be vetiver is generally recommended as a perennial plant for environmental services such as C sequestration, soil conservation, phytoremediation, protection of embankments of water bodies and slopes among others. However, vetiver for livelihoods could render vetiver as a seasonal crop to facilitate harvests. Strategies to enhance environmental and economic benefits have been suggested wherein vetiver could support livelihoods and carbon sequestration (Prakasa Rao et al., 2008).

In this direction the work carried out by Singh et al. (2014) have shown that an annual crop of vetiver can capture significant quantities of CO₂ in plant and root biomass. While a portion of C goes back to atmosphere, a good amount C can be captured and stored in deeper layers of soil. Thus, vetiver could be utilized for economic activities such as essential oil production, handicrafts, health products, while its deep root system can store significant amounts of C in deeper layers of soil. Vetiver system has built 1.12-1.39% soil organic C compared to 0.64-0.7% in cultivated soils at the end of 5 years (Singh et al., 2014). While harvesting vetiver for essential oil production, generally the roots are dug from surface soil layers. Being a deep-rooted plant vetiver may increase soil organic C in deeper layers and improve soil physical properties as well.

C Sequestration, Possible Revenue Through Carbon Credits

It is important that the above ground biomass should not be burnt as it is practiced in several vetiver growing areas, but recycle the biomass for a variety of uses such as bio-energy production, compost manure preparation, handicrafts, roofing for sheds etc. Vermicomposting of vetiver shoots along with other farm wastes could add 4.7 t C/ha (E.V.S.Prakasa Rao, unpublished data).

Our estimates show that if 10 % of estimated 107.83 m ha of degraded lands in India are put to vetiver systems, nearly 150 Tg C year⁻¹ can be sequestered which is about 46 % of total C emissions in India (Singh et al., 2014). Many countries such as China (Xia, 2003), Brazil (Pereira, 2011), and the USA (Truong, 2000) have large land areas where vetiver can be cultivated with potential contribution to C sequestration and possible revenue through carbon credits.

Good agronomy can produce higher biomass yields of vetiver; improving livelihoods and C sequestration as well (Prasad et al., 2011).



Dr Janardhanan Ramanujalu
Vice President
South Asia, Australia & New Zealand
at SABIC

“ Through its Bengaluru-based research centre in India, SABIC is focusing on minimizing the early losses of urea by developing coatings and inhibitors that slow its release. We use digital farming tools extensively in our research and development processes to create better products customized for Indian farmers and Indian farmlands ”

TIME FOR SMART FARMING

Smart Farming Techniques, Smart Irrigation, Smart Fertilization



To paraphrase a parable – ‘Teach a man to farm, and you feed him for a lifetime’. But traditional farming can no longer keep up with feeding mankind, at least, not without the help of science and technology.

With the global population now standing at eight billion, which has doubled since 1975, food security and effective food distribution have become some of the key concerns for both poor and wealthy countries alike, though in different ways. Food security is so important that land-scarce countries have focused on both diversifying import sources as well as trying to maximize limited land capacity to grow food through methods such as indoor farming. For larger countries, which employ more conventional methods, it is about maximizing the yield from the space available with mechanical farming, drip irrigation and smart fertilization.

The keyword here is smart – smart farming techniques, smart irrigation and smart fertilization. India, which is vying to become a global food supplier, is facing several challenges that threaten its food security, including climate change, water scarcity, land use change as well as pests and diseases. The Indian government has undertaken several initiatives to address these challenges. One such strategy has been to adopt smart farming practices, which would help increase yields and boost productivity.

Smart Farming And AI On The Rise

Digital data collection and AI, when used effectively, can help farmers, resulting in better productivity and yield which is key to increasing food production and supply. World Bank statistics showed that in 2014, an average of 190k data points were produced daily per farm and when used effectively such analysis should help farmers to adjust their planting timings and management practices to maximize their yields, profits and help put food on the table.

In India, the government is already using advanced technologies to increase yields to meet the domestic and global food demands. India is a major player in the agriculture sector globally and the sector is the primary source of livelihood for about 58 per cent of India's population.

Getting Smarter About Smart Fertilizers

Organic (non-chemical) fertilizers alone are unlikely to meet the need for global food security. Nitrogen-based fertilizers in combination with other agri-nutrients have helped to increase crop yields tremendously in recent decades. However improper, unbalanced and excessive use of fertilizers is unproductive and also environmentally harmful. Therefore, ensuring farmers fully understand the appropriate use of fertilizers is important.

When used appropriately, state-of-the-art nitrogen fertilizers can help in maintaining a high level of crop yield while at the same time minimize the environmental impact improving plant uptake. SABIC, a world-leading producer of agri-nutrients, has focused on developing enhanced, sustainable fertilizers, which are controlled/slow release to increase productivity. These fertilizers may also reduce contributions to greenhouse gases (GHG) while increasing organic carbon in the soil.

Bengaluru-Based Research Centre In India

Through its Bengaluru-based research centre in India, SABIC is focusing on minimizing the early losses of urea by developing coatings and inhibitors that slow its release. We use digital farming tools extensively in our research and development processes to create better products customized for Indian farmers and Indian farmlands.

Separately, farmers globally are also increasingly utilizing satellite technology to help them understand when and where to use fertilizers, which will help in ensuring that they are used only when needed. Soil testing, to ensure the appropriate application of any deficient nutrients can help to ensure appropriate application, increasing productivity and yield. Resources can be optimized when enhanced fertilizers are used in combination with digital tools such as auto irrigation, auto climate control, AI and advanced sensors.

Indoor Farming On The Rise

Innovation and more efficient farming tools are both helping traditional farms and creating new solutions such as indoor farming. Indoor farming includes vertical farming, which is being adopted by developed and land scarce countries. It involves cultivating crops indoors in stacked rows, which can also mitigate climate and pest risks to crops. Indoor farming can be capital and energy intensive. However, the industry undergoes constant innovation to bring energy use down and such farms are also increasingly using renewable energy.

It can be done in either in a small space or in a large area. Old warehouses, skyscrapers, and extra unused space can be used for vertical farming. In India, vertical farming is mostly polyhouse-based, which is a safe method that gives high yield and production of crops in different parts of India.

Vertical Farming

Adoption of vertical farming has been on a steady rise - the industry is expected to grow to USD 9.7 billion worldwide by 2026 and such farms are getting larger. Dubai opened the world's largest vertical farm this year –the more than 330,000-square-foot facility grows lettuce, spinach, arugula, and mixed greens. In Singapore, Genesis One Tech Farm operates 6.8 meter high, 14-tier cultivation racks which can produce five to six hundred kilograms of fresh vegetables daily in an area smaller than 1,000 square meters. The system re-circulates water-based nutrients, which allows the farm to use 95% less water than conventional deep water-based hydroponic farming.

Water-soluble fertilizers are widely used by indoor farms which grow their produce through hydroponics. In 2020, SABIC commercially tried and then launched local sales of its WS NPK 13-13-13 product, Rusmadah, the world's first fully water-soluble granular compound NPK grade fertilizer.

