NOTES ON THE VISIT TO SPAIN IN JULY 2016

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1. BACKGROUND

Vetiver was first introduced to Spain in 1994 by Marco Troglia to assess the suitability of VGT as a bio engineering method in the Mediterranean region. The project was carried out by Dr. P.K. Yoon from Malaysia for TVNI and Dr Diego Frutos, a horticultural specialist, seconded from the Murcia Agriculture and Irrigation Department to help setting up the project. With his own time Diego has monitored its progress from 1995.The trial site was on a steep batter of a water reservoir near at Lorca in the Murcia province of southern Spain. The results of this trial up to September 1995 was reported in a paper "*The introduction, early results and potential uses of VGHR in Mediterranean regions"* at the First Vetiver International Conference in Chiang Rai in 1996. The following photos show the success of the trial.

Three years after planting at LORCA in 1997, Vetiver established well with drip irrigation during establishment phase (the first summer) and no further irrigation

Four years after planting. Contrast between vetiver and control plots at Lorca site. No natural colonisation of native plants.

The European and Mediterranean Vetiver Network (EMVN)

In 1996 Mike Pease, based at Lagos, Portugal initiated the EMVN to promote the application of VGT in Iberia and other countries in the Mediterranean region, including some Middle East and North African countries. In March 1998 Mike imported a large consignment of vetiver from Zimbabwe for EMVN trials, NGOs and private growers in Portugal and Spain. Subsequently in 1998 a number of trial plots were established by government agencies and private properties throughout the Algarve, Alentejo and Azore in Portugal.

Independent from Mike Pease introduction, Antonio de Mello also introduced Vetiver from South Africa in 1996 to establish a nursery at Santarem, NE Lisbon for use in soil and water conservation and land stabilisation on his farm.

Antonio de Mello (left) and Mike Pease at nursery and Antonio used vetiver to stabilise Creek bank, dam wall and other erosion control in his farm

2. SEMINAR AT UNIVERSITY OF MALAGA ANDALUSIA (UMA)

Recently, 22 years after planting (1994-2016) Dr Diego Frutos reported that the original planting is still in place, holding up the slope. Despite this extraordinary result, VST is not being widely used in Spain. To revitalise VST applications in Spain, **Jose Luis Cortés**, TVNI Coordinator for Spain, initiated a Seminar entitled ***VETIVER SYSTEM: ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY*** at the Assembly Hall of University of Malaga Andalusia (UMA) at Andalusia Technology Park on 15 July, 2016. In addition to bioengineering application, the emphases will be also on Environmental Protection and Agriculture.

The program includes presentations by:

- Jose Damian Ruiz and Paloma Hueson of the Geography Department on ***Water and soil conservation basics needs***
- Jose Luis Cortes and Miguel Angel Botella on ***Vetiver System: Soil and Water conservation alternatives***

- Paul Truong on ***Vetiver System: Application, Research and Development projects***. The presentations were in English with Spanish PowerPoints, these include:
    - Introduction to TVNI and Vetiver System Technology (VST)
    - Application of VST in Environmental Protection
    - Application of VST in Infrastructure Protection
    - Application of VST in Soil and water conservation in Agriculture
    - Application of VST in Wastewater Treatment of Pig farms
- David Olson of Vetiverspain on*:* ***Results and experience after 5 years of VST applications on highly erodible hills at Sayalonga, Malaga***

There were about 50 participants including 3 from Portugal. The participants were from University staff and students, local and regional government officials, construction and waste management industries

Discussion

The seminar was well received as participants showed great interest in the various presentations, particularly on environmental issues by environmentalists, government officials, waste management industry and academics.

3. PROJECTS CONDUCTED BY JOSE LUIS CORTES IN MALAGA

- **Planting for landscaping and sand blast protection at Caleta Playa Restaurante on Malaga beach**

This planting was carried out for both landscaping and protecting clients from windblown beach sand at this open sided restaurant at Malaga main beach. It was planted directly to beach sand with only initial watering in the first few weeks. No watering and no fertilising in the last 8 months, so it is reasonable to assume that its roots have reached the saline subsoil moisture.

