



UNIVERSITY OF MAURITIUS
RESEARCH WEEK 2016
(9th Edition)



Knowledge to Action

Book of Abstracts

19 September - 23 September 2016

Agriculture
Engineering
Law and Management
Ocean Studies
Science
Social Studies and Humanities
Innovative and Lifelong Learning

Message of the Pro-Vice-Chancellor (Academia)

The vision of the University of Mauritius (UoM) is to be one of the leading international tertiary education providers and a research-led University and one of the strategic directions identified to achieve this vision is 'Excellence in Research and Innovation'. At the UoM therefore, staff and students strive to make a difference through innovative and multidisciplinary research. The research effort at the UoM is strongly supported by its pool of talented researchers who are recognised nationally and internationally and the work of its postgraduate research students.

The Research Week has been held annually at the UoM since 2007 and it is part of the University's ongoing effort to foster its research mission by providing a forum to the researchers in all fields of study to disseminate and share their work and findings. The Research Week is in fact a key event in the Calendar of Activities of the UoM since it is the annual celebration of the research undertaken at all levels by staff and students at the UoM. It is also a means to acknowledge the contribution and support provided to the researchers through the Office of the Vice-Chancellor, Pro-Vice-Chancellor (Academia) and the Pro-Vice-Chancellor (Planning and Resources), the Tertiary Education Institution (TEC), the Mauritius Research Council (MRC) and other External Funding Organisations/Agencies.

The Knowledge Transfer Office (KTO) was launched in April 2016 at the UoM and its role is to become a platform for knowledge transfer between the University and stakeholders for a sustainable society. The KTO will therefore communicate the research findings to the community so that same may be used in policy making, in the industry or by Non Government Organisations (NGOs). In the same spirit, this year the Research Week at the UoM will be open to people from the industry since the University wishes to highlight the importance of applying the knowledge generated through research. The Research Theme for this 9th Edition of the Research Week is therefore "Knowledge to Action". The Research Week 2016 will focus on showcasing research through various events to be attended by staff, students and other researchers. Each Faculty and Centre will have its own research day. Exhibition of posters, oral presentations and discussions will be held during the whole week.

Following online submission of abstracts and consideration by the respective Faculty/ Centre Research Week Organising Committees, 216 abstracts have been accepted for oral presentations and poster sessions namely 53 from the Faculty of Agriculture, 33 from the Faculty of Engineering, 43 from the Faculty of Law and Management, 10 from the Faculty of Ocean Studies, 42 from the Faculty of Science, 26 from the Faculty of Social Studies and Humanities and 9 from the Centre for Innovative and Lifelong learning.

I would therefore like to thank all participants as well as the UoM Research Week Organising Committee and the Faculty/Centre Research Week Organising Committees for their valuable contribution to this 9th Edition of the Research Week.

I hope that you will actively participate in the different activities that will be held and I wish you all a successful Research Week 2016!

Professor A H Subratty

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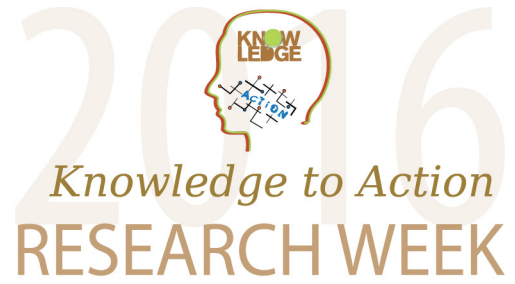
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Faculty of Agriculture

*Innovation and Technology Transfer:
Advancing Sustainable Agri-food Production*



UoM Research Week 2016

Faculty of Agriculture

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**ORAL
PRESENTATIONS**

The effects of 2 types of phase feeding system on growth performance and carcass characteristics of broiler in the summer and winter in Mauritius

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Abstract:

Feed represents up to 75% of the major cost in poultry meat production. Local feeding recommendations for broilers are based on a 3-phase feeding system (14 days on starter, 8 days on grower and 20 days on a finisher) to cater for the needs of birds at different stages of growth and for optimizing production. However, informal surveys have shown that farmers prefer to adopt a 2-phase feeding system (21 days starter and 21 days finisher or 30 days starter and 12 days finisher) to reduce production costs. Broiler production is market-sensitive and places high emphasis on yield of major carcass parts, namely, bone-in breasts, boneless breast fillets, thighs and drumsticks, which are influenced by several factors, the major one being nutrition. In this regard, the objective of this study is to evaluate the effect of 2-phase feeding systems using commercial feeds from 2 local feed mills (A and B) on the growth performance and the yield of carcass components of broiler chicken. It was carried out both in summer (December/February) with an in house relative humidity of 75% and a minimum 27^oC and maximum 31^oC temperature and in winter (June/August), with an in house relative humidity of 82.3% and a minimum 21.4^oC and maximum 26.6^oC temperature. In both periods, commercial broiler feeds (starter, grower and finisher) from the two feed manufacturers (A and B) were tested in different combinations using 300 mixed sexes Classic Hubbard day-old chicks per treatment, with a stocking density of 9 birds/m², in a completely randomized design over a period of 42 days. The treatments were: T1 (3-phase feeding A), T2 (2 phase feeding A), T3 (2-phase feeding A), T4 (3 phase feeding B), T5 (2 phase feeding B), T6 (2-phase feeding B). 15 birds were tagged in each treatment group and weighed at weekly intervals up to 42 days. At the end of the trial, four birds from each treatment group were randomly selected, weighed, slaughtered, eviscerated and chilled at 4^oC overnight for determination of the yield of the major carcass cuts. Average daily gain (ADG), feed conversion ratio (FCR) and performance index (PI) were also calculated.

At 42 days, the live weight of the birds ranged from 1609±71g to 1876±58g in summer and was significantly lower (P<0.05) than those birds fed in winter which ranged from 1891±68g to 2255±61g. The ADG was higher (P<0.05) in winter (52 g/day) compared to summer (41g/day). The FCR (P<0.05) was better in winter (1.87) than in summer (2.40) and higher PI (P<0.05) was obtained in winter (250) compared to summer (160). The 2-phase feeding and 3-phase feeding systems had no significant effects (P>0.05) on slaughter weight and carcass weight of the broilers. The feed cost for 3-phase feeding was lower (P<0.05) compared to the 2-phase feeding system in both seasons and for feeds from both manufacturers. Feed cost for the 3-phase feeding using feeds from both manufacturers (A and B) was lower (P<0.05) in winter (Rs 35/kg live weight) than in summer (Rs 45/kg live weight). The chilled carcass weight (1370g) was significantly lower (P<0.05) in summer than in winter (1665g). The yields of breast (30 %), thighs (17%) and drumsticks (14%) of the whole chilled eviscerated carcass were not significantly (P>0.05) affected by the type of the feeding systems and season.

This study has thus shown that broilers had better performance (ADG, FCR and PI) in winter than in summer under the 3-phase controlled feeding system than the other 2 phase types. The 3 phase feeding system is thus recommended since it is more economical to produce at a lower cost of feed per live weight gain.

Keywords: Controlled phase-feeding, Broiler, Yield, Cost

Isolation of marine bacteria from Western part of Mauritius and antimicrobial properties of their exopolysaccharides

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Abstract:

Microorganisms can arguably be considered to be amongst the most ubiquitous species on Earth, with their presence being observed in a wide range of habitats. Given their versatile nature, it is, therefore, not surprising that a lot of efforts have been geared towards their isolation from various environments in order to study their functions and in an attempt to discover novel species/products. The maritime zone of Mauritius, with its area of around 2.3 million square kilometres represents an interesting region for exploration. In fact, there is currently increasing emphasis on the development of an ocean economy through the exploitation of Mauritian marine resources in several ways. However, relatively little attention has been given to the potential of using marine microorganisms for industrial applications. Consequently, probing Mauritius seawaters to study its diversity of microorganisms would undoubtedly help to provide a broad understanding of the types of organisms present as well as on their practical usefulness. One particular characteristic of marine bacteria is their ability to produce biofilms which help them survive diverse conditions. The extracellular polysaccharides which form a major component of these biofilms have received considerable importance due to their potential applications in a number of industries as well as in medicine. The main objectives of this study were to isolate and identify the microorganisms morphologically, biochemically and by molecular methods.

Organisms capable of producing exopolysaccharides were selected and tested for antimicrobial activity. A first set of seawater samples were collected from the Western region of Mauritius and plated onto four different media namely, Plate Count Agar, Marine agar, R2A agar and seawater agar prepared by adding agar to filtered seawater. After incubation, morphologically distinct colonies were picked up and sub-cultured until pure cultures were obtained. DNA was then extracted from the isolated bacteria and PCR amplification of 16S rRNA gene was performed, prior to sequencing. Results were finally compared to NCBI databases to determine the identity of the isolated organisms. As far as the production of exopolysaccharide is concerned, 40 bacteria were selected out of all isolated organisms and cultured. After incubation, cells were removed and the polysaccharides were precipitated out of solution. The latter was subsequently partially purified through removal of proteins and dialysis. The 40 partially purified extracts were tested for antimicrobial activity by disc diffusion against 7 pathogenic strains and those showing significant activity were tested against 7 more pathogens using both disc diffusion assay as well as broth microdilution for determining the Minimum Inhibitory Concentration (MIC).

Analysis of diversity in the samples showed that overall; all the isolates were divided into 13 distinct genera. Members of *Proteobacteria* and more specifically *Gammaproteobacteria* were more dominant, although *alpha* and *beta-Proteobacteria* were also present. The other phyla obtained included the *Firmicutes* and *Actinobacteria*. 8 isolates were retained after primary screening as a result of their activity and after secondary screening only two isolates showed activity against more than half of the test strains. MIC values for the polysaccharides ranged mostly from 125 µg/ml to 1 mg/ml, with the lowest value being 62.5 µg/ml for one extract against *Salmonella typhimurium*.

Further work is being carried out on the nature of the bioactive polysaccharides as well as on the characterisation of the isolates producing them.

Keywords: Mauritius, Marine Bacteria, Exopolysaccharides, Antimicrobial

Enzymatic production of biodiesel using waste cooking oil

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Abstract:

The recent incentives undertaken at an international level to bolster the quest for renewable sources of fuel form the very framework of this project.

Lipase-producing microorganisms were isolated from a dumping ground (lipid-rich) of Saint Pierre where peanuts were previously cultivated. A baiting method was used to increase the incidence of lipolytic bacteria at a specific site. Firstly, a hole was dug in the soil which was then irrigated with vegetable cooking oil. After 10 days a soil sample was collected from the site and used for the isolation procedure. The lipolytic bacteria were isolated using an olive oil agar supplemented with 0.001 % Rhodamine B dye.

Out of 9 lipolytic microorganisms, two highest-yielding isolates were selected based on their lipase activity using the titrimetric lipase assay and named isolate 7 and 12 accordingly. After biochemical characterization and consulting the Bergey's manual of determinative bacteriology, the two isolates were presumed to belong to the genus *Staphylococcus*. The activity of the lipases was optimized for culture parameters including temperature, pH, carbon source and incubation time. Their peak activities were observed at 37°C, pH 7, with vegetable oil as the best substrate and 48h-54h past inoculation time. The extracellular lipases were then isolated and used as biocatalysts for the transesterification of waste cooking oil to produce biodiesel. A 1:4 molar ratio of oil: methanol was used and the latter was added stepwise at 0.25 h intervals. Hexane was used as a hydrophobic solvent. The biodiesels were harvested after 8 h and purified using the water-washing technique. Lipase harvested from isolate 7 and 12 resulted in a biodiesel yield of 95.96 % and 95.61 % respectively. The fuel grade properties of the biodiesels were then assessed. B7 and B12 had densities of 0.8582 g/ml and 0.8618 g/ml respectively as opposed to 0.9124 g/ml for the waste cooking oil. The moisture content of the oil was as low as 0.01% whereas B7 and B12 had a slightly higher value of 0.02%. B7 and B12 had low acid values of 0.20 mg KOH/g compared to 1.43 mg KOH/g for WCO. The refractive indices of WCO, B7 and B12 were 1.47, 1.45 and 1.43 respectively. The peroxide values for WCO, B7 and B12 were reported as 30 meq O₂/kg, 15 meq O₂/kg and 20 meq O₂/kg respectively. The gas chromatographic analysis of the two products revealed that B7 contained high amounts of methyl linoleate (*cis*-C18:2) and methyl oleate (*cis*-C18:1). B12, on the other hand, contained methyl elaidate (*trans*-C18:1) and methyl oleate (*cis*-C18:1) in larger proportions. Besides, B7 consisted of relatively higher amounts of FAMES compared to B12. B7 and B12 contained 0.218 and 0.122 µg/µL of FAMES under C14:0, which is reasonably low.

This study warrants the isolation of good lipase producers from the Mauritian soil that may subsequently embolden the appropriate individuals to launch a biodiesel production plant in the country to anneal to the "Maurice île durable" concept. Many overseas industries have already implemented the chemical alkaline process which engenders high yields. However,

the main pitfall of this approach is the high amount of waste products generated, difficulty in recovering the catalyst, high operating temperatures, neutralisation of waste products and high saponification level. This study sought out to surmount these hindrances that would otherwise limit the availability of biodiesel, by implementing the enzymatic process. The latter has been hailed as a figure of success as it cuts down on most restrictions that are presented by the alkaline process; hence, operating at an ambient temperature, resulting in very low amount of waste products, the recovery of the catalyst is virtually easier and the use of waste cooking oil does not result in saponification.

Keywords: Bacterial Lipase, Biodiesel, Waste Cooking Oil

Application of natural farming in banana production in Mauritius: Promising results from preliminary trials

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Abstract:

Banana is the most consumed fruit in Mauritius and for years it was among the few crops that could be grown with negligible chemical inputs. However, recently, its intensive cultivation is relying on regular use of agro-chemicals. In addition, during the last two decades the banana sector has been threatened by two major diseases (Mycosphaerella Leaf Disease Complex and the banana freckle), affecting mainly the Cavendish-type banana. On the other hand, the flourishing tourist industry and hypermarkets are setting higher quality standards for banana. To satisfy the market demands in terms of quantity and quality despite biotic and abiotic challenges, growers are having recourse to a wide range of agro-chemicals.

Systemic and contact fungicides are used for disease control while systemic insecticides are used to control weevil borers. Inorganic fertilizers are recommended to promote plant development for improved fruit quality. Regular nitrogen fertilizers are applied to promote new leaf development which has a direct correlation on bunch size while potassium-based fertilizers are used to improve fruit quality. However, with the rising concern of consumers about the negative effect of agro-chemicals on health and environment there has been an increase in demand for safe fruits and vegetables. This prompted the Food and Agricultural Research and Extension Institute (FAREI) to initiate experimental trials in 2014 by converting an experimental station to integrate natural farming techniques for the production of several fruit species, including banana. The objective was to evaluate the performance of banana during the transition period.

Natural farming practices were adopted in a banana germplasm collection of over 30 banana accessions. Due to the nature of the banana germplasm collection, the number of plants per variety did not allow a statistical design to be applied for the study. The performance of commercial varieties namely the Cavendish type bananas (Grande Naine, Petite Naine, Ollier, Williams, Cavendish 901) and the dessert-type bananas (Hybride Ducasse, Mamoul, Philibert and Gingeli) before (years 2010-2013) and after the application of natural farming (2015-2016) was compared. Pests and diseases were kept under control without using chemicals. Soil fertility was maintained through systematic use of mulch and fortnightly to monthly application of a locally prepared biofertiliser ('Jiwamritam'). 'Jiwamritam' is prepared using fresh cow dung, cow urine, chickpea flour, raw sugar and soil. The mixture is allowed to brew for two days, with regular stirring, to promote proliferation of beneficial microorganisms. This concentrate is then diluted (1:4) and then applied in the field on mulched soil. The biofertiliser does not provide any minerals, but the microbes found in the mixture promote the activity of nutrient-mobilising micro-organisms in the soil. Tree parameters (plant height and pseudostem girth), bunch parameters (bunch weight, number of hands and number of fingers) and fruit characteristics were recorded. The average bunch parameters of each variety for years 2010 to 2013 were bulked and compared with those of production years 2015 to 2016.

Plant height and girth for each variety were similar in both production methods. There was an average reduction of 14%, 8% and 11% in bunch weight, number of hands and fingers per bunch respectively. The fruits were healthy and the decrease in yield parameters was compensated by the reduction in production costs due to saving on agro-chemicals and labour costs for their application ranging from 30% to 50% depending on whether the field is irrigated or rainfed. The activity of biofertilisers is slow and results may not be as immediate as with inorganic fertilisers but soil structure, fertility and health are improved.

In this study, several constraints were faced in particular regarding disease control but the preliminary performance of the banana varieties under natural farming system showed promising results. Thus, to evaluate the sustainability of this new method of production and to assess its long term effect on crop performance, soil health and return to grower, further evaluation is being pursued on the same site and as well being replicated on-farm for validation.

Keywords: Banana, Agro-chemicals, Natural farming, Yield

“Knowledge to Action” in food science and technology: student research in real-life contexts

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Abstract:

Since 1997, the Faculty of Agriculture has played an instrumental role in providing undergraduate and postgraduate training in food science and technology in Mauritius. The BSc (Hons) Food Science and Technology programme aims at developing the necessary competence for a career in the food sector. Interaction with stakeholders and students has established the need to contextualise learning within real life situations to improve the quality and employability of graduates. Thus, compulsory industrial training was included in 2002. Most food science and technology graduates have undergone winter vacation placements in food organisations. In the light of long-standing experience in implementation of short-term student placements and stakeholders' feedback, the Faculty has mounted programmes which include a 6-month sandwich work placement.

The first cohort of students on the BSc (Hons) Food Science and Technology (with 6-month work placement) programme graduated in April 2016, an important milestone in the history of teaching at the Faculty. Implementation of student placements promotes mutually beneficial relationships between the Faculty and stakeholders including the food industry and hospitality sector. The student placements have created opportunities for industry/hotel-based undergraduate final year student projects/dissertations which address specific needs of food production/service organisations. At least one final year project has been industry-based for every undergraduate cohort in the area of food science and technology. In 2015, seven research projects were undertaken in a food industry or hospitality organisation. These studies emerged from the 6-month student work placement experience. In this context, the present case study aimed at sharing the process implemented to facilitate and guide two final year student projects undertaken in the hospitality sector in 2015. It involved documenting professional experience and review of relevant University of Mauritius Regulations as well as Faculty of Agriculture guidelines and records.

The projects were initiated by students who contacted the potential supervisor at the Faculty during their 6-month work placement. The dissertation title was developed through discussion between the student and the proposed Faculty/external organisation supervisors. The academic supervisor submitted the dissertation title to the Faculty for approval. Once the allocation of dissertation titles was finalised, the student worked on the synopsis. In one case, the student interacted by email with the supervisors to write and improve the research proposal. In the other case, a face to face meeting was arranged. The student submitted the synopsis to the Programme Co-ordinator as per University Regulations. The academic supervisor requested approval of the synopsis and notification of confidentiality requirements

by the hospitality organisation. A formal letter template has been designed by the academic supervisor for this purpose. The Faculty has developed guidelines to ensure compliance with confidentiality agreement. One project was identified as confidential and the student was required to complete the non-disclosure form in line with University Regulations. Upon approval of the project synopsis by the organisation, the students started to apply the research methodology. The time spent on-site was as follows: one day per week during the semester and full time during the vacation. The student projects included a food hygiene knowledge and attitude survey among the organisation's food handlers. Data was collected by face to face administration of a questionnaire individually or in groups. This was facilitated by the on-site supervisor. The academic supervisor provided guidance on the rationale and principles to be applied in construction of the questionnaire to ensure validity. Multiple choice questions were developed to assess knowledge. Attitude statements were formulated and a likert scale was used to measure level of agreement of respondents. The content of the data collection instrument was based on organisation's food hygiene training provision, observed food handlers' behaviour, scientific literature, previous research, legislation and international standards. In one case, the questionnaire was translated in French to facilitate communication with participants who could not understand English. The survey data was analysed statistically to generate results which contributed to assess the effectiveness of the organisation's training programmes. The knowledge created has led to actions to ensure continual improvement of food handlers' behaviour. Thus, real-time knowledge transfer was achieved to give meaning to research. The experience described in this case study could contribute to enhance the Faculty's practices for extended connectivity with the real world and continued research uptake.

Keywords: Knowledge Transfer, Student, Industry, Hospitality

Screening of the local brown algae, *Sargassum* species for bioactive compounds and antimicrobial properties

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Abstract:

The search for novel antibiotics from natural sources has gained worldwide interest to address the antibiotic-resistance crisis. Macroalgae produce a panoply of secondary metabolites having broad spectrum of biological activities. The objectives of this study were: (i) to extract phytochemicals from *Sargassum binderi* and *Sargassum pfeifferae*, (ii) to measure the phenolic and flavonoid contents of the different extracts, (iii) to investigate *in vitro* antioxidant properties of the extracts; (iv) to examine the antimicrobial activities of the extracts on human pathogenic bacteria (v) to analyze functional groups in *Sargassum binderi*, *Sargassum pfeifferae* and *Sargassum robillardii* and (vi) to extract high quality DNA from the phaeophytes and amplify DNA sequences using random primers.

S. robillardii and *S. binderi* were obtained from Melville while *S. pfeifferae* was obtained from Anse la Raie beach. Washed seaweeds were air-dried for 7 days. Dried seaweeds were then crushed with liquid nitrogen and phytochemicals were extracted in solvents including methanol, chloroform, ethyl acetate, hexane, chloroform - methanol mixture and hexane - methanol mixture by the decantation method. Total phenolic content (TPC) and total flavonoid content (TFC) were measured by spectrophotometry. Antioxidant assays carried out included the total antioxidant capacity (TAC) assay, ferric reducing antioxidant ability (FRAP) and free radical scavenging ability by DPPH assay. The antimicrobial activity of the extracts was determined qualitatively by the disc diffusion method and quantitatively by the broth microdilution assay. Test organisms included *Staphylococcus epidermidis*, *Enterococcus faecalis*, *Enterococcus* species, *Streptococcus agalactiae*, *Staphylococcus aureus*, *Proteus mirabilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella* species and *Acinetobacter* species. Functional groups in the brown algae were analyzed using Fourier Transform Infrared Spectroscopy (FT-IR). Two modified CTAB protocols were used to extract DNA from *S. binderi*, *S. pfeifferae* and *S. robillardii*. The DNA was quantified by spectrophotometry. Finally, RAPD-PCR was carried out with primers OPA02, OPA03, OPA04 and OPA13.

Alkaloids, flavonoids, flavonols, flavones, chalcones, steroids, coumarins, phenols and terpenoids were found to be present in the different extracts by a series of test tube tests. TPC varied between 24.500±0.541 and 341.844±25.889 µg GAE/mg in *S. binderi* and between 62.469±0.716 and 478.094±2.359 µg GAE/mg in *S. pfeifferae*. TFC ranged between 6.110±0.274 and 130.229±0.666 µg QE/mg in *S. binderi* and between 13.612±0.202 and 27.070±0.920 µg QE/mg in *S. pfeifferae*. Highest FRAP was in ethyl-acetic extract of *S. pfeifferae* (1462.148±0.018 µmol Fe²⁺/g extract) and chloroform extract of *S. binderi* (1632.542±0.061 µmol Fe²⁺/g extract). Highest TAC was in chloroform and ethyl acetic extracts of *S. binderi* (354.849±2.040; 338.860±4.348 µg AAE/mg) and ethyl-acetic extract of *S. pfeifferae* (656.718 ± 34.314 µg AAE/mg). Highest radical scavenging activity was at 10

mg/ml hexane extract of *S. binderi* (72.267 ± 0.769 %) and at 10 mg/ml ethyl acetic extract of *S. Pfeifferae* (74.511 ± 0.550 %). Antimicrobial testing showed that the hexane, ethyl acetic and chloroform extracts had broad-spectrum activity. Furthermore, the tested extracts were more efficient than the antibiotics ampicillin and chloramphenicol against the test pathogens. The FT-IR spectra showed presence of polysaccharides, amino acids, aliphatic compounds, phosphine, esters, cellulose, starch, sulphated polysaccharides, sulfates and disulfides, fatty acid and phosphates. For the molecular part, high mass of sample was required to extract satisfactory amount of DNA. Nevertheless, the DNA degraded very rapidly possibly due to presence of polysaccharides and phenols and these interfered with RAPD-PCR amplifications.

High TPC and TFC contents and high antioxidant content make *Sargassum* an important resource to be further studied and exploited. High antibacterial activity suggests exploitability of the extracts for novel antibiotics. The DNA extraction protocols should be optimized to obtain good quality and quantity of DNA from *Sargassum*. FT-IR is a very useful tool to study components present in *Sargassum*. Alginates and fucoidans having industrial importance can be isolated from these brown algae and studied further.

Keywords: *Sargassum*, Antioxidant, Antimicrobial, FT-IR

Prospects of high biomass sugarcane varieties for bioenergy production in Mauritius

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Abstract:

Sugarcane is recognized worldwide as a renewable environment-friendly bioenergy crop in view of the fluctuating prices of petroleum, its dwindling worldwide stocks and its adverse effects on environment. In Mauritius, the demand for exploiting sugarcane for bioenergy is felt even stronger due to the reduction in sugar price as a result of the EU sugar reform and the forthcoming abolishment of production quotas in the EU by September 2017. High biomass canes are considered a lifeline for both the sustainability of the Mauritian sugar industry and the national energy security. Significant genetic diversity for sucrose and fibre percentages exists in sugarcane related wild species, mainly from the *Saccharum* and the *Erianthus* genera. However, current varieties have not been optimized to achieve the required high biomass with high fibre, commonly termed as energy canes, under a range of environments that would be necessary for an extensive production of biofuels.

In Mauritius, studies on energy canes started in the mid-1980s with the assessment of basic species and early generation interspecific crosses, and later on with the evaluation of locally bred and imported genotypes at an intermediate selection stage. Multivariate analysis allowed the pioneering definition of four types of canes (*Type 1* to *Type 4* canes) for different end-uses. The classification 1 to 4 was mainly based on increasing fibre content and in relation to sucrose content and biomass yield. A selection algorithm was developed that could simultaneously screen the different types of varieties. The most promising genotypes were further evaluated in several environments, representative of the different pedo-climatic zones of the island. The genotypes were evaluated over three consecutive harvests. Linear mixed models were developed to determine the highest biomass varieties as well as those showing adaptation to specific environments. Broadly, three imported clones yielded high biomass with nearly 5 t ha⁻¹ (+22%) more of cane dry matter compared to the average of commercial varieties. They were categorized as low-sucrose-high-fibre *Type 3* canes. Three locally bred genotypes were identified as *Type 2* canes in specific environments with sucrose content equivalent to existing commercial varieties and moderately higher fibre. Studies using linear-bilinear models confirmed the stability and adaptation of the different genotypes. High fibre clones showed better adaptation in the more humid environments. Highest differences were observed in the very humid region of Mon Desert Alma where three imported clones produced 100% more fibre and 50% more cane dry matter yields than those of the commercial varieties. Generally, the high fibre varieties have high density of thin, tall and light cane stalks compared to the high sucrose types that are relatively thicker, shorter and heavier with lower stalk number per unit area. In the drier regions, current commercial varieties were the highest biomass yielders. One commercial type genotype, with slightly lower sucrose content than existing commercial varieties, produced 24% and 20% higher biomass and sugar yields, respectively, than those of existing commercial varieties in the dry zone. With this genotype and other enhanced fibre type canes, biomass yield can be maximized without jeopardizing sugar yield. The high fibre energy canes can be cultivated in marginal and abandoned lands

for the production of electricity and bio-ethanol. Overall, six genotypes constitute the existing best biomass yielders with variable sucrose to fibre ratios and adapted to different environments.

Further trials are in progress for the evaluation of biomass potential in contrasting marginal environments and for year-round harvest.

Keywords: Sugarcane Biomass, Bioenergy, Adaptation

Dairy cattle and Rusa deer are potential sources of Shiga-toxigenic *Escherichia coli* (STEC) of clinical significance to Mauritians

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Abstract:

Shiga-toxigenic *Escherichia coli* (STEC) are important human foodborne pathogens, characterized by their ability to produce Shiga toxins (*stx1* and *stx2*). Intimin (*eaeA*) and enterohemolysin (EHEC-*hlyA*) genes are also major virulence factors associated with these strains. Clinical symptoms associated with STEC infections can vary from abdominal cramps and acute bloody diarrhoea to more severe sequelae including hemorrhagic colitis, hemolytic uremic syndrome and thrombocytopenic purpura, which can lead to kidney failure and death. Elderly and children under 5 years old are particularly susceptible to STEC. STEC are regarded as highly pathogenic since they are capable of withstanding both normal food processing procedures and the highly acidic contents of the stomach in human intestinal tract. The most prevalent serotypes are O26, O45, O103, O111, O121, O145 and O157. Warm-blooded animals are reservoirs of STEC and their derived foods or foods contaminated with their faeces have been implicated in several STEC-related outbreaks. The aim of this study was to estimate the prevalence of STEC in faeces and raw unprocessed foods derived from dairy cattle and deer (*Rusa timorensis*) in Mauritius.

A total of 50 composite faecal and 50 bulk raw milk samples were aseptically collected from five dairy farms known to house STEC-positive cows during the period of March to August 2015. At each farm, about 30 g of fecal matter from individual animals were first collected and mixed in a sterile container. Then, about 30 g of the composite fecal matter were transferred into a sterile stool container for analysis. On the same farm, 40 ml of raw milk were collected in a sterile container, from the bulk bucket for small and medium scale farms, and from the bulk tank for large scale farms. Similarly, raw meat and faecal samples were collected from 61 deer carcasses at the slaughter site of three deer *chassées* located in the North, West and East of the island during the hunting season in September 2015. For each carcass, about 30 g of fecal matter was withdrawn from the rectum and about 100 g of raw meat was cut out of the carcass near the rectal region. All samples were analysed for presumptive STEC using CHROMagar STEC and Eosine Methylene Blue (EMB) agar, after enrichment in modified Tryptic Soy Broth (mTSB). Presumptive STEC isolates were purified on nutrient agar and stored in 20% glycerol supplemented-mTSB at -20°C. Further screening of the suspect isolates for the presence of four virulence genes namely *stx1*, *stx2*, *eaeA* and EHEC-*hlyA* was performed using multiplex PCR. DNA templates positive for single or multiple combinations of virulence factors were further analyzed for serogroup identification of O26, O45, O103, O111, O121, O145 and O157 by uniplex PCR with primers based on the *wzy* gene.

10.0% of the raw milk samples and 6.0% of the faecal samples from 3 dairy farms were contaminated with STEC strains. 9.8% of the deer meat samples and 44.3% of the faecal samples were found to be STEC positive. None of the confirmed-STECS isolates were from the major O serogroups but were found to possess multiple virulence combinations.

Thus raw milk and deer meat may be potential vehicles of STEC other than the major seven O-serogroups. And transmission of STEC to man via un- or under-processed milk and meat is possible. This research study highlights the importance of implementing risk assessment programs and good hygienic practices at farm level, along with adequate cooking and hygienic practices at consumption level to prevent STEC-related illnesses. Future work will aim at serotyping the STEC isolates through Sanger sequencing to provide further information about the serotype diversity and genetic relatedness existing in dairy cattle and deer.

Keywords: Cattle, Deer, Shiga-toxigenic *Escherichia coli*

A comparative study of plant diversity in managed and unmanaged native forests in the Black River Gorges National Park

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Abstract:

Forest loss due to invasive alien species is of major concern to the Mauritius biomes as they influence several ecological processes. The main objective of this study was to assess the differences in the seedling pattern and species diversity at Pétrin in the Black River Gorges National Park of Mauritius. The study was carried out in two managed and one unmanaged native forests. The first managed forest was weeded and fenced since 14 years, the other managed forest was only weeded in 2012(4 years) and the unmanaged forest was never weeded.

A stratified design was used as sample design and three plots of 1000 m² were demarcated and surveyed in the three types of forests. A comparative analysis of the forest patterns were assessed using 30 quadrats of 100 m² each. Pétrin being a super humid mesothermal area had stunted vegetation and ericoid heath vegetation. The results revealed that the managed forests were considerably healthier than the unmanaged forest. This was supported by the managed forest having twice as many individual native plants as in the unmanaged site. Moreover, the managed forest (high quality weeded plot) comprised of taller native plants, higher number of natural seedlings, less weeds and comparatively less invasive strawberry guava, *Psidium cattleianum*. This could be attributed to the fact that the managed forest has been converted into Conservation Management Area (CMA) since 14 years. The high quality weeded plot consisted of 26 plant families which were represented by 1914 woody plants, the low quality weeded plot with 24 plant families representing 1050 plants and 21 plant families with 932 woody native plants for the unmanaged forest. In the 0.3 ha surveyed, *Phillipia brachyphylla* (*Ericaceae*) was the most dominant native plant and the regeneration rate (15.9 %) was higher compared to other native plants. The highest individual native plants noticed in the managed forest is due to the continuous weeding of the alien invasive plant species, which were preventing the native plants from growing and regenerating due to competition for space, light and nutrient, which was observed in the unmanaged forest. The Shannon Weiner index for the high quality, low quality weeded and the unmanaged plot were 2.7, 2.5 and 2.4 respectively. The regeneration of the native plants was more prominent in the managed forest (high quality weeded plot) with a total of 532 natural seedlings followed by 15 in the low quality weeded plot. However, no natural seedling was observed in the unmanaged forest as their growth was being hindered by the invasive species. The most abundant invasive alien plant found in the unmanaged forest was *Psidium cattleianum*, with an average height of 1 metre and an average number of 270000 plants per hectare.

CMAs were found to be very important for forest conservation as it helps to restore a large number of native plants. As such, more effort should be devoted to mitigate the negative effects of alien invasive species and forest loss.

Keywords: Diversity, Conservation, Forests, Shannon-Weiner Index

Recycling Waste Paper from the Printing Industry for Use as Poultry Litter Materials

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Abstract:

In 2014, the production of chicken meat in Mauritius was 47,500 T and is expected to reach 50,000 T in 2020. Given expected increase in chicken meat production, there will be an increasing strain both on the supply of litter materials used as bedding materials and the disposal of the spent litter, thus creating waste management challenges for the industry. The most common litter material in Mauritius is still wood shavings, but the economic and environmental sustainability of wood-shavings supply can be questioned, as it will become a scarce input. The type of litter used as bedding material for the birds is a critical factor affecting the welfare of the birds, with an impact on the efficiency of production. This study was conducted to explore alternative litter materials that promote the welfare of the birds and performance, and that can be disposed of without environmental damage. It was hypothesised that waste paper from the printing industry can be used as litter co-materials with chopped dry grass.

An experimental trial was carried out at the Poultry Unit of the University of Mauritius (UoM) Farm in Réduit. 150 Ross 308 broilers as-hatched chicks were randomly allocated to 12 pens in a completely randomised design. A three-phase feeding programme was used industrially formulated feeds: broiler starter crumbles (1-20 d); broiler grower pellets (21-34 d); broiler post-finisher pellets (35-42d). 150 Ross 308 broilers as-hatched chicks were reared on a mixture of chopped dry grass litter material for a 42 d-growth cycle. The production performance of the birds was compared to those reared on a mixture of chopped dry grass litter and shredded paper (passed through a strip-cut shredder; 12 mm wide) from the printing industry (50%:50%). Performance parameters (feed intake (g), live-weight (g), live-weight gain (g /week), Feed Conversion Ratio (FCR) were monitored on a weekly basis. The welfare of the birds was assessed through visual observations of breast blisters and foot pad dermatitis using a scoring system (1-5). The spent litter was analysed for chemical parameters (pH; electrical conductivity (EC); organic matter; total N; carbon, potassium, calcium, total phosphorus; NDF (Neutral Detergent Fibre); ADF (Acid Detergent Fibre) and ADL (Acid Detergent Lignin), and physical characteristics (moisture; temperature; water holding capacity; bulk density), using standard test methods.

The results indicated that the type of litter had no significant difference ($P > 0.05$) on live-weight (2294 vs 2231 g), average weight gain, feed consumption, FCR. Mortality rate was very low (0.67%) and was not influenced ($P > 0.05$) by the type of bedding material used. The moisture content increased from 12.5 to 31 % in dry chopped grass and 10 to 29 % in the grass: shredded paper co-litter material. Dry chopped grass volatilised greater amounts of NH_3 than grass: shredded paper co-litter material ($P < 0.05$). It was also found that the spent litter (shredded paper and dry grass) had the required characteristics to be used as fertiliser and is a good substrate for composting due to its contents of NPK, minerals and low ADL

content. However, birds reared on both litter types showed breast blisters (Score of 1.50 vs 1.33) and FPS (2.17 vs 1.83), with no significant differences between the two treatments.

It was concluded that shredded printing paper could be used as an alternative co-litter material with wood shavings, for the production of broiler chicken. Waste paper from the printing industry can therefore be recycled as alternative bedding materials for poultry production.

Keywords: Poultry, Litter, Grass, Waste Paper

Abundance of a new thrips species, *Ceratothripoides brunneus* Bagnall (Thysanoptera: Thripidae) on tomato in Mauritius

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Abstract:

A new thrips species, *Ceratothripoides brunneus* Bagnall was detected on tomato plants at Richelieu in April 2015 during the routine pest surveillance on crops. *Ceratothripoides brunneus*, commonly known as the tomato thrips, is believed to be of African origin. It is reported to be mostly a pest of solanaceaeous crops (e.g., eggplant, chilli, sweet pepper, tomato and potato) but has also been found on other crops and even on weeds. Its larvae and adults feed on leaves, buds, flowers and fruits of tomato. The pest, as such, has not reported as a virus vector.

An investigation was undertaken during April 2015-June 2016 to study the abundance of *C. brunneus* on untreated tomato plots on three research stations at Richelieu (sub-humid), Reduit (humid) and Wooton (super humid region). The plots were monitored every 15 days. At every visit, 30 plants were selected at random from each site. From each plant, the number of adult thrips on the underside of three terminal shoots were counted. A similar methodology was used to determine the abundance of *C. brunneus* in farmers' fields.

Ceratothripoides brunneus was found present in untreated tomato plots on research stations and farmers during the period of study. The adult population of *C. brunneus* per plant in untreated plots in the humid region (6.0/terminal shoot) was highest but without any significant difference with that in the sub humid region (5.8/terminal shoot). It was significantly low in the super humid region (3.8/terminal shoot). The adult population per plant in the three climatic regions did not differ significantly between the summer and winter period. The average number of *C. brunneus* adults per terminal shoot in untreated plots during the vegetative stage was two-fold higher than that of the flowering/fruitlet stage. During 2015, *C. brunneus* was found in tomato fields of farmers at Piton, Medine and Goodlands (sub humid region) and at Le Chaland and Plaine Magnien (humid region) and also in tomato greenhouses at Phoenix, St Hubert and Reduit during 2016. Damage symptoms of tomato plants appeared when the number of *C. brunneus* adults per plant was more than 5 per terminal shoot. Such plants showed damage symptoms such as, cracking of small fruits and scarring of developing fruits.

Further investigation is warranted to determine the host range of *C. brunneus* and to develop strategies to manage the pest.

Keywords: Tomato, Thrips, *Ceratothripoides brunneus*

Evaluation de l'impact des agrobusiness sur le revenu des exploitations agricoles familiales dans le Delta du Fleuve Sénégal et à Maurice

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Résumé:

L'économie agricole occupe une place prépondérante dans les économies des pays de l'Afrique. En effet, la plupart des activités agricoles sont organisées et mises en œuvre par les exploitations agricoles familiales, la forme de production la plus importante au sein de l'économie familiale en Afrique. Cependant, elles sont peu productives et peu rentables. Conscients de l'importance de l'agrobusiness dans la génération de revenus pour les petits producteurs, et dans sa contribution à la sécurité alimentaire, les pouvoirs publics et les institutions nationales et internationales prônent le développement de l'agrobusiness. Malgré son importance dans l'amélioration de la productivité, de la réduction de la pauvreté et de la création de la valeur ajoutée dans l'agriculture familiale, l'agrobusiness exerce une pression croissante sur les ressources naturelles, accapare des terres des producteurs, utilise leur main-d'œuvre, augmente leur dépendance alimentaire entraînant ainsi la vulnérabilité de ces derniers. D'où l'importance de cette recherche dont l'objectif principal consiste à évaluer l'impact des agrobusiness sur le revenu des exploitations agricoles familiales (EAF) bénéficiaires au Sénégal et à Maurice.

Nous avons abordé la question par des enquêtes directes des producteurs, couplées à des entretiens et recherches bibliographiques. Ainsi, 270 producteurs ont été enquêtés à Maurice et 350 producteurs au Delta du fleuve Sénégal. Le cadre général pour l'analyse empirique est basé sur une comparaison de bénéficiaires des agrobusiness avec un groupe de contrôle, en utilisant la méthode du score de propension Logit. Ceci nous a aidé à évaluer les conséquences des agrobusiness en contrôlant le problème de sélection sur des décisions de bénéficier ou non des agrobusiness. L'analyse des données a été faite en utilisant la méthode de l'appariement (*matching*) qui consiste à utiliser les caractéristiques observées des bénéficiaires et non bénéficiaires pour générer un groupe de comparaison. Pour évaluer l'impact des agrobusiness sur le revenu des EAF, nous avons mis en place le modèle suivant : $Y_{iv} = \alpha + \beta X_{iv} + \delta Z_{iv} + \mu_{iv}$, où Y_{iv} représente le revenu relatif à l'exploitation agricole familiale i au village v ; X_{iv} représente les caractéristiques variables des exploitations agricoles familiales; α est une constante, β et δ étant les vecteurs des coefficients respectifs à ces variables; Z_{iv} représente l'ensemble des variables constantes (caractéristiques du village et aussi des exploitations agricoles familiales); et μ_{iv} est le terme d'erreur. La variable dépendante est le niveau de revenu. Les variables explicatives sont: l'âge, le sexe, le niveau d'instruction du chef d'exploitation, la taille de l'exploitation, le nombre d'actifs, le mode d'appropriation foncière, le niveau d'équipement, les spéculations cultivées, la superficie emblavée, la fertilisation utilisée, le niveau de production, et le lieu de vente de la production.

Les résultats montrent qu'à Maurice l'impact des agrobusiness sur le revenu des exploitations agricoles est de 1648 €. De plus le test T-stat atteste que cette valeur est significative au seuil de 10%. Il existe donc une corrélation positive entre le revenu des producteurs et la participation aux contrats ou partenariats avec les agrobusiness. Ce qui confirme l'hypothèse selon laquelle les producteurs améliorent leur revenu en bénéficiant des services des agrobusiness. Les résultats montrent qu'au Delta du Sénégal l'impact des agrobusiness sur le revenu des exploitations familiales est de 505 €. Cependant, les résultats révèlent aussi que cet impact n'est pas significatif pour le développement des producteurs. Les résultats montrent que le contrat et partenariat agricole suivent un modèle informel et sont souvent verbaux. L'analyse du modèle d'impact montre que la relation avec les agrobusiness permettent aux exploitations bénéficiaires potentielles d'augmenter leurs revenus agricoles d'environ 1648 € par an pour les exploitations de Maurice et 505 € par an pour les exploitations du Delta du Sénégal.

Cela donne à penser que le développement de l'agrobusiness approprié peuvent contribuer à la réalisation des objectifs des politiques pour le développement de l'agriculture familiale. Dans cette recherche, nous essayons de contribuer au courant de recherche visant à mieux comprendre les problématiques du développement de l'agrobusiness et de sa contribution au développement des exploitations agricoles. En outre, cette recherche pourra identifier des orientations claires du modèle de développement des exploitations agricoles à travers l'agrobusiness pour une aide de décision politique.

Mots-clés: Agrobusiness, familiales, Revenu, Sénégal, Maurice

Typologie et analyse de la dynamique des exploitations agricoles familiales dans la région de Kaolack (Sénégal)

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Résumé:

Au Sénégal, l'agriculture a toujours occupé une place centrale pour les populations rurales du fait de son rôle en termes de génération de revenus, mais aussi de sécurité alimentaire. Cependant, cette agriculture fait face à une croissance démographique galopante, une libéralisation du secteur primaire, une mondialisation de l'économie mais surtout une dégradation des conditions de production. L'objectif de cette étude est de dégager une typologie pour mieux cerner les performances et la dynamique des exploitations agricoles familiales afin de proposer des mesures appropriées pour relever le défi de la sécurité alimentaire.

La démarche adoptée dans cette étude est composée premièrement d'une revue documentaire suivie d'une enquête par sondage, effectuée sur la période de 10 Aout au 25 Septembre 2014, auprès de 185 exploitations familiales. Enfin, le recours aux méthodes d'analyse quantitatives et qualitatives nous ont amenées à fournir des explications à partir des points de vue des acteurs interrogés.

L'analyse des résultats montre que les exploitations sont confrontées à une dynamique de sur-utilisation des ressources menant à la dégradation des sols et la faiblesse des rendements ainsi que les problèmes d'écoulement et de stockage de la production. D'autres contraintes comme la variabilité des pluies, la saturation du foncier, et la vétusté des matériels agricoles ne font que renforcer les problèmes existants. Nous avons regroupé l'échantillon en trois types sur la base des variables de structure, de fonctionnement et de performance : les exploitations (i) de type I qui sont de taille réduites, sous équipées et générant les plus faibles revenus par exploitant ; (ii) de type II qui sont de taille moyenne, peu équipés en matériel et disposant d'un peu de bétail avec des revenus de niveau moyen par exploitant ; (iii) de type III qui sont de grande taille, plus équipés en matériel agricole et mieux pourvus en traction animal. Elles génèrent un revenu substantiel très important. Une exploitation familiale de la zone de la recherche compte en moyenne 5 actifs et chaque actif cultive 4,68 ha en moyenne par an. Leur taux moyen de couverture des besoins céréaliers par rapport à la production domestique est de 76 % soit une période de 9 mois et 7 jours et le revenu moyen annuel est de 35846 Francs CFA (FCFA) par exploitant. Devant cette situation de déficit, les exploitations ont adopté différentes stratégies à savoir: diversifier leurs revenus par l'introduction de nouvelles cultures; développer des activités non agricoles génératrices de revenus; rationaliser la commercialisation en évitant le bradage des récoltes; sacrifier la vente de bétail et de matériels agricoles pour faire face à la période de soudure. Dans cette présente étude, nous nous sommes intéressées aux capacités des exploitations familiales à faire face à leurs

besoins, afin de mettre en exergue les principaux changements et leurs conséquences pour l'agriculture. La caractérisation et la typologie des exploitations familiales dans la région permettent de retenir ces principaux enseignements: les chefs d'exploitations familiales, peu instruits, sont en majorité de genre masculin (94 %) avec une moyenne d'âge de 52 ans. Elles sont de type traditionnel dont la productivité reste faible de manière générale. Les superficies cultivées demeurent faibles car les exploitations agricoles familiales ont en moyenne une superficie cultivée de 4,68 ha par actif et par an. Elles comptent en moyenne 10 personnes. Le niveau d'équipement est très faible et une bonne partie du matériel agricole est vétuste. Compte tenu des contraintes naturelles, économiques et techniques qu'ils rencontrent, les agriculteurs ont tenté de trouver des solutions à leurs problèmes, notamment par la diversification des activités non agricoles comme le commerce, le travail salarié, l'émigration et l'artisanat. Les revenus générés par ces activités sont essentiellement destinés à la couverture des dépenses de consommation des ménages.