Investment In Innovation Vital To Food Security

The World Economic Forum has identified livelihood crisis as among the top global risks by impact in 2021 that our planet could be facing. Innovation will be a key to feeding the world's growing population while reducing the agricultural sector's environmental impact and improving the resiliency of the food system. From incorporating digital technology to investing in smart fertilizers and making full use of available space, the sector can continue to grow food and grow it more sustainably to meet humanity's increasing needs.

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VETIVER ZIZANIOIDES

For Sustainable Environment management
Solutions



Rapid industrialisation and increased anthropogenic activities have enhanced the levels of toxic pollutants in soil and water bodies. Vetiver (*Vetiver zizanioides* L. Nash) with its extensive root system tolerates extreme climatic conditions such as drought, flood, salinity, high and low temperatures, high acidity and alkalinity and can accumulate heavy metals such as lead and zinc and biodegrade organic pollutants such as phenols, TNT, atrazine etc. and hence is an ideal plant for protection and cleaning up of polluted lakes and water bodies.

Extensive Uses Of Vetiver Across Diverse Sectors

Vetiver grass can be used to rebuild the eco-system, site restoration, river embankment stabilization and sustainable green belt development. Vetiver plants as a floating island in contaminated lakes, water bodies and canals are being used for pollution management.

Vetiver grass is extensively used for river front development, river embankment slope protection and stabilization, fly ash dump site management, mining area development, rebuilding of closed solid waste dump sites, green capping and land recovery. Low carbon green highways, coastal restoration and wet land conservation can also be achieved using Vetiver plants.

Vetiver plants take up high levels of radioactive caesium and strontium and can be grown in low level nuclear waste. Within 15 days, the low-level radioactive waste reaches below detection level. The plants are also be used as a biological curtain in low level radioactive sites thus preventing its infiltration into surrounding areas. Various studies have been conducted in Jaduguda mines containing low level Uranium waste after extraction.

Biostarts Ventures has developed an integrated climate-friendly nature-based solution by bio-engineering intervention by environmental biotechnology applications to create strong and durable climate resilient Water, Soil contamination & Air Pollution management by increasing the ecological footprints.

We have a range of innovative, scientific, sustainable, environment friendly & cost-effective Environment management solution using low carbon Bioengineering techniques

- Restoration of Contaminated Lakes, Water bodies & Canals
- Integrated river pollution management & Riverfront front development
- River embankment Slope Protection & Stabilization
- Fly ash dump site pollution mgmt. and Mining area sustainable plantation
- development
- Solid Waste Management solutions
- Closed Solid Waste dump site stabilization, green capping & land recovery
- Contaminated site management & Land Recovery
- Coastal Protection & Restoration
- Wetland Conservation

Bio-engineering techniques are integrated technological interventions by environmental biotechnology to create strong and durable climate resilient Water, Soil contamination & Air Pollution Management by increasing ecological footprints.



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Tamil Nadu Agricultural University

Pivotal Role In Vetiver Farming In State

Vetiver is an upcoming aromatic crop preferred by many farmers particularly the north eastern coastal region of Tamil Nadu on account of its reaping commercial value of the root. The word vetiver has its origin in Tamil Nadu, 'Veti' meaning dig and 'ver' meaning the root in tamil, speaking conceptually about its deep rooted nature. Tamil literature, particularly the Sangam literature, provides insights into the cultural and historical significance of vetiver in Tamil society. It is mentioned in poems and songs, highlighting its fragrance, medicinal properties, and use in perfumes and natural remedies.

Vetiver R&D By TNAU

The Tamil Nadu Agricultural University (TNAU), Coimbatore, a pioneering research institute in India has been playing the pivotal role in vetiver research and development. The university has conducted significant research with promotional activities on vetiver in Tamil Nadu since 2017 after the India Vetiver Network was re-established at TNAU.

TNAU's research on vetiver focuses on genetic diversity, molecular characterization of land races, varietal evaluation, quality planting material of improved varieties, association with CIMAP's Aroma Mission for which an MoU was signed between TNAU and CSIR in 2017. TNAU has initiated activities related to bioremediation of polluted water bodies, soil conservation, mitigation of soil improvement, and its potential as a source of essential oil.

The Vetiver-preneurs Of Tamil Nadu

In Tamil Nadu, vetiver is cultivated in more than 600 Ha and Cuddalore being the leading district to nurture the crop as well as numerous agripreneurs who take up value addition in vetiver. As an integral crop in agriculture, farmers are able to earn attractive income ranging from Rs.1 to 2 lakhs per acre within a span of 10-12 months period.

Nochikaadu, a coastal place in Cuddalore district is now popular for vetiver roots since majority of farmers who cultivated casuarina and cashew, now takes up vetiver cultivation since the income earned by the farmers are better than other crops. More than that, vetiver income realization is within a year when compared to the long duration crops like cashew or casuarina.

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Promotion of Vetiver FPOs, connecting the fragrance market with FPOs, and GI tagging of Cuddalore vetiver are some of the priority areas to accomplish in the coming years with active support of The India Vetiver Network

Dr K Rajamani and Dr L Nalina
Tamil Nadu Agricultural University
Coimbatore

Farmers still recall how their vetiver crop survived the 2004 Indian Ocean tsunami. During that period, cashew and casuarina trees got devastated but vetiver survived and sustained their livelihood despite problems like sea water intrusion into land holding and extreme salinity of sea water

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The farmers still recall how their vetiver crop survived the 2004 Indian Ocean tsunami. During that period, cashew and casuarina trees got devastated but vetiver survived and sustained their livelihood despite problems like sea water intrusion into land holding, extreme salinity of sea water. Vetiver is regarded as a saviour crop as it helped them to cope up the disaster and sustain their living within a short period of time when all other perennial crops were uprooted due to the tsunami cyclone.

Ideal Crop Model For Climate Resilience

Vetiver could be seen very closely cultivated along the sea coast (even at 50 feet from the coastal line) in Cuddalore and is one of the best crop model for climate resilience. Vetiver grows so well in the coastal sandy soil due to its inherent salinity tolerance, and within a year, the root system spreads wider and deeper fetching an attractive income to the farmers. Farmers use ground water to irrigate the crop especially in early stage. Since the root system is so deep, farmers use exclusive mechanised harvester by using a JCB through which, the operation is simplified.



CIMAP, Lucknow has evolved improved cultivars like Dharini, CIM Vridhi which are capable of yielding upto 2 t of root per acre and has an essential oil recovery of 1 per cent. Though Cuddalore district ranks the highest vetiver production in India, vetiver witnessed set back many times in marketing when the prices dropped to less than Rs.70 per kg as compared to Rs.150/kg a few years back resulting in loss in income to the farmers.