Eight month old planting on the on the side of the restaurant

Plants reaching 1.6m height before trimming back and view from inside the restaurant

Planting outside the toilet block for screening and this was occasional watered by kitchen wastewater, so it is very flush as compared with planting on the other side, reaching over 1.8m

- **Wastewater treatment**

The runoff water from the garden at the Malaga Cemetery was first collected in a pond, this water is contaminated by both nutrients and sediment. The polluted water from the pond was first treated by Vetiver in an ornamental “fountain” being used as a constructed wetland, then it was released into a large drain, about 25m long, acted also as a constructed wetland. The following photos will show the effectiveness of vetiver in removing nutrients from this polluted water:

- Vetiver growth at the point of entry in the top section was luxurious, even with weeds
- As the water went down the drain, growth was gradually reduced and very poor at the end

- This indicates that most nutrients were removed by vetiver within to top section of the drain, only clean water reaching the end of this 25m long drain

Polluted water in the collecting pond

Fountain wetland and outlet into lower wetland

Better growth at outlet of water to top end of drain from "Fountain" wetland

Growth gradually reduced as water moved down the drain from inlet

- **Erosion control at deTlox**

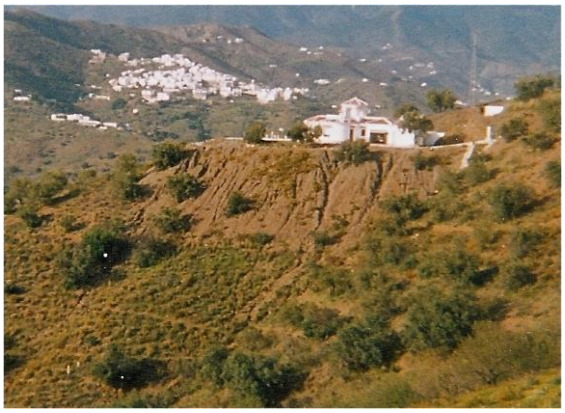

- **Nursery near Malaga**


This nursery can supply quality bare root slips and potted plants

4. PROJECTS CONDUCTED BY ANNA AND DAVID OLSEN OF VETIVERSPAIN AT SAYALONGA

Anna and David Olson, proprietors of VetiverSpain, invited us to visit their farm at Sayalonga, about 120km from Malaga, and we stayed at their lovely hill top house, overlooking their vetiver-protected orchard and nursery.

Anna and Dave became involved with Vetiver soon after they purchased their home at Sayalonga. They had a severe erosion problem on the newly created terraces. They wanted to find an inexpensive and ecologically friendly solution to their problem. They found Vetiver through the website of TVNI at www.vetiver.org. They bought their first plants from Sardinia, Italy. After planting Vetiver the erosion stopped within the first few months. After about 3 years they started dividing plants and planting more and more to solve erosion issues on other areas of the property. Then neighbors wanted to buy Vetiver as they had the same problems with erosion. So Vetiverspain was born and it is now the biggest vetiver plant supplier in Europe, the company supplies high quality bare root slips and potted plants



Original erosion situation on the farm ***Erosion under control today, 5 years later***

The followings are some of their results and experience:

- ***Increase in crop yield***: Some of their worse performing olive and citrus trees became their best producing trees after they planted Vetiver around them to halt the erosion. There are flowers and fruits on 2 year old avocado trees with Vetiver planting.
- ***Vetiver used as a wind break*****:** Vetiver planting is being used extensively on the property to protect trees, plants, and vegetables from the high winds due to high elevation.
- ***Vetiver as a natural insecticide*** Chickens, ducks, and rabbits love the Vetiver in their pens along with the normal hay that is used for the flooring. The rabbits actually eat it and the animals no longer had the normal spring mites. Vetiver planted around picnic areas to keep away mosquitoes and other airborne pests.
- ***Vetiver as a fodder*****:** When planted for erosion control around a newly leveled horse corral, the horses started eating it so his client now cuts the Vetiver back every few months and feeds it to the horses. His client has also noticed that he no longer has a worming problem with his horses.

