

Present Status of Paraviwella Reef Tangalle Southern Sri Lanka: A Potential Natural Mesocosm for Marine Research

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ABSTRACT: *Shallow reef habitats dominated with living corals is relatively accessible all times of the day and could be useful to consider as a natural mesocosm. This study was conducted at Paraviwella near shore reef patch, Tangalle, Southern Sri Lanka (6° 01' 17.07" N, 80° 48' 01.21" E) from 25th April 2014 to 10th September 2014 to examine the current status of the substratum composition. Line Intercept Transects (LITs) method was used for benthic composition study (number of transects = 6, length = 25m and area 3500 m²). Temperature (T), Salinity (S), Turbidity (Tb) and Dissolved Oxygen (DO) were measured in sea water collected from transect locations. Results disclosed that sea water quality at Paraviwella reef were within the suitable condition for growth of corals and other associated organisms (T=29 ± 1°C, D=54 ± 17 cm, S=34 ± 1ppt, Tb=3 ± 0.6 NTU, DO=8.6 ± 1 ppm). Transect study showed that living corals (64.7 ± 18.9%) and algae (19.2 ± 13.4%) were dominant life forms represented by higher percentage cover at Paraviwella. Also rock (13.8 ± 5.9%), coral rubble (1.5 ± 2.4%) sand (0.6 ± 0.7%) and others (0.2 ± 0.4%) were represented as non-living components. Two dominant coral species were identified as *Pocillopora damicornis* and *Montipora aequituberculata*, their percentage values from the total coral cover were 28.8 ± 14.2% and 24.6 ± 9.6% respectively. Other living corals were represented as 11.3 ± 5.4%. Algae cover also consists of several fleshy and filamentous Algae types (*Caulerpa racemosa*, *Halimeda* sp. and *Chaetomorpha* sp, *Padina* sp, Crustose coralline algae). In addition to corals and algae, giant clams (Family: *Cardiidae*, *Tridacna* sp) and typical coral reef fish (herbivore 59.1 ± 11% [sergant fish 41.2 ± 14%, damsel fish 27.3 ± 2.5%], carnivore 34.2 ± 4.4%, and omnivore 6.7 ± 5.2%) were also present associated to coral in Paraviwella. Other invertebrates such as Sea cucumbers (Order *Elasipodida*, family *Pelagothuriidae*), Sea Urchins (Order: *Echinoidea*). The present water quality, the living and non-living benthic composition suggest that the Paraviwella reef could be used as a natural mesocosm for experiments.*

Keywords: coral, marine research, natural mesocosm, Paraviwella, substratum composition.

Preliminary Observation on Bird Diversity in Vairavapuliyankulam Tank and Adjacent Paddy Land in Vavuniya, Sri Lanka

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ABSTRACT: *Bird diversity is an excellent indicator of an ecosystem's health, both terrestrial and aquatic. The objective of the present study was the diversity and abundance of bird species in the Vairavapuliyankulam tank (VT) and in adjacent paddy land. This area is notable for their bird diversity as well as being a major habitat in Vavuniya. The last ten years there were no studies had been carried out in this area on the diversity and abundance of bird species. This VT is a seasonal tank, therefore, the water level change according to the climate. Due to the eutrophication, Eichhornia crassipes was covered a major area, which gives a suitable habitat and good feeding habitat for many birds. In dry season water level is very shallow that invite many wading birds. A total of 37 species of birds were recorded during the survey carried out from April to July 2014. Point transect was used to count birds. Peak counting hours were between 06.30 to 08.30 and 16.00 to 17.30 each day. And counting was taken weekly. Area of the tank was 183 Acre feet. 6 sampling points were selected using simple random sampling. A minimum distance of approximately 100m was kept between points to avoid pseudo replication. Birds were counted for 15 minutes at each point using binocular. The most abundance, species was purple coot (Poyphyrio porphyria) (total count >2000) other notable species were common coot (Fulica atra)(1263), black headed ibis (Threskiornis melanocephalus)(768), common snipe (Gallinago gallinago)(474), common sandpiper (Actitis hypoleucos)(352), spot billed pelican (Pelecanus phillipensis)(42), little grebe (Tachybaptus ruficollis)(36), black winged stilt (Himantopus himantopus)(26), purple heron (Ardea purpurea)(18), Egrets and cormorants were very common. This study indicates that the area had the high species richness of resident birds and the eco touristic potential. They are undoubtedly very important area for bird conservation.*

Keywords: *Eco touristic, eutrophication, point transects, species richness, wading birds*

Identify the Soil Salinity Pockets and It's Reclamation Methods at Pooneryn in Kilinochchi, Sri Lanka

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ABSTRACT: *In Northern region of Sri Lanka, about 99,600 ha of land is utilized for agricultural related activities. These lands have been degraded due to indiscriminate use of agrochemicals, intrusion of sea water and other agricultural practices. Soil testing has not been performed for farmers' fields in the Northern part of Sri Lanka after 1980. Especially, Soil salinity is a widespread in the Paddy fields. A study was carried to identify the soil salinity pockets and causes at Pooneryn in Kilinochchi district of Sri Lanka to educate the farmers on remedial measures. Soil pH and electrical conductivity (EC) were measured for hundred fifty one soil samples randomly collected from 0 – 30 cm depth from Pooneryn area in Kilinochchi District during Maha 2012/13. Soil pH ranged from 4.35 to 9.90 (CV = 12.6 %), among all sampled soils where 11 % of soils were in acidic range (< 5.5) and 29 % of samples were in alkaline range starting from slight alkalinity (>7.0). Rest of the soils samples were under suitable range. Therefore, there is a need for using of soil amendments for soil pH management for enhancement of nutrient availability to plants. Electrical conductivity (1:5 soil- water suspension) showed maximum value as 11.52 dS/m in Paddy fields. These results revealed that there is a soil salinity problem in Pooneryn area. Salinity may be due to frequent intrusion of sea water and there is a need to construct dams or sand dune or other infrastructures to control the sea water intrusion into Paddy fields. Rice variety AT354 performed well in soil salinity locations. Hence saline land could be managed by cultivating salt tolerant varieties and proper soil and water management.*

Keywords: *electrical conductivity, soil salinity, soil fertility*

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The Variation Of Stand Basal Area Calculation Using Three Different Methods For Dry Zone Teak Plantations In Sri Lanka

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ABSTRACT: Stand Basal Area (G) is simply the cross-sectional area of all the trees at breast height per hectare of a forest or a plantation (m^2/ha). G can be used to estimate stand volume and is a useful measure of the degree of competition in the stand. The present study was conducted for a 44 years old homogeneous Teak (*Tectona grandis* L.f) plantation in the dry zone located in Anuradhapure Range, Mihintale Beat of Sri Lanka. Initially, a $100m \times 100m$ square plot was demarcated and then it was divided into $100 \times 10m \times 10m$ subplots to be compatible with the research design. Then at the breast height point, eight readings were taken using tree caliper and, a single reading was taken using the diameter tape. Using different basal area factors of three instruments such as angle gauge, Spiegel relascope and wedge prism, stand basal area readings for five locations within 1 ha plot were also taken. The G calculated by using the tape reading and eight diameter readings of caliper in the sample plot and wedge prism, Spiegel relascope and angle gauge were tested by one way analysis of variance test together with Turkey's pair wise comparison to recognize the differences among instruments used. According to the results, there is no significant difference among the tape, number of caliper readings and spiegel relascope. But the results showed significant differences for angle gauge and wedge prism with the absolute basal area value. Also there was no significant difference among the number of diameter readings were taken by caliper. In order to identify the minimum plot size that has to be used to collect data for G calculations using sample plot method, one sample t - test was used for selected plot sizes. The test mean used for this method was absolute basal area value calculated using cut and weight method. According to the test, it showed that the minimum plot size was $400m^2$ for the accurate basal area in the sample plot method. Also the results showed that the absolute error difference decreasing with the increasing of plot size. The three instruments used to calculate relative basal area values were compared statistically by one sample t -test to identify the best instrument for relative basal area calculation. In this method absolute basal area value was used as the test mean and test results showed that Spiegel relascope predicts relative basal area accurately and other both wedge prism and angle gauge do not predict relative basal area accurately. Finally, it is concluded that use of sample plot is the best method for total basal area calculations with a minimum plot size of $400m^2$. The diameter tape was recommended to use in the field when taking diameter measurements for basal area calculation. When calculate the relative basal area, Speigal relascope is recommended. The error generated due to use of angle gauge and Wedge prism is very high and it is not recommended these instruments to take basal area measurements in the dry zone teak plantations.

Keywords: absolute basal area, diameter at breast height (dbh), relative basal area, stand basal area, sample plot method

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Impact of Land Use Changes on Bird Diversity: A Comparative Study of Disturbed and Undisturbed Tanks in The Vavuniya District

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ABSTRACT: Bird diversity and richness is an ecological indicator of natural terrestrial and aquatic ecosystem quality. Objective of this study was to compare avian species richness and abundance under two different levels of disturbance. The structure of the avian community inhabiting a disturbed (urban area: Vairavapuliyanakulam tank) and undisturbed (forest area: Kombuvaithakulam tank) sites were compared. The extent of the two tanks Vairavapuliyanakulam and Kombuvaithakulam measured using Arc GIS 10 were 33.7 and 93.5 acres respectively. At each site, six transects (100m<100m) were used to document the avifaunal diversity. A combination of aquatic plants such as lotuses, water hyacinth, and the reed vegetation along the bund provides habitat to more birds. The study was carried out from May to June 2013. Observations were carried out between 0630h to 0800h and 1630h to 1800 h on week days. Birds were counted for 15 minutes at each transect. Both tanks were observed simultaneously. There were 32 and 54 bird species and total count 2873±15, 4938±25 individuals and most abundant species were Intermediate Egret>Little egret> Black-headed Ibis, Painted Stork> Intermediate Egret> Black-headed Ibis identified in disturbed and undisturbed tanks. Highly significant differences were found between the numbers of species, numbers of individuals in almost all comparisons performed. Our results showed clearly, disturbed habitat where low bird species diversity occurred is under great pressure due to deep rooted anthropogenic factors. The mean number of species in undisturbed tank was significantly greater than disturbed tank. Almost every aspect of this study confirmed that birds were significantly influenced by the activities of humans; compared to those living in completely undisturbed locations, birds living in locations experiencing high levels of disturbance were characterized by significantly lower species richness. Increasing the land use changes and anthropogenic disturbance are reducing the bird diversity and population in study area. This study indicates these areas had the high species richness of birds and the eco touristic potential. These are very important areas for bird conservation and bird watching.

Keywords: Bird watching, diversity richness, land use, undisturbed tank, Vavuniya

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Estimation of Carbon Storage of Different Forest Plantations Established by Sadaharitha Plantations Limited

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ABSTRACT: *In order to mitigate the global warming resultant due to the rapid industrialization, the “Green Economy Concept” has been introduced to the world which is defined by the United Nations Environmental Programme as one that results in improving human well-being and social equity, while reducing environmental risks and ecological scarcities. Therefore green economy leads to low emission of CO₂ and similar gases and efficient resource utilization with great social care.*

Admiring the green economy concept, Sadaharitha Plantation Limited (SPL), the Gold Winner of Green Awards in 2012, is engaged in forest plantations management with Sandalwood, Teak, Mahogany, Rambutan and Agarwood to earn foreign exchange to the country. SPL manages its all plantations under ISO 14001 principles and Teak and Sandalwood plantations are being prepared to obtain Forest Certification. In addition, natural forest patches are maintained whenever possible in these plantations for the purpose of biodiversity conservation and landscape protection. In order to minimize the environmental damage due to the application of chemical fertilisers, over 1,500 MT of compost are annually made within the estates to use as organic fertiliser. Further, the company has provided over 900 direct green employment opportunities and introduced innovative forest-based income generation opportunities such as Agarwood Homegarden Concept to the villagers as a strategy to eliminate persistent poverty in Sri Lanka.

This paper investigates the carbon storage values of 156.0, 196.6, 3.4 and 13.9 ha of Sandalwood, (2 and 3 years old), Teak (2,3,4,5,6, and 7 years old), Mahogany (10 years old) and Rambutan (9 years old) plantations respectively managed by SPL in Colombo, Kalutara, Rathnapura, Puttlam, Badulla, Galle, Matale and Matara Districts. For this purpose, representative trees were selected from each species of each age and the tree volumes were estimated using appropriate volume functions. Then the carbon values were estimated using the guidelines of Carbon-Fix Standards V3.2 for each species. These values were then projected to 20 years after planting considering the growth rates and removal of trees in thinning.

According to the results, carbon storage values for 10 year old Mahogany plantations is 242.0MT/ha and 9 year old Rambutan plantations is 3.8 MT/ha. The carbon values for 2 and 3 year old Sandalwood plantations are 0.1 and 0.6 MT/ha while those values for 2, 3, 4, 5, 6 and 7 year old Teak plantations are 4.9, 9.7, 13.1, 23.4, 29.7 and 50.1 MT/ha respectively. At the 20th year, the carbon contents of Mahogany, Rambutan, Sandalwood and Teak plantations will be 242.0, 41.3, 69.5 and 326.7 MT/ha respectively which are equivalent to 887.2, 151.4, 254.78 and 1,197.7 MT/ha respectively.