Vetiver roots command wider market application ranging from root powder which is used in Siddha and ayurvedic formulations, roots for making hand woven fabrics, hat, pillow, beds, aromatic oils and many other products. One could witness busy trading of roots in this region and buyers even from essential oil traders from Mumbai and Karnataka visit this place to buy vetiver root.

The India Vetiver Network (INVN)

The INVN was re-established at Tamil Nadu Agricultural University, Coimbatore in 2017. A National Workshop on Vetiver was conducted on 14.2.2017 in which Dr.Paul Truong, Mr.Haridas,

Mr.Ashok Kumar participated. Many imminent persons shared their research accomplishments in vetiver for bio-remediation, river embankment lining to conserve soil, vetiver planting for contour slopes, water treatment. The INVN activities got intensified by subscriptions among farmers, students and environmentalists. The research and extension activities in vetiver were also strengthened. In due course of time, many farmers took up cultivation of vetiver in Erode, Tirupur and Sivagangai districts.

ISHA foundation Of Coimbatore

The INVN and TNAU took up a major drive by associating with ISHA foundation of Coimbatore who embarked a major drive on River Restoration in India for revitalization of rivers in India. As vetiver is important for riverside conservation, a One day Training programme for the Volunteers of ISHA Foundation was held on 19.04.2018. Nearly 100 volunteers from ISHA were trained on role of vetiver in erosion control.

Success in vetiver cultivation

Vetiver has groomed numerous entrepreneurs and one among them is Mr.C. Pandian who has established a vetiver farm, Cm. Eco – Herbal Plantations in Tirupattur, Sivaganga district in Tamil Nadu since 2006. As a farmer, he initiated contractual production of vetiver in 60 acres besides promotion of vetiver in his own 10 acres. He has developed many value added products from vetiver which is being marketed through online and direct marketing.

As a part of the journey, he has supplied nearly 60 lakh vetiver slips for public awareness, soil and water conservation. He has also supplied 1.5 crores of planting material of vetiver variety Dharini and CIM Virdhi to farmers who have taken up cultivation. The entrepreneur has set up an essential oil distillation unit through which high value essential oil is distilled and marketed.

Promotion of Vetiver FPOs, connecting the fragrance market with FPOs, and GI tagging of Cuddalore vetiver are some of the priority areas to accomplish in the coming years with active support of The India Vetiver Network.

Siesto Green's Bio Capsules Healing Soil, Bringing Earth Back to Life

Soil in our country has reached a saturation point. It cannot endure any further chemicals. He has been polluted and depleted over decades post the advent of green revolution. Meeting the food requirements doesn't mean one has to sacrifice on food quality. Higher yield can be attained even by following the natural way. With the emerging cases of diseases like cancer, the need of the hour is to produce bio-fertilizers. Established in Raipur, Chhattisgarh, Siesto Green is developing bio fertilizers and Pesticides, basically capsules that can replace chemical fertilizers like UREA, DAP, Potash, etc. One bio capsule contains 1 lakh crore CFU to enrich the soil. These capsules are patented under the ICAR-Indian Institute of Spices Research (IISR), Kozhikode, Kerala. The biofertilizer is patented under 'ENCAPSULATION' technology. These products are certified by NPOP, NOP, EU, UK Cert.

These natural bio capsules will not only save the soil and environment, but also save the overall farming cost. Farmers can expect a higher yield in an organic soil. Siesto Green's research team has developed an innovative technology which directly induce microbes in the soil of crop, tree, and plant at all stages to increase the absorption of essential nutrients. The process holds a plethora of benefits, including 20 to 30% production to the farmers, soil fertility gets increased, nutrition in the soil gets up. The overall revenue of the farmer also increases upto 40 to 50%. All in all, 60% of the damage done on soil reduces. The organisation is making sure that it gradually shifts from completely chemical set-up to a partial one.

Who Can Use the Capsules?

A farmer or a grower aiming for crops like legumes, cash crops, cereal crops, fodder crops, oil seed crops, horticultural crops, vegetables, fruit trees, forest trees, medicinal, herbal and decorative plants, can use these capsules.

"A farmer does not grow crops. A farmer creates an environment where crops can grow" – says Siesto Green's Managing Director Mr. Vikas Agrawal.

Unlike pesticides, if you are overusing it, there is no harm to the crop. It is completely harmless and safe. It has a shelf life of up to 16 months. It is easily soluble in water and compatible with all kinds of irrigation. One capsule of CFU count contains at least 1 lakh crore CFU, while 1 kg of bio powder contains five thousand crore CFU and one litre bio liquid has 10 thousand crore CFU. It is highly recommendable for the farmers as Siesto Green's bio fertilizers are



not only economical but also efficient. Just one cap of bio liquid can be used in an area as wide as one acre, replacing 80% effect of harmful pesticides and chemical fertilizers like urea. These products are very conveniently handled and transported. There is no hassle of storage or maintenance. These products take minimal space and can be stored in the room temperature.

All in All, bio capsules are economical, efficient, convenient, hassle-free, easy to use, and of course, environment friendly. Then, why would someone not pick it? It is easy on your pocket, giving you a higher yield, making your soil fertile, then why to jeopardise the health of this country and your family, producing food full of chemicals. Moreover, these chemicals leave a unerasable impact on the lives of the farmers. Trust and choose the best bio fertilizers available in the market at the best price. It is high time that we should stop using these harmful chemicals on our motherland.

Millets for Sustainability

Dr Shaik Reshma Sulthana

Dr. Snehal Mishra

Dr. Shakti Ranjan Panigraphy

By 2050, the population of the globe is predicted to increase by nearly 34 per cent, reaching 9.8 billion people. According to the FAO (2009), our global food needs would increase by 70 per cent if current eating habits, income levels, and consumption trends are taken into account.

India's population is currently 1.42 billion people (or around 17.7 per cent of the world's population). By 2030, it is anticipated to increase to 1.51 billion people. In addition to rising abiotic and biotic stress, the challenges of producing more when per capita arable land and water availability are continuously diminishing.

The severe negative effects of climate change on agriculture are already being seen, with the production of crops like rice, wheat, and maize, by the degradation of land and forests with inefficient use of chemical fertilizers. Therefore, reorientation and changes in agriculture are urgently required to fulfill the most crucial SDGs (Sustainable Development Goals), such as environmental sustainability and the elimination of poverty and hunger. India is facing challenges related to sustainability, nutrition, water scarcity, soil degradation, biodiversity loss, declining forest cover, and higher emissions of greenhouse gases (GHGs).

Why Millets Are The Answer

Millets are a great substitute for water-intensive crops like wheat and rice that are severely depleting groundwater in many regions of South Asia, including India's Haryana and Punjab. In essence, millets have a far smaller environmental impact than wheat or rice. They are the one-stop solution with their high nutritional content and ability to offer sustained food security in the face of drought, water shortage, and climate change circumstances.

Diets having a minimal environmental effect are defensive of biodiversity and ecosphere, which aid to assure food access and nutritional security. Without adversely affecting nutritional value, changing cropping pattern using more coarse grains, such as millets, can increase food production, lower greenhouse gas (GHG) emissions, and improve climate resilience in agriculture.

