Editors:
Prof. Marius Otesteanu, Politehnica University of Timisoara, Romania
Prof. Selma Celikyay, Zonguldak Karaelmas University, Turkey
Prof. Nikos Mastorakis, Military Institutes of Univ. Education (ASEI), HNA, Greece
Prof. Simona Lache, University Transilvania of Brasov, Romania
Prof. F.-K. Benra, University of Duisburg-Essen, Germany

ENVIRONMENTAL SCIENCE, ECOSYSTEMS & DEVELOPMENT

Published by WSEAS Press
www.wseas.org

Proceedings of the 5th WSEAS Int. Conf. on
ENVIRONMENT, ECOSYSTEMS and DEVELOPMENT (EED '07)

Energy and Environmental Engineering Series
A Series of Reference Books and Textbooks

Puerto De La Cruz, Tenerife, Canary Islands, Spain,
December 14-16, 2007

ISBN: 978-960-6766-20-6
ISSN: 1790-5095

Isa Yunusa
2007

WSEAS

ENVIRONMENTAL SCIENCE, ECOSYSTEMS & DEVELOPMENT

Proceedings of the 5th WSEAS International Conference on ENVIRONMENT, ECOSYSTEMS and DEVELOPMENT (EED'07)

Puerto De La Cruz, Tenerife, Canary Islands, Spain
December 14-16, 2007

ENVIRONMENTAL SCIENCE, ECOSYSTEMS & DEVELOPMENT

Proceedings of the 5th WSEAS International Conference on ENVIRONMENT, ECOSYSTEMS and DEVELOPMENT (EED'07)

Energy and Environmental Engineering Series
A Series of Reference Books and Textbooks

Published by WSEAS Press
www.wseas.org

All papers of the present volume were peer reviewed by two independent reviewers. Acceptance was granted when both reviewers' recommendations were positive.
See also: http://www.worldses.org/review/index.html

ISSN: 1790-5095
ISBN: 978-960-6766-20-6

WSEAS
World Scientific and Engineering Academy and Society

Isa Yunus
2007

Editors:

Prof. Marius Otesteanu, Politehnica University of Timisoara, Romania
Prof. Selma Celikyay, Zonguldak Karaelmas University, Turkey
Prof. Nikos Mastorakis, Military Institutes of Univ. Education (ASEI), HNA, Greece
Prof. Simona Lache, University Transilvania of Brasov, Romania
Prof. F.-K. Benra, University of Duisburg-Essen, GermanyProfessor Dr. Selma Celikyay, Zonguldak

Scientific Committee:

M. Cristina Amezquita, COLOMBIA Joanna Boguniewicz, POLAND Zbigniew Bzowski, POLAND Roberto De Lotto, ITALY John Gelegenis, GREECE Carlo Giaconia, ITALY Anastasia Giannakoula, GREECE Valentina Golubeva, RUSSIA Volker C. Hammen, GERMANY Alice Hatzopoulou, GREECE Chih-Hong Huang, TAIWAN Alexander Iomin, ISRAEL Kamaruzaman Jusoff, MALAYSIA Alexander Kantartzis, GREECE Christos Karydas, GREECE Fotini Kehagia, GREECE Selma Celikyay, TURKEY Reza Khoshraftar, IRAN Chockalingam Letchumanan, MALAYSIA	Pablo Lopez, SPAIN Ion Melinte, ROMANIA Homayoun Moghimi, IRAN Jitka Mohelnikova, CZECH REPUBLIC Jose Navar, MEXICO Agelos Papaioannou, GREECE Daniela Rosca, ROMANIA Radu Rugescu, UNITED STATES Roberto San Jose, SPAIN Masoomeh Sohrabi-Mollayosefi, IRAN Filippos Vallianatos, GREECE Bram Van Putten, the NETHERLANDS Mark Van Wijk, the NETHERLANDS Shahab Varkouhi, IRAN Surendra P. Verma, MEXICO Rong Wang, SINGAPORE Shih-Hung Yang, TAIWAN Dimitrios Yfantis, GREECE

Preface

The book you are currently holding contains the Proceedings of the 5th WSEAS Int. Conf. on ENVIRONMENT, ECOSYSTEMS and DEVELOPMENT (EED'07) which was held in Puerto De La Cruz, Tenerife, Canary Islands, Spain, December 14-16, 2007

Environmental Science and Engineering as well as Environmental Policy is now of fundamental importance to our civilization. Several problems have now become major political issues and the subject of international debate and regulation. It is for this reason that there is a need for conferences dedicated to energy and environment issues. Environment, Ecosystems and Development is an interdisciplinary conference aimed at natural scientists, technologists and the international social science and policy communities covering the direct and indirect environmental impacts of environment, ecology and ecosystems, sustainable development, cultural heritage, energy acquisition, transport, production and use, natural hazards, water resources management and so on.

The Plenary Speech of EED'07 was:

Natural Rain – Analysis, Modeling, Simulation

Professor Marius Otesteanu
Politehnica University of Timisoara, Romania
Dean of the Faculty of Electronics and Telecommunications

Abstract:
NATURAL RAIN. Sprinkle equipment is used to generate water drops for fire protection, for irrigation or for functional and reliability tests of different systems designed for outdoor use. Neither of this known equipment generates patterns of drops according to natural (real) rain.
But other applications need detailed tests in atmospheric conditions, with controlled parameters, among which natural rain is one of the most important.
For such applications, a rain simulator (generator) with natural parameters, in a controlled environment, has to be developed. To achieve such equipment, next steps must be fulfilled.
RAIN ANALYSIS. In order to classify different types of rain, rain parameters have to be understood, defined and measured. Meteorological definition, limited to rain intensity (water quantity / m2 / time), is not enough to correctly classify rain types. Technical definition uses a set of measurable parameters (number of drops / m2 / time, drops size, drops velocity, etc), which allows precise classification of rain types. The rain analysis is based on measuring methods and equipment. The paper presents rain classification criteria and, based on large amount of collected data, answers the questions:
• Is rain intensity uniformly distributed in space ? and time?
• Is the rain drops diameter constant for each type of rain ?
• What relationships are between rain intensity, drops diameter and drops velocity ?
RAIN MODELING. Several sets of parameter recording where used to select appropriate rain models. The model must match the natural rain behavior, so real rain parameters distribution where compared with computed values.

