Pacific Rim Vetiver Network Technical Bulletin No. 2013/1

Application of the Vetiver System for Wastewater Treatment: An Innovative Nutrient Removal Technology for Sewage Water Treatment in Southern Guam

By

Mohammad H. Golabi

and Manuel Duguies

Office of the Royal Development Projects Board

Bangkok, Thailand

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The Office of the Royal Development Projects Board and the Establishment of PRVN

His Majesty King Bhumibol Adulyadej of Thailand has been dedicated to development work ever since the beginning of his reign in 1946. His Majesty has become familiar with the problems and real conditions of the people through constant visits to every region of the country, often accompanied by Her Majesty Queen Sirikit and other members of the Royal Family. It is during these many Royal visits to the rural areas that His Majesty has realized the need to initiate development projects that would directly benefit the people at the grassroots. Thus, the first Royal Development Project was launched in 1952 followed by numerous projects, which currently reach more than 4100.

However, the implementation of the Royal Development Projects in the past lacked cohesiveness because each agency carried out the work on its own without coordinating with other concerned agencies. Therefore, in order to serve and implement the Royal initiatives through a consistently integrated system which allows the Royal Development Projects to run efficiently, the Thai government issued a "Regulation of the Office of the Prime Minister" which became effective on 9 September 1981. The Regulation led to the establishment of the Coordinating Committee for Royal Development Projects which later became the Royal Development Projects Board in 1993. The Board has the major task of directing, monitoring and coordinating the operation of government agencies and state enterprises concerning the Royal Development Projects. Moreover, it considers and approves projects, plans and activities as well as expenditures to be used in the operation of the projects. All of these tasks are supported by the Office of the Royal Development Projects Board (ORDPB), the secretariat of the Board.

With agriculture being the backbone occupation in the Thai society, His Majesty the King understood the vital need in preserving natural resources and therefore, initiated the vetiver grass project in Thailand. The project principally aimed to mitigate soil erosion, a distinct aspect of environmental deterioration in Thailand which needs to be managed properly. His Majesty recognized the potential of vetiver grass as a practical and inexpensive yet effective management and conservation tool to address the soil erosion problem. As a result, the Committee on the Development and Promotion of the Utilization of Vetiver (CODPUV) under His Majesty's Initiative was set up under the administration of the ORDPB in 1992 to look after all the Royally-initiated vetiver projects implemented in various parts of the country. The First International Conference on Vetiver (ICV-1) was held on 4 to 8 February 1996 in Chiang Rai, Thailand. ICV-1 was co-organized by the Chaipattana Foundation and the Mae Fah Luang Foundation with the collaboration of the World Bank and the FAO. The main purpose was to commemorate the 50th Anniversary Celebrations of His Majesty the King's Accession the Throne.

Immediately after ICV-1, a proposal was made by Mr. Richard Grimshaw, who was then the President of the Vetiver Network, to establish the Pacific Rim Vetiver Network (PRVN) in Thailand with the principal objective of serving as the center to collect and disseminate information on the use of vetiver grass in the form of newsletters, occasional publications as well as a homepage on the internet. His Majesty the King agreed with the proposal and commissioned the setting up of the PRVN under the supervision of the CODPUV, to be administered by the ORDPB. The PRVN then became active with the establishment of a working team on 6 May 1997.

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Foreword

One of the immediate activities of the Pacific Rim Vetiver Network (PRVN) is to disseminate information on the Vetiver System (VS), especially those techniques that are adaptive to local conditions of developing countries in the Pacific Rim. In this connection, the PRVN Secretariat is publishing a series of technical bulletins that provide useful information about the VS to readers who are active members of the PRVN.

Since 1998, one to three TBs have been published annually. Altogether, 15 TBs have been published. These are:

-1998: (1) "Vetiver Grass Technology for Environmental Protection" by Paul Truong and Dennis Baker; and (2) "Vetiver Grass for Slope Stabilization and Erosion Control" by Diti Hengchaovanich.

- 1999: (1) "Vetiver Handicrafts in Thailand" by the (Thai) Department of Industrial Promotion; (2) "Vetiver Grass Technology for Mine Rehabilitation" by Paul Truong; and (3) "The Use of Vetiver Grass System for Erosion Control and Slope Stabilization Along the Yadana Gas Pipeline Right-of-Way" by the Petroleum Authority of Thailand.
- 2000: (1) "Techniques of Vetiver Propagation with Special Reference to Thailand" by Narong Chomchalow.
- 2001: (1) "The Utilization of Vetiver as Medicinal and Aromatic Plants with Special Reference to Thailand" by Narong Chomchalow; (2) "Vetiver System for Wastewater Treatment" by Paul Truong and Barbara Hart; and (3) "The Development of the Vetiver System in Guangdong, China" by Hanping Xia.
- 2002: (1) "The Role of the Private Sector in Disseminating the Vetiver System with Special Reference to China" by Hanping Xia; and (2) "The Use of Vetiver for Soil Erosion Prevention in Cassava Fields in Thailand" by Somsak Suriyo and Wilawan Vongkasem.
- 2003: (1) "Vetiver Root - Oil and Its Utilization" by U.C. Lavania; and (2) "Vetiver Victorious: The Systematic Use of Vetiver to Save Madagascarís FCE Railway" by Diti Hengchaovanich and Karen Schoonmaker Freudenberger.
- 2004: (1) "Utilization of Vetiver as a Construction Material for Paddy Storage Silo" by Pichai Nimityongskul and Thammanoon Hengsadeekul
- 2006: (1) "Rehabilitation of Ravine on the Congolese Floodplain" by Alain Ndona, Paul Truong, and Dale Rachmeler.
- 2009: (1) "Vetiver Phytoremediation for Heavy Metal Decontamination" by Nualchavee Roongtanakiat.