Millets were recognized as a feasible choice for ensuring food security and environmental resilience in a quantitative analysis of changing monsoon cereal output in India. The monsoon cereals' contribution to calories is shown in Table 1 along with their maximum protein and iron content, water and energy usage, and greenhouse gas emissions. Cereals contain a large amount of macronutrients such as carbohydrates, lipids and proteins also form a major cause of global warming.

Millets Can Help Slow Down Global Warming

Wheat has the greatest global warming potential of all the major cereal crops, with an estimated 4 tonnes CO₂ eq/ha, followed by rice and maize (an estimated 3.4 tonnes CO₂ eq/ha). Additionally, the carbon equivalent emissions from these crops are considerable, coming up at 1000, 956, and 935 kg C/ha for wheat, rice, and maize, respectively. They are widely farmed and the main sources of sustenance for the entire world's population despite having greater emission rates.

Other minor cereal crops, including millets and sorghum, have far smaller carbon footprints. One of the main justifications why millets might be one of the crops that could reduce carbon footprint in the world is that they are a member of the C₄ group of cereals that convert more carbon dioxide to oxygen, helping to slow down global warming.





Millets Are Climate Resilient Crops

Millets are generally thermophilic (thriving at relatively higher temperatures) and xerophilic (can reproduce with limited water input) making them climate resilient crops. Pearl millet is known as a crop that stands out in this looming climate chaos because of its diverse repertoire of genes for natural wax proteins, which act as thermal protection for the plant, its long root system, and it has a “built-in” drought escape mechanism of early flowering,

inherited from its wild progenitors which are evolved in semi-desert environments.

Pearl millet has a short crop cycle, grain-filling period, and small seed sizes, which is a clear advantage in unfavorable growth conditions such as heat and drought. At last, the important prerequisites for attaining the SDGs will be increased by investing in Millet’s research for innovation and development as well as supportive policies with efficient coordination and monitoring mechanisms.

Table 1: Current nutrient production, Resource use, and climate resilience of monsoon (Kharif) cereals

Characteristics	Finger millet	Maize	Pearl millet	Rice	Sorghum	% for rice
Harvested area, Mha	1.4	7.9	9.4	43.6	3.1	67
Food supply						
Calories, 1012 kcal	6.7	64.6	35.9	344.3	11.2	74
Protein, ktonne iron	149	1702	1131	7679	334	70
Iron, tonn	96	482	662	629	132	31
Resource demand and emissions						
Irrigation water, km3	0.1nu	0.9	0.5	76.7	0.1	98
Energy 109kWh	1.1	15.5	4.7	94.0	2.4	80
GHGs, Mtonne CO2eq	0.6	12.3	3.8	161.5	1.5	90
Resilience 1012kcal loss under extremely dry year	0.00	0.00	-1.39	11.47	-0.03	89

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AgroVetiver

Why better than AgroForestry



Mr K Vinod Kumar
Kerala, India

In nature, plants grow at suitable places, produce shoots, roots, flowers and fruits. Some of these are eaten by birds, animals but mostly the plants return to dust and regenerate in the carbon, nitrogen, oxygen cycles.

In agriculture humans 'engineer' what, when and where to plant, how to harvest the crop. The regenerative cycle is broken. The rice plant absorbs water and nutrients from the soil, grows under the sun, is harvested and proceeds as straw, rice from the shoots; as rotting roots. The soil life is mostly one way to loss of fertility, especially in annual cereal crops.

There are attempts to regain the soil fertility by using farm yard manure, or synthetic fertilizers. Compacted soil structure is corrected by ploughing. But ploughing resulted in Dust Bowl instead of Granary of the World in the 1930s in America.

The Principle Of Co-Existence

We learned that perennial trees or perennial grasses must coexist with annual crops for sustainable agriculture. AgroForestry allowed portions of farm fields to be forests. In the US, Prairie Strips are formed along, say, 10 % of the vast corn fields. They should be named AgroPrairie or AgroGrassland.

The farms in Asia and Africa are small. One or two trees will not make an agroforest. But thin perennial grass strips can be made in the farm fields to bring the soil structure and soil biome back to the natural sustainable form.

Vetiver As Intercrop

Enter vetiver, a tropical, vertical deep rooted perennial grass. Vietnam vetiver enthusiasts led by Tho NGO AgroVetiver have grown vetiver as intercrop in their natural horticultural fields. When the plantation matures, the vetiver could be shaded. Vetiver is shade intolerant.

Cereal crops, say rice, are not cultivated with vetiver as intercrop; rice fields are in water, the 'hard pan' prevents the puddles from infiltrating or losing to the ground. But vetiver will break the 'hard pan'.

AgroVetiver should be possible with taller annual cereal crops like corn or millets. Vetiver strips of width 10 cms can be made with separation of, say 40 cms between the vetiver strips. Before the millet saplings or seeds are planted in the 40 cm wide row, the vetiver is trimmed to, say 5 cms height.

The millet should overgrow the vetiver. Millets will not be shaded. The vetiver will be gradually shaded more and more. Finally the whole field, millet and vetiver, is harvested at again 5 cms height. The millet meets an annual end. The vetiver continues perennial. The perennial deep roots of vetiver maintain the soil structure and biochemistry including soil organic matter.

The Many Benefits Of Vetiver Roots

Vetiver roots increase water infiltration, percolation and retention in the soil. Unlike matrix flow through soil particles and the space between them, vetiver roots move water through preferential flow on the long vertical root surfaces assisted by cohesion of water molecules and their adhesion to the surface, not capillary action. (Tree roots, whether living or dead, create preferential channels for rainwater flow through soil, magnifying infiltration rates of water up to 27 times).