The paper presents additional requirements, imposed to a rain simulator (as desired velocity of the rain drops).
RAIN SIMULATION. Different devices (nozzles, sprinklers) where tested and selected, to simulate (generate) each type of natural rain, according to the real set of parameters.
Based on defined parameters for each type of rain and on selected rain generation devices, the design and development of a rain simulator can be started.
RAIN SIMULATOR. The paper compares different rain simulators, according to their target application and presents solutions for generating fog, drizzle, light rain, heavy rain, etc.
A complex system, based on mechanical, hydrodynamic and intelligent electronic blocks, controlled by software, is proposed to create a controlled rainy environment, able to simulate natural rain, with all its measurable parameters.

Brief Biography of the Presenter:
Prof. Marius Otesteanu obtained the Diploma of engineer – with honors, in 1978, and the Ph.D., in 1983, both in electronics, at the Politehnica University in Timisoara, Romania. From 1978 to 1982 he was with AEM Timisoara company (Electronic Measuring Equipment) as R&D engineer. Starting with 1982 he is with Politehnica University in Timisoara.
Specialized at Texas Instruments in Freising, Germany (1993, 1994) as third party consultant in digital signal processors for T.I. Visiting professor at University of South-Carolina in Columbia, U,S,A (1995-1996), at University of Central Lancashire in Preston, England (1997), at Polytechnic Institute in Oulu, Finland (1998), at Institute of Technology in Nice, France (2001), at Technical University in Ostrava, Czech Republic (2007) and at Czech Technical University in Prague (2007). Invited professor at University of Technology in Bocholt, Germany (1999, 2000) and at University of Technology in Gelsenkirchen, Germany (2006).
His scientific interest is in real time systems and in image compression. He wrote 12 books, he published 73 articles, he has 9 patents and he was involved in 18 R&D contracts.
He was organizer and chairman of the Special Session Intelligent Systems and Adaptive Control, at the WSEAS International Conference on Dynamical Systems and Control (CONTROL '05), Venice, Italy, 2005. He was chairman of the 7th International Symposium on Electronics and Telecommunications (ETc'06), Timisoara, Romania, 2006, co-chair of the 2nd WSEAS International Conference on Dynamical Systems and Control (CONTROL '06), Bucharest, Romania, 2006, and co-chair of the 8th WSEAS International Conference on Mathematical Methods and Computational Techniques in Electrical Engineering (MMACTEE '06), Bucharest, Romania, 2006. He has co-editor of Proceedings of WSEAS International Conferences CONTROL '05, CONTROL '06, MMACTEE '06.

We would like to thank all members of the organizing laboratories for their contribution to the organization of the conference.
The contents of this Book are also published in the CD-ROM Proceedings of the Conference. Both will be sent to the WSEAS collaborating indices after the conference: www.worldses.org/indexes.

In addition, papers of this book are permanently available to all the scientific community via the WSEAS E-Library.

Expanded and enhanced versions of papers published in these conference proceedings are also going to be considered for possible publication in one of the WSEAS journals that participate in the major International Scientific Indices (Elsevier, Scopus, EI, Compendex, INSPEC, CSA .... see: www.worldses.org/indexes) these papers must be of high-quality (break-through work) and a new round of a very strict review will follow. (No additional fee will be required for the publication of the extended version in a journal).

We cordially thank all the people of WSEAS for their efforts to maintain the high scientific level of conferences, proceedings and journals.

The Editors

Proceedings of the 5th WSEAS International Conference on ENVIRONMENT, ECOSYSTEMS and DEVELOPMENT (EED'07)

TABLE OF CONTENTS

Evaluation Method of Ecological Environment Vulnerability and its Application 1
Dongjie Guan, Baoshan Hu, Weijun Gao

Mathematical Model for Diffusion- Sorption Processes in Layered Strata with Interlayers 7
Solvita Kostjukova, Andris Buikis

Limit Analysis of Stability of Circular Foundation Pit 13
Cui Xinzhuang, Yao Zhanyong, Jin Qing, Wu Shimei

Cross Section Strength Calculation of Partial Bonded Prestress Concrete Beam on Dynamic Loading 19
Fengze Hou, Yanzhao Li

Direct Mesh Method of Sewer Networks Optimal Design Based on Topography-Geomorphic 24
Yu-Zhou Sima, Yuan-Ming Yang, Bing Zhao, Jian-Sheng Guo

Formal Description and Modeling Topological Relations in 3D Based on Dimension-Extended and Euler-Poincare Characteristics 29
Nian Dong Deng, En Ke Hou, Zhi Hua Zhang, Jun Hua Guo

Study on 3D Mine Tunnel Modeling 34
Zhi Hua Zhang, En Ke Hou, Nian Dong Deng, Jun Hua Guo

Linear Instability of Wake-Shear Layers in Shallow Water 40
I. Volodko, V. Koliskina

On Active Filtering of Harmonics Pollution -Theoretical Aspects 45
Vladimir Rasvan, Dan Popescu

Structural Identifiability of some Biotechnological Systems 49
Dorin Sendrescu, Emil Petre, Eugen Bobasu

Heat Transfer Enhancement in Swirl Annulus Flows 55
Ali M. Jawarneh

Mathematical Modeling and Simulation of Automotive Internal Combustion Engine 61
I. H. Kazmi, Q. R Butt, S. I. A. Tirmizi, A. I. Bhatti

Study on the Maximum Thickness of Superposition Throttle Slices of Shock Absorber 68
Changcheng Zhou, Zhiyun Zheng

Experimental Research on Hysteretic Behavior of Top-Seat and Web Angles Connections 74
Xinwu Wang

Experimental Research and Finite Element Analysis on Behavior of Steel Frame with Semi-Rigid Connections 79
Xinwu Wang

Influence on the Dynamic Characteristic of Non-Bonded Prestressed Concrete Beam by Initial Effective Prestress 84
Fengze Hou, Yanzhao Li

Diesel Engine Emission Improvements by the Use of EGM-DMC-Diesel Blends Fuel 89
Yanxia Wang, Yongqi Liu

Methane Mitigation by Thermal Oxidation in a Reverse Flow Reactor 94
Ruixiang Liu, Yongqi Liu, Zhenqiang Gao