Due to the lack of manuscript, no bulletin has been published during 2007-8 and 2010-11. The present bulletin, the first one for the year 2012, deals with the application of the Vetiver System (VS), which is a green, and environmentally friendly wastewater treatment technology as well as a natural recycling method. Its goal is to use low-cost VS for up-taking nutrients and other contaminants from the sewage water as a natural wastewater treatment in southern Guam.

On behalf of the PRVN, we wish to express sincere thanks to the authors, Dr. Mohammad H. Golabi of the Western Pacific Tropical Research Center (WPTRC) at the University of Guam, and Dr. Manuel Duguies of the Agriculture and Natural Resources, Cooperative Extension Service, University of Guam for their generous contribution. We would also like to express our sincere gratitude to Dr. Samran Sombatpanit who helped to edit manuscript voluntarily.

It is hoped that this publication will be of value to vetiver scientists, agricultural extensionists and others who would like to use vetiver grass for erosion control and sedimentation mitigation, or as a wastewater treatment technique and/or use the roots for extraction of essential oil and other handicrafts to earn extra income from the vetiver plant.

Narong Chomchalow
Coordinator, Pacific Rim Vetiver Network

Contents

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Abstract

Regular storm water run-off in addition to non-treated or semi-treated wastewater causes adverse impacts to marine water quality, essential for fish habitats, and aesthetics in Guam. The islands' communities recognize non-point source pollution is a pressing issue for Guam and the other islands of the western Pacific. Given the lack of appropriate infrastructure, the need to find low-cost innovative methods for protecting Guam's waters and living marine resources has never been so important to the survival of the islands' economies. The Inarajan Sewage Treatment Plant (ISTP) in southern Guam (Fig. 1) is of particular concern due to its high intake volume serving southern villages. The facility is a secondary wastewater treatment employing a four-cell aerobic lagoon treatment system. In this particular site, the Vetiver System (VS) is used as an alternative to current mechanical method for treating wastewaters. The goal was to use VS as a low-cost technology to remove the nutrients (i.e. phosphorus and nitrogen) as well as some of the heavy metals from the lagoon before the treated water is released to the percolating field and eventually to the ocean. The vetiver grass responded extremely well to the new environment (sewage water pond) and growth rates were rapid and healthy during the experimental period. A brief glance over the data indicates that the vetiver grass is effective in removing pollutant including heavy metals (data not shown).

Project Scope: The goal of this project is to use a low-cost VS for up-taking nutrients and other contaminants from the sewage water as a natural wastewater treatment in southern Guam.

Project Narrative: Application of the VS for wastewater treatment is a new and innovative nutrient removal technology recently developed in Queensland, Australia by the Department of Natural Resources and Mines (Truong and Hart, 2001). It is a green and environmentally friendly wastewater treatment technology as well as a natural recycling method.

1. INTRODUCTION

Guam's economy relies heavily upon tourism for its socio-economic livelihood. The local economy was greatly depressed by the drop in the Japanese economy during the late 1990's. The island economy has still not recovered and environmental as well as economy might have played a big role in that slow recovery. Numerous economic reports indicate that a good portion of Guam's tourism dollars depend upon healthy marine resources and its waters. Storm water run-off in addition to non-treated or semi-treated wastewater (i.e., Umatac-Merizo, Inarajan Sewage Treatment Plants) causes adverse impacts to marine water quality, essential fish habitats, and aesthetics. The islands' and scientific communities recognize non-point source pollution is a pressing issue for Guam and the other islands of the western pacific not only from the environmental point of view but economy too. Given the lack of appropriate infrastructure, the need to find low-cost innovative methods for protecting Guam's waters and living marine resources has never been so important to the survival of the islands' economies. In this regards, use of the Vetiver System (VS) for waste water treatment is a new and innovative nutrient removal technology recently developed in Queensland by the Department of Natural Resources and Mines (Truong and Hart, 2001). The Vetiver System (VS) is a green and environmentally friendly wastewater treatment technology as well as an effective natural recycling method.