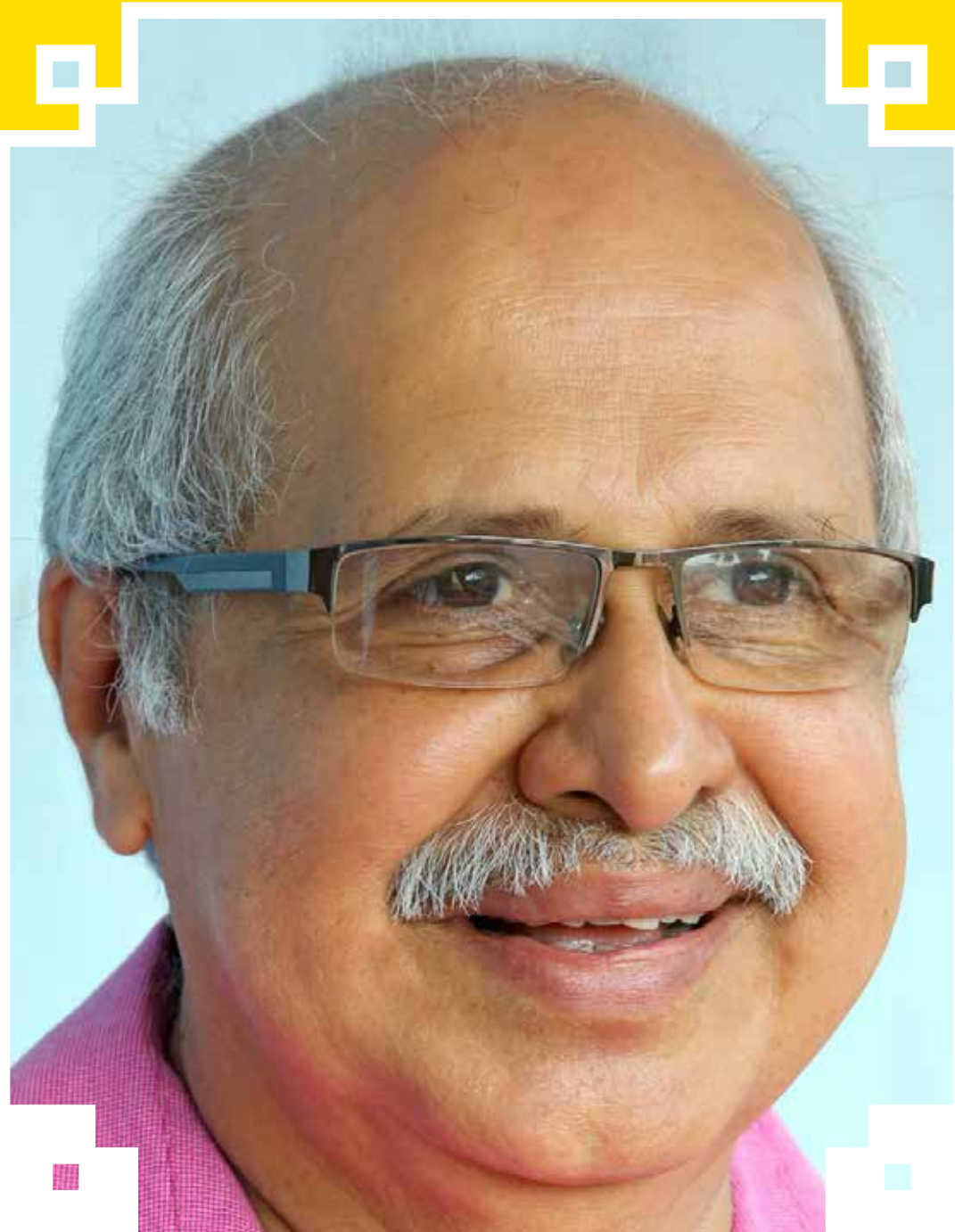
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Vetiver roots increase water infiltration, percolation and retention in the soil. Unlike matrix flow through soil particles and the space between them, vetiver roots move water through preferential flow on long vertical root surfaces



FROM THE ARCHIVES

This write-up was published on <https://indiatogether.org/> on 10 May, 2006



Mr Shree Padre



In 1987, the World Bank team learnt from these farmers that they had been successfully growing vetiver against soil erosion for centuries. It reduced rainfall runoff by as much as 70%, recharged groundwater (villages that use vetiver have much higher water levels in their wells), and improved ephemeral stream flow

The Root Of The Solution

Vetiver plants have long been known to provide economical protection against soil and water loss, and more recently they have also been found to be useful for water purification. But while other nations have rapidly embraced it, in India itself its adoption remains rare, finds Shree Padre.

Recently, Kanan Devan Hills Plantations Company (KDHP), one of the country's large tea producers, took an interesting decision. Henceforth, while replanting tea gardens, they will establish vetiver (in Tamil, the word means 'dug up root') hedges in place of stone revetments to conserve soil and moisture. While this didn't receive much attention in our media - which is generally blind to important developments on the farming front - this significant decision should be an eye-opener for us Indians, about one of the many uses of a 'wonder plant' of our own.

Why Vetiver Hedges Are Important

For the tea industry, this will reduce the expenditure of soil and water conservation work to 30 per cent. If adopted properly, starting from soil and water conservation, vetiver could save crores of rupees in each district through embankment stabilisation and waste water treatment - to mention only two of its many uses.

The Research and Development department of KDHP, under the leadership of P. Haridas, Deputy General Manager, has been conducting trials on vetiver for the last one and a half decades. He explains, "In the hilly terrains where tea is grown, soil erosion is a big problem. The tea estates established by the British didn't have permanent soil and water conservation measures. As such, during replanting, a lot of expenditure has to be incurred for this. In the past, our company too spent heavily to construct stone walls (revetments) across the slope. Depending on the gradient, normally two or three walls (top, middle and bottom) will be needed. On an average, stone revetments for a hectare of tea garden would

require 350 man-days. Instead, 100 man-days would be sufficient if you opt for vetiver hedges."

70% savings in soil and water conservation work

According to Haridas, KDHP has a replanting programme beginning this year. They hope to cover at least one percent of their total tea area of 8800 hectares. This means, every year, they will have to replant in about 88 hectares. Consider the savings: in replanting one hectare of tea garden, if vetiver hedges are raised in place of stone walls, there will be a savings of 250 man days. Assuming the daily wages is Rs.120, this makes a neat reduction of 30,000 rupees a hectare.

How Vetiver Caught The World's Attention

In 1987, noting that soil erosion is the most serious agricultural problem in the world, Richard Grimshaw and John Greenfield, two agricultural scientists of the World Bank decided this had to be tackled on war footing. During their visits to different states of India, they chanced upon the solution they were so eagerly looking for in a sleepy village near Gundlupet in Karnataka. The village evokes vivid memories in Grimshaw's mind. "We learnt from these farmers that they have been successfully growing vetiver against soil erosion for centuries. It reduced rainfall runoff by as much as 70%, recharged groundwater (villages that use vetiver have much higher water levels in their wells), and improved ephemeral stream flow."

Subsequent studies prompted the World Bank to launch The Vetiver Network (TVN), which has been disseminating vetiver technology to the world with a missionary zeal. Now there are more than 20 vetiver networks in the world and newer ones are being formed every year. In China alone, vetiver is so popular that the country now has a Chinese Vetiver Network and 6 corporations for the implementation of vetiver systems for environmental protection.

Best candidate for 'earth repair'

What makes vetiver so popular?