Ainsi, des efforts d'intensification et de modernisation des exploitations agricoles familiales doivent être faits pour relever le niveau de productivité et les productions agricoles afin de leur permettre d'assurer leur sécurité alimentaire et de générer des revenus substantiels pour ses membres. Les résultats de cette recherche pourront servir dans l'amélioration des stratégies prises pour renforcer la performance des exploitations agricoles familiale et favoriser une dynamique de production durable.

Mots-clés: Sécurité Alimentaire, Stratégies, Revenus, Sénégal

Consumers' knowledge, attitude and practices towards halal food in Mauritius

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Abstract:

The expanding global halal food industry caters for Muslim and non-Muslim consumers. "Halal" is an Arabic word which means lawful or permissible according to Islamic laws. The halal concept is not only confined to the slaughtering of animals, alcohol usage and sources of food. It also involves animal welfare, social justice, food hygiene, safety, quality and sustainability. "Halal-certified" is the term given to products which have been endorsed as "Halal" by accredited Islamic bodies. A food label can make a "Halal" claim or use a "Halal" logo if the product fulfils halal requirements throughout the food chain. International research has provided evidence that religiosity is a determinant of demand for halal food. However, it has also been reported that in some countries, non-Muslim consumers understand that halal food has been prepared in the most hygienic way and respond positively to halal food certification. There is a need for information on consumer behaviour which determines the future of the halal food market. In Mauritius, research on halal food is scarce. In this context, the present study was conducted to determine consumers' knowledge, attitude and practices relating to halal food.

A structured questionnaire was constructed as follows: fourteen multiple choice questions to assess consumers' knowledge; nineteen attitude statements with a three-point likert scale; twelve close-ended questions to determine halal food purchasing and consumption practices. The survey was conducted by face to face interview of staff and students of the University of Mauritius. The sample size was 90: equally distributed among three educational levels (primary, secondary, tertiary) and three religious groups (Hindu, Muslim, Christian). The data collected was analysed using the statistical software, SPSS (Version 16.0).

Results reveal a significant relationship between halal food knowledge and religious group ($p < 0.05$), as well as educational level ($p < 0.05$). Muslim respondents obtained highest mean % correct answers compared to those belonging to Hindu and Christian religious groups ($p < 0.05$). The trend of mean % correct answers to halal food knowledge questions for participants having different levels of education was: highest for those educated to tertiary level followed by those who had secondary and primary education respectively. 93.3% of respondents identified the correct definition of the term "halal food". A high proportion of respondents gave correct answers to the following halal food related questions: the purpose of the halal logo (84.4%); species considered as halal (76.7%); drinks considered as halal (73.3%); authorising body providing halal certification in Mauritius (68.9%); halal slaughter method (67.8%). On the other hand, a high % of respondents stated that they did not know the answers to the questions on halal food additives (68.9%) and kosher species (63.3%). 71.1% of consumers expressed agreement with the following attitude statements: "Religious rules play a critical role in food choice"; "Halal logo on products correctly informs Muslim consumers that the food product is halal". The same proportion of respondents stated that they disagreed with the attitude statement "Only Muslim consumers can eat halal foods". 67.8% of

participants indicated agreement with the statement relating to the need to educate consumers about the meaning of halal foods. About half of the respondents gave an undecided response to attitude statements on food safety, quality, animal welfare, sustainability and distribution issues associated with halal practices. A higher proportion of Muslim participants claimed agreement with the following attitude statements compared to the non-Muslim consumers: “I am willing to pay more to purchase halal foods” (53.3%); “I am willing to drive far to purchase halal food product” (66.7%); “Some food products containing the halal logo can be non halal” (60.0%); “I would buy more halal products if they were readily available” (53.3%); “I will not eat in restaurants which do not display the halal certificates” (86.7%). More than 80% of Muslim consumers surveyed affirmed that they “always” implement the following: purchase halal food products; check for the halal logo; check for the list of ingredients; ensure use of halal food ingredients; check for halal certificate when eating out. 83.3% Hindu and 73.3% Christian respondents responded that they “sometimes” purchase halal food products.

This study has demonstrated that religiosity affects halal food knowledge, attitude and practices. The findings provide a factual basis for consumer education to modulate behaviour towards promoting halal food.

Keywords: Halal, Food, Consumer, Religiosity, Education

DNA barcodes for the identification of armyworm species affecting sugarcane in Mauritius

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Abstract:

Outbreaks of armyworm species in commercial sugarcane cultivation in Mauritius have increased with the introduction of mechanical harvesting and these severely affect shoot development. Six species have been reported in Mauritius and identified morphologically as belonging to genus *Mythimna* (*M. loreyi*, *M. pseudoloreyi*, *M. phaea*, *M. insulicola*, *M. tincta* and *M. pyrausta*). However, there have been numerous debates among traditional taxonomists regarding the genus of the sugarcane armyworms, with genus *Leucania* being preferred in Australia. This has been cause of confusion and since all six species recorded in Mauritius are morphologically similar, identification has been more problematic. This situation may be a hindrance especially when biological control methods such as application of entomopathogens are considered, as they are highly species-specific. Hence, resort to DNA barcodes was made to assist in identification of the armyworms.

A 658 bp fragment amplified from the the 5' end of the mitochondrial cytochrome c oxidase 1 gene (CO1) was used as a barcode to discriminate amongst the armyworms species. Total nucleic acids were extracted from adult moths of all six species and PCR performed using universal primers LCO1490 and HCO 2198. The resulting 700 bp fragments were recovered from agarose gels and cloned using the pGEM T Easy Vector system (Promega). Plasmids were purified and the inserts were sequenced on both ends using standard SP6 and T7 primers. Sequence analysis was performed by comparing the local sequences with those of armyworm species in Genbank and in the Barcode of Life Database-BOLD.

M. pyrausta and *M. tincta* sequences did not reveal any exact match. For *M. pseudoloreyi*, 100 % sequence homogeneity was obtained with *M. curvula* barcode from Madagascar. Similarly, *M. loreyi* from Mauritius shared 100 % similarity with *M. loreyi* sequence from Pakistan and with *Leucania loreyi* from Australia. The *M. phaea* barcode had a 100 % match with a *M. phaea* barcode from Kenya. Thirteen barcode sequences from the six Mauritian armyworm species were deposited in Genbank and accepted as *M. pseudoloreyi* (GQ353296, JQ979422), *M. loreyi* (JQ979430, JQ979425), *M. phaea* (GQ353295, JQ979423), *M. pyrausta* (JQ979426, JQ979429), *M. tincta* (JQ979427, JQ979428) and *Leucania insulicola* (GQ353294, JQ979424, JQ979431). Sequence analysis using MEGA version 5.0 showed a divergence of only 2.34 % between *M. pseudoloreyi* and *M. loreyi*, revealing the close relationship between these two species, which are also very close morphologically. Mean interspecific sequence distances between the other species varied between 7.44 and 11.95 % confirming the presence of six distinct species of sugarcane armyworms in Mauritius. Mean pairwise intra-specific sequence divergences were 0.38 %, 0.09%, 0.09% and 0.16 % within

M. loreyi, *M. pseudoloreyi*, *M. insulicola*, and *M. phaea* respectively. A molecular identification tool for the armyworm species was developed following digestion of the barcode region. A combination of four restriction enzymes (*PvuII*, *TaqI*, *RsaI* and *SacI*) effectively distinguished the six armyworm species. This simple tool is now being applied for routine identification of armyworms, as a complement to conventional taxonomy especially in doubtful cases.

These results highlight the potential of DNA barcodes for insect pest identification. This technique would be extremely useful to entomologists in Mauritius either in a bid to characterise existing agricultural insect pests or to identify new and emerging unidentified ones.

Keywords: Armyworms, DNA Barcodes, *Mythimna*, *Leucania*

Assessment of the diversity of crop wild relatives in Mauritius and Rodrigues

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Abstract:

Mauritius is committed to set up conservation programs for its plant genetic resources under the Aichi Biodiversity Target 13. The rising need to find alternative food sources so as to mitigate climate change and consolidate food security urges the exploitation of crop wild relatives (CWR) as potential genetic resources for crop improvement. No scientific study focusing on CWR has been conducted in Mauritius and Rodrigues despite a high level of floral diversity and endemism. The “*In situ* conservation and use of CWR in three ACP countries of the SADC region” project, led by Bioversity International, aimed at assessing the diversity of CWR found in Mauritius and Rodrigues and at proposing adequate conservation measures to ensure their sustainable use.

A comprehensive list of the native wild species was collated from The Mauritius Herbarium and published literature. Detailed annotation of the following criteria: socio-economic value of the related crop, utilization potential for crop improvement, relative distribution, occurrence status and IUCN Red List Categories, for each species was done. A scoring method was devised and validated for each criterion, and this was used for the prioritization process. The occurrence data for the priority species were collected, verified and geo-referenced in order to develop distribution maps for the different species. The distribution of the priority species were mapped using DIVA-GIS version 7.5 and diversity and gap analyses were conducted using the Complementa tool of the CAPFITOGEN application, developed by the Food and Agriculture Organization (FAO). Out of the 526 taxa recorded for Mauritius, there were 42 that are related to food crops, 59 to forestry species, 106 to species used as ornamentals and 208 related to species of medicinal use, while Rodrigues with 142 species, 10 are related to foodcrop, 19 to forestry, 28 to ornamental and 65 to medicinal species. For active conservation, only the food crop-related species were selected and these included 3 *Coffea* (coffee), 2 *Elaeocarpus* (olive), 2 *Ficus* (figs), 2 *Digitaria* (millets), *Olea europaea* subsp. *cuspidata*, *Pandanus utilis* and *Acantophoenix rubra* for Mauritius. For Rodrigues, 9 species were chosen as follows: *Aloe lomatophylloides*, *D. ciliaris*, *D. didactyla*, *F. rubra*, *F. reflexa*, *Asparagus umbellulatus*, *Olea lancea*, *Ipomoea pes-caprae* and *I. violacea*. Each species was mapped to determine the distribution and threats at each location. Measures to address their conservation were proposed and it was found that some of the species were already within the established protected areas, except for a few.

The *Coffea*, a major global beverage crop, was found to have the highest diversity in terms of species, as well as number of populations in Mauritius. The study also revealed that for future predictive characterization works on CWR of interest; all surveyed populations have to be studied, given the small size of the island. The diversity hotspots for the CWR in Mauritius were also determined, showing that Mondrain Nature reserve harbors the highest diversity of CWR, followed by Florin and Le Pouce Mountain. Although a wide diversity of CWR has been surveyed, most of them do not relate to the major economic crops of Mauritius and Rodrigues, however a couple of them may be gene donors to economic crops at the regional and global level. The information gathered was used to develop a National Strategic Action Plan (NSAP), which lays down concrete actions to be taken for active conservation and sustainable use of CWR. The NSAP will be endorsed by the Government of Mauritius and will contribute to the formulation of the National Biodiversity Strategic Action Plan.

Future research should investigate into the utilization potential of these priority species through morphological, biochemical and molecular characterization and how they can be integrated in current pre-breeding programmes.

Keywords: Crop Wild Relatives, Genetic Resources

An assessment of consumers' purchase intention of organic chicken in Mauritius: an application of the Theory of Planned Behaviour

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Abstract:

Mauritius has achieved almost 100% self-sufficiency in chicken meat with a baseline production of 47,500 tonnes in 2014 and production forecasted to reach 50,000 tonnes by 2020. Organic chicken meat production can be identified as an opportunity for the development of a viable market niche in the poultry meat sector in Mauritius. Over the years, agriculture has evolved to meet the ever changing demand of consumers. Consumers are becoming more and more conscious of the food they consume, its health benefits and consequences. Some consumers are even more focused on the management and quality of the products they take in. This study was carried out to predict and describe the likely purchase behaviour of consumers in Mauritius towards organic chicken, and hence the intention to buy organic chicken. Consumers' intention of buying organic chicken is the first step in developing the demand for the niche organic production.

This study examines the perception of consumers about chicken available on the Mauritian market and their likely proclivity towards organic chicken. The Theory of Planned Behaviour (TPB) was used to inform the research framework and hypotheses of the research work. A critical investigation of attitudinal, motivational and demographic factors, and the interrelationships between them, that could influence consumers' interest for organic chicken was investigated. 373 consumers were sampled using multistage sampling technique (systematic, stratified and quota sampling) across the five major urban areas in Mauritius. The survey was conducted around the major supermarkets and hyper markets in the urban areas. Structural Equation Modelling (SEM) under Confirmatory Factor Analysis (CFA) and descriptive analysis were used.

Findings revealed that 72% of consumers believed that chicken contained added hormones and steroids, 62% had the belief that chicken contained antibiotics, whilst 59 % believed chicken was housed in cages. It was further observed that 40% of consumers had no clear definition of the word "organic". The results of the structural equation modelling (SEM) indicated that attitude (AT) and perceived behavioural control (PBC) exerted significant ($P < 0.05$) positive effects on the willingness of consumers to purchase organic chicken. Subjective norms (SN) on the other hand were not significant ($P > 0.05$). The proposed model fitness parameter (CMIN=29.58, GFI=0.983, CFI=0.988) validated the model used to predict the behaviour of consumers towards organic chicken. Findings of the study using TPB confirmed that consumers' intentions towards organic chicken was influence their attitude, subjective norms and perceived behavioural control and this leading to the actual purchase of the niche product.

It was concluded that there is a positive and fertile environment for organic chicken production in Mauritius. However, in the area of policy, the government through the Ministry of Agro-Industry and Food Security should focus on developing clear guidelines for marketing as well as labelling chicken and other related organic products. Furthermore, development of a detailed certification document for organic chicken needs should be considered for future implementation. Stakeholders involved in conventional chicken production (Innodis Poultry Ltd, Food and Allied Industries, etc.) also need to work on proper discrimination of production information in order to communicate the commitment of the poultry sector to food safety, environmental sustainability, animal welfare and disease risk management. This will promote positive consumer attitude and trust for chicken products.

Keywords: Theory of Planned Behaviour, Organic Chicken

Processing of *Gracilaria salicornia*, a local seaweed in Mauritius into Jam and Pickles

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Abstract:

Seaweeds constitute one of the potential commercially important marine living renewable resources. They are widely used in various industries as gelling, stabilizing and thickening agents. Seaweeds are good sources of human food and are being more widely consumed and exploited worldwide by the manufacturing, pharmaceutical and cosmetic industries. Seaweeds can be used in the manufacture of edible products such as jelly, pickles and jam. They are rich in protein, vitamins, amino acids, growth hormones, minerals and other trace elements.

In the context of food security it would be highly beneficial to exploit the nutritive potential of locally available seaweeds in the Mauritian diet and to develop an edible seaweed industry. This study was the first one to be conducted on the locally available seaweed *Gracilaria salicornia* (red algae) in Mauritius. The objectives were to (i) determine the suitability of the seaweed in the pure form and mixed with selected local vegetables and fruits for processing with particular focus on the manufacture of jams, jellies and pickles and protocol formulations (ii) determine the quality of the seaweed processed products with regard to nutrient composition and shelf life (iii) assess consumer acceptability.

The seaweed was sourced from the Mauritian lagoon, stored at 6°-8°C up to 3 days, cleaned and processed. Different protocols were evaluated taking into consideration pre-treatments, salt concentration, acidification, sugar concentration and different ratios of seaweed to vegetables or fruits. Visual assessment of the local *G. salicornia* indicated that the alga's colour vary from dark green to greenish brown and with a firm, brittle and crunchy texture. A protocol was developed for cleaning *G. salicornia* and it was found that boiling of the seaweed as pre-treatment was essential to facilitate processing. No pectin was used in the evaluation of *G. salicornia* for jelly and jam products. Jellies from the seaweed did not set well indicating low gelling capacity of this local seaweed species. *G. salicornia* was found highly suitable for processing into (i) jam production in pure form and mixed with local fruits like roselle and pineapple without addition of pectin (ii) spicy pickle in the pure form and mixed with vegetables like carrots and tomatoes, resulting in the development of 6 products. Comparison of the nutritional values of the processed products with fresh seaweed indicated that the carbohydrate content increased while mineral content decreased after processing. Shelf life studies based on physico-chemical parameters like colour and texture (visual), flavour (sensory), °Brix and titratable acidity have shown that the jam can be kept above 15 months while the pickles have a shelf life of up to 12 months. Microbiological analysis indicated that the products were within prescribed limits as per the Mauritian Food Regulations 1999 for the following parameters: Total Viable count (up to a maximum of 28,000 cfu/g), Yeasts & Molds (less than 1 at dilution 10¹ cfu/g), *Coliform*, *E. coli*, *Salmonella* and *Staphylococci* were absent. Consumer acceptability study throughout the island targeting people of different social and cultural background and including the fishermen community has shown that above 95% of people claimed to taste seaweed products

for the first time and that on average above 70% of consumers liked the products. Above 65% of the consumers stated they detected an after taste associated with sea based products; 75% of the participants mentioned that they would purchase the products occasionally. The consumer study also provided an opportunity to create awareness on seaweed consumption locally.

Protocols of the processed products have been disseminated through training sessions among women entrepreneurs in Rodrigues and Mauritius. The protocols have been adopted by a group of fisherwomen and entrepreneurs in Rodrigues and the products are currently commercialized in Rodrigues and Mauritius.

Key words: Seaweed, Processing, Jam, Pickle, Quality

Opportunities for tomato processing in Mauritius

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Abstract:

Tomato (*Solanum lycopersicum*) is cultivated over an area of 740 ha in Mauritius with an average annual production of 10200 t mainly for the local market as fresh produce. There is an ever increasing demand for tomato processed products such as whole peeled in cans, ketchup, sauce, puree, and juice. An average of 8451 t of processed tomato products for a value of 270 M rupees is being imported annually. Therefore, opportunities exist in commercial cultivation of processing tomato varieties and in production of processed products. To enhance the agro processing sector and reduce imports, the Government, in its Non-Sugar Sector strategic plan 2007 – 2015, had provided support measures to entrepreneurs to invest in the technology of agro processing.

In line with the Government policy to ensure food security and reduce importation, a project was set up in 2009 to investigate the cultivation of different tomato varieties for processing and to develop processing techniques that can be subsequently used by entrepreneurs interested in agribusiness. Fourteen varieties were introduced in 2009 and evaluated on FAREI research stations in two agro-climatic zones for their yield and tolerance to major pests and diseases. Four processing varieties (AB 2, AB 3, AB 4606 and AB 8058) were found to adapt well to the two local agro-climatic conditions with an average yield of 20 to 25 t/ha. The average fruit weight ranged from 81 to 105 g and fruit diameter from 5.0 to 5.7 cm.

The fruits of these four promising varieties were characterized for processing attributes in terms of shape, size, firmness, total soluble solids and acidity. Seven protocols were developed for the production of processed products. The total soluble solids and acidity percentage was found to be in the range of 5.0 to 6.7 °Brix and 0.60 to 0.67% respectively. Following the physical and chemical analysis, the four varieties were found to be suitable to be processed into different products such as puree, ketchup, diced tomato, dehydrated tomato, pasta/pizza sauce and tomato oyster mushroom sauce. An average yield of above 50% was obtained for the different products. They were highly appreciated following sensory evaluation with a high sensory value of 6/7. However, due to their high acidity, the varieties were not suitable for processing into juice.

The technique for cultivation of the four identified varieties for tomato processing was demonstrated at one farm at Plaines Sophie and in four women entrepreneurs' farms. Sixty women entrepreneurs were trained in the production of processed products. Information sheets on value addition to tomato were produced. An audiovisual was also made involving the different steps in processing.

This study showed that local production of processed tomato products can be achieved. To promote the expansion of this industry, incentives in terms of clustering and financial support should be provided to tomato growers, entrepreneurs and the industry.

Keywords: Tomato Varieties, Processing, Entrepreneurs

Smart Agriculture: Une méthodologie pour la réduction de l'utilisation des pesticides en agriculture vivrière

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Résumé:

La Chambre d'Agriculture de Maurice s'est engagée dans le projet Smart agriculture depuis juin 2015 avec les objectifs finaux d'offrir des produits alimentaires sains aux consommateurs tout en favorisant une agriculture raisonnée. Une enquête a alors été réalisée auprès de 300 agriculteurs répartis sur l'ensemble de l'île Maurice dans le but de comprendre les pratiques phytosanitaires de ceux-là sur leurs légumes. Cette étude a montré que les agriculteurs utilisent beaucoup de pesticides de manière préventive et répétée (90% des cas) et doivent faire face à de nouvelles impasses techniques. Dans l'ensemble ils souhaitent changer leurs pratiques agricoles, ils ont conscience qu'elles ont un impact sur la santé et l'environnement, mais ne savent pas comment faire autrement. Ces résultats ont mis en avant le besoin d'accompagnement et de formation des agriculteurs afin de les rendre plus autonomes et responsables par rapport à un conseil trop prescriptif pour le moment. De ces constats a émergé une seconde phase au projet Smart Agriculture dont les buts sont de démontrer qu'il est possible de réduire l'utilisation de pesticide pour la production vivrière, d'essayer et de valider des techniques alternatives aux pesticides en les adaptant aux conditions mauriciennes et enfin de diffuser les résultats obtenus.

Pour montrer ceci, il est prévu de créer deux réseaux des fermes pilotes (appelés réseaux FERME), un composé d'une dizaine de petits agriculteurs groupés sur une zone géographique restreinte et un second composé d'une dizaine de gros agriculteurs répartis sur l'ensemble de l'île Maurice. Cette caractérisation a pour but de montrer l'impact de ce projet sur des échelles et des conditions pédo-climatiques différentes. Les agriculteurs participants s'engageront pour une période de trois ans à un travail participatif qui consistera à identifier, tester et mettre en œuvre des solutions innovantes leur permettant d'utiliser le moins de pesticides possible. Chaque agriculteur restera indépendant par rapport à ses objectifs et au fonctionnement de son exploitation agricole. La méthode du projet se compose de quatre étapes qui se répéteront chaque année pour permettre une amélioration continue des systèmes mis en place. La première étape sera un diagnostic initial de chaque ferme selon la méthode proposée par le Guide Tropical publié par le Centre de coopération International de Recherche Agronomique et de Développement (CIRAD) (Le Bellec, 2015). Le but sera de comprendre le fonctionnement global de chaque exploitation agricole, les contraintes et atouts pour la gestion phytosanitaire et les problèmes de bioagresseurs rencontrés. A partir de là il faudra évaluer les marges de progrès possibles entre le système en place et un système plus performant. Chaque agriculteur pourra alors se fixer un objectif à atteindre de réduction de pesticide. La seconde étape consistera à concevoir des systèmes de culture alternatifs. Le partage entre les agriculteurs au sein de chaque réseau sera la clé pour identifier collectivement des méthodes de luttés alternatives soit déjà existantes à Maurice, soit

approuvées à l'étranger, de les tester chez chaque agriculteur pouvant les appliquer. Pour cela une part de formation sera prévue par de la documentation, la rencontre d'expert ou d'autres acteurs du monde agricole. L'animation de chaque réseau sera assurée pour un ingénieur et le suivi technique des performances se fera par les ingénieurs réseaux, les autorités locales compétentes (Food and Agriculture Research and Extension Institute) et un partenaire technique extérieur (CIRAD). La troisième étape sera l'évaluation, après une année, des systèmes mis en place d'un point de vue environnemental par une Analyse de Cycle de Vie, économique et social. De nouveaux objectifs de réduction de pesticides pourront alors être déterminés. La quatrième étape du projet sera la diffusion des résultats obtenus par des publications scientifiques, l'organisation de journées portes ouvertes, des films de sensibilisation.

Enfin le projet devrait permettre de créer une dynamique d'échange d'idées novatrices au sein de secteur agricole à Maurice. Sa mise en œuvre est déjà innovante car elle change la posture de conseil en responsabilisant les agriculteurs, mais aussi parce qu'elle permet l'appropriation de techniques alternatives, notamment par transfert technologique. Il devrait débuter en septembre 2016 et les premiers résultats seront disponibles à partir de la fin 2017.

Mots-clés: Agriculture Durable, Méthode Participative, Innovations

Accessibility and relevance of extension methods, information and communication technologies among farmers in Mauritius

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Abstract:

Agricultural information is vital for improving productivity and for development. This study determines the accessibility and relevance of information provided by different extension methods. It also evaluates the potential and effectiveness of ICT tools, acting as a medium in disseminating agricultural information in order to achieve optimum productivity in agriculture.

A quota sample of 100 farmers (60 crop producers and 40 livestock farmers) were interviewed across the four respective zones (North, South, East and Centre West) of Mauritius. Structured interview schedule was used in collecting raw data from farmers. Quantitative data obtained were analysed using SPSS (version 20) and Microsoft Excel.

The most efficient and preferred extension methods of farmers were firstly visits by extension officers (25.2%), followed by phone calls (19.8%) and video films (13.1%). The respondents also claimed that training, SMS, exhibitions and mass media are useful in providing beneficial information. Mobile phone is the main ICT device used by farmers (65%) to retrieve agricultural information. The findings revealed that training and access to publications were dependent on age ($p < 0.05$) and educational level ($p < 0.05$). The access of smartphone and computer ($p < 0.05$) was significantly associated with income rate and educational level. Lack of knowledge, high cost of the device and inability to use internet were major barriers for not possessing ICT tools. It was concluded that extension methods such as visits, training and exhibitions should be intensified to allow accessibility to useful information. ICT tools has a promising consequence on the upcoming farming system in Mauritius. These devices are considered as genuine tools to link extension agents and farmers. The study also revealed that there was significant difference between the socio-demographic characteristics of farmers and mean usage of communication technologies to solve different farming activities.

It is recommended that efficient extension methods such as visits, video films, training and exhibitions are regularly carried out and awareness creation on the effective use of ICT tools should be reinforced by the government and private sectors leading to encouragement in enhancing productivity and boost up the agricultural sector providing policies, schemes and agricultural ICT courses.

Keywords: Agricultural Information, Extension, ICT Tools

Vegetation and nutritive value of forages in deer ranches (chassées) in Mauritius

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Abstract:

Rusa deer (*Cervus timorensis russa*) is of socio-economic importance in the local context for the production of venison, of which the annual production fluctuates between 450-500 tonnes. Deer are reared mostly in ranches (deer chassées), an extensive system of production based on native vegetation and is associated with low productivity. However, little is known about the diets of deer in the ranches and a study was conducted to establish baseline data on the vegetation in ranches and the nutritive value.

The types of vegetation in three 3 ranches located in 3 agro-climatic zones (sub-humid: Bel Ombre; humid: Etoile; super-humid: Bar Le Duc) were studied during the summer and winter seasons. The forages of the pastures in the ranches were sampled using 06m x 0.6m quadrats while the line intercept method was used to sample the trees and shrubs. About one fifth of the total area of the ranches was surveyed. The collected samples were first identified, then dried and ground for proximate analysis, determination of copper, and dry matter degradability using the nylon bag technique.

Grasses for grazing and trees/shrubs for browsing were the two broad types of vegetation available in the ranches throughout the year. Herbe d'argent (*Ischaemum aristatum*) formed a pure sward and is grazed throughout the year on the 3 ranches. A wide range of trees and shrubs were also identified but relative abundance varied from farm to farm. Fatac bambous (*Thysanolaena maxima*) was common in all 3 ranches. Trees that were abundant in the sub-humid zone were Bois noir (*Albizia lebbek*) and Ficus (*Ficus sp.*). In the humid zone, a combination of trees and shrubs were abundant namely Bambusa (*Bambusa multiplex*) Piquant loulou (*Rubus alceifolius*), Bois d'oiseaux a grande feuilles (*Litsea monopetala*) and Cannelle (*Cinnamomum verum*). On the other hand, trees/shrub species namely Vieille fille (*Lantana spp.*), Bambusa (*Bambusa multiplex*), Privet (*Ligustrum robustum*) and Piquant loulou were common in the super-humid zone. Other vines, grasses, trees/shrubs that form part of the vegetation in the ranches and were less abundant include the following: Liane lègue (*Paedenia foetida*), Stargrass (*Cynodon plectostachyus*), Guatemala grass (*Tripsacum laxum*), Bois d'oiseaux a petite feuilles (*Litsea glutinosa*), Acacia (*Leucaena leucocephala*), Ravenala (*Ravenala madagascariensis*), Privet (*Ligustrum robustum*) and Goyave de chine leaves (*Psidium cattleianum*). The crude protein content (% of dry matter) of Herbe d'argent, Stargrass and Guatemala grass was 4.5%, 8.9% and 14% respectively while that of most trees/shrubs was in the range of 6.5 to 13 %, except for Bois noir and Acacia which range from 15 to 20 % on a dry matter basis. The acid detergent fibre (ADF) and lignin contents of browses, indicative of their digestibility, ranged from 30 to 67 % and from 10 to 36 % on a dry matter basis respectively, irrespective of season and location. Browse species like Bois d'oiseaux a grande feuilles, Vieille fille, Ficus spp, Acacia and Bois noir had high contents of copper (9-19 mg/kg DM), an important element in avoiding physiological disorders like enzootic ataxia. Rumen degradability of browses/shrubs was classified in two groups: low to

moderate (35 to 49 % at 48h) comprising of Canel, Piquant Loulou, Ravinela and Goyave de Chine and high value (50 to 70% at 48h) comprising of Bambusa, Bois d'Oiseaux a grande feuilles, Privet, Bois Noir, Liane Lengue, Fatac bambous, Acacia and Guatemala grass. Herbe d'argent which forms the bulk of the forage diet of deer had low degradability (40% at 48 h).

The study showed that browse/shrub species (Bois Noir and Acacia, Vieille Fille, Ficus and Bois d'Oiseaux) have high nutritive value in terms of crude protein contents compared to other foraging species and may have the potential to complement Herbe d'argent in the diet. Bois noir is available only in sub-humid zones and its utilisation can be exploited through propagation in the ranches. On the other hand, a promising tree species *Calliandra calothyrsus* which produces biomass with high crude protein has been studied on FAREI station and is recommended for planting in the ranches in the humid zones so as to offer a better source of on farm feed supplement.

Keywords: Rusa Deer, Chassées, Browse Species

Towards marker assisted selection for yellow spot disease resistance in sugarcane breeding programme

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Abstract:

Yellow spot (YS) is a major disease of sugarcane caused by the fungus *Mycovellosiella koepkei* Deighton and accounts for up to 25% yield loss among susceptible varieties in the super-humid zone of Mauritius. The selection for resistant varieties in the breeding programme of the Mauritius Sugarcane Industry Research Institute (MSIRI) is complex, costly, time-consuming, and its accuracy is dependent on weather conditions and disease pressure in a given year. To improve on conventional selection for resistant hybrids, research focused on the identification of molecular markers linked to yellow spot disease resistance (YSDR) quantitative trait loci (QTL) to complement traditional selection and for their eventual use in marker assisted selection (MAS).

Amplified fragment length polymorphism (AFLP) and simple sequence repeats (SSR) marker data was available for mapping population of 180 individuals derived from a cross between M 134/75 (resistant to YS) and R 570 (susceptible to YS). This population was further genotyped with five sugarcane and 62 sorghum expressed sequence tags SSR primers (EST-SSRs) and restriction site associated DNA sequencing (RADseq) in order to construct high density linkage maps of the mapping parents and for YSDR QTL analysis. The EST-SSRs revealed 142 polymorphic markers that were present in M 134/75 and absent in R 570. RADseq genotyping involved the reduction of the genome complexity of the mapping parents and each progeny by a double digestion with restriction enzymes *MseI* and *NsiI*, adaptor ligation and selective amplification of restricted fragments (RADtags). The amplified RADtags from the samples were pooled in three RADseq libraries which were sequenced on the Illumina HiSeq 2500 sequencer. On average, 177 million reads of 100 nucleotides were produced per library. Sequence analysis was carried out using Stacks, Novoalign and Samtools software.

In total, 8,873 single nucleotide polymorphisms (SNPs) were identified for the resistant variety M 134/75. These were trimmed to 2,777 markers based on percentage of missing data and single dose segregation ratio. Variety R 570 revealed 12,157 RADseq SNP markers which were trimmed to 4,500 markers for linkage map construction. The SNP marker data was combined with the 142 EST-SSR markers and 658 previously scored AFLP and SSR markers to construct a linkage map of variety M 134/75 using Joinmap 4.1 software. Marker grouping was carried out starting with a LOD of 10.0 and gradually reducing it to 6.0. Regression mapping with Kosambi mapping function at a recombination rate fraction fixed at 0.4 was used to determine the map distances and order across each linkage group (LG). The enhanced M 134/75 map consisted of 286 LGs derived from 2048 markers with a total map size of 8277 centimorgans (cM). The linkage map of variety R 570 was constructed solely from RADseq markers and consisted of 1769 markers integrated into 222 LGs and was 4779

cM in size. Analysis of QTL for resistance to YS was carried out using the disease infection rate data scored in 2001 and 2002 from two locations, the linkage maps of the mapping parents and the combined marker data. The multiple QTL model approach from MAPQTL software identified a major QTL on LG28 of variety M 134/75 flanked by markers EST-SSR SAT2033 and SAT2036 at a distance of 4 cM and 8 cM respectively. This new QTL explained 30% of the phenotypic variation with an additive effect of 14.8 and was found to be stable across the two locations. On the same LG was located the SSR marker CIR12284, which was already associated with a QTL for YS resistance and which accounted for 12.9% of the phenotypic variation. QTL mapping of susceptible parent R 570 identified a haplotype of four SNP markers collinear to sorghum chromosome 6 in the region 60183062- 60183025 bp, which was negatively associated to YS resistance. This QTL exerted an additive effect of -11.3%, in which case, selection has to be carried out against the presence of the marker. In order to assess the association of the SAT2033 marker to the YSDR QTL, 50 commercial and pre-commercial sugarcane varieties were screened with EST-SSR primer SAT203. All varieties rated as susceptible and highly susceptible to YS (35) based on field data, failed to show the presence of the SAT2033 marker. This marker was however present in one out of six slightly susceptible varieties and seven out of nine resistant varieties

These results indicate a good potential of the SAT2033 marker for the screening of YS disease resistance in sugarcane.

Keywords: RADseq, QTL, Yellow Spot, Sugarcane

Antimicrobial properties and DNA protective potential of endemic Myrtaceae plant species

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Abstract:

The plant kingdom houses an array of bioactive compounds which are employed in the synthesis of numerous drugs. The increasing interest in these drugs is due mainly to the side effects associated with synthetic drugs and because of emerging drug-resistant microorganisms. The objectives of this study were: (i) to screen the selected plant species for the presence of bioactive compounds, (ii) to assess the antioxidant properties of the plant species, (iii) to investigate the antibacterial activities of the plant extracts against selected Gram-positive and Gram-negative bacteria, (iv) to establish the molecular profile of the selected species, and (v) to investigate the DNA protective potential of the plant extracts.

Solvent extraction was carried out using two solvents, namely methanol and hexane. The phytochemical profiles of the selected plant species were then determined using a series of test tube tests and thin layer chromatography (TLC). The total phenolic content (TPC) of the plant extracts was carried using the Folin-Ciocalteu procedure while the total flavonoid content (TFC) of the extracts was analysed using the AlCl₃ colorimetric method described by Brunchault *et al.* (2014). The antioxidant activity of the plant extracts was assessed using two assays which are the 2,2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging assay and the ferric reducing antioxidant potential (FRAP) assay. The antimicrobial activity of the methanol and hexane extracts against *Escherichia coli*, *Staphylococcus epidermidis* and *Staphylococcus aureus* was also determined using a modified broth microdilution assay whereby the minimum inhibitory concentration (MIC) of the extracts was obtained. For the molecular analysis, DNA was extracted from the leaves of the plants using a modified CTAB method. The extracted DNA was analysed spectrophotometrically and was then amplified using two sets of primers, namely Ab101 and Ab102 and rp120 and rps12. The PCR products obtained were purified and then sent for sequencing. The sequences were then assembled, verified and edited using the BioEdit Sequence Alignment Editor program. A phylogenetic tree was generated. Lastly, a DNA protective assay was performed using supercoiled pUC19 DNA plasmid with the methanol and hexane extracts.

Preliminary qualitative chemical screening of the methanol and hexane extracts revealed the presence of alkaloids, terpenes, tannins, phenols, saponins, anthraquinones, leucoanthocyanins and flavonols. Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) indicated that the methanol extracts had higher content of total phenolics and total flavonoids than the hexane extracts. For the DPPH assay, it was observed that the lowest IC₅₀ value was obtained with the methanol extract of *S. coriaceum* while the methanol extract of *S. petrinense* had the highest IC₅₀ value. The highest FRAP value was obtained with the methanol extract of *S. petrinense* (81.11±0.509 mM Fe²⁺/mg extract) while the hexane extract of *S. latifolium* had the lowest FRAP value (2.04±0.103 mM Fe²⁺/mg extract). The antibacterial activity evaluated by the broth microdilution method resulted in all the 6 plant

species inhibiting *S. epidermidis*, *S. aureus* and *E. coli* at various levels. However, the methanol extracts were more effective against *E.coli* with MIC values ranging from 0.39 mg/mL to 1.56 mg/mL. For the PCR analysis, PCR products were obtained only with the primers rp120 and rps12. From the phylogenetic tree generated, the *Syzygium* species were found to form a separate cluster from the *Eugenia* species. For the DNA protective assay, no bands were obtained for either the methanol or the hexane extracts, therefore demonstrating the degradation of the pUC19 plasmid DNA. The study on the methanol and hexane extracts of *S. latifolium*, *S. commersoni*, *S. coriaceum*, *S. petrinense*, *E. pollicina* and *E. pyxidata* revealed that the species contain a wide array of bioactive compounds which are medicinally important. The methanol extracts of the six species were found to have high TPC and TFC as well as high antioxidant activities.

Hence, these 6 plant species may have therapeutic applications. The molecular analysis of the species showed that the *Syzygium* species were more closely related to each other than they were to the *Eugenia* species. Moreover, the presence of large amounts of contaminants in *S. commersoni* could account to the fact that no sequences were obtained for the latter.

Keywords: Myrtaceae, Antioxidant, Antimicrobial, DNA-Protective-Assay

Mycoremediation of textile effluents

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Abstract:

This study has been conducted in response to the water quality crisis and damage to the environment caused by textile effluents. The discharge of textile effluents in water bodies results in aesthetic pollution, eutrophication and consequently, harmful algal blooms. In addition, constituents (e.g. dyes, detergents and organic acids) of these effluents exhibit toxic, carcinogenic, mutagenic and teratogenic effects on all life forms. The failure of common physical and chemical wastewater treatment methods to adequately treat wastewaters is mainly due to the cost aspect. The purpose of the research was to provide a cost-effective and efficient alternative to manage textile effluent so that it is safe to dispose of. To accomplish this aim, bioremediation using fungal isolates, a concept termed mycoremediation, was investigated. The objectives of this study were to isolate fungal species from the soil of the dormant volcano Trou aux Cerfs, to identify the fungal isolates using molecular tools and to assess the efficiency of each isolate in the treatment process using physicochemical indicators.

Fungal species were isolated on potato dextrose agar at room temperature from the collected soil samples. The site is a potential fungal diversity hotspot and its microbial diversity has never been explored before. To identify the isolates, the ITS region was amplified using the ITS4/5 primer pair. The mycelial cells were immobilised by the entrapment method in a 4% alginate matrix. The bioremediation process was tested on textile effluent and was carried out in triplicates for each isolate over a period of 12 days. Physicochemical parameters including chemical oxygen demand (COD), nitrate, sulfate and phosphate concentrations, pH and electrical conductivity were characterised and used as indicators of bioremediation.

Four fungal species were selected and molecular data indicated that Trou aux Cerfs harbours fungi of the genera *Curvularia*, *Penicillium*, *Pestalotiopsis* and *Phoma*. Nearly all of the tested parameters of the untreated textile effluent were significantly higher than the standard discharge limits: COD level of 1923 mg L⁻¹, nitrate level of 23 mg L⁻¹, sulfate level of 669 mg L⁻¹, phosphate level of 3 mg L⁻¹, acidic pH of 2.92 and electrical conductivity of 1563 μS/cm. After a 12-day treatment period, the results showed that all four isolates were able to degrade the contaminants present, consequently forming additional phosphate, nitrate and sulfate compounds. The isolates eventually assimilated these ions to different extents, thereby reducing the concentrations of these undesirable compounds in the effluent. COD was reduced by 80 to 93%, nitrate levels were reduced by 74 to 82%, sulfate levels decreased by 10 to 13%, phosphate levels were reduced by 41 to 84% and electrical conductivity experienced 13% reduction at most, reflecting the capacity of fungal species to treat textile effluents and to bring the levels of the undesirable compounds below the standard limits.

The findings indicate that all the isolates can be employed to treat textile effluents effectively. Immobilisation of the mycelial cells enabled easy recovery of the beads and the immobilised cells can also be reutilised for another round of treatment. The non-fastidious nature of fungal organisms coupled with the reusability aspect of immobilised cells creates a cost-effective

strategy. Use of immobilised fungal isolates therefore represents a promising and efficient system for the bioremediation of textile effluent.

Keywords: Bioremediation, Environmental Microbiology, Fungi, Textile Effluent

POSTER PRESENTATION

Antimicrobial properties and DNA barcoding of endemic *Pandanus* species

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Abstract:

Among the different endemic flora species of Mauritius, there exists the genus *Pandanus*. The *Pandanus* genus is made up of approximately 700 species. The present study was carried out with seven endemic species of *Pandanus* out of the 19 endemic species that are known in Mauritius. The aim of the study was to assess the antimicrobial and antioxidant potential and DNA barcoding of the endemic *Pandanus* species. The objectives of the project were to establish the phytochemical profile, to test for the antimicrobial properties and the antioxidant capacities of *Pandanus* species and to characterize the uniqueness of different endemic *Pandanus* species at the molecular level using DNA barcodes.

The leaves of the 7 species of the *Pandanus* were extracted with the solvents methanol and hexane using a rotary evaporator. The methanol and hexane leaf extracts were screened for the presence of bioactive compounds such as tannins, saponins, anthraquinones, phenols, flavonols, steroids or alkaloids by test tube tests and Thin Layer Chromatography (TLC). Quantitative assays using UV spectrophotometer were used to measure the total phenolic content and total flavonoid content of the extracts. The antioxidant activities were determined using the DPPH (Diphenylpicryl-hydrazyl) and FRAP (Ferric reducing antioxidant power) assays. The broth microdilution assay was used to assess the antimicrobial activities of the *Pandanus* species. The DNA was extracted, followed by RNase treatment and PCR amplification was done. PCR optimization was done by purifying the DNA using the DNeasy Plant Mini kit, by changing the annealing temperatures, by increasing the volume of dNTPs and by using different primers. The results were expressed as mean±standard derivatives and the statistical significance was declared when *p*-value was < 0.05. The relationship between the TPC, TFC and the antioxidant capacity (FRAP and DPPH) of the extracts was determined by Pearson correlation. One-way ANOVA with Tukey's test was used to determine differences between the 7 species with respect to TPC, TFC and antioxidant capacities.

The percentage yield ranged from 0.28 to 7.42%. The highest yield was observed with the methanol extract of *Pandanus rigidifolius* and the lowest yield was found with the hexane extract of *Pandanus carmichaelii*. Tannins were found in both the methanol and hexane extracts. Saponins, anthraquinone, leucoanthocyanin and flavonol were found mostly in the methanol extracts and absent in all the hexane extracts. Alkaloids, phenols and steroids/terpenes were present in both extracts. The phytochemicals were present in higher amount in the methanol extracts. The free radical scavenging activity (DPPH) of the extracts ranged from 21.37±0.265 % to 80.39±1.04 % and the FRAP value ranged from 1.09±0.099 to 12.23±0.00 mg FeSO₄/g extract. The highest TPC (Total phenolic content) value was observed with methanol extract of *Pandanus glaucocephalus* with 53.33±1.69 mg GAE/g and the lowest value was from the hexane extract of *Pandanus weihei* with 14.04±1.75 mg GAE/g. The TFC (Total flavonoid content) value ranged from 9.29±2.58 to 416.2±29.5 mg QE/g and the highest value was observed with the methanol extract and the lowest with hexane extract. The *Pandanus* revealed to have antimicrobial activities against *S.aureus*,

S.epidermidis and *E.coli* with minimum inhibitory concentration ranging from 3.125 to 20.83±7.22 mg/ml. Genomic DNA was obtained for all the species but the RNase treatment was not effective. The PCR amplification was not successful due to the presence of contamination inside the extracted DNA. Furthermore, since the methanol extracts revealed most of the phytochemicals, it can be inferred that the bioactive compounds in the *Pandanus* are of polar origin. TPC values varied significantly among the different species. This might be due to environmental conditions. *Pandanus* contains various phytochemicals and was observed to have antioxidant activities through DPPH and FRAP assays. Antimicrobial activities were also screened in all the 7 species. Hence, the *Pandanus* can be used for advanced research in the pharmaceutical field.

Keywords: *Pandanus*, DPPH, FRAP, TPC, TFC

Application of hydroponic used substrate as soil amendment for crop production

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Abstract:

Protected soilless culture is a remarkable way of producing fruits and vegetables by being more environmental friendly compared to the conventional method, mainly because of the lower use of pesticides and herbicides and also due to the highly controlled and monitored environmental conditions. The principal advantage of this method of crop production is that resources such as land can be exploited at its best while its main constraint is the disposal of the growing media after use. In Mauritius as compared to other countries, there exists a problem of coir disposal; after its useful lifespan of up to four years in greenhouses, the latter is often disposed outside or in dumping grounds. This study is based on the reuse of disposed hydroponic substrate, namely cocopeat.