2. THE UMATAC-MERIZO DRAINAGE

The Umatac-Merizo Drainage wastewater treatment in southern Guam (Fig. 1) is of particular concern due to its high intake volume serving southern villages. The Umatac-Merizo Drainage frequently exceeds the Guam water quality standards resulting in beach closures and fish advisories. Aerial images like the one shown in Fig. 1, illustrate the condition for a fragile marine habitat. This is due to nutrients promoting excessive macro algae growth in the once-healthy benthic environment (personal communication with local observers). In addition, numerous public complaints have been voiced about odor and the health concerns associated with swimming or fishing in the immediate vicinity of the Umatac-Merizo Drainage facility (personal communication with local observers).

The Umatac-Merizo Drainage Treatment Plant (UMDTP) has been, and is currently operating on, a zero discharge scheme, where disposal is accomplished by evapo-transpiration and percolation in the overland flow system. However, the water quality standards for stream discharge, primarily nutrients (phosphorus and nitrogen) limits, are impossible to achieve with the existing facilities (GWA, 2006b).

FIGURES

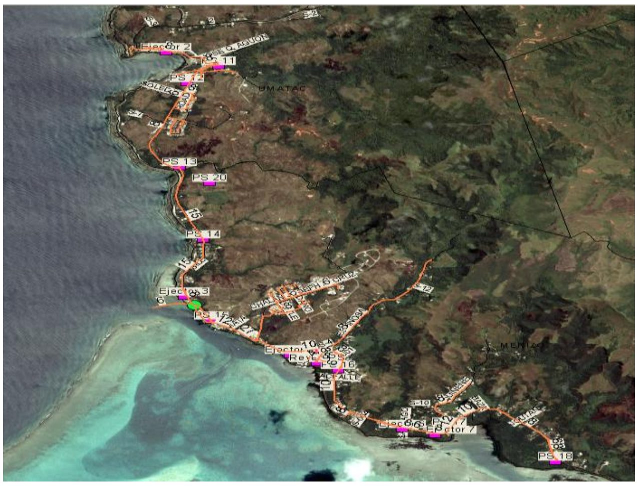

Fig. 1. The Umatac-Merizo Drainage Wastewater Treatment plant.   .

Fig.2. Aerial view of Inarajan Sewage Treatment Plant in southern Guam before planting the vetiver grass in May 2008.

Fig. 3. At the Inarajan Sewage Treatment Plant each cell is aerated by floating mechanical surface of aerators running daily for 24 hours.

Fig. 4. Vetiver tillers for propagation and purposed were prepared at the University of Guam's research Station in Inarajan.

Fig. 5. The vetiver grass is being placed in pontoon and prepared for floating.

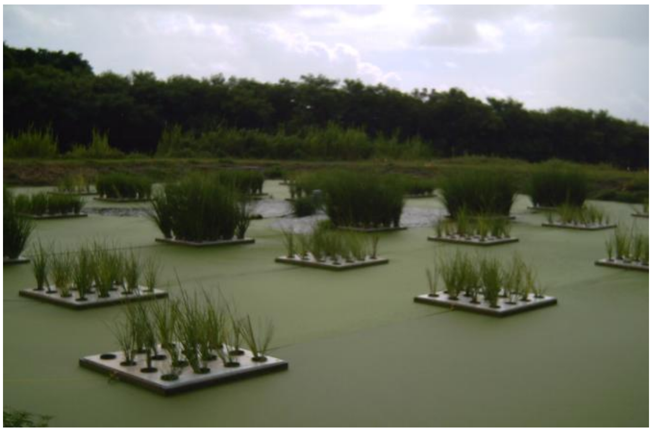

Fig. 6. Initial planting of vetiver at Inarajan Sewage Treatment Plant in July 2008.

Fig. 7. Planting was completed during August 2008.

Fig. 8. Vetiver grass shots at its mature growth stage three months after the initial planting.

Fig. 9. Roots as well as upper growth performance three weeks after planting.

Fig. 10. Water samples were collected in order to establish baseline levels of BOD, salinity, nitrates, orthophosphates, and turbidity.

Fig.11. Student intern filtering water samples for nutrient analysis at the UOG Soil Lab.