Keywords: *Tree biomass, mahogany, sandalwood, teak, green economy*

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The Escaping Mechanism of *Avicennia marina* Against Cattle Browsing in Kalpitiya Mangrove Forest in Sri Lanka.

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ABSTRACT: A research study was conducted (in May 2014) in an *Avicennia marina* mangrove forest in Kalpitiya, Sri Lanka, (8°21.95'N, 79°74.4'E) that is regularly browsed by cattle. When a small browsing class is progressing in to medium browsing class as well as when a medium browsing class is progressing in to larger browsing class, significant increments were observed for the height and the average canopy spread. Thus, during the progression period of small class to larger class, the vertical and lateral growth increments were noted. It was noted that the average canopy spread of the small and middle classes stays within the downward browsing limits of the cattle and hence the browsing occurred all over the canopies. However in the large browsing class, the increased average canopy spread had created a "browsing free area" in the middle of the canopy as the area was out of the downward browsing limits. The middle height of the larger browsing class (101.6±16.4cm) was significantly taller than the browsing biomass height (60.70±18.43cm) of the escaped trees. This height increment had been resulted by the vertical growth of the "browsing free area" and the height to this point (101.6±16.4cm) was identified as the Maximum Browsing Height: (MBH) for the studied site as it was the upward browsing limit of the cattle. As a result of exceeding the downward and upward browsing limits, the "browsing free area" of the larger browsing class was found to have started producing the "escaping biomass". The average canopy spread for the larger browsing class and the browsing biomass of the escaped trees showed no significant differences. Thus, it was clear that the large browsing class transits in to the escaped class producing the escaping biomass at its middle (in the browsing free area) while their lateral growth remain constant. The mean height of the escaped biomass of the escaped trees (mean±SD) was (142.9±52cm). The mean height ratio between the below MBH: biomass: above MBH biomass was 2.6±1.5 indicating that the escaped biomass could grow up to 4.1 times taller than the below MBH biomass. The browsing has caused multi-stem conditions for all the browsing classes. Since the cattle browsing has profound effects on the growth of *A.marina* in the associated site, necessary management initiatives should be implemented to control the cattle browsing on mangroves in Kalpitiya area.

Keywords: Biomass, Browsing, Cattle, Escaping mechanism, Mangroves,

Present Status Diversity of Medicinal Plants of Keechangulam Forest Reserve in Mullaitivu District of Sri Lanka

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ABSTRACT: Sri Lanka is one of the smallest but biologically most diverse country. The flora of Keechangulam forest reserve in the Mullaitivu District was surveyed for medicinal plants over a period of three months (January 2013- March 2013), using a belt transects method. Interviews we also held with traditional physicians surrounding the surveyed area to identify ethno-botanical information about the medicinal plants flora of the forest. The predominant forest type observed in the study are was Dry Mixed Evergreen forest. A total of 252 medicinal plant species belonging to 60 families were recorded during the study. This includes 130 trees, 52 herbs, 55 shrubs, 9 lianas, and 6 stragglers comprised of perennials (78%), annual (20%), and biennials (2%). Among the medicinal plant species recorded, 13 species were identified as native species, 1 endemic species, and one critically endangered species.

Out of the 252 medicinal plant species, 10 species were identified to be poisonous, 20 species are used for diabetic mellitus, 12 in vadha diseases, 15 in treating skin diseases, and 16 for respiratory disorders. It was observed that 32 species are collected for medicinal purposes by the physicians surrounding the forest. Rauvolfia serpentina, Salvadora persica, Erythroxylum monogynum, Andrographis paniculata, and Salacia reticulata were recorded as economically useful medicinal plants in the survey area. The primary threats to the flora of medicinal plants of the Keechangulam Reserve include illegal logging, encroachment, and lack of knowledge on identification of medicinal plants. Due to these kinds of threats many native medicinal plants of Keechangulam Reserve are in the verge of extinction. It is suggested that necessary steps should be taken to declare the Keechangulam forest area as a natural reserve for medicinal plants.

Keywords: Diversity, Keechangulam forest, medicinal plants, status

Necessity of More Reliable Meteorological Model for Vavuniya District for Effective Planning

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ABSTRACT: *The field of meteorology has begun to receive renewed interest globally on account of environmental awareness and concern regarding climate change and of weather anomalies. Weather and Climate bear on critical fields such as energy, irrigation, public health, infrastructure planning, construction, fisheries, wildlife, vegetation and agriculture. This study aims to reveal the necessity of more instantaneous and accurate meteorological information for Vavuniya District. Meteorological parameters (Atmospheric temperature, Land surface temperature, Relative humidity) were obtained from two different sources includes, with respect to selected 20 reference points in Vavuniya District during the period of March to August of 2012. Sources for meteorological parameters include the information collected from meteorological information from meteorological station Vavuniya, portable devices and remotely sensed imagery. The various statistical analyses Student t test and 2 t test were carried out in order to find significant differences between two different data sets of particular parameters. Analyses showed, for atmospheric temperature the p values for 2t test were 0.067, 0.011, 0.277, 0.006, 0.174, and 0.767 respectively, and for Relative Humidity (RH) data sets, 0.975, 0.679, 0.030, 0.913, 0.039 and 0.028 respectively. Student t test for land surface temperature data showed the p values as 0.705, 0.956, 0.051, 0.052, 0.02 and 0.001 respectively. This study reveals that few data sets of all three parameters show negligible differences, but, most of the data sets from two different sources shows significant differences. As far as the temporal and spatial differences were concerned the differences reflects the location and the acquisition time of particular parameters. This study emphasizes the need of more instantaneous and accurate meteorological information for Vavuniya district towards more reliability for more successful future development planning.*

Keywords: *Remotely sensed imagery, Atmospheric temperature, Relative Humidity, Land surface temperature, significant differences.*

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Determination of Subsurface Profile Maps in Colombo Division using Geotechnical Investigation

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ABSTRACT: All constructions such as Highway road system, underground tunnels, dams, bunds, bridges, tower foundations and high rise buildings build up on the surface and subsurface. Stability and durability of constructions depend on the condition of the soil layer patterns, groundwater table and soil bearing capacity. It can be decided the foundation type of the construction, depth of foundation, method of ground improvement and dewatering method etc. Borehole drilling is a geotechnical method to get real information of a particular location from ground surface up to bed rock and beyond. Standard Penetration Test was done by using split spoon sampler. This research was carried out in Colombo Division. Secondary and primary boreholes (200) data used to determine the soil bearing capacity, groundwater table, and rock level. Data analysis process was done by using Arc GIS (9.2) software. Standard Penetration Test (SPT) values are changed with grains sizes of soil types and it is increased with dense sand and completely weathered rock. Standard penetration test average range was 2-42. Soil bearing capacity was maximum in Mattakkuliya, Kotahena, Kirulapana and Havelock and minimum in Orugodawatta, Sedawatta, Dematagoda and Kollupitiya. Maximum groundwater table was (8.59±0.01) m, places where deepest were Narahenpita, Colombo 12 and groundwater table minimum was (0.10±0.01) m places in sedawatta ,orugodawatta. Maximum rock level was (-27.98±0.01) m, places were Dematagoda,Havelock and Rajagiriya and minimum was (25.59±0.01) m, places were Kotahena, Mattakkuliya and Dematagoda referred to Mean Sea Level. Lower elevation and Higher elevation were (5.00±0.01) m, places were Orugodawatta, Dematadoga and Havelock (26.99±0.01) m, places were Kotahena and Pettah within Colombo division. However, this preliminary study revealed well relationships among groundwater table, rock level and soil layers patterns. However, groundwater table is inversely proportional to soil bearing capacity and Soil bearing capacity increases with dense sand and completely weathered rock. Finally, groundwater table was above and rock level was almost below to Mean Sea Level. Subsurface profile maps of Colombo division can be used to minimize flood risk management and to improve town development projects.

Keywords: borehole, mean sea level, standard penetration test, subsurface

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Use of Satellite Data to Identification, Evaluation and Change Detection Wetlands in South-Eastern River Basin in Sri Lanka

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ABSTRACT: Sri Lanka is an island consists of numerous wetlands and many of these ecosystems have been indiscriminately exploited for a commercial, agricultural, residential and industrial development and waste dumping.

South Eastern River Basin Region in Sri Lanka is becoming rapidly urbanizing, which leads more threats to the surrounding wetland ecosystems considerably. Therefore, it is important to identify and designated them as reserved areas where necessary in order to protect them under the National Environmental Act of Sri Lanka as Environmental Protection Areas. Land use/ cover mapping, habitat mapping, change detection and vulnerability maps of wetlands in the selected region is a key requirement to managing the protection area. this study there are 42 wetlands were explored on ecological and socio-economical through field based survey. However, conventional mapping required more labor, time and money. To overcome this limitations, GIS and Remote Sensing techniques were used to identify and analyze the wetland eco systems.

According to that, Landsat ETM+, ALOS-AVNIR2, ALOS-PALSAR images were analyzed for identifying habitats, land use land cover types and change detection of selected 42 wetlands. The secondary information and data were collected through a questionnaire survey to recognize the possible threats and benefits. SWAT analysis was done for each wetland systems to ranking, valuation and results incorporated with satellite to quantify the highly sensitive wetlands. Finally, 7 wetlands were selected as highly important wetlands among the 42 systems to consider to declare as Environmental Protection Areas under the National Environment Act of Sri Lanka.

Keywords: Wetlands, GIS and Remote Sensing

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Application of GIS and RS Techniques to Identify Farmer's Contribution for Soil Erosion in Upper Mahaweli Catchment

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ABSTRACT: Soil erosion is a complex process that involves the detachment, movement and deposition of soil particles influenced by both wind and water. The Upper Mahaweli Catchment is an area subjected increase in erosion over the years due to anthropogenic activities. The catchment covers an area of about 3118 km² and four hydro power plants located in the catchment contributes nearly 60% of the electricity supply of the country. Therefore, this area is very vital to national economy and considered as heart of the county. The natural forest cover of the UMC has been cleared during the last two centuries. The region remained protected with virgin forest until the colonization in the early 19th century. Afterwards, the forest was largely cleared first for coffee and later for tea plantation. It was further deforested mainly due to the demand for agricultural activities, development activities and human settlements in the hill country. Presently, only a few isolated patches of forest remain, and the rest is being exposed to severe erosion.

Despite the fact that substantial land use change has been occurred in this catchment as in many others, no recent soil erosion related study has been carried out. Lack of recent data limits the application of some empirical and process-based models to assess erosion. Another limitation is that most soil erosion studies do not take into account the contribution of socioeconomic factors linked with soil erosion studies. Hence, this study aims to assess the current status and socio-economic determinants of soil erosion.

Data used for the study were digital elevation data (DEM), Landsat 7 ETM satellite image, and socio-economic data through a comprehensive farm household and famer plot survey (n=100).

Using the Honda's model, soil erosion of the catchment was calculated. To find out socio-economic determinants of soil erosion, stepwise multiple regressing analyses was employed using ten correlated covariates.

This study disclosed that the average soil erosion rate is about 18.53 t ha⁻¹ yr⁻¹ (sd=13.98). However, the natural soil generation rate of the catchment ranges from 0.13 to 0.30 t ha⁻¹ yr⁻¹. According to the natural soil generation rate, present soil erosion is 800 to 1800 times higher. Moreover, the significant socio-economic determinants of soil erosion were farm income, cropping types and total income (p= 0.01), and extent of cultivated land area (p=0.05).

Keywords: Upper Mahaweli Catchment, Household, Soil erosion, Honda model

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Estimating the Net Surface Shortwave Solar Radiation Using MODIS Data

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ABSTRACT: *Net Surface Shortwave Radiation (NSSR) is a key quantity for the estimation of net radiation (R_n) and R_n is a key component of the Earth energy balance and is used for various applications including climate monitoring, weather prediction and solar power generation. The most practical and reliable method for estimating solar radiation is based on remote sensing because remote sensing observation values are higher than location based measurements for acquiring the features.*

Over the past years, many models for estimating surface shortwave radiation or its components have been developed from various remote sensing observations.

It has been observed that existing ancillary data are not sufficient to have an accurate solar radiation estimates due to the limited amount of ground equipments, hence available net surface shortwave solar radiation data is not accurate. Therefore, in this research the aim is to fill this gap and provide the required information on reliable spatial solar radiation data using high spatial and temporal resolution remote sensing data and products.

This research tries to provide accurate solar radiation data based on the data and products from Moderate Resolution Imaging Spectroradiometer (MODIS), on board the Earth Observing System (EOS) Terra satellite, as an alternative solution for existing unreliable Pyranometer data.

The primary objective of this research is to explore an appropriate methodology to capture the spatial distribution of NSSR using MODIS data. In addition, this study describes the methods for estimating instantaneous and daily average NSSR.

By this developed model, the average RMSE value for estimated instantaneous NSSR is 29.44 W m^{-2} , 55.51 W m^{-2} and 44.43 W m^{-2} for the clear sky, cloudy sky and both clear and cloudy sky condition respectively. For the estimated daily average NSSR, value of average RMSE is 29.53 W m^{-2} , 31.83 W m^{-2} and 30.70 W m^{-2} for the clear sky, cloudy sky and both clear and cloudy sky condition respectively. Instantaneous NSSR and Daily average NSSR also mapped over the study area.