In order to assess the effect of used hydroponic substrate in open field crop production, an experimental trial was conducted at the University of Mauritius Farm, at Réduit, using tomato (*Solanum lycopersicum* Cv. Swaraksha) from November 2015 to February 2016. Tomato plants were grown in the field and the treatments were applied according to the nitrogen requirement as per recommendation in Le Guide Agricole of the Food and Agricultural Research and Extension Institute (FAREI). Before conducting the experiment, soil samples from the experimental site were analysed and was found to have a pH of 7.00 ± 0.05 , electrical conductivity of 0.0032 ± 0.0004 dScm⁻¹, total nitrogen 1.58 ± 0.238 g/kg dry matter (DM), available phosphorus 0.0008 ± 0.0005 g/kg DM and available potassium 0.158 ± 0.0124 g/kg DM. Similarly, the used hydroponic substrates were analysed and their parameters were as follows: pH of 6.93 ± 0.04 , electrical conductivity of 0.0023 ± 0.0001 dScm⁻¹, total nitrogen 8.77 ± 3.39 g/kg DM, available phosphorus 0.0108 ± 0.00065 g/kg DM and available potassium 0.191 ± 0.0127 g/kg DM. The treatments applied were calculated on a weight basis as follows: 0% cocopeat and 100% inorganic fertiliser (T1), 25% cocopeat and 75% inorganic fertiliser (T2), 50% cocopeat and 50% inorganic fertiliser (T3), 75% cocopeat and 25% inorganic fertiliser (T4), and 100% cocopeat and 0% inorganic fertiliser (T5) laid in a randomised block design with four blocks. The treatments were applied at three different stages; that is, at transplant where the incorporated inorganic fertiliser was supplied as 13:13:20:2, and the latter was mixed with the disposed coconut coir one day prior to transplant. Secondly, 27:0:0 was incorporated as inorganic fertiliser three weeks after transplant and lastly 13:13:20:2 was supplied at flowering stage as top dressing.

T2 and T5 produced highest plants and the largest value of stem diameter ($p < 0.05$), while the highest value for percentage dry matter was obtained from T1 and T4 ($p < 0.05$). Highest difference in nitrogen content was noted in T3, followed by T1 and T2; while T1 and T5 showed the highest difference for total phosphorus and total potassium ($p < 0.05$). Finally, highest fruit yield was obtained from T1 (27.5 t/ha); 0% cocopeat and 100% inorganic fertiliser, followed by T2 (26.4 t/ha); 25% cocopeat and 75% inorganic fertiliser. Only a

small difference of 4% was observed between the yield from 100% inorganic fertiliser and that of 25% cocopeat and 75% inorganic fertiliser.

This result revealed that the hydroponic used substrate can be incorporated together with inorganic fertilisers as soil amendments for crop production. This will eventually help to mitigate the disposal problem of used hydroponic substrate and also to reduce heavy use of chemical fertilisers. While findings suggest that a ratio of 1:3 of used hydroponic substrate to inorganic fertiliser could lead towards sustainable crop production, there is a need for further work to come up with definite recommendations on its practical use. This method of crop production could be very useful as this will help the crop growers to decrease the use of inorganic fertiliser, thereby reducing the cost of production and consequently mitigating the disposal problems associated with hydroponic used substrate.

Keywords: Tomato, Cocopeat, Fertiliser, Plant Height

Assessing the marine biodiversity of Mauritius: A DNA barcoding approach

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Abstract:

Marine biodiversity is under constant stress from human activities and climate change, with a large number of species becoming extinct even before being documented. The marine ecosystem in Mauritius is no exception, as it faces continuous coastal habitat degradation and over-exploitation of its marine living resources. In this context, it is critical that the existing organisms present in the Mauritius waters are properly identified and inventoried. The Mauritius Oceanography Institute (MOI) has since 2010, initiated an inventory of marine organisms in the Republic of Mauritius by combining both traditional taxonomy and contemporary tools such as DNA-based techniques. This technique employs patterns of sequence variation from the mitochondrial 5' region of the cytochrome *c* oxidase subunit I (COI) gene to identify known species and flag the presence of cryptic diversity. Our study aims at (i) undertaking an inventory of commercial fish and sea cucumbers using both taxonomy and DNA tools (ii) establishing an online marine living resources and genetic database (iii) providing services to the seafood and aquaculture industries (iv) publication of posters and field guides for use by various stakeholders.

For each specimen collected, the sampling location, date of collection and morphometric data were recorded. Each specimen was tagged with a unique identification number and photographed. All vouchered specimens collected were stored at the MOI and preserved in formaldehyde or kept as frozen. Tissue samples from the body muscle and/or tentacles were preserved in ethanol and kept frozen till DNA extraction. COI gene was amplified using the Polymerase Chain Reaction (PCR) technique. PCR products were visualized on agarose gels and all successful amplicons were selected for sequencing. The amplicons were sequenced bidirectionally on an Applied Biosystems DNA analyser and assembled using BioEdit. The edited DNA sequences were analysed using the sequence similarity approach, Basic Local Alignment Search Tool (BLAST) algorithm for confirmation of species. The BLAST nucleotide query (BLASTN) was carried out for each sequence data using GenBank and cross-referenced with BOLD databases. The distance based method, Neighbor-Joining (NJ) trees were generated to determine the clustering of species. From the data generated a searchable database was developed using MySQL. SQL programming and PHP server side scripting language was utilised to facilitate the retrieval as well as filtering of data from the database.

The bidirectional COI sequence for 307 fish and 23 sea cucumber specimens with read lengths between 650 -700 bp was amplified and sequenced successfully. The fish specimens analysed for this study were distributed across 186 species from 107 genera and 46 families. Most of the species sampled were from the family of Serranidae (13.4%), Labridae (11.8%), Lutjanidae (7.5%), Scaridae (7.5%), Acanthuridae (7.0%), Carangidae (6.5%). The results also revealed that 41 commercial species were previously not reported in Mauritius. The 23

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sea cucumber specimens analysed were clustered into 9 species from 5 genera and 2 families. A custom-designed online marine diversity and genetic database (www.mdgdb.com) for storing both morphological and genetic information has been created. The database provides a platform where both, morphological and genetic data can be queried for the proper identification of marine organisms.

The information gathered from this project will be valuable for marine biodiversity management, regulation and enforcement and for conserving biodiversity.

Keywords: DNA-based Techniques, COI, Neighbor-Joining tree

Use of natural additives to enhance the probiotic potential of yoghurt

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Abstract:

Probiotics are live microorganisms which when given in sufficient amounts benefit the health of the host. Numerous studies have proven that the addition of prebiotic supplements enhances the probiotic potential of foodstuffs. The common probiotics used in the dairy industry are *Lactobacillus* and *Bifidobacteria* species. Prebiotics are defined as a particular fermented ingredient that allows specific changes both in composition and activity of the gastrointestinal microflora that causes a positive impact on human health. Due to the fact that flavored yoghurt is the most preferred among consumers compared to plain yoghurt, it is of utmost importance to scientifically assess the prebiotic potential of flavoring agents such as fruits and cereals.

In this present study, the efficiency of flaxseed, pomegranate and oat was compared in a sugar-free semi solid as well as a sugary drinking yoghurt formulation containing probiotic bacteria. *L.acidophilus*(LA), *L.bulgaricus*(LB) and *Bifidobacteria* were isolated from commercial yoghurt and their identity confirmed by physical tests, namely; gram stain, endospore stain, pH test and biochemical tests, namely; MR VP test, Sulfur Indole Motility test, simmon's Citrate test, oxidase test, catalase test. Their identity was also confirmed by molecular test by carrying out boiling extraction method and phenol chloroform extraction method. The viable population of presumptive LA, LB and *Bifidobacteria* were monitored by plate count method. The pH of the different prebiotic-supplemented yoghurt formulations was also determined. Flaxseed and oat was ground into fine powder. Seeds from pomegranate were removed, ground and pasteurized. A control experiment was also set up. 5g of prebiotic supplement was added to their respective sterile pots containing 25g of yoghurt. The yoghurts were then incubated at 4°C for 15 days and analyzed on daily intervals. MRS and Bifidobacterium agar was used as selective agar. Supplementation of the yoghurt bases with the different prebiotics stimulated growth of the probiotic bacteria compared to the controls.

Addition of flaxseed resulted in a significantly higher *Lactobacillus* count in semi-solid (9.5 log CFU/ml) compared to drinking yoghurt (7.5 log CFU/ml). LA (8.30 log CFU/ml) and LB (8.29 log CFU/ml) count was significantly lower in the control experiment. Addition of pomegranate and oats resulted in *Lactobacillus* populations of 8.6-8.7log CFU/ml and 7.1-7.3 log CFU/ml in semi solid yoghurt and drinking yoghurt respectively. LB, LA and *Bifidobacteria* showed highest growth with flaxseed. LA and LB responded differently with different prebiotic supplements. The counts of *Bifidobacteria* were higher than *Lactobacillus* with a difference of 1 log CFU/ml. The counts of the probiotics were lower in drinking yoghurt with a difference of 2 log CFU/ml. Bacterial counts decreased as the incubation period increased. Boiling extraction method proved, despite its lower yield, proved to be more efficient than phenol chloroform method Confirmation of the 3 presumptive isolates proved to be efficient with one sample which corresponded to LA (86% homology) and the other sample was identified as *Bacillus* sp using BLAST. The third sample was not able to be identified. Flaxseed was found to be a potential prebiotic probably by virtue of certain

components which are rapidly metabolized by the probiotics. It is conjectured that the soluble non-digestible oligosaccharides found in flaxseed, pomegranate and oat play a major role in viability of the 3 different probiotic isolates. Sweeteners have an effect on the viability of probiotics by competitively inhibiting the uptake of non digestible oligosaccharides. This is because different prebiotic supplements resulted in different bacterial counts and their growths were found to be lower in sugary drinking yoghurt. Molecular identification of the two isolates in this study was hindered probably by the quality of primers used and possible contamination of the samples.

Overall, this study shows that natural additives enhance the growth of probiotics. Flaxseed proved to be the most efficient supplement. For molecular identification, boiling extraction method proved to be more efficient than phenol chloroform method.

Keywords: Probiotics, *Lactobacillus*, *Bifidobacteria*, Non-digestible Oligosaccharides

Assessing the biodegradability of biodegradable plastic under composting and landfilling conditions

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Abstract:

This study aimed at assessing the biodegradability of a plastic bag under composting and landfilling conditions using ASTM D5338 (2015) and ASTM D5526 (2012) respectively. Under the composting conditions, the following analyses were conducted namely (i) plastic bag (BP) (ii) cellulose base powder as positive control (PC) and (iii) blank (compost only), to assess the carbon dioxide evolution from the mineralization process at 58°C using double titration method until the plateau phase was reached. Under landfilling conditions, the following experiments were carried out in an incubator namely (i) plastic bag (BP) (ii) cellulose base powder as positive control (PC) and (iii) blank (anaerobic inoculum and pretreated household waste). The methane and carbon dioxide gas evolved were monitored and measured using a landfill gas analyser over 4 months. The biodegradability was determined by subtracting the cumulative amount of gas produced from blank from the cumulative amount of gas produced from BP and dividing the difference by the theoretical amount of gas produced from BP. The percentage biodegradation of BP was 51% under composting conditions compared to landfilling conditions where the percentage biodegradation was 0.5%. PC achieved a percentage biodegradation of more than 70% as per the requirement of the ASTM standard under composting conditions. A heavy metal test was also performed after the plastic were exposed to the composting and landfilling conditions and BP did not release hazardous metals like iron, zinc, copper and chromium.

Keywords: Biodegradable Plastics, Landfill, Composting, Biodegradability

Rearing systems and feeding practices on smallholder dairy farms in Mauritius

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Abstract:

The cattle sector in Mauritius counts about 6000 heads, comprising 3350 dairy cattle, reared by 530 farmers for the year 2015. Fresh milk is produced mostly by smallholder farm units of 1 to 5 cows with a total annual production of around 4.5 million litres, representing around 4% of the total milk consumption. The dairy sector relies heavily on the use of concentrates implying increasing production costs due to the increasing trends in the prices of feeds and raw ingredients. This may be a constraining factor to fresh milk production locally and, there is need to formulate a sustainable and effective feeding recommendation package to the dairy farmers. A survey was thus conducted to assess the current on-farm rearing and feeding practices as well as constraints faced by farmers.

The survey was conducted on 132 randomly selected smallholder farms located in the 3 agro-climatic zones of the country over a period of 12 months. Data on rearing and feeding practices as well as daily milk production were collected through direct interview of farmers using a structured questionnaire and observations during farm visits. A total of 132 respondents were interviewed, fodder samples were collected over two seasons, (summer and winter) and identified based on local knowledge of farmers. Fodder samples were dried and ground to 3 and 1 mm for chemical analysis and *in-vitro* gas production, respectively.

Most of the respondents (85%) were above 40 years of age and 40% were women who were directly involved in routine care for the animals. A total of 626 cattle comprising of Local, Friesian and Crosses were surveyed, of which 223 were cows, representing about 11% of the national dairy herd. Average daily milk production ranged from 5-30 litres/head for cows in different stages of lactation, parity and breeds. Majority of farmers (85%) kept their animals in confined stalls which were of good condition and with concrete flooring (80%). About 54% of farms had adequate space behind the animals for cleaning and other activities such as milking and artificial insemination. All farmers collected fodder daily from fallow lands, forest and mountains and only 3 of them cultivated fodder, namely elephant grass (*Pennisetum purpureum*), stargrass (*Cynodon plectostachyus*) and setaria (*Setaria sphacelata*). Farmers collected a wide range of fodder consisting of combinations of the following in different proportions depending on the availability: sugar cane tops (*Saccharum officinarum*) and maize stover (*Zea mays*) during the harvest seasons; native grasses such as Herbe d'argent (*Ischaemum aristatum*), Herbe collier (*Coixla chryma jobi*), Herbe fataque (*Panicum maximum*), leaves and branches from trees and browses, namely acacia (*Leucaena leucocephala*), Bois noir (*Albizia lebeck*), Bois d'oiseaux (*Litsea glutinosa*), Gros feuilles (*Litsea monopelata*) and jack fruit leaves (*Artocarpus heterophyllus*) for use as the basal diet. These species were available throughout the year, with the exception of sugarcane tops and maize stover which were seasonal. However, most farmers (85%) offered browse species such as acacia, bois noir and gros feuilles. In addition, 95% of farmers used commercial concentrates, the most common being 2384®, 85% and only 13% of farmers used Dairy trial® as supplement to the basal diet. Sugar cane tops and native grasses had low crude

protein contents of 5.7 and 4.2% respectively, while cultivated grasses namely elephant grass, guatemala and stargrass had 9.6, 6.7 and 5.3% CP on a dry matter basis (DM), respectively. Trees and browse species such as acacia, gros feuilles and bois noir had higher CP contents (DM) namely, 19.9, 15.8 and 15.4% respectively, comparable to commercial compounded concentrates (12 to 17% CP). There were significant ($P < 0.05$) differences in the fermentation pattern of the different grass and browse/shrub species. Among the grasses sugar cane produced the higher gas volumes, 49 ml at 96 hours of incubation followed by 39 ml for setaria while the browse/shrub species produced 31 to 37 ml at 96 hours of incubation.

The survey showed that rearing practices on smallholder dairy farms are satisfactory and that farmers can optimize on the use of browse/shrubs species as supplement to the basal fodder and for partially replacing commercial concentrates.

Keywords: Smallholder Dairy, Fodder, *in-vitro* Gas Production

Effect of antimicrobial edible coatings on the shelf-life of fresh-cut vegetables

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Abstract:

Consumers are opting more and more for fresh-cut fruits and vegetables which are convenient, nutritious, attractive and ready-to-eat or cook. Fresh cut vegetables (FCV) for cooking or salads represent the largest segment of the fresh-cut produce industry. However, fresh-cut processing increases respiration rates and causes major tissue disruptions, which accelerate microbiological and physicochemical spoilage of the product. Coating with edible films represents a judicious measure to reduce these changes in quality and safety. Edible films provide good protection for perishable food products from senescence by delaying dehydration and respiration, improving the quality of the product in terms of flavour, texture and colour, and decreasing microbial growth. The incorporation of antimicrobial agents in edible coatings can enhance their barrier functionalities and further prevent irreversible microbial spoilage, thus controlling wastage of fresh produce. This study aimed at investigating the effect of edible coatings with and without added antimicrobial agents on the shelf-life of fresh-cut red bell peppers and tomatoes during refrigerated storage for 10 days.

Antimicrobial edible coatings were prepared by incorporating potassium sorbate (PS) (0.5%) and sodium acetate (SA) (1%) into alginate (1.75%), carboxymethyl cellulose (3%) and xanthan gum coatings (0.2%). The coating treatments used were alginate (A), alginate + potassium sorbate + sodium acetate (A+PS+SA), carboxymethyl cellulose (CMC), carboxymethyl cellulose + potassium sorbate (CMC+PS), xanthan (X), xanthan + potassium sorbate (X+PS), xanthan + sodium acetate (X+SA), xanthan + potassium sorbate + sodium acetate (X+PS+SA). Aseptically cut pepper strips (5 cm x 2 cm) and tomatoes slices (0.5 cm thickness) were dipped in the prepared coatings, drained, air dried and packaged in Styrofoam plates overwrapped with cling film. Coated and uncoated (control) samples were subjected to microbiological (TVC and yeasts and moulds counts), physicochemical (pH, colour, moisture content, vitamin C and total antioxidant activity (TAA determinations) and sensorial (hedonic test) analyses at 2 to 3 days intervals during a 10-day storage period at 4 °C.

Alginate coatings were ineffective in reducing the growth of bacteria and yeast and molds on the FCV which also had poor sensorial acceptance at the end of the storage period. However, xanthan coatings with added antimicrobials namely, X+SA and X+PS+SA, improved the shelf-life of fresh-cut peppers and tomatoes from both microbiological and physicochemical perspectives in comparison with the uncoated fresh-cut vegetables. Fresh-cut peppers and tomatoes coated with xanthan (X+SA and X+PS+SA) had a lower reduction in ascorbic acid content than the other treatments and the control over the 10-day storage period. Furthermore, starting with an initial TAA of 75%, the TAA for the control pepper samples at the end of the storage time was 37.3% whilst the TAA for the peppers coated with X+PS+SA was 54.2%. Sensory ratings of the FCV coated with xanthan and carboxymethyl cellulose coatings did not differ significantly from control ($p>0.05$) during the 10- day storage period

whilst samples coated with alginate coatings had significantly lower ($p < 0.05$) overall acceptability scores.

This study has demonstrated the potential commercial application of antimicrobial xanthan-based coatings to enhance the microbiological, sensorial and physicochemical quality of fresh cut tomatoes and peppers during refrigerated storage.

Keywords: Fresh-cut Vegetables, Antimicrobial Edible Coatings

A comparative analysis of the perceived and actual quality of fresh-cut fruits and vegetables sold in retail outlets of Mauritius

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Abstract:

Quality is a very important term in the agri-food sector. According to the International Standard Organization, quality means the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs. Therefore it can be said that a product of good quality is one that meets the acceptance of the consumer. In this context, the objectives of this study were to (i) shed light on the 'quality' traits of whole and fresh-cut fruits and vegetables perceived as important by consumers and retailers; (ii) determine the microbiological, physicochemical and nutritional quality of selected fresh-cut and whole fruits and compare the results of these objective analyses against the subjective perception of consumers and retailers and (iii) sensitize consumers on the importance of ensuring quality of fresh-cut produce by adopting good domestic practices.

Survey questionnaires were administered to 75 customers to shed light on their purchase habits and preferences as well as quality attributes that influence their acceptance of fresh produce items. In addition, a survey questionnaire was also administered to retailers to determine how they perceived the quality of fresh produce sold. For laboratory analyses, whole and fresh-cut fruits (pineapple) and vegetables (tomatoes) were purchased from markets and supermarkets and tested for physicochemical parameters (pH, moisture content, instrumental color), microbiological parameters (Total Viable count (TVC); Yeast and Mold count) and vitamin C content. A sensory test was also conducted among untrained panelists to compare the organoleptic traits of these fruits and vegetables obtained from markets and supermarkets.

84% of consumers were reportedly already aware of the concept of fresh-cut produce thus indicating the scope of this niche market. Consumers mentioned that the three most important quality attributes considered when buying fresh fruits and vegetables were overall appearance, nutritional value and freshness. Retailers claimed being satisfied with the quality of fresh produce on sale and mentioned that considerations such as “overall appearance” and “safety” of their products were of greatest importance for marketability of their products. The TVC of whole and fresh-cut pineapples purchased from markets and supermarkets ranged from 4.0 to 5.9 log cfu/g; pH was in the range of 4.00 – 6.00 while the Vitamin C content ranged from 20.00 to 29.00mg/100g and 11.0 – 13.00 mg/100g for pineapples and tomatoes respectively.

In the light of this study, we can infer that results of sensorial, microbiological, physicochemical and Vitamin C tests pointed to a satisfactory quality of fresh produce sampled, hence suggesting little disparity between the perceived and actual quality of fresh fruits and vegetables. Since the fresh-cut sector in Mauritius is rapidly growing, the different

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players in the fresh-cut value chain need to be increasingly aware of the 'quality' attributes of importance to consumers and find ways to extend the keeping quality of these produce. It is hoped that this study will be a precursor to future research on aligning consumers' expectations with retailers' products to maximize consumer satisfaction and minimize produce wastage.

Keywords: Fresh-cut, Vitamin C, Fruits, Vegetables, Quality

Development and evaluation of quality of a healthy taro (*Colocasia esculenta*) snack

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Abstract:

Taro, *Colocasia esculenta*, is a major staple food crop in many countries in the world. There are two major types of taro: the eddoe (*Colocasia esculenta* var. *antiquorum*) and the dasheen (*Colocasia esculenta* var. *esculenta*). The dasheen is much bigger in size than the eddoe. Some taro corms have white flesh with purple specks, while others are white inside. In Mauritius, they are known as “arouille violette” and “arouille carri”. Taro is a good source of digestible starch and potassium, and has a low fat content. A fried taro snack, “gâteau arouille”, is a famous delicacy in Mauritius. Traditional fried snacks contribute to dietary fat intake which needs to be controlled to prevent non-communicable diseases. There is also scientific evidence that deep-fried foods might contain acrylamide, a possible carcinogen for humans. Taro is not processed commercially in Mauritius whilst in other countries like the United States of America, processed taro in the form of flour, bread and chips are commonly available. The Food and Agricultural Research Institute (FAREI) has investigated the development of taro French fries and chips. There is a need for further research to develop traditional healthy snacks that promote the utilisation of taro as a food security crop and fulfil consumer sensory expectations. In this context, this study aimed at developing taro burgers by using three cooking methods namely, deep frying, microwave-cooking and steaming. The taro burgers were also assessed for their physical, chemical and sensory characteristics.

The dasheen taro type was used for the experiments. The following physical and chemical characteristics of raw and processed taro were measured: edible portion; colour with a Chroma Meter, CR-400/410, Konica Minolta Sensing Europe; hardness with a penetrometer, STANHOPE-SETA, England; pH (using a pH meter); moisture content (air-oven drying method); fat content (soxhlet extraction method); titratable acidity (indicator method); ascorbic acid content (dichlorophenolindophenol (DCPIP) dye method). Six students were selected for training and quantitative descriptive analysis of twelve identified sensory descriptors of taro burgers. 35 consumers were recruited from the University of Mauritius to carry out a consumer hedonic test. Data was analysed using Microsoft Excel 2007.

The physical and chemical characteristics of the raw taro corms were: % flesh (84.06 ± 2.92); CIE L* (73.89 ± 0.23), a* (4.94 ± 0.05), b* (9.83 ± 0.19); penetrometer values (3.33 ± 0.24 10th/mm); pH (6.64-6.78); titratable acidity (0.05 ± 0.00 g/100g); ascorbic acid (1.60 ± 0.00 mg/100g); moisture content (71.21 ± 0.95 %); % fat content (0.16 ± 0.05). The physical and chemical characteristics of the taro burgers prepared using three methods of cooking were: CIE L* (fried: 39.08 ± 0.03; microwaved: 47.43 ± 0.03; steamed: 41.04 ± 0.06), a* (fried: 7.95 ± 0.03; microwaved: 6.87 ± 0.02; steamed: 6.23 ± 0.02), b* (fried: 14.98 ± 0.02; microwaved: 12.87 ± 0.03; steamed: 8.86 ± 0.03); penetration depth in 10th/mm (fried: 63.67 ± 1.53; microwaved: 125 ± 1.00; steamed: 155 ± 1.00); pH (fried: 5.37 ± 0.01; microwaved: 5.76 ± 0.01; steamed: 5.79 ± 0.01); % titratable acidity (fried: 0.17 ± 0.00; microwaved: 0.14 ± 0.00; steamed: 0.18 ± 0.02); % moisture content (fried: 36.72 ± 2.36; microwaved: 38.05 ± 1.15; steamed: 69.26 ± 0.12); % fat content (fried: 20.77; microwaved: 1.46; steamed: 1.30).

From the quantitative descriptive analysis by trained assessors, the steamed taro burger obtained highest mean rating, compared to the microwaved and fried burgers, for the following sensory descriptors: smooth appearance; pink colour; melting and light in-mouth texture; ginger flavour ($p < 0.05$). Highest mean rating for golden brown colour was recorded for fried taro burgers, while highest mean rating for dry appearance and white colour was noted for the baked burgers ($p < 0.05$). Distinct sensory profiles were associated with each cooking method. The consumers who volunteered to participate in the hedonic test were aged between 18 to 50 years. 66% were female participants and 83% claimed to have tertiary education. The mean degree of liking was highest for the fried taro burgers followed by the baked and steamed burgers. 83% of consumers expressed their intention to purchase taro burgers.

The findings of this research could be used by local food entrepreneurs to further develop healthy taro burgers which fulfil consumers' dietary needs and sensory expectations.

Keywords: Taro, Burgers, Cooking methods, Quality

Establishing and validating the shelf life of homemade condiments

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Abstract:

Homemade condiments are very popular in the Mauritian local cuisine and are used to enhance the flavor of food or accompany main-course dishes. The overarching aim of this study was to determine the shelf life of several popular homemade condiments (mayonnaise, Achaar legumes, Sauce à l'ail and Coconut chutney) as affected by the microbiological, sensorial and physicochemical changes in these products during storage at refrigerated and room temperatures. The objectives of the study were to (i) identify four popular homemade condiments in Mauritius via a consumer survey, (ii) shed light on consumers' practices that have an impact on the shelf-life of home-made condiments and (iii) compare the microbiological and sensorial shelf-life of selected popular homemade condiments (mayonnaise, sauce à l'ail, achar legumes and coconut chutney) subjected to abusive (opened and periodically left at room temperature) and ideal (unopened and consistently kept at refrigeration temperature) storage conditions.

A questionnaire survey was administered to 45 women to identify the condiments they often prepare and evaluate their knowledge, perception and behaviors with regard to preparation, storage and serving of condiments. Four popular condiments were prepared in the laboratory following traditional recipes and using local ingredients. Samples were either stored unopened at refrigerated temperatures (ideal) or periodically opened and left at ambient temperature for 30 minutes (abusive). Samples were then subjected to microbiological, physicochemical (pH, water activity) and sensorial tests at defined intervals (2-3 days). Parameters for sensorial evaluation included general appearance, colour density, aroma and overall acceptability. Total Viable Counts (TVC), Yeasts and Molds, and Lactic Acid Bacteria (LAB) were enumerated on Plate Count Agar, Potato Dextrose Agar and De Man Rogosa Sharpe Agar respectively and the presence of *Salmonella* in homemade mayonnaise was determined by primary and secondary enrichment steps and detection on Xylose Lysine Deoxycholate agar. The instrumental colour of homemade condiments was also determined using a Chroma meter. Data was computed and analysed using MS Excel and Minitab Inc.17 respectively.

There was a negligible change in the a_w for both opened and unopened states of the products except for sauce à l'ail, where the a_w had decreased from 0.755 to 0.595 or increased to 0.899 in the opened and unopened states respectively. The pH changed to variable extents over the storage life of the products depending on the condiment in question and the states in which they were kept. For instance, the initial and final pH of opened and unopened sauce à l'ail increased by 1.7 and 2.9 pH units respectively. The L^* values of mayonnaise and achar legumes did not change appreciably; on the other hand the lightness index increased and decreased for sauce a l'ail and coconut chutney respectively. The end of the microbiological shelf-life of food products or the onset of spoilage is generally marked by TVC reaching a population of 7 log cfu/g. Condiments left under abusive conditions spoil more rapidly than when kept under refrigerated conditions. In essence, the shelf-life of opened mayonnaise,

sauce a l'ail, achar legumes and coconut chutney were ≤ 2 days, >15 days, > 15 days and ≤ 15 days respectively. It is however possible to prolong the shelf life with the use of various natural preservatives, antimicrobial agents and other advanced food preservation methods.

It is recommended that condiments be prepared under strict adherence to Good Hygienic Practices and Good Manufacturing Practices such as strict cleaning, sanitation and storage regulations. Findings garnered from this study may be used in the future to set critical limits for HACCP plans specifically designed for Small and Medium Enterprises (SMEs) in the condiments business.

Keywords: Condiments, Storage, Microbiology, Physicochemical, Sensory

Evaluation of antimicrobial and antioxidant properties of Aloe Vera Gel

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Abstract:

Aloe barbadensis Miller, commonly referred to as *Aloe vera*, is one of more than 400 species of *Aloe* belonging to the family *Liliaceae* that originated from South Africa, but have been indigenous to dry subtropical and tropical climates. It is a stemless, drought-resisting succulent plant that has been used medicinally for over 5000 years by Egyptian, Indian, Chinese and European cultures. *Aloe vera* is widely promoted as a dietary supplement in the treatment of numerous diseases including gastrointestinal disorders. In fact, *Aloe vera*, when ingested orally, has a systemic influence on improvement of gastrointestinal function by favouring beneficial gut microorganisms. The objective of the study was to evaluate the antioxidant properties of raw *Aloe vera* gel (AVG) as well as its effect on pathogenic, commensal and beneficial gut microorganisms.

Aloe vera leaves were collected from the Northern, Southern, Eastern, Western and Central regions of Mauritius. The leaves were washed and dissected longitudinally using a sterile knife and the gel was scooped out. The gel was then cut into pieces and blended using an electric blender. The well disc diffusion method was used to test for the antimicrobial properties against pathogenic (*Enterococcus faecalis* ATCC 29212, *Staphylococcus aureus* ATCC 25923, *Enterobacter cloacae* ATCC 13047), commensal (*Escherichia coli* ATCC 25922) or beneficial (*Lactobacillus plantarum* ATCC 8014 and *Bifidobacterium bifidum* ATCC 11863) gut microorganisms. Fluorescence Recovery After Photobleaching (FRAP) assay and DPPH free scavenging radical methods were used to determine the antioxidant properties of *Aloe vera* gel. Total phenolic, total flavonoids and vitamin C content were also determined.

The results show that AVG from Central and Western regions exhibited the highest antimicrobial properties against *Enterococcus faecalis* and *Escherichia coli*. AVG was however not inhibitory against probiotic bacteria and in fact growth of *Bifidobacterium bifidum* and *Lactobacillus plantarum* was encouraged. The DPPH scavenging activity of AVG from the different regions ranked in the following order: Flic en Flac (25.91 ± 1.17 mg/100g FW) > Trois Boutiques (21.2 ± 1.67) > St Julien (19.38 ± 0.64) > Curepipe (15.81 ± 4.84) > Piton (14.8 ± 0.38) > Beau Bassin (12.30 ± 0.88). The phenolic content ranged from 0.01-0.03 mg/g and the total flavonoids ranged from 0.33 to 0.58 mg/g. The vitamin C content was shown to be in a range of 4.90 to 8.34 mg/100ml while the pH varied from 4.83 to 5.12.

Based on the findings of the study, it can be deduced that the biologically active compounds in AVG favour the growth of gut probiotic bacteria and prevents the colonization of pathogenic bacteria. Moreover, AVG also exhibited appreciable antioxidant activities although regional differences were noted. It is likely that the variable *terroir* of the climates prevailing in the different regions of Mauritius could have contributed to the variation in the

antibacterial and antioxidant properties. AVG may thus have the potential to be used in the manufacture of pharmaceutical foods by virtue of its health-promoting properties.

Keywords: *Aloe vera*, Antimicrobial, Antioxidant, Phenols

Modeling the growth of *Listeria monocytogenes* and spoilage bacteria in cold smoked salmon

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Abstract:

Cold Smoked Salmon is a widely consumed chilled perishable RTE food that naturally harbours spoilage bacteria and is often contaminated with the pathogen *Listeria monocytogenes*. Growth of *L. monocytogenes* and spoilage microbiota can be greatly affected by temperature. During storage, distribution and retail handling, cold smoked salmon is exposed to a wide range of temperatures, which can impact on the quality and safety of the product. Predictive microbiology involves the extensive application of mathematic modeling techniques and is a useful tool to predict microbial growth responses of pathogens and spoilers to environmental factors such as temperature. The purpose of this research was to (i) shed light on the consumer behaviors, preferences and habits when buying, handling and storing chilled perishable RTE foods, (ii) use mathematical modeling to predict the growth characteristics of spoilage microflora and pathogen *Listeria monocytogenes* in cold smoked salmon, when stored under isothermal conditions and, (iii) predict the microbial growth of *L. monocytogenes* and spoilage bacteria in smoked salmon under fluctuating temperature conditions to simulate typical consumers' refrigerators.

A survey questionnaire was administered to 50 customers purchasing chilled RTE foods in a supermarket. To construct primary isothermal models, data sets for growth of *L. monocytogenes*, mesophilic aerobic bacteria, Lactic Acid Bacteria (LAB), *Enterobacteriaceae*, and psychrotrophic bacteria in cold smoked salmon stored under different temperatures (2 °C, 4 °C, 7 °C, 10 °C, 13 °C and 15°C), were generously provided by a collaborating institution. Modeling programs were then used to fit the empirical data to the "Baranyi and Roberts" model and growth parameters such as the maximum specific growth rate (μ_{max}), asymptotic cell number (y_{max}) and lag time (t_{lag}) were subsequently extracted. Secondary models were then generated by plotting the log of μ_{max} as a function of their corresponding temperatures using MS Excel 2010 program. To construct dynamic models, the temperature history of cold smoked salmon products was recorded from the time of purchase through a 14-day chilled storage in a domestic refrigerator using an Infrared Thermometer. Physicochemical parameters such as pH and water activity were also determined using a water activity-meter and pH meter respectively. A specialized predictor software was then used to generate the dynamic growth model for *L. monocytogenes* with the initial bacterial population ($\log N_0$) set at one of three hypothetical initial values (0, 1 or 2 log cfu/g).

Survey results suggested that 67% of consumers were aware of the perishability of chilled RTE food products such as smoked fish and also acknowledged the presence of pathogenic and spoilage microorganisms in these products. At all six temperatures used (2, 4, 7, 10, 13 and 15°C), Baranyi and Roberts models were found to fit the data with a reasonable goodness of fit, with R^2 value of 0.896 at 2°C, 0.939 at 4°C, 0.906 at 7°C, 0.868 at 10°C, 0.884 at 13°C and 0.918 at 15°C. Secondary models consistently showed a linear increase in $\log \mu_{max}$ as

growth temperature was stepped up. Dynamic modeling under fluctuating temperature conditions indicated that when $\log N_0$ of *L. monocytogenes* was set at 0 or 1, the predicted y_{\max} of *L. monocytogenes* present was less than 2 log cfu/g after 14 days in the refrigerator hence pointing to the safety of the product for consumption. On the other hand, when the initial value was set to 2, the level of *L. monocytogenes* present increased; thereby rendering the product unfit for sale and consumption.

Taken together, findings indicate that the abusive storage temperature of 15°C was the most favourable for growth of psychrotrophic and mesophilic pathogenic and spoilage bacteria in cold smoked salmon. The European Food Authority has enforced a Food Safety Objective for *L. monocytogenes* in RTE food of < 2 log cfu/g; and this FSO can be met provided that the initial level of contamination does not exceed 1 log cfu/g.

Keywords: Temperature, Cold Smoked Salmon, Modeling

Isolation, characterisation and identification of potential probiotic bacteria from Mung Bean Sprouts available in Mauritius

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Abstract:

Probiotics are live microorganisms that, when administered in adequate amounts, confer a health benefit on the host. Over the past decades, there has been a rise in the consumption of probiotic-containing foods owing to the ever-increasing awareness of their beneficial effects on human health. Dairy products have long been reported to be traditional sources of probiotic bacteria. However, there has recently been a decline in dairy probiotic applications namely due to lactose intolerance, allergy to milk proteins, high fat and cholesterol contents and the particularly intransigent regulations and high costs associated with milk products. Non-dairy products serve as an alternative solution to deliver probiotics. Raw foods such as sprouts are potential non-dairy sources of probiotics. For instance, probiotic *Lactobacillus* sp. and *Bifidobacterium* spp. were isolated from Indian mung bean sprouts. In this regard, the aim of the project was to isolate and identify autochthonous lactic acid bacteria from mung bean (*Vigna radiata* var. *radiata*) sprouts available in Mauritius and subject the isolate(s) to specific biochemical (motility, catalase, carbohydrate fermentation and reducing tests), physiological (acid and bile tolerance), and molecular tests (16s rDNA sequencing) to assess their probiotic properties.

A sprouting box was set-up to germinate mung bean seeds under aseptic conditions over 4 days at room temperature. Sprouts were harvested and mixed with sterile Buffered Peptone Water in a 1:4 ratio and ground to a slurry. The sprout slurry was then spread-plated on de Man, Rogosa and Sharpe and *Bifidobacterium* agar media. Isolates recovered were then subjected to Gram staining, biochemical tests and a series of challenge tests. While no characteristic *Bifidobacterium* could be recovered in this study, two Gram-positive isolates were recovered on MRS agar, one cocci-shaped (L1) and the other rod-shaped (L2). Results of biochemical tests on the isolates suggested that L1 produced a pseudo-catalase enzyme and was homofermentative while L2 was catalase-negative and heterofermentative with mixed acid fermentation, typical of lactic acid bacteria. They both fermented glucose and fructose but not citrate and were non-motile, γ -haemolytic, non-nitrate reducing, non-sulfur reducing and non-indole producing. In terms of survivability, both isolates withstood acid stress at pH 3.0 and bile stress at 0.3% bile salt during a 3 h-exposure, which is the time taken for gastrointestinal transit. Surviving these physiological stresses is an important trait for the probiotic strain in order to deliver any beneficial probiotic effects to the host. Both isolates L1 and L2 showed temperature and salt tolerance, which are technological aspects required for viability during processing and storage. Pertaining to antibiotic resistance, isolate L1 might raise safety concerns since it was found to be resistant to Nalidixic acid (30 μ g), Streptomycin (25 μ g), Tetracycline (30 μ g), Trimethoprim (1.25 μ g) and Vancomycin (30 μ g). Following DNA extraction by boiling method and PCR amplification of the 16S rRNA gene, isolate L2 showed 79% homology with probiotic *Lactobacillus kunkeei*.

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Taken together, this project shows that mung bean sprouts are a source of potential probiotic bacteria and points to their capacity at achieving a more competitive share in the food market. Future work could be extended to other sprouts, which could also potentially harbour probiotic lactic acid bacteria.

Keywords: Isolation, Probiotics, Mung Bean Sprouts

Grass silage for better returns to the dairy industry

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Abstract:

Milk production in Mauritius for 2014 was estimated at 5 million litres. The target production for 2020 is estimated to reach 8 million litres, representing 6.5 % of the total milk consumption. The major challenge facing the dairy sector in Mauritius is the low average daily production of milk per cow. The average daily milk yield at small-holder dairy farm is estimated at 6-7 L/ head. One of the constraining factors is the feed input, due to the decreasing availability of fodder and the increasing costs of concentrates. To meet the projected target for 2020, the problem of availability of forages should be addressed. It is hypothesised that ensiling grass forages, can be considered as a scenario for the production of year-round supply of high quality forages. The present study was carried out to investigate the optimum growth stage to harvest Guatemala grass (*Tripsacum laxum*) for ensiling.

This research work was carried out on the University of Mauritius Farm (Réduit) from November – December 2015. Guatemala grass shoot (leaves and stems) was harvested at 2 harvest intervals (viz. 5 weeks and 7 weeks). Basal nitrogen (N) top-dressing fertiliser (85 kg N / ha) was used. The moisture (% as fed) content was determined using the oven-dry method; the muffle furnace was used to determine the organic matter; nutritive value (% crude protein, Neutral Detergent Fibre - NDF, Acid-Detergent Fibre - ADF and Acid Detergent Lignin –ADL, Total Water Soluble Carbohydrates, calcium content, potassium content and phosphorus content) and the Gross Energy content of the green grass was determined. Guatemala grass silages were made with no additive, molasses/urea (5 % / 0.6 %) and acacia (*Leucaena leucocephala*) (25 %), used as silage additives. Guatemala grass was wilted to 30% dry matter prior to ensiling, chopped to 3 cm length and compacted in airtight glass jars (750 ml capacity) for 56 days. The physical and chemical characteristics of both types of ensiled grass and the fresh grass were determined with and without additives. The moisture (% as fed) content, the % dry matter, organic matter, nutritive value (the % crude protein was determined by the Kjeldahl method, for the Neutral Detergent Fibre - NDF, Acid-Detergent Fibre - ADF and Acid Detergent Lignin –ADL was analysed using the Van Soest method via the FibreTec Hot and Cold Extraction Unit, the Anthrone method was used to analyse the Total Water Soluble Carbohydrates (WSC), the calcium content and the potassium content was determined using the Flame Photometer and phosphorus content was analysed using the Troug's method) and the Gross Energy content was determined using the Bomb Calorimeter.

The study showed that the stage of growth had significant effects ($P<0.05$) on forage yield and nutritive value of the Guatemala grass. The herbage dry matter was significantly higher ($P<0.05$) at 7 weeks (25.6 % DM) compared to 5 weeks (22.0 % DM). However, the nutritive value declined as the harvesting interval increased from 5 to 7 weeks. In particular, crude protein content decreased ($P<0.05$) from 9.8 % at 5 weeks to 5.2 % at 7 weeks of growth. Total fibre (Neutral Detergent Fibre; NDF) increased significantly ($P<0.05$) from 58.9 % to 69.1 %. The fresh Guatemala grass contained 37.4% of total WSC, and the silage without additives had a content of 25.6%. The total WSC for the silage enriched with molasses/urea

was 47.0%, compared to acacia- enriched silage with 13.5%. The water soluble carbohydrates (WSC) decreased from 6.9 % to 6.5 % ($P>0.05$). The low level of WSC in the grass was a constraint for optimum silage fermentation. The results indicated that the silage additives had a positive effect on the fermentation of Guatemala grass as the physical and the chemical characteristics were well preserved. Ensiling was most effective (texture and aroma of good quality) with *Leucaena leucocephala* as additive, with Guatemala grass harvested at a harvest interval of 5 weeks. The CP content of acacia-Guatemala grass silage was 13.2 %. There was no fungal spoilage in most silage treatments.

The present study confirmed that harvesting Guatemala grass (*Tripsacum laxum*) at the optimum maturity stage would ensure a better quality of silage during conservation. Silage additives (urea, molasses and acacia) can be added to supplement the low level of water-soluble carbohydrates and crude protein of Guatemala grass (*Tripsacum laxum*).

Keywords: Grass, Ensiling, Smallholder Dairy Production

Molecular characterization of barnacles

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Abstract:

Barnacle is an intertidal colonizer of rocky shores. In the quest for new food products, barnacle can be explored for the Mauritian aquaculture industry, and might also be used as bio-monitors of marine pollution. Traditionally, taxonomic studies of this group of marine organisms were based on morphological characterization but with the advent of modern molecular tools offer more reliable and accurate identification as they are not affected by morphological plasticity due to environmental factors. This study aimed at assessing the genetic diversity of local barnacles.

Six suspected species were collected based on external appearance of shells, and four of them were barnacles with three acorns and one stalked. Of the remaining two, one was identified as a mollusc and the other one an invertebrate which was confirmed by Cytochrome C Oxidase Subunit 1 (CO1) sequences. The protocol used for DNA extraction yielded adequate amount and acceptable DNA purity which varied between 0.067-2.4. The pair-wise distance between sequences varied between 0.013 up to 0.611. Most parsimonious tree regenerated using CO1 sequences showed its robustness with bootstrap values above 50% for the major clades except for one clade showing 37%. Moreover, operon primers OPAS 13, OPAS 14, and RAPD H showed very high density of polymorphic bands indicating their potential use in future inter specific and intra specific studies. OPAS 12 were proved to be ideal for the assessment of genetic diversity in mollusc rather than barnacles. ISSR (Inter Simple Sequence Repeat) markers such as ISSR 1, ISSR 2, ISSR 4, ISSR 5 and ISSR 8 were screened and produced more reproducible bands than RAPD (Randomly Amplified Polymorphic DNA).

Keywords: Barnacle, Bio-monitoring, CO1, ISSR, RAPD

Molecular and bioactive screening of marine sponges in Mauritius Island

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Abstract:

Marine sponges and their microbiome are reported to produce bioactive metabolites as a defence mechanism against predators and pathogens. The production of bioactive compounds by these organisms can be a constitutive, an activated or an induced defence system. In fact the marine environment is a rich source of novel compounds that can exhibit action against antibiotic-resistant bacteria and life-threatening diseases. Several studies have also described the bioactivity of the surface-associated microorganisms of the marine sponge against drug-resistant microorganism and cancer cells. The aim of the study was to relate the bioactivity of a marine sponge collected from Mauritius coastal water to its microbiota by using bioassays and molecular studies.