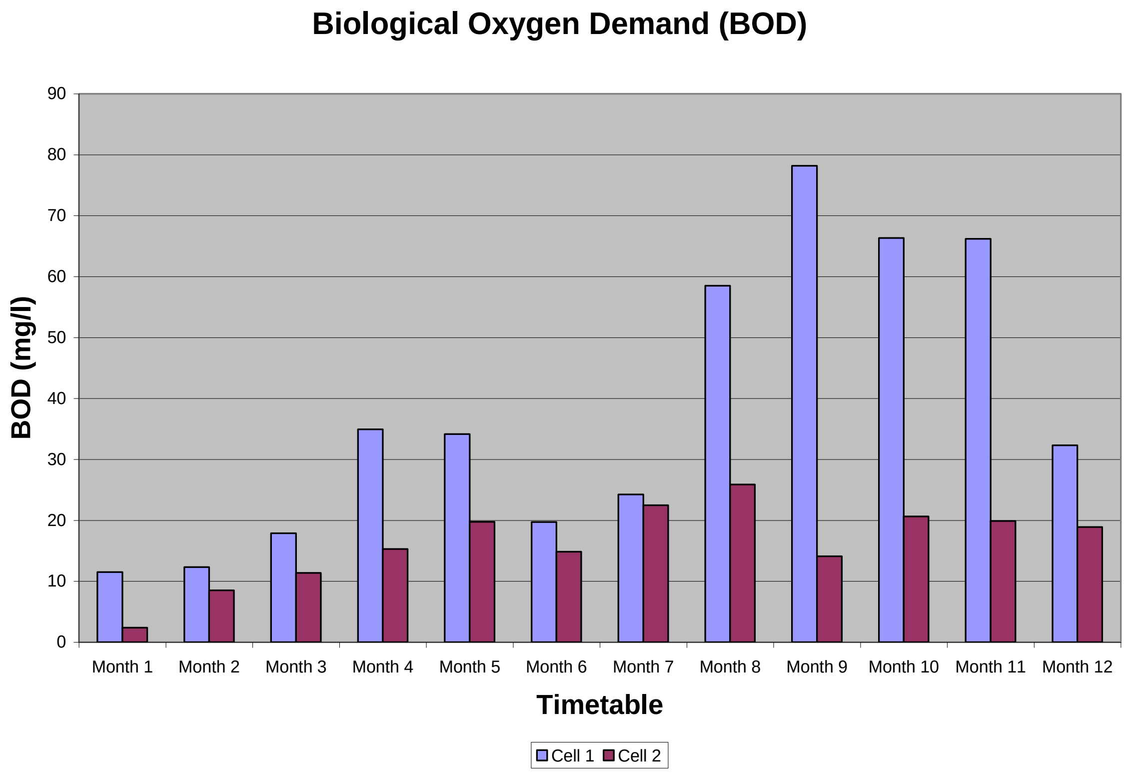

Fig. 12. Data showing BOD for both cells during the monitoring period.

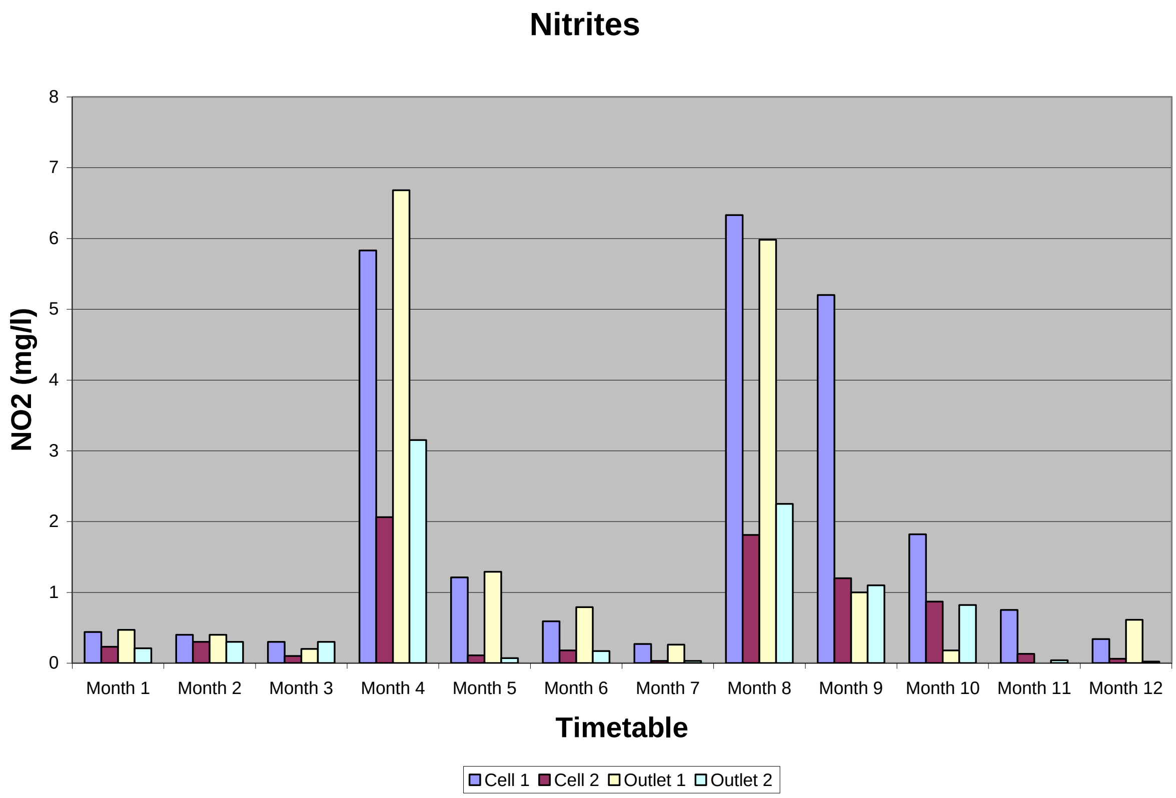

Fig. 13. Data showing nitrite content for both cells during the monitoring period.