Optimization of the Operating Parameters of a Reverse Flow Reactor for Methane Thermal Oxidation 99
Ruixiang Liu, Yongqi Liu, Zhenqiang Gao

Modeling Study on a Forward Recursive Construction Approach of Dynamical Equations of Mechanism Systems with Flexible Articulated Joints 103
Yuan-Ming Yang, Bing Zhao, Jiansheng Guo, Chuan-Yao Chen, Tian-Xia Song

Base Resistance of Individual Piles in Pile Group 111
Mohamed M. Shahin

Design and Performance of a Multiple Compressor Solar Ice-maker 116
Petros Axaopoulos, Michael P. Theodoridis

Lean Burn Engine Control for Fuel Economy and Exhaust Aftertreatment 121
Zhengmao Ye, Zhijun Li, Habib Mohamadian

Considerations on Environmental Engineering Education for Sustainable Development in Oltenia Region 127
Adrian Rosca, Daniela Rosca

Ant Colony System vs ArcGIS Network Analyst: The Case of Municipal Solid Waste Collection 133
Nikolaos V. Karadimas, Maria Kolokathi, Gerasimoula Defteraiou, Vassili Loumos

The Evaluation of the Oxycombustion for Power Cycles 140
Gheorghe Dumitrascu

The Study on the Water Budget of Hashtgerd Plain in North West of Tehran, Iran (Kordan Basin) 146
Homayoun Moghimi

Comparison of Actuated and Fixed Traffic Signals in Controlling Air Pollution and Delay at Intersections 153
Mansour Hadji Hosseinlou, Somaye Sadat Azimi

Predicting and Identifying Hot Spots by Applying Neuro- Fuzzy Systems 159
Mansour Hadji Hosseinlou, Mahdi Sohrabi Moshtaghin

Biogeochemistry of Macrophytes in Reservoirs of St.-Petersburg 165
Margarita Ufimtseva, Natalia Terekhina

Models and Indicators for Energy and CO2 Emission Assessment of Electric Chillers and Direct-Fired Absorption Chillers 168
Gianfranco Chicco, Pierluigi Mancarella

Application of Modern Electrochemical Techniques and Electrode Materials in Determination of Trace Elements in Environment 174
Tomas Navratil, Ivana Sestakova

Measuring the Sustainability of Biomass Resources – The Sustainable Biomass Index SBI 180
Stefan Konig, Juergen Sachau

Non-Traditional Metal Electrode Materials in Electrochemical Environmental Analysis of Biologically Active Compounds 186
Bogdan Yosypchuk, Ivana Sestakova

Portugal Wind Energy Situation 191
F. A. Barata, J. C. Quadrado

Energy Saving in a High Insulated House in Iran 196
Reza Srkan Dizaji, Ahadollah A'Zami, Mohammad Hariri

Sustainable Development and Processes Innovation 200
Davorin Kralj, Mirko Markic

Product Responsibility as a Part of Sustainable Development Strategy 206
Davorin Kralj, Maja Skafar, Mirko Markic

Desertification in Crete and the Effect of Global Warming 211
Maria Tsakona, Vassilis Gekas

Design of a New Micro Direct Methanol Fuel Cell Using MEMS Technology 217
Xiuling Ji, Wenzhong Lou

Air Quality Modelling by Kohonen's Neural Networks 221
Vladimir Olej, Petr Hajek, Jiri Krupka, Ilona Obrsalova

Multi Temporal Disaggregation of MODIS Images Using Non-Linear Analysis 227
Hasan Roosta, Rahmatolah Farhoudi, Majid Roosta

A Simple Approach to Estimate the Steady-State Performance of Self-Excited Induction Generator 233
K. S. Sandhu, Dheeraj Joshi

Evaluation of Ecological Preservative Management Using Multi-Stage Decision and FAHP Process in a Mountainous Maoli site, Taiwan 238
Kuei-Yang Wu, Wann-Ming Wey, Wen-Zer Lin

A Framework on Urban Design Strategies for Sustainability of Cultural and Historical Heritage in Urban Landscape 245
Selma Celikyay, Sirin Donmez, Emine Ikiz, Pinar Aydin, Sevgi Gormus Cetinkale, Nurhan Kocan

Major Components of Environmental Protection Process 250
Selma Celikyay, Nazmiye Uzun

Preliminary Thermal and Mineral Water Survey of Nisyros Volcano, Aegean Sea: A Study Targeted Towards Sustainable Development 256
Dimitrios Zouzias, Karen St. Seymour, George Papaioannou

Influence of Atmospheric Pollution on Materials of Culture Heritage. A Physicochemical Study 262
I. Bassiotis, T. Agelakopoulou, S. Margariti, V. Siokos, E. Metaxa, Ch. Karagianni, F. Roubani-Kalantzopoulou

Aerosol Hygroscopic Models Based on in Situ Measurements and Lidar Retrievals 268
Daniela Viviana Vladutescu, Yonghua Wu, Barry Gross, Leona Charles, Fred Moshary, Samir Ahmed

A Study of Forest Structure, Diversity Index and Above-ground Biomass at Tok Bali Mangrove Forest, Kelantan, Malaysia 274
I. Kasawani, J. Kamaruzaman, M. I. Nurun-Nadhirah

The Efficiency of Water Reservoirs at the Region of the Former Lake Karla in Thessaly to Meet Irrigation Requirements 282
P. Lokkas, S. Kotsopoulos, J. Alexiou, G. Gravanis, V. Vassiloglou, S. Magalios, V. Kassos

Methodological Approach for Ground Contamination Assessment and Remediation of Brownfields 288
M. G. Brito, C. N. Costa, D. Vendas

Economic and Environmental Advantages of Using Fly Ash as a Soil Amendment in Agronomy 294
Isa Yunusa, V. Manoharan, Derek Eamus, Greg Skilbeck

Distribution Pattern of Rare Tree Species in Two Virgin Jungle Reserves in Pahang and Johor, Malaysia 303
I. Faridah-Hanum, J. Kamaruzaman, A. Hikmat, A. Latiff

M5 Model Tree for Regional Mean Annual Flood Estimation 311
K. K. Singh

Removal of Ni(II) from Aqueous Solution by Biosorption using two Green Algal Species Oscillatoria sp. & Spirogyra sp. 315
Diwan Singh