The bioactivity of the marine sponge was investigated upon different extracts (methanol (MeOH), ethyl acetate (EA) and hexane (Hex)). In the present work, the total antioxidant activities were found to be 29.2% and 1.780 mM FE/mg extract for the EA extract (highest observed) for DPPH and FRAP assays respectively. Also positive linear relationship was found between the DPPH and FRAP assays ($R^2=0.851$). However a negative correlation was observed between the total antioxidant activities and total phenolic content of the sponge extracts ($R^2= -0.730$). The highest antimicrobial activity was observed for the EA extract (3.125 mg/ml) against some clinically important bacteria (*S.aureus*, *S.epidermidis*, *E.coli* and *E.faecalis*). 4 different methods were used to extract the sponge DNA for identification of the sponge via amplification of the *col* (cytochrome oxidase subunit 1) gene. The ribosomal gene and the *polyketide synthase* gene were amplified by PCR from the bacterial genome and the products were sequenced.

The overall antimicrobial activity was attributed to the presence of terpenes/steroids or alkaloids which were tested positive in the semi-polar (EA) and polar (MeOH) fractions. The antioxidant activity of the sponge was found to be low compared to previously studied marine sponges and the antimicrobial activity the sponge extracts were lower than the positive control (chloramphenicol) used. Guanidine thiocyanate + Proteinase K extraction method yielded a better of quality genomic sponge DNA and PCR product. Amplification of *col* gene of the sponge had high similarity to a hydroid that can suggest horizontal gene transfer between the species or DNA contamination from the epibiotic hydroids. The total bacterial genome was isolated from the sponge and the ribosomal gene was amplified and sequenced. *pks* (*polyketide synthase*)-specific gene was successfully amplified from the total bacterial genome of the sponge that consisted predominantly of *Pseudomonas* sp.

It can thus be proposed that the defence mechanism of the sponge was related to its microbiome. In fact previous studies have reported several *Pseudomonas* sp. as having striking antimicrobial effects against antibiotic resistant bacteria. As such the marine sponge investigated can be a prominent source of bioactive molecules that can be of biotechnological and pharmaceutical importance.

Further studies would include the isolation of the marine microorganisms from the sponge metagenomically which can be used to understand the relationship between the host and the symbiotic microorganisms. Insights on the genomics of marine microorganisms would help in developing culturable clones so as to manufacture clinically approved drugs industrially.

Keywords: Sponge, Antioxidant, Antimicrobial, Microbiome, *pks-specific* gene

First report of banana freckle disease caused by *Phyllosticta cavendishii* in Mauritius

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Abstract:

Dwarf Cavendish is the main dessert banana variety cultivated in Mauritius. *During the hot and humid month of February 2014*, symptoms consisting of dark black spots were observed on banana fruits of this variety from the region of Nouvelle Découverte, situated in the super humid zone of the island. An incidence of more than 50% was reported by our local extension services. These spots gave a sand paper feel when rubbed with the fingers. The same symptoms were observed on the leaves, exhibiting a sooty-like appearance with a rough texture. The spots clustered in lines and appeared as streaks running diagonally across the leaf, or from the midrib to the leaf edge. On the fruits, the initial symptom starts with a minute individual reddish brown fleck/spot delimited by a dark green, water soaked margin. Large areas of the fruit surface eventually become black due to dense aggregations of spots, rendering the fruit unmarketable but without affecting its eating quality. Results from a rapid island-wide survey undertaken showed that all the Cavendish-type banana varieties (AAA sub-group) displayed typical symptoms, including Dwarf Cavendish, Petite Naine, Ollier, Williams and Grande Naine. Sixty five percent of 98 banana fields surveyed (50.9 ha) were found to be affected. It was observed that the percentage of fruits affected tend to increase as the fruits approach maturity.

Identification of the *Phyllosticta* species causing the banana freckle symptoms was carried out in Australia using DNA sequencing of the internal transcribed spacer region (ITS). Extraction of DNA was carried out on approximately 50mg wet weight plant tissue using the Biosprint 15 DNA Plant Kit (Qiagen, Germany). Tissues were first homogenized using a TissueLyser (Qiagen, Germany) in a 2ml Snaplock tube containing a 3mm metal bead for two 30 second bursts at 30Hz. Two microliters of the eluted DNA was used as template in an ITS PCR amplification using AmpliTaq Gold 360 Mastermix (Applied Biosystems, USA) and 0.5µM each of primers GMF1 and GMR2 (Wong *et al.*, 2012). Thermal cycling conditions were 95°C for 10min followed by 40 cycles of 95°C for 30sec, 55°C for 30sec and 72°C for 1min. Final extension of PCR products was carried out at 72°C for 10min. Amplicons (approximately 550bp) were visualised on a 1.5% agarose gel using GelRed stain (Biotium, USA) against 400ng GelPilot 100bp DNA ladder (Qiagen, Germany). Amplicons were direct sequenced using primers GMF1 and GMR2 and BigDye v3.1 (Applied Biosystems, USA) on a ABI3730XL sequencer (Applied Biosystems, USA). Resulting sequences were analysed using BlastN v2.2.30+ as well as compared manually to known sequences of *Phyllosticta* which cause freckle disease of banana. The causal species for all samples tested was found to be *Phyllosticta cavendishii*.

This is the first report of banana freckle disease caused by *Phyllosticta cavendishii* in Mauritius.

Keywords: Banana, Freckle, *Phyllosticta cavendishii*, Sequencing

An assessment of the water quality captured by rain-water harvesting techniques in Mauritius: implications for possible health hazard

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Abstract:

Water being a scarce resource is the most important commodity in Mauritius. With the effect of climate change and dwindling rainfall amount, water is limited during low rainfall season with continuously increasing manufacturing/industrial development and population growth, where accessibility of water will be undoubtedly a restraining feature in our social and economic growth. The amount of precipitation received over the island of Mauritius is ever decreasing over the years and people have opted to implement different rainwater harvesting techniques (RWHTs) so as to ensure availability of water during scarcity period.

A survey was conducted among 30 respondents who adopted different rainwater harvesting techniques (RWHTs) synchronously with an assessment of the water quality captured under different RWHTs. A face to face interview was carried out to procure maximum information among the 30 respondents. The findings of the survey revealed that all the RWHTs were different from each other in terms of configuration and conformability. The major aim of 50% of the interviewees behind the adoption of a rainwater harvesting system (RWHS) was to overcome water scarcities problems and severe cuts from Central Water Authority (CWA), the water supply authority in Mauritius. Most of the interviewees had adopted rooftop concrete catchments whereas none of them opted for concrete basin as RWHT. The majority of respondents (53.3%) used collected rainwater for irrigation purposes of crops and lawns whereas it was also noted none (0%) of the respondents were using the harvested rainwater for drinking purposes. The findings also depicted that 96.7 % of the interviewees were satisfied with the quality of harvested water. The level of satisfaction was found to be dependent on the types of RWHT ($p < 0.05$).

As for the water quality test, areas like Quatre-Bornes, St-Martin, Réduit and Rivière des Anguilles were the sampling points for this research and the different water samples were collected from six different RWHTs across those areas in Mauritius. The following parameters namely pH, conductivity, temperature, dissolved oxygen (DO), salinity, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), nitrate, phosphate, potassium, and micro-algae composition were analysed from the rainwater samples. The major findings revealed that the pH level was in the range of 7.36 to 8.31, conductivity with a range of 0.05 to 0.35 dS/m, temperature (24.0-28.2 °C), DO (6.9-8.5 mg/L), COD (19.41-40.31 mg/L), BOD (8.86-20.0 mg/L), nitrate (0.0-10.2 mg/L), phosphate (0.01-0.14 mg/L) and finally the level of potassium obtained was in the range of 0.005 to 0.31 mg/L. It was found that the catchment material using concrete roof and connected directly to closed fiber glass tanks yielded a less nutrient-enriched rainwater than those from land catchment area (infiltration pit). RWHT using infiltration pit and plastic underlayment pond were found to lodge micro-algae of the genus *Gyrosigma sp.*, *Achnanthes sp.*, *Cylindrospermum sp.*,

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Synedra sp., *Nostoc sp.* and the dominant genus *Pediastrum sp.* than the concrete rooftop RWHT with closed fiber glass tanks to store the water. However, harvested water from all the RWHTs were suitable for irrigation purposes as the COD and BOD was within permissible limits according to Government Notice No.46 of 2003 from the Environment Protection Act 2002 while further tests needs to be performed for safe human consumptions.

Results were found promising and therefore rigorous sensitisation campaigns on RWH concept should be organised to increase awareness and encourage the Mauritian population to adopt a RWHS for a sound and ecological perspective which will also help for a judicious use of Mauritian water resources.

Keywords: Rainwater Harvesting, Water Quality, Micro-algae

Consumers' knowledge, attitude and practices relating to wheat flour and bread quality

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Mauritius*Corresponding Author. Email: eaumjaud@uom.ac.mu**Abstract:**

Bread is a staple food preferred by many consumers around the world and derived from the processing of wheat flour. Bread quality is affected by the composition of wheat flour. Gluten is a protein formed by the addition of water to flour which causes hydration of gliadin (monomeric) and glutenin (polymeric) proteins. These gluten component proteins are located around starch granules in the interior part of the wheat grain and are important for flour bread-making quality. During wheat flour dough mixing, a gluten network is developed, giving the dough its strength and elasticity. The gluten network expands and holds gas produced during fermentation, allowing the dough to rise. Baking sets the gluten, resulting in a firm, open and light textured loaf of bread which fulfils consumers' expectations. Dietary fibre, B-vitamins and minerals are found in the external layer of the wheat grain, namely the bran, which is removed during milling to produce white flour. In Mauritius, a proportion of bran is added to white flour to increase the fibre content. This flour is known as "brown" flour, "farine complète" or "farine di blé" or "farine Atta". It is used to produce "brown" bread or "di pain di blé" or "di pain complet". In the wake of the incidence of non-communicable diseases, the Government subsidises the price of brown flour and bread to promote a healthy diet. However, price is not the only determinant of food choice and dietary change. Education, knowledge, sensory appeal, emotions, attitudes, beliefs, culture are examples of other important factors that influence what people eat. To date no scientific study has been undertaken in Mauritius to explore consumer behaviour with respect to wheat flour and bread. In this context, this research was conducted to evaluate consumer knowledge, attitude and practices relating to wheat flour and bread quality.

A structured questionnaire was designed as follows: sixteen multiple choice questions to assess consumer knowledge; nineteen attitude statements with a three-point likert scale; seventeen open or close-ended questions to determine preference and purchasing practices. The English version was translated into Creole. The data was collected by face to face administration of the survey questionnaire to groups of consumers at the University of Mauritius. The sample size was 100, stratified according to educational level (primary, secondary, tertiary) and gender. Data analysis was performed with the statistical software, SPSS (Version 20.0) and Microsoft Excel 2007.

Results establish a significant relationship between knowledge on wheat flour and bread, and gender ($p < 0.05$). Female respondents provided evidence of higher level of knowledge than male respondents based on % correct answers ($p < 0.05$). However, no significant relationship was obtained for knowledge and level of education ($p > 0.05$). The proportion of respondents giving correct answers to questions on wheat flour ranged from 31 to 50%. The percentage of consumers giving correct answers to questions on good hygienic practice, expiry date and spoilage micro-organisms relating to bread was high: 76 to 93%. In the case of questions on the nutritional value of bread, the range was 20 to 57%. A high proportion of participants expressed agreement with the following attitude statements: "bread displayed on the market

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shelf should be covered with a net” (90%); “I prefer the quality of fresh baked bread than packaged bread” (87%); “bread is a healthy food” (74%); “the price of ‘pain complet’ in Mauritius is affordable” (69%); “names used for the different types of bread on the market are confusing” (68%). 71% of consumers claimed to buy white flour manufactured locally, while 51% stated that they purchase “farine di blé” (brown flour). A higher proportion of respondents indicated that they always buy white bread (80%) compared to those who mentioned that they always buy “pain complet” (brown bread) (24%). 32% of consumers stated that they throw away stale bread while the others indicated that they use it as follows: breadcrumbs, bread pudding, fried bread, reheating, feed for pets. Only 36% of interviewees expressed that they would agree to replace white wheat flour with breadfruit or cassava flour.

The research findings could be used by consumer organisations, government bodies and food businesses to promote consumption of wheat flour and bread with enhanced nutritional and sensory quality.

Keywords: Wheat Flour, Bread, Quality, Consumers

An assessment of the impact of climate change on food security along the coastal regions of Mauritius

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Abstract:

Agriculture, which accounts for 13.5% of GHG emission, is badly hit by climate change impacting directly on the food security. Mauritius being a developing country is as much affected as the other developing ones as there has been a change in the climatic factors: temperature increase, increase in sea water level and unpredictability of rainfall patterns. Increase in intensity of pests and diseases and changes in the marine ecosystem along with the changes in climatic factors have impacted on the local food security status namely availability, accessibility, utilization and stability. An analysis of the yield trends during the last few years as well as the relationship between climate change and the dimensions of food security will help to determine how climate change is impacting on food security. The main aim of this study was to have concrete information on the impacts of climate change on food security along the coastal regions in Mauritius and how the farmers and fishermen respond against these impacts.

The survey was carried out to determine how the farmers and fishermen have adapted to climatic change and what are they doing to minimize and recover from these changes. A sample size of 40 questionnaires was taken for both the planters and fishermen respectively. The data collected was analyzed by using SPSS software 20.0.

The results showed that both planters and fishermen are vulnerable to the impacts of climate change. The yield of the crops and overall fish catch (50% for fishermen & 60% for planters) have noticed a significant decrease during the last few years and the planters counteract this effect by applying more fertilizers and pesticides and the fishermen by using more cage fishing. Temperature is the critical factor making the planters and fishermen vulnerable to climate change. Increase in temperature impacts on rise of sea level, affects the rainfall pattern, increases pests and diseases and eventually the price of food products. Adaptation, mitigation and being resilient are the only solutions to counter the effects of climate change. Only 20% of fishermen and 28% of planters interviewed have followed training on climate change. The fishermen and planters therefore need to be trained in order to adapt, mitigate and to recover from the effects of climate change. However there are some barriers that prevent them from adapting and mitigating against climate change. Insufficient institutional capacities and integration to deliver knowledge to the farming and fishing communities and also financial difficulties to adopt new types of production system are amongst the barriers that they face. Funding, schemes and grants offered by the government to the farmers and fishers could limit the impacts of climate change affecting the food security on the island.

It can be concluded that the coastal community is vulnerable to the impacts of climate change and the status of food security decreases gradually due to crop failures and changes in the fish population. The current situation will deteriorate to worse if no action is taken to adapt and mitigate to the changes in climatic effects.

Keywords: Farmers, Fishers, Climate, Food Security

An evaluation of the antibacterial and larvicidal potential of soil mycoflora from Trou aux Cerfs

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Abstract:

The need for chemical insecticides is increasing due to insect infestation in the agricultural sector. However, these insecticides are not environmental friendly and eventually cause considerable damage to the human being. Additionally, the emergence of resistant bacteria gives rise to the need for new sources of antibiotics. Therefore, this study aimed at isolating soil fungi and the evaluation of their antibacterial efficacy on 4 Gram positive bacteria and 6 Gram negative bacteria, and their larvicidal potential against 2 fruit flies larvae.

Soil samples were collected from the crater site of Trou aux Cerfs at 6 different points along a zigzag line. The soil samples were analyzed for parameters such as soil pH, electrical conductivity, soil organic matter, phosphorus and available sodium, calcium and potassium. The samples were serially diluted up to 10^{-6} , plated on PDA supplemented with chloramphenicol and the fungal isolates were regularly sub-cultured on PDA for pure cultures. 5 fungal isolates were selected according to their growth rate and these were used to extract DNA whose ITS region was eventually amplified using the primer pair ITS4 and ITS5. The PCR products were sent for DNA sequencing and the sequences were subjected to BLAST searches for the purpose of identifying the isolates.

Bioactive molecules from the fungal isolates were extracted by liquid fermentation followed by the addition of ethyl acetate and evaporation of the extraction solvent. The extracts were then screened for their antibacterial and larvicidal potential. Ten bacteria including *P. mirabilis* ATCC 12453, *S. epidermidis* ATCC 12228, *L. innocua* ATCC 29213, *S. marcescens* ATCC 14756, *S. aureus* ATCC 29213, *P. aeruginosa* ATCC 27853, *K. pneumoniae* ATCC 13883, *E. coli* ATCC 25922, *E. faecalis* ATCC 29212 and *E. cloacae* ATCC 13047 were used for the antibacterial assay. The larvae of the fruit fly *B. cucurbitae* and *B. zonata* were used to test the larvicidal potential of the extracts at 3 different concentrations: 0.2g/ml, 0.4g/ml and 0.6g/ml over a period of 3 days.

Soil analysis revealed that the volcanic soil was slightly alkaline in nature as indicated by the soil pH (8.33 ± 0.058) and the amount of available calcium (48.32 ± 5.314) respectively. Also, the soil organic matter was found to be more abundant. The results from molecular analysis showed that the selected isolates were closely related to the genus *Cochliobolus*, *Aspergillus*, *Phoma*, *Penicillium* and *Pestalotiopsis*. The fungal extracts were effective in controlling the growth of the tested bacteria with *L. innocua* and *E. coli* being more susceptible as well as in causing larval mortality. The larvae of *B. cucurbitae* were more susceptible than that of *B. zonata* with a percentage mortality of up to 60% at the highest dose. Therefore, numerous microorganisms dwell in the crater site which, were able to decompose the organic material from the plant debris into organic matter.

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The fungal species isolated from the volcanic soil proved to be an alternative source for new antibiotics and biological agents against insects in agriculture without any detrimental side effects and can thus be used to treat bacterial infections as well as in insect management.

Keywords: Trou aux Cerfs, Fungi, antibacterial, larvicidal

Assessing the potential of mixed branded spices to enhance the safety and quality of raw chicken breasts

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Abstract:

Raw chicken can either harbour spoilage or pathogenic bacteria. Microorganisms responsible for meat spoilage, especially lactic acid bacteria and *Pseudomonas* spp, cause undesirable changes in chicken meat while pathogens such as *Salmonella* constitute a health hazard. In recent years, there has been a lot of concern over means of food preservation and consumers prefer the use of natural products such as spices over chemical preservatives. This study therefore aimed at assessing the potential of mixed branded spices to enhance the safety and quality of raw chicken breast, as well as assessing their potential as shelf life extenders.

A survey was first conducted among consumers to determine the three most popular spice blends used for the preparation of chicken marinades. “Tandoori”, “Kalia” and “Masala for chicken” were found to be the three most popular spices used. The efficacy of these spices in controlling the growth of spoilage and pathogenic bacteria in chicken was subsequently investigated by marinating raw chicken breasts in each of three different spice blends, and storing at 4°C for fifteen days. Samples of marinated chicken were periodically withdrawn at intervals of three days and subjected to microbiological, physicochemical (pH, water activity), sensorial and instrumental colour (L*, a*, b*) analyses. Parameters for microbiological analyses included Total Viable Counts (TVC), Lactic acid bacteria counts (LAB), *Pseudomonas* spp and Yeasts and Molds counts (YMC) while parameters tested for sensorial evaluation included colour, odour, texture and taste.

By the end of the storage period, the spice treatments had reduced the microbial load although no significant differences ($p>0.05$) were observed in the final TVC, *Pseudomonas* and LAB counts. However, TVC and *Pseudomonas* counts of treated samples were significantly lower ($p<0.05$) than the control untreated ones although a steady increase in the counts was observed during the storage period. Furthermore, no significant differences ($p>0.05$) were observed among the treatments in terms of the pH, water activity and a* and b* values. However, the lightness value (L*) of chicken increased over the storage period due to a white exudate. The results showed that the spices used were effective in controlling the growth of microorganisms and this effect was most pronounced during the first few days of storage. Furthermore, “Kalia” was the most effective spice blend, followed by “Masala for chicken” and “Tandoori”.

This study revealed the potential of spice blends that are widely used in the Mauritian cuisine to enhance the microbial and sensorial quality of the raw poultry products.

Keywords: Spices, Chicken, Shelf-life, Antimicrobial

Isolation, identification and study of antimicrobial activity of *Streptomyces* species from Mauritian soils

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Abstract:

This study consisted of isolating and identifying different species of *Streptomyces* present in the Mauritian soil and testing the antimicrobial properties of the purified secondary metabolites present in the microorganisms.

Soil samples were taken from Mont Roches aseptically at a depth of 12 to 20 cm. The Starch Casein Agar medium was used to isolate the *Streptomyces* species. The cottony appearance of the colonies was used for the selection of antimicrobial compound-producing microorganisms. After isolation, the purification was done on Yeast Malt extract glucose agar starch casein agar media. Twelve isolates were obtained and out of these, only six showed potential antimicrobial activities. This selection was done using the bacterial solution pouring analysis and the 90° cross streaking method. Gram staining and several biochemical tests including catalase, oxidase, Sulphur Indole Motility test, Triple Sugar Iron test, gelatin and starch hydrolysis, citrate utilization, nitrate, MRVP, urea and casein hydrolysis, osmolarity and pH tolerance tests and finally the sugar hydrolysis tests were done so as to identify and characterise the six different isolates. The pure cultures of the isolates were maintained on both Starch Casein Agar and Yeast Malt extract glucose agar media. The fermentation process was carried out using the Mueller Hinton broth. The isolates (1×10^5 cfu/ml) were inoculated aseptically on Mueller Hinton broth and fermented on a rotary incubator shaker for 8 days (100 rpm at 37°C). Following filtration, the bioactive agents were extracted from the filtrate, firstly by allowing a proper mixture of both the ethyl acetate solvent and the incubated broth for one hour. The organic layers containing the bioactive agents were then removed aseptically and were transferred into sterile tubes for further antimicrobial assays. The mycelium biomass was separated and ground with methanol using a mortar and pestle. The extracts obtained from the two methods were then concentrated using a rotary evaporator (40 rpm, 50°C). Using the disc diffusion methods, extracts obtained from both methods of extraction were tested on *Staphylococcus aureus* (ATCC 29213), *Escherichia coli* (ATCC 25922), *Bacillus cereus* (ATCC 10876), *Proteus mirabilis* (ATCC 12453) and *Candida albicans* (ATCC 10231). A synergistic analysis was also done using mixture of extracts, and it was observed that the zones of inhibition were increasing because of a synergistic reaction which occurred. This synergistic reaction was observed when zone of inhibitions which were greater than 15 mm were obtained when tested against *Candida albicans* and *Staphylococcus aureus*. *Proteus mirabilis* and *Staphylococcus aureus* were most sensitive against the supernatant extracts rather than the ground mycelium extract while *Bacillus cereus* was not sensitive to either the mycelium free supernatant or the ground mycelium extracts.

Keywords: *Streptomyces*, Antimicrobial, Mauritian Soils

Optimising yield of tomatoes through the use of naturally-occurring plant growth substances

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Abstract:

Tomato (*Solanum lycopersicum*) is one of the most widely grown vegetables worldwide. Several methods are being used to boost up vegetable production. Plant growth substances are products used to modify a crop by changing the rate or pattern of its response to the internal and external factors. In order to assess the effect of different plant growth substances on the production of tomatoes, an experimental trial was carried out at the University Farm at Réduit. The trial was carried out to test the effectiveness of different naturally-occurring plant growth substances in enhancing growth and development of tomato (*Solanum lycopersicum*) variety THN 988 from October 2015 to February 2016.

The soil type under cultivation was low humic latosols with a pH of 6.98 and electrical conductivity of 0.27 mS/cm. Tomato plants were grown in the field and fertilised as per Food and Agricultural Research and Extension Institute recommendations. The trial was laid according to a randomised block design with five different treatments, each having four replicates. Commercial plant growth substances Perfectose® (both powder and liquid formulation), Pronto® (Liquid formulation) and Kelp Extract® (Liquid formulation) were used at the recommended dosage. Perfectose® powder was applied at 15 days after transplantation and at flowering; Perfectose® liquid and pronto® liquid was applied at flowering stage and fruit formation stage and kelp extract® was applied at 15 days after transplantation, at flowering stage and fruit formation stage.

Kelp extract® treatment resulted in the greatest plant canopy diameter with a mean of 38.7 ± 0.95 cm, shoot dry matter content with a mean of 64.1 ± 0.82 g, with a mean number of flowers of 47 per plant, number of fruits (21 fruits per plant) and produced the highest yield of 14.0 T/ha as compared to control treatment ($p < 0.05$). Perfectose® powder produced the tallest plants with a mean of 98.6 ± 0.62 cm at 60 days after transplantation and had a significant increase in all studied parameters. Perfectose® Liquid also had a significant increase in all studied parameters as compared to control treatment ($p < 0.05$). Pronto® had a significant increase in all studied parameters as compared to control treatment ($p < 0.05$) except in shoot dry matter and in the number of fruits. This study has demonstrated that plant growth regulators promoted growth and development as well as well as impacted positively on the yield of tomato plants. The application of Kelp extract® and Perfectose® biostimulant had a statistically significant effect on all studied parameters as compared to the control treatment.

Kelp extract® proved to be the most effective as most of the parameters studied in the trial (canopy diameter, dry matter content, number of flowers, number of fruits per plant and yield) were all prominent under Kelp extract® application.

Keywords: Tomato, Naturally-occurring Plant Growth Substances

Comparative Microbiological and Hygienic Status of Glass, Plastic and Wooden Chopping Boards

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Abstract:

Chopping boards (CBs) are principal processing equipment used in food preparation everywhere, including households, restaurants, hotels and various food preparation outlets. Microorganisms are ubiquitous in nature and as such, the microbial contamination of water, air, food and food contact surfaces, such as chopping boards, can be the cause of specific site-borne illnesses, mainly caused by cross-contamination.

This study aims to (i) shed light on typical practices adopted in households of Mauritius with respect to usage, cleaning, disinfection and maintenance of chopping boards, (ii) identify the microflora from routinely used chopping boards and (iii) compare the bactericidal efficacy of various treatments to disinfect CBs.

A questionnaire was first administered to a sample of 45 female respondents to assess their individual preferences, usage, maintenance, and general hygiene pertaining to domestic chopping boards. The microbiological and hygienic status of used glass, plastic and wooden chopping boards, collected from various households, were subsequently determined by enumerating their Total Viable Counts, yeasts and molds, *Escherichia coli*, presumptive *Salmonella spp*, presumptive *Listeria monocytogenes* and presumptive *Clostridium perfringens* counts. Their mean population densities were compared by statistical analyses. Fungal species were also isolated from the chopping boards and characterized by carrying out their DNA extraction, using a CTAB DNA extraction method, PCR amplification, sequencing and phylogenetic analysis. In addition, new, unused glass, plastic and wooden chopping boards were inoculated with *Escherichia coli* (ATCC 25922) and *Listeria innocua* (ATCC 33090), and subjected to one of the five treatments (Soap and cold water, Dettol and cold water, hot water (65°C), domestic bleach (Javel) and vinegar). The bactericidal efficacies of the different treatments were compared by statistical analyses.

The questionnaire revealed that plastic chopping boards were mostly preferred by the respondents due to their higher affordability and availability, and the most common way of cleaning chopping boards was the use of water and any dish washing detergent. Only 24% of respondents used separate chopping boards to cut vegetables, non-vegetarian, and ready – to – eat foods. Most of those who mentioned the use of separate boards to cut different food items were found to be vegetarians as compared to their family members. From the microbiological study, plastic chopping boards were found to harbor highest numbers of microorganisms (3.6-1.8 log cfu/cm²) followed by wooden chopping boards (3.3 - <1.6 log cfu/cm²) and finally lowest counts of microorganisms were recovered from glass chopping boards (2.6-<1.6 log cfu/cm²). The three fungal species molecularly and phylogenetically characterized were found to be mostly air-borne and not food-borne. The fungal species were presumably identified as *Penicillium citrinum* (species B), *Peynorellaea glomerata* (species C) and *Cladosporium halotolerans* (species D) upon using BLAST on the NCBI platform. 97, 92 and 99 percentage similarity was obtained for the three fungal species respectively.

This study revealed that among the five treatments used, vinegar was the most effective at reducing the bacterial counts from the chopping boards, with a mean bactericidal efficacy (BE) value of 1.3 log cfu/cm² followed by bleach solution (mean BE of 1.28 log cfu/cm²). However, there was no significant difference between the various mean bactericidal efficacies obtained for the five treatments, since a P value of > 0.05 was obtained upon carrying out statistical analyses.

Keywords: Chopping Board, Microbiological, Phylogenetic, Bactericidal

Food organisations' knowledge, attitude and practices relating to the revised ISO 9001 quality management system standard

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Abstract:

ISO 9001 is a standard that sets out requirements for a quality management system (QMS) which is suitable for all types of organisations. Food businesses seek ISO 9001 certification to provide evidence of commitment to quality and expand market share. The revised version of ISO 9001 was adopted in September 2015 and organisations were given a three-year transition period to update their quality management system. The ISO 9001:2015 standard specifies what organisations should do to manage activities efficiently to fulfil customer, regulatory and relevant requirements. The standard applies seven quality management principles: customer focus; leadership; engagement of people; process approach; improvement; evidence-based decision making; relationship management. QMS activities are structured into categories of interrelated processes which transform inputs into outputs. Processes should be monitored to evaluate their performance for continual improvement of effectiveness and efficiency. The revised standard gives increased prominence to risk-based thinking. Organisations are required to identify risks and opportunities associated with QMS processes which should be managed by applying control that is proportionate to risk. Understanding of the risk-based thinking is essential to achieve quality in a sustainable manner. This can be achieved through training, sharing of practices and research.

In this context, this study was carried out among selected food businesses to (i) determine the level of implementation of ISO 9001 (ii) assess knowledge and attitude towards ISO 9001 (iii) identify activities to update the QMS to meet the requirements of ISO 9001:2015 (iv) investigate the ISO 9001 motives, barriers and benefits. A structured questionnaire was constructed as follows: table on status of implementation of quality and related management systems with five categories of responses; a "true or false" quiz comprising of fifteen knowledge statements; a checklist of activities to update the QMS; fifteen attitude statements with a five-point likert scale; thirteen motives, thirty-three barriers and fourteen benefits based on previous research on QMS experience of organisations. Data collection was carried out by face to face interview of the quality management representative of twelve businesses involved in food manufacturing. Data analysis was carried out on Microsoft Excel 2010. The Pareto method was used to analyse QMS motives, barriers and benefits according to frequency of selection by participating organisations.

Results show that 10 out of 12 food companies stated that they implemented the ISO 9001:2008 QMS standard. The mean % correct answers to ISO 9001 knowledge statements was 72.8 ± 16.19 (range: 46.7-100). The highest proportion of respondents gave correct answers to statements relating to: the current version of ISO 9001; date of publication of the revised standard; change in the clause "Preventive Action". The majority of participants indicated that they made use of the International Organisation for Standardisation (ISO) (75%) and British Standards Institute (BSI) (66.7%) web-sites to update their ISO 9001 QMS. 58.3% mentioned that they had purchased the Draft International Standard. 50% stated

that they had started to collect data for risk and opportunity management. Only 33.3% claimed to use ISO and BSI resources to understand and apply the risk-based thinking underlying ISO 9001:2015. A high proportion of the quality management representatives expressed agreement with the following statements: “the proposed changes in the new version of ISO 9001 will add value to the QMS” (11 out of 12); “upgrading the old to the new version will require investment and lots of training” (10 out of 12); “ISO 9001 certification contributes to enhance export potential” (10 out of 12); “displaying the ISO 9001 certification logo on a food label provides a competitive edge” (9 out of 12). All food companies responded that they disagreed with the statement “application of the risk management process to identify risk and opportunities with respect to quality, is not feasible”. Undecided opinion was significant for issues on time required to update from old to new version (8 out of 12) and action taken by the Mauritius Standards Bureau to enhance awareness of changes in ISO 9001:2015 (10 out of 12). From the Pareto analysis, motives (5 relating to market share, customer satisfaction and quality), barriers (6 relating to employees) and benefits (6 relating to customer satisfaction and quality) were identified 50% of the time by the quality management representatives.

The findings could be used by local organisations to enhance effective application of the ISO 9001:2015 requirements.

Keywords: ISO 9001, food, organisations, quality management

An assessment of the refrigerated shelf-life of opened canned tuna meat and homemade tuna salads

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Abstract:

Canned tuna meat is popular in the Mauritian diet due to its low cost, availability, high quality, high protein content, culinary versatility and ease of preparation. Canned tuna given a full retort process is shelf stable for three years. However, once opened, their safety and quality is compromised especially when these products are stored under abusive conditions or subjected to cross-contamination with other food contact surfaces. Since tuna is a scombroid fish, it may develop significant levels of heat-stable histamine and cause scombroid/histamine poisoning. In addition, the sensorial and nutritional quality also rapidly deteriorates once the canned product is opened and stored.

Hence the objective of the work was to assess the shelf-life, load of spoilage microorganisms as well as the histamine level in opened-canned fish meat stored in different types of storage containers, at different storage temperatures. In addition, tuna salad prepared with mayonnaise, celery, onion, lemon juice and seasoning, were tested for the same parameters.

Cans of tuna chunks in brine or sunflower oil, having a net weight of 160 g, were sanitized and aseptically opened with a flame-sterilized can opener. Tuna meat samples were either left in the original medium or drained; left in the can or transferred to a glass container; and stored at either room temperature for up to 8 hours or refrigeration temperatures for up to 7 days. These samples were then analysed immediately after opening (t_0), after 8 hours following opening (t_8) and at daily intervals up to 7 days for Total Viable Count (TVC), hygiene indicator organisms such as *E.coli*; and *S.aureus*, and spoilage microorganisms such as lactic acid bacteria (LAB) and *Pseudomonas* spp. Physico-chemical tests such as pH and water holding capacity, and chemical tests such as histamine and peroxide value were also determined. Instrumental colour (CIE L^* , a^* , b^*) measurements of the products were also determined at hourly or daily time intervals for samples stored at ambient temperature and refrigeration temperature (4°C) respectively. In addition, products were also subjected to sensory evaluation by untrained (naïve) panelists and parameters included general appearance, colour, texture and aroma.

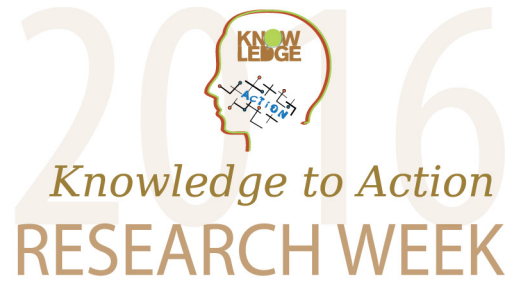
The pH was found to decrease by about 0.9 pH units over the 7 days of storage. The CIE L^* value was also found to decrease (from 68 to 27) in canned tuna in brine and oil, thus indicating darkening of the product. Furthermore the water holding capacity (WHC) of canned tuna in brine decreased by 32.3% over the 7 days of refrigeration whereas the WHC of canned tuna in oil decreased to a lesser extent (16.2%). There was a steady increase in the Total Viable Counts, LAB counts and presumptive *S. aureus* counts from <2 to >4.5 log cfu/g of tuna meat and the homemade salads. Presumptive *Pseudomonas* and *E. coli* was undetectable (<2 log cfu/g) over the storage period. However, microbial counts were consistently less than 7 log cfu/g, which usually marks the onset of spoilage. The peroxide value of canned tuna meat in oil increased consistently over the storage duration from 6.64 to

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195.40 meq/kg oil which indicated evidence of lipid oxidation. Histamine level was below the detection limit (<5ppm) throughout the study, thus pointing to the safety of the product. According to the sensory evaluation done, the overall quality of the products decreased from an initial score of 9 (most acceptable) to a final score 1 (least acceptable) for the canned tuna meat and its homemade salads by the end of the storage period.

Overall findings indicate that the microbial quality of opened canned tuna meat and tuna salad did not deteriorate considerably and the products had not exceeded their microbiological shelf-life even after a week of refrigerated storage. However, the quality of canned tuna in brine and oil as determined by sensory analysis, instrumental colour assessment and peroxide value analysis deteriorated appreciably during extended refrigerated storage. Findings from this study may be used by food service institutions to establish guidelines for the safe preparation, handling and storage of canned scombroid fish products including canned mackerel and bonito fish.

Keywords: Tuna, Shelf-life, Quality, Safety, Histamine



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ORAL PRESENTATIONS

Impact of planning on the construction cost of residential building projects in Mauritius

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Abstract:

Within the residential building construction sector, many projects are never completed on time. Numerous are the reasons, however, in this particular research work the emphasis is on the planning aspect of the construction and execution of the works. Within each of the nine districts, 10 residential buildings were selected based on the following attributes: (i) building was only one storey high; (ii) construction was carried out by a contractor on a shell and core basis; (iii) and the building had a flat roof. The selected building's footprint did not exceed 110 sq.m. and the average construction time was within 1.5 months. Data was collected, on the selected dwellings, through personal interviews with contractors and through observations of the construction activities over the period January 2013 to January 2016. The results showed that many of the contractors work on an ad-hoc basis without too much planning. A lot of idle time was observed among the workers during the construction phase and construction duration was 3 months. On average these contractors had profits ranging between 10 to 15%, some even made losses. However, contractors who had proper planning completed the structure within the 1.5 months and had profits ranging between 25 to 35%. It was also observed that apart from the planning, rigorous monitoring of the works as per the programme contributed to an increase in the profit margin.

Keywords: Residential buildings, construction cost, profit margin.

Proposed Asset Management framework for Maintenance, repair and/or rehabilitation of roads in Mauritius

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Abstract:

Road management agencies, worldwide, has always been facing the same problem that of limited funding for repair, rehabilitation and/or maintenance of the roads. The number of roads requiring due attention from authorities is always increasing while the amount of finance available is always decreasing. The decision making process with respect to which road need to be repair, maintain or rehabilitated first is always complex. Mauritius is no different to this particular issue and whether it be repair, maintenance and/or rehabilitation the decision is taken on an ad-hoc basis. The intent of this particular piece of research is to come up with a decision making framework for repair, maintenance, and/or rehabilitation of roads in Mauritius. A thorough literature search was carried out on the different asset management models and tools with the main building blocks of the proposed framework model determined as Operating Cost, economic evaluation and deterioration models. Using Vensim software a system dynamic (SD) model was developed and tested using data obtained from the Maintenance Section of the Road Development (RDA) Authority on a 10 roads in the district of Riviere Du Rempart. The results showed that applying an improvement decreases considerably the operating cost of a road. In the economic evaluation model, the most feasible maintenance option could be appraised by considering cost- benefit analysis of proposed projects. As for the deterioration model, it analysed efficiently the pavement roughness (International Roughness Index) trend before and after applying an improvement. With the proposed framework and model it was possible to produce a prioritize list of roads. Decision making with respect to which road needed to be repaired, maintained and/or rehabilitated first was easier.

Keywords: Asset Management framework, road maintenance, repair, rehabilitation

A wave-driven hydrodynamic model for Flic-en-Flac: Application to Beach Erosion

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Abstract:

Swell and wind waves are the primary forcing for the hydrodynamics within reefed lagoons, particularly those with low tidal ranges as in Mauritius. Hence they can be the primary driver for near-shore processes including the morphodynamics inside such lagoons. During the past two decades, erosion has been heavily impacting the beaches of Flic-en-Flac on the western coast of Mauritius. It has been suggested that the degradation of the reefs is one of the main causes although this has not been properly studied. Here the effects of wave action on the morphodynamics inside the Flic-en-Flac lagoon are explored using a nearshore numerical model.

We use a surfbeat modelling approach with sediment transport to assess the natural coastal response during normal and hurricane conditions. Surfbeat models are basically shallow-water models forced on the primary wave group scale. This type of numerical model is computationally efficient since individual short waves don't need to be resolved. It is therefore adapted to the scale of the whole lagoons such as Flic-en-Flac. The hydrodynamics is examined using linear shallow water equations, taking into account the presence of bottom friction principally due to coral reef, the infragravity wave response, tidal modulations, setup of the mean water level and the induced longshore currents. One of the most important aspects of the setting up of such models is the use of appropriate bathymetry. In this study, the bathymetry used inside the lagoon was established in 2009 by the Mauritius Oceanography Institute. This was complemented by additional datasets from aerial imagery as well as drone stereo-imagery. Outside the lagoon, Admiralty hydrographic charts were used, up to the forcing boundary.

The model was successfully constructed and run on a four-node desktop workstation. Several wave forcing scenarios were examined and the effect of reef degradation was investigated. Validation was carried out using field data for lagoonal hydrodynamics. Erosion assessment was done through shoreline evolution which in turn was investigated from remote sensing. Overall, the results obtained tend to agree with the limited available observations. However the results are essentially qualitative rather than quantitative. This is mainly because of the limited computing power available, which restricted the study to relatively short time-spans. Several factors were identified which would constitute improvements on the model for future studies.

Keywords: Wave modeling, erosion, hydrodynamics

Innovative Design of an Anthropomorphic Robotic Hand for Fingerspelling

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Abstract:

This paper focuses on the design and implementation of an anthropomorphic robotic hand, which can be used for fingerspelling; a useful device that can bridge the communication gap for persons unfamiliar with sign language when corresponding with deaf and deaf-blind persons. The hand parts were modelled using the Solidworks® 3D CAD software and manufactured using an object rapid prototyper (3D printer) which is a fast and cost-effective process. The robotic hand, like its human counterpart consists of three segments: the distal phalanx, the middle phalanx and the proximal phalanx and 3 joints; metacarpophalangeal joints (MCP), proximal interphalangeal joints (PIP) and distal interphalangeal joints (DIP). Specific design rules are adopted to maintain human form and functionality in a robotic hand while overcoming the difficulty of actuation within a confined geometry. For instance, the fingers of the robotic hand have the same length and width as the human hand. Furthermore, the robotic hand possesses an opposable thumb with 3 joints and three degrees of freedom (DOF) where the interphalangeal joint (IP), metacarpophalangeal joint (MCP) and carpometacarpal joint (CMC) are simplified as hinge joints. The axis of the CMC joint, located at the base of the thumb, has been designed such that it makes an angle of 109.44° and 105.61° with horizontal in the front and side plane of the hand respectively. This feature enables the thumb to touch the fingertip of the Little finger which is a fundamental characteristic of the human opposable thumb.

The mechanism of the robotic hand is based on the actual musculoskeletal system of the human hand which is made of joint activated by group of muscles, pulling the bones via the tendons. In that perspective, a group of remotely located actuators pull the mechanical structure of the finger (phalanx) by means of cable to control the position of each finger. The cable-driven mechanism is adopted only for the flexion of the hand and the extension of the phalanx is carried out by torsion spring located at the joint. The springs (extensor) chosen provide a torque greater than moment due to the self-weight of the finger assembly so that to keep the fingers stiff. Consequently, the torque of the motor (flexor) overcomes the maximum torque of the spring in order to be capable of pulling the fingers down. The hand consists of 11 servo motors housed remotely below the hand palm. The index, Middle, Ring and Little fingers consist of 3 DOFs each which are actuated by 2 servo motors per each finger due to the coupling of the DIP and PIP joints like in the human hand. However, the opposable thumb is made of 3 DOFs, 1 servo motor for each DOF. The motors are controlled by the Arduino Mega, a microcontroller board based on the ATmega2560, by means of pulse width modulation (PWM) signal sent by the microcontroller.

The robotic hand system operates both in automatic and manual mode. For the automatic mode, the controller communicates with a computer via a USB cable and a keyboard is used as input device. By using switch cases in the programming segment, any alphabet typed on the keyboard by the user is translated into a corresponding gesture of the robotic hand respectively. This enables the robotic hand to form each letter of the alphabet in the fingerspelling language (American Sign Language). In the manual mode, the device also

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consists of toggle switches to select the motor to be actuated and a potentiometer to map the angle of the knob of the potentiometer with the angle of the servo motor. The manual mode is mainly utilised in case of emergency and more importantly as a teach pendant in order to allow the hand to perform new gestures which can further be included in the automatic mode. To conclude, the robotic hand is able to form the sign of the fingerspelling language as per requirement. The implementation of a wrist can be included for orientation of hand palm as an extension.

Keywords: Anthropomorphic, robotic hand, fingerspelling, mechatronics

An android framework to improve mobile application testing

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Abstract:

With the widespread use of android mobiles, the urge for the development of new and properly customized android applications has exponentially increased in the past decade. However, in order to ensure fast deployment of quality applications, the latter require adequate testing in the least time frame possible. Also, mobile applications are not only expected to meet user demands, but also the interaction with the graphical user interfaces (GUI) is equally important. Therefore, it is essential to ensure that functionalities that are triggered from GUI are properly implemented. This work analyses the recent android application testing tools with the view to develop a framework to improve the mobile application testing process thereby reducing testing time. In the proposed framework, the deployment of a software automation testing tool, based on the concept of automated test data and capture/replay method, has been investigated together with a few guidelines that are common to android applications.

Five guidelines, which help in enhancing the testing process, have been identified. (1) It is best to make use of error-prompt messages rather than toast messages which usually take long time to appear and disappear thereby constantly irritating users. (2) Instead of using multiple screens (activities in android studio), the use of dialog boxes makes it easier to test the interface. (3) Constant scrolling through the interface is quite tiresome and might cause the application to crash. A search bar can help avoiding such issues. (4) Providing users with an overview of the format to use for inputs is user-friendly but restricting their freedom to write is very inconvenient; it is therefore best to use a grey-out text whereby users are able to enter data according to the format without erasing the previous one. (5) Rotation is an issue as components may get distorted as the orientation changes. Grid layout format is recommended compared to Relative layout.

A car rental mobile application with features such as new member registration, login, browsing for cars and renting cars has been proposed. Based on the car rental prototype and the above guidelines, two android applications have been developed and tested using the Robotium Recorder tool. A normal application (without any guidelines) and a specialized prototype (with appropriate guidelines) have been implemented. The time taken for testing the normal application as well as the testing difficulties has been determined. A set of guidelines was then devised to amend the interface for rapid testing with respect to the issues faced by the user. The suggestions for improving testing are implemented as a framework in the specialized application and the testing results are recorded. Both testing results for the normal prototype and the specialized application are eventually compared and a summary report is generated. Based on the test results obtained, the total time taken to test the normal application is 49.258 seconds while the total time taken to test the specialized application is 27.649 seconds. It can therefore be concluded that the proposed framework reduced the testing time by about 50%. This reduction in testing time is therefore very significant for the quicker deployment of mobile applications on the android market.

Keywords: Robotium, Prototype, Android, Mobile, Framework

Biogas Production from Organic Waste for Households

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Abstract:

Burning of fossil fuels, have a negative impact on the environment releasing greenhouse gases and adding carbon dioxide directly to the atmosphere. An alternate way to protect the planet and environment is by using biogas. The purpose of the research was to assess the viability of biogas production at household level, considering all the safety issues so as to replace traditional liquefied petroleum gas cylinder. It investigated the implementation of a household biogas reactor tank for cooking purposes. Unlike other fuel, biogas does not give a pungent smell while burning and also is a natural source of energy.