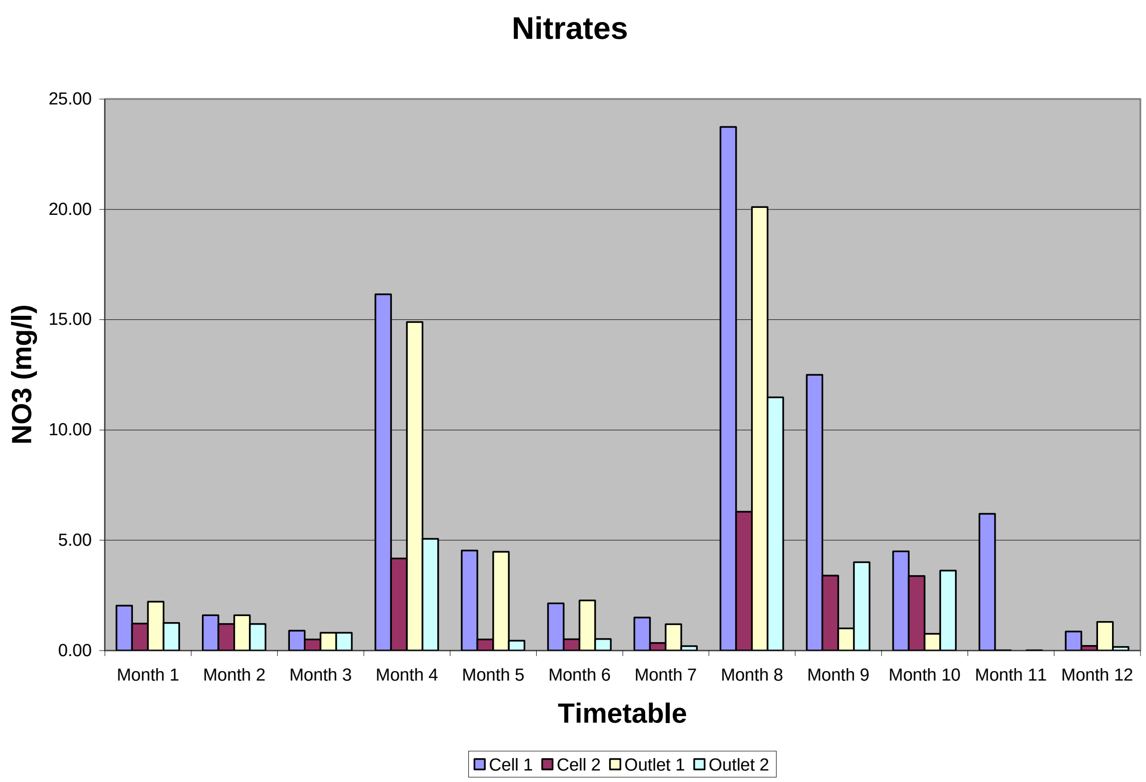

Fig. 14. Data showing nitrate content for both cells
during the monitoring period.