Reducing Risks of Power Plants Development 320
Anna Lampridou, Konstantinos Kirytopoulos

Some Problems in Water Vapor Tomography 326
Peep Miidla, Kalev Rannat, Peep Uba

A Hydrologic-Hydraulic Method to Define of Ecological Flows Downstream Dams Located in South European Semi-Arid Regions 334
Maria Manuela Portela

Variation in Air Pollution Tolerance Index of Plants near a Steel Factory: Implications for Landscape-Plant Species Selection for Industrial Areas 340
Yanju Liu, Hui Ding

Telerobotics – Control over the Internet 346
Ionut Resceanu, Marius Niculescu

Multivariate Statistical Interpretation of Physical, Chemical and Microbiological Data of Potable Water in the Context of Public Health 352
A. Papaioannou, K. Kakavas, P. Plageras, A. Minas, Z. Roupa, A. G. Paliatsos, P. T. Nastos, A. Minas

Zinc Removal From Aqueous Solutions By Turkish Clinoptilolite 358
H. Inan, E. Yazici, Z. Yigit

Risk Assessment for Redevelopment of Contaminated Land at an Old Industrial Site 363
D. F. Vendas, C. N. Costa, M. G. Brito

Evaluation of Daylighting in Office Buildings 368
L. Doulos, A. Tsangrassoulis, F. V. Topalis

Introduction of Wind Power into a Weak Power System Considering System Fluctuation and Limitation 377
Jeff Huang, Zulati Litifu, Ken Nagasaka

EUCLIMA: The Personal Micro-Clima Concept, as Environmental Policy Redefinition for Modern Cities: Sensor Interfacing, Anti-Pollution Technology and Economic Development Aspects 386
George Topalidis, Emmanouil Katsanos, Pocha Zoi, Margarita Ganatsios, Dimitrios Zissopoulos

Propulsion and Trigeneration by Fuel Cell: an Eco-friendly Camper Van 394
L. Fabiano, G. Florio, P. Fragiacomo

Adaptation of Socio-Ecological Systems in sub-Saharan Africa to Global Environmental Change: ICSU ROA's Strategy 400
Achuo Enow, Sospeter Muhongo

Dense Ocean Floor Network for Mega Thrust Earthquakes and Tsunamis around the Nankai Trough in Southwestern Japan 406
Yoshiyuki Kaneda, Katsuyoshi Kawaguchi, Eiichiro Araki, Hiroyuki Matsumoto, Takeshi Nakamura, Keisuke Ariyoshi, Hinichiro Kamiya, Takane Hori, Toshitaka Baba

Conservation of a Wetland Near a City: A Case Study 410
Maisarah Ali, Amnah Shurfa Binti Mohammed Shukry, Noor Shakilah Bt Mohd Radzi, Kamaruzaman Jusoff

Fibre Shedding from Cotton Spun Yarn -A Serious Indoor Air Pollution in Knitting Industry 419
N. Bhowmick, S. Ghosh

Steady State Modeling of Isolated Induction Generators 425
K. S. Sandhu

Geographical Relations Dynamics (3) - on a Material Basis Vs. on a Monetary Basis - 432
Minoru Ueda

Mangrove Conservation through Community Participation in Pakistan: The Case of Sonmiani Bay 438
Amjad A. Shah, Kamaruzaman Jusoff

Spectral Signatures of Some Mangrove Species in Malaysia 445
J. Kamaruzaman, I. Kasawani

Water as a Design Material in Nine Plans of Le Notre; A Topological Study of Relations Between Ensemble, River and Settlement 455
Martin van den Toorn

Environmental Education and Design; The Role of Landscape Architecture 465
Martin van den Toorn

Air Pollution and Urban Form: Evidence from Satellite Data 477
Julian D. Marshall, Heather Sander, Steven M. Manson

Economic and environmental advantages of using fly ash as a soil amendment in agronomy

ISA YUNUSA, V. MANOHARAN, DEREK EAMUS, GREG SKILBECK
Institute for Water and Environmental Resource Management (IWERM) and Department of Environmental Sciences
University of Technology, Sydney
PO Box 123 Broadway, NSW 2007
AUSTRALIA
isa.yunusa@uts.edu.au; http://iwerm.uts.edu.au

Abstract: In this paper we highlight the findings of our ongoing studies on the agronomic use of Australian coal fly ashes in the light of pre-existing concerns that the ashes could cause phytotoxicity and, hence, reduced growth and yield of crops. We tested canola on soil treated with an alkaline fly ash added at up to 625 t/ha, and obtained increases in seed yields with fly-ash rates of not more than 36 t/ha, beyond which there was no further response in yields. Concentration of B was elevated in the leaves with ash addition of 625 t/ha, while that Mo elevated in the leaves and grains with addition of fly ash at all rates, but that of Zn was not affected by addition of fly ash. There was a correlation between plant dry weight and tissue concentration of P at flowering, suggesting that addition of fly ash might have enhanced P nutrition. We found in another experiment that both acidic and alkaline fly ashes applied at not more than 12 t/ha significantly increased the pH of acidic soil by up to a unit of 0.4 within 6 months of soil treatment. Much of the benefits of fly ash in terms of amelioration of acidity and other nutritional benefits could be achieved with fly ash applied at not more than 10 t/ha without any detrimental effects on the environment. Salinity (EC < 4.0 dS/m) and B concentration (<60 mg/kg hot water soluble) are the main criteria for selecting Australian fly ashes for soil amelioration. Developing a sustainable application for fly ash in agriculture should reduce the need for its disposal in landfill, while saving farmers at least 30% the cost associated with treating the soil using lime.

Key-words: agronomy, soil acidity, plant nutrients, phytotoxicity, plant growth

1. Introduction

Soil health as determined by its structural and nutritional characteristics, is a key to viability of agricultural enterprises. Soils in Australia are very old, highly weathered and poor in essential plant nutrients. They have topsoils that are generally low in nutrients while the bottom soils are often dense and poorly permeable to water and plant root. These soils therefore need significant input of nutrients through fertilisation, correction of pH with lime, and structural amelioration through application of gypsum. Furthermore, almost half of the 100 million ha of the agricultural land has pH levels of less than 5.5, with 11 million ha considered extremely acidic (pH < 4.5) [1]. Soil acidification is continuing due to excessive use of fertilizers, increasing inclusion of legumes in farming systems and product removal from the farms. Acidity adversely affects availability of some of the major plant nutrients and structural properties of soil. Fertilisers, agricultural lime and gypsum are therefore common inputs in Australian farming systems.