The research investigated the construction of a low cost anaerobic digester cask. Biogas was generated by the process of anaerobic digestion of organic wastelike kitchen waste and cattle dung.

Biogas was generated in a 250 kg high density polyethylene (HDPE) container that served as the digester tank. 150 kg of mixture consisting of water, cow dung, and 10 kg of kitchen waste was fed in the system. The components of this substrate were used in equal proportion that is 1:1:1. The mixing of substrate was done in a separate vessel. The HDPE tank was filled up to 80% and the remaining 20 % was left for gas production. Before using the system, a profound test was carried out to ensure all joints of the equipment were air tight to avoid any gas leakage. The mixture was kept for fermentation and monitored for a period of 28 days. It was observed that the generation of biogas could be recorded after two weeks of fermentation. A total amount of biogas produced after 28 days was 227 L. It was measured by using the inverted measuring cylinder method. The highest amount recorded on a particular day was 19.5 L, again the gas produced was measured by the inverted measuring cylinder method. It was observed that the gas production decreased after a few days and thus more water of about 20L was added to the container. Consequently the addition of water increased the gas production. A simple stove was used to test the flame generated on burning the gas produced. The system was set up taking thorough precautions using non returnable valves and regulator during testing. To avoid gas run-off, all joints were secured tight. The Biogas burned with a hot, clear blue flame and partially yellow flame. It did not produce black stains underneath the utensils. An economic analysis was conducted to assess the feasibility of the project and the payback time was calculated. The entire system was executed using a total capital investment of Rs 1330 and having a payback period of 0.2 years that is 73 days. Proper use of equipment such as a non-returning valve, gas valve amongst others minimized the risks of gas run-off, explosion and leakage problems. Thus proper construction materials should be chosen and used.

The project shows potential as a viable means to produce gas for cooking purposes from organic waste for a household consisting of four individuals. It would serve as a profitable waste management system as less waste would be disposed if biogas is being produced at home. It implies that it is rational to invest on biogas production at household level. This attempt will ease the problem of waste stream at Mare Chicose because organic waste can be used to generate biogas instead of being disposed at landfills, creating a proper waste control. Households can generate own renewable fuel. Government can provide awareness and incentives to promote the usage of biogas and create job opportunities.

Keywords: Cooking, Biogas Production, Organic Waste, Households

Challenges of implementing production progress monitoring in SMEs Case study in garment making in Mauritius

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Abstract:

Lack of production monitoring and control is one of the major drawbacks for SMEs to improve quality, productivity and competitiveness. Because of this deficiency, several SMEs struggle to meet customer quality requirements and order delivery dates. If ever they are able to cope with the order specifications, they indulge in lots of rework, reject and excess inventories which substantially impact their cost of production and thus lowers their productivity levels in terms of material utilisation. This research aims to demonstrate, through a case study on an SME, the impacts of lack of production monitoring and control through empirical measurement of several productivity and industrial engineering indicators and the information gaps in production planning which impact management decision making.

In the case study, the first level was to assess the productivity levels of the company with the existing planning and control approach. A frequency distribution of lateness was first conducted with historical data on past order deliveries, whereby it was found that most common delays were 3-5 days and 15-17 days and 78% of the orders were not delivered at the right time. Substantial variations were identified from the analysis of output per man-hour, line efficiency for the assembly operations and line balancing efficiency. It was observed that line balancing was poorly known technique. Line balancing calculations showed that 3-4 out of the 11 workstations in the assembly line were not required from different orders, thus indicating poor utilization of production capacity. The highest achieved line balancing efficiency among different production orders was found to be 70%.

Quantitative analysis of the productivity level was followed by a mapping of the pre-production planning to identify the information gaps in planning and control. The key bottlenecks were identified as lack of planning before launching any production order, no information conveyed to production on the quality standards and control, feedback on an order received only after completion of order and no records on the production progress, productivity levels and reject levels. Thus, very often, the company management was unable to provide accurate information on work progress when it received queries from customers.

The paper also discusses the inherent challenges in SMEs which hamper the adoption of production management and industrial engineering techniques in order improve production efficiency and effectiveness in customer delivery. Lastly, it presents the design of a production progress monitoring control board, based on the fundamentals of industrial engineering – such as line balancing, takt time, output per man-hour, etc -, which caters for the realities of the SME in terms of production type, production volume, supervisory level, improving the quality standards of the pre-production procedures, internal technical support and quality control. The design also takes into account certain re-structuration which would need to be also implemented with the production control board, such supervisory control, rationalization of the material flow and review of the planning information provided to production.

Keywords: production monitoring and control, industrial engineering

Design and Implementation of Rain Water Harvesting System in Keats College

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Abstract:

Environment and climate change is a risk that is pressurizing the hydrological framework and water assets of Mauritius. The impact of climate change can be felt and seen on the island. In Mauritius, the percentage amount of rainfall differs from one region to another. Initiative has been taken by the government of Mauritius to include a rainwater harvesting scheme in his schedule for the year of 2015/2016. It encourages local authorities, schools and other government agencies to use rainwater for non-potable water needs like washing yards, toilet and watering. The government has introduced grants in aid for eligible institutions /organizations. The concept of water harvesting includes the accumulation of water from surfaces on which rain falls, and collecting this water for later utilization. In general water is collected from the tops of buildings or structures and stored in water tanks for use. This model is not been used to its best by many institutions of the island. Keats College (boys department) is a secondary institution which is situated at Chemin Grenier (district of Savanne), in Mauritius. About 700 people including students, teaching and non-teaching staff are present in the school on regular school working days. It was observed that during rainy days, the college receives an abundant amount of water which gets channelized from its roof top to the ground as a wasted resource causing wetlands in the school building. The aim of the present study was to design and implement a Rain Water Harvesting System (RWHS) in Keats College to store rainwater as a back-up resource for its non-potable usage. The implement the system would also help to decrease the impact caused by rainwater runoff in the school compound. The objective of the project was to propose an RWHS that will comply with the structure of the institution. The methodology included a thorough study of the site and preparing a blue print of the proposed system. The total cost of the proposed RWHS was calculated. A cost benefit analysis to assess the effectiveness of the project was carried out. An optimum design to fit in the existing structure of the college was proposed. The design was approved by the officials was then implemented to provide the college with rainwater resource for non-potable usage. The system was evaluated and alternate design was proposed to modify components that would help to a better performance of the system. A system which comprised of a combination of four vertical and one horizontal pipe component was mounted along the length of the building which connected the roof to the water storage container. During the implementation process, four significant components were introduced which enhanced the performance of the system. A coarse mesh that could be easily be disassembled and manually cleaned from time to time was introduced to filter the water from debris was introduced; PVC connectors which assemble one PVC pipe to another one; PVC Clips which holds securely the pipeline system on the surface of a building and the wall; Inclination of the horizontal pipe so that rainwater could be channeled from the rooftop to the water container by its acceleration of free fall caused by gravity. When the rainwater was channeled through the pipelines, it finished its course in the water storage tank and could directly be used. A pump could be used to transport the water to the ground floor, first and second floor respectively for the water to be used in draining systems of toilets. The concept of rainwater harvesting proved to be a beneficial proposition for the school.

Keywords: Design, Implementation, Keats College, Rain Water Harvesting System

Design of a service recovery system for a supermarket**UoM Research Week 2016**B. S. Toolsy¹ and C. Seesurn¹¹ Department of Mechanical and Production Engineering, Faculty of Engineering, University of Mauritius, Reduit, Mauritius

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Abstract:

In Mauritius, consumers have an array of options when it comes to buying groceries. During the last few decades, traditional grocery shops have slowly been replaced by supermarkets, of different sizes and some integrated in major retail chains. Consumption and purchasing patterns have changed and consumers have become heavily dependent on supermarkets for their grocery needs. In Mauritius, there are approximately 155 supermarkets and competition is very fierce as range of products and prices are more or less comparable. Thus, in order to compete and build long term relationships, supermarkets on service excellence, strategic locations, personnel attitude, service quality, store environment and sometimes even availability of kids' corner. However, it is recognized that service quality is the prime differentiating factor in order enhance customer loyalty and retention. The key features in the nature of a service is that services are instantly consumed, human factor plays a critical role and delivery of services has always been marked by some service failures. Service failures is the dissatisfaction of customers due to several reasons among which can be long waiting time, bad personnel attitude, inattentive listener, untidiness of sales space and unavailability of resources. Service failure can also be considered as a customer's economic and/or social loss in an exchange. Thus supermarkets should make their best to propose social and economic resources so as to prevent the adverse effects of service failures. A service recovery system is very important in order to improve justice to the customer, customer satisfaction and thus avoid tarnishing the reputation of the company. This paper examines the different failures in a supermarket service and analyses them profoundly using the SERVQUAL model and FMECA tool by involving both customers and employees. It also covers a review of the difference concepts, frameworks and practices in service recovery and discusses their relevance to the supermarket. Lastly, the QFD technique was used to link the customer perceptions on service failures and the employee's evaluation of potential service recovery approaches and thus design a service recovery system.

Keywords: service quality, service failures, service recovery system

Assessment of road user behaviour along a specific road segment In Central FlacqD.D. Sookharee¹ and A. Seeboo^{1*}¹Department of Civil Engineering, University of Mauritius, Reduit, Mauritius* Corresponding Author. E-mail: a.seeboo@uom.ac.mu**Abstract:**

Road accidents have become a global concern, causing 1.25 million deaths every year (WHO, 2015). In 2015 alone, the roads in Mauritius have caused 139 fatalities (Defimedia, 2015). Some identified key risk factors are distracted driving, speeding and drunk-driving. Despite the fact that pedestrian crossings and intersections have been designed to reduce the number of accidents and enhance road safety, accidents are still quite pervasive. This paper assesses road user behaviour along a specific road segment at Central Flacq in Mauritius. 5 specific sites were chosen at signalised and non-signalised crossings and at junctions along that stretch of road. Data was then gathered by direct observance for a minimum of 5 days at each site. Observations included a set of violations committed by drivers and pedestrians, along with other common trends captured at the different sites. Moreover, a questionnaire was designed for road users living and travelling in the region of Central Flacq; it captured their perception on road safety, which was compared with the data gathered via observation. The analysis of data has shown that at signalised crossings, more females crossed on green and a significant number of pedestrians crossed on red. In addition, a high percentage of drivers did not stop on amber and about 30% did not stop on red. Furthermore, 31% of pedestrians did not make use of the zebra crossing and 61% of the drivers did not yield to pedestrians, many of which were two-wheelers. Finally, at the non-signalised junction, it was observed that the majority of pedestrians accepted a safe gap while crossing and the majority of vehicles stopped at the stop-line. 60% of vehicles favoured the conventional right turn as compared to the weaving merging right turn. As far as the questionnaire was concerned, the respondents' claims did not always tally with the observations, for instance, the majority reported that they almost always stopped at amber or 'rarely' violated the amber signal.

Keywords: Road user behaviour, crossing, junction, roads

End-Host Mobility Criteria for Locator Identity Splits Protocols

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Abstract:

The current Internet Protocol (IP) architecture is not designed to inherently support end-to-end mobility because of the overloaded semantics of the IP address. When the IP architecture was designed, the TCP/IP stack was developed at that time for large devices which were fixed and stationary. They connected to the Internet via wires and therefore it was sufficient for the TCP/IP stack to identify these stationary devices by their location. To route and forward the messages towards these devices, their location information was more than enough to be supplied in the IP address because it would be delivered to the addressed devices. The IP address is therefore able to both identify these devices as well as to topologically locate them in the network. This situation is true as long as those devices are stationary.

However, now the Internet has evolved to support wireless communication, enabling users to connect to the Internet using devices such as smartphones and netbooks. As a result, those devices are no longer fixed, but are mobile. Users can use their mobile devices to connect to a wireless network and start communication. When the mobile device changes its point of attachment or moves from one network to another, its location changes as well as its IP address. However the change in IP address does not imply a change in the identity of the mobile device. As a result, the TCP/IP stack cannot handle this situation. This is because the TCP/IP stack always expects to see the same IP address for an ongoing connection due to the fact that the IP address is used to identify the mobile device at the network layer protocol as well at the upper layers (transport and application). Hence this situation means ongoing connections will be disrupted, and packets will be undelivered. Thus the dual role of the IP address hinders mobility.

The Research Routing Group acknowledges that decoupling the IP namespace into distinct Locator and Identity namespaces will help in providing support for mobility. Protocols which decouple the semantics of the IP address are referred to as Locator Identity Split protocols and most of them uses IPv6 Protocol as its addressing scheme. These protocols are based on the concept of separating the endpoint identification and locator functions of the IPv6 address. Hence an IPv6 address does not need to both identify and locate a device within the proposals. That is the addressing is separated into two parts: the Locator and Identifier. By decoupling the IPv6 address, mobility is enhanced. Locator Identity Split protocols helps to tackle end-host mobility as well as network-mobility. In this research, a set of end-host mobility criteria have been analyzed, defined and evaluated for Locator Identity Splits protocols in order for them to successfully support end-host mobility.

Therefore to successfully support end-host mobility, a Locator Identity Split protocol should meet the following criteria:

- Packet Forwarding: How are the packets being delivered to and from the end-host? For example is there any initial delay before a communication starts?

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- **Route Update:** How quickly the new route is updated in the network after the end-host has moved to another point of attachment, so that the end-host is reachable and packets can continuously be routed to the end-host new location.
- **Efficient Handover:** Limiting the amount of packet loss during handover.
- **Support for Sleep Mode:** The ability to forward messages to the end-host when it is in sleep mode (sleep mode helps to prolong the battery life of the end-host).
- **Security:** Added challenges are brought when the IP address is decoupled. For example, how to prevent tracking the location of an end-host based on its Identifier?
- **Robustness:** How to ensure that the protocol does not have a single point of failure which will render the service unavailable.
- **Concurrent Movement:** How does the protocol allow the end-host to move simultaneously without disrupting an ongoing session?
- **Deployment:** Can the protocol be deployed within a reasonable means and costs, and still interact with the legacy network?
- **Scalability:** Can the protocol cater for a large number of moving end-hosts?

Keywords: IPv6, TCP/IP Stack, Mobility, Locator Identity Protocols

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Interactive Soft Skills Training Toolkit

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Abstract:

Communication skills or soft skills play a vital role in people's personal, academic and professional life; be it at home, at schools, in college, in universities, in a professional environment or any other places which involves human beings. Some of the soft skills include writing skills, interpersonal skills, teamwork, leadership and management and presentation skills. Having good academic qualifications do not necessarily guarantee that a person will perform well in a professional environment. Companies are investing huge amounts of money to train people in mastering their soft skills. The latter help to improve peer communication and collaboration, enhance management and leadership skills, and also help to improve customer service and retention. These factors definitely play an important role in improving productivity and staff throughput of the organisation. When fresh graduates join the job market in Mauritius, one of the dark areas still being pinpointed is the lack of their soft skills' mastery.

Via different platforms uniting the University of Mauritius and the industry, communication skills have been integrated in different modules across different programmes that the campus offers. For example, for the past three years, the Computer Science and Engineering department has been offering a full yearly module on Communication skills adapted for IT graduates to meet industry standards contributing to a smoother transition once they join the job market. In this module, via different types of face-to-face activities, students are trained and evaluated on different skills such as writing skills, interpersonal skills, team work, leadership and management skills, conflict management and so on. This module also includes a yearly inter programme competition, sponsored and highly appreciated by the industry. After analysing the different challenges for fresh graduates to acquire and master soft skills, this research therefore attempts to minimize the soft skills problems by designing and implementing a cloud based application software known as the "Urasoft" soft skills training toolkit. It is expected that this toolkit can be useful mainly for upper secondary students and tertiary students. It should be noted that this toolkit is complementary to the face-to-face interaction required to develop soft skill capabilities of each student.

The toolkit consists of a Front End and a Back End and the main modules included are Administrator management, Tutor Management, Training Material Management, Assessments Management, Class Management, Student Enrolment and Analytic Graphs. The Assessments management module consists of both Exams and Scenario Assessments based on Role-play Scenarios. Different algorithms have been designed for Administrator Management, Tutor Management, Training Material Management and Assessment Management. As far as the Analytic Graphs are concerned, a special algorithm has been used in the back-end in order to generate several Analytics Graphs based on data captured. The system also offers different levels of Training and Assessment. Once a person enrolls in the course, he/she is not allowed to move to advanced levels without completing intermediary levels.

After implementation and testing of the system, satisfactory results were achieved where Training and Assessments of soft skills can both be accomplished. Tutors can set up their classes, assignments, exams and make different types of analysis with respect to student performance. Students on their side can use this platform to train themselves and take different forms of assessment. This tool definitely adds value and can complement the teaching and activities carried out in a face-to-face room setup. Students can revisit existing activities and enhance their skills and easily submit different forms of assessments including role plays via videos. However, no investigation has been made with respect to different learning styles and pedagogies and the needs for different age groups.

This toolkit can be enhanced and integrated in existing curriculum related to communication skills. More user acceptance testing and the integration of this toolkit as a pilot system in one module will generate feedback which can be used to enhance the system. Moreover, this cloud based application can be extended to ‘guest access’ where any user can enrol in the course for training without any tutor assignment for their own personal growth. With the concept of nine-year schooling in Mauritius where Communication is integrated as a subject, this toolkit could be further extended for primary, secondary and vocational schools while applying the learning pedagogies appropriate for each age group.

Keywords: Soft skills, Soft skills Training Toolkit, Training, Assessment

BactAnnot - A Re-annotation pipeline for Bacterial genomes using Node.js

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Abstract:

Modern sequencing technologies are generating large volumes of information at the genome level. Interpreting this information into a biological meaning remains a very complex process and thus a major portion of proteins discovered remain as proteins of unknown function (PUFs) or hypothetical proteins. Attempts to reveal the functional significance of hypothetical proteins are limited due to a lack of easy and high throughput functional annotation tools.

Research shows that there is a significant increase in the number of genomes being sequenced and submitted to GenBank, which is a publicly available nucleotide sequence database at the National Center for Biotechnology Information (NCBI). This rate of increase is even more pronounced with the next-generation sequencing (NGS) technology. Consequently, manual expert annotation cannot keep up with such an increase in submission rate and bioinformatics solutions prove to be an efficient method to perform *in silico* annotations instead.

One problem with annotated genomes is that they are rarely updated; gene positions could have been wrongly identified and annotation could be erroneous due to a variety of factors. Moreover, the function of given proteins might not have been correctly identified and even if another scientist has made a correction, only the author has the right to edit his publication. This research aims to re-annotate the functional description of hypothetical proteins in bacterial species using the Node.js web technology. More specifically, a pipeline is developed using existing tools. Commonly, the functional annotation process takes place after identifying genes from nucleotide sequences. The proteins sequences are searched against databases using sequence similarity. High sequence similarity usually implies homology, hence a high probability of the proteins to share the same function. The research elaborates further into the various methods of functional transfer, tools and databases commonly in use in the literature for determining functional transfer. The research also assesses the benefits and drawbacks of using the new server side technologies such as Node.js, which uses Google v8 engine providing great performance and high scalability. Furthermore, existing pipelines are also evaluated and discussed.

The objectives of this research work are to develop a pipeline to annotate hypothetical proteins of bacterial genomes using the following steps:

- Downloading selected genome sequences data from GenBank
- Use of techniques like BLASTP to create an initial list of probable matches
- Use of other tools including protein domain databases to obtain the name and function of the protein coding sequences
- Re-annotate a maximum of 'hypothetical protein' sequences and integrate the new annotated genome in a local database

In order to identify the best strategy for functional re-annotation of the hypothetical proteins, the methodology used consists of studying the tools and databases from the literature,

evaluation of the existing pipelines as well as comparative tests on the results of the different tools to determine which tools are most appropriate for constructing the pipeline.

The current architecture uses a cluster of node.js application coupled with RedisDB which maintains a session data as well as job scheduling data. MariaDB is used as the main permanent data storage for the service.

The proposed pipeline allows for the upload and parsing of GenBank files to retrieve a list of hypothetical proteins. The hypothetical proteins are then searched using the NCBI BLASTP RESTful services on the Swiss-Prot database as it happens to be a manually curated database which includes high quality annotations. The results data will then be further enriched using different tools. The results will then be stored on the local MariaDB database.

The installation of the pipeline is simple and can be either hosted as a cloud service or set up as a local intranet. The developed pipeline should improve the current annotation by keeping the annotation data up to date and finding functional description of hypothetical protein wherever possible. It is important to refer to up to date information with respect to proteins as they are involved in different kinds of research, including medical research, and complements our understanding of bacterial genomes.

Keywords: Bioinformatics, Functional annotation, Hypothetical proteins, Genbank, Node.js

Extraction and Processing of Pineapple leaf fibres

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Abstract:

Pineapple plants belong to the Bromeliaceae family which contains around 1300 varieties that are mostly native to America. They are planted all around the world. Mauritius has been cultivating pineapple fruits for many years intended for consumption due to their delicious taste and the non-edible parts (such as the leaves) are thrown or destroyed as they are not even suitable to feed cattle due to the thorns present on the edges of the leaves. They take very long time to degrade due to its fibrous component and cause inconveniences for planters to dispose them.

Natural fibres refer to fibres obtained in nature, found in animals as protein fibres, in plants as cellulose fibres and in minerals as asbestos (M.Sfiligoj Smole et al., no date). In the early eighties, pineapple leaves fibres were tested with success as a fundamental material for fabric making. Massive research work was made on pineapple leaves fibres which proved their prospective in the textile industry (S.K Dey et al., 2015). With some expertise in the field, it may not be difficult for a country like Mauritius to start making yarn and cloth out of pineapple leaves as a large amount of the fruit is cultivated throughout the year.

The study investigates the various mechanical and manual techniques of extracting fibres from pineapple leaves. Experiments were carried out using different tools and methods such as scrapping with knife and nail brush to remove the fibres from the leaves which were covered with a protective thick layer of hydrophobic wax. Other techniques such as boiling the leaves and putting them to ret under atmospheric conditions to separate the thick layer of the leaves from the fibres, with the help of microbial and bacterial activities were experimented.

The obtained fibres were processed by bleaching in sodium hypochlorite and dyed in natural colour dyes namely the turmeric powder, carrot, beet root, sandal wood bark, tea leaves, onion outer skins and Jamblon fruits. The carrot and beet root dyes did not work on the fibres despite the use of salt as mordant. The other natural dyes gave good colours to the fibres. Extracted fibres were spun into handmade yarns by twisting. Twisting the fibres with application of water gave a neater finish to the yarn than without the use of water.

The best way of extracting pineapple leaves is the combination of methods that is boiling the leaves in water and retting them in tap water for at least one month. The leaves are then scrapped with a putty knife for decorticating the fibres. Leaves that are boiled and retted in seawater works serves as a good method of extracting pineapple leaves fibres, however the process is very time consuming. Some natural dyes like dry turmeric powder, dry tea leaves, onions outer skins, sandal wood barks and Jamblon fruits gave good colours to the fibres. The spun yarns are strong and may have a variety of applications. They can find use for cloth making and sustainable products development. The yarns produced can be used for developing products such as crafts, bags, door mats and many other products that can give new dimensions to the market of these products in Mauritius.

Keywords: Extraction, Dyeing, Pineapple leaf fibres, Processing

Extraction of Natural Dyes from locally available sources and their Application on the Extracted Sisal fibres

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Abstract:

The paper reports the extraction process of natural dyes from plants and locally available sources and their application to the extracted Sisal leaf fibres.

Natural dyes have been in use for dyeing textiles since a long time. Natural dyes are substances that can be obtained from sources that we come upon in our everyday lives, for instance, vegetables, fruits, insects etc. By processing these diverse natural sources, a large variety of colours can be obtained. Different sources give different colours. In an era of sustainability, natural dyes must be promoted to create awareness of their applications and benefits.

Sisal fibres are in use in a number of countries worldwide. It is a plant that grows in any type of soil except clay. Its cultivation method is very simple and the fibres extracted from this plant have diversified uses. The plant is found in many places all over Mauritius. However, it has not been exploited in Mauritius to its fullest. It finds its use mainly as a decorative plant. The textile industry holds an important stake in the economic standing of Mauritius. Exploring the plant's potential can contribute to the economy of the country. Similarly, Sisal fibres combined with natural dyes can play a big role in the three pillars of sustainability. The introduction of Sisal fibres and natural dyes in the industry would serve an asset and generate employment for the country especially in the handicraft sector. Handicrafts sector would flourish with the use of Sisal fibres.

In the present study extraction of the Sisal fibres was carried out by various manual and mechanical processes. Simple processes which could be replicated were experimented. Similarly, simple and replicable methods to extract dyes from locally available materials were investigated. Various sources such as onion skin, turmeric, tea, coffee, henna, hibiscus flower, bougainvillea flower, beetroot, carrot, acalypha, spices and soil were used for extracting the dyes. Dyeing of sisal fibres in these extracted dye baths was carried out. Locally available mordant such as Alum and Cream of Tartar were used as pre-treatment to dye the fibres. Using a mordant makes the colour set into the fibre so that it will not bleed out on washing. Most fibres were dyed at a temperature of 65°C to 70°C for one hour. However, the time and method required for obtaining an appropriate shade varied and depended on the type of source used. Evaluation of the dyed fibres was carried out for light fastness and wash fastness. The dyed fibres were assessed for Pantone colour code using PANTONE CAPSURE. Evaluation of colour composition was measured by obtaining the RGB and L*a*b* values.

The extracted Sisal fibre proved to be an excellent fibre for dyeing with natural dyes. It possesses a good tensile strength and dyes uptake. A range of vibrant colours were obtained when dyeing sisal fibres with the natural dyes. Dyes extracted from turmeric, onion skin, tea, coffee, plum skin, hibiscus flower, henna, bougainvillea flower, red and acalypha exhibited

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very good results. While extracted dyes from beetroot, eggplant, basil leaves and carrot required modifications in the dyeing process.

The project opens avenues for use of such natural fibres as alternative resources to synthetic fibres. They are cheap renewable and environmentally friendly. Similarly in combination with natural dyes the fibres can open new ventures especially in field of art and craft.

Keywords: Application, Extraction processes, Natural dye extraction, Sisal fibre

Environmental and Socio-Economic Impacts of Implementing Alternatives to Plastic-Carry Bags in Mauritius

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Abstract:

With the prohibition of plastic bags in Mauritius since the 1st January 2016, a variety of alternatives to plastic-carry bags has gained value and found their way on the local market. The aim of this research consists of the evaluation of the socio-economic and environmental impacts of implementing alternatives to plastic-carry bags in Mauritius. A survey was thus conducted in Mauritius for the identification of the most preferable alternative to plastic-carry bags, as well as, to analyze the willingness of Mauritian people to use alternatives to plastic-carry bags; and to conduct similar surveys in Rodrigues, where the ban of plastic-carry bags has already been implemented (i.e. Rodrigues is taken as the baseline); to analyze the environmental aspects related with the banning of plastic-carry bags and with the integration of its alternatives based on both Mauritian and Rodriguan perception. A simple random sampling method was used for both population surveys and a sample size of 385 and 50 was used for Mauritius and Rodrigues, respectively. Data collected from the population surveys were analyzed by SPSS software where both descriptive and inferential statistical methods were used. The findings of this study demonstrated that both Mauritian and Rodriguan populations were in favour of banning plastic-carry bags with a percentage of agreement of 74.55% for Mauritius and 86% for that of Rodrigues. The main attributes which made plastic-carry bag usage so popular were its availability (32%), cheapness (25%) and lightness (21%), therefore these requirements need to be considered when retailing or designing of the upcoming alternatives to plastic-carry bags. Among the alternatives to plastic-carry bags under consideration in this study (i.e. bioplastic bag, paper bag, jute bag, cotton bag, woven PP bag and vacoas bag), cotton bag was the most preferable alternative to plastic-carry bag for Mauritius with a percentage of preference of 30% and vacoas bag for that of Rodrigues, with a percentage of preference of 44%. 52.47% of the Mauritian respondents were not satisfied with the alternatives to plastic-carry bag available for their daily usage, whereas 56% of the Rodriguan respondents were satisfied with the latter. 88.31% and 94% of the population of Mauritius and Rodrigues respectively were aware of the environmental problems caused by plastic bags wastes. Based on the perception of Mauritian people, the main environmental problems caused by plastic bag wastes were deterioration of environment (35%), blockage of drains (30%), animal death (20%) and human health problem (15%). 92.2% of the Mauritian disposed of their plastic-carry bags wastes in dustbin, which consequently found their way to the landfill and since they are non-biodegradable they contributed to landfill overloading, 5.7% were disposed by open dumping, hence causing eyesore, drains blockage and they were carried away to the sea which resulted in flooding and animal death, and 2.1% were burnt which released toxic gases, hence causing human health problem. The Pearson Chi-square test proved that the preference of the alternative to plastic-carry bag was independent on the level of income of respondents and the Spearman's Correlation test shown that the level of income did not affect the usage time of the alternative to plastic-carry bags.

Keywords: Banning of plastic-carry bags; Alternatives to plastic-carry bags; Environmental and socio-economic impacts; Mauritius and Rodrigues; surveys

An automated corner making device for enhancing safety, accuracy and productivity of SMEs in the aluminium industry in Mauritius

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There has been a clear shift from the use of mild/galvanised steel to aluminium for fabricating openings in the construction industry, with a drastic increase in the number of small and medium enterprises (SMEs) offering such services. This trend has also been observed in the increased use of aluminium as base material for manufacturing kitchen and bathroom furniture at the expense of wood, mainly due to the damage caused to the latter when exposed to moisture. During surveys carried out at local aluminium workshops, it was observed that SMEs are mostly engaged in the aluminium industry, and basic tools and fixtures are used for carrying out the machining operations as opposed to state-of-the-art technologies such as CNC. High capital investment and the need for trained personnel are among the barriers to the use of CNC machines for SMEs. The downsides in using rudimentary tools and fixtures are inaccuracies and misalignment that adversely affect the process of joint making, with safety problems also reported in the current, predominantly manual techniques.

Of relevance to this project is the use of 1.5" (38.1 mm) or 2" (50.8 mm) square profiles, for which high risk of injury and misalignment were reported, due to the work methods involved for making joints with these square profile bars. For jointing the two pieces of bars cut each at 45°, 38.1 mm, right angle brackets are typically used. The latter is generally held by hand during the fixing process, which can lead to serious injuries as well as misalignment. Drilling both the angle bracket and aluminium profile separately is one of the major causes of misalignment, and holding them in place correctly while drilling and riveting is a challenge for the worker in itself. No system exists locally to align and clamp 90° corner joint for drilling and riveting.

The aim of this project is to design an automated system to align and clamp the two bars for making the joint, allowing the worker to safely drill and rivet the joint, without any undue strain needed to keep the joint aligned manually. The proposed prototype is intended to be cost effective so that SMEs involved in the aluminium industry can afford such a solution and use it to improve their product quality and thus improve customer satisfaction. Furthermore, this device will ensure the safety of the workers, while being ergonomically designed to reduce physical strain on the operator.

For the latter, ISO standard 14738 (Safety of machinery – Anthropometric requirements for the design of workstation at machinery, 2002) was consulted for anthropometric data related to the work environment and how the user can be made to work with the proposed prototype effectively. Concept ideas were generated to meet the following system requirements: alignment and clamping, drilling of angle bracket and a frame support for the worktable. The final concept was obtained using a weighted matrix method, which was further detailed to obtain specifications for materials, mechanical components, electrical motors, drives and sensors. The design criteria for the components were set based on data collected on the

aluminium bar square profiles and experimental tests carried out to determine appropriate clamping forces to be applied to hold the bars in place.

Jigs were designed for the two square profiles considered to accommodate and hold the 90° angle brackets for drilling using appropriate tolerances allowable for these aluminium bar profiles. To start the joining operation, the suitable jig with the angle bracket is placed inside the aluminium bar, and upon pressing a start pushbutton, electrically actuated clamps are moved sequentially to hold the two 45° bars with the angle bracket held by the jig so that the worker can drill the holes for the rivets. 90° inner and outer guides were designed and manufactured for the precise and repeatable positioning of the aluminium profiles, with appropriate recesses to allow drilling and riveting.

The worktable was designed with an adjustable mechanism feature to allow levelling, with due consideration of the load to be supported by the system. The structural design was validated by a truss analysis using finite element method to determine the deflection, force and nodal force of the worktable.

The components were designed, constructed and assembled to erect the complete 90° alignment and clamping system. Requisite software was developed using the Arduino (Atmega 2560) microcontroller, to control the operation of the various clamps sequentially as per the set mode of operation. Force resistive sensors used to control the clamping force exerted on the bars. The system was tested and the device was successful in producing proper 90° joints, meeting the accuracy, aesthetics and safety requirements set.

A cost benefit analysis was carried out using data collected from various aluminium companies, and a payback period of around 2 years was obtained, which is deemed favourable given the multiple benefits achieved. This corner making device will contribute in modernising the work practices of small and medium enterprises involved in the aluminium industry in Mauritius, with knock-on benefits in terms of less material wastage (both aluminium bars and also less use of Silicon sealant to hide poor joints) and better customer satisfaction.

Keywords: 90° corner joint system, clamping and joining, process automation.

Towards a Mobile Application for the Mauritian Police Force

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Abstract:

Routine traffic stops by police officers is something very common in Mauritius and in other countries. Usually the police officers ask for the driver's license, check the insurance vignette and other important things in the vehicle to ensure that the vehicle is fit to be on the road, the driver is apt to drive the vehicle and the occupants are not engaged in any illegal activities. At the end of the routine check, the driver is asked to sign on a register as a proof of being checked at this specific location and time. Computerisation of the Mauritian Police Force has already begun with the Crime Occurrence Tracking System (COTS) which provides for secure data capture and sharing in order to track and combat crime occurrence in Mauritius. However, lack of readily accessible information might also be a key obstacle to public security. In this paper, we present a system, MPFApp that can be used by the Mauritian Police Force or even other police departments in other countries, and which provides real time information to police officers performing routine traffic stops on roads. The system consists of both a mobile application installed on a mobile device and a web application. The mobile application can be used by field police officers to view the driver's details based on the license number or the national identity card number. The mobile application can also list all available information of a specific motor vehicle based on its registration number. The policeman can also use the mobile application to issue tickets to drivers, send emergency messages to the attached police station and view traffic related information among others. The main functionalities of the web application is to allow the police officers to immediately notify other officers of latest updates, generate and validate contravention case files and get the exact location of police officers using the GPS capabilities of the mobile devices. The main advantage of such a system is that it provides real time information to the officers performing the routine traffic stops. Hence, stolen vehicles, vehicles with fake number plates, wanted persons, drivers with previous offences can easily be identified through routine traffic stops and prompt actions, such as performing a thorough vehicle check or proceed with an arrest, can be taken to enhance the effectiveness of these routine checks. A prototype application has been implemented and tested in simulated environment and has proved to be beneficial in providing real time information which can be vital in ensuring the security of tourists and inhabitants in general in Mauritius. A system such as MPFApp should interface directly with the National Transport Authority, a department responsible for the registration and transfer of ownership of motor vehicles, and licensing of public service vehicles and goods vehicles. An interface with the Civil Status Division, responsible for the registration of births, deaths and marriages and other matters relating to the civil status of persons in Mauritius, is also required. The system can easily be integrated with the existing COTS in order to improve the efficiency of these traffic stops.

Keywords: routine traffic stops, Mauritius Police Force, mobile application, real time

Analyzing the effects of pesticides on a food crop

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Abstract:

The agricultural land occupies more than 40 percent of the surface area of Mauritius. With the aim of attaining self-sufficiency for food, Mauritius has to import large quantity of pesticides. According to the National Environmental Action Plan (NEAP), imports of pesticides have relatively increased by around 6 percent on an annual basis since the year 1991 even though there has been no proportional increase in the vegetable yield. Vegetable growers make use of these pesticides in order to protect their vegetables and fruits thus increasing their productivity. Very often when insects and pests become resistant to the pesticides sprayed, planters have the tendency to increase the dosage than the recommended one with the view of overcoming this problem and they end up accumulating in the environment. This study assessed the effects of pesticides on a food crop named Pak Choy. The pesticides under study were namely: Cypermethrin and Deltamethrin. Seven different treatments were devised as follows: Soil only (T1), Soil and compost (T2), Soil, compost and pesticides at recommended rate (T3), Soil compost and pesticides at three times recommended rate (T4), Soil, manure and fertilizer (T5), Soil, manure, fertilizer and pesticides at recommended rate (T6) and Soil, manure, fertilizer and pesticides at three times recommended rate (T7). The physicochemical properties of the all treatments were assessed before any application of pesticides (Day 0) and after the harvesting the plants (Day 56). The following physical and chemical properties of the soil were analyzed: bulk density, moisture content, pH, electrical conductivity, porosity, volatile solids, and water holding capacity, heavy metal content and nutrient content (NPK). It was noted that incorporation of organic fertilizers such as MSW compost and cow manure increased the nutrient content, productivity and fertility of the soil. Uses of organic fertilizer such as 13:13:20:2 further raised nutrient content and electrical conductivity (by 52%) of the soil. Mixing of manure and compost triggered a rise in pH of bare soil which was 5.93 to a pH (6.9-7) which is deemed conducive for vegetation. Water holding capacity, porosity and organic matter were boost up in treatments involving soil amendments. Upon analysis, it was found that these additives did contribute to upgrade the heavy metal content of the treatments. Further investigation involved analysis of crop yield, percentage of dry matter, percentage growth and level of pesticide residue in Pak Choi that was harvested for each treatment. After harvesting the plants the same physicochemical properties were analyzed again and it was found that treatments whereby pesticides were used had a decrease in bulk density, moisture content and pH value. The decrease in pH of the treatments could be attributed to the release of H⁺ ions on breakdown of both pesticides thereby making the soil more acidic. It was also deduced that that T6 (soil, manure, fertilizer, 1.0mL/L deltamethrin and 0.5 mL/L cypermethrin) was the best one to be chosen for the cultivation of Pak Choi. T6 was able to sustain 100% growth; it was the treatment exhibiting the highest crop yield. It was able to maintain the highest water holding capacity (5.61%), organic matter content (15.6%) even after harvest of the plants. Plants cultivated from T6 were healthy and safe to be consumed since it did not contain any residue of detamethrin and it had only 0.42 ppm of cypermethrin, which far below the Maximum Residue Limit (MRL) for cypermethrin. T3 (soil, compost, 1.0mL/L deltamethrin and 0.5 mL/L cypermethrin) could be considered as the second best option since it sustained 100% growth and plants harvested from T3 has residue of pesticides(0 ppm

deltamethrin and 0.54 ppm cypermethrin) below the MRL. However plants obtained from T4 and T7 where a high dosage of pesticides was applied (3.0mL/L deltamethrin and 1.5 mL/L cypermethrin) were advised not to be safe for consumption

Keywords: pesticides, Cypermethrin, Deltamethrin, Pak Choi, manure, compost, chemical fertilizers

Evacuation simulation of a large tunnel station using a Hybrid Space Discretisation

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Abstract:

Roadway and railway tunnels are becoming increasingly common all around the world. Tunnels present an efficient alternative when geographic altitudes are high or too steep for traffic to pass above ground. Besides, tunnels are considered suitable where there may be obstructions, such as waterways, to land-based traffic. Moreover, tunnels provide efficient means for solving traffic problems in large and densely populated urban areas. Whilst tunnels do present several benefits, however, they do introduce a number of risks to life safety [1]. In this work, the focus is on railway tunnels which present a set of unique characteristics and in turn, a series of unique risks to safety. For example, the number of emergency exits in railway tunnels can be very limited and this can prove to be a severe limitation in the case of fires or accidents inside the tunnels. In addition, given the limited number of entrances to railway tunnels, it becomes challenging for rescue services to access affected areas during emergencies. Therefore, it is crucial to demonstrate that railways tunnels can be evacuated safely.

Safety managers, engineers and other personnel dealing with tunnel stations can benefit from evacuation simulation tools to identify the time taken to evacuate affected areas inside tunnels and also to identify the appropriate routes to safety locations. The pedestrian evacuation tool may be used to evaluate and test evacuation procedures, certify the evacuation efficiency of the tunnel, used for training personnel and guide decision making during an actual event. As such these requirements call for different degrees of model fidelity and computational efficiency. We present a technique called the Hybrid Spatial Discretisation (HSD), that can adapt the granularity of the pedestrian movement space to accommodate a particular user or application requirements. The HSD is capable of utilising all the spatial representation approaches, namely coarse regions, fine node networks and continuous spaces for representing the geometry [2]. The HSD approach is implemented in the buildingEXODUS software [3]. In this work, the HSD approach is applied to a large tunnel station with a population of 2000 agents. With a view to demonstrating the differences and similarities between the HSD approach and the Fine node approach, the simulation is repeated using the fine node approach. The HSD approach is seen to predict evacuation times of similar accuracy to that of the Fine node approach, but with a computational speed up of 47.9%. The work presented here facilitates the application of evacuation modelling by providing results faster than real time rate while providing an optimal environment for representing agent movement and behaviours in constrained environments.

Keywords: Evacuation modelling, Tunnel station evacuation, Agent-based evacuation, Hybrid Space Discretisation

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Identifying Molecular Modules in Protein-Protein Interaction Networks

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Abstract:

Background: Proteins are large biological molecules and they are responsible for a diverse range of functions in cells. To perform its function, a protein often interacts with one or more proteins. Hence, proteins form a dense network of protein-protein interactions (PPIs) in a cell. In a PPI network, molecular modules are densely connected within themselves but sparsely connected with the rest of the network. These molecular modules may give important insights into cellular organization and function, and thus aid our understanding of the mechanisms of disease. Hence, it is important to be able to identify them accurately and systematically.

Aim: The aim of this study is two-fold. Firstly, to develop a fast graph-based algorithm to identify accurately molecular modules in PPI networks. Secondly, to develop a publicly-available web-based application to allow a user to visualize in a convenient way molecular modules in a query PPI network.

Methods: The two main data sources are BioGrid (Chatr-Aryamontri et al., 2015) and UniProt (UniProt Consortium, 2015). BioGrid collects 749,912 PPIs from 30 model organisms. UniProt provides functional annotation of proteins and currently contains 551,705 entries. Given the complexity and heterogeneity of the data sets, the knowledge discovery in databases (KDD) approach was used to carry out the study. KDD is a process in which voluminous low-level data is transformed into a more compact, abstract, and useful form (Fayyad et al., 1996). The KDD process involves several steps, some of which are understanding the domain application, preparing the data, finding useful features that describe the data, performing data mining, and interpreting the patterns and models found (Napoli, 2005). To summarize, our data mining algorithm is based on modularity-maximization. It first employs a local moving heuristic search to find the optimal number of sub-networks. This is achieved using divisive clustering. However, in order to identify biologically significant modules, the algorithm then uses biological knowledge to apply an agglomerative hierarchical clustering in order to merge the clusters obtained by the local moving heuristic search.

Results: Our algorithm was compared with SLM (Waltman and van Eck, 2013) using a subset of the yeast PPI data set. The results show that our algorithm has a better precision (0.82 vs. 0.69), recall (0.43 vs. 0.16), and sensitivity and specificity (0.57 vs. 0.26). Furthermore, given that the algorithm is implemented in C, the running time is significantly reduced. To make the program publicly available, a Web application has been developed. It allows a user to upload a PPI data set in CSV format. The user may choose to preprocess the data (e.g. delete nodes). The modules can be visualized online graphically thanks to Cytoscape, and can be exported for further analysis. Additional information such as protein function annotation and taxonomic details are also displayed.

Conclusions: The web application together with its core algorithm constitute a useful

resource for detecting and analyzing molecular modules in PPI networks. This work is being extended to study the human protein-protein network taking into consideration other biological information such as pathways, three-dimensional structures of proteins and disease-associated gene information.

Keywords: Knowledge Discovery in Databases, Data Mining, Graph-based Algorithms, Bioinformatics, Protein-Protein Interaction Networks

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A Study on the Comparison between Ecoblocs and Conventional Blocks in Terms of Structural Strength, Thermal and Acoustic Insulation and Cost Benefit

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Abstract:

For the past 50 years, cellular concrete blocks were the exclusive masonry units used in the Mauritian construction industry. With an annual production of about 40 million units, this particular block was used in almost all construction projects for its good structural strength and simple usage. However with problems such as carbon footprint and energy crisis, stakeholders in the construction industry across the world are switching to more ecological materials to reduce energy consumptions. Therefore there is a need for Mauritius to develop more sustainable construction materials for a healthier future. Thus, with the sustainability aspect in mind, the Ecobloc, a solid concrete block with polystyrene core for thermal and acoustic insulations was introduced in early 2015. Though commonly used in the hot climate of Middle East countries, the performance of the Ecobloc has yet to be tested in a tropical setting like Mauritius.

The aim of this research was to test the performance of the Ecobloc compared to conventional blocks in the local climate. Hence the compressive strength, thermal and acoustic properties of Ecobloc was tested compared to conventional blocks. A cost analysis based on the air-conditioning savings due to Ecoblocs was also undertaken.

To assess the insulation performances of the Ecobloc, two identical test rooms, one made up of Ecobloc and the other of conventional blocks were built in the same climatic conditions. Temperature sensors were placed on the external and internal facades of both test rooms for several days to compare the temperature difference between the blocks. Using the thermal transmittance value (U-value) of each block and the external and internal temperature of the walls, the heat flow rates across the blocks were determined. The level difference field test from BS EN ISO 140 was used to assess the acoustic resistance of the blocks. The air-conditioning requirements buildings made up of each type of block were determined by calculating their heat load using the Cooling Load Temperature Differential (CLTD) method. Furthermore an air-conditioning unit was placed in each test building and connected to electric meters to compare the electrical consumption of each room. As for the structural strength assessment, compressive strength tests were performed on both blocks after 7 and 28 days.

Results from this study revealed that the Ecobloc had similar structural strength as conventional blocks and was 10 times more effective in attenuating the sound intensity into a building. The temperature trend recorded by the sensors on the facades showed that the heat transfer through the Ecobloc was much less than the conventional blocks during both days and nights. The heat flow rate across conventional blocks was found to be 3 times more than across Ecoblocs. The air-conditioning unit in the Ecobloc building used less electricity than

in the conventional one as a lower consumption was recorded on the electric meter. Further analysis revealed that the Ecobloc is more cost effective for buildings with central air-conditioning systems and commercial buildings and the amount invested on the Ecoblocs can be recovered within a period of four years based on the amount which would have been spent on electricity for air conditioning.