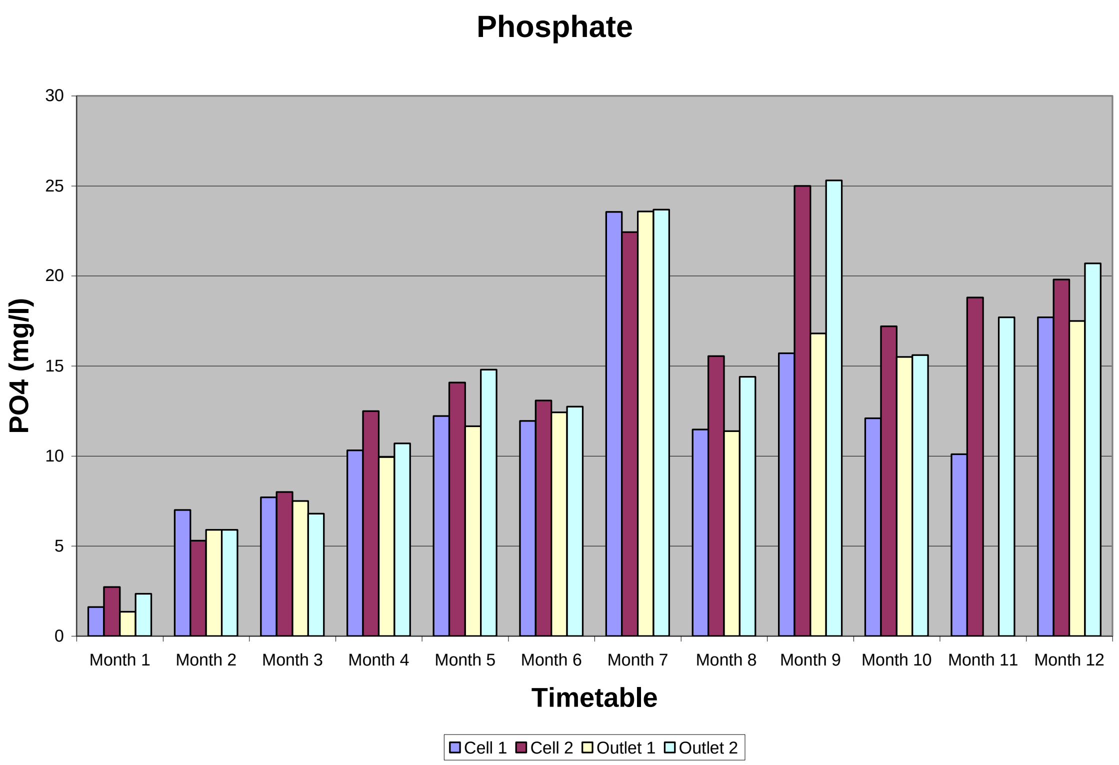

Fig. 15. Data showing phosphate content for both cells
during the monitoring period.

3. THE INARAJAN SEWAGE TREATMENT PLANT

The Inarajan Sewage Treatment Plant (ISTP), also in southern Guam (Fig. 2), is in similar condition although the facility uses an aerated facultative lagoon with effluent disposal through an overland flow evapo-transpiration/percolation system to achieve a secondary treatment objective.

The Inarajan Sewage Treatment Plant is a secondary wastewater treatment facility employing a four-cell aerobic lagoon treatment system. The facility was built in 1989, with a design capacity of 0.191 mgd (GWA, 2006a). Effluent disposal is through percolation, so there is no requirement for NPDES permit. Because there is no NPDES permit, flow and wastewater quality information was not available. Major unit processes include four aerated lagoons, three percolation basins, and six sludge drying beds. Additional equipment includes a weir box, two dosing chambers, a decant well, and portable pumps (GWA, 2006a).

The general process description of the Inarajan Treatment Plant, including liquid and solid streams, is as follow (GWA, 2006a):

Liquid Stream

Raw influent from the influent pump station flows to four aerated lagoons via a 5-inch force main. The flow is designed to pass through the lagoon in series and exit the last cell to a weir box unit. The cell can also be operated in parallel. The facilities are designed such that any cell can be completely isolated for maintenance purposes. Each cell is aerated by floating mechanical surface aerators (Fig. 3). The treated wastewater flows through the weir box to dosing chambers. A 60^{o} V-notch weir is equipped with an ultrasonic level sensor to measure the influent flow rate (although the meter is not operational). The dosing chambers are designed to alternate flow into each percolation pond (GWA, 2006a) (Fig 1).

Solid Stream

Solids that accumulate in each lagoon are anaerobic ally stabilized in the lagoon. The stabilized solids are transferred to the decant well for thickening, where they are allowed to settle. The top layer of water is decanted back to Cells 1 or 2, and the thickened waste sludge is pumped to the sludge drying beds (GWA, 2006a). Dried sludge is raked and transported by truck to the landfill.

4. GOALS OF THE PROPOSED ALTERNATIVE SYSTEM

The goal of this project is to use a low-cost vetiver grass technology to remove the nutrients (i.e., P and N) as well as some of the heavy metals from the lagoon before the treated water is released to the percolating field and eventually to the ocean.

Project Objectives

The specific measurable objectives are to:

1. Regular analysis of effluent followed by the treated wastewater using VS to show a percentage reduction in nitrates and orthophosphates as compared with the control lagoon over an 12-month time period.

2. Regular analyses of the wastewater lagoon to show the efficiency factor of using the VS as a natural wastewater treatment technique when it is compared with the wastewater in the control cell treated with the floating mechanical surface aerator.

3. Although the cost analysis of the system was not among the objectives of the project, using natural systems as a wastewater treatment strategy especially in northern Guam would prove to be of a financial advantage when aerators are replaced with the VS.

5. MATERIALS, METHODS AND MONITORING PROCEDURES

Wastewater Facility

For evaluating the effectiveness of vetiver grass for wastewater treatment, we chose the Inarajan facility over the Umatac-Merizo wastewater treatment facility because the Inarajan facility includes four cells, of which we could use two for evaluation. One of the cells continued using the aerator as a control and in the other one; we established vetiver grass as an alternative to mechanical treatment (aerators). It is anticipated that the vetiver grass system will replace the aerator in Umatac-Merizo facility following the test results obtained from the Inarajan facility, also in southern Guam.

The Vetiver Grass

Characteristics: In this project the vetiver grass is used for treating wastewaters and polluted waters due to its ability to take up contaminating nutrients and other contaminants. Extensive research in over 100 countries including Australia, China, Vietnam, and Thailand, has demonstrated that vetiver is tolerant of a wide range of soil pH and elevated levels of salinity, sodicity, aluminum, manganese, arsenic, cadmium, chromium, nickel, copper, mercury, lead, selenium and zinc. Vetiver grass also has associated nitrogen-fixing mycorhiza (Truong and Baker, 1998) with an exceptional ability to absorb and tolerate high concentrations of nutrients and agrochemicals. These attributes make vetiver highly suitable for treating polluted wastewater from discharges, making it an ideal plant for terrestrial and aquatic environmental applications such as the one proposed (Hengchaovanich, 1999). In contrast with conventional engineering structures, the efficiency of vetiver improves with time as the vegetative cover matures; it is virtually maintenance free (Truong, 2006).