Keywords: *Daily average net surface shortwave radiation; Earth energy balance; MODIS; Net surface shortwave radiation; Narrowband-to-broadband conversion;*

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Cloud Based GIS Approach for Environmental Monitoring in the Coastal Zone of Kalutara, Sri Lanka

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ABSTRACT: *GIS is a powerful tool in many aspects of handling geospatial data. Using this approach the research is focused on monitoring the costal environment of Kalutara for sustainable conservation activities. The identification of existing environment and available natural resources was the first objective and it was derived using satellite images and other hosted web map services. The green vegetation patches, water bodies and beech areas were detected using visual interpretation and remote sensing techniques. Then the detailed field survey was done with GPS devices and detected the minor costal environmental conditions such as sand dunes, salt marshes, mangrove areas, grasslands etc. The collected information were used to improve the data sets available in the study area. Each data set was prioritized using a weighted scoring method by considering the availability and rareness of the natural resource. The research experience as well as expertise knowledge were combined to define the weightages. Using derived information, GIS maps were created using ArcGIS and data were uploaded to the ArcGIS online cloud platform. Several web maps were created and hosted using this cloud infrastructure. Some data layers were given web based editing capabilities for field monitoring using mobile devices through mobile apps. The field monitoring was conducted by using this infrastructure to detect changes or any effects caused to this environment. Weather a physical damage or a human interaction can be uploaded to web map from the field. The operations dashboard was created for analyzing the types of effects occurred in the area and spatial quarries were created to detect the incidents in different categories. The summaries and charts are used to get better understanding and awareness of the environment changes during certain time period. As the results, changes in the environment were identified and minor costal environments has a significant effect by both human and physical ways. GIS based cloud infrastructure, can be used to bring down the barriers of data sharing in a significant way and reporting mechanism became more convenient for the field observations.*

Keywords: *GIS, Costal Environment, Cloud Infrastructure*

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Geospatial Approach in Predicting Soil Erosion - A Case Study in a Watershed of Himalayan Landscape, India

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ABSTRACT: Soil erosion by water is a worldwide environmental problem, associated with environmental impacts and crop productivity loss which helps in understanding of the erosion process important to guarantee food security and environmental safety. It is an important process of land degradation in Himalayan Mountains. The mountainous, sub-mountainous and foothill area of the entire Himalayan region are subjected to various degree of soil erosion. Steep slopes, sparse vegetation, high rainfall intensities, unstable geology overgrazing and illicit cutting of forest for meeting fuel and fodder needs, faulty road construction and un-scientific mining have caused severe soil erosion on the hill slopes. The present was carried out to predict soil erosion employing modeling approach using geospatial technologies in a watershed. Tons watershed located at Asan catchment in Dehradun district of Garhwal Himalayas in India was selected for the study. It lies between 30°20' to 30°24' N latitude and 77°10' to 77°55' E longitude covering 1271 ha of area at Lesser Himalayas. RUSLE model was used to predict the soil erosion over the area. Support practice factor map and cover management map for RUSLE was generated from Land Use – Land Cover (LULC) map derived from LISS IV image through supervised classification process. LS factor map and the K factor map representing the RUSLE were created using the DEM and the Soil map of the area. Rain fall erosivity (R) factor map was generated by integrating DEM and rain fall data. The study reveals that 46.85 percent of land is covered by forest and 20.58, 24.07, and 01 percent by agriculture, Scrubs and barren/rocky cover. Analysis revealed that 6.92 percent area lies in nearly level (<3%), 20.28 percent under gentle sloping (3-8%) 22.43 percent area lies under strongly sloping (8-16%), 22.57 percent under moderately sloping (16-30%), 23.26 percent under steep (30-60%), and 4.55 percent under very steep (>60%) slope class. 46.85 percent of land is covered by forest and 20.58, 24.07, and 01 percent by agriculture, Scrubs and barren/rocky cover. Analysis revealed that 6.92 percent area lies in nearly level(<3%), 20.28 percent under gentle sloping (3-8%) 22.43 percent area lies under strongly sloping (8-16%), 22.57 percent under moderately sloping (16-30%), 23.26 percent under steep (30-60%), and 4.55 percent under very steep (.60%) slope class. Study clearly demonstrated that the vegetation cover at the watershed has major impact on soil erosion by varying from 2.44t/ha/yr in dense forest to 124.5 t/ha/yr in open scrub land cover. Soil erosion according to the physiographic unit ranges from 6.77 t/ha/yr in residual hills to 148.41 t/ha/yr in Himalayan scrub. Sub watershed vice highest soil loss can be observed is (133.63 t/ha/yr) and minimum soil loss was observed is 21(34.93 t/ha/yr). Tons watershed was divided in 21 sub-watershed 6 sub-watershed had very high average annual soil loss (>50 t/ha/yr), 2 sub-watersheds high average annual soil loss (25-50 t/ha/yr), 9 sub-water sheds medium level avg. annual soil loss (10-25 t/ha/yr) and rest 4 sub-watersheds show low avg. annual soil loss (<10 t/ha/yr).

Keywords: Remote Sensing, GIS, Soil erosion, RUSLE, Himalayan landscape

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Centralized Web System for Monitoring/Management and Mapping of Environmental Data

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ABSTRACT: *Climate change and environmental monitoring and management have received much attention recently, and an integrated information system (IIS) is considered highly valuable to support country level environmental management. This paper introduces a novel approach in combining Geoinformatics, WebGIS (web based geographical information system), combined with cloud computing to provide comprehensive environmental monitoring, management and mapping tools. This innovative system provide general user with tools to visualize local level to county level environmental data with simple information manipulation. Advance users are supported with different data types and data streams, and real-time use of sensor networks for analytical studies. Important environmental related analysis algorithms have been simplified and incorporated to the system with web based visualization tools for spatial and non-spatial data. The system enables easy data sharing and collaboration for data analysis and mapping. New algorithms can be easily integrated as plugins to the system making it easily expandable based on the user requirement. This comprehensive system supports effective environmental monitoring and management in country level as well as district and sub district level.*

Keywords: *Web-GIS, GIS Analysis, visualization, remote sensing*

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Effects of Different Vermicomposts on Earthworms Inhabiting in Contaminated Soils: An Approach for Bioremediation

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ABSTRACT: *Bioremediation is the most effective innovative technology that uses biological systems for treatment of contaminants. Vermicomposting has been identified as a potential tool for bioremediation although it has not been previously used in Sri Lanka. Therefore two selected vermicompost were assessed for their usage as a possible bioremediation tool in contaminated soils. The epigeic earthworm Eisenia andrei was used as the standard test organism with suitability being assessed in terms of survival, growth and reproduction. The experimental procedures were based on standard ISO and OECD guidelines for earthworm toxicity studies. It was found that 5 to 25 % vermicompost was the suitable range of amendment while 50 % and 75 % amendments were highly toxic to the adult earthworms. Higher toxicity with the latter two amendments could be due to the both the high acidity and mineral content. Tests with growth and reproduction of earthworms indicate that the optimum amendment concentration was 5 % which suggests that lower percentages of amendments may be used as bioremediation tools for restoring contaminated arable lands.*

Keywords: *Agrochemicals, Bioremediation, Eisenia andrei, Soil, Vermicomposting,*

Influence of *Sesbania rostrata* and *Crotalaria juncea* on Nitrate Leaching in Agricultural Fields and Ground Water Pollution

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ABSTRACT: *The study was carried out in a Government seed farm in Vavuniya from June 2011 to September 2012 using a Random Completely Block Design (RCBD) with nine treatments and three replicates, to study the role of Sesbania rostrata and Crotalaria juncea on nitrate leaching in an agricultural field and on ground water pollution. The green manure was incorporated into the soil 14 days before planting onion bulbs (Vethalam variety) at a spacing of 10 cm x 10 cm in a plot size of 1m x 1m. The treatments' T₂ – T₉ plots were fertilized with urea, Sesbania rostrata and Crotalaria juncea and its combinations at the recommended application of 6.21g total N per m². Plants were irrigated once in four days as usual practiced by the farmers. Soil samples were collected from 0-15cm and 15- 30cm depth at 3 weeks after planting and harvesting of the bulbs. NO₃-N in soil was determined using the sodium salicylate method. Statistical analysis was carried out using the SAS package (version 9.0) and mean separation was done by the Duncan's mean separation method. The NO₃-N at 15-30 cm soil layer after 3 weeks of planting was significantly higher (P<0.0001) in the recommended inorganic N (urea) added plots and in the combination of inorganic N and green manure added plots, than in the control where no fertilizer was applied in both years. Hence application of nitrogen fertilizer increase NO₃-N to the bottom layer. Research also revealed that one and a half time urea added soil showed highest amount of NO₃-N in root zone, thus indicate that over usage of fertilizer could cause ground water pollution. Further, the study showed that nitrate leaching could be minimized by using a combination of organic and inorganic N fertilizers. Changing the farmers' attitude towards using green manure in addition to inorganic fertilizer is the viable alternative for sustainable production.*

Keywords: Crotalaria juncea, ground water pollution, inorganic fertilizer, nitrate leaching, Sesbania rostrata.

Ocean Wave Energy-Pneumatic Electricity Conversion (OWEPEC) in Sri Lanka

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ABSTRACT: *Electricity is one of the basic needs of any society. Hence, the demand has been increasing with the rapid socio-economic development and population growth. To accomplish this task, tremendous amounts of non-renewable fossil fuels have been using for centuries as sources to the electricity generation. Due to the emission of GHGs by such processes, a number of serious environmental impacts have arisen, such as global warming, air pollution etc. Also, some social and economic suppression could occur in many countries.*

Ocean wave energy has a big potential to generate electricity. Therefore, a number of energy conversion techniques were invented by various governments and institutions. However, still Sri Lanka has not tended to harness the wave energy from surround oceanic resource to answer the serious energy related economic crisis.

OWEPEC is a method that converts ocean wave energy to electric energy using pneumatic power. Wave energy converting air pumps (WECAP) harness the energy from reciprocating movements of wave propulsions and pump air to the storing vessels at the coast. In this process, pneumatically operated motor, rotate the dynamo to generate electricity.

A prototype of OWEPEC which has a single WECAP with the capacity of 2022cm³ (~2 l) was tested at inshore swells of Panadura fisheries harbor. Under the conditions of ~26 cm wave height and ~3 sec wave period the WECAP has taken ~10-12 min to pressurized up to 8 psi (55.15KNm⁻²) by ~30000 cm³/min (30l) flow of pumped air. Pneumatic generator worked at max rpm of 560 by consuming ~ 62000cm³/min (62l) constant air flow at the regulated pressure of 6 psi and the generated electric power was 3W of AC 5.8V as max output.

Average energy output for 10-12 running hours/day is 0.033KWh and 0.99 KWh/month (~1KWh). Carbon emission in generation phase = ~0.00Kg/KWh, carbon saving = 7.32Kg/year (610g/KWh), cost to the resource = ~0.00LKR/KWh, money saving = ~168LKR/year by prototype and it can be scaled up for more benefits; with zero level or insignificant environmental impacts.

The recommended swell conditions for commercial scales can be found throughout the year in many locations of the country with continuous supply and the sustainability. Near coast industrial and hotel personals can use their own OWEPEC plants for captive generations, while considering the limiting shore conditions.

Keywords: *Renewable energy, Electricity, Ocean wave, Pneumatic.*

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Plants for Constructed Wetlands-A Study of Wetland Plants Potential for Remediation of Dairy Wastewater

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ABSTRACT: Constructed Wetland (CW) technology has become an emerging greener remedy for treatment of wastewater. It had been widely employed to treat dairy wastewater worldwide though in Sri Lanka CW for treatment of dairy wastewater is still in grassroots level. Constructed Wetlands are characterized by wetland plants grown in order to enhance phytoremediation process, thus wetlands plants are an indispensable component of CWs. Their capacity to thrive in stressful conditions in CW need to be identified with respect to the type and strength of the pollutants in wastewater due to the variations in inherited traits of wetland plants. Hence this study primarily aimed at investigating the potential survival of three wetland sedges in a medium containing dairy wastewater. In this study *Schoenoplectus grossus*, *Eleocharis dulcis*, and *Fimbristylis dictoma* plants of family Cyperaceae were grown in the premises of Industrial Technology Institute (ITI) (latitude 06° 54' 18"N, longitude 079° 52' 14"W), from May-September 2014. The mean air temperature ranged from 27°C to 31°C, Light intensity 8200lx to 48300lx, Humidity from 66% to 86% over four months of culture period. Plants were established in plastic pots (10L) containing natural wetland soil (n=16 per species, N: P:K, 10:2.5:1) and in an artificial mixture (n=16 per species, N:P:K, 2:2:1).

Growth parameters including number of shoots, shoot diameter and height was recorded weekly during the establishment for six weeks. In the second phase plants were provided with dairy wastewater with seven COD levels 45mg/L, 45mg/L, 120mg/L, 65mg/L, 168 mg/L, 162mg/L, and 435mg/L. Control groups for both growing mediums were maintained for each species with addition of tap water (n=8). Plant dry biomass was recorded at harvest. Analysis of Variance (ANOVA) General Linear Model was performed to compare the mean differences in growth parameters. Results showed that the substrate has not significantly affected the growth of plant species during the first phase of the study since obtained P values were >0.05 in one way interactions. Application of dairy wastewater has not considerably affected the growth of all three plant species in mixture (P>0.05) whereas corresponding P value (< 0.05) for *Fimbristylis dictoma* plants in Bog soil indicated a significant difference in growth compared to other two species in bog soil with respect to all measured growth parameters. Significantly higher accumulation of biomass has resulted in the *Fimbristylis dictoma* in accordance with the Root/Shoot dry weight ratio obtained for this plant. Hence this paper recommends *Fimbristylis dictoma* plants grown in bog soil for dairy wastewater treatment. However further research is needed to investigate the threshold dairy waste water concentration for *Fimbristylis dictoma* and its removal efficiency of nutrients.