Conclusively, this study shows that Ecoblocs are comparable to conventional blocs in terms of structural strength but are better in attenuating sound. They can also be very cost effective for buildings equipped with a central air-conditioning system.

Keywords: Ecobloc, strength, insulation, acoustic resistance, cost effective

The effect of the local weather conditions on the strength of structural timber rafters and use of Eurocode 5 for the design of timber structures in Mauritius.

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Abstract:

When properly designed, timber structure is strong and durable. When properly maintained, timber structures provide aesthetic qualities that last for several decades. Eurocode 5: Design of timber structures, commonly known as EC 5 in Mauritius, gives the procedures to design buildings and civil engineering works in timber. It was approved by the European Committee for Standardizations on 16 April 2004. In Mauritius, timber structure is commonly used for the construction of hotel roofs. Mauritius does not develop codes. But instead foreign codes are adapted for its use in the local conditions. One of the main reasons for adapting the code is that the climatic conditions in Mauritius and Europe are not similar. Since the code has been developed for use in Europe, the performance of timber rafters has yet to be tested in a tropical setting like Mauritius to confirm the degree of adaptability of the Eurocode 5: Design of Timber Structures to the Mauritian context.

The aim of this research was to assess the strength reducing effects of the local climatic conditions on the strength of single plank structural timber rafters made of Balau wood and to determine the adaptability of the Eurocode 5 to the local climatic conditions..

Timber beams of three different cross sections were cut. All the samples have a thickness of 30 mm and three depths were considered, namely 30 mm, 45 mm and 60 mm. The samples were polished and varnished. Different depths were used to consider the effect of lateral torsional buckling. The samples were exposed separately to two service classes, also known as weather conditions, for at least one month. The service classes considered were 1 and 2, as described in the Eurocode 5. All the samples were then subjected to flexural test in the laboratory. The moisture content within the samples was measured in the laboratory and daily ambient humidity, which varied within the range of 62% to 95%, temperature, ranging from 21.9 °C to 31.4 °C, and rainfall data, ranging from 0 to 72 mm, were recorded. The theoretical design bending strength for all the samples was calculated using Eurocode 5. The theoretical strengths were then compared to the actual maximum bending strengths obtained in the laboratory.

Results from this study revealed that all the tested timber samples, irrespective of exposure conditions, had an actual maximum bending strength higher than the calculated theoretical bending strength from EC5. However, this ratio, which is called safety margin, was higher for timber samples exposed to Service Class 1. The results showed that for timber exposed to service class 1, the actual maximum bending strength is about 1.9 times the design bending strength and for the service class 2, the actual maximum bending strength is about 1.6 times the design bending strength. It was also found that the moisture content within the timber

samples, for both service classes considered, was directly related to ambient humidity and temperature.

Conclusively, this study shows that Eurocode 5 can be used for the design of timber structures made of Balau wood and exposed to service classes 1 and 2.

Keywords: Timber, Eurocode 5, service classes, bending strength

Upcycling Waste Cooking Oil into Soap

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Abstract:

The most popular means of disposal of oil wastage consists of dumping it down the sink, in garbage or in the soil. These non-sustainable actions cause many environmental problems such as blockage of the sewage system due to accumulation of fat, oil, grease (FOG) and give rise to bad odours, contamination of water and soil and proliferation of bacteria and rats. The present study adopts the Japanese concept to offer a sustainable alternative by upcycling waste cooking oil into a biodegradable soap. Recycling waste cooking oil to make soap could be a very good alternative than disposing the oil. Oil was collected from food industries and upcycled into a handmade soap. Investigation was carried out in three types of food industries namely snacks outlets, restaurants and catering services to estimate the amount of oil waste generated. Evaluating the data from the study conducted in food industries at Port Louis, shows that a large amount of oil wastage is generated in each of these industries. The wastage oil collected in the snacks, restaurants and catering has different variations in colour as compared to the normal fresh edible oil. Edible oil has a shelf life. Oil can be used for frying food or snacks up to a certain number of cycles after which it becomes rancid leading to the degradation of the oil and making it unusable. During frying the length of fatty acid in the oil increases and makes the oil dense and viscous. The waste oil collected from industry and food outlets was filtered and purified with ginger to improve the quality of the oil. This made it suitable for manufacturing into handmade soap. Saponification is the chemical reaction that occurs when a vegetable oil or animal fat is mixed with a strong alkali resulting in soap. During saponification, the oils and lye or alkali is mixed to become soap. The waste cooking oil was processed by two methods cold and hot processes. In the cold process a certain proportion of sodium hydroxide and water was added to fatty acids or waste oil that reacts chemically to make soap. The soap produced from the cold process was a hard smooth bar lightly brown in colour. The soap produced high bubbles lather and luxury foam. However, the final soap had a slightly rancid odour but a neutral odour was observed on the cloth used for testing. In the hot process soap the mixture was heated between 60°C and 80°C. It was then allowed to cool down. This resulted into a hard rough bar, light brown in colour which also produced luxury bubbles foam. However, the foam produced was slightly less compared to cold process soap. The hot process soap resulted into neutral odour soap. While comparing both soaps it has been noted that both had a good cleaning property and can be used to produce laundry soap. According to the tests conducted, the soaps produced from waste cooking oil can be classified as laundry soap. Soap making of waste oil can bring a sustainable alternative to prevent the wrong disposal of waste cooking oil. Instead of throwing away waste oil, it can be upcycled into soap in easy and simple ways at home.

Keywords: Cold process, Hot Process, Saponification, Waste Cooking Oil

Heuristic Evaluation of Doctor Assistant for designing user-centered Electronic Medical Record (EMR) mobile health application.

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Abstract:

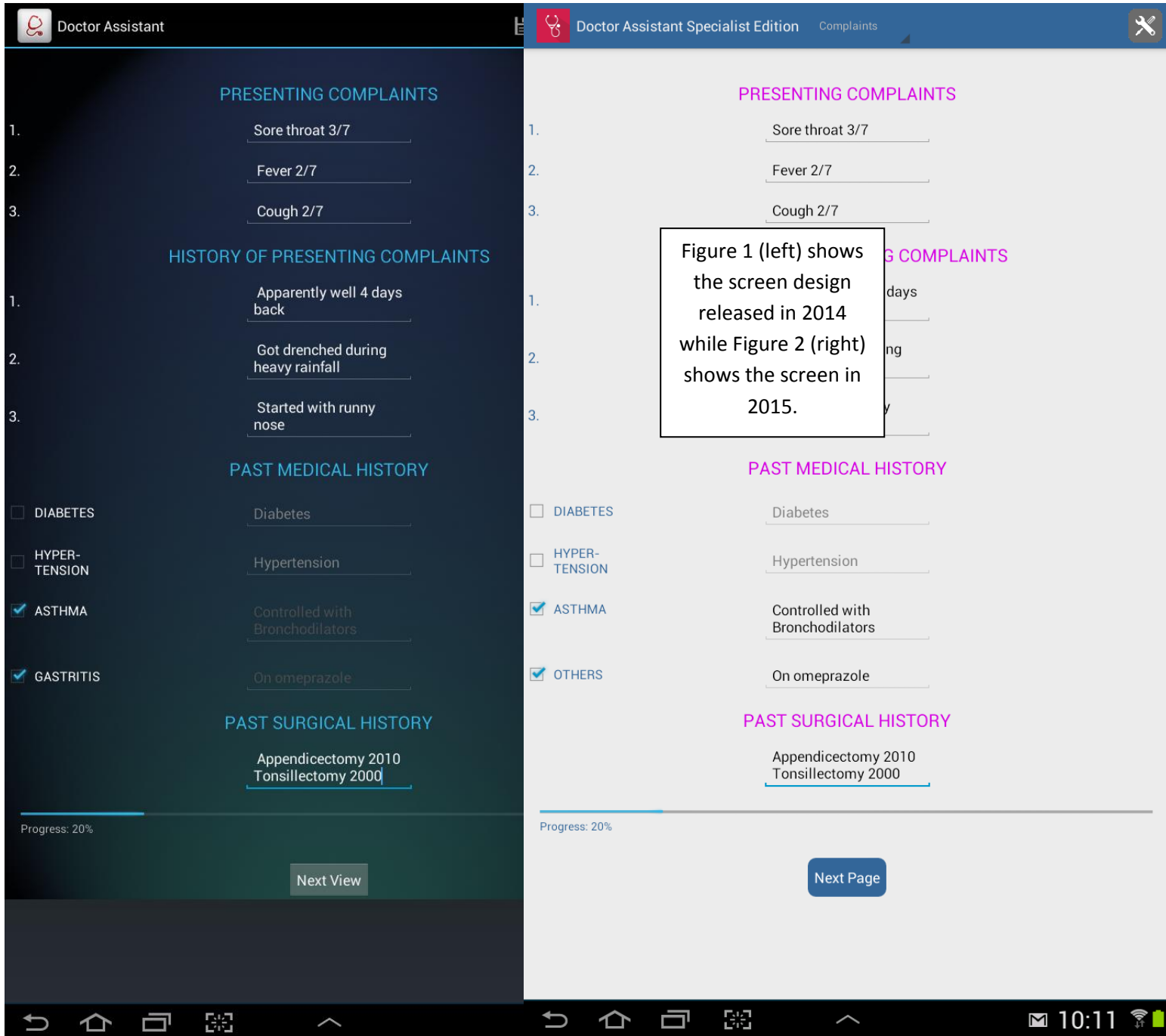
Heuristic evaluation is a usability inspection method with focus on the user interface (UI) design. In this paper, evaluation of the design of a free application, Doctor Assistant [1], will be done. The application has been published in 2014 and has progressively improved since then. The aim is to understand how mobile health application design change following user feedbacks. The free version core features will be analyzed and contrasted with the new version which is being developed and released in an enterprise version of the application. Usability is part of ensuring a good user experience. Along the design process, many challenges arose which provided opportunities for figuring out what needs to be changed and improved. Heuristic evaluation is a usability engineering method for finding the usability problems in a user interface design so that they can be attended to as part of an iterative design process [2]. The key elements were to ensure effectiveness, efficiency and user satisfaction [3]. Following work of the authors, Doctor Assistant application has been published in the World Health Organization (WHO) Compendium of Innovative Health Technologies for Low Resource Settings 2014 [4] [5].

In 2014, the authors of Doctor Assistant aimed to replace paper medical records with application based on smart devices (tablets and smart phones). The authors are both practicing medical professionals who studied computer programming from Internet resources. They first collected all the different clinical case sheets in the hospitals and private practices. Following that, they analyzed the core features of the clinical paper sheets. They then started drawing the different screens of the application thus developing a paper prototype. This allowed to make changes prior to engaging the development stage. It has been shown that it is ten times bigger impact if the need for a design change is discovered early and also hundred times cheaper to make the change [6]. The first paper prototype consisted of 40 pages which were spread out over the floor and taped together. The author drew the different screens and walked bare foot to mimic the interaction of the user with them. This allowed to better design the user interface and streamlined the different work flows that clinicians use to input data. It was a fun experiment as well as a highly enriching one. Pencils were used instead of pen so that the drawings can be erased easily. The insights were collected and the paper prototype was used for the application development process. A rapid prototyping approach was taken where three clinicians were recruited as testers to give feedback during the development process. The idea of rapid prototyping is to develop a learning experience in a continual design-evaluation cycle that continues throughout the life of the project [7].

For the heuristic evaluation of the application, two screens will be compared contrasting 2014 and 2015 version. The design has changed a lot and features has been added which will be analyzed. For the purpose of this paper, the data inputted has been kept the same as depicted in the diagrams.

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Design and structural analysis of laminated bamboo as an alternative to traditional building material

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Abstract:

By 2050, with an estimated world population nearing the 9 billion figure, the exploitation of existing conventional construction material such as wood, concrete and metals will be further stretched to their limit. In order to keep up with the increasingly high demand in material needs in the housing and infrastructural sector, the consideration of sustainable material as an alternative construction material will unquestionably alleviate the dependency on depleted resources. This research investigation, which is perfectly in line with the concept of Mauritius as a sustainable Island, was carried out on laminated bamboo to evaluate its mechanical properties. Bamboo has been thoroughly studied in Asian countries and is recognized globally based on its remarkable physical and mechanical characteristics. However, due to its tubular structure, bamboo does not easily fit in assemblies and requires specific joining techniques. The methodology of this research study was focused on the design of a novel manufacturing process in an attempt to render *Bambusa ssp*, the utilized species of bamboo, in a more versatile construction material in the form of laminates.

Before the lamination process, bamboo culms, having a maturity age between 3 to 5 years, were chemically treated using a mixture of boric acid and borax at a ratio of 1:1.5 to prevent against any form of degradation. To further reduce the development of fungi, the material was left to expose to the sun for a period of two weeks in order to achieve an acceptable moisture content for lamination, i.e. 12 %. For better adhesion, raw bamboo culms, split into smaller sections using hand tools, were stripped off their inner and outer layers on a bench saw. The laminate specimens were produced according to the ASTM D3039 and ASTM D143 standard and Monatex glue was used as adhesive between the various layers. Specimens were then subjected to tensile, compressive and bending strength tests according to set standards on the Universal Testing Machine in order to evaluate the mechanical characteristics of the material.

From the test results obtained, it was found that laminated bamboo displayed similar tensile strength ranging between 26.3 MPa to 51.0 MPa when compared to wooden materials namely redwood, spruce, cedar and pine. Moreover, the compressive strength of laminated bamboo for parallel and perpendicular to grain was found to be 34.0 MPa and 4.7 MPa respectively. For poplar, fir and pine, the compressive strengths for parallel to grain are 18.2MPa, 32.3MPa and 48.3MPa respectively while the compressive strengths for perpendicular to grain are 2.2MPa, 2.7MPa and 2.8MPa respectively. The results obtained proved that the compression properties of laminated bamboo were better and comparative to those woods. The discrepancy observed in the test results was found to be associated with the deterioration of the test specimen due to a lack of adequate treatment. Other than being economical, environmentally friendly and structurally robust, this research study clearly highlights the strength and stiffness of bamboo, which is comparable to that of wood, and can eventually

compete with other material in similar category in structural application. Challenges and difficulties encountered in this research, namely in the chemical treatment and in the lamination process, could be further investigated and improved.

Keywords: Bamboo, Laminates, Structural, Universal Testing Machine

POSTER PRESENTATIONS

Research Week 2016

A Smart Kitchen Cupboard Simulator

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Abstract:

The world is witnessing a revolution from the technological perspective. With the Internet of Things (IoT), intelligent appliances have emerged into people's daily life. Based on this revolution, several ideas such as Smart Home, Smart Cities and Smart Agriculture are being explored and set up. In addition to the great number of futuristic ideas contributing towards improving the lifestyles of people, a current research area gaining popularity is the concept of Smart Kitchen. Smart Kitchen is a home management system that allows home owners to easily manage their daily lives by provisioning for a routine that brings together energy management and provide a fast service. From the point of view of researchers and scientists, the lifestyle of people in the future shall change drastically. Homes are imagined to be completely equipped with novel interactive devices which shall aim at easing life and saving time. In line with future research directions in smart homes, this work aims at bringing a small contribution in the area of Smart Kitchen.

With new lifestyle and standards, people are increasingly finding options which can help them save time for their routine tasks. Apart from record keeping, applications with smart features definitely add value to decision making processes even if it is for routine tasks. Very often people do not know with certainty which items are available in their kitchen cupboard, which one is nearing expiring, where a particular item is stored in the cupboard and which recipe can be made out of the items available. Grocery items are often bought on the way back home with the possibility of people not remembering all of the required items thereby entailing the need to go through the different stalls in a supermarket, not buying items required or buying items already available. The objective of this research is therefore to develop a smart web-based kitchen cupboard simulator for better management of food items, time and grocery budget.

Existing systems such as smart fridge, cupboard management and recipe management have been analysed to come up with the design of the Smart Kitchen cupboard simulator. The main components implemented are inventory management, item traceability, recipe management (including smart options), cupboard management (including smart options) and mobile shopping list management. The cupboard management tackles the positioning, expiry and availability of ingredients. The smart cupboard management is based on the concept of computational intelligence which automatically places items input on spaces available on different shelves while keeping track of the latter items. It also automatically generates a shopping list which can be viewed on a cross-platform mobile app and can be automatically inserted in the system to update the simulated cupboard with the items bought. The smart recipe management proposes the users different recipes based on available ingredients and their BMI while taking care of their expiry dates. Finally, an audit trail is also available to keep track of item consumption and replenishment per user.

The Smart Kitchen has a simple and user friendly interface for users. The different options of the simulator aid the user in having proper visibility of the items currently available, those which are soon going to be out of stock, location of specific items in the cupboard, proposal of recipes

based on items available in stock and recipe prioritization with respect to expiry dates of specific ingredients to prevent wastage. Moreover, the intelligent cross platform mobile shopping list generated allows users to save time and improve their grocery management which can ultimately lead to positive results on grocery budget.

Apart from basic data management options, the system offers several smart options which add value to the system. However, there are several improvements required to deploy this system in a real life setup. Some parts of the Website are not responsive. The system currently comprises of only one static cupboard. In a real life scenario a dynamic cupboards and fridge are desired. Moreover, the mobile app has been tested on an emulator only. This simulator brings a small contribution in the area of Smart Kitchen and more extensive research and improvements are required to come up with a generic design which is flexible and which can easily be adapted to different kitchen setup.

Keywords: IoT, Smart Home, Smart Kitchen cupboard, simulator

A Document Management System for the University of Mauritius

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Abstract:

Managing, storing and organizing documents in any organization is a challenging task and for large organizations such as the University of Mauritius, being able to efficiently manage documents is key. Efficiency in managing documents within an organization can significantly contribute to knowledge management and knowledge transfer. Knowledge management, the process of capturing, developing, sharing and using organizational knowledge, allows an organization to focus on continuous improvement. In the context of the University of Mauritius, knowledge management can undoubtedly help to meet the strategic vision in terms of performance and efficiency in an era of competition. The aim of this project is therefore to tackle a component of knowledge management, that is, investigate how documents are created, shared and stored within the Faculty of Engineering at the University of Mauritius. Hence, in this respect, the current practices at the University of Mauritius were investigated through interviews and questionnaires within the Faculty of Engineering to identify the key elements that should be focused on. Academics from different levels of the hierarchy were interviewed including a Head of Department whose administrative load is significantly higher as all correspondences from academics to any level of the university management have to be acknowledged by the Head of Department. In fact, within the University of Mauritius, the process of sending and managing documents is particularly challenging as documents have to go through different hierarchical levels and at each level of the hierarchy, recipients have to comment on the documents before forwarding to the next recipient at a higher level. Thus, it is difficult for the sender to keep track of the level that the document has reached at any time. Taking into consideration the recommendations of the academics surveyed, an application was developed through an evolutionary prototyping approach whereby a prototype version of the application was evaluated and feedback from potential users were incorporated to refine the prototype. The technologies employed in the application development include PHP for the server side programming, MySQL as database software and a combination of JavaScript, JQuery, Ajax and AngularJS for the front-end. The interface of this application had to be carefully designed to avoid information overload and to allow users to seamlessly create, share and keep track of their documents. Typical features of a document management system such as Search, Filter, Sort etc. were also within the scope of this project. After thorough testing through white box and black box approaches, the application was evaluated with potential users and a User Acceptance Testing was carried out to ensure that all requirements within the scope of this project have been met. The user evaluation showed that through a document management system, it becomes easier and more efficient for users to send, share and manage documents. For example, for the Head of Department, given the administrative load, managing documents received from staff for onward progression to management levels becomes less time consuming and it is easier to keep track of comments. Therefore, if such a system is adapted through out the University of Mauritius, both administrative and academic staff may find sending and sharing documents more manageable and efficient. Future improvements to this application should incorporate other aspects of knowledge management, knowledge transfer and recommender systems in order to make it 'smart' as this will support the university's vision for innovation, efficiency and competitive advantage.

Keywords: Document Management System, Knowledge Management, Knowledge Transfer

Causes, effects and methods of minimising delays on residential construction projects

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Abstract:

The residential sector is of great importance to the economy of Mauritius as it is the sector on which, economic growth and other sectors thrive on. However, the main problem of the construction industry and residential sector is delays in projects. The aim of this research was to identify the causes, effects and methods of minimising delays on residential construction projects in Mauritius. A survey questionnaire was designed using parameters obtained from literature and used to collect data from targeted stakeholders such as clients, contractors and consultants. An average response rate of 68% was obtained for the whole survey. For data analysis, the relative importance index (R.I.I) and the Spearman's rank correlation coefficient was used. The main causes of delays identified were poor planning and scheduling of projects, poor communication and coordination by contractor, lack of qualified labour, difficulties to finance project and poor communication and coordination by client. The main effects of delays were time overrun and cost overrun. The main methods of minimising delays were determined to be strategic planning, proper site management and supervision, proper project planning and scheduling, accurate estimation of project cost and time and regular progress meeting with involved parties. The results of this study are fundamental for reducing delays as well as increasing efficiency in residential construction sector, thereby reducing cost and time overrun. Therefore, confidence of clients and investors in the sector is expected to upsurge. Consequently, investment in the sector is expected to increase considerably. Finally economic growth and also investment in other sectors is expected to rise.

Keywords: Residential construction, Delays, Causes, Effects, Methods of minimising delays

Factors affecting the performance of residential building projects

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Abstract:

Residential building construction projects executed in the Republic of Mauritius are subjected to numerous problems as well as multi-faceted issues. In this specific paper the aim is to identify the factors affecting the performance of local residential construction projects; and to stimulate perceptions of their relative importance. A set of factors affecting project performance was generated following a comprehensive literature review and the survey questionnaire designed accordingly. 250 questionnaires were distributed to the 3 main groups of project participants; namely owners, consultants and contractors. The findings of the survey indicated that all 3 groups agree that the most important factors affecting project performance are: unavailability of resources; low level of project leadership skills; escalation of material prices; unavailability of highly experienced and qualified personnel; and poor quality of available equipment and raw materials. Based on the above-mentioned findings, the paper commends that: 1) project owners and contractors should work collaboratively and expedite payments regularly in order to overcome delays, disputes and claims; 2) project participants should be part of the decision-making process; and 3) continuous coordination and healthy relationship among project participants are required throughout the project construction life cycle in order to mitigate problems and enhance project performance.

Keywords: project performance, residential construction projects, owners, consultants, contractors.

A computer-aided learning package for students of the University of Mauritius

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Abstract:

The work presented in this paper aims at achieving one of the goals listed in the strategic plan of the University of Mauritius which is to develop e-learning courses. In this paper a computer-aided learning package for students enrolled in Information and Communication Technology (ICT) courses is designed, analyzed, tested and implemented.

This work provides a practical and realistic approach to curriculum and student skills development. The e-learning framework has been designed using modern learning theories consisting of cognitive and psychological factors [1-3]. Functional and non-functional requirements of the proposed e-learning package will be analyzed and designed employing Data Flow Diagrams (DFDs) [4].

The ICT module will contain online tutorials comprising of multiple choice questions and True or False questions for each chapter and correction of these tutorials will be performed automatically by the system. The web application also provides for flexibility since it can cater for introduction of new modules. Moreover, the tutor can add, modify and delete as well as update questions in the bank. The tutor is also allowed to evaluate the student's progress while moving through the module contents.

The package is used to manage and support a group of students and it is used by tutors to design the curriculum for a module. The tutor uses the software to plan the delivery of the materials and the latter provide tracking and usage information to the learning management system. From the perspective of the student the package grants access to the syllabus as laid out by the tutor which can be in the form of a study plan or a schedule of contents with links to the materials in the syllabus.

In the system analysis and design state the e-learning platform will be in the form of assessments, courseware design, feedback and motivation [5]. It is impossible to design a website for an unknown audience and without understanding the needs of the users. User identification is important for the proper development and planning of the website, in terms of web application aims and objectives. This e-learning platform consists of an administrator, students and tutors. The learning content management system acts as a collaborative environment for creating and delivering learning materials. This e-learning platform will provide a project management capability that incorporates an instructional design methodology of choice.

Fig. 1 shows a Data Flow Diagram (DFD) for the user type, lecturer and student. The DFD approach [4] puts forward the logic underlying the functions of the system with the design requirements. Fig. 2 presents the homepage implemented using a dynamic PHP web page. The web page contained many tables that were created and linked together to create the above homepage. The web banner has been created in Flash and it is present in all the web pages to provide familiarity to the users. The Fireworks images have been designed in Macromedia Fireworks and the menu navigation bar has been implemented in Dreamweaver

itself. In addition, labels and text boxes were created for the student login section where both the username and password can be entered, allowing students to log onto the system [6-8]. Different testing methodologies and testing tools are used to discover defects that were committed during the previous phases. Black box testing has been used [4,9,10]. After successful login the student is ready to go through the chapters of each module and on selecting the tutorial link the student is provided with multiple choice questions as well as True or False questions. Fig. 3 shows the page used for multiple choice questions.

In this work, a computer-aided learning package in the form of an e-learning system has been successfully designed and implemented for a module named ICT for the students of the University of Mauritius. Various Human Computer Interaction (HCI) techniques have been used throughout the web application to make the user interface user-friendly, easy and simple to use. Database Management System (DBMS) concepts have been used as well, in order to implement the system successfully. Data Flow Diagrams (DFDs) have been used throughout the design stage for both the student and lecturer levels. The designs have been analyzed and tested for all web pages and simulation results show that the e-learning package has been successfully implemented.

Keywords: e-learning, computer programming, instructional design, database systems

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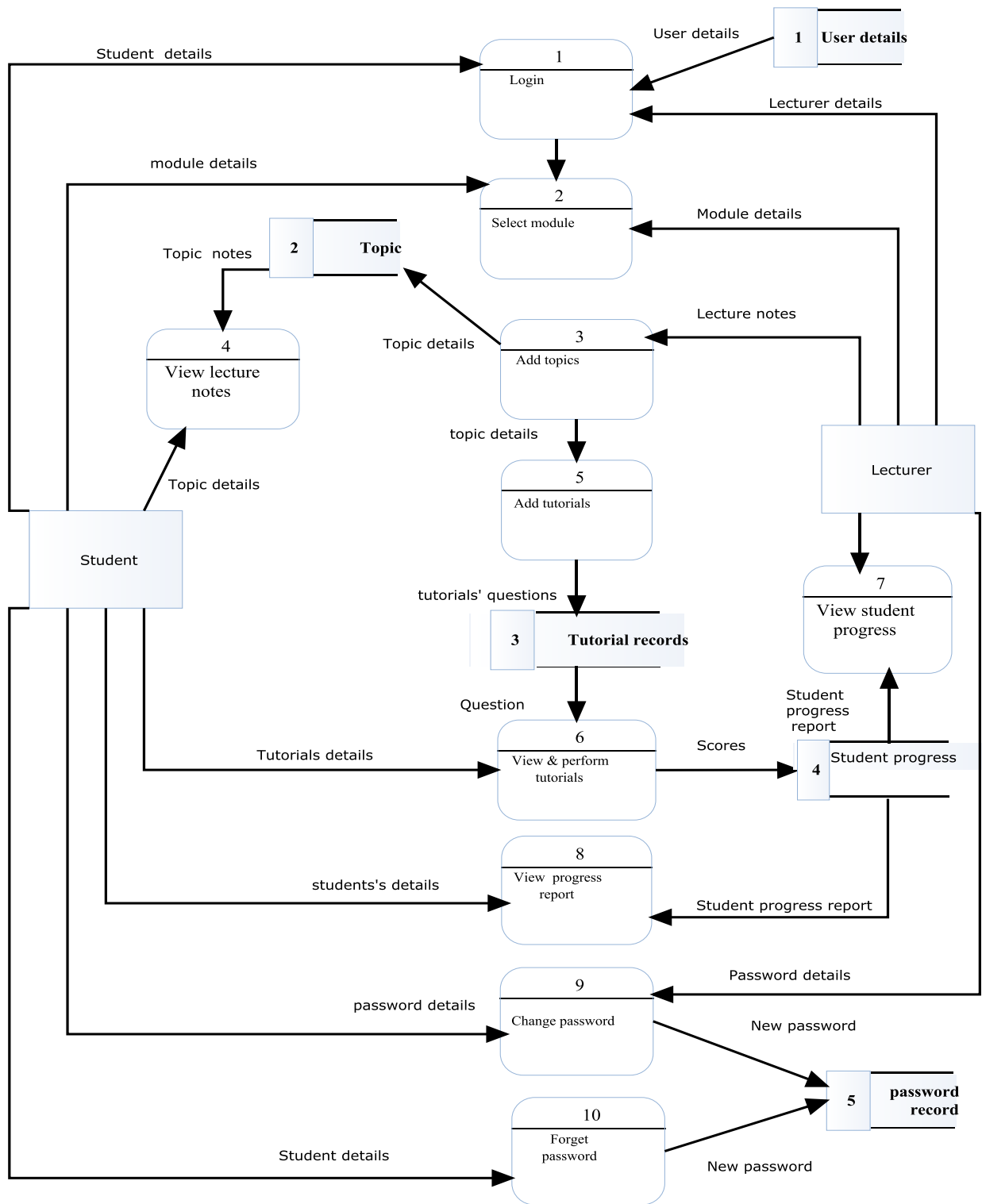


Fig. 1:Data Flow Diagram for both student and lecturer level

INFORMATION & COMMUNICATION TECHNOLOGY

Advance your career
Achieve your goals

Web banner

Fireworks images

Admin

Menu

Welcome!

Login

Student login section

ADMINISTRATOR

LECTURER

MODULE

E-LEARNING

CONTACT US

Study Anytime, Anywhere.
Our online degree and certificate program are taught by practicing professionals. Because they work in the field they teach, you are sure to acquire the most current knowledge and skills. That's an important benefit when it comes to information communication technology module, where the information is constantly evolving. No

Student Login:

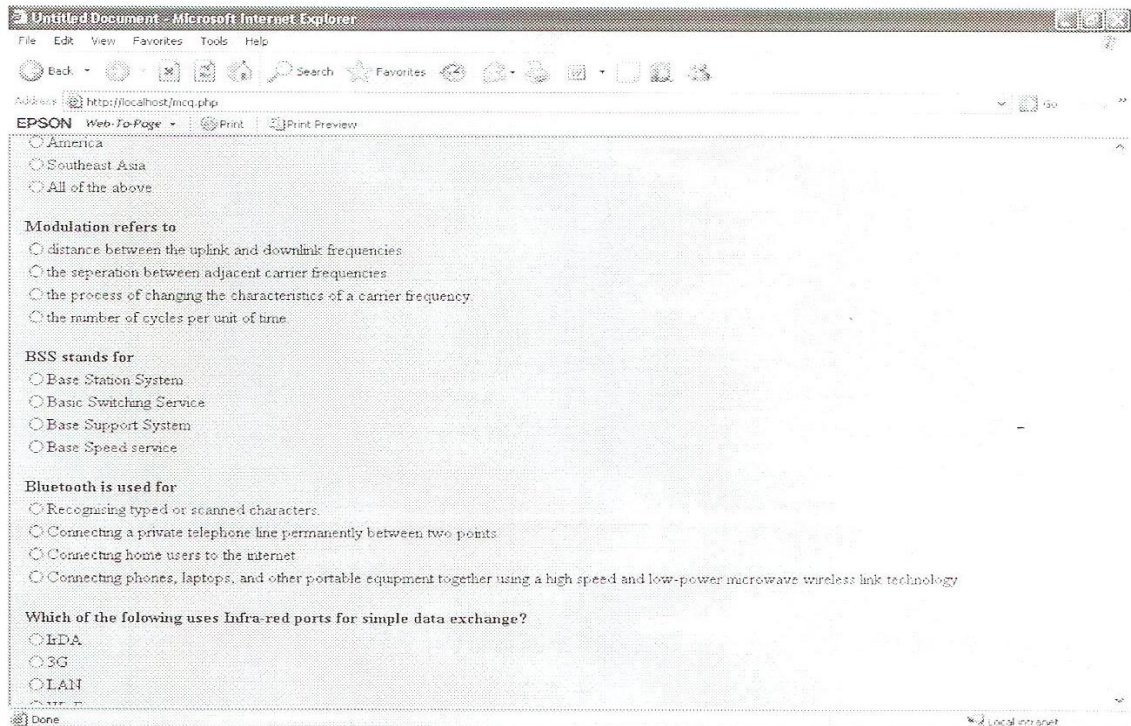
Username

Password

Sign In

Forgot password? Click here!

Fig. 2: Homepage



You scored 5 out of 10

Not bad - You can still do better next time.

Here are the answers:

GSM is accepted cellular standard in:

You answered All of the above, which is correct.

Modulation refers to

You answered the separation between adjacent carrier frequencies. The correct answer is the process of changing the characteristics of a carrier frequency.

Fig. 3: Multiple choice questions

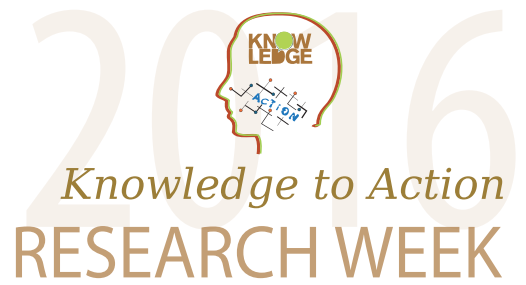
Tablet and Mobile Monitoring for Improved LearningL. Nagowah^{*}, S. D. Nagowah, A. Coonjan and D. Choony

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^{*} Corresponding Author. E-mail: l.nagowah@uom.ac.mu**Abstract:**

In 2014, the Ministry of Education in Mauritius launched the Tablet PC project, the main objective being to induce a paradigm shift in the teaching and learning process in secondary schools. In 2016, the Minister of Finance, in his budget speech, announced that much investment will be directed towards further enhancing human capital and digital literacy by distributing digital tablets and relevant education software to students of Grades 1 and 2. As in most countries, education is also changing in Mauritius. Students are using digital technologies which is impacting on where and how education is delivered. Digital devices such as tablets and mobile phones allow the students to quickly connect to a number of educational tools and materials delivered by top professionals and researchers around the world. Students and teachers are also using social media such as Facebook and Twitter to share resources with peers. The Government is distributing digital tablets to students to provide them with more opportunities to obtain education. However, recent studies also indicate a negative association between academic outcomes and the use of electronic media. It is therefore imperative to limit the use of electronic media while studying since this multitasking is detrimental to student performance as shown in prior research. It is also important for the child to know that he is being monitored so that he refrains from performing non-academic related activities, hence limiting distractions in the learning process. The main aim of this paper is to show that it is possible for the teachers and parents to monitor the activities performed by students and children on their tablets or mobile phones by using the Mobile Eye system (MEye), hence contributing in improving the learning process of these children. MEye system consists of two main components, firstly an application that runs as a background service on the tablet or mobile device, and secondly, a web application that allows the teacher/parent to view the activities of the students/children. The background service continuously monitors the activities on the mobile device, in terms of the call logs, messages sent and received, applications installed and usage, web browser histories, images and videos, and, GPS positions. As soon as an internet connection is available, the service checks whether the corresponding data has already been uploaded on the website and then proceeds to transfer only the updates, if any. The teacher/parent then view the activities of the associated device(s) on the website where any new information is highlighted for attention. MEye system has been installed and tested on a small sample of android devices and proves to be beneficial to supervisors who can view the mobile device activities on the cloud. The main drawback is that it might take considerable time to upload images and videos which is dependent on the internet connection and on the size of these files. The future works include the creation of filters where a teacher/parent can limit the use of specific applications and features of the mobile device. The geo-fencing feature is also in the pipeline where virtual barriers can be set in terms of GPS locations and the parent is automatically notified in real time if the child moves out of this barrier. Hence a system such as the MEye system is vital if a parent wants to supervise the activities of a child on a mobile device. However, MEye might not be accepted by teenagers to whom digital and social media give the private space that they often lack in their offline adult-controlled lives. On the other hand, Government will benefit from such an application as authorities will be able to monitor the Grades 1 and 2 students' activities, in near real-time, on devices distributed to them using public funds.

Keywords: tablet monitoring, mobile monitoring, improved learning, background service



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ORAL PRESENTATIONS

After 30 years of existence should the United Nations Convention on the Law of the Sea be reviewed?

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Abstract:

Background

The United Nations Convention on the Law of the Sea (UNCLOS), which is considered as the Constitution of the sea, was first signed in 1982 and then came into force in 1994. This Convention is the sole international legal instrument that divides the sea into several layers. The main divisions of the sea under the UNCLOS are: the baseline, the internal waters, the territorial sea, the contiguous zone, the exclusive economic zone, the continental shelf and the high seas. The largest portion of the division is the exclusive economic zone (EEZ) which extends up to 200 nautical miles from the baseline as per Article 57 of the Convention. The reason why the EEZ was given the largest portion is linked to the fact that most of the marine resources live in this area of the sea. In addition to the division of the sea, the Convention provides for the degree of sovereignty that a State has over the sea surrounding it. Under the Convention, a State has sovereignty as from the baseline up to the contiguous zone and within the exclusive economic zone and on the continental shelf, a state has sovereign rights. The division of the sea and the allocation of sovereignty and sovereign rights by the Convention have been the centre of debates for many years. Many critics have pointed out the way that the division of the sea has been made. They consider the division as inappropriate as it does not take into consideration the marine ecosystem.

Objectives

The objectives of the paper will be to examine and evaluate the impacts of the Convention in regulating marine activities. The presentation will address the following issues: After more than 30 years of existence, isn't it not the time to review or bring some changes to the Convention? The Convention provides for the exploitation of the sea in a sustainable way, should the Convention provide for the way exploitation should be done? Finally, the Convention allocates sovereignty and sovereign rights to States over the various divisions of the sea, what is the relevance of such an allocation?

Methodology

The method used to conduct this research is mainly desktop research as most information are available in books, journals and on online resources. The journals and books that would be used mainly are: R. Beckman and T. Davenport, "The EEZ Regime: Reflections after 30 Years" Proceedings from the 2012 LOSI-KIOST Conference on Securing the Ocean for the Next Generation (2012), H. Swanepoel and F. de Beer, *Introduction to development Studies* (1997) and ¹ Daniel Hollis & Tatjana Rosen, "The United Nations Convention on the Law of the Sea (UNCLOS), 1982." Available at <http://www.eoearth.org/view/article/156775/>

Findings

The presentation will show that there is a move from many States to amend some of the legal provisions present in the Convention. Many countries as well as non-state stakeholders are of the opinion that it is important to review how the division of the sea has been done. It will be argued that a new form of division of the sea should be done which will take into consideration the marine ecosystem. Moreover, it will also be proposed that marine spatial planning be introduced in the Convention in order to enable states to know how to sustainably exploit their marine resources. Finally, the importance of giving sovereignty to States over the water surrounding them will be exposed.

Conclusion and Significance

The purpose of this research is to enable academics as well as practitioners working in the field of maritime law to have a broader view about the actual status of the UNCLOS and all the debates surrounding the convention. The presentation will also provide for solutions to address the flaws present in the Convention.

Keywords: United Nations Convention on the Law of the Sea, Sovereignty, division, sovereign right, marine spatial planning

A Human Rights Impact Assessment to Evaluate HIV/AIDS Policy and Gender in Mauritius

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Abstract:

Introduction

A well-conceived Public Health Policy brings together gender and human rights to promote civil, political, economic, cultural, structural and societal determinants of health and provides physical contexts in which men and women live up their biological endowment, behave, define options and make healthy choices. In 2015, HIV prevalence rate was 0.97 percent ranking Mauritius as a low prevalence country with a concentrated epidemic. Injection Drug Users account for 31%, and women 41% of all newly infected cases, constituting the bridge population. Since 1987, successive National HIV/AIDS Strategic Frameworks were formulated to halt HIV epidemic, but they failed. Thus, a human rights impact assessment to evaluate Public Health Policy became most unequivocal.

Objectives

- To assess whether Public Health policy strikes the balance between public health benefits and human rights burden;
- To examine the extent to which government protects other fundamental human rights of PLHIV as much as the right to health.

Methodology

The methodological precepts were based on Triangulation Methods. Assuming that policy-makers had no grounded means to know policy outcomes, data was collected from both quantitative and qualitative methods. Two focus groups discussions allowed for sophisticated quantification of forthcoming research. For quantitative research (Phase I), a purposive sampling was used to select 40 Policy-makers, whereas, research (phase II) employed a snowball and respondents-driven sample of 90 PLHIV of which 54 (60%) were male, and 36 (40%) female, who accessed health services. Both studies covered the views and experience of policy-makers and PLHIV based on health, human rights and gender. The research used 'Women Health Rights Impact Analysis' Model (HeWAI) and Harvard 'Human Rights Optimization Model'(HROM) to evaluate the impact of Public Health policy.

Findings and Conclusion

The research indicated that out of 7 categories of respondents interviewed, the private sector was ranked among the highest population having criticised the policy for its failure to protect public health and promote human rights which strongly correlated with the views of PLHIV. Both research found that the policy was not articulated to all stakeholders and it was not well-targeted to achieve its intended purpose, due to structural and institutional inadequacy. The policy failed to address gender equity, gender mainstream, and gender planning in health which perpetuated sex discrimination, stigma and vulnerability to HIV/AIDS. Being both under-and over-inclusive, the policy masked discrimination, created classification that

disproportionately impacted on high risk groups which stood unwarranted, raising serious human rights concerns.

The policy being too coercive restricted fundamental rights of key population. It was found that human rights burden created by the policy resulted from 1) nature of human rights violation, 2) invasiveness of interventions, 3) frequency and scope of interventions, and, 4) its duration related to HIV prevention and treatment services. The research indicated that, 'if coercive policy was the most effective, least restrictive alternative, then it had to be based on significant-risk standards, nature of risk and severity of harm' which were not properly addressed in strategies. To avert the significant risk of HIV contamination, the policy violated the rights of PLHIV but provided no procedural safeguards to ensure fact-finding process to redress violation of those rights. Moreover, HIV and AIDS Act had no provision for criminalization of HIV/AIDS. The research showed that there remained dearth of research and mechanism to monitor and examine the extent to which the policy strikes the balance between public health benefits and human rights burden.

Recommendation

- A gender-sensitive policy with robust legal and institutional structures that respect women's Human Rights; promote gender equity in health; and preserve justice.
- A human rights-based policy that realizes the full and equal enjoyment of fundamental rights and freedom of PLHIV without distinction;
- A policy that reinforce accountability and transparency; political commitment; and government obligation to protect, promote and fulfill other human rights of PLHIV as much as right to health;

Keywords: Under- and Over-inclusive policy, human rights burden, public health benefits, gender and health equity.

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An analysis of the effectiveness of climate change diplomacy in the African, Indian Ocean Mediterranean and South China Sea (AIMS) Small Island Developing States (SIDS) region

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Abstract:

The growing threat of climate change cannot be underestimated. Its harmful effects are already impacting on economically and environmentally vulnerable small island states, which do not have the resources, finance and technical know-how to properly respond to the impacts of climate change. This paper will deal with a critical assessment of the effectiveness of climate change diplomacy in addressing the concerns of countries forming part of the Africa, Indian Ocean Mediterranean and South China Sea (AIMS) region of Small Island Developing States (SIDS). This paper will demonstrate the failings of climate change diplomacy in creating synergies, collaboration and cooperation between the various states forming part of the AIMS SIDS network. It will explain how climate change diplomacy, while equipped with the potential of nurturing debate, consensus, and strategies to curb the effects of climate change in the region, has failed to generate the level of trust, effectiveness and institutional mechanisms, as well as adequate funding necessary to provide a uniform, efficient and concerted approach to solving the climate change dilemma. Moreover, this essay will assess whether the Third International SIDS Conference which was held in Apia, Samoa in September 2014, had the potential to raise the status of SIDS in the international community and generate more media attention and genuine concern towards the plight of SIDS in relation to climate change. It will be argued that climate change diplomacy is in its developing phase and that more effort should be made among the international community to address this issue. At the same time, the role of diplomacy will be assessed to determine to what extent states are cooperating among themselves to address the growing threat of climate change in their region and around the world. The paper will also evaluate the weaknesses of the institutional framework under which the AIMS SIDS actor is operating. It will be discussed that effective climate change diplomacy among AIMS SIDS will help in bringing greater collaboration, sharing of expertise and technical knowhow especially in terms of adaptation and mitigation, and also harnessing the potential for greater synergy of action between the relevant states. Agreement constitutes the turning point in finding sustainable solutions to climate change in AIMS SIDS, and it is believed that diplomacy should be at the centre of any endeavour to coordinate adaptation and mitigation efforts, funding initiatives and grass root action at tackling climate change, and also for greater AIMS SIDS representation at international climate change fora. It will be seen that without real willingness of state actors to provide a relief mechanism to address climate change, it will be very difficult for small island states to use diplomatic tactics to help them cope with the harsh reality of climate change. It is not too late, it will be argued, to build a strong diplomatic rapport between small island states to cope with the issue of climate change. Additionally, further marginalisation of island states has put them under increased pressure and it is noted with concern that their voices are not adequately heard at the international level.

Keywords: Climate change, Diplomacy, Small Island Developing States, AIMS

An Analysis of the India-Mauritius Double Taxation Avoidance Agreement

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Abstract:

The Global Business Sector, previously known as the offshore sector, is without any doubt an important pillar of the Mauritian economy. Since its inception in 1992, this sector has experienced sustained growth. Mauritius has focused on its development by continuously expanding its Double Taxation Agreement network. Forty-three treaties are currently in force and another seventeen are under negotiation. The DTA network provides for interesting tax planning opportunities, hence enhancing the image of the jurisdiction as a tax planning center.

Among the most active treaties is the India-Mauritius Double Taxation Avoidance Agreement. Although initially dormant, the treaty turned out to be beneficial not only for the island but equally for India. Mauritius accounts for up to 40% of FDI in India. Being strategically located, Mauritius is an ideal platform for foreign investors wishing to invest in African nations. However, despite the numerous benefits for both states, the India-Mauritius DTAA has been the center of controversy several times in the past decade. The island has been under close scrutiny by India, who is worried that the India-Mauritius DTAA is causing more harm than good to its economy. Mauritius is believed to allow misuse of the tax treaty and to shelter shell companies.