Coal fly-ash may have significant benefits in the management of these agricultural soils by ameliorating structural and/or chemical constraints to attaining high productivity of horticultural and field crop and of pastures. This is because the

ash has unique properties that can ameliorate many of the chemical and structural deficiencies, which cause poor soil health and constraint crop productivity. Results from previous studies were inconsistence on the plant responses to treatment of growth media with coal fly ash [2, 3, 4, 5]. These inconsistent results could be mostly associated with different experimental setup and context (e.g. greenhouse versus field), and differences amongst the ashes, soils and crops used. Developing modalities for sustainable use of fly ash in soil management will benefit the environment by reducing the substantial amounts of the ash that is disposed in landfill, while providing a significant input for the agricultural sector. For instance, more than half of the 13 million tonnes of fly ash produced annually in Australian is disposed in landfill [6]. Meanwhile, production cost for amendments commonly suit to treat soil could be prohibitive. This cost for lime production, for instance, accounts for between 20 and 50% the total cost of using this material to treating soil acidity [1].

Earlier studies in Western Australia have shown that ash application increased productivity of clovers (*Trifolium subterraneum*) [7] and turf (*Cynadon dactylon*) [8, 9] on coastal sands. These studies showed that fly-ash could double the productivity of turf sown on sandy soils, primarily by increasing the water holding capacity and phosphorus availability in the soil.

There is however, a greater potential for fly-ash in the mainstream horticultural and agricultural sector, where high amounts of plant nutrients, including Ca, K, Mg, P and Mo, are removed from the soil and ash application will be of great benefit to supplement these elements. We have been engaged in a series of glasshouse and field studies testing a range of fly ashes on selected crop species in the past few years in Australia. Our ultimate objective is to develop protocols for routine use of fly-ash in soil management. In this paper we briefly highlight progress of this project and the significance of our findings in the light of information available in literature.

2.0 Potential for coal fly ash in Australian Agriculture

Although fly-ash has many of the beneficial characteristics of agricultural lime and gypsum, to-date there has been no studies that systematically examine all the facets of how fly-ash can be employed in soil amendment for field and horticultural crops in Australia. Our overall objective was to explore the potential for a sustainable use of fly ash in managing agricultural soils in terms of:

1. Identifying desirable characteristics of fly-ashes for agronomic applications
2. Potential benefits of fly ash for ameliorate soil acidity
3. Crop yield benefits due to fly-ash
4. Uptake and phytotoxicity of key elements by plants grown with fly ash

2.1 Desirable ash properties for agronomic application

Fly ashes are highly variable in their chemical and physical properties depending on the parent coal and operating conditions of the power plant. As such, we don't expect all fly ashes to be equally effective in ameliorating problems of the soil and/or increasing crop productivity. Although there is considerable homogeneity in the physical properties of ash, for example, most are in the fine sand category, there is a wide range in terms of their chemical properties (Table 1). Well-defined criteria for the selection of fly ash in crop and pasture production is rare in literature. Concentrations of trace metals, dioxins, salinity and pH are key properties that would determine suitability of fly ash for agronomic use. Fly ashes from Australian coals, however, have generally low concentration of trace elements (Table 1) compared with coals from other parts of the world [10]. Hence, concentration of these elements in Australian fly ashes are low and well below the threshold limits set by the US-EPA according to Pathan et al. [9].

Table 1. Concentrations of selected total elements (mg/kg) for Australian and international coal fly ashes

Elements	Australian ashes[1]		International ashes[2]	
	Acidic ash	Alkaline ash	Acidic ash	Alkaline ash
Al ($\times 10^3$)	106–134	21.1–60.4	93.9–110.1	*na*
As	7.4–25	0.36–9.8	23–139	322–366
B	7.4–25	11–123	10.2–59.8	7.5–534
B (hot water extractable)	2.5 –9.1	5.4 –13.7	*na*	*na*
Ba	13–4310	61–605	599–1020	311 –3134
Be	13.0–24.0	5.4–8.6		*na*
Cd	0.38–1.34	0.01–0.19	0.4–0.5	1.0–52.4
Co	11.0–100	6.0–44	33–48.5	*na*
Cr	49.6 –130	2.9–34	125–167	23.4–281
Cu	51.6–94	1.8–20	147–395	5.0–47.7
Fe ($\times 10^3$)	7.1–86	7.62–343	68.7–86.6	*na*
Pb	59.0–81	1.1–22	14.5	16.1–1075
Mn	88–488	5–157	109–272	*na*
Mo	8.1–21	0.21–4.2	2.9–24.4	3.0–47.7
Hg	0.1–0.08	0.03–0.19	0.3–1.3	0.01–1.4
Ni	41.2–242	1.5–2.1	6.6	13.0–377
Se	1.09–5.15	0.15–5.0	5.1–16.8	2.4–36
Zn	108–283	5.1–305	11.8–233	20–924
	Other constituents (ng/kg)[3]			
Dioxins	<100	<100	*na*	*na*
Furans	<100	<100	*na*	*na*

[1]from Killingly et al. [10] and Yunusa et al. [11]; [2] from literature [12, 13, 14, 15, 16, 17]; [3] from Anon. [18] (2004); *na*, data not available;

Table 2. Responses in the mean pH (± standard errors of means) for soils treated with Australian fly ashes

Soil type	Type of fly ash	Rate of ash applied (t/ha)	Resulting pH
Clay loam (pH = 5.41)	Alkaline (pH = 10.77)	0	4.9 ± 0.03
		12	5.3 ± 0.05
		36	5.1 ± 0.11
		108	5.1 ± 0.10
	Acidic (pH = 3.28)	0	4.9 ± 0.03
		12	5.1 ± 0.08
		36	5.1 ± 0.17
		108	5.0 ± 0.13
Sandy loam (pH = 4.45)		0	4.0 ± 0.07
	Acidic (pH = 3.28)	4	4.1 ± 0.08
	Alkaline (pH = 10.78)	4	4.1 ± 0.08