- It's perennial and requires minimal maintenance.
- It's both xerophyte and hydrophyte. Once established, it can withstand drought, flood and long periods of water logging.
- It will grow in all types of soil regardless of fertility, pH or salinity. It is highly tolerant to toxic levels of aluminium, manganese, arsenic, cadmium, chromium, nickel, copper, mercury, lead, selenium and zinc.
- It will grow in a wide range of climates, survives in areas with average annual rainfall between 200 and 6000 millimeters and with temperatures ranging from 1 to 45 degree C.
- It is a climax plant and therefore even when all surrounding plants are destroyed by drought, flood, pests, diseases, fire or other adversity, vetiver will remain to protect the ground from the onslaught of the next rains.
- It has a strong fibrous root system that penetrates and binds the soil to a depth of three meters and can withstand the effects of tunneling and cracking.
- The vetiver system is low cost and extremely effective system for soil and water conservation, infrastructure stabilization, pollution control, waste water treatment, mitigation and prevention of storm damage and many other applications. Vetiver grass, vetiveria zizanioides, is central to all vetiver system based bioengineering and conservation applications. It can be used in the tropics and semi tropics, and areas outside the latter (such as Italy and California that have a Mediterranean climate) where there are hot summers, and winters that do not include permanently frozen soil conditions. The roots of the grass have an average tensile strength of Mpa 75 (one-sixth the strength of Mild Steel), and improve the shear strength of soil by between 30 and 40%. Engineers liken them to a "living soil nail".

(for more details see: <http://www.vetiver.com>)

Crutch for rain-fed farmers

Richard Grimshaw, now President of TVN and John Greenfield have visited India many times and have a clear picture of the farming conditions here. Recalls John Greenfield, "When I was introducing the vetiver system in Kabbinala and other areas, especially down in Karnataka, I introduced it by saying 'We have a technology that can improve your yields by 15-50%, that is permanent, once established, costs nothing and will drought proof your crops'. Then I go on with the explanation of how vetiver hedges conserve runoff and increase the moisture in the soil. Farmers are not interested in spending money on "soil conservation". Vetiver hedges providing moisture conservation are of course preventing soil erosion; you just don't need to mention it."

He adds, "We have got to revive the fact in the farmers' minds that crop plants are dependent not on the amount of rainfall, but on the soil moisture which the rainfall provides - excessively heavy falls under traditional methods of cultivation are lost by surface runoff and evaporation and are therefore relatively ineffective. Vetiver hedges hold back runoff for a great distance behind the hedge, they also prevent the loss of organic matter (farmyard manure) as we were able to show farmers down in our Karnataka project - they could see the benefit of that, we never mentioned soil conservation."

Vetiver Hedges Vs Contour Bunds

Are these vetiver hedges in any way better than contour bunds? "Certainly", elaborates John Greenfield. "A bund diverts runoff to the drainage network, thus denying the rainfed farm the full benefit of the rainfall it gets. The area immediately in front of the bund rarely gets sufficient moisture for crop growth. The vetiver hedge holds the rainfall back, spreads it out and gives it a chance to soak in to the ground as stored moisture. Excess runoff filters through the hedge and carries on down the slope at greatly reduced speed, but wetting all the ground as nature intended it to do."

"In a particular case in Karnataka," he recalls, "the farmers had planted their Ragi, received six millimetres rainfall, enough to germinate their seed but then no more rain for over a month, the seedlings died. Their neighbours who had planted vetiver hedges retained enough moisture in the soil to carry their plants over and produce very good yields."

"Soil moisture is essential for crop growth", analyses John Greenfield, "So, it is no use talking about the benefits of 'drought tolerant' and especially 'drought resistant' (which don't exist) crop varieties, as without sufficient moisture none of these will survive. Therefore it is essential that the rainfed farmer controls runoff to enhance moisture conservation - controlling runoff also controls soil loss. The only efficient way to control runoff is with the use of vetiver hedges."



The vetiver hedge holds the rainfall back, spreads it out and gives it a chance to soak in to the ground as stored moisture. Excess runoff filters through the hedge and carries on down the slope at greatly reduced speed, but wetting all the ground as nature intended it to do."

Embankment Stabilisation

Another widely adoptable use of vetiver is for embankment stabilisation. What is required is just timely planting of vetiver slips in linear rows across slopes. Using this technology alone, countries like China, Brazil, Philippines, Malaysia, Vietnam and the West Indies have saved millions of dollars. In recent years, China has extensively used vetiver for major highway and railroad embankment stabilisation.

Vetiver float to purify water in Mahavishnu temple pond, Tiruvalli. (Picture by P Haridas)

Vetiver Can Check Weed Invasion

Apart from its value for soil and water conservation, vetiver can check weed invasion too. Points out Haridas, "Vetiver grass grows so densely that it can block the spread of other grasses including some of the world's worst creeping grasses. In Zimbabwe tobacco farmers reportedly plant vetiver around their fields to prevent invasion of other tough grasses. In Mauritius sugar cane growers rely on vetiver to prevent Bermuda grass from penetrating their fields from adjacent road-sides. In High Range, for example, a vetiver plot established at Kundaly in the early 1990s kept Kiky grass (Pennisetum clandestinum) from creeping in. Obviously establishing vetiver hedges along the periphery of tea fields could prevent invasion of deep rooted tough grass weeds."

Role In Desiltation

Sums up Grimshaw: "Water ponds and tanks that are being cleaned and desilted would benefit from surrounding vetiver hedgerows to prevent future siltation, and floating platforms of vetiver on the ponds would significantly increase water quality. Spring heads can also be very effectively protected by vetiver. Additionally vetiver could be used in villages to help clean up household effluent, and stabilise those communities that live on steep slopes."

Water Purification

One recently discovered attribute of vetiver is its capacity to purify water, and thus to help in wastewater treatment. Vetiveria zizanioides, a species widely present in India, can absorb many heavy metals, nitrogen and phosphorous from water. In studies conducted in China using vetiver to treat effluents from piggery farms, the results were quite encouraging. Using vetiver to purify water bodies is easy, too. Being hydrophyte, the plants don't require a separate medium to grow in water. The only arrangement required to make vetiver plants survive in water properly is a float to maintain the balance between roots and shoot and to make the plant stand erect. Cut pieces of bamboo make a good float.

In a lighter vein, Haridas says that our predecessors in the remote past would have named the plant "vetriver", a winner among roots. But, he complains, "we have made this 'miracle plant' an orphan in its own motherland".

Good Growth of Vetiver In Water

Using vetiver, Haridas has started experiments in the company's estate and later in the pond of Mahavishnu temple at Thiruvalli, his homeland near Manjeri in Malappuram District. Though both trials have just started, one promising aspect is of its good growth in water. "I was surprised to see growth of more than a foot in three weeks", he says.

TVN has been awarding certificates to individuals who have been doing good work and demonstrating a high level of knowledge in specific areas of the vetiver System technology. Haridas has been a recipient of this certificate of excellence. He is the only person from India to get this recognition so far, and is one of 14 persons from around the world.

Learning Of Vetiver Use From China

Sometime ago, he had sent one truckload of vetiver tillers to a tea estate in Darjeeling. He says the owner of that company is quite satisfied with the results in soil and water conservation, but despite his excitement at vetiver's good performance in the tea estates, Haridas is far from happy. He'd like to see widespread adoption of vetiver by governments, which can really scale the benefits very high. He simply does not understand why our watershed departments and the administration have almost shut their doors to vetiver Grass Technology."