Keywords: Constructed Wetland technology, Dairy wastewater, Wetland Plants

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Agroforestry for Facing the Environmental Challenges in Sri Lanka

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ABSTRACT: Agroforestry is an integrated land management system that provides sustainable economic, environmental and social benefits to people. Despite Sri Lanka has long history of occurrence of 29 agroforestry systems, it has received little attention from policy makers and research institutes. This paper addresses the importance of agroforestry in terms of facing the environmental challenges in Sri Lanka. Currently, more than 25% of the country's land area is occupied by agroforestry land use systems, and the extent of land under agroforestry has increased during the last few decades. Thus, Sri Lanka can create a scenario to face and mitigate environmental challenges through agroforestry without sacrificing the food production. Agroforestry in this context involves growing appropriate but high value trees and crops together in well planned and systematically managed cycles as a specialized way of farming. This may be one of the few but effective options for reducing the environmental challenges in Sri Lanka. Past experiences revealed that agroforestry systems can contribute to socio-economic development of people and the country. They also help to conserve soil and moisture and protect land from soil erosion and environment from air pollution. Agroforestry can also reduce the pressure on natural forests through on-farm production and provision of forest products such as timber and firewood. On farm production will also support food and nutritional security of the society. They can act as alternative habitat for wild life and jungle corridor among fragmented forests. Agroforestry can also provide climate change mitigation mechanism through CO₂ sequestration result in lower contribution to the greenhouse gas pool. Further, evidences are accumulating with respect to the resilience nature to climate change on some of the agroforestry systems such as homegardens in Sri Lanka. In addition, it is identified that perennials are more resistance to the extreme events which can nicely matching with the concept of agroforestry adaptation to climate change and other environmental challenges in Sri Lanka. Finally, authors argued that in Sri Lanka, agriculture related land extent exceeds about 3 million ha. If 5% of such area can be used for agroforestry modals by inclusion of a few high value fruit, timber and medicinal tree species, such areas represent over 150,000 ha which is more than the total lowland forest area of the country. This ultimately helps in facing environmental challenges of the country.

Keywords: Agroforestry, Socio-economic development, on-farm production, food and nutritional security, climate change, homegardens, perennials

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Determination of the Factors Affecting the Stability of Road Cut Slopes along Badulla Nuwaraeliya Road

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ABSTRACT: *The stability of cut slopes in mountainous areas has serious impact on road performance and traffic safety. Substantial excavated slopes and filled embankments associated with the road bed, usually constitute the construction of roads and highways in such terrains. The number of excavated slopes, thus, could be having a significant impact on the construction of highways.*

This study, therefore, tried to assess the cut slopes stability along the Badulla Nuwaraeliya (A-5) road based on the soil characteristics. Methods used for this study were visual inspections and experimenting on soil physical parameters viz. particle size distribution, Atterberg's limits, bulk density, water content, specific gravity, porosity and free swell index of stable and unstable cut slope soils.

Results revealed that the plasticity index (PI), porosity (η), water content (WC) and free swell index (FSI) of soils from stable slopes were lower ($PI < 7$, $\eta = 35-40\%$, $WC \sim 20\%$ and $FSI = 8-9\%$) compared to those of soils from unstable slopes ($PI > 7$, $\eta = 40-45\%$, $WC \sim 30\%$ and $FSI = 15-16\%$). However, the specific gravity (ρ_s) was higher in the stable slope soils ($\rho_s = 2.40-2.50 \text{ gcm}^{-3}$) compared to the unstable soils ($\rho_s = 2.3-2.4 \text{ gcm}^{-3}$). Moreover, the study disclosed that the particle size distribution was significantly influencing the cut slope stability. Soils extracted from stable slopes had more soil particles (>65%) of sand size [retained on 1.118-0.180 mm aperture range (# 16-80)] allowing easy drainage compared to the soils from unstable slopes.

According to the obtained results of the study, it can be concluded that soils from stable slopes have low PI and FSI i.e. lower clay content, η and WC values compared to the unstable cut slope soils while the values of ρ_s is higher in the stable soils. Thus, to enhance the stability of cut soil slopes, it is necessary to control the dynamic factors (clay content and WC) of soils.

Keywords: *Cut slope stability, Dynamic factors, Soil physical properties.*

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Resource Efficient Cleaner Production Potential of Rubber Processing Factory Located at Horana, Sri Lanka

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ABSTRACT: HRC is one of the leading polymer based product manufacturing companies having quality certifications such as ISO 9001:2008, ISO14001:2004 & OHSAS18001 owned by a foreign company which functioning under BOI. HRC is manufacturing various rubber products for industrial applications using 450 employees as work force and having several awards with respect to environmental and product efficiency aspects. Objective of this study was to find Cleaner Production (CP) solution to enhance the productivity through resource efficient approach by reduction of emissions and generation of waste in order to manage the environment as well as overcome shortcomings associated with the processes. Furthermore, this study intends to improve awareness of the staff and increase the facilities for the employees through savings. Resource efficient cleaner production (RECP) assessment has been carried out within the factory by the support of National Cleaner Production Center and appointed employees who are working in different production lines. CP assessment tools were used to analyze the industrial data. Consumption of total raw materials, unmixed materials and mixed compounds were calculated as 5496 ± 100 , 2151 ± 60 , 3346 ± 66 MT/annum respectively. Consumption of water has been calculated as 7287 ± 1500 m³/annum from public water supply and 29481 ± 500 m³/annum from company owned well. Energy for the production has been acquired by national grid supply $4,380 \pm 800$ MWh and fossil fuels including fuel oil $789,305 \pm 65,000$ L/annum and Diesel $25266 \pm 1,000$ L/annum. Resource productivity performance indicators have been calculated for raw materials, Water consumption, Energy consumption, Solid waste generation (kg of waste per 1 MT of product) and Air emission (only direct emissions considered) were 1.009 ± 0.01 (MT/MT), 4.119 ± 0.05 (m³/MT), 9.27 ± 1.2 (GJ/MT), 8.3 ± 0.9 (kg/MT), 0.49 ± 0.01 (CO₂ kg/kg) respectively. CP Potential of the company was found as over 40 million Sri Lankan rupees per annum by considering rejected products, spew raw materials, intermediate outputs and water budget. Implementation of Fuel switching to fire wood, Power factor correction, Applying an insulating paint on molds, Thickness monitoring after maturing at water pillow production line, Installing a kVA alarm system, Recovering spew at water pillow production line and use of sky lighting during day time as CP solutions will save 32.3, 3.2, 1.8, 1.5, 0.9, 0.5, and 0.3 million LKR/annum respectively.

Keywords: CP Assessment, CP solution, Resource productivity

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Effect of Raw Material Manipulation on Quality of Municipal Solid Waste Compost

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ABSTRACT: Composting is an environmentally friendly method for disposal of Municipal Solid Waste (MSW). The composition and proportions of raw materials used in composting determine the quality of the end product of MSWC. This study investigates the effect of raw material manipulation on the quality of MSWC, focusing in particular on the use of night soil, another municipal waste product. Three compost piles were prepared using different combinations of rock phosphate (RP), night soil (NS), wood-shavings (WS) and animal waste (AW) as additional raw materials. A fourth pile containing only MSW was used as the control. The moisture content, color, sand content, pH, and the content of organic carbon, total nitrogen (N), potassium (K) and phosphorous (P) in each of the four finished products were tested using three replicates for each test. The treatments were compared with each other as well as the Sri Lanka Standard (SLS) for compost. Significant effects were found in regard to the phosphorous, carbon and potassium contents and the carbon to nitrogen ratio with raw material manipulation. When the night soil was added at the beginning of the composting with RP, it resulted in significantly higher P₂O₅ contents. This result shows the potential of the night soil to further enhance the effectiveness of RP solubilizing during composting. In regard to total nitrogen content, all the treatments other than the control maintained more than 1% of N content in conformity with the SLS standards. Organic carbon and potassium contents too were in conformity of the SLS standard in all treatments but the content was significantly lower in treatments containing night soil. However, only the night soil added treatments were conformed with SLS standard for the carbon to nitrogen ratio. All the treatments exhibited pH values near neutral and conformed to SLS limits for pH. These studies show the feasibility of quality improvement of MSWC through the manipulation additional inputs such as night soil where using it as an input solves the problem of its disposal as well. However, further research is necessary to investigate the effect of night soil application on biological characteristics and heavy metal content in MSWC.

Key words: Municipal Solid Waste, Compost, SLS

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Assessment of Microbiological Water Quality in West Coast Sea Bathing Sites of Sri Lanka

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ABSTRACT: Globally, there is a growing concern in investigating microbiological water quality in sea bathing sites due to the increasing coastal pollution. This is more important for islands such as Sri Lanka, since coastal pollution has considerable socio-economic implications. Therefore, this study was conducted to assess the current status of water quality in two popular sea bathing sites, Mount Lavinia (Colombo district) and Moragalla (Kalutara district) and a reference site in Kalutara district, which is a non-bathing site. Weekly changes of seven water quality parameters of the selected sites were recorded for three months and microbiological tests were performed to detect fecal coliforms (FC) and fecal streptococci (FS) separately. The comparison of these parameters in all three sites during the experimental period was conducted by ANOVA using Minitab 16 software. Sanitary inspection was conducted in both sea bathing sites to identify the potential sources of fecal contamination. Finally Beach Suitability Grades (BSG) was determined by combining categories obtained from sanitary inspection and microbial assessment. The results showed that temperature, dissolved oxygen and pH were in the standard range for healthy sea bathing sites whereas salinity, conductivity, turbidity and total dissolved solids were below the standard range throughout the experimental period. A significant difference was observed in temperature, salinity, total dissolved solids and electrical conductivity between the three experimental sites ($P < 0.05$). Further, Mount Lavinia showed a significantly higher FC count compared to the reference site ($P < 0.05$). Based on the FC count, BSG for both Mount Lavinia and Moragalla sea bathing sites were determined to be 'very high'. However, based on FS count, the BSG for Mount Lavinia and Moragalla were 'poor' and 'fair' respectively. Hence, it is recommended to develop and implement strategies including environmental education, water quality monitoring procedures and beach management to maintain healthy sea bathing sites in Mount Lavinia and Moragalla.

Keywords: Beach Suitability Grades, microbiological, physico-chemical, sea bathing sites, water quality

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Case Study on Acute Toxic Chemicals in Sri Lanka: Environment Impacts, Distribution, Intended Use and Safe Handling

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ABSTRACT: *A number of acutely toxic chemicals (ATCs) are used in the industrial sector in Sri Lanka. These chemicals may cause serious hazards to humans and environment when released to the environment. Formation of a toxic cloud is the characteristic feature of ATCs. Generally, it moves with the wind and gets dispersed in the environment. The wind patterns and other whether and terrain conditions contribute to disperse the cloud in the environment very quickly.*

The Kalutara Industrial Park was selected for this case study. Chlorine and ammonia are the identified ATCs which exceed the threshold limit value (TLV). Averagely 8 MT of ammonia and 300 nos. of 900 Kg chlorine cylinders were stored at respective plant sites. Based on the “Technical Guidance for Hazards Analysis” published by U.S. Environmental Protection Agency and the computer programme “ALOHA” to model the vulnerable zone (VZ). It was calculated that in the worst case scenario 9 MT of ammonia can pose immediate danger for life and health (IDLH) to living beings at 0.7 miles radius while bursting of two chlorine cylinders, i.e., 1800 kg can pose IDLH to the living beings at 0.6 miles radius.

Baseline ambient parameters of air, soil, ground water is very important to indicate a possible chemical contamination in the future. The prevailing soil pH value is 6.56; the ground water pH value is 5.47. Due to the high precision of the pH value of the measured sample this value can be taken as a baseline figure. But the conductivity values were dispersed and as such a precise baseline figure could not be calculated.

In order to mitigate consequences of emergency situation critical population characteristics and critical facilities within the risk zone such as schools, daycare centers, nurseries, hospitals, police stations were identified.

None of the above mentioned installations have prepared the emergency management plans for an emergency, while the authorities who granted approval for these plants have not forecasted the possibility of chemical hazards. Hence this is an attempt to understand the long felt need.

