area. The main objectives of this study were to identify these governing factors and ways to overcome constraints in implementing a IWMS successfully in the country.

For this case study 135 households (HH) representing high, medium, and low income categories were selected from 3 LAs in the DS and field surveys were conducted for a period of three months. These households were given 3 bags of different colors once a week and householders were requested to separate the waste into different types and collect separately once a week. Waste collected on the other days was given to the municipal collectors. This sorted waste was measured to assess participation. The willingness to engage in an ISWM program was gauged through questionnaire surveys asking for their willingness and also by actually monitoring their continuous participation in the solid waste sorting exercise throughout the study period. A second questionnaire survey was conducted on the same group of people to assess whether their response has changed after actually engaging in the ISWM exercise. In addition surveys were also conducted to assess the Duties and Responsibilities of LAs with regard to SWM, Practices of 3R (Reduce, Recycle, Re-use) systems by LAs and HHs, final disposal mechanisms and Public awareness and attitudes towards issues related to SWM etc. Interviews were held with LA officials also for these information. The study revealed that the dominant SWM problems in the LAs are, lack of suitable land for final disposal, lack of public participation and cooperation, among others.

The questionnaire survey conducted at the beginning of the study revealed that willingness to sort out SW was found to be 98.33%. However after the three month period it was found that only 86.6% have participated in the actual sorting out and the second survey has shown the response to be 87.39% for willingness to sort. At the beginning willingness to Re-use or Recycle of SW was 77.69%. Statistical analysis showed that this factor is related to the chief occupants educational level, Income and the service provided by LAs. 53.3 % participants have indicated willingness to compost if a compost bin is provided whereas only 19.17% have indicated willingness to compost if a bin is not provided. In addition it was revealed that only 28.7% of the participants are willing to make an additional payment for a better service and only 52.63 are willing to assist the local authority resolve SW problems in the LA. The waste generation quantity data which were statistically analyzed showed that waste generation depends significantly on the income levels and the locality. According to the results it can be concluded that ISWM involves a wide variety of tasks, involving both individual and team work. Since factors such as education level, income level also govern participation in an ISWM program a common practice cannot be targeted for all. Specific programs should be developed for different neighborhoods and targeted awareness creation is compulsory.

058

Lichens as biomonitors of sulphur dioxide and nitrogen dioxide pollution in Colombo and suburbs

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Biological monitoring is an efficient and inexpensive method for monitoring air quality. Studies have confirmed that lichens are among the most reliable accumulators of airborne inorganic contaminants. As limited research has been done in tropics with regard to biological monitoring, a study was carried out to monitor lichen diversity and distribution in selected locations in Colombo and its suburbs.

Thirty one sites located on six radial transects diverging from Colombo Fort were selected for this study. Eight trees from three trees species, (*Cocos nucifera*, *Mangifera indica*, and *Artocarpus heterophyllus*) within each site (1km^2) were chosen for the study. Coverage and frequency of corticolous all lichens found on selected trees were recorded by using 250 cm^2 grids. After studying their morphology, anatomy, reproductive structures and chemistry, lichens collected were identified using keys. In addition, land use pattern, traffic density, pH of substrates, exposure levels of these sites to light were also recorded. Ambient SO_2 and NO_2 levels at each site were determined using passive samplers having filter pads coated with the absorbing reagents, ethylene glycol and acetone, for SO_2 and NaI, NaOH and Ethylene glycol for NO_2. Data were statistically analyzed by using the mean comparison, correlation and by principal component analysis to investigate relationship between diversity of lichens and environmental parameters.