General vetiver planting for various applications on Vetiverspain farm

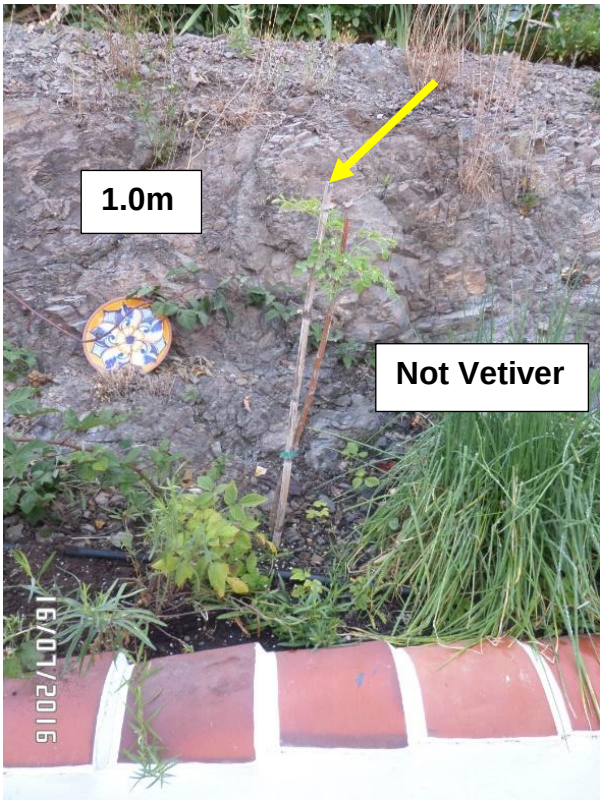

General vetiver planting for various applications on the farm

The most remarkable outcome of vetiver planting on the farm is its effect on horticulture crops such as avocadoes, citrus, olive and mango. Anna and David attribute this to soil and water conservation. The following photos show a very well developed two year olds avocado with its first fruits. This is not for this single plant but on all avocados planted between vetiver rows. This effect was most remarkable when it also “rejuvenated” old olive trees and also observed on new mango crop.

Two year old avocado tree with its first fruits

New mango and new avocado planting between vetiver rows

Similarly, the same effect occurs on *Moringa Oleifera* tree in the garden. Under same soil and irrigation conditions, the one planted with vetiver is flourishing and at least 1.6m tall, while the one without the accompanying vetiver is only about 1m.



While the this effect can be attributed to soil and water conservation on the steep slopee of the farm, the effect on *Moringa Oleifera* tree in the garden suggests some other factor/factors contributed to this really remarkable result.

- The first comes to my mind is soil pathogen such as nematodes, a soil born microscopic worms that infect the roots and severely affected plant growth. This infestation is very common in old orchards, it may occur on this very old olive plantation. The following photos show the effects of nematode infestation on Sweet Tamarin in Thailand. Due to this infestation, planting vetiver around orchard trees is a very common practice in Thailand now.

With vetiver planting

Without vetiver planting

- The second possibility is some fungal diseases infected the roots, so I suggest a soil pathology test to be conducted on various soils in the farm and garden

5. VALENCIA VISIT

Following the Seminar I visited Jorge Blanco projects in Valencia and surrounding region. Jorge has been working and promoting the use of VST in the Valencia region in the last 3 years,

- **Sewage Treatment Plant at Tavernes de la Valldigna**

This is a holiday town for people in this region, about 60km south of Valencia. Its permanent population of about 18 000 increases to 40 000 in summer. As expected, the existing sewage treatment facility has a major problem coping with the increase in effluent in summer. To supplement the existing conventional treatment facility, the city is interested in the use of Vetiver to treat its excess inflow with vetiver constructed wetlands. Vetiver wetlands offers a unique and ideal solution to the city problem as vetiver is dormant in winter, its peak growth in summer coincides with the high tourist season.

A set of 3 sand filled containers will be used to determine the efficiency and optimal flow rate to reduce the nutrient levels to regulated standards. Effluent will move from the highest to the lowest containers.

Tavernes de la Valldigna Sewage Treatment Plant and containers set up for the trial

- **VALENCIA City Drinking Water Treatment Plant**

AGUA DE VALENCIA is a private company supplying potable water to Valencia City. The water is sourced from rivers and wells in the region. As this region is highly populated and due to the intensive agriculture of the area, the underground water is high in nutrients, especially Nitrogen coming from fertilizers.

In the overall treatment process, the liquid extracted from the de-watering of the sludge is highly contaminated with nutrients and pollutants. This liquid is then mixed with the fresh incoming water for treatment.

A wetlands trial was set up to test the effectiveness of vetiver in removing nutrients and pollutants from this sludge liquid . The following photos show the very good vetiver growth in the first container, which gradually reduced and was very poor in the third container, indicating that almost all nutrients were taken up by vetiver in the first two containers.

Engineer Miguel Ano Soto *et al* will publish the results of this trial in a paper entitled ***Treatment of recirculation flow through a vertical pilot scale constructed wetland*** (in press). The parameters monitored are: suspended solids, organic matters (COD, BOD), Aluminium, nutrients and pathogens. Trial results confirmed their expectation that Vetiver *would enhance the quality of the water and also optimised the whole water purification process due to lower maintenance costs and energy saving as compared with traditional treatment process*.