Planting and Monitoring:

Propagation Techniques: Vetiver grass (*Chryspogon zizanioides*, formerly known as *Vetiveria zizanioides*), was harvested from the University of Guam's research station located in Inarajan, a remote region in southern Guam. Tillers were prepared (Fig. 4) and used from July 2008 through August 2008 (Guam's rainy season). Propagation took place at the Western Pacific Tropical Research Center (WPTRC) and the Cooperative Extension nurseries at the Inarajan Research Station in southern Guam.

Panel Construction: Vetiver grass was propagated from stock plants at the Inarajan Tropical Research Center. Stock plants were divided and individual plantlets were planted into 4-inch plastic pots for propagation (Fig. 3). The bottoms of the pots were later cut off so that plant roots could grow directly into the water. A total of 480 plants were planted into the system throughout the month of July 2008. In order to ensure that a sufficient number of tillers survive for transplantation propagation of up to 2,000 tillers was supervised by University of Guam researcher (M. Golabi) and the agricultural extension field workers. Graduate and undergraduate students were taught how to build 4 x 4-feet floats to support the vetiver tillers. It was estimated that 20-30 floats would be needed for "planting" in the lagoon under study. This would allow for quick replacement of dieing or "failed floats" with fresh "tillered floats" to keep within the project timeline.

The vetiver grass was grown in pots and placed in floating panels (pontoons) (Figs. 5 - 6). Conditions at the initial stage were closely monitored weekly by the graduate student. Floating panels were taken to the project site during the month of June and 4-inch pots were placed in the already drilled holes in the floating panels. Each floating panel consisted of 20 holes as each hole would hold one 4-inch pot. Three to four tillers were planted in each pot and placed in the floating panel before the panels were allowed to float in the pond or cells (Figs. 6 - 7).

The vetiver grass responded extremely well to the new environment (sewage water pond) and growth rates were rapid and healthy during the experimental period (Figs. 6 - 9). As shown in Fig. 2, the presence of duckweed was a concern from the beginning as it was an unwanted plant growing in the sewage pond interfering with the vetiver experiment causing variation in data evaluation. Despite many attempts for removing the duckweed from the pond, it kept growing as fast as the vetiver grass itself (Fig. 8). Although the duckweeds were not analyzed for nutrient uptake, it is believed that duckweed can take up considerable amount of nutrient (N, P) from the sewage water ponds. However, it also can create anaerobic condition hence reducing the dissolved oxygen in the sewage water during the process affecting phosphorus availability for uptake by vetiver grass during the experiment.

Water Quality Analysis

Before the vetiver grass is transplanted, samples from the effluent ponds were collected (Fig. 10) in order to establish baseline levels of biological oxygen demand (BOD), salinity, nitrates, orthophosphates, and turbidity. Water samples were collected bi-weekly thereafter until the end of the project period. The nutrient levels were analyzed over time and compared to baseline levels in order to determine if the goals of contaminant reduction have been met.

6. NUTRIENT ANALYSIS AND LAB WORK

Sample Filtering

Nutrient analysis was conducted at the University of Guam (UOG) Soil Laboratory. Sewage water was analyzed for pH, electro-conductivity (EC), nitrate (NO_3), ammonia (NH_3), nitrite (NO_2), phosphate (PO_4), and potassium (K) using a photometer (Model 9100, YSI Incorporated, Yellow Spring, OH, USA). All water samples were filtered with Whatman #1 filter paper, prior to analysis (Fig. 11).

BOD Analysis at the Agana Wastewater Lab

BOD test was also conducted at the Agana Wastewater Treatment Lab, in cooperation with the Guam Water Authority. The BOD test was performed by incubating a sealed waste-water sample for a standard five-day period for determining the change in dissolved oxygen (DO) content. The BOD value is then calculated from the results of the DO depletion rates.

7. RESULTS AND DATA ANALYSIS

Some of the results from the data collected are presented in the following paragraph. Note that environmental variables such as wind, rain, sunshine, and cloud cover could not be controlled during the experiment. These variables changed throughout the year.

As shown in Fig. 12, the BOD content for Cell-2 (vetiver-treated cell) was considerably lower than in the Cell-1 (aerator treated cell), an indication of low nutrient content in Cell-2 as the result of excessive uptake by the vetiver grass.

As shown in Fig.13 the level of nitrite content in Cell 2 is considerably lower than in Cell-1. Also as shown in Fig. 13, the nitrite level in outlet-2 is considerably lower than in Cell-1. This is an indication of low level of nitrogen content in Cell 2 resulted from high nitrogen uptake by the vetiver grass in Cell-2.