2.2 Potential benefits of fly ash for ameliorate soil acidity

Fly ashes tend to possess high amount of calcium oxides and related basic components, which would nominally be expected to neutralise soil acidity. They therefore have significant agronomic and economic potential in Australia where about 50 million hectares of land are affected by acidity [1] and costing yield losses of more than \$1.5 billion dollars annually [19]. This is however often hampered by the poor pH buffering capacity and liming value of the ash [3], and more so for the Class F than for Class C ashes. Class C ashes are derived from low-rank coals, such as lignites, and are high in CaO (> 10%), alkali and crystalline compounds, but low in silica, while Class F are derived from higher-rank coals, e.g. bituminous coals, and contain only modest concentrations of CaO (< 10%) [20]. We have found, however, that Class F fly ashes, such as those produced in Australia, can provide some neutralisation of soil acidity in some soils. Both fine textured clay loam soil and the coarse textured sandy loam showed increases in pH eight months following treatment with variable amounts of either acidic or alkaline fly ash (Table 2). These increases in pH were achieved at much lower rate (12 t/ha) of ash application than would be expected from short-term titration assessment of liming value of fly ash in the laboratory, which predicted that up to 60 – 80 t/ha of ash would need to obtain liming value equivalent of 1 t/ha of pure lime [21]. Treatment with fly ash also produced increases in the pH of leachate collected during the 5-month growth of canola (*Brassica napus*) in large intact cores of acidic soil [22]

Table 3. Yield characteristics for canola grown on ash-amended soil in the glasshouse.

Ash rate (Mg/ha)	Number of pods/plant	Seed yield (g/plant)	Mean seed weight (mg)
0	59c	2.17b	3.95a
5	75a	2.64a	3.97a
25	65b	2.65a	4.02a
125	60bc	2.42ab	3.53b
625	54c	1.96b	3.49b
SED	5.39	0.364	0.215

Flower numbers were determined from flower stalks soon after flowering. Means within each variable followed by the same letter(s) are similar at $p \leq 0.05$.

2.3 Crop yield benefits due to land application of fly-ash

Growth and yield responses by plant to media treated with fly ash have been highly variable. Where positive responses were reported they were often associated with amelioration of either physical [5], chemical [23] and/or nutritional [8, 7]. Adverse yield outcomes are generally ascribed to phytotoxicity caused by excessive uptake and accumulation of trace elements by the plant [3]. From these previous studies it could be deduced that the crop response depends on the types of soil, fly ash and crop type, but perhaps more significantly the type and rate of fly ash used. When we tested an alkaline fly ash at rates equivalent to 0, 5, 25, 125 and 650 t/ha on canola in a laboratory study, we found a 23% increase in yield with 5 or 25 t/ha of fly ash (Table 3). Other yield attributes were either increased by, or remained benign to, ash applied at up to 125 t/ha, and any reductions in the magnitudes of any of the response variables occurred only when ash rate was raised to 625 t/ha. It is noteworthy that seed yield was not reduced even with ash rate of 625 t/ha. It seemed in this case that fly ash enhanced P nutrition for canola given that we found a significant correlation between plant weights with tissue P at flowering:

$$\text{Shoot weight (g)} = 0.022x - 7.32,\quad r^2 = 0.41,\ n = 48 \qquad (1)$$

where x is P concentration in plant tissue (mg/kg). It had been reported earlier that fly ash enhanced availability and uptake of this P and growth by turf [8].

A later field study in which we applied either an acidic or alkaline fly ash to wheat also showed either benign or increased yield. Taken overall, we observed decreases in plants growth that were supplied with fly ash at rates greater than36 t/ha most probably due to high salinity rather than any particular trace element. This is considered further in the next section below.

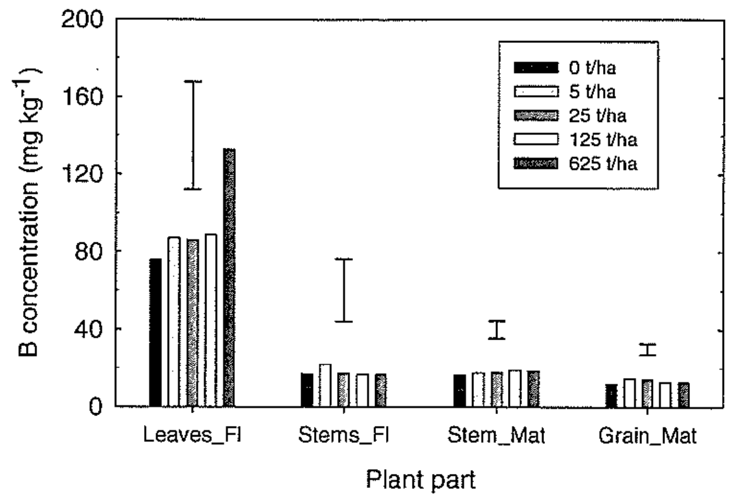

Fig. 1. Accumulation of B in the plant part at flowering (Fl) and at maturity (Mat) for canola supplied with coal fly-ash at rates between 0 and 625 t/ha.

2.4 Uptake and phytotoxicity from elemental content of fly ash

One of the major impediments to routine of fly ash in agricultural soil management is the concern over risk posed by the high levels of trace elements in the fly, which have been classified as being of either major (As, B, Cd, Hg, Mo, Pb and Se) or moderate (Cr, Cu, Ni, V, Zn and F) concern in terms of environmental considerations [24], which is highly relevant to agricultural applications of fly ash. Fly ashes derived from Australian coals generally have low concentrations of these and other trace elements falling well below the threshold limits set by the US-EPA [9]. While dioxins and furans, along with other organic toxins, in these ashes are usually found to be so low as to be reported as "not detected" with most measuring less than the regulatory limit of 100 ng/kg [18]. Earlier studies with Australia fly ashes identified B as the major cause of phytotoxicity in plants [3], and it was the main reason that had precluded utilisation of fly ash as a soil ameliorant, particularly in New South Wales, which is the largest state and producer of fly ash in Australia. Detrimental effect of excessive B on plants is well established [25, 26], but majority of these earlier studies applied excessively large amounts of ash (equivalent to 180 – 1200 t/ha) and also often to limited volume of soil in containers without leaching. In laboratory studies where fly ash was mixed with substrate even at seemingly low rate of just 10% by weight could translate to 180 t/ha in the field. In our study, introduced above, in which canola was grown in six litres of soil, we found no significant elevation in the uptake of B by canola grown with fly ash applied at up to 125 t/ha (Fig. 1). Amongst the other trace elements only Mo showed elevated concentration in the leaves and in the seeds (data not presented), but the latter was below regulatory limit. A follow-up study using large one meter long cores later also showed that B uptake was significantly elevated only when canola was supplied with 108 t/ha of a particular alkaline fly ash, which was noted for having high amounts of hot water extractable B [22]. Similarly field studies where the roots are not confined, plants grown on fly ash treated soil did not suffer B toxicity [4].