Water quality before and after VPT treatment

- **Landfill MBT Plant at Manises**

In Spain, the most common municipal waste treatment is carried out in a Mechanical and Biological Treatment plants (MBT), this process produces a leachate which has to be treated with a high cost process. Therefore VPT can be used to eliminate the leachate in a natural and low cost, similar to the process conducted in Australia and the USA. As the leachate is highly concentrated with salt, a container trial is being set up to test vetiver tolerance to salinity levels as well as its water consumption over the whole year.

The UTE INSTALACION 3 company is interested in the use of the VPT and has offered its facility located in the municipality of Manises for doing the test.

Indoor fresh solid waste treatment plant

Management and monitoring team

Trial set up with 9 containers

3 month old vetiver ready for testing

Due to high salt content of leachate (17,600 uS/cm), the treatments will have 50%, 30% and 20% of pure leachate concentration.

- **La Goleta beach, Tavernes de la Valldigna**

La Goleta Beach is the main beach of Tavernes de la Valldigna City, a natural depression was formed after the flooding caused by the Júcar River overflow in 1982. It is a storm tank, built in 1989 to collect runoff of nearly 200.000 m^2 area. It has a surface área of 11,264 m^2, with an average depth of 1.3 m and storage capacity 10,000 – 14,500 m^3

Around the lake there is a recreational area that is mostly used in summer during touristic season. Since its construction, the lake has suffered repeated events of fish deaths and bad odours that cause the alarm of residents and tourists. Municipal authorities worried by the environmental health risk and the economic impact on tourism industry decided to undertake a restoration project and Professors Maite Sebastià and Jose Andrés Sanchis from Valencia Polytechnic University are the team Leaders to revitalise this lake.

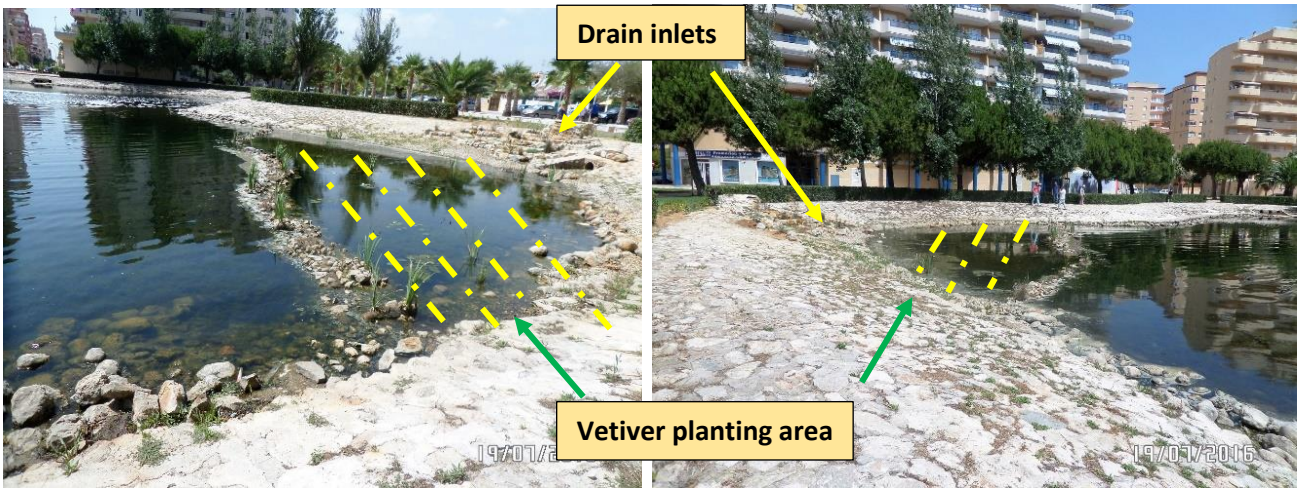
General view of the lake

Selected restoration measures include: Creating a closed circuit for recirculating water, aerators, fountains, waterfalls, Biofilters, UV-C Clarifiers, filtering system at lake inputs, diverting first flush water, fauna control measures (ducks, geese, turtles, carps) and diverting first flush water. However the main disadvantages are high installation, operating and maintenance costs. In addition, the proposed measures will have a high risk of vandalism.

The council is still looking for a natural, green solution with low installation, operating and maintenance costs. So they are very interested in using Vetiver System that is operating at Springfield Lake in Brisbane, Australia. The system is very effective in reducing nutrients, sediment from runoff, in addition to its landscaping value.