“

Using vetiver to purify water bodies is easy, too. Being hydrophyte, the plants don't require a separate medium to grow in water. The only arrangement required to make vetiver plants survive in water properly is a float to maintain the balance between roots and shoot and to make the plant stand erect. Cut pieces of bamboo make a good float



While more and more countries are embracing vetiver technology, it is quite ironic to see that in India itself, vetiver is a sort of 'touch me not' plant, despite having its origins here! A few months ago, Haridas read a report in an English daily that upon hearing a success story of railroad stabilisation in China courtesy vetiver, Konkan Railways approached the railway authorities of China to know more about this.

He sent a letter to Konkan Railways saying that the technology has in reality originated from our own country, and lot of information is available with him. Unfortunately, he hasn't drawn a response!

The Growing Tribe Of Vetiverites

Haridas, though disappointed at our administrations' indifference to this simple, cheap and sustainable technology, is hopeful. He intends to concentrate on use of vetiver to purify water. The link with soil conservation is also a strong motivator. "To get the water stored properly you need a medium, which is the earth - hence our soil too has to be protected from erosion. Let us work on SOS (Save our Soil)", says this confident vetiverite.

(Shree Padre is a journalist with many years of experience in agricultural reporting. He is the author of several books, including one on rainwater harvesting, published by Altermedia.)

Farm Fluence

Technology in Agriculture, Making Lives of Growers Easy

While Artificial Intelligence has taken the industry by storm across the globe, agriculture is also using Internet of Things to meet the industry requirements. According to UN Food and Agriculture organisation, world would need 70 percent more food by 2050. Increasing the yield without using harmful chemicals is quite a challenge before the agricultural world. However, internet of things can fit the bills in this array. Companies like FarmFluence are using technology in the best manner possible to ease out the burden from farmer's shoulders. It is a one-stop-solution provider of best sensors, controls, integrated monitoring and control solutions. The company has a cloud enabled dashboard powered by AI & ML. FarmFluence Co-Founder & CIO, Gaurav Shah, said, "Our solution comprises three major elements. (i) Sensors, (ii) Control/Automation, and (iii) IoT. Our sensors range from water monitoring (pH, EC & Temp), soil monitoring (pH, EC, NPK & Moisture), environment monitoring (Humidity, Temperature, CO2 & Lux). All these sensors perform online real-time monitoring and reporting."

Their control or automation part system, powered by IoT, can compute, store data, make decisions based on events and triggers reports. All this is accumulated through cloud computing 2G/3G/LTE/Wi-Fi connectivity. This system controls motors, pumps, foggers, sprinklers, fans, grow lights or dosing systems. The IoT function help of this system, farmers are able to directly manage their fields remotely. This dashboard incorporates loads of features like deep analytics, historical data, crop cycle management, season management, real-time alerts, nutrition management, and also energy monitoring.

He further said, "We help farms with effective water management, energy management and resource management. Our product is 'Atmanirbhar Bharat' in its true sense."



Gaurav Shah, Co-Founder & CIO, FarmFluence

Citing an example of one of its clients, he said, One of our clients, a Hydroponic farm, was running with a failed automation system that was supplied by a local vendor. When they approached us first, the initial challenge for us was to convince them that automation does work if designed and implemented properly. The second challenge was the budget, since a decent amount of money had already gone into the existing setup. But with a couple of rounds of discussions and a visit to their farm, we could win their confidence and the system has been running smoothly.

With a bold vision, the company aims to automate over 10,000 commercial farms in India by 2025. By leveraging technology and automation, they seek to optimize processes, reduce manual labor, and boost overall productivity. By introducing sensors and controls, they enable farmers to enhance their capabilities and prepare for future expansion.

The time is ripe for a revolution in agriculture, and this company is poised to lead the charge. By embracing cutting-edge solutions, they empower farmers to meet the demands of a rapidly evolving market while increasing efficiency and profitability. Together, we can build a future where automation drives success in the farming sector, ensuring a sustainable and thriving food supply for all.



Mr Himkar Mishra
Chief Executive Officer
Summer-Shell Natural Farm

In Purnia, vetiver cultivation had started in 200 BC. But now, its cultivation had to be reintroduced because the people had forgotten about its goodness and its many benefits. This experiment of ours for the production of vetiver plants will inspire the farmers in our region and hopefully promote more cultivation of vetiver



VETIVER

The Unique Gift Of Nature

A new step has been introduced in the traditional farming method at the Summer-Shell Natural Farm Ramnagar, Purnia, the center of Rishi farming. It is the cultivation of vetiver. Vetiver cultivation is definitely a new experiment for us. We are promoting the cultivation of vetiver keeping in view the increasing pressure on the environment. Shri Patanjali Jha is our guide for this work.

For the purpose of overcoming the soil and water crisis, we are promoting vetiver cultivation on a large scale here. We have tied up with Indian Army's Eco Task Force to provide two crore vetiver plants to deal with the worsening environmental imbalance.

Vetiver is unique species of plant whose roots are very strong. Khus, known as Vetiver in south India, is grown on a large scale in Kerala and other parts of South India. Vetiver is a Tamil word. This grass is known by this name all over the world. In northern and western India, it is popular with the names of khus.

Vetiver seed is the best unique gift of nature. It is a matter of regret that we Indians have failed till now to make suitable use of this amazing gift of nature.

Globally Popular As An Environment-Friendly Resource

Vetiver has gained great popularity as an environmentally beneficial tool in many parts of the world. Until a few years back, Vetiver was extensively used in houses in many ways. Vetiver curtains were usually hung on the doors of the house to avoid the heat. It was once considered a sign of comfort and opulence.

Vetiver cultivation is not only used to provide coolness. It is also used a lot in medical traditions like Ayurveda. If it is propagated in a better way, it is useful in maintaining soil fertility and water level. For promoting handicrafts and for improving the fiscal health of small scale industries, vetiver can be an excellent option.

We need to come together and emphasize on large-scale cultivation of vetiver. It prevents soil erosion and is helpful in preventing landslides in hilly areas. Vetiver is a special plant. It maintains the moisture and nutrients of the soil. Research shows that by planting vetiver, soil health increases tremendously and productivity increases. Vetiver root keeps the water pure.

Vetiver keeps water more pure than the state-of-the-art water machines. Vetiver oil is sold at Rs 40,000 to Rs 50,000 per kg in the global market. Vetiver can even remove the bad odour of drains. In Purnia, vetiver cultivation had started in 200 BC. But now, its cultivation had to be reintroduced because the people had forgotten about its goodness and its many benefits. This experiment of ours for the production of vetiver plants will inspire the farmers in our region and hopefully promote more cultivation of vetiver.