This thesis makes an attempt at understanding how the treaty is perceived by the professionals of the global business sector and whether it has benefited India in terms of FDI. Moreover, the year 2015 has brought satisfaction to India as a renegotiated convention has been signed by the two contracting States. It was also necessary to assess the implications of the potential amendments to the treaty. Furthermore, the possible introduction of a provision of GAAR in the tax treaty has been considered. Bearing in mind the strong criticism faced by the anti-avoidance rules, the researcher tried to analyse whether the introduction of GAAR is necessary and what would be required for an effective implementation.

A survey was carried out among professionals of the Global Business Sector and the findings clearly depict that the India-Mauritius DTAA has played a key role in developing the Mauritian financial services sector. The existence of the treaty has led to significant cross-border investments. Despite the rumours of a renegotiated treaty that may not be in the best interests of our island, it has been found that tax specialists are confident that the island will rebound as Mauritius has already started reaching out for new opportunities that will bring about a new era of development and cooperation. As far as India is concerned, it can do without the DTAA as it has a vast treaty network and FDI will continue to flow from low tax jurisdictions. For Mauritius, however, it seems that the treaty has had its years of glory and the future of the DTAA seems to be gloomy.

Keywords: India-Mauritius DTAA, GAAR, financial sector services, global business sector, double taxation agreement

An Evaluation of the Factors Affecting Effectiveness of Audit Committee: A Case in Mauritius

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Abstract:

Objective/Purpose: The main focus of the study is on the importance of having an effective Audit Committee. The assessment has taken different factors into consideration such as independence of Audit Committee of members, composition of Audit Committee, financial expertise of Audit Committee members, frequency of Audit Committee meeting, diligence and care on behalf of Audit Committee members, reliance on Internal Audit, level of earnings management and Future challenges of Audit Committee. The objective is to help firms set up a more effective Audi Committee, to have higher corporate governance while overseeing the financial reporting process and to maximize investors' confidence in the reliability and neutrality of financial statements

Design/Methodology/Approach: Both primary and secondary data were collected. A questionnaire was designed as research tool and was targeted to accountants, managers and auditors. A population of 100 respondents was questioned and the response rate was 78%. Respondents were mainly selected from auditing firms taken from the list given by the Mauritius Institute of Professional Accountants (MIPA).

Findings: Without an effective Audit Committee, a company may be bound to fail due to a lack of corporate governance. Typical example is the Enron case where the company had its Audit Committee but failed due to a lack of effectiveness. The findings of the research evaluate that all the factors assessed had an impact on the effectiveness of Audit Committee, taken from literature. The analysis done captured the opportunity to show that most of the results obtained were positive. All the factors assessed have an impact on Audit Committee effectiveness. Most of the respondents strongly agree or agree to the fact that the proxies assessed will help to have a better and more valuable financial reporting process and higher corporate governance. An effective Audit Committee is one of the main pillars of corporate governance, so companies should focus on these factors while establishing their Audit Committee in order to be effective and generate positive result. Also, emphasis on risk and control area will increase. An effective Audit Committee will give directors a better insight about the firm's accounting and control system.

Limitations: However, while collecting data and analyzing the research, the main limitations encountered were a lack of respondents and it was difficult to generalize the results. Also, some of the results obtained were not significant.

Conclusion: The study highlighted that independence of Audit Committee is the main factor affecting the effectiveness of Audit Committee. If there is no independence, though all other factors were present and positive, the financial reporting process would not be effective due to a lack of independence.

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Originality/Value: Henceforth, the study adds value to the existing literature researched by supporting the view that effectiveness of Audit Committee is a must for the success of a company and is based on certain factors.

Keywords: Audit Committee, independence, corporate governance

An Examination of Accruals Quality in Mauritius

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Abstract:

High quality of financial accounting information is important for firms to attract finance capital. For a Small Island Economy (SIE) such as Mauritius, finance capital is rare and therefore it is essential for Mauritian companies to attract finance capital so as to expand and contribute to the economic growth of Mauritius. This implies that superior quality of accounting information is crucial for Mauritius. In addition poor quality of financial accounting information may affect investment and economic growth in the country. SIEs usually find it difficult to attract Foreign Direct Investment (FDI) as compared to resource seeking nations because SIEs have poor infrastructure and suffer from lack of resources. In this spirit it is essential for Mauritius to improve its financial reporting infrastructure so as to enhance confidence among investors. Therefore it is important for SIEs to improve financial accounting environment to ensure transparency and good governance which can ultimately enable these countries to attract foreign as well as domestic investments. Since good accounting quality is crucial for companies to attract finance, an examination of the accounting quality in Mauritius is important. This paper has assessed the evolution of accounting quality in Mauritius over the period 1999 to 2014. Accruals quality has been used as a measure of accounting quality using the cash flow model developed by Dechow and Dichev (2002), a model which has also been used in other studies such as Francis et al. (2005), Doyle et al. (2007), Barua et al. (2010), Kim and Qi (2010) and Ittonen et al. (2013). Accounting information of 29 companies, excluding companies from the financial sector, listed on the Stock Exchange of Mauritius were analysed over the period 1999 to 2014. The total number of firm year observations was 339. The standard deviation of residuals from the cash flow model developed by Dechow and Dichev (2002) is a measure of accruals quality. The higher the standard deviation of residuals, the poorer the accruals quality (accounting quality) and the lower the standard deviation of residuals, the higher is the accruals quality. The study revealed that accruals quality deteriorated since the year 2000 up to the year 2009 and improved in the years 2010 to 2012. However the accruals quality started to deteriorate again in the years 2013 and 2014. The accruals quality was poorest in the years 2009 with a standard deviation of residuals of 7%. In fact during the period 2007-2009, accruals quality was very poor since the standard deviations were 6.06%, 5.9% and 7.0% in the years 2007, 2008 and 2009 respectively. A plausible argument for this poor accruals quality might be the impact of the 2008 financial crisis on the accruals quality. The results of this study are consistent with the findings of Davis-Friday et al. (2006), Graham et al. (2000) and Ho et al. (2001) whereby but are not consistent with Francis et al. (2004). To have a better understanding of the accruals quality in Mauritius, the analysis was conducted on a rolling periods of 1999-2004, 2005-2010 and 2011-2014. The standard deviations of the residuals were 2.7%, 5.4% and 4.1% for the periods 1999-2004, 2005-2010 and 2011-2014 respectively. It can be observed that the accruals quality of Mauritian firms was worst during the period 2005-2010. Mauritian firms might have engaged in 'big bath' practices during this period. However the poor accounting quality might have been due to real poor economic performance rather than "big bath" practices during this period.

Keywords: Accruals Quality, Small Island Economy, Investments.

A Question Answer System for the Mauritian Judiciary

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Abstract:

Law is a research-orientated profession. Legal research is an activity that also cost time and money (Houlihan, 2014). Information Technology is revolutionising the way in which legal research is being done (Elias and Levinkind, 2014; Feliú and Frazer, 2012). More and more legal communities (universities, libraries, legal scholars, legal practitioners, students, etc) around the world are increasing their investment in online legal services rather than on law books (Margoris and Murray, 2014). Many universities are now challenging the way law and legal research has been taught for the past two centuries and wish to be prepared for the paradigm shift that is occurring in the way legal document are accessed (Valentine, 2010; Harker, 2013).

According to a World Bank report (SCD, 2015), Mauritius is doing well in areas like cross-border trade, company registration and taxes. However, according to the same report, additional reforms are required in the judicial domain. The vision of the Mauritian Government via its two-phased eJudiciary project (National Audit Office, 2013; eJudiciary Mauritius, 2016), which started in 2010, is to implement an online case filing and management system, in order to improve the overall efficiency of the whole legal system in Mauritius. Every year, more than 9000 cases are lodged at the Supreme Court, a similar number of cases are disposed of and consequently, the Supreme Court finds itself with a backlog of about 9000 cases every year (The Judiciary, 2015). As the old adage goes, “justice delayed is justice denied”.

Thus, in order to bridge the gap in the eJudiciary project which do not cater for legal research, we have implemented a web-based question answer system for the Mauritian Judiciary (lawanswers.me, 2016). Currently, the knowledge-base of the system consists of a sample of statutes and cases obtained from the website of the Supreme Court of the Republic of Mauritius (Supreme Court, 2016). On the lawanswers.me portal, users can enter their queries freely using natural language. The system processes the query by extracting the relevant keywords and discard those that do not carry much distinguishing information and returns the relevant sections of law which contains these keywords or keyphrases. The system also returns a list of relevant Supreme Court cases. Unlike other legal search engines (Wheeler, 2011), our system is very simple to use as it has only two additional options to choose from. For example, the user can decide on the number of results to be displayed. The user can also wish to have only the name of the relevant acts be displayed. Furthermore, our system does not require the user to know how the law is structured or how the knowledge-base is built in order to derive maximum benefits from it. Considerable efforts have also been invested in making the portal mobile-friendly.

Although the question answer system is operational and can already be useful to legal practitioners for their legal research and to the public at large to learn about Mauritian laws,

there are still many improvements that can be made. At present, only a small sample of legislations and cases have been considered. We expect to increase these numbers by significant amounts in the future. The current system is also unable to process words or phrases which contain French accents. It is hoped that this will soon be remedied. Furthermore, in order to provide results of even better quality, we also intend to devise a ranking algorithm which will assess each result and display them in order of relevancy. McGinnis and Pearce (2014) even foresee a world where legal advice will be provided by laypersons through machine intelligence.

Keywords: Question Answer, Judiciary, Statutes, Mauritius

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Assessing and Forecasting Short Term Interest Rates: A Case Study on Developing Countries

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Abstract:

‘Term structure of interest rates’ often described as the ‘yield curve’ is the relationship between short-term and long-term interest rates. The term structure of interest rates is believed to carry useful information regarding the future state of the economy. Furthermore, the term structure of interest rates is of great importance to financial economists because it provides useful information about the inter-temporal choice made by economic agents and sheds light on the efficiency of financial markets in utilising information to form expectations. At the macroeconomic level, the term structure represents one channel of monetary transmission. The monetary authorities directly influence short-term interest rates, while long-term rates evolve on the basis of investors’ expectations of future real interest rates and inflation rate. Domestic investment and production are also affected by expectations of future real interest rates. Thus, the term structure transmits monetary policy effects to the real sector of the economy. In the global open economy, the term structure also affects international capital flows and hence exchange rate. Thus, assessing and forecasting interest rates remain a concern for researchers, economists as well as other players in the financial markets.

To explain yields dynamics over time, four basic theories have been proposed: the expectations hypothesis, preference for liquidity, market segmentation, and, finally, preferred habitat. The expectations hypothesis of the term structure is one of the most intensively examined models in economics. Many researchers have empirically tested the information content in the yield curve to predict changes in interest rates. However, the joint hypothesis of rational expectations and pure expectations theory of term structure has been rejected in most studies. In early studies, authors focused on the empirical examination of expectation hypothesis at short horizons; then they moved on exploring more distant maturities. Former contributions have been methodological as well as empirical; economists and econometricians have figured out techniques for testing expectation hypothesis. This thesis re-examines the validity of the Expectation Hypothesis (EH) of the term structure of interest rates and extends the work of Longstaff (2000).

We examine the evidence of the expectations hypothesis in the context of Mauritius, a developing country, by looking at the interest rates on financial assets such as Treasury Bills of different maturities. Our EH model is estimated by using the method of two stage least square. It is a special case of instruments variables method. The instruments used are the current and two lags of changes in all short-term interest rates and two lags of the other spreads between long and short-term rates. To remove serial correlation and to obtain consistent estimates ARMA terms are added to the regressions. The ARMA model is estimated by using nonlinear regression techniques. The nonlinear least square estimates are asymptotically equivalent to maximum likelihood estimates and are asymptotically efficient.

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Our first and main limitation is the availability of data in the case of developing countries, hence restricting our study to Mauritius only. Secondly, long-term rates in Mauritius are not always available, hence limiting our study to the use of short-term interest rates only. The ultimate purpose of this study is to fill the gap in literature as previous related studies focused mainly on developed countries.

Keywords: Term Structure of Interest Rates, Expectations Hypothesis, Developing Countries, Autoregressive Model

Assessing the presence of herding behaviour and the profitability of the Contrarian investment strategy on the Development and Enterprise Market

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Abstract:

Background and Purpose: After reading a review about a local restaurant a man decides to have dinner there. Upon his arrival, he found the restaurant empty while another restaurant next door was almost full. The man would most likely start to hesitate and start to wonder if he should trust his information or follow the crowd and go to the other restaurant. Investors very often are faced with the same dilemma. A rational investor would not let opinion of other investors influence his decisions. An investor is said to be herding when he ignores his own information and follows what other investors are doing. The purpose of this study is to test whether investors on the Development and Enterprise Market (DEM) herd and assess whether they should continue to herd. In order to determine if they should continue to herd, the profitability of the contrarian investment strategy is assessed. Previous studies have already been done regarding both the profitability of the Contrarian investment strategy and the presence of herding behaviour. However most of the studies were focused on the official market. The current study focuses on the DEM with the aim of providing more information regarding herding behaviour and profitability of contrarian investment strategy on Mauritian stock market as a whole.

Design/Methodology/Approach: In order to test for the presence of herding behaviour on the DEM, the Modified Dummy Method and the Linearity Method were used. Data from 32 companies listed on the DEM from 2006 to 2015 were used. To test for the profitability of the contrarian investment strategy on the DEM, the method proposed by Jegadeesh and Titman (1993) was used. A “J-K” portfolio was created where stocks were ranked according to their returns in period J and then the best and worse stocks were held for a period of K. A portfolio was then created using the contrarian investment strategy, that is, the loser portfolio was bought and the winner portfolio is sold. Since short selling is not allowed in Mauritius, the profitability of the strategy relies heavily on the loser portfolio. Three strategies were used when assessing the profitability of the Contrarian investment strategy on the DEM. The estimating and holding period were varied to assess the profitability of the strategy in various situations namely when the estimating and holding periods are homogenous, the estimating period is longer than the holding period and vice versa.

Findings: The results indicate no presence of herding behaviour when using monthly and quarterly data. This contradicts the results obtained in previous studies when testing herding behaviour on the official market of the SEM. One reason for this might be because the companies listed on the DEM are smaller in terms of market capitalisation and investors find it easier to predict share price movements. Shares on the DEM are not traded as often as those on the official market, hence giving investors more time to analyse market conditions. As regards the three strategies used to assess the profitability of the Contrarian investment strategy on the DEM, it was found that all three were profitable except for when the estimating period is longer than the holding period where the strategy was found not to be

profitable in the medium horizon. It was found that the highest return is earned when the estimating period is shorter than the holding period. Moreover, it was also observed that the winner portfolio generates positive returns in all horizons and all three strategies. This indicates that even if short selling was allowed in Mauritius, the profitability of the contrarian investment strategy would still rely heavily on the loser portfolio.

Conclusion: The findings of this study contradict previous studies that were conducted on the official market where it was found that investors tend to herd and that the contrarian investment strategy does not work.

Keywords: Herding Behaviour, Contrarian Investment Strategy, Development and Enterprise Market

Social and Environmental Accounting: Evidence from Mauritius

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Abstract:

This study aims to analyse the extent to which Social and Environmental Accounting (SEA) is applied by determining the methods of disclosure, the reports disclosed by the firms and the importance allocated by certain stakeholders.

The study objectives are elaborated below:

- ❖ Identify the social and environmental practices and disclosure methods of the SEM-listed firms.
- ❖ Determine the extent to which social and environmental accounting practices are applied in those firms.
- ❖ Examine the factors behind the application of social and environmental accounting.
- ❖ Establish the factors that hinder the advancement of social and environmental accounting into becoming a regular accounting practice.
- ❖ Propose measures to fuel the integration of social and environmental accounting into a regular financial practice and reporting.

The target population of this study was firms listed on the Stock Exchange of Mauritius (SEM) as at December 2015. However, certain exclusions were made (further explained in later chapters). Data collection was undertaken through the use of questionnaires.

Non-parametric tests were carried out for each question's data collection. For instance, if the data was nominal, Chi-Square Test was carried out to measure association or Fisher's exact test.

The main findings reflected that: the **most responsive sector** was found to be the **finance sector**; around **14%** of the firms adopted SEA prior to being listed; the **most common disclosure methods** is through **annual reports**, followed by websites, separate reports and company brochures; around **16% of companies issue a Sustainability Report**; SEA is mostly disclosed in the **Corporate Governance Report** in the Annual Report; most of the companies do not follow a procedure in SEA disclosure ; **environmental contribution** is the most common type of disclosure followed by public contribution, product/services contribution, net income contribution and human resources contribution; **environmental stakeholders are considered to be the most important stakeholders** followed by HR, community and products and customers.

In addition, a statistical association exists between the type of industry and the importance attached to SEA. However, no association exists between the type of industry and the issue of Sustainability Report. Firms have also affirmed in the open-ended questions that awareness of SEA is quite scarce among Mauritian firms.

Kruskal Wallis H Test between the types of contribution and importance given to certain fields are given below:

- (i) There exists a correlation between net income contribution and importance allocated to community.

- (ii) There exists a correlation between public contribution and community involvement.
- (iii) There exists a correlation between HR contribution and importance allocated of HR.
- (iv) There exists a correlation between product/service contribution and importance attached to product/service.
- (v) There exists a correlation between environmental contribution and importance allocated to environmental contribution.

According to data collected, more than 70% of the firms indulge in SEA disclosure due to legal obligation while 44% practice SEA out of a moral obligation.

Hypotheses tests reveal that there exists a weak association between finance companies and HR contribution. Furthermore, a weak association also exists between the manufacturing sector and environment disclosure.

To increase the implementation of SEA, it is recommended to improve the legislation in this matter and amend laws to add the practice of SEA. In addition, awareness campaigns among the companies and stakeholders are also recommended.

SIGNIFICANCE OF THIS STUDY

This study aims to provide further literature on the topic of SEA in Mauritius. In fact, latest research on this topic was found to be in 2012. Since then, various changes have occurred in the accounting arena. Thus, this study also aims to provide a fresh perspective on latest developments.

Keywords: Social and Environmental Accounting, Social Accounting, Corporate Social Responsibility, Environmental Accounting

Causal Relationship between E-government and GDP: Dynamic Panel Data Analysis for 190 Countries

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Abstract:

Out of the various techno-economic phenomena e-government is relatively new. Being new various aspects of e-government is still unexplored. One of such aspect is economic impact of e-government. The objective of this paper is to examine the relationship between e-government development index and per capita national income via the panel Granger causality method. Our paper has very important theoretical implication. Paper extends the Solow model of economic growth by integration e-government as a technological parameter and its relation to the GDP of a country. Implementation and nature of e-government is one of the important policy decision to be taken by all the governments. Therefore, our study is important for policy implication as well.

Various literature have concluded that e-government has direct as well as indirect impact on national economy. The extent of impact of ICT investment by countries is accounted between 0.3 to 1.3 percentages of growth in GDP. However, there are limited statistical causalities studies that uncover the relationship of e-government development to the economic development of the nations. Some researchers have attempted to testify this relationship. But they did not use the most appropriate statistical instrument available for it i.e. Granger causality. Some uses cross-sectional data to establish the relationship and others have used the panel data but adopted rank regression approach. In our study we use Granger causation approach to establish more authentic relation. Our study will put the relationship between e-government and countries GDP in right perspective. Furthermore, our study will motivate policy makers to give enough thrust to the e-government initiative in case results are positive. With e-government data from the year 2003 till 2014, we used cross-country panel data to analyse thee-government (EGOV)-GDP nexus. Next, we express the explanation of models used to perform the causality test. We devise two Granger causality models for various computations. First model studies the impact of EGOV on the GDP and second model demonstrates the reverse directional causation estimation of GDP on EGOV. In both the models we have used the lagged variables of GDP and EGOV as independent variable to estimate the amount of explanation for our dependent variable. The GDP taken in our model is the real per-capita income of a country obtained from the source as explained in next paragraph. Both models are used for pooled panel data analysis that is parallel to the aggregate OLS model.

Data for 190countries from 2003 to 2014 were taken from two resources. Per-capita income is obtained from World Bank and is based on a current US \$. E-government index is retrieved from United Nations. According to the pooled panel regression in model-1 and 2, the estimated coefficient of lag EGOV and GDP is significant. This means that previous value of EGOV does have an influence on the GDP of the country and vice versa. Increase in one point of e-government index increases the 10 USD GDP of the countries and increase of 10000 USD of per capita GDP increases the e-government by one percent point. Therefore, we found evidence that the conclusions of both the models are positive and between EGOV to GDP bi-directional causality is established.

Keywords: E-government, GDP, Panel Granger causality

Corporate Social Responsibility as an Integral Part of Business Strategies towards Sustainable Development

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Abstract

Background and Purpose: Corporate social responsibility (CSR), also known as corporate conscience or corporate citizenship, can be described as a bridge which connects a wide range of companies towards a more sustainable world through various initiatives. The concept of CSR exists for more than a century; however, due to global problems like climate change and poverty, this subject has gained unprecedented interest worldwide. The social and environmental impact of businesses cannot be ignored as corporations and the society are intertwined. Thus, corporations have to adopt good business practices that benefit the present and future generations. Sustainable Development has become a crucial agenda for corporations whereby instead of pursuing economic prosperity in isolation, they apply sustainability principles into their operations and policies in order to minimize their potential adverse effects on the society and environment. In this way, Corporate Sustainability (CS)-the capacity of the business to generate long term value through reciprocal favorable relationships with its stakeholders- is also ensured. CSR and sustainability practices lessen the risk profile of a company and enhance its performance and reputation making it more attractive to customers and investors. The policies, strategies, choice of decisions and actions taken by businesses act as a mirror image of how they integrate economic, social and environmental concerns into the values of their companies. In Mauritius, all registered companies are required by the law to make a contribution of 2% of their profit after tax to CSR. However, the different companies have different approaches to tackle social and environmental issues. Moreover, the extent to which CSR projects are being realized and how people and the environment are benefitting from them is not known.

Hence, this paper's objective is to shed light on the benefits and sustainability elements of the CSR initiatives taken by the Mauritian companies in different areas of intervention. It also aims at giving an insight on the areas where companies contribute the most and also reveal areas that are ignored and can consequently be given more attention in the future. Also, this research paper seeks to uncover the reasons why companies need to implement CSR into their business strategies, the moral obligations that companies have towards their stakeholders, society and environment and also their attitudes and perceptions on the implementation of CSR and the laws regarding CSR in Mauritius.

Design/Methodology/Approach: For this research, a sample from a population comprising all companies listed on the Official Market and the Development and Enterprise Market of the Stock Exchange of Mauritius was chosen to represent companies from different sectors of activities. A survey was conducted whereby an online questionnaire was sent to various companies by email and their responses were collected and analyzed.

Findings: This study has found that CSR has indeed taken an integral place in most companies. While some carry out CSR activities independently, others collaborate with the government or non-profit organizations (NGOs). This study has also shed light on the

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sustainable activities that are implemented by companies in Mauritius and hence the objectives of carrying out this research have been satisfied. So far, it has been seen that the CSR activities have been successful to a great extent by creating a win-win situation for both companies and stakeholders, including the society and the environment. The approach that companies have adopted in incorporating CSR into their organization indicates that CSR entails more than just a legal requirement. CSR is now seen as a necessity and many corporations have integrated it into their business as a core strategy.

Conclusion: Majority of companies have genuine intention of performing business ethically using the right practices to achieve SD. It can be concluded that CSR will in the future be an important development agent. Companies, alongside being profitable, will play a pivotal role in empowering deprived communities through specific assistance and opportunities that will uplift them socially and economically.

Keywords: Corporate social responsibility, Sustainable development, Business strategy, Stakeholders

Determinants of the Real Effective Exchange Rate in Mauritius

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Abstract:

Exchange rate management has become one of the most crucial international macroeconomic issues and has been subject to many theoretical and empirical studies in the last decade. Despite the importance of exchange rate in sustaining economic growth, especially in Sub-Saharan African (SSA) countries, empirical analyses in these countries are sparse. Research done in this area focusing only on Mauritius remains more fairly limited. Most governments care about the equilibrium of the exchange rate of their currency. Thus, it is important to understand the factors that cause developments in the exchange rate. Hence, this study aims at investigating the determinants of the real effective exchange rate in Mauritius. We propose a vector error correction model (VECM) of the real effective exchange rate which includes terms of trade, trade openness, technological progress as a measurement of productivity (proxied by real GDP per capita), investment and money supply (proxied by broad money as a percentage of GDP) using annual data spanning from 1980 to 2013. The dynamic VECM caters for both endogeneity and dynamism. Within this framework, both the short-run and long-run dynamics have been captured. The results show that in the long-run, the real effective exchange rate is significantly influenced by the five variables. In particular, a rise in terms of trade, investment and technological progress leads to the appreciation of the real effective exchange rate: a one percent increase in terms of trade, investment and technological progress causes the real effective exchange rate to increase by 0.6 percent, 0.77 percent and 1.63 percent respectively, while an improvement in trade openness and money supply leads to the depreciation of the latter: a one percent increase in trade openness and money supply causes a decrease of 1.97 percent and 1.12 percent respectively in the real effective exchange rate. However, in the short-run, our findings indicate that the effects of only two of these variables - trade openness and money supply - are significant. In contrast to their long-run effects, both trade openness and money supply are associated with the appreciation of the real effective exchange rate. A one percent increase in trade openness and money supply leads to 0.31 percent and 0.36 percent increase respectively in the real effective exchange rate. We further extend our analysis of the long-run and short-run estimates by considering each variable of our model as dependent. Our findings reveal that the real effective exchange rate positively influences technological progress and investment in the long-run, and terms of trade in the short-run. The results from the long-run estimates also indicate that technological progress and investment can be driven by the other control variables included in our model. In the short-run, terms of trade is found to have a positive impact on technological progress, investment and money supply. Furthermore, technological progress negatively influences investment in the short-run while the latter has a positive impact on it. Similarly, investment causes broad money to increase while the latter has a negative impact on it. The findings of this study can form the basis of policy measures developed by the government on capital and exchange rate controls in an attempt to keep the country's currency in equilibrium.

Keywords: Real Effective Exchange Rate; Determinants; VECM; Mauritius.

Determinants of tax noncompliance in Mauritius

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Abstract:

The state collects revenue through taxes. This revenue is re injected in the economy to finance many projects such as funding for education, pensions, public goods and services. Governments are concerned with tax non-compliance because it presents a burden to the population's interests as well as the way the economy uses the revenue to cater for these interests (Cowell, 1990). However, during the fiscal year 2013-2014, the Mauritius Revenue Authority (2015) reported a declining level of tax compliance. Hence, there is a need to reduce such tax outflows so that more funds are secured for economic growth. Therefore, an understanding of what causes individuals not to comply with their obligations and to evade tax becomes imperative. A comprehension and an awareness of tax noncompliance behaviour can assist authorities in ensuring a maximum level of tax compliance.

Hence, the purpose behind this research is to critically analyse the different factors that influences an individual's non-compliance with his/her tax obligations. For this purpose, the study uses the theory of planned behaviour and the perceptual deterrence theory to assess causes of tax non-compliance in Mauritius. The use of the theory of planned behaviour and the perceptual deterrence theory is based on the premise that these theories provide a better understanding of human behaviour. For instance, the theory of planned behaviour has been widely referenced in the field of behavioural research and constitutes concrete elements that justify a person's behaviour. Additionally, the perceptual deterrence theory suggests that a person's unlawful behaviour is influenced by the perceived psychological risk, perceived prosecution risk and perceived social risk. Against this backdrop, the use of these theories was deemed relevant to investigate the research problem.

Primary data was collected by using questionnaires which were administered to a sample of 384 individuals. Data was analysed through a multiple regression analysis. Results of the regression analysis show that a higher psychological and prosecution risks perceived by an individual ultimately materialize into a lower intention not comply with their tax obligations. Furthermore, results demonstrate that one's intention not to comply with tax obligations is explained by one's attitude, subjective norms, perceived behavioural control. The outcome of this study provides an insight on the current tax behaviours which may be useful to the tax administrative body of Mauritius.

Many developing economies rely on the tax revenue to initiate sustainable development projects and meet other budgeted expenses. Therefore a significant amount of non-compliance can set back the progress of developing countries and increase the burden of the economy. This study attempts to provide evidence on the factors that influence non tax compliance. The outcome of this study provides an insight on the current tax behaviours of tax payers in Mauritius. Hence findings of the study have strong policy implications for the government and may be useful to the tax administrative body in terms of reforms and regulations so as to minimize tax non-compliance.

Keywords: Tax non-compliance, theory of planned behavior, deterrence theory, Mauritius

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Abstract:

This study presents the idea that there might be several factors determining FDI flows between two countries. In this modern era of globalisation, trade is becoming easier and FDI flow determinants more difficult to theorise through equations. Also, massive changes at a global level like imminent introduction of BEPS project by the OECD, probable amendments to double-non tax treaties, fight against round tripping and other treaty abuses makes this study important. Mauritius, as a financial centre has been subject to controversy when it comes to its tax treaty networks. It has been accused, by some, as being a host for round tripping money and other treaty abuses. There have been renegotiations and amendments in some of the Mauritian tax treaties in recent past and shows the country's willingness to combat treaty abuse and desire to show a positive image as a centre of financial excellence. Many of these amendments come from the Article 13 of tax treaties, which deal with Capital Gains Tax.

Theoretical evidence also suggests that keeping CGT low will increase the level of FDI. Past literature in the 1970s suggest that small open economies should not tax capital gains as it will be against their favour. Diamond et al. (1971) showed, through a one consumer economy, that a small open economy will attain an efficient production rate by offering a low tax scheme or not tax at all. (Bucovetski, 1991; Wilson, 1991) showed that tax base relocation is proportionately more important for small economies and hence, will have a higher incentive to keep CGT, whereby they could create a "race to the bottom". This is supported by the argument of Razin-Sadka (1989) whereby investors will be attracted by low tax jurisdictions and will to countries offering low taxes.

The aims of this study are threefold: first to find out some of the possible main causes of FDI flows through the Mauritian route when it concerns trading with tax treaty partners. Secondly to investigate if CGT is the main or one of the main determinants of FDI. Being regarded as a tool of treaty abuse when CGT is not taxed, it is important to see if the inexistence of CGT in a tax treaty really affects significantly FDI. This will then lead to a possible conclusion about whether the Mauritian route can be used as a treaty abuse destination. Finally, this study aims to provide valuable insight about perceptions of stakeholders from the Mauritian accounting and finance sector on the newly introduced BEPS. This new measure is likely to become imminent in the near future and is supposed to act as a detriment to invest in a country for treaty abusing purposes.

This study uses a mixed methodology approach to empirically analyse taxation and its impact on Foreign Direct Investment in Mauritius. A total of 180 accountants were surveyed in this study, and the main findings were: Capital Gains Tax is an important factor determining FDI flow within a tax treaty but is not the only significant factor. The study used a gravity to confirm the survey's conclusion. Using Mauritius and a host of its tax treaty partners as proxies, it was found that Gross Domestic Product per capita, Capital Gains Tax, common language and distance were major factors affecting FDI flows in a bilateral tax treaty. This

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study also gives a good insight on the reasons why foreign investors use the Mauritian tax treaty network as a platform for investment. The main rationale for such investments was attributed to Mauritius offering a 0% Capital Gains Tax. This study findings also sheds new light on this reasoning and provides evidence that investment does not depend solely on Capital Gains Tax levy but also a host of other important factors.

Keywords: FDI, CGT, determinants of FDI, Gravity model.

Financial fraud-Importance of Internal Control System

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Abstract:

Objective/Purpose: The main focus of the study is on the effectiveness of the internal control system to fight against fraud in organisations. Fraud includes fraudulent accounting transactions and non-compliance with accounting laws and regulations followed by the importance of a good system of internal control. The objective is to assess the importance of internal control system in organizations and how it can help in effectively preventing and detecting fraud in organisations.

Design/methodology/approach: An appropriate method has been selected where several factors have been considered including accuracy, time and recourse constraints. Both primary and secondary data have been utilised. It is research based on a survey and a questionnaire is designed to collect data. Questionnaires are sent to the most reputed accounting and auditing firms in Mauritius. The ten first firms as per the list of members of the Mauritius Institute of Professional Accountants (MIPA) were selected. The questionnaire comprises of three sections namely Demographic, Internal Control and finally Fraud. The questionnaire has been pilot tested and revised in such a way to make it simple to understand and as such ensuring a high response rate but at the same time avoid incomplete questionnaires.

Findings: The results show that internal control plays a major role in fraud prevention and detection. Based on the results gathered from the analysis performed, the majority of the respondents agreed that internal control was the most important layer for detecting and preventing fraud in organisations. Respondents also agreed that reviewing internal control system of a company often helps reducing the risk of fraud and increase confidence in business operations. An inverse relationship was found between reviewing internal control and fraud occurrence. However, it should be pointed out that quality of the internal controls is of importance to ensure their effectiveness.

Limitations: It was very hard to acquire response from all the firm surveyed and at the start the response rate was very low. There has been a low response rate at the beginning and a second attempt was made to encourage the remaining respondents to submit their questionnaire. Some of the firms said that they were still taking into account whether or not to fill the questionnaires because some said that it can violate their internal policy to disclose information about their company to outsiders. Time constraints have also disrupted the response rate.

Conclusion: This study sheds light on the matter that internal control system is of paramount importance in any company for detecting and preventing fraud and irregularities. Companies should improve and review their internal control system on a regular basis to ensure fraud risk is kept at a minimum. However, it would be relevant to look at the factors of quality audit as a further research aspect as it would contribute the effectiveness of the internal controls.

Originality/value: The study adds value to the existing literature by supporting the view that a good system of internal control is a must for the success of a company. It also helps to develop new internal control strategies to fight against fraud in organisation.

Keywords: Internal Control system, Fraud

**Hedging against fluctuations in jet fuel prices and foreign exchange risks-
The case of Air Mauritius**

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Abstract:

Background and purpose: The objective of this study is to grasp a better understanding on the use of fuel price hedging and foreign exchange hedging as tools to mitigate different risks that an airline company faces. The paper is contextualized to the sole airline company in Mauritius: Air Mauritius Limited. The central part that revolves around determining hedging policy is shaping the right balance between uncertainty and the risk of opportunity loss. As such, this paper assesses the efficiency of derivatives like Forwards to hedge fuel prices according to what the circumstance demands.

The methodology approach: Principally data was collected through various interviews that have been carried out specifically targeted to head treasuries, financial controllers and financial analysts. Moreover, secondary data from sources such as Annual Reports, official communiqués and Private and Notice sessions relevant to Air Mauritius from the year 2007 to 2014 have been applied to support the arguments. Emerging reflection like that of Michel Porter's theory of competition has been adapted to explain hedging strategies and approaches.

Findings: Besides analyzing the relationship between total shareholder's interest and Hedge Equity Reserve, the importance to consider operational hedging strategies like risk shifting, leading and lagging proves to be the most appropriate means to curtail risk for an airline industry. It is also firmly believed that the loss on hedging goes beyond the financial impact on the company. It affects its image and questions the competency and integrity of the decision makers of the company. It has been found that there are different reasons and motivations that Air Mauritius considers before taking into account whether it should hedge or not. Sensitive concepts like political interference and the bureaucratic aspect of risk management framework have been proved to affect the quality of decision making of hedging at Air Mauritius.

The notion of fuel surcharge used as a way of pricing strategy to increase profitability has questioned the equitability and fairness attitude that Air Mauritius carries towards its passengers. The lack of transparency and disclosure of information about the use of the different derivatives used to hedge made it difficult to assess its outcome a hedged portfolio. The importance of an exit clause under a forward contract and the "ideal" length of time to hedge carry a great importance for Air Mauritius especially when things do not materialize as predicted. Diverse recommendations are being suggested be it at the level of the management of the company, or at the Board level. Despite the huge loss in 2008, today Air Mauritius Ltd is still in business, doing its level best to achieve world first class services and provide competitive air ticket prices. However, the company should also focus on alternative views to reduce risk while still maintaining profitability by considering more environment trendy approaches like "green flight" and hence contributing to a better perception of the company while at the same time promoting innovative ideas.

Conclusion: In line with the Chinese government, Dufey and Scinivasulu findings and the classical finance theory like Modigliani and Miller (1958), Smith and Stulz (1985), Tufano (1996) and Lookman (2004), this paper largely supports the idea that hedging should not be viewed as the only way to mitigate risk in a company and the only means to maximize firm's value. Sometimes not to hedge proves to be more suitable and profitable for Air Mauritius.

Keywords: hedging, forward contracts, Air Mauritius, exit clause.

Human Rights and Religion: Bridging the Gap for Islamic Sharia

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Abstract:

In a contextualised approach, this presentation shed light on human rights and religion to bridge the gap between the two for Islamic Sharia, and what shall come out of this research would enlighten the contribution of Islam in the welfare of mankind. Indeed, Shar'ia Law is essentially based on divine law unlike continental law on Human Rights (*Human Rights Act*) which are tailored man-made law made for non-Muslims principally whereas all Muslims have their Muslim Personal Law. In fact, most of the provisions of the *European Convention on Human Rights (1950)* are borrowed and inspired from the *Universal Declarations of Human Rights (1948)*. So, there is nothing new in it. In 1990, the Organisation of Islamic Cooperation met in Cairo to adopt the *Cairo Declaration of Human Rights in Islam* inspired from Shar'ia Law. Article 24 of the Cairo Declaration states that "all the rights and freedom stipulated in this Declaration are subject to the Islamic Sharia". Sharia Law, its framework and human rights are incompatible (Tibi, 2008), but Sharia Law is sometime misunderstood due probably to a failure to distinguish sharia law and *Siyasah* (politics) (Carney, 2003).

The legal philosophers of Islam, such as Ghazālī, Shāṭibī, and ShāhWalīullāh explain that the aim of Shar'iah Law is to promote human welfare and there is ample evidence in the Holy Qur'an, and in most sources of Shar'ia Law. Actually, Islamic banking attracts trillions of dollars despite there is no interest like traditional banks, which are in the decline because of fraud and corruption. It is also a law for mankind especially women, children, elderly persons and even provides protection for refugees similar to various international legal instruments such as the *Geneva Conventions 1949*. However, there is no law which is above the Holy Qur'an. Verily, Allah has neglected nothing in His law (VI.39). Human rights mean to do things which are just and fair. And it is the Holy Qur'an which contains relevant verses on righteousness. The righteous in Islam will be amidst gardens and fountains and for them will be the Gardens and Eternity. This is because Allah is merciful, forgives and accepts repentance and those who have done good deeds in the name of Allah will admit those who believe and work righteous deeds to Gardens. They shall be adorned therein with bracelets of gold and pearls. Their garments will be of silk (XXII.23).

Islamic Law justifies the formal inequality of individuals and gives priority to its religious collective (Glenn, 2014). Islam is peace but hates people who provoke Islam, Allah and His Holy Prophet through blasphemes and other forms of defamation. Most democratic countries have passed blasphemy laws to protect believers and their faith despite it is easy to provoke on the Internet and among billions of internautes to identify who is liable or not (Gunputh, 2015). Dr Muhammad Imara (Muslim unity:an elusive goal) stated that:

"It is easy to avoid discussing the differences in the *Ummah* but it is impossible to remove them and say that all will accept the same ideology and school. Whoever thinks that about the Muslim *Ummah* can one day be free of schools of thought, is in fact an enemy of freedom and diversity, or believes in an idealistic dream which is, in reality, impossible to expect..."

Shah, in his *Hujjatullah al-baligha*, refuted those who compared Shariah with the commands of a master intending only to test his slaves loyalty and sense of obedience, rejected this view

and argued that Shariah Law were not merely for the sake of obedience; they have human welfare as their goal and distinguished between religion and laws and elaborate his idea that religion is based on the principle of unity, while laws are based on the principles of change and diversity. The research methodology will be based on relevant hadiths, ayats, Islamic doctrine and various school of thoughts to enable us to understand to what extent Sharia Law has developed human rights

Keywords: Islam, Sharia Law, Human Rights

**Investigating the prevalence of a fraud risk management structure
Within Mauritian financial companies**

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Abstract:

Background and Purpose: Fraud does not discriminate between individuals and companies, thus both are vulnerable to fraudulent activities. Having an appropriate policy which caters for the risk of fraud is important as otherwise this could lead the fraud victim to endure loss of money, reputational damage or loss of employee morale. In the context of making Mauritius a financial Centre, it is imperative for financial companies to protect themselves from these loss bearing activities. This can be done through internal controls implemented by the Management of the company and endorsed by the Board of Directors. Hence, this study aims to see whether the Mauritian Financial companies implement adequately the internal controls with the aim of deterring the occurrence of fraud. These internal controls cover five main areas namely corporate governance, fraud risk assessment, fraud prevention, fraud detection and Fraud Reporting. The combination of these different measures helps to create a fraud fighting environment within an organization and encourages an ethical business environment, which boosts up market confidence.

Design/Methodology/Approach: To achieve the abovementioned objective, a survey has been conducted whereby a questionnaire was administered to 300 financial companies.

Findings: The responses were consequently analyzed and it has been found that most of the companies recognized the threat of frauds, and an average of 76% of controls was implemented within the organizations. Most of the companies catered for corporate governance in their system, with two or more corporate governance controls implemented. Most of the respondents recognized the need for a fraud risk assessment framework, with 56.4% having all five controls listed under the said banner, implemented within the organization. Out of the ten controls listed under the banner prevention and detection, 78.18% of the companies had six or more of the controls implemented. However, statistics pertaining to the reporting controls did not seem to be adequate. Reporting controls were lacking and thus companies have to improve on this front so as to deter the recurrence of same. Overall, 47.3% of the companies had around 21 to 25 of the controls proposed in the questionnaire, which suggest that companies do recognize the threat of fraud but more has to be done to encourage a more proactive battle against the threat of corporate fraud. Moreover, it has also been seen that Mauritian financial companies have been fighting fraud not only through implementation of internal controls mentioned in the survey but also by means of other controls.

Conclusion: The fact that 83.6% of the respondents recognised that there is a need for a specific framework to fight fraud shows that Mauritian financial companies are fighting fraud despite it not being a popular issue in Mauritius. This has been shown by the respondents' opinion that there is a lack of regulations in Mauritius to cater for corporate fraud. Hence, this study has shown that despite recognising the need for a specific framework to fight fraud in organisations and implementing internal controls as means to deter fraud, the laws in

Mauritius are still lacking. However, there is the prevalence of an ethical culture among the companies which is a plus point for the country. As such, more regulations have to be introduced and a more proactive sensitisation of fraud deterrence should be done among companies within the financial sector.

Keywords: fraud, fraud risk management, Mauritian financial companies, internal controls, Mauritian laws

The Effects of Exchange Rate and Exchange Rate Volatility on Foreign Direct Investment: A Meta-Analysis Approach

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Abstract:

This paper examines the effect of exchange rate and exchange rate volatility on Foreign Direct Investment (FDI) by using a meta-analysis approach. The mixed results yielded by the voluminous empirical research relating exchange rate and FDI is one of the primary motives of this study. We begin our investigation by fettering out publication bias within the 1342 estimates (692 for exchange rate and 650 for exchange rate volatility), pooled from 101 studies. Initially, out of 712 estimates collected for exchange rate volatility, we note that a certain amount of observations were considerably inflating our mean and standard deviation. We thus decide to exclude these outliers and accept the convenience of working with a narrower set of 1342 estimates, rather than having them excessively contributing to the mean and standard deviation. Our test shows evidence of publication bias among the studies, although significantly weaker among the exchange rate volatility studies. However, the failsafe N and fisher failsafe N suggest that the relationship between exchange rate and FDI is not susceptible to publication bias. The simple mean of estimates for exchange rate and exchange rate volatility are -1.159 and -1.489 respectively. When we apply the fixed effects meta-analysis and weight the estimates by their precision (the inverse of standard error) the mean reduces to -0.001 and -0.020 respectively. Taking into account potential heterogeneity, an alternative approach is used; the random effect meta-analysis. In general, heterogeneity is likely to be substantial in these type of literature and this is formally confirmed by the Q test and the L-square values (which are above 75% for both exchange rate and exchange rate volatility). With the random effect meta-analysis, we find that the average estimates for exchange rate has become -0.008 and -0.307 for volatility. These results are in line with the common impression that empirical conclusion is rather mixed. We also use box plots to verify heterogeneity with respect to methodology. By choosing the country most frequently examined, we find that results may vary across studies from negative to positive, from negligible to economically significant. This is one of the main reasons to control for method choices in our investigation. In an attempt to explain the substantial heterogeneity in the reported statistical results, a meta regression analysis (MRA) is used. We employ Bayesian Model Averaging (BMA) to identify potential determinants. The compile results reveal that both the impact exchange rate and exchange rate volatility on FDI have their signs and magnitudes highly related to the domestic economic condition and research methodology approach. The impact of an appreciation or depreciation of host currency varies significantly from one study to the next mainly due to estimation characteristics. Moreover, when it comes to exchange rate volatility, the exchange rate system, geographical distance and patent rights remain among the most important sources of heterogeneity. The results also point out that the negative effect of exchange rate volatility still persist during a pegged exchange rate regime but can be counteracted by providing larger opportunity to international trade and a strong protection of intellectual property rights.

Keywords: FDI; Exchange Rate; Exchange rate volatility; Meta regression-analysis; Bayesian Model Averaging.