The proposed system consists of: 1) Floating pontoons on the lake, 2) Vetiver planting directly to shallow áreas near runoff inlets and 3) Selected locations around the water edges

Floating pontoons on an effluent pond in Australia



Planting in shallow pool near drain inlets

Planting in shallow pool on Springfield lake in Australia

Planting on the wáter edge

Planting on the wáter edge of effluent pond in Australia

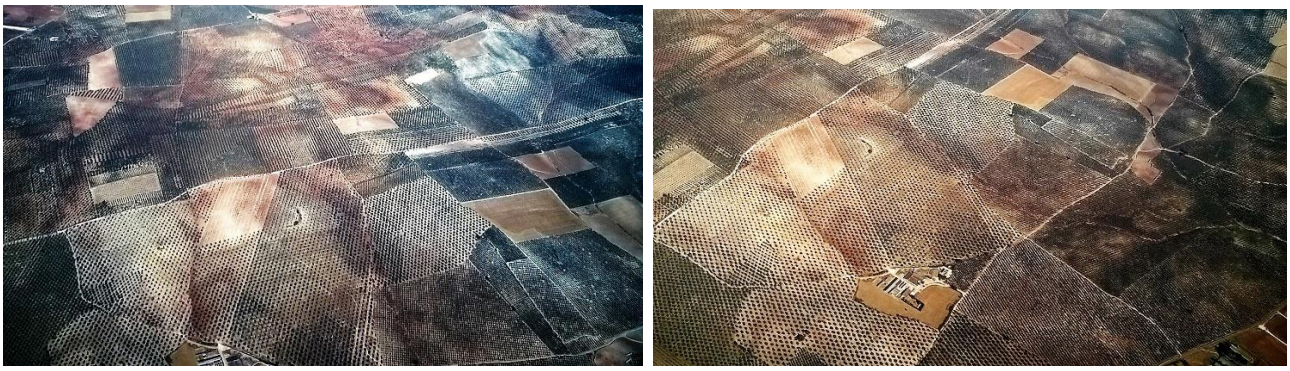
Jorge Blanco will start implementing the wáter edge and shallow pond planting this summer.

6. OLIVE OIL INDUSTRY

Italy and Spain are the biggest olive oil producing countries in the world, due to the popularity of the Mediterranean Diet, the industry is expanding rapidly in recent years. In my experience, while the Italian olive oil industry is based on numerous small to medium size

plantations, the Spanish industry is mostly concentrated on massive size plantations. These plantations are mostly on sedimentary rock- derived soil on undulating topography, which are highly prone to both water and wind erosions.

Massive olive plantations on highly erodible soil in Andalusia



Vetiver System can offer at least two potential applications to the industry;

- Planting vetiver for soil and water conservation on sloping land, particularly for wind erosion control during crop establishment phase. In addition to potential crop improvement as found on Vetiverspain farm at Sayalonga.
- Treating the olive mill waste water (OMWW), also known as Margines, the effluent produced during the oil extracting process, which has the following characteristics:
    - Strong colour: dark brown to almost black
    - Low pH : 4.5 – 5.2
    - High organic content: COD 150g/L for pressure extraction and 85 g/L for centrifugal extraction
    - High levels of Phenol (4 to 12 g/L), free fatty acids and tannins
    - Highly saline due to the salt used to preserve olive fruits

These characteristics make Margines at least 100 times more contaminated than urban water supply

Preliminary trial in Morocco in 2011 indicated that Vetiver could be established on land contaminated by Margines and was used successfully used in remote villages in the Sidi Majbeur mountain region to stabilise the contaminated sites.

Presently Margines is being treated chemically in Spain, it is worth exploring this potential applications of Vetiver further.

7. BEACH EROSION CONTROL

I also noticed some erosions in Andalusia, Valencia and Barcelona beaches, where restoration like this on Sao Paolo beach in Brazil can be applied.


Beach erosion and restoration with vetiver on Sao Paolo beach, Brazil

CONCLUSION AND RECOMMENDATIONS

Feedback indicating that the seminar and my visit to Valencia has revitalised the awareness and the benefits of various Vetiver System applications in Spain. There have been since several enquiries on sewage effluent and industrial wastewater treatment and erosion control in winery.

It is recommended that:

1. Soil pathology tests be conducted on different sites at Vetiverspain farm
2. Promotions should be made to introduce Vetiver System to the olive oil industry
3. Promotions should be made to introduce Vetiver System to local authorities on its beach erosion control effectiveness.

I would like to thank Jose Luis Cortes, Anna and Dave Olson and Jorge Blanco for their hospitality and sharing their vetiver experience with us.