Dr J Shankaraswamy
 College of Horticulture, Mojerla, Sri Konda
 Laxman Telangana State Horticultural
 University, Wanaparthy, Telangana, India

“ In tropical countries, vetiver roots are used in the production of homemade evaporative coolers. These functioned as air conditioners before the inception of electricity. Due to their coolness, the roots were ideal for use in making grass mats



VETIVER

OIL OF TRANQUILITY

Fragrance Of The Soil

Value addition is frequently understood in relation to adding value to fresh commodity of horticulture crops. But in modern scenario value addition involves more than just changing the form of horticultural crops according to the market demand and consumers preferences.

In general sense value addition in horticulture is a multi-dimensional. A new dimension from the consumer point of view is added to the existing understanding of value i.e. how a consumer perceives the value delivered to him through a bundle of product services. This new approach of value addition through the consumer's mind needs special attention. All the activities now must be seen from the consumer point of view. In other words, market demand and consumer orientation is required in all spheres of horticulture sector. So factors like quality of the product, form of the product, size of the product, packing of the product, labelling of the product, time or season for value addition, transport, shelf life of the product etc. need to be considered while value addition of the horticulture produce.

It is commonly believed that that value added products are only for consumption purpose but they may be also for non-food usage. In this same context, we talk of vetiver crop. (Vetiver zizanioides (Linn.) It is popularly known as Sugandhaimulah in Sanskrit.

The Amazing Uses Of Vetiver Oil

Vetiver is a densely tufted plant. It originated in India located in swamp regions and belongs to the family Poaceae, exclusively used as aromatic crop. The root is the most economic part of the plant. It contains fragrant oil considered as one of the finest aromatic oil extracted through hydro or steam distillation. Vetiver oil is the one of the most valuable and important perfumer's raw material. Its oil is light to dark brown, olive, or amber viscous oil and having a deep smoky, earth-woody odour with sweet persistent undertone.

Vetiver oil has a powerful smell but very pleasant when diluted. In dilute state, it smells like sandalwood oil. Hence, it has been utilized as a major raw material in various fragrant products (cosmetics, perfumes, deodorants, lotions and soaps) and also used as high grade fixative and blends well with sandal wood, lavender, patchouli, and rose oil.

It is exclusively used in the preparation of compound perfumes in which the oil on account of its low volatility is normally used as base to fix other high-value volatile oil like rose, lavender and jasmine oil. Vetiver plays an important role in aromatherapy.

UP Leading Producer In India, Haiti The World Leader

Vetiver is also used as a flavouring agent in sherbet and as well as food preservatives. This oil is also shown to have insecticidal, antioxidant, and anti-cancer activities. Uttar Pradesh state in India produces the highest quantity of vetier oil, mainly through wild sources.



Vetiver oil produced in North India is of premium quality and fetches a very high price in international market. Haiti is the world largest supplier of vetiver oil and it is very competitive. The Haitian vetiver oil export market share is steadily increasing in world trade. Haiti has made significant inroads in capturing the French market. After Haiti, only Indonesia and USA are the other major suppliers of vetiver oil to France.

Vetiver In The Cosmetic Industry, Household Usage

Vetiver oil dilution @15-30% in alcohol is good enough to make a true vetiver perfume. Because of its fixative function, it is a contributor in various perfumery applications. Vetiver oil is recognised as a source of a synthetic material named vetiver acetate used in perfume.

The main aroma active constituents in vetiver for economic value due to presence of α -vetivon, β -vetivon, and khusimol, where α -vetivone, β -vetivone, and khusimol are in the fingerprint area. Because of fragrance of vetiver root oil, it is popularly known as "oil of tranquillity" and 'the fragrance of the soil'. It has a calming scent.

The entire plant can be used for various applications including the making perfumes, soaps and cosmetics. In nutraceuticals applications, extracts or waste from vetiver are used as antioxidants for protection against oxidative stress. In foods and drinks vetiver is used for making a cooling beverage. In tropical countries, vetiver roots are used in the production of homemade evaporative coolers. These functioned as air conditioners before the inception of electricity. Due to their coolness, the roots were ideal for use in making grass mats.

Work Done At College of Horticulture, SKL Telangana State Horticultural University

In College of Horticulture, Mojerla, Sri Konda Laxman Telangana State Horticultural University, aromatherapy oils were prepared with vetiver essential oil by blending with lemongrass oil, Grape fruit peel oil, Basil oil, lemon oil, Frankincense oil, Jasmin concrete and absolute oil, Ylang-ylang oil, palmarosa oil, citronella oil, eucalyptus oil, rosemary oil, lavender oil, balsam of Peru oil, ajwain oil, cumin oil, fennel oil, grape seed oil, almond oil. This was done based on the evaporation rates of essential oils for correction of dosha imbalance and also for preparation of the personal care oils preparation (bath care, inhalation, compress, cold compress, dental care, skin care, hair care).

College of horticulture, Mojerla under the supervision of Dr. J. Shankaraswamy prepared many forms of vetiver oil diluted preparation like face gels, creams, lotions, soaps, shampoos, sprays, perfumes. Even scented candles are prepared. Based on immense health benefits of vetiver essential oil, there is possibility of preparing a wide range of products to enhance libido.

Vetiver oil provides relief from all types of inflammation. It improves and maintains nerve health. It rejuvenates the body and helps boost immunity. It heals wounds and provides relief from insomnia.

Based on our experience in product development, vetiver essential oil appears to be appropriate for business development for small land holding farmers. Vetiver plantation also leads to effective utilization of wasteland. Based on our research and marketing survey, vetiver oil based products can provide new avenues for future business development.

“Based on our research and marketing survey, vetiver oil based products can provide new avenues for future business development



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VETTIVER INDIA

Vetiver is the main root of Health & Happiness



C. PANDIAN
VETTIVER INDIA
Cm.Eco-Herbal Plantations

Vetiver, a native plant of India, has been used for medicinal purposes for over five thousand years. The Shiddas, an ancient Indian civilization, used Vetiver in more than 40 medicines to cure over 100 diseases. Nowadays, Vetiver is used in a variety of industries, such as medicines, perfumes, environmental solutions, handicrafts, and organic farming.

VETTIVER INDIA, founded by Mr. C. Pandian, started Vettiver farming 16 years ago by collecting wild varieties. Today, they have extended their cultivation to 60 acres with the new varieties of CSIR-CIMAP of the Indian Research Organisation. They have supplied 60 Lakh Vettiver saplings for public awareness, water conservation, and soil conservation, and 1.5 crores of saplings for commercial cultivation.

VETTIVER INDIA now produces over 100 types of Vettiver value-added products, including handicrafts, cosmetics, and medicines. They have employed 60 female and 10 male employees directly, and indirectly more than 300 employees. According to Mr. C. Pandian, Vetiver has an essential role in the health and happiness of global life in the future.

For more information, contact CM ECO HERBAL PLANTATION at Kuruvadipatti, Sundakadu Post, Thirupathur TK, Sivagangai, Pincode-630203, email at vettiverpandian@gmail.com, visit their website at www.vettiverindia.com, or call 96779-85574.

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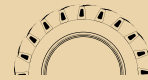
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