The Development of Human Rights and Labour and Industrial Relations Law in Mauritius During the Pre-Independence Period (1715-1810)

-The Mauritian *Métissage Juridique* Case Study-

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Abstract:

A small island of only 1865 km square, Mauritius has a very long and rich history. Because of its strategic position in the Indian Ocean it soon became an easy prey for the super powers at that time (Britain and France) in search of free and cheap man power. Indeed, it is open from the East to the West and from the North to the South and there is an easy maritime access for economic and monetary trade (slaves, spices and gold). The Arabs visited the island in the 12th century followed by the Dutch in the late 16th. Though they brought cane plants on the island they overexploited the famous Dodo until its extinction. Mauritius was colonised successively by the French (1715-1810) and the British Government (1810-1968). A great nation like France had no choice than to capitulate before the British Empire. On the 8th July 1810, the Act of Capitulation was signed at Sainte Suzanne and R.T.Farquar, famous for a proclamation he issued, became the first British Governor of Ile Bourbon, then by Colonel Keating (when R.T.Farquar served as British Governor of Isle de France). The Treaty of Paris 1814 ended hostilities between the two nations. Bourbon (l'Ile de la Reunion), Mahé and Pondicherry were restored back to France but Isle de France, now Mauritius, was kept under British authority. As from 1968, it became an independent country and on the 12th March 1997, it became the Republic of Mauritius. Through an Act, dated the 7th August 1833, the British Government abolished slavery in 1833 (by Ordinance No. 8 of 1835 while William Nicolay was the Governor of Isle de France) at a time where there were The Code Napoléon 1804, The French Penal Code 1791 and The French Code de Commerce. There was also a *Code Noir* 1723 for the slaves. Some reformers like William Wilberforce, in Britain, fought towards the abolition of slavery. Slaves are human beings and there is no reason why they should be treated differently. As a result about 28000 agricultural workers out of a population of 61 000 black slaves were freed and consequently they refused henceforth to work in the fields because of the inhuman treatment meted out to them. Like other colonised islands (Haiti, Reunion and eventually Mauritius), there were free people and freedman (*affranchis*) of mixed-race, primarily European and African and many were Indo-European as well, and they played an important role in the development of labour and industrial relations law following the ill-treatment they received. What shall come out of this paper would therefore contribute to better understand the contribution of coloured people or *gens de couleur* in insular societies, and the Mauritian case study would inevitably provides the right model and platform adding a *plus-value* in the historic development of human rights, labour law and legislations inspired from British and French law during that period (1715-1810) to give birth to another form of mixed system or *métissagejuridique*.

The Law and Practice of International Arbitration: Its future in Mauritius

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Abstract:

Today with the growth in international trade, commerce and investment, corporations, States and individuals have become more and more wary about legal risk management issues. A recourse adopted by the companies over the past years has been to resolve disputes using the alternative dispute resolution methods, and to apply cross border dispute resolution policies. This explains why the concept of international arbitration as a method of dispute resolution is on the rise.

For instance, Mauritius has concluded 42 double taxation avoidance agreements (DTAs) worldwide, allowing our country to become an international financial centre of repute. To keep pace with such recognition, Mauritius has to focus on fine-tuning its Alternative Dispute Resolution regimes of law, especially, in the field of international arbitration, in light of the Global Business Sector, which is a fast-growing sector. The Financial Services Commission (FSC) is more and more encouraging shareholders of a Global Business Company to arbitrate in Mauritius with regards to dispute arising out of the constitution of the company, thus accentuating the positioning of Mauritius as a jurisdiction of choice for the resolution of business and investment disputes in the African region and beyond.

Given the fast emergence of international arbitration law in Mauritius, this paper will analyse, compared to other jurisdictions such as the United Kingdom and India, how the practice of international arbitration can be used effectively, while at the same time ensuring proper steps are taken to make Mauritius become a hub/centre for international arbitration and mediation for Africa and Asia.

The outcome of this paper rests heavily on the analysis of the history of arbitration law, its importance, impact and characteristics as well as the recent and ongoing developments proposed in this field, laying emphasis on the International Arbitration Act 2008. The paper will focus on the scheme of economic development that an international business platform should own and stimulate to be an effective means of dispute resolution and how to progressively make it become part of our legal culture while enhancing our business climate. At the end of this paper, the guidelines proposed herein will help in ensuring an effective and efficient evolution of international arbitration in Mauritius.

It is hoped that, in the future, Mauritius will be experiencing tremendous growth in international

trade and investment as the country is perceived as a neutral one by both developed economies and emerging ones. Furthermore, the prevalence of the rule of law in our democracy and our strategic move to position Mauritius as the bridge between the economic giants of the southern hemisphere give legitimacy to the implementation of international systems of dispute resolution for business in the African region as well as in the emerging global business community. However, having examined the current obstacles to its development, we take the view that there should be greater training given to the interested

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Mauritian lawyers for them to acquire the expertise expected of them from international tribunals. Regular workshops should also be conducted to initiate the business tycoons into the practice of international arbitration so that Mauritius is viewed as an acceptable and attractive venue for international arbitration in the region.

Keywords: Arbitration, Mediation, International Arbitration Act

Microfinance and Economic Growth: Empirical Evidence from Mauritius

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Abstract:

It is believed that SMEs are the backbone of the economy of any country. They are essential for the stability of the country since they constitute a large employment base of the nation. However, despite their importance, SMEs still lack access to finance. Hence, the microfinance concept was introduced to help SMEs and poor families to be included in the financial sector. Therefore, it is believed that microfinance helps in the growth and development of SMEs. Several research have been conducted in its respect and the roles of the microfinance institutions in providing small loans and other financial services to SMEs and poor families who are “excluded from the formal banking sector” (Morduch, 1999) and standard financial systems but it is somehow still vague whether microfinance will impact positively on SMEs and economic growth.

The problem that will be addressed in this study is whether microfinance does bolster the growth of the SME sector in Mauritius and do SMEs really contribute to economic growth. The objectives of this paper are threefold. The first is to analyse the impact of microfinance on SMEs, whether it contributes to SMEs development. The second objective is to identify the major constraints that SMEs face to access finance and if government plays a role in promoting SMEs and findings showed that a lack of governmental support is a constraint for SMEs to access microfinance. The last aim of the study is to analyse how microfinance contribute to SMEs and hence, to the economic development of Mauritius.

A random sampling technique was conducted to choose 300 SMEs out of the 6416 SMEs found in the SME Database, that is, all SMEs registered under the SMEDA. However, out of the 300 SMEs selected, only 100 answered questionnaires were received. In addition the Ordinary Least Square Method (OLS) is applied to analyse the time series data in the linear regression model. Data was collected for the period 2002 to 2014 as available by SMEDA.

From the analysis and findings, we can conclude that when ROI is too high, SMEs find themselves in difficulties to repay their loans. Hence, they often refrain from accessing finance with the fear of not being able to repay loans. However, with better access to finance, SMEs can perform better in terms of turnover, capital, popularity and payments of bills. The test done to bring about a conclusion as to whether government plays a role in promoting microfinance showed that these two variables are not independent and a lack of governmental support means that government is not really promoting microfinance in Mauritius. On the other hand, the results of the multiple regression model revealed that gross output is not a significant variable whereas contribution of SME to GDP and SME investments are significant in the regression model. We can also deduce that all the independent variables contribute positively to the economic growth of Mauritius. It can be inferred from this study that if the small entrepreneurs are provided with finance, business assistance and support, they can produce value-added products and make better investments which contribute to the economic growth of the country, as stated by Mc Kinnon and Shaw (1973). Hence, as results affirm, there exists a positive relationship between the growth and SMEs and economic development.

Keywords: microfinance, SME development, economic growth, Mauritius

The Maputo Protocol on the rights of women in Africa: When does Mauritius intend to ratify?

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Abstract:

This paper is part of an ongoing research on the impact and implementation of African human rights instruments in Mauritius. It is inspired from an early work carried out by the author and an Ethiopian Judge and Human Rights Activist by the name of Ms. MeskeremGeset. A book chapter on the topic is already under publication and some concepts and ideas have been taken from there.

The African Charter was signed by Mauritius on 27 February 1992 and ratified shortly on 19 June 1992. On the contrary, after ten years of becoming a signatory (signed in 2005), Mauritius has not ratified the Maputo Protocol to date. The Maputo Protocol notes that women's rights and women's essential role in development, have been reaffirmed in the United Nations Plans of Action on the Environment and Development in 1992, on Human Rights in 1993, on Population and Development in 1994 and on Social Development in 1995. It firmly reaffirms that any practice that hinders or endangers the normal growth and affects the physical and psychological development of women and girls should be condemned and eliminated (Preamble, 3).

The Maputo Protocol provides for a unique protection to women. For instance, it demands total abortion legalization. Article 14, "Health and Reproductive Rights," calls for the legalization of what would be in effect abortion-on-demand in Africa. As typically interpreted by international jurists and Western courts, the language of the Maputo Protocol would legalize any abortion for any woman at any point in pregnancy, even in the ninth month. All effective restrictions on abortion would be abolished by the Protocol. It also demands the governments promote other policies that Catholics and others believe to be immoral (Maputo Protocol, website <http://maputoprotocol.com/about-the-protocol>).

A comparable study conducted in 2011 (Geset, 2011), attempted to explore the ratification history of the African Charter without success in accessing primary sources. In spite of such impediments, government officials share a firm opinion that ratification of the African Charter has been galvanized by the sentiment to reinforce the State's commitment to human rights, bearing in mind that Mauritius already boasts a democratic Constitution at the time that recognizes fundamental rights and freedoms (Mauritius Country Report, 2007).

Reports show that the ratification of the Maputo Protocol is underway (Mauritius Country Report, 2007) albeit, it was difficult to note any tangible progress over the years. Notwithstanding assertions from government authorities as to the absence of any obstacles to ratification (Ministry of Gender, 2011), the long delay begs critical questions. The African Commission had also highlighted its concern that Mauritius has still not ratified the Maputo Protocol (Concluding Observations, 47). Yet, the question of ratification has not been tabled before cabinet.

Mauritius could presumably be playing the card of ‘compliance without ratification rather than ratification without compliance’ (Schulz, 2008). However, it is argued that there are more benefits than disadvantages to ratify the Maputo Protocol. Despite a decent standard of human rights prevailing in the country, the State of Mauritius need to come to term with the fact that the African Charter and the Maputo Protocol confer additional and essential protection of human rights. It is imperative that the state show genuine political will to enshrine the provisions from the African human rights instruments in the domestic legal framework.

The aim of this research paper is therefore to establish the multiple advantages that Mauritian women can draw from the ratification and implementation of the Maputo Protocol. It also aims at analysing what have been the impediments that have caused such a delay for Mauritius to ratify the Maputo Protocol.

Keywords: Maputo Protocol, Mauritius, Women’s rights, African Charter.

To what extent can socio-economic rights be added to the Mauritian Constitution and bring changes?

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Abstract:

Background of the study:

In 2018, Mauritius is going to celebrate 50 years of independence. Since independence, the country has known both economic and political stability, despite major economic crisis shaking the world. The country has been ruled by one Constitution and has followed a single regime which is parliamentary. There have been some minor amendments brought to the Constitution without disturbing the major principles enshrined in it.

These elements qualify Mauritius as a success despite the fact that the country has been colonised by three former powerful countries namely Netherlands, France and English. Since the Constitution is an important document for it governs the main institutions in Mauritius, this paper will study the areas where improvement must be brought.

Objectives:

This paper bears two objectives. The first objective will identify the areas where amendments are not needed. The rules contained thereof will remain unchanged. This study will focus on areas where the changes to the Mauritian Constitution need to be brought. Those important changes consist into adding new rights to chapter 2 of the Mauritian Constitution. Giving more rights to the citizens of Mauritius can be done by adding socio-economic rights to the Constitution.

Adding socio-economic rights to the Constitution must be done in a constructive way. In other words, since the Constitution is based on giving freedom, equal treatment and full enjoyment of rights to the citizens, the implementation of socio-economic rights must reflect the concepts and principles that the Constitution adheres to. This is the second objective of this paper. After making an assessment of the socio-economic rights that can be added to the Mauritian Constitution, recommendations will be made.

Methodology

The methodology that will be used to conduct this research paper will be through interviews. Three categories of interviewees have been selected. The first category of interviewees that will be interviewed is law practitioners specialised in Constitutional law cases. The reason is that some cases have not been successful for the Mauritian Constitution is quite restrictive in terms of giving more rights to citizen. The second category of interviewees is going to Judges of the Supreme Court. The justification is that in some leading cases, the Supreme Court has by obiter expressed the opinion that more rights must be added to the Constitution. The third category of interviewees is law students. The students are full time and part-time undergraduate students. They will be able to show whether they are aware of the changes that need to be brought to the Constitution.

Major findings

The majority of interviewees agree that the Mauritian Constitution needs to be amended. However they are not convinced about the adding of socio-economic rights to the Constitution for there is a lack of understanding of the significance of those rights.

Conclusion

Socio-economic rights must be clearly defined; the major challenges must be set out in order to make way for its implementation in the Mauritian Constitution.

Significance

This paper will contribute to the positive impact of socio-economic rights in the Mauritian Constitution.

Keywords: Constitution, adding, socio-economic rights

To what extent will the proposed reform on the electoral process bring adequate and fair representation in the Mauritian context?

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Abstract:

Background of the study:

Since independence, there have been seven proposals through different reports recommending the changes needed to be brought to the Mauritian electoral system. In all reports, recommendations were made to guaranty adequate and fair representation of the Mauritian population at the National Assembly. The majority of those reports have suggested that the first change to undergo is to replace the best loser system (BLS) by another means of representation. However no relevant formula has been found to replace the BLS. The BLS is unique to Mauritius. Its first aim is to operate as a reassurance and safety valve to correct imbalances in respect of fairness and adequate representation of all communities. Secondly as pointed out by the Supreme Court of Mauritius in a judgment the other aim of the BLS is to temper as far as possible the deleterious effect which the acceptance of communal was bound to have on stable government and on the political and social life of Mauritius.

The issue is that despite being considered as outdated, the BLS has never been replaced and has maintained a form of stability among the institutions. However the reform of the electoral process is not only limited to the abolition of the BLS. In order to guarantee adequate and fair representation other changes are needed to give representation its full meaning.

Objectives:

The objectives of this study are of two folds. The first objective is to assess the concept of fair and adequate representation in a democratic State. This assessment will be used as a platform to test the Mauritian electoral system. Since its implementation the Mauritian electoral system has nevertheless guaranteed stability amongst the different institutions. On the other hand despite the number of reports requiring changes, the Mauritian electoral system has remained the same.

Since there is an actual study carried out by an inter-ministerial committee on reforming the electoral system in Mauritius, the second objective is to make recommendations about bringing a fair and adequate representation system.

Methodology

The methodology used in this paper is a desktop approach. The theories of democracy coupled with representation will be studied. The recommendations made by the different reports will also be used as a background in order to propose a good electoral process.

Major findings

The major findings are that representation is only one aspect of the electoral system. Further studies must be carried out to propose a relevant electoral system. This entails the redesigning of constituencies as some contain more voters than others. How participants in a general

election are funded, is another finding. Media coverage during electoral campaign is another element which must be studied.

Conclusion

The best way to achieve adequate and fair representation in the Mauritian context is to replace firstly the whole system with proportional representation (PR) and secondly widening the powers of the Electoral Supervisory Commission.

Significance

The significance of this paper is that it will propose ways of ensuring better representation at the National Assembly. It is vital that representation reflects the Mauritian population.

Keywords: Elections, representation, reform, proportional representation

Turnover Intentions of Employees in the midst of the Hospitality Sector in Mauritius

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Abstract:

The tourism industry is one of the world's largest and most dynamic industries with a high growth rate potential (Firag, 2001a) which makes it one of the most remarkable economic and social phenomena of the past several decades. Mauritius now attracts around 1,000,000 visitors from various parts of the world making it the third economic pillar with 112 hotels in operation. Government and most operators in the sector expect tourists' arrivals to increase considerably in the coming years. In view of the possible increase in arrivals, it becomes important to study and understand the dynamics of this industry. Being a service industry, it depends heavily on its human capital, which acts as the differentiation power and the key success for this particular industry. Nevertheless, numerous issues pertaining to employees in the hospitality sector have caused high employee turnover rate. Empirical studies have continuously showed that exuberant employee turnover rate is acknowledged to be the most hectic issue and mostly detrimental to the global hospitality industry, which ranged about 60% annually (Birdir, 2002). However, very little effort has been done to address human resources issues in the hospitality sector in small island developing countries; thus remaining poorly understood (Prayag and Hosany, 2015).

Turnover intention has been defined as the degree one's plans to leave an organization. The concept of turnover intentions was first brought forward by March and Simon in 1953 and the main focus was on the desirability and perceived ease of job movement. Numerous factors that contribute towards turnover intentions have been reported in previous studies. Researches have demonstrated that any unfairness being viewed by employees regarding future organizational decisions, they may be more prone towards moving to a new employer (Cohen-Cbarash and Spector, 2001). Any unfairness in organizational context has often been debated by the concept of organization justice; distributive justice, procedural justice and interactional justice. Job satisfaction plays a significant role in contributing towards turnover intentions and Mobley *et al.* (1978) advocated that low job satisfaction was found to be a substantial predictor of turnover intention. Hom and Griffeth (1995) have reported that organizational commitment is negatively related to turnover intention. However, if employees are experiencing low commitment towards their organization, they will be more likely to quit. Lastly, emotional labor was found to be strongly related to burnout, depression and psychosomatic diseases (Schaufeli & Enzmann, 1998) and positively related to turnover intentions. Eight hypotheses will be developed on the basis of existing empirical and theoretical studies.

This paper will attempt to develop and test a labor turnover intention model. Variables like job satisfaction, organizational commitment, emotional labor and quality of work life will be tested against turnover intentions. A questionnaire will be designed and 800 employees from the hospitality industry will participate in the survey. The collected data will be analyzed through SPSS software version 20. A series of recommendations will be provided in order to

discourage labor turnover and enhancing the present human resources practices in the hospitality industry.

Keywords: Turnover intentions, Job Satisfaction, Organisational justice, Organisational commitment, Emotional Labour

**Universal pension review:
Between rational and subliminal judgment**

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Abstract:

RESEARCH BACKGROUND AND OBJECTIVES

The aim of this research paper is to analyse rational and subliminal judgments around the heated national debate of reviewing the universal pension in Mauritius where the government intention is to review the pension to people falling into the high-income earner group. The Rs 5,000 universal pension was an electoral bargain which led the existing government to an overwhelming electoral victory.

RESEARCH FRAMEWORK

The National Pensions Act 1976 (Act No. 44) still serves as the framework for the pension system in Mauritius. Regarding the basic retirement pension, subject to section 10, a person who has attained the age of 60 shall be qualified to receive a basic retirement pension.

Despite arguments for and against the review of universal pensions, there have been two broad types of arguments which are briefly discussed.

The rational economic perspective

A first scientific perspective would be the rational economic one. This is the scientific rationale for the universal pension. The immediate question would be to ask whether the universal pension needs to be addressed to all senior citizens attaining the age of retirement. There is an economic perspective in that pensions have been so far provided without targeting the senior citizens regardless of the size of pension that they might be earning.

The subliminal perspective

The subliminal perspective is complex to understand but can implicitly question the argument of questioning the rationale of re-engineering the universal pension. It is based on psychological evaluations of the individual and questions whether the incumbent is really willing to accept or reject the universal pension targeting. This requires questions that solicit emotional intelligence, behaviour or components of attitude that either show acceptance or rejection of a universal pension indistinctively to all categories of citizens.

APPROACH & METHODOLOGY

The objective of the research was to see how respondents answered to both metrics: rational economic and subliminal. A questionnaire was designed based on Likert scale in order to ensure appropriate ranking of items leading to obtaining mean values per question.

The sample size was 50 respondents within the age group 25-60. There was no precise 'location' of respondents given that public officers wherever they work, are subject to the same work conditions under Establishment. Basically, they were all educated and qualified prior to joining the public service while undertaking 'white collar' jobs and having senior positions.

DATA COLLECTION: SECONDARY AND PRIMARY DATA

For the purposes of the study, secondary data was taken from scholarly work undertaken at the international level where respected researchers explained the importance of pensions within the welfare systems in force in developed nations and the need to reengineer them. Primary data was taken both from the local environment namely published data in Mauritius followed by fieldwork undertaken with respondents that fulfilled the requirements of a representative sample.

MAJOR FINDINGS

Despite the fact that there were clear arguments criticising the need for targeted pension in Mauritius, the subliminal perspective stated that there were apprehensions from respondents who feared the pension re-engineering from the point of view of uncertainty, apprehension, the likeliness to live in 'empty nest', the fear of loneliness. This psychological test was more overwhelming than the rational economic view of pension targeting.

CONCLUSION

From the research findings, pension review by the State based on economic arguments are not the sole decision criteria because people about to retire think of the basic universal pension as an acquired right regardless of the income that they have.

SIGNIFICANCE

This research is contemporary and highly focused on the present day's government strategy regarding a review of the pension scheme. It innovates by exposing the choices that society has with regard to targeting universal pension but foretells that despite rational arguments for reviewing the pension, the subliminal perspective has something more to add to the State proposal of universal pension reform.

Keywords: universal pension, rational economic, subliminal, re-engineering.

The Influence of Higher Education Service Quality Dimensions on University Image

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Abstract:

Higher education institutions operate in an organizational environment which increasingly appears like a traditional business environment. One where satisfying customers and fostering positive behavioural intentions such as word of mouth recommendation is key to the long-term sustainability of the organisation. It is therefore, not surprising to witness a growing emphasis in the marketing and higher education literature on concepts such as service quality, student satisfaction and image, which regard students as customers of the higher education service. Image has been found by past studies to be a major determinant of student loyalty, making it a key construct for ensuring the competitiveness of universities; however, research on the determinants of image in the context of higher education has been scarce. In empirical studies conducted in the context of telecommunications industries, Cheng et al. (2008) and Lai et al. (2009) found that service quality is a significant antecedent of corporate image. Similarly in a study conducted in the context of service provided by gaming establishments, Wu (2014) found that image is significantly predicted by service quality ($\beta = 0.831, p < 0.01$). Differentiating between the functional and technical dimensions of service quality, Kang and James (2004) tested for the effect of both constructs on image separately. The results revealed that both functional service quality ($\gamma = 0.53, p < 0.01$) and technical service quality ($\gamma = 0.21, p < 0.21$) were positively and significantly influencing image. It is worth noting that according to these results, functional service quality has the greatest impact on image. In the higher education context, the study of Clemeset *al.* (2013) suggested that service quality perceived by university students has a direct positive effect ($\beta = 0.800, p < 0.01$) on their perception the image of their university. That is the university's image is heightened when students view that the quality of services provided to them is higher. It is therefore hypothesized that there is a direct positive relationship between students' perceptions of higher education functional service quality and their perceptions of the university's image

This study aims at assessing the effect of service quality dimensions on university image, while controlling for demographic variables. The survey method is used to collect data and hierarchical regression analysis is performed to test the research hypotheses. Service quality in higher education was measured using the HESQUAL model. Reliability of scales were verified using Cronbach's Alpha scores. Ten hypotheses were formulated each corresponding to a particular service quality dimension. The findings reveal that competence of academics, support facilities, and attitude and behaviour of administrative staff to be key determinants of university image. Accordingly, theoretical and managerial implications are discussed and potential avenues for future research are proposed.

Keywords: Service Quality, Higher Education, Image

POSTER PRESENTATIONS

An Empirical Investigation of FDI and Higher Education in Sub Saharan Africa

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Abstract:

FDI in Sub Saharan Africa has become a key component for economic development. More importantly, the spillovers effect of FDI is considered as crucial for the host economies. The benefits from FDI are mainly in terms of technology, technical and managerial skills. With foreign investment, there is greater demand for skilled labour in the host countries which creates incentives to the local population to seek higher education and be able to secure skilled jobs. The motivation for this investigation comes from the mixed results obtained on the FDI-Higher education spillover. Based on the PVAR and PVECM method, this empirical study investigates whether any links exist between FDI and higher education in a selected group of 20 Sub Saharan African countries during the years 1990-2014.

4.2 MODEL SPECIFICATION

Referring to earlier studies such as Mughal et al (2009), the following econometric model is being adopted for the present study;

$$TER = \alpha_0 + \beta_1 FDI_{xt} + \beta_2 GDP_{xt} + \beta_3 CPI_{xt} + \beta_4 TO_{xt} + \beta_5 POP_{xt} + \mu_{xt} \text{-----(1)}$$

However, because of the variance stabilizing properties of log transformation, the log values of the variables are used. In fact, logged variables yield a more clear-cut interpretation of the coefficients in terms of percentage change.

Converting all the variables in logarithmic terms yields:

$$LTER = \alpha_0 + \beta_1 LFDI_{xt} + \beta_2 LGDP_{xt} + \beta_3 LCPI_{xt} + \beta_4 LTO_{xt} + \beta_5 LPOP_{xt} + \mu_{xt} \text{-----(2)}$$

Where LTER, LFDI, LGDP, LCPI, LTO, LPOP are the logs of tertiary enrolment, gross domestic product, consumer price index, trade openness and population growth respectively. $\beta_1 \dots \beta_5$ represent the parameter estimates and μ_{xt} is the random disturbance term.

Brief Findings

In both the long run and short run, a positive and direct relationship was found between foreign investment and higher education. Furthermore, economic performance and trade openness is seen to be a key determinant of higher education. However, both population growth and inflation are seen to discourage individuals to seek higher education. In addition to that, it is observed that there is a bi directional causality between FDI and higher education. Finally the Generalised Response Function depict that LEDU is responsive to a shock to LFDI.

Keywords: FDI, Higher education, PVAR, PVECM, Causality

A new Paradigm Explaining Internal Audit Quality

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Abstract:

Background

Nowadays internal audit is playing a significant role in the management of organizations. Therefore the quality of audit provided should be high and accurate. Many studies are made about the effectiveness of IA in the public and private sectors. Most researchers have also studied the audit quality framework. However, current research in this field is fragmented. Besides, no study has examine the effect of factors such as job satisfaction, working environment, career perception of the IA and culture within the organization, on Audit quality, and specially in a developing country as Mauritius.

Research Objectives

1. To explore the factors that could potentially influence the quality of internal audit
2. To develop an integrated IAQ concept, based on existing models and incorporating new constructs to have a more comprehensive and holistic view on the factors impacting internal audit quality

Methodology

A survey (*using the questionnaire method*) will be conducted among a representative sample of internal auditors from MIPA. The conceptual framework will be based on the model used by Marwa Abdel Razek (2014).

Outcomes

By combining new constructs and considering cultural factors within the organization, this study contributes to generate a comprehensive model that could better explain IA quality and guide future auditors in Mauritius. This research also contributes to the existing literature of IAQ with the development of this new inclusive paradigm especially in the context of a developing economy.

Marketing of Litchi (*Litchi chinensis* Sonn.) in the Domestic and Export Markets

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Abstract:

Proposing an apt marketing system for the litchi sub-sector for the domestic and export markets, with focus on measures that would decrease the marketing costs was the aim of this study. A survey was carried out with major stakeholders in the litchi sub-sector; namely wholesalers, retailers, exporters, commercial and backyard growers. The main objectives were to portray the different marketing channels selected by these channel operators, their costs of production- fixed or variable- and marketing costs as well. Equally, strategies used by the latter to increase their marketing margins were assessed and constraints affecting this sub-sector at marketing and pre-marketing phases were identified. Mauritius has both low and high topographies, as such, even if litchi is mostly yielded during summer times, the evolution in the growth and maturity of litchi fruits is much dependent on the topography as well. Thus, different areas of Mauritius will harvest the fruits at different periods of the summer season. The researcher ensured to cover almost all these regions and contacted available commercial and backyard litchi growers as starting point of the survey by using convenience sampling and the latter's respective marketing channels were eventually surveyed using snow-ball sampling technique. In terms of sampling, 25 backyard litchi growers and 15 commercial litchi growers were interviewed whilst when applying the snowball sampling technique 18 wholesalers, 45 retailers and 4 exporters were questioned.

Among the main findings were that the channel operators showed little awareness about the marketing costs; though they dealt with them regularly. This was however, an exception for exporters. Commercial growers benefited from maximum marketing margins of 73.2% and 67.5% when marketing to retailers and wholesalers, respectively. Backyard growers had the same gain when marketing to intermediaries; however, with lower marketing margins of 61.7% and 61%, in that same order. The survey also revealed interesting findings about exportation of litchis. Additionally, it was found that high production costs were a major drawback for some stakeholders while for some it was the marketing costs which were soaring. For exporters for instance, 57% of their marketing costs were due to freight and packaging. Product losses due to pests, diseases and delayed transportation were constraints which elevated further the marketing costs. Yet, channel operators were willingly investing in finding solutions to such problems. Value addition to litchis was another interesting element that was well understood by commercial growers and exporters. Essentially, investing in and having good storage facilities were crucial to have high value-added litchis. 80% of the commercial growers, 48% of the backyard growers, 44.5% of the wholesalers, 36.7% of the retailers and 100% of the exporters recognised about the importance of value-addition in the litchi business. Yet, surprisingly most of those who already adopted value addition practices, qualified them as being tedious jobs which had lots of implications.

Consequently, it could be deduced that both exporting and selling litchis locally have benefits that can be judiciously explored by controlling costs, choosing the right marketing channels and by adding value to this promising fruit business. Enhanced training should be imparted to stakeholders regarding improvement of both quantity and quality of litchis and eco-friendly,

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less costly measures can be adopted by commercial or backyard growers for reducing the production as well as marketing costs. Upgraded post-harvest handling practices can not only minimise wastage but, improve quality of litchis. Organisations having the competencies of providing such training and skills to stakeholders in this business should be encouraged of doing so. New schemes and policies can be proposed to raise interest of more people in this sub-sector which is of great economic importance.

Keywords: Marketing, Costs, Litchi, Domestic, Export

Measuring Service Quality Delivery and Patients' Satisfaction in the Public Health Sector of Mauritius

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Abstract:

The purpose of this study is to build a comprehensive conceptual model to understand and measure the variables affecting service quality (SQ) in the public healthcare sector of Mauritius. Healthcare quality and patient satisfaction have gained increasing attention in recent years (Ygge and Arnetz, 2001; Zineldin, 2006; Labarere *et al.*, 2001). A number of studies have demonstrated that positive patient perception is significantly correlated with health behaviors including increased compliance with treatment plans, disclosure of important medical information to healthcare providers and reduction of complaints against health institutions, which benefit patient health outcome and positive staff morale (Shelton 2000, Glickman *et al.* 2010 Ortega *et al.* 2013 and Hall *et al.*, 1998).

One of the key concepts underlying patients' involvement is the belief that informed choices will lead to enhanced quality. Patients' voices can provide policy makers, regulatory bodies, hospitals, and consumers with a window onto what is happening at the front lines of care and provide opportunities to set themselves apart.

One of the biggest challenges faced by the healthcare sector is to define and measure the service quality that is universally acceptable (Karekar *et al.*, 2015). Studies stress the importance of patients' views as an essential tool for monitoring and improving service quality and many hospitals are adopting a patient-centered approach (Hendriks *et al.*, 2002). Consequently, a multitude of studies investigating patient satisfaction use a wide range of measurements depending on their patient satisfaction definition (Al Qatari and Haran, 1999). There is evidence that several constructs make up overall quality and satisfaction models (Badri *et al.*, 2008; Amyx *et al.*, 2000; Bredart *et al.*, 2001). Although researchers use healthcare quality and patient satisfaction cross-cultural studies (Badri *et al.*, 2005; 2002; Kersnik, 2000), there is a lack of studies that develop and test comprehensive models for capturing causality between various constructs (Badri *et al.*, 2008), Kassean and Juwaheer (2005).

The contribution of this study is therefore expected to be twofold. First, the author reviews the scientific knowledge on service quality (SQ) in general and the theories underpinning SQ in the health care sector from an emerging economy that is of relevance to our understanding of what patient-centeredness may mean if we focus on the independent variables, i.e. elements of SERVQUAL. He then follows this with a review the literature on other theories that are equally fundamental to the healthcare sector but have not been incorporated into a comprehensive model with for example, Patients' Engagement, Pain Management and Control and Patients' experience. Appropriate hypotheses will be formulated and tested and the model 'fit' using structural equation modeling (SEM). These would constitute an original contribution to literature and to practice in terms of a comprehensive model.

Methodology

This study adopts a quantitative approach with cross-sectional design as a survey method, combining cluster and convenience sampling and SEM to validate the research model and test the hypotheses.

**Networking and Internationalisation of SMEs in Small Island Developing States (SIDS):
The Mauritian Case**

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Abstract:

1. Research Background

Globalisation, fuelled by the sustained improvement in Information and Communication Technology (ICT), transport and the decreasing trade barriers, offers international opportunities to firms irrespective of their sizes.

SMEs play a vital role in driving the socio-economic development of a country by creating direct and indirect jobs, contributing to the economic growth and reducing poverty level.

The importance of network in supporting and enhancing the internationalization process of Small to Medium Enterprises (SMEs) has been widely discussed in the literature (Coviello & Munro, 1997 and Wincent, 2005). Ellis (2000) and Andersen and Buvik (2002) argue that networking can be a potential source for gaining knowledge or learning about international opportunities, and can thus facilitate and accelerate the SMEs' internationalisation process. In a similar vein, Senik and Entekin (2011) note that networking is an important source of SMEs business expansion in developed and developing economies.

Despite the increasing important roles of SMEs for SIDS economies which are faced with serious economic and environment challenges, research linking the SMEs' internationalisation and networking is inexistent. Therefore, this study aims at bridging this gap in literature by analysing the roles of government institutions, business associates and personal relations for SMEs internationalisation in SIDS economies.

2. Research Questions and Objectives

Research Questions:

- What are the roles of networking of SMEs internationalization in SIDS?
- What are the sources of networking of SMEs internationalization in SIDS?

Research Objectives:

- To identify the sources of networking that assist SMEs to internationalize.
- To evaluate the roles/functions of networking that assist SMEs to internationalize.

3. Proposed Methodology

Type of project: Exploratory Research

Research Approach: Mixed Approach (Qualitative and Quantitative)

Data Collection:

Qualitative Research: Semi Structured Interviews will be conducted with key informants and experts who are directly and indirectly in the development and internationalisation of SMEs. These include policy makers, government agencies (for example SMEDA, and BOI) and The Mauritius Chamber of Commerce amongst others.

Quantitative Research: Survey (using questionnaire method)

Sample: A representative sample of SMEs servicing international markets.

Data Analysis: The questionnaire will be processed and analysed with the statistical software SPSS using descriptive and inferential analysis. Content analysis will be used to analyse data from the qualitative research. The following hypotheses are being proposed for this study:

1. Network with Government institutions influence the scope of SMEs' internationalisation
2. Personal network have an impact on SMEs' internationalisation.
3. Network with business associates influences SMEs' internationalisation.

4. Significance of this Study

Being the first study to explore the role of networking for SMEs' internationalisation in a SIDS context, this study will attempt to contribute empirically to the ongoing research in the field of International Entrepreneurship (IE). Also, the outcomes of this research will assist:

1. Policymakers in assessing the effectiveness of existing institutional support mechanisms, and
2. Entrepreneurs in enhancing their business internationalisation.

Keywords: International Entrepreneurship, Networking, SMEs, SIDS Economies

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**Perceived Benefits of Consumers' Online Purchase Influence in Adopting e-Tourism:
The Case of Mauritius**

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Abstract:

Background

Information and Communication Technologies (ICT) have rapidly expanded over the years affecting the way businesses operate and compete (Porter, 2001). The Tourism and hospitality industry has also jumped the bandwagon by implementing ICT in sales and marketing as well as various other operations. Tourism consumers have followed suit, with easy access to the internet, by considerably changing their conventional buying behavior for tourism hospitality services and products increasingly available online. The internet and emerging technologies have provided unparalleled tools for communication and virtual interaction, bridging the gap between tourism suppliers and consumers globally (Kiprutto, & al, 2011). The unique characteristics of tourism hospitality products and services are such that they are well adapted for online selling or E-Tourism (Jolly and Dimanche, 2009). eTourism happens when traditional travel agents, tour operators, national tourist offices, airlines, car rental agencies, hotels and other accommodation providers offer their services online enabling tourists to schedule their trip with various services online (Scottish parliament, 2002).

Even though etourism is very well established worldwide, there is a need to further understand the behaviours of e-tourists to improve on existing e-tourism services (Morand and Mollard, 2008). In other words understanding the dynamics behind consumers' decisions to adopt etourism to meet their ever changing needs is imperative in the context of developing countries. Several studies examining online tourism purchase behavior exist in the context of developed countries (Beldona, Morrison, and O'Leary 2005) but very few in the context of developing countries. One of the few studies (Nunkoo and Ramkissoon, 2013), tested a model predicting travelers' intent to purchase tourism products and services online suggesting that travelers' perceived usefulness, trust, and perceived risks are determinants of attitude to e-purchasing, which in turn significantly influences e-purchase intent. This study will focus on the influence of perceived benefits of online tourism purchase of products and services in adopting E-tourism.

Rationale of Study:

The increasing importance of etourism as a significant contributor to marketing and distribution influences the growth and development of the tourism industry in developed countries. Consumers have become very powerful, sophisticated, experienced and in determining elements of tourists products and services due to internet, thus challenging tourism and hospitality organizations to satisfy them (Crnojivac & al, 2010). Therefore, an

understanding of consumer behavior for etourism is needed given the increase of online bookings and promotion of Mauritius during the past few years.

Research Objectives

- To profile the demographic and behavioral characteristics of tourists purchasing online tourism products and services
- To identify the perceived benefits of online purchase of tourism products and services
- To evaluate the influence of the above perceived benefits in adopting etourism.
- Provide recommendations to tourism suppliers on the factors affecting the adoption of etourism

Proposed Methodology

A study sample will be calculated representative of international tourists visiting Mauritius.

Preliminary qualitative research will be conducted to find out whether factors that will be identified in literature actually influence adoption of etourism and to find out any other influences in the Mauritian context to build the conceptual framework.

Quantitative research through a face-to-face survey method will be then conducted including information gathered through the preliminary survey and literature review.

Research Design

The questionnaire will be designed based on the objectives of the study mostly using a 5-point likert scale and open-ended questions. The questions will be structured on a number of constructs in the literature such as personal, economic, usefulness, social dimensions of online purchase and demographics.

Factor analysis will be carried out to group the most significant factors in order of importance. Then a multiple regression analysis maybe carried to determine the most influential factors in adopting etourism.

Significance of proposed study:

The tourism industry is an information dependent economic activity and internet as an innovative tool is providing it with a dynamic platform for information supply and exchange (Bajpai& Lee, 2015). However, the perception of consumers' perceived benefits of using online information provided on the websites is very crucial in determining their behavior in adopting e-tourism services. Therefore, this study will provide insights to tourism and hospitality organisations in making etourism more consumer oriented in the context of Mauritius in the future.

Keywords: Etourism, consumer behaviour, perceived benefits of online tourism purchase

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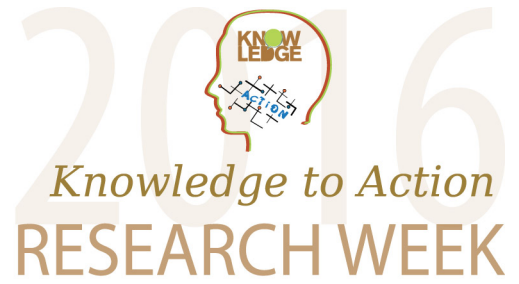
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ORAL PRESENTATIONS

The biology of *Platorchestia* sp. (Crustacea, Amphipoda) at Poste La Fayette, Mauritius.

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Abstract:

Amphipods (Phylum Crustacea, Class Malacostraca) are widely distributed worldwide due to their vast diversity. Members of the Superfamily Talitroidea include amphipods with body lengths varying from 3 to 30 mm and are often extensively spread in the tropical and subtropical areas. Family Talitridae found in the superfamily are mostly semi-terrestrial and terrestrial. The beach hopper, *Platorchestia* was collected from October 2015 to February 2016 from Poste La Fayette public beach found in the north eastern coast of Mauritius. *Platorchestia* sp was studied since very little is known about their biology in the tropics. Poste La Fayette was chosen because a previous study reported the occurrence of the species there. These talitrids do not possess a carapace and thus they are susceptible to dehydration when exposed to high temperatures. They are sexually dimorphic and hence males and females are distinguished from each other by the large gnathopod 2 in males. The collection of *Platorchestia* was done by digging holes of up to 5 cm deep into the sand by using shovels and buckets and by searching through beach wrack made of *Sargassum*, the substrate which the amphipod inhabits. A sufficient amount of substrate was collected to ensure that above 50 *Platorchestia* individuals were present. The collections were sorted in the laboratory under the microscope into different categories (male, female and juvenile) using morphological analysis and stored into different vials filled with 10% formalin to avoid body degradation. Population count was done from October 2015 to February 2016 by counting the number of individuals present in each month. The body lengths of male, female and juvenile individuals were recorded to the nearest 0.1 mm by the use of a calibrated eye piece graticule under a stereomicroscope. Female *Platorchestia* sp. were separated into incubating females (females with eggs in the brood pouch) and non-incubating ones. The mean body lengths were calculated and one-way ANOVA was used to test for difference in size classes. Reproductive status, fecundity were recorded on a monthly basis and sex ratio was computed. Throughout the study period, the population count decreased significantly from November 2015 to February 2016 as the temperature at Poste La Fayette increased from 32° to 38° C. November was the month with the highest population count while February was the least one. The maximum size, 6 mm reached by a male individual and the largest female, 7 mm were both recorded in November. The highest and lowest frequency of these talitrids had body size ranging from 3-4 mm and 6-7 mm respectively. Juveniles had body sizes ranging from 1-2 mm. The sex ratio calculated from October 2015 to February 2016 was strongly female biased as females considerably exceeded the number of males. Incubating females declined during the hot months of study and most had body lengths ranging from 2.1-5.1 mm. It was also observed that female *Platorchestia* sp. with greater body lengths were able to produce more eggs. The difference in the numbers of *Platorchestia* sp. with time might be the outcome of the adults migrating, changing habitat structure and conditions or dying due to unfavorable conditions. Talitrid populations at high ambient temperatures are known to develop quicker, mature more rapidly, and achieve smaller final body sizes than others which develop at lower temperatures. Females collected had eggs present in their brood pouches throughout the collection period thus showing a life history strategy of Type I whereby production of offsprings occur continuously and thus described as multivoltine species. The

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geographic location of Mauritius, high ambient temperatures of the warm months contributed in the increase rate of the moulting process leading to the *Platorchestia sp.* to mature at small body sizes thus describing these amphipods as r-strategists. This study adds to the knowledge on the biology of the species. Such type of information is important to understand the survival of *Platorchestia* in the future and their interaction with the changing environment.

Keywords: Population count, size class variation, sex ratio, female reproductive states and fecundity.

Primary Productivity and Nitrogen Fixation of Benthic Cyanobacteria on a Coral Reef around the Southwestern Indian Ocean Island, Mauritius

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Abstract:

Coral reefs are known as the underwater rainforests with a high diversity of marine organisms, performing various ecological functions important for their survival and resilience in the wake of a globally changing marine environment. However, the role of benthic microbes, especially cyanobacteria within a coral reef system has yet to be thoroughly investigated around Mauritius, a volcanic island in the southwestern Indian Ocean. The aim of this study was to determine the role of heterotrophic bacteria, pico-cyanobacteria, benthic cyanobacteria and other microbes in the cycling and re-mineralization of organic matters, and the production and consumption of nutrients as well as the role of nitrogen fixation as a source of new production in coral reefs of Albion, Mauritius. The temporal and spatial distributions of fundamental chemical and biological parameters in coral reefs at Albion were also investigated. On 19 March of 2008 two transects, starting from the beach towards the reef crest, were established. Along these transects, depth and type of substrate were recorded. Samples for determination of bacteria, cyanobacteria, auto and hetero-nanoflagellates, plankton abundances, pH, alkalinity, nutrients, particulate and dissolved organic carbon (DOC), were taken at three different locations along these transects. A fix station located between both transects was chosen, and depth, light, current and temperature sensors were set up. At the fixed station, the water current recorded between 15:00 and 17:00hrs on 19 March 2008 showed an average velocity of $1.3 \pm 0.3 \text{ cms}^{-1}$ with a direction South West ($220^\circ \pm 24$). Average light and temperature were $980 \pm 420 \mu\text{molm}^{-2}\text{s}^{-1}$ and $28.3 \pm 1^\circ\text{C}$, respectively. Zonation was observed along transect 1 (T1, northern transect) and transect 2 (T2, southern transect). A general trend was seen for the different types of substrate along transects. Starting from the beach seagrass bed was observed, followed by an area of sand and gravel with some cyanobacteria mats and small patches of seagrass. Small colonies of *Porites* spp. alternated with gravel and/or small patch of seagrass. At 150 m from the beach, seagrass bed was absent and corals became dominant. The coral coverage increased rapidly near the reef crest. Towards the reef crest, big colonies of *Porites* spp. micro-atolls types, small *Acropora* spp. colonies were observed. *Porites*, *Acropora* and *Monitpora* were dominant. T1 had significantly higher abundance of cyanobacteria. Other microorganisms did not show any significant differences in abundance between transects. Higher abundances in cyanobacteria were in agreement with the observation of high coverage in cyanobacteria mat at T1. Moreover it appeared that heavy grazing occurred between T1 and T2 due to water flow, thus the current seems to bring the water from the north to the south of the lagoon. Alkalinity ($2200.0 \pm 181.0 \mu\text{molL}^{-1}$), pH (8.2-8.3) and salinity (34.5 ppt) were similar to values on normal reefs and did not differ between transects during our short observation period (2 h). Total nitrogen was less than $0.3 \mu\text{M}$, PO_4 was very low and Si showed usual levels in coral reefs. The particulate organic matter (POC) ranged from 37.6 to $50.6 \mu\text{gL}^{-1}$ and pico-cyanobacteria and bacteria contribution ranged from 1 to 10%, with the highest at T1. In

March 2010 we performed *in situ* incubations at different substrata of the benthos at T1 and T2: sand, coral rubbles and cyanobacterial mats. Also we incubated seawater and compared their primary production and N₂ fixation rates. Among the three studied substrata the maximum primary production rates were found in the cyanobacterial mats, being one order of magnitude and two orders of magnitude higher than those of coral rubbles and seawater, respectively. N₂ fixation rates were also up to 2 orders of magnitude higher for the cyanobacteria than other substrata types. N₂ fixation rates in the seawater was near negligible when compared to those of cyanobacterial mats but may be important considering the vast area covered with reef waters in comparison with small areas covered by cyanobacteria mats. In April 2011 we performed a detailed transect survey from near shore towards the reef crest of Albion covering 260 m. High concentration of DOC was found at the seagrass bed after 12 and 24 h. This study showed that benthic substrata covered by cyanobacteria mats and coral rubbles at Albion constituted an important source of new nitrogen production based on allothonous nitrogen rather than recycled nitrogen.

Keywords: Coral reefs, cyanobacteria, picoplankton, primary production, nitrogen fixation

Thermally-tolerant massive *Porites* spp. under other stressors in Mauritian lagoons

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Abstract:

Climate change-induced ocean warming has been a major cause of mass coral bleaching and mortality worldwide. Scleractinian corals exhibit differential bleaching tolerance with massive coral *Porites* being one of the