Given the generally low contents of trace elements in Australian fly ashes, individual trace elements may pose minimal risk of phytotoxicity if fly ash is applied at agronomically realistic rates. It is most likely that the rather than phytotoxicity caused by a single element, the salinity of ash, which sums the magnitude of total soluble will be of greater concern. Salinity of the ash may be more practical surrogate for assessing trace elemental concentration for fly ashes and suitability for agronomic application.

3.0 Basic protocols in using fly-ash for soil management

Protocols for routine use of fly ash for soil treatment involve several steps, principally:

a. selection of fly ash
b. rate of ash to apply
c. mode of, and precaution in, application
Each of these is discussed briefly further.

a. *Selection of ash:* The first step in developing protocols for use of fly ash in land management, especially in an agricultural context, is the choice of ash. It is imperative that application does not exacerbate any pre-existing physical and/or chemical conditions of the soil. The aim in agricultural use of fly ash then is to maintain the soil as near to optimum conditions for plant growth as possible. It is impossible to prescribe detailed guidelines for use of fly ash tailored for the myriad of individual ashes, soils, crops and pastures, and their various combinations. A productive topsoil should have low salinity with its electrical conductivity (EC) of < 1.5.0 dS/m, sodicity measured as sodium absorption ratio (SAR) of < 4.0 and a pH range 6.5–7.5 (http://wwwrrualbertaca/courses/RenR495/course_materialasp). On this basis, a vast majority of Australian fly ashes would be suitable for soil treatment, because they have low salinity and sodicity, along with low concentrations of trace elements as presented in Table 1. The pH of ash is of minor consideration because of the poor buffering capacity of the ash, and selection of the ash for agronomic use can be based on the following criteria:

i. Salinity – this gives a measure of the amounts of soluble salts in the ash, which, if high, may cause soil salinity with prolonged application of ash. Ashes should have electrical conductivity (EC) below 4.0 dS/m, but preferably below 2.0 dS/m.

ii. Boron content – boron is possibly the only element found in considerable amounts in many fly ashes that could be injurious to plants on certain soils. An upper limit of hot water extractable B of 60 mg/kg ash has been set in New South Wales.

iii. Nutrient content – high concentrations of cations (especially calcium, magnesium and potassium) and phosphorus are beneficial to the plant

iv. pH – this may be important in determining the leaching potential of the constituent elements within the ash

b. *Rate of ash to apply*: It is desirable from environmental and economic considerations that rates of fly ash do not exceed that commonly used for other soil amendments such lime and gypsum. From our studies for which some results are presented here (Table 2), the rates should not exceed 10 t/ha, and in most cased less than 5 t/ha.

c. *Mode of, and precaution in, application*: Equipment such as those used applying fine soil amendment such as agricultural lime should be effective in incorporating the ash into the soil. a typical example is the spreader equipped with belt-fed spinner and horizontal discs with radial ribs. Attachment of shrouds to the

spreader and/or moistening the ash with about 4% by weight of ash is effective in minimising spray drift. It is important, too, that the ash be incorporated into the top 5–10 cm of the soil.

4. Conclusion

Our studies have shown that the uncertainty over the agronomic potential of Australian fly ashes is largely unfounded and need to be reconsidered. Being mainly Class F and containing low soluble calcium ions, these ashes can still be effective ameliorants of soil acidity. These ashes could also be a significant source of P amongst others for plants. Development and implementation of uniform protocols applicable across all states will establish fly ash to complement, and in some cases substitute, the non-renewable amendments commonly used, such as gypsum and lime. Although our studies showed potential benefits of fly ash in agricultural applications, there are several questions to be addressed. These include uncertainties over the longevity of the benefits of fly ash, loading of trace elements in the soil, bioaccumulation, and offsite effects, under sustained used of fly ash for soil amelioration.

References:

[1] Dolling, P.J., Moody, P., Noble, A., Helyar, K., Hughes, B., Reuter, D., Sparrow, L., 2002. Soil acidity and acidification. National Land and Water Audit. http://nlwra.gov.au/.

[2] Adriano, D.C., T.A.Woodford, and T.G. Ciravolo. 1978. Growth and elemental composition of corn and bean seedlings as influenced by soil application of coal ash. J. Environ. Qual. 7: 416–421.

[3] Aitken, RL and Bell, LC 1985, Plant uptake and phytotoxicity of boron in Australian fly ashes, Plants and Soil, 84, 245–257.

[4] Cline, JA, Bijl, M & Torrenueva, A 2000, Coal fly ash as a soil conditioner for field crops in southern Ontario, Journal of Environmental Quality, 29, 1982–1989

[5] Mishra, M, Sahu, RK & Padhy, RN 2007, Growth, yield and elemental status of rice (Oryza sativa) grown in fly ash-amended soil, Ecotoxicology, 16, 271–278.

[6] Heidrich C., 2003. Ash (CCP's) Utilisation - An Australian Perspective. Proc. International Ash Utilization Symposium, University of Kentucky, Lexington, Kentucky, USA, . April 11-15, CAER. http://www.flyash.info/2003/.

[7] Summers, R, Clarke, M, Pope, T & O'Dea, T 1998, Western Australian fly ash on sandy soils for clover production, Communications in Soil Science and Plant Analysis, 29, 2757–2767.

[8] Pathan, S.M., Aylmore, A.G., Colmer, T.D., 2001. Fly ash amendment of sandy soil to improve water and nutrient use efficiency in turf culture. International Turfgrass Soc. 9, 33-39.