Keywords: *pH value, acutely toxic chemicals, ambient parameters*

Simulation of Ambient Water Quality of Lower Kelani River to Assess the Impact of Point Sources and Non-Point Sources, using Selected Parameters

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ABSTRACT: *This study focuses on the Kelani River, which plays an important role in Sri Lanka's economy. It is the main source of drinking water to the capital city, Colombo. However, the water quality in the lower Kelani River has been a concern for many years. Therefore, managing river water quality has become critical and also challenging as the lower catchment of the river is a highly complex system which is impacted by many forces and pollution sources.*

We configured a river catchment based hydrological model to identify the main sources of water pollution and their impact on ambient water quality of the river, coupling three modules (Hydrodynamic (HD), Eco Lab(EL) and SHE Network) of MIKE software developed by the Danish Hydraulic Institute. We simulated changes in three water quality parameters i.e. Biochemical Oxygen Demand (BOD), Dissolved Oxygen (DO) and Fecal Coliforms (FC), along the river from Seethawaka downstream to the open ocean point. The HD module was forced using water level and river discharge at the open ocean point and the upper river boundaries, respectively. With the use of industrial, households and sewerage data of pollution loads, source data for the EL module was specified. The pollution due to natural vegetation and non-point sources were captured by the SHE Network module using the river basin network, where parameters (rain fall, precipitation, soil and vegetation) were provided using observational data and default values. The couple model simulations were conducted for 8 years commencing from 2004. The model validation was undertaken by comparing model predictions with observations of BOD, DO, FC at 8 locations, where, skill level values indicated good agreement between the observed and predicted values. Experimental simulations were undertaken including and excluding the pollution loads from different sources.

Simulation results reveal that industries (point sources) contribute to reduce water quality of the river, although the contributions vary between different sections of the river. Pollution loads from household and sewage also contribute to the poor river water quality, despite being of a small magnitude. Findings of this study provide a holistic approach for practitioners to make management and policy decisions to manage river water pollution.

Keywords: *Water Quality, Hydrology Modelling, Water Pollution, Water policy*

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Effects of Tea Cultivation on the Quality of Water and Aquatic Macro Insects in Selected Perennial Water Bodies from the Three Major Tea Growing Elevations in Sri Lanka

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ABSTRACT: *This study was conducted to identify the land use effects on the physico-chemical and biological parameters: aquatic macro insects (AMI) diversity of water in selected perennial water bodies from eight tea estates in three major tea growing elevations: 03 from low-country (<600m msl); 03 from mid-country (600-1200m msl) and 02 from up-country elevation (>1200m msl) under management by a single plantation company were sampled during rainy season and dry season from year 2011 to 2014. 2232 samples from 62 sites were analyzed from 5 different land uses i.e. springs within the forest, springs within tea estates, springs within relatively undisturbed areas-without anthropogenic effects (marshy lands, Eucalyptus plantations), streams in undisturbed area, streams after flowing through the estates. Findings were subjected to PCA ($p > 0.05$) and Shannon-Wiener diversity Index.*

Except in low-country estates, tested parameters (flow rate, depth & width of the water body, Temperature, turbidity, conductivity, salinity, DO, BOD₃, Nitrate, Ammonium, Sulfate, Phosphate, Calcium, Zinc) did not show a significant difference with the land uses. Except pH, all other tested parameters in all the 08 estates were found to be within the WHO₂₀₁₂ potable water standards. Undisturbed areas and forest areas in low-country estates were significantly lower than mid and hill. However, there was a significant difference of AMI diversity with land use patterns and 28 morpho-species were recorded from all estates.

The low pH even in the spring waters within forests indicates that the low level of pH found in other sites could not be due to any anthropogenic activity. The composition of AMI communities in a stream reflects the stream's conditions over time while physico-chemical tests describe the quality at the time the samples were taken. This study revealed there was a significant difference of AMI with land use patterns while physico-chemical parameters were not.

This study revealed that the water bodies related to the low-country estates are in a more vulnerable situation of pollution compared to the estates in higher elevations and this could be due to lack of undisturbed habitats for the purification process and it revealed the importance of maintenance of undisturbed habitats to enhance the quality of water in this perennial water bodies.

Keywords: *Aquatic macro insects, land use effect, tea growing elevations, forest, water pollution*

A Greener Method for Reduction of COD and Zinc Level in Textile Effluents during Primary Treatment Process

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ABSTRACT: *Fabrics with the traditional batik patterns are firmly established in many Asian countries including Sri Lanka as the demand increased with the tourism. Manual wax-resist dyeing technique is the main process for the production of colourful fabrics while generating large amount of wastewater contaminated with organic chemicals which having severe environmental consequences as it contain large amount of surfactants, suspended solids, trace metals, color and high Chemical Oxygen Demand (COD). Reduction of COD, colour and contaminated Zn²⁺ present in raw effluent using low cost coagulant with sea water as a freely available ionizing agent was the major objective of this study. Simple jar test was used to optimize the dosage requirement of seawater and FeSO₄ in order to remove the suspended particles from the effluents by controlling the pH of the test reactor 11.5 with addition of lime. COD, colour and concentration of Zn²⁺ were determined by open reflux digestion followed by titration, UV-Visible spectrophotometer and acid digestion followed by Atomic absorption spectrophotometer respectively. Characteristic of raw water from textile effluent was found have pH; 11.4±0.2, Salinity; 6.8±0.06 g/L, TDS; 9.3±0.1 g/L, COD; 1417±52 mg/L, Zn²⁺; 0.162±0.02, and colour; at λ_{max}300nm. After the treatment of raw water using seawater followed by iron alum coagulation and flocculation colour, COD and Zn²⁺ concentration found to have decreased by 41%, 60% and 65% respectively. However salinity increase was observed by approximately 18% which requires further treatment in order to meet the requirements of the Sri Lankan industrial effluent discharging guide lines. Constructed wetland treatment process and increasing the retention time of the primary treated water in digestion tanks are recommendations for the completeness the treatment process with greener approach.*

Keywords: *Coagulation, Effluents, Seawater*

Nutrient Removal of Dairy Wastewater by Pilot Scale Subsurface Horizontal Flow Constructed Wetland Planted with *Schelonoplectus grossus*

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ABSTRACT: Constructed wetland (CW) technology, artificial engineered systems designed to treat wastewater, is relatively a novel practice in Sri Lanka. This greener wastewater treatment method requires low cost for implementation and maintenance thus it is a good alternative to replace high cost conventional wastewater treatment methods. Therefore, the primary objective of this study was to examine the nutrient removal efficiency of pilot scale CW designed to treat dairy wastewater arising from small and medium sector dairy industries. This experiment was conducted at the premises of Industrial Technology Institute (latitude 06° 54' 17"N, longitude 079° 52' 14"W), Sri Lanka from April to August 2014. Two pilot scale fiberglass wetland units were designed to function as subsurface horizontal flow (SSHF) CWs. A gravel based medium was layered for the inlet and the outlet of each unit. CW bed was filled with sand and the upper layer was filled with compost: top soil mixture (1:2). Both units were planted with *Schelonoplectus grossus* (giant bulrush). After establishing plants for three months, the treatment unit was saturated with seven biochemical oxygen demand (BOD) levels of diluted dairy wastewater ranging from 5g/m²d to 186 g/m²d intermittently, maintaining 7 days as the retention time. Control unit was fed with tap water. Samples were collected from the inlets and outlets of each unit and analyzed for BOD, chemical oxygen demand (COD), total nitrogen (TN) and total phosphorous (TP). Removal efficiencies of BOD, COD, TN and TP were calculated. The results of this study showed BOD removal efficiencies in the range of 30%-100%, COD removal efficiencies in the range of 75%-92%, TN removal efficiencies in the range of 40%-100% and for TP in the range of 0%-100% with respect to studied loading rates. Based on these results this paper suggests that this type of pilot scale SSHF CWs planted with *Schelonoplectus grossus* is appropriate for removal of BOD, COD, TN and TP in dairy wastewater arising from small and medium sector dairy industries.

Keywords: Constructed Wetlands, Dairy wastewater, *Schelonoplectus grossus*, COD, BOD

In Situ Denitrification as a Suggested Remedial Measure for Jaffna Peninsula Aquifers

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ABSTRACT: Groundwater nitrate levels in the Jaffna peninsula of Sri Lanka are well above the World Health Organization limit of 10 mg/L as N. Other studies point to high use of chemical fertilizers and close proximity of septic systems to drinking water wells as the probable causes. Since aquifers in the peninsula are primarily porous shallow karstic miocene limestone, they provide high levels of infiltration. If the current situation continues unabated, the public may suffer the harmful effects of nitrate toxicity. This paper discusses in situ bioremediation processes, along with other possible mitigation measures, to remove nitrate and improve drinking water quality. Five in situ denitrification projects conducted in the Northern USA and Canada are presented, using carbon sources such as ethanol, methanol and acetate. Treatment was achieved by a) injecting carbon and phosphorus or b) infiltrating treated water with excess carbon and phosphorus, into groundwater. Nitrate-nitrogen concentrations as high as 60 mg/L have been removed to below the limit of 10 mg/L with no ill effects.

Keywords: Bioremediation, denitrification, karstic aquifer, nitrate toxicity, pump and groundwater

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Comparison of Peak and Time-Weighted Average Concentrations for Effects of Insecticides as Observed in Semi-Field Experiments

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ABSTRACT: Areas with intensive agriculture are highly integrated with aquatic ecosystems because of their dependence on water supply and/or drainage. When pesticides are applied with the prevailing application methods used for crop protection, however, it is inevitable that a portion of sprayed pesticides will reach these such untargeted edge-of-field surface waters. Since aquatic ecosystems contain species related to the target organisms of pesticides, unintended repercussions may occur when these ecosystems become contaminated. Nowadays, evaluation of the potential adverse effects of a pesticide stress on non-target aquatic organisms in aquatic ecosystems/environment is considered as a major challenge. Therefore, governmental authorities have set criteria to protect aquatic life from pesticide-stress. The aim of present study was to describe the effects as observed in model ecosystem experiments with peak as well as the time-weighted average (TWA_{21d}) concentrations using different sensitivity endpoints. For this purpose, a literature review was performed of empirical PERPEST database which has been built by performing a review of freshwater model-ecosystem studies evaluating the effects of pesticides. Peak exposures of single and multiple applications of insecticides were derived from the publications and its corresponding TWA_{21d} concentrations were calculated. In order to allow comparison of studies with different insecticides, we expressed the exposure concentrations as toxic units (TU). TU were calculated by dividing the concentrations evaluated in the cosm study by the Hazard Concentration 50% (HC50). Different grouped endpoints were selected from each model ecosystem study and responses were assigned to effect class. When standardised on peak exposure concentrations in case of the insecticide chlopyrifos, clear effects were reported for all endpoints at exposure concentrations of 0.1 $\mu\text{g/L}$ and higher. When expressed as TWA_{21d} concentrations, clear responses were reported at concentrations of 0.05 $\mu\text{g/L}$ and higher. On the basis of these comparisons between peak and TWA_{21d} concentrations, we found that when applied once, direct effects became apparent at TWA_{21d} exposure concentrations which were a factor of 5 lower than their corresponding peak exposure concentrations. For acetylcholinesterase inhibitor insecticides, TWA_{21d} concentrations can be used as good predictors for predicting long-term effects on sensitive endpoint groups in the risk assessment process.

Keywords: environment pollution, peak and TWA concentrations, PERPEST database, sensitive endpoints, toxic unit

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Innovative and Low Cost Method for Leachate Treatment using Modified Sequencing Batch Reactor Process

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ABSTRACT : *The sequencing batch reactor (SBR) is a wastewater treatment system based on activated sludge, which includes a biological nutrient removal process. This technology is reputed because of its low foot print and capacity to handle a wide range of hydraulic and organic loading variations. Since degradation process takes place in one reactor, this method is low cost relative to other conventional wastewater treatment processes. With the growth of the usage of microprocessor-based programmable logic controllers (PLCs), the reliability of these systems have increased. The step-feed mechanism is an innovative and novel operation mode of SBR. The aim of this research is to study the performances of SBR to treat municipal solid waste landfill leachate. Synthetic leachate is used in this research. At the initial stage, conventional SBR cycle (fill, react, settle and decant) was performed and at the second stage the process was modified to enhance the nitrogen removal. The step feed process is introduced as the nitrogen removing mechanism to SBR model. This process has three phases of consecutive aerobic and anoxic period and three steps of feeding in between them, combined with real-time control. The control strategy is pH as the on-line control parameter. The durations of aerobic and anoxic phases will be flexibly controlled by using the pH curve. Since leachate has a low C/N ratio, complete denitrification is achieved by using influent as the carbon source. Only a small amount of external carbon source was used for the final denitrification process before the settling phase. In this way, a real saving in treatment has been achieved, an increase in treatment efficiency (in terms of C and N removal) and a good adaptation of high strength loadings.*

Keywords: *Denitrification, Landfill Leachate, Real-time control; Sequencing batch reactor, Step-feed process*

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Evaluation of New Rice Hybrid Combinations

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ABSTRACT: Bg407H is a hybrid rice variety released under 4 month age group by the Rice Research and Development Institute, Batalagoda. It has high yield potential (12 - 14t/h) and good demand within farmers, cultivated 4 months age varieties. At present, there is a good demand for short age varieties (3and1/2months) all rice growing areas in the island since they have short time duration, need less water and other inputs than the 4 months varieties. Hybrid rice programme was focused to develop the high yielding hybrid rice variety under 3 ½ months to fulfill the above requirement and enhancing the rice production to meet future demands. Therefore, several hybrid combinations could be developed under 3 and 1/2 age groups having acceptable morphological and grain quality characteristics. Preliminary yield trails(PYT) have been carried out in 2011/2012 Maha and 2012 Yala seasons to test the 15 hybrid combinations to evaluate the yields of selected hybrids combinations and compare them with high yielding in bred varieties (Bg357, Bg300). Out of the 15 combinations BgCMS4A/R147 (Bg-HR10) was selected as promising combination and it obtained 5.7t/h yield in 2011/2012 Maha and 6.8t/h yield in 2012 Yala seasons respectively. Check variety Bg357 has given 4.50t/h and 5.4t/h yield in above two seasons respectively. According to that, Bg-HR10 has given 26.66% stranded heterosis (SH %) in 2011/2012 Maha and shown values of SH 25.9% respectively in 2012Yala season. In addition Bg-HR10 showed high tillers, long panicle and same plant height compare to Bg357 and acceptable grain quality (medium slender white per- carp). It showed 5 days shorter to come for the 85% maturity than the check variety (Bg357) and same resistant to Bacterial leaf blight (BLB). Other hybrids combinations showed same and less performances and negative heterosis for the tested characters than the check variety. According to that, Bg-HR10 was selected to further testing under different agro-ecological zones in order to release as new hybrid under 3and ½ month age group.

Keywords: Heterosis, grain quality, rice, yield potential,

The Potential of Biofilmed Biofertilizers to Reduce Chemical Fertilizer Use in Vegetable Cultivation of Sri Lanka

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ABSTRACT: Biofertilizers are live formulates of beneficial microorganisms which perform beneficial functions in agricultural ecosystems. As a recent development, microbial biofilms (BF) have been developed as promising inoculant biofertilizers to reduce chemical fertilizer usage in agriculture and in plantations. These biofertilizers are called biofilmed biofertilizers (BFBFs) and have been tested for tea, rice and maize. Here, a range of crop-specific biofertilizers was formulated for upcountry and low country vegetables using plant growth-promoting rhizobacteria (PGPR) and fungi, and tested in major agro-ecological regions. Microbial species were isolated from bitter gourd (*Momordica charantia*), eggplant (*Solanum melongena*), okra (*Abelmoschus esculentus*), capsicum (*Capsicum annuum*), radish (*Raphanus sativus*) and tomato (*Solanum lycopersicum*) grown in vegetable crop lands in Sri Lanka. Effective strains were screened based on biofilm formation ability, nitrogenase activity and plant growth promoting ability. Thereafter, selected effective strains were used for biofilm formation, following protocols developed by the Institute of Fundamental Studies, Sri Lanka. Field experiments arranged in Randomized Complete Block Design with three replicates were conducted with the developed crop specific BFBFs of the above vegetables during two consecutive dry and wet seasons. Vegetable yields under the full dose of recommended chemical fertilizer (100% CF), reduced dose of chemical fertilizers (i.e. 50% CF), 50% CF + BFBFs and no fertilizer were evaluated during the two cropping seasons. In the dry season, BFBFs formulations for bitter gourd, capsicum and okra gave higher vegetable yields than even 100% CF, when those were coupled with 50% CF. In tomato, BFBFs alone gave a comparable yield to 100% CF. In the wet season, BFBFs alone gave the highest yield in bitter gourd. Results of tomato suggested the potential of BFBF formulation to replace 50% CF without affecting the yield. Further, capsicum, okra and radish yields during wet season with 50% CF + BFBFs were higher than that of 100% CF. In eggplant, 50% CF + BFBFs gave a comparable yield to 100% CF treatment during both seasons. These studies show the feasibility of the developed crop specific BFBFs formulations for replacing from 50% to 100% of chemical fertilizer usage in different vegetables under different soil and climatic conditions for a sustainable vegetable production.

Keywords: Plant growth-promoting rhizobacteria, biofilms, biofertilizers, vegetables

Production of Natural Vinegar from Waste Coconut Water using High Rate Generator

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ABSTRACT: *Currently, there are around 65 desiccated coconut (DC) mills in the country and collectively process a quantity of nearly 550 million nuts annually. Thus, approximately 80-100 million litres of coconut water is released annually from the industry. At present, value addition to this waste coconut water has been accomplished by converting it into natural ready to serve drinks, bio gas and freeze cubes. However, nearly 80% of coconut water is still discharged into the environment after going through several physical treatments. For those industries coconut water has become an enormous burden since it has become an environmental concern. This is a wasting of a valuable resource, which contains lots of nutrients including sugars (21.68 mg/mL), vitamins (1.833 mg/L), amino acids (0.57 mg/mL), organic acids (35.07meq/mL) and enzymes. The potential of producing natural vinegar with this waste coconut water is higher if it can be collected hygienically. In this study a novel method of producing natural vinegar using a vinegar generator has been introduced. Though, the traditional vinegar generation method consumes 2-3 months to obtain the final product. The significance feature of this method is that this process is faster and it takes minimum 10 days. Vinegar is defined as an acidic liquid in which the key ingredient is acetic acid (ranging from 4-18 % (w/v)) and is produced by aerobic fermentation in the presence of acetic acid bacteria. This method can also be utilized for a wide variety of applications ranging from coconut water to various fruit juices extracted from fruit wastes. This vinegar generator has been used to produce natural vinegar from wines prepared using waste coconut water. The rate of acetification in this generator has been enhanced with facilitated aeration. This novel method is a combination of submerged and generator methods. The key concept is from rotating biological contactor which is widely used in the wastewater treatment sector. A mix culture of Acetobacter converts the alcohol (7 – 10 %) to 4-6 % acetic acid. During the process, a favourable platform is provided to “attached growth” of Acetobacter bacteria which converts ethyl alcohol into natural vinegar.*

Keywords: *Coconut water, Natural Vinegar, waste*

Evaluation of the Attitude and Awareness of the International Resolution on Responsible Fishing: A Case Study on the Multiday Fishermen of Matara

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ABSTRACT: *The worldwide increasing demand for fish has resulted an increase of IUU fishing activities. Because of this, responsible fishing concept has developed. The regional resolutions for avoiding IUU fishing activities have developed by IOTC (Indian Ocean Tuna Commission). In Sri Lankan fisheries sector, especially the multiday fishermen who are engaging in high seas fishing operations have the ultimate responsibility to comply with these resolutions. This case study was done by taking a selected sample from multiday fishermen of Matara fisheries district. Sample was selected through the stratified random sampling technique. The minimum sample size (105 stakeholders) was determined using “moving average”. Data were collected using a questionnaire and secondary data also were used. Questionnaire was prepared considering international resolutions which highly impact to Sri Lankan fisheries sector. Collected data was analyzed using “Likert scale” and One Way Analysis of Variance (ANOVA) on 95% confidence interval. According to this study, the awareness of multiday fishermen in Matara fisheries district is medium level (Mean Likert value is 3.38). But there is a significant difference in responses for some questions according to the types of stakeholders. The identified major reasons for this significant difference are difference of the participation level for the awareness programs and different attitudes among types of stakeholders. Compared to the crew members, the awareness of boat owners and skippers were high. The reason for this was identified as the high level of participation for the awareness programs while others are engaging in fishing activities. The awareness of other service providers was very low. Because they just consider on their occupation. Therefore, awareness programs on international resolutions should be modified taking the participation of all the stakeholders for better results in order to increase the level of non-compliance and partial compliance issues in Sri Lanka. It is better to use mass media for the awareness programs. Other than using the mass media, it is better to display posters regarding these resolutions in the harbour premises, maintain a continuous dialogue between the stakeholders and the government. While improving common knowledge of stakeholders, developing positive attitudes regarding international resolutions and importance of these resolutions is very important.*

Keywords: *Illegal Unreported Unregulated (IUU) fishing, Indian Ocean Tuna Commission (IOTC), International Resolutions, Responsible fishing*

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Species Composition and Diversity of Breeding Habitats of Malaria Vectors in the District of Mannar, Sri Lanka.

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ABSTRACT: Sri Lanka embarked on a malaria elimination program in 2009. Biological and ecological data on malaria vectors are important in planning vector controlling strategies. Lack of reliable biological and ecological data on malaria vectors in Northern Province of the country, a malaria endemic region, is a major constrain in successful implementation of malaria control programmes. Therefore, the objective of this study was to explore the diversity of breeding habitats and species composition of malaria vector mosquitoes in the District of Mannar, Sri Lanka. Potential larval habitats for *Anopheles* mosquitoes were surveyed from June, 2010 to July 2012 on a monthly basis in selected sampling sites in the Mannar District: Mannar Town, Vankalai and Silawathura, within a radius about 20 km. In each site, 4 sub sites were selected. A total of 37,788 *Anopheles* representing ten species was recorded from 12 breeding habitat categories (Tank margin, waste water collection, water storage tank, field canal, main canal, paddy field, pond, built well, cemented tank, lagoon water collection, burrow pit and rain water pool). Built wells and waste water collections were conducive for anopheline breeding. *Anopheles subpictus* (96.2%, n= 36,351) was the dominant species followed by *An. peditaeniatus* (1.47%, n= 557), *An. barbirostris* (1.23%, n= 463), *An. nigerrimus* (0.75%, n= 285), *An. varuna* (0.19%, n= 74), *An. barbumbrosus* (0.1%, n= 38), *An. vagus* (0.03%, n= 12), *An. pallidus* (0.01%, n= 4), *An. jamesii* (0.05%, n= 2) and *An. pseudojamesi* (0.05%, n=2). Use of wells and waste water drains as breeding places by *Anopheles* indicate that both of these habitats act as larval reservoirs during the dry season. Presence of these habitats in close proximity to human habitats create a high risk of malaria transmission among humans. Therefore, health authorities need to be vigilant on these new habitats in vector control programmes.

Keywords: Entomological, Malaria, *Anopheles*, Controlling

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Radical Learning in Arboriculture: Environmental Education on Biodiversity and Forest Restoration via Exploring a Nature Tour at the IFS-Popham Arboretum in Sri Lanka

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ABSTRACT: *This study examines visitor information of the IFS-Popham Arboretum about educational and awareness programs conducted for school children, university students and naturalists from 2007 to 2013. Integrating classroom teaching with field trips is vital for learners to visualize and to understand ecological processes in the nature effectively. IFS-Popham Arboretum is a sanctuary of tropical trees and a wildlife refuge, which utilizes a simple silvicultural method to turn shifting cultivation land to a productive forest. The arboretum had been gifted to the Institute of Fundamental Studies in 1989 for conservation, research and education. In 2005, the Arboretum was developed as a visitor and research center under the management of Ruk-Rakaganno, a national NGO. The key role of the arboretum, since 2005, is to conduct workshops and awareness programs, stewardship programs, train naturalists, and provide nature tours for visitors. The results of the study showed that the largest number of school children (i.e. 756 students with 49 teachers) have visited the arboretum in 2007. In 2010 and 2011, school visitors for the Arboretum were comparable with visitor attendance doubling in 2012 (438 students and 23 teachers). The largest number of university students (e.g. 131 students) visited the Arboretum in 2010. This increase in visitor participation resulted from school awareness programs and workshops for university students conducted through visitor promotion and media campaigns. We evaluated the students' interests for the activities conducted through the awareness program. The students from the primary schools were mainly interested in active learning methodologies i.e., observing the feeding behavior of Jungle fowls, while the middle school children were interested in learning seed bank collection of the dry zone plants and bird watching. The university students were concerned about the silvicultural methods adopted by Popham, taxonomy and ethnobotanical values of dry zone plants, and the stakeholder activities. In addition, naturalists were interested in the Geoffrey Bawa's architectural design of the cottage, nature trail visits and wildlife gardening. We conclude that different environmental education programs should be formulated according to the interest of different focal groups. The environmental education programs directed at school children and naturalists in the Arboretum have influenced learners' keen interest in protecting the valuable plants and/or planting trees in their home gardens to support wildlife gardening.*

Keywords: *IFS-Popham Arboretum, forest restoration, biodiversity, environmental education*

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Study on Bio Medical and Health-Care Waste Audit of Government Hospitals in Colombo District

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ABSTRACT: *Healthcare services aim to reduce health problems and to prevent potential health risks. In doing so, however, waste often generated is potentially harmful to public health and the environment. Most waste generated in healthcare establishments can be treated as regular municipal waste. Only a small proportion of healthcare wastes called special wastes such as sharps, pathological, infectious, pharmaceutical, biological, and hazardous chemical waste require special attention.*

Healthcare workers, patients, waste handlers, waste pickers, and the general public are exposed to health risks through healthcare wastes. Haphazard disposal of special healthcare wastes, including open dumping and uncontrolled burning, increases the risk of spreading infections and of exposure to toxic emissions from incomplete combustion. Otherwise, negligence in the process of wastes management, significantly contributes to environmental pollution, affects public health and depletes natural and financial resources.

This study using a questionnaire and sites visits was carried out to search waste handling practices of government hospitals in Colombo District. The questionnaire was developed on recommendation of World Health Organization and divided into sections as General information, Amount of Waste, way of Wastes handling and Treatment, Waste Water Generation and Treatment and Following Regulations.

18 out of 26 hospitals including National, General, Base, Peripheral and rural hospitals were examined during this study. Site observations and Interviews with personnel involved in handling of wastes in those hospitals were made to collect data on questionnaire. Data was analyzed considering the hospitals under the central government and the provincial government as group A and B respectively.

All hospitals in group A segregate wastes as per category wise using colour codes and generate total of Pathological, Infectious Sharps, Radioactive, Recyclable, Other and General wastes 724.8, 1966.8, 150.0, 42.0, 693.6, 6.7, 8285.6 Kg per day respectively as estimation. Most hospitals in group B segregate especially sharps and generate total of Pathological, Infectious Sharps, Radioactive, Recyclable, Other and General wastes 120.0, 186.0, 30.0, 16.8, 146.4 Kg per day respectively as estimation. Wastes management in many hospitals includes wastes collection and disposal only. Most of hospitals are aware of risk or health impacts however are not aware of environmental damages or pollution due to poor management of healthcare wastes.

The findings of this study recommend that formal regulations on segregation, treatment and final disposal of healthcare wastes are utmost need. Further adequate physical and financial facilities, guidelines and training, special expert staff for healthcare wastes management should be provided for hospitals.

Keywords: *healthcare wastes, management, segregation, treatment, hospitals*

Environmental and Waste Management Awareness in Executives' Perceptions of Corporate Environmental Reporting in Sri Lanka

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ABSTRACT: *Most of environmental reporting studies examine annual reports of companies and using proxy variables adopting quantitative methods. However, there is a lack of study focusing on managerial values and beliefs behind disclosing of environmental information in the annual report. Previous studies confirm that corporates' environmental reporting gradually increases over the world including Sri Lanka due to increasing environmental issues like global warming, soil and water pollution etc. resulted in concern of environment. Despite environmental reporting is not mandatory, most of Sri Lankan public companies voluntarily disclose environmental information. Therefore, the study has two objectives. First, to examine the Executives' opinions about environmental reporting in Sri Lankan public companies. Second, to explore reasons behind Sri Lankan public companies to disclose environmental information. Legitimacy and Stakeholder theories are used to examine the study. The study was conducted on interpretative perspective adopting multiple case study strategies. Data were collected via fifteen in-depth interviews from Executives, who have been directly involving in the process of environmental management and/or reporting of fifteen companies which disclosed more environmental information. Content analysis was used to analysis qualitative data using NVivo 7 software. Interview data were converted into text through process of code and categories primary patterns or themes. Question by question and pattern matching techniques were used to analyse the data. The study shows that general opinion of disclosing environmental information is good practice which facilitates to utilize the scarce resources properly and reserve for future generation. Further, results of study reveal reasons for environmental reporting are: requirement of new reporting guidelines, marketing the company, dealing with dangerous chemicals, show as responsible corporate citizen, stakeholder rights to know, culturally inbuilt in the company, fulfill suppliers' requirements, changing people attitude and having membership of United Nation Global Compact, amongst others. In conclusion, companies report environmental information to gain social acceptance, trust and confidence for successfully running the business by satisfying numerous stakeholders. The results of the study would help to the government, regulators, companies, and other stakeholders to effectively implement environmental conservation and reporting for sustaining the greenness in the world.*

Keywords: *Environmental reporting, Green reporting, Legitimacy theory, Stakeholder theory*

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Environmental and Waste Management Awareness in Secondary Schools in Sri Lanka

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ABSTRACT: *In the society today, the recycling of Solid waste is supposed to be achieved through hierarchies. The nomenclature Solid Waste Management (SWM) explains that the society is attempting to achieve this target through management processes helped by the law and order. This current strategy: 'punishment avoiding and reward seeking' method generally known as the standard regulatory path. The method is successful in countries such as Switzerland and Singapore.*

Notwithstanding the success obtained in these wealthy and small geographies, in the global scale an evident failure can be seen in recycling. Therefore it is a current and urgent necessity to understand reasons behind such a failure. It is universally agreed that increasing the environmental awareness in the society would be a positive approach to resolve this problem. The research therefore, has been conducted in secondary school atmosphere to understand the alternative approaches to the above described regulatory path.

Two main alternative paths identified by the previous researchers to the typical regulatory path of recycling have been tested to validate the researches conducted in foreign nation-states to understand their practical applicability in Sri Lankan context. The paper came with the conclusion that 'distress reduction path' is more effective as a motivation path to increase recycling behaviour than the regulatory path. The result would be helpful in preparing future education awareness programs as well as in policy making process.

Keywords: *Environmental Education and Awareness, motivation behind recycling*

Captive Breeding of Fresh Water Fish Species - Promise for Natural Stock Enhancement

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ABSTRACT: *Conserving aquatic biodiversity, especially freshwater fish species in Sri Lanka, has become an increasingly daunting task. While culprits of stock depletion i.e. overexploitation, pollution and habitat destruction, are associated with the process of controlled/uncontrolled development, they have major impacts on freshwater fish stock-depletion in natural habitats. Even when these factors would be managed correctly, that alone would not increase freshwater fish populations. If these depleted species can be multiplied in captivity to release into nature, those would contribute for natural stock enhancement, hence, could be used in integrated conservation plans. The objective of this paper is to review such captive breeding efforts for freshwater fish, conducted by the author.*

Efforts in captive-breeding endemic fish species were succeeded in Esomus thermoicos (flying barb) by manipulating the bottom substrate and tank conditions. It was the first such records found in this regard and unlike the already known observations in the wild, they were found to be very fecund, laying large number of eggs per female, short embryonic development and quick hatching, larvae preferring live feeds. Similar techniques, but different substrates were successful in breeding Devario aequipinnatus (giant danio) and Puntius bimaculatus (red-side barb), both preferring vegetation for their spawning and having quick embryonic and larval development. The silvercarplet, Amblypharyngodon melettinus did not breed with environmental manipulation. Even with low success rate, they could be induced to breed naturally once chemically induced stress was given. However, all these captive breedings provided key knowledge in reproductive behavior and biology of those fish species, which would be instrumental in increasing their numbers. In similar efforts, Channa striata (snake-head), a heavily exploited food fish species could be successfully bred in captivity. Environmental manipulations did not succeed, yet hormonal manipulations gave the first evidences of their captive breeding in Sri Lanka. Together, these information show that captive breeding, by environmental manipulation or induced breeding can enhance stocks of freshwater fish in captivity, hence, suggesting a promising applications in conservational management.

Keywords: *captive breeding, conservational management, freshwater fish,*

Conversion of Spent Broiler Litter into Environmental Friendly Organic Manure

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ABSTRACT: *The broiler industry plays a major role in supplying the protein requirement of the Sri Lankan community. As a result a huge volume of broiler litter (BL) is produced daily, as a waste and its demand as a direct organic fertilizer is limited due to its phytotoxic properties. Piling into large heaps is the common practice in broiler production areas that creates lot of environmental problems. It requires longer period to degrade due to its imbalance C: N ratio which impairs the speedy decomposition. Therefore, broiler litter is accumulated in the open lands in larger quantities. The objective of this study was to find suitable co-composting material and to develop a protocol for speedy composting of broiler litter (BL). Compost piles were made with BL+ Saw Dust (SD), BL+ Paddy Straw (PS) and BL+ Market Waste (MW) mixture on which the C: N ratio was adjusted to 20:1. The experiment was arranged in three places in a steep land and used Randomized Complete Block Design (RCBD) with three replicates and temperature, pH, electrical conductivity (EC), N, P, K, maturity of the compost through germination index were tested in each pile. The earliest maturity was achieved by BL/MW mixture (6 weeks) and followed by BL/SW (8 weeks) and BL/PS (9 weeks) mixtures. Up on maturity the highest EC value (4.933), N (1.78%) and P (0.0197%) were observed in BL/SD mixture. The highest K content (1265ppm) and ash content (60.66ppm) was observed in BL/PS mixture. All three compost mixtures comply with the Sri Lankan standards. It was concluded that paddy straw (PS), saw dust (SW) and municipal waste (MW) are ideal co-composting material to convert broiler litter into valuable organic fertilizer and BL would be efficiently composted with a six-step procedure as follows. 1. Piling of C: N ratio adjusted (20:1) mixtures, 2. First turning was done at 3rd day, 3. Second turning was done at 7th day, 4. Third turning was at 3rd week, 5. Fourth turning was done at 6th week, and 6. Dispatch between 6-9 weeks depending on the co-composting material.*

Keywords: *broiler litter, co-composting material, electrical conductivity, pH value*

Reef Fish Associated with Coral Dominant Area in *Paraviwella*, Tangalle, Sri Lanka

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Abstract Reef fish abundance and their feeding in relation to habitat characteristics are essential to understand the function of food web in coral reef systems. We selected *Paraviwella* reef, Tangalle, South coast of Sri Lanka ($6^{\circ}01'17.09''N$, $80^{\circ}48'01.21''$, Depth = 54 ± 17 cm) from 12th of February to 31st of May 2014 as a natural mesocosm to study the reef fish abundance at different times of the day [morning–TM (7am–9am), afternoon–TA (11am–1pm), evening–TE (3pm–5pm)]. The aim of the study is to determine the reef fish abundance with reference to their feeding type (herbivorous–HB, carnivore–CV, omnivores–OM and planktivorous–PL). Underwater visual and video surveys were performed along permanent belt transects ($n=3$, transect length = 25m, observation time = 30 min) to obtain data on fish abundance. Fish transect census disclosed that percent abundance for different feeding behaviors viz. herbivores ($51.7 \pm 1.7\%$), carnivores ($30.9 \pm 5.8\%$), planktivorous ($10.6 \pm 4\%$) and omnivores ($6.8 \pm 6.4\%$). Fish feeding observations during the study indicated that herbivorous and carnivorous species were dominant in the study area. The herbivorous assemblage was dominated by four species of damselfishes (*Abudefduf vaigiensis*, *Chrysiptera brownriggii*, *Pomacentrus chrysurus*, *Abudefduf sordidus*) and five species of surgeonfishes (*Acanthurus bleucosternon*, *Acanthurus lineatus*, *Acanthurus triostegus*, *Acanthurus nigricauda*, *Ctenochaetus striatus*). The percent abundance percentage of herbivorous fish families was highest during the evening ($55.1 \pm 11.3\%$) compared to the morning ($48.3 \pm 11.4\%$) and the afternoon ($52.1 \pm 11\%$). Statistical comparison (two sample t-test) showed that, there was no significant difference in abundance between time periods ($p > 0.05$). The carnivorous assemblage was dominated by twelve species of wrasses (*Halichoeres hortulanus*, *Halichoeres marginatus*, *Halichoeres nebulosus*, *Halichoeres scapularis*, *Halichoeres vroliki*, *Thalassoma hardwicke*, *Thalassoma janseni*, *Thalassoma lunare*, *Stethojulis trilineata*, *Labroides dimidiatus*, *Gomphosus caeruleus*) and four species of butterflyfishes (*Chaetodon auriga*, *Chaetodon collare*, *Chaetodon decussatus*, *Chaetodon citrinellus*). The percent abundance percentage of carnivorous fish families were higher during the morning ($34.9 \pm 3.8\%$) compared with the afternoon ($29.9 \pm 4.2\%$) and the evening ($27.6 \pm 5\%$) but showed no significant difference (Two sample t-test, $p > 0.05$). This study suggest that more detailed studies are necessary to find out the connectivity of reef fish to food web function in a coral reef.

Keywords: coral reef fish, feeding type, food web, natural mesocosm

Management Perspectives of Carbon Footprint Minimizing: Case of Rubber Products Manufacturing SMEs in Sri Lanka

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ABSTRACT: *Considering the global warming effect due to excessive caused by the increased levels of anthropogenic greenhouse gas emissions in the atmosphere, it is necessary to protect the natural environment for preservation and organism conservation purposes. As a result it is essential to take up carbon footprint mitigation measures during industrial processes and consumption stages. Available literature reveals that, there are many methods introduced to mitigate carbon footprint and the SMEs have still not considered implementing measures to mitigate carbon footprint. The main purpose of this study is to analyze factors influencing Management Perspective in Rubber Products in Sri Lanka as a carbon footprint minimization measure. To carry out management perspectives of carbon footprint minimizing, data were collected from 100 rubber products manufacturing SMEs in the Western Province of Sri Lanka. Apart from this exercise, 10 face-to-face interviews were conducted with the industry experts to ascertain their opinion regarding carbon footprint mitigation measure. The primary data gathered were analyzed to compare barriers for implementing carbon footprint reduction and management perspectives towards carbon footprint reduction. There are several findings in this research: namely, relationships between management perspectives for carbon footprint minimizing and use of 3R, worker awareness, management motivation, certification as ISO, GRI application, maintenance of machinery, awareness on energy cost reduction, access to finance, carbon labeling, and use of cleaner production techniques. These findings were obtained by the application of the cause-effect model of fishbone model. Unfailingly, these findings can be used in any country to minimize carbon footprint.*

Keywords: *Carbon Footprint Minimizing, Management Perspectives, Small and Medium Scale Enterprises*

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Growth And Yield Performance of Sri Lankan Grown Sesame/Thala (*Sesamum indicum* L.) and Its Wild Relatives to Water Deficit Conditions

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ABSTRACT: *The agriculture sector is often challenged by dry weather and subsequent threats to food security and well-being of rural communities. Hence, a better understanding of growth responses of crops to changes in climate is imperative.*

This research was aimed to reveal responses of Sri Lankan grown Sesame varieties: Uma, Malee, Idal, Pokuru, Kalu thala, wild varieties and its wild relatives to reduced water availability during their growth and reproductive stages.

A field experiment was conducted at the Field Crops Research and Development Institute, Mahailuppallama to simulate the effect of drought on growth of Sesame plants, using four different irrigation intervals (4, 7, 10 and 13 days) following establishment of seedlings of 10 Sesame varieties/ races. The main plots and subplots were randomly allocated for each treatment and variety respectively and the experiment was conducted according to split plot design with three replicates / treatment. Plant height was measured at the first, second months and maturity, total dry biomass, of shoots and roots, root: shoot were calculated. Yield parameters: number of capsules per plant, capsule dry weight, seed dry weight and 1000 seed weight were also measured. Yield per area and harvest index (HI) were calculated. Data were subjected to ANOVA using, Statistical Analysis System (SAS). The effect of irrigation intervals had a significant effect on Plant height at maturity ($p < 0.01$) as the low water availability suppressed plant height. A significant positive impact on logarithm of root: shoot ($p < 0.01$) was observed. However, yield parameters and HI did not change among treatments. The crop showed a greater plasticity in vegetative growth in response to the simulated water stress levels. A significant varietal effect was also observed. Wild relatives showed a slow growth during first two months and significantly low values for yield parameters and HI while a significantly high HI was recorded from Uma, Malee, Idal, and Kalu thala.

The findings explained the drought tolerance ability of Sri Lankan Sesame varieties and wild relatives.

Keywords: *Drought tolerant ability, Growth and Yield of Sesame, Sri Lankan Sesame varieties, Water deficit conditions*

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Performance Evaluation of the Biological Unit in Polishing the Effluent at Unilever Ceylon (Ltd) Treatment Plant

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ABSTRACT: A research study was carried out by me to evaluate the performance of the biological unit (Activated Sludge) of the treatment plant (ETP) at Unilever Ceylon Ltd, involved in the manufacture, marketing and distribution of personnel goods and goods. The ETP consists of physical, chemical and biological units and it treats the waste water generated from various plants of factory. It operates 24 hours a day. Although there are some problems during the operational stage, the results indicate that the system is operating quite efficiently with respect to COD and BOD removals and also the concentrations of the above in the treated effluent meet the standards stipulated by the Central Environmental Authority (CEA). Also this research study indicates that the plant can assimilate considerable high shock loads of the above pollutants without significant treatment failure. Based on the study, it is concluded that, Dissolved Oxygen (DO) concentration is extremely low in aeration tank. Nitrogen availability in the aeration tank is not quite sufficient for cell synthesis. Low food to Micro- Organism Ratio (F/M) values due to high mixed liquor concentration in the aeration tank etc. Accordingly remedial measures have been recommended as follows. Install a closed loop control system in PH adjustment and chemical dosing in the process. Increase the Dissolved Oxygen level in the aeration tank. Feed nutrients as required by the ratio BOD₅: N: P=100:5:1. Main Mixed Liquor Suspended Solid (MLSS) concentration in the range of 3000 to 4500mg/l etc.

Keywords: activated sludge, biological unit, dissolved oxygen, F/M ratio, mixed liquor suspended solids, nitrogen availability,

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Life Cycle Assessment of Tea Manufacturing in Sri Lanka

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ABSTRACT: Tea industry is one of the main foreign currency earners in Sri Lanka. Current tea production and export amount is nearly 350 million kilograms annually. Tea plantation sector was started by British planters in late 18th century. Currently it was developed to 230 thousand hectares out of total plantation sector in Sri Lanka. Tea plantation and processing have different impacts to the environment. Soil erosion, use of chemical fertilizers, significant energy usage is the main issues related to the production. There are studies which were conducted to find the impacts on environment, by taking some stages in to consideration. But a complete study of existing and potential impacts covering all stages of manufacturing of black tea was not done. This study aims to carry out a Life Cycle Assessment (LCA) covering all stages in black tea manufacturing based on ISO 14044 guidelines; from cultivation to reaching them to local consumer. The factories and the plantations taken in to account in this study are located in Nuwaraeliya district. In this study, the CTC tea processing method was considered as the main manufacturing method. The impact assessments were carried out with the assistance of commercial software; simapro, aiming GHG emissions to the atmosphere. The impact assessment protocols used in the study are Eco-indicator 99 (H), Ecological scarcity-method-2013, Greenhouse Gas Protocol V1.01. The impact categories evaluated using the software are, Global Warming, Ozone Layer Depletion, Land Use, Carcinogenic effects etc. Based on the outcomes; that the electricity used in the manufacturing process is the highest contributor to the considered environmental impacts. Among the electricity required process steps, the rolling process contributes 39% of CO₂ emission to the atmosphere where the 38% emission is due to withering process. Fertilizer usage in the plantations is the next significant impact to the biosphere. These results can be used to reduce the GHG emission and hazardous discharges to the environment and to convert the industry greener in future.

Keywords: Life Cycle Assessment, Tea Industry, Impact Categories, GHG emission

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Identification of Potential Sites for Aquaculture using GIS integrated AHP (Analytical Hierarchy Process) in Badulla District, Sri Lanka

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ABSTRACT: *This paper discusses the application of Geographic Information System in identifying potential areas for aquaculture in Badulla district. Aquaculture is farming aquatic organisms including fish, mollusks, crustaceans and aquatic plants. There is a potential to develop aquaculture practices in Badulla district. Selection of potential site is the first and foremost step for successful aquaculture practice. The study was carried out in Badulla district in Sri Lanka by the geographical coordinates of longitude 80°45 to 81°15. Latitude 6 °.34 to 7°18. In this study environmental factors related to aquaculture practices were considered. Data have been collected from secondary sources. Water availability (proximity to rivers and perennial tanks), soil texture, soil pH, rainfall, temperature, topography (slope, elevation) and land use factors were considered to identify potential areas for aquaculture (pond culture). Protected areas were considered as constraints. Water availability, soil texture, soil pH, slope, elevation, rainfall, temperature, land use/ land cover thematic layers were created using ArcGIS 10.1 software. All these thematic layers have been assigned the weights according to their relative influence on pond construction using Analytic Hierarchy Process and GIS approach. The use of Analytic Hierarchy Process and GIS is described; each thematic layer was evaluated using the scores that were obtained according to the weighted linear combination. Finally all thematic layers have been integrated in an ArcGIS 10.1 environment to generate an aquaculture potential map. Four aquaculture potential areas have been Identified, viz. "Suitable", "Less Suitable", "Least suitable" and "Exclusionary Areas". The north part of the Badulla district is identified as suitable and the southern part of the Badulla district is identified as least suitable, exclusionary areas for aquaculture in Badulla district. By using this aquaculture potential map, users able to identify a location to establish aquaculture practices. It helps decision makers to develop aquaculture practices in Badulla district.*

Keywords: *Analytic Hierarchy Process, Aquaculture, Environmental factors, Geographic Information System, Weighted linear combination*

Traffic Noise Contour Mapping in Weligama City - Sri Lanka

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ABSTRACT: *An unwanted unpleasant sound is called noise. Noise pollution is one of the major environmental problems in many cities with the rapid urbanization. Therefore, a systematic study on city noise pollution is essential to control the situation. The noise emitted from different sources can be mapped quantitatively on to a single map, is called "noise zone map". Noise contour maps play a major role in planning, tourism, leisure, transportation, investment and other developments in cities. These maps have been used in Environment Impact Assessments (EIA) and they provide a great remark of well-being of future generation in the country.*

The main objective of this study was to map the noise distribution in Weligama city which is a popular destination among tourists and investors. Noise measurements were carried out using a B&K Type-2250 hand held analyzer (IEC 61672-1; 2002 Class1) in December, 2013. L_{Aeq} values of the diurnal sound level variation were used to produce noise contours. Internationally recommended IMMI mapping software was used to calculate the noise distribution and to prepare the noise map. The traffic volume, vehicular type, their speed, nature of road surface and meteorological conditions were considered. According to the results, the noise level in Weligama city is exceeding the maximum allowed level for a mixed-residential area (According to Sri Lanka National Environment Act. No. 47, 1980, maximum allowed level for mixed-residential area is 63 dB(A) in day time) in 40.7±5.7 % of the total area of 49.07 km². The densely populated area in the city lies within the noise contours of 70-80 dB(A). At some locations the recorded L_{Aeq} was more than 85 dB(A), especially near at main bus stand and surround area. Noise contour varies between 75-80 dB(A) along the A2 road. The results suggest that necessary regulations and noise reduction techniques have to be imposed to control the noise pollution and to protect the economic value of the city.

Keywords: *L_{Aeq} , Noise contour map, Noise mitigation, Traffic noise, Weligama city*

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Sand Mining in Kanagarayan Aru, Mullaithivu District, Sri Lanka – Post War Development Perspective

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ABSTRACT: *Post War development activities have been taking place in many sectors in the Mullaithivu district. Construction of houses, roads, schools, government departments and other buildup land uses are rapidly changing after war. One of the important building materials for construction is river sand. In-stream sand mining is a common practice because the mining locations are usually near the sales outlets or along the transportation route, hence reducing the transportation cost. This has resulted in a mushrooming of river sand mining activities which have given rise to various environmental problems that require urgent action by the authorities. This paper describes the environmental problems due to unsystematic river sand mining activities in natural tributaries of Kanagarayan Aru (river) in Panikkankulam Forest, Oddusuddan divisional secretariat division, Mullaithivu district and outlines the best management practices in order to minimize the adverse environmental impacts. Kanagarayan Aru originates in Semamadukkulam, Vavuniya district and run towards north, mix in a place of Elephant pass East lagoon nearby Thadduwankoddi and Ooyian in Kilinochchi district. This river is 90 Kilometers long & has a catchment area of 906 square kilometers. Recently due to post war development sand is hugely excavated in the Kanagarayan Aru. These sand mining activities have been taking place without a sustainable environmental conservation plan. The natural resources have been deteriorating rapidly in the Kanagarayan Aru. These unsystematic sand mining activities has led to loss of fauna & flora, river bank erosion, river bed degradation, river buffer zone encroachment and deterioration of river water quality and groundwater availability. It is difficult to totally ban sand mining practices in Kanagarayan Aru, because many people living near the river are totally dependent on this job, and also there should be an alternative material for the construction sector. Given the importance of post war development in this area and the concerns on the environment, systematic sand mining approach is deemed to be the utmost importance for sustainable environmental conservation. The recommendations made in this paper are intended as guidance for decision makers who are specifically involved in the review of sand mining operations to make more informed decisions. Some of these recommendations are establish a district level management committee to control River Sand Mining activities, Establish a mechanism to observe and follow up whether permit procedure is efficient and controlled, Raise public awareness and strengthen community organizations to combat illegal River Sand Mining activities, Enforce law in an efficient and unbiased way and Restore damaged and affected natural environment using natural barriers such as tree plantations.*

Keywords: *Sand Mining, Environmental Impacts, Sustainable Environmental Conservation Plan*

Antibiotic Resistant Phosphate Solubilizing Bacteria

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ABSTRACT: *Phosphate solubilizing bacterial strains were isolated and were tested for antibiotic resistance using six antibiotics namely kanamycin, streptomycin, ampiciline, tetracycline, rifampicin and chloramphenicol. Out of thirty five phosphate solubilizing isolates, Klebsiella oxytoca and Enterobacter ludwigii were found to be highly tolerant to varying concentrations of all the tested antibiotics except chloramphenicol. According to the results, both strains were resistant for kanamycin, streptomycin, ampiciline, tetracycline and rifampicin up to 100, 200, 500, 100 and 100 µg/ml concentrations respectively. However, both strains were sensitive to chloramphenicol by producing large inhibition zone (17-20 mm diameter) even at 100 µg/ml. These antibiotic resistant strains as bio-inoculants would have attractive beneficial impacts on sustainable agricultural practices in contaminated soils.*

Keywords: *Antibiotics, Enterobacter ludwigii, Klebsiella oxytoca, resistant, sensitive*

Low Cost Mosquito Larvae Trap to Control Dengue

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ABSTRACT: *Dengue epidemic has become a severe threat in the country from past 2 decades. However, still a successful solution has not sought in this regard. Though destroying breeding places is considered as a solution, it results in mosquitoes finding alternative places for breeding, which in turn makes Dengue control difficult. Not only the density of Aedes Genera but also other mosquito species densities are increasing day by day which has become a major detriment to businesses and day today life of humans. This mosquito trap is introduced as a successful solution for mosquito epidemic elimination and Dengue control.*

This is a 7 inch high cylindrical shaped container with a cross sectional diameter of 7 inches. A plastic funnel is placed upside down on the cylindrical shaped water basin and two levers are fixed to the neck of the funnel using supports to make water currents. Water was poured in to the basin and to the water containing inside the funnel, kerosene oil was added. The end of the funnel was covered with a small lid to prevent kerosene from evaporating. A small piercing was made on the basin to remove the excess water. Finally, the basin was covered with a wire mesh. To another cylindrical container with a lid containing a small hole, hay with water was added to attract the mosquitoes and placed close to the trap. The mosquito larvae trap attracts mosquitoes by providing optimal conditions to lay their eggs. The larvae emerge from the eggs hatched inside the trap and die without becoming pupae within few minutes. All the mosquito larvae emerging from the eggs die inside the trap by averting the creation of new mosquito generation and after about two months adult mosquitos die due to aging. Therefore, using this method will eliminate mosquito menace which will eventually help to become a healthy environment. As no other organism is affected except mosquitos and no other use of environmental harmful pesticides, this is an eco-friendly mosquito suppression method. As there is no need for maintenance or observance of this mosquito trap, this is a very successful time and energy saving mosquito suppression method for general public.

Keywords: *Dengue, mosquitoes, trap*