As shown in Fig.14, the nitrate levels in Cell-2 were always lower throughout the monitoring period. The nitrate level in outlet-2 is also lower than in outlet-1 throughout the monitoring period except during the Month 9 and Month10 that for an unexpected reasons the nitrate levels were higher in Cell-2 during those period (Months 9, and 10).

With respect to phosphate level, the story is different. As shown in Fig.15, the phosphate level in Cell-2 (vetiver treated) is generally higher than in Cell-1 (aerated). This is due to the anaerobic condition created as the result of duckweeds covering the surface of the pond and possibly blocking the oxygen from entering the water below the surface in Cell-2. The reduced condition created by this process (low oxygen) is believed to be the cause of low phosphorous content in the water samples from Cell-2.

8. DISCUSSIONS

Application of the VS for wastewater treatment is a new and innovative nutrient removal technique that was developed in Queensland, Australia by the Department of Natural Resources and Mines (NRM) (Truong and Hart, 2001). As indicated by Truong and Hart (2001), it is a green and environmentally friendly wastewater treatment system with low cost maintenances. Its end-product has several uses including animal fodder and material for organic farming.

VS is based on the use of vetiver grass, which was first recognized early in the 1990's for having a "super absorbent" characteristics suitable for the treatment of wastewater and leachate generated from landfill in Queensland (Truong and Claridge, 1996). Research conducted by NRM showed that Monto vetiver grass has a fast and very high capacity for absorption of nutrients, particularly nitrogen and phosphorus in wastewater. In addition it has a very high water use rate and tolerant to elevated levels of heavy metals in the effluent. As a result of these findings, presently VS has been used successfully for these purposes in Australia, China, Thailand, Vietnam and Senegal (Truong and Hart, 2001; Truong, 2000), and in Guam (Golabi, et al., 2009).

In Guam the use of VS as a wastewater treatment technique started in May 2008. A monitoring system was developed to evaluate the effectiveness of vetiver grass for treating the wastewater at the Inarajan Waste Water Treatment Plant (IWWTP). The IWWTP is located at the Inarajan village in southern Guam. The plant is consisted of four cells (72 x 72 x 17ft) designed to allow for settling the suspended solid and primary treatment using aerators. As explained earlier we selected Cell-2 for using vetiver system as treatment methods.

A brief glance over the data indicates that the vetiver grass is effective in removing pollutant including heavy metals (data not shown). However, due to unsteady conditions and the presence of numerous unexpected factors such as duckweeds, and variables beyond our control the result of this experiment needs to be evaluated accordingly.

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The Pacific Rim Vetiver Network (PRVN)

Objective: To serve the countries of the Pacific Rim as the center to collect, compile and disseminate information on the use of vetiver in the forms of newsletter, occasional publications, and homepage of the internet.

Member Countries: The following 20 countries, geographical situated in the Pacific Rim, are members of the PRVN: Australia, Brunei, Cambodia, China, Cook Islands, Fiji, Indonesia, Japan, Lao PDR, Malaysia, New Caledonia, New Zealand, Papua New Guinea, Philippines, Samoa, Taiwan, Thailand, Tonga, Vanuatu, and Vietnam.

Scientist Members: Scientists of the member countries of the PRVN who had made prior contact with the RDPB are automatically registered as the PRVN members, which at present amount to about 800. Others who want to join the Network can apply directly to its Secretariat Office. No application form in necessary. Those who are interested to apply just identify themselves with name, current position, place of work, and mailing address, e-mail address, and other information which they deem necessary.

Activities:

Newsletter: An 8 to 16-page quarterly English-language newsletter under the name of VETIVERIM has been issued, starting first number in July 1997. Its circulation is 500 copies for each number. It has been sent in bulk to the Country Representatives of the member countries for further distribution to scientists and institutes within the country in order to save postage and other difficulties in international mailing. Starting from No. 63, an e-mail edition has been issued.

Internet Homepage: The PRVN has established its internet homepage which can be seen through: http://prvn.rdpb.go.th. Scientists of the member countries, or from other regions for that matter, are invited to submit information on new research and technologies on vetiver, especially those appropriate to the Pacific Rim countries. Information and pictures are most welcome and can be sent to the PRVN Secretariat by mail, fax, or e-mail (see addresses below).

Publications: It has been the intention of the Secretariat to publish technical bulletins and other documents, as and when opportunity arises. A series of technical bulletins (from one to three bulletins per year) have been launched since April 1998. So far, more than 20 bulletins have been issued.

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Dr. Manuel Duguies received his Master of Science in Animal Sciences, from the University of Hawaii at Manoa and Doctor of Veterinary Medicine from the University of the Philippines. He is currently working as an Agriculture Extension Agent IV / Associate Professor at the Cooperative Extension Service, College of Natural and Applied Sciences of the University of Guam. He published papers related to animal health and artificial insemination of swine in Guam and the other islands of the pacific region. His extension grants included Alternative Housing for Livestock and Poultry for Guam and Micronesia and Using Vetiver Grass Technology for Wastewater Treatment for poultry and swine producers in the island of Guam.