[9] Pathan, SM, Aylmore, LAG & Colmer, TD 2003, Properties of several fly ash materials in relation to use as soil amendments, Journal of Environmental Quality, 32, 687–693.

[10] Killingley J., McEvoy S., Dokumcu C., Stauber J., and Dale L., 2000. Trace element leaching from fly ash from Australian Power Stations. End of Grant Report, Australian Coal Association Research Program, Project C8051, CSIRO Division of Energy Technology.

[11] Yunusa, I.A.M., Eamus, D., DeSilva, D.L, Murray, B.R., Burchett, M.D., Skilbeck, G.C. and Heidrich, C., 2006. Fly-ash: an exploitable resource for management of Australian agricultural soils. Fuel, 85, 2337–2344.

[12] El-Mogazi, D, Lisk, DJ & Weinstein, LH 1988, A review of physical, chemical and biological properties of fly-ash and effects on agricultural ecosystems, Science of the Total Environment, 74, 1–37.

[13] Gupta, DK, Rai, UN, Tripathi, RD & Inouhe, M 2002, Impacts of fly ash on soil and plant responses, Journal of Plant Research, 115, 401–409.

[14] Moreno, N, Querol, X, Andres, JM, Stanton, K, Towler, M, Nugteren, H, Janssen-Jurkovicova, M & Jones, R 2005, Physico-chemical characteristics of European pulverized coal combustion fly ashes, Fuel, 84, 1351–1363.

[15] Schumann, AW & Sumner, ME 2000, Chemical evaluation of nutrient supply from fly ash–biosolids mixtures, Soil Science Society of America Journal, 64, 419–426.

[16] Furr, AK, Kelly, WC, Bache, CA, Gutenmann, WH & Lisk, DJ 1976, Multi-element uptake by vegetables and millet grown in pots on fly ash-amended soil, Journal of Agricultural and Food Chemistry, 24, 885–888.
[17] Furr, AK, Parkinson, TF, Gutenmann, WH, Pakkala, IS & Lisk, DJ 1978, Elemental content of vegetables, grains and forages field-grown on fly ash-amended soil, Journal of Agricultural and Food Chemistry, 26, 357–359.
[18] Anon. 2004, Coal combustion product (CCP) environmental testing programme 2003–2004, Ash Development Association of Australia Inc., Wollongong, NSW, 27 pp.
[19] Hajkowicz, S & Young, M 2005, Costing yield loss from acidity, sodicity and dryland salinity to Australian agriculture, Land Degradation and Development, 16, 417–433.
[20] American Coal Ash Association (ACAA) 1995, Fly ash facts for highway engineers, Report FHWA-SA-94-081, American Coal Ash Association and Federal Highway Administration, National Technical Information Services, Springfield, USA.
[21] Bell, LC & Aitken, RL 1984. The potential for edaphic utilisation of fly ash from Australian power stations. In: Proceedings of Australian Mining Industry Council, Environment Workshop, Kalgoolie, Australia, p 1 -12. 2 -5 October.
[22] Manoharan, V, Yunusa, IAM, Lawrie, R, Skilbeck, GC & Eamus, D 200-, Changes in soil chemical properties and distribution of boron, molybdenum and selenium in soil and plant following application of coal fly ashes to two acidic soils, Fuel, (under review).
[23] Clark, RB, Zeto, SK, Ritchey, KD & Baligar, VC 1999, Boron accumulation by maize grown in acidic soil amended with coal combustion products, Fuel, 78, 179–185.
[24] ACRL, 1996. Trace Elements in Coals: Australian thermal coals generally have low levels of toxic trace elements in comparison to internationally traded thermal coals from other countries. Australian Coal Research Limited; Project 3096. http://www.acarp.com.au/Newsletters/traceelements.html.
[25] Kukier, U & Sumner, ME 1996, Boron availability to plants from coal combustion by-products, Water, Air and Soil Pollution, 87, 93–110.
[26] Matsi T, Keramidas VZ (1999) Fly ash application on two acid soils and its effect on soil salinity, pH, B, P and on ryegrass growth and composition. Environmental Pollution 104, 107-112.

Distribution Pattern of Rare Tree Species in Two Virgin Jungle Reserves in Pahang and Johor, Malaysia

FARIDAH-HANUM, I & KAMARUZAMAN, J
Faculty of Forestry
Universiti Putra Malaysia
UPM 43400 Serdang, Selangor, Malaysia
i.faridahhanum@gmail.com; kamaruz@aeroscan.com.my
http://www.upm.edu.my

HIKMAT, A
Department of Forest Resource Conservation
Faculty of Forestry
Bogor Agricultural University
Bogor, Indonesia
ahikmat62@yahoo.com

LATIFF, A
Faculty of Science and Technology
Universiti Kebangsaan Malaysia
Bangi, Selangor, Malaysia
latiff@pkrisc.cc.ukm.my

Abstract: A study on the distribution pattern of rare tree species was carried out in Bukit Bauk Virgin Jungle Reserve (VJR), Terengganu and Gunung Pulai VJR, Johor. A single plot of 2 ha (100 m x 200 m) was established in each VJR by using purposive sampling design. The plot was further divided into contiguous 50 subplots of 20 x 20 m^2. Based on the IUCN categories, six species are critically endangered and two species vulnerable in Bukit Bauk VJR. In Gunung Pulai, five species each are critically endangered and vulnerable. Both VJRs registered tree species distribution that is random and clumped in different proportions.

Key-Words:- Spatial distribution, Rare tree species, Virgin Jungle Reserves, Conservation, IUCN

1 Introduction

The establishment of Virgin Jungle Reserves (VJRs) within the timber production areas in Peninsular Malaysia was initiated in 1950's to serve as permanent nature reserves and natural arboreta; control for exploited and silviculturally treated forest; and undisturbed natural areas for general ecological and botanical studies of fundamental importance [1].

Malaysian rain forests are being managed by establishing an extensive network of protected areas since 1930's. For this purpose, a total of 1.39 million hectares of protected areas have been set aside for the conservation of biological diversity in the form of national parks, wildlife sanctuaries and nature reserves [2].

Although these protected areas and VJRs constitute insignificant proportion as compared to the permanent forest estates, many of the VJRs are now seriously depleted with little conservation value [3]. About 30% of the VJRs established have been lost due mainly to