Forty seven genera of lichens were identified, out of them ten genera are sensitive to air pollutants. The highest atmospheric SO_2 and NO_2 levels (48.35μg/m^3 and 42.825μg/m^3) as well as the lowest lichen diversity (0.8374) were recorded from the site located in Colombo Fort. When land use pattern changed from village to urban and with increase of traffic density of sites, diversity of lichens reduced significantly. The relationship between diversity of lichens and levels of SO_2 and NO_2 was negatively correlated but significant only with levels of NO_2. Further, a significant negative correlation was found between the pH of substrates and levels of SO_2 and NO_2. Principal component analysis revealed that principal component 1(PC1), PC2 and PC3 explain 38%, 20% and 15% of the total variation in the data set respectively. Biplot developed by PC1 vs PC2 revealed that low lichen diversity class is clearly separated from other classes due to increased concentrations of SO_2, NO_2 land use pattern and the traffic density, all of which are included in PC1. Bark pH values of *Cocos nucifera* and *Artocarpus heterophyllus* that are represented by PC2 also had contributed to above grouping. Index of atmospheric purity (IAP) values increased along all transect with gradual decrease of SO_2 and NO_2 levels when moving away from the city.

Absence of several pollutant sensitive tropical lichens and decrease of lichen diversity in sites with high levels of SO_2 and NO_2, indicate that tropical lichens have the potential to be used as indicators in air pollution monitoring work.

059

Emission factors for selected PAHs and carbonyl compounds from locally available mosquito coils and joss stick brands

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In recent years, numerous investigations have revealed that indoor air pollution has a subtle chemistry which produces a range of pollutants. Combustion sources (some of which can be eradicated from indoors) have become the major contributor to the indoor air pollution and the pollutants emanating from these sources can poses serious health threats. Two of the combustion sources which can be eliminated from indoor settings, burning mosquito coils and joss sticks, were investigated in this study with the emphasis on the emissions of the carbonyl compounds and polycyclic aromatic hydrocarbons [PAHs].

Both carbonyl compounds and PAHs are known health hazards which are ubiquitous in the indoors due to incomplete combustion of organic compounds as well as due to the off gassing from consumer products. Poor air circulations entrap the pollutants indoors elevating the exposure and hence the health risks.Seven mosquito coil brands (locally made) and eight joss stick brands (both locally and Indian made) were burned in a laboratory setting simulating the indoor conditions. All the smoke emanating from the combustion source was passed through a prototype sampler. The volatile carbonyl compounds were derivatized to non-volatile 2,4-dinitrophenyl hydrazones and PAHs were collected separately using methanol. The hydrazone derivatives of the carbonyl compounds and the PAHs were separated individually using reversed-phase HPLC and quantified using UV and fluorescence detectors respectively.

The average emission factors for mosquito coils were 266 $\pm$ 114 μg g^{-1}(formaldehyde), 94 $\pm$ 37 μg g^{-1} (acetaldehyde) and 67 $\pm$ 13 μg g^{-1} (acetone) compared to that of joss sticks 127 $\pm$ 18 μg g^{-1}(formaldehyde), 38 $\pm$ 11 μg g^{-1} (acetaldehyde) and 38 $\pm$ 11 μg g^{-1} (acetone). The levels of acrolein, crotonaldehyde and propanaldehyde were very low and they could not be quantified with significant accuracy and precision.

The emission factors for naphthalene, acenapthene, acenapthylene, fluorine, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene and benzo[a]pyrene were 6.33 $\pm$ 1.00 , 9.45 $\pm$ 1.04, 2.44 $\pm$ 0.47, 6.54 $\pm$ 0.54, 9.07 $\pm$ 0.55, 3.96 $\pm$ 0.98, 4.63 $\pm$ 0.44, 0.64 $\pm$ 0.17, 1.52 $\pm$ 0.42, 2.67 $\pm$ 0.66, 0.25 $\pm$ 0.08, 0.21 $\pm$ 0.05 and 0.17 $\pm$ 0.15 μg g^{-1} respectively for mosquito coils and the emission factors of joss sticks for the same compounds were 5.33 $\pm$ 0.94, 7.80 $\pm$ 0.95, 2.14 $\pm$ 1.14, 4.25 $\pm$ 1.04, 4.79 $\pm$ 0.66, 3.53 $\pm$ 0.42, 5.04 $\pm$ 0.99, 0.44 $\pm$ 0.12, 1.14 $\pm$ 0.17, 1.63 $\pm$ 0.63, 0.18 $\pm$ 0.04, 0.23 $\pm$ 0.15 and 0.15 $\pm$.06 μg g^{-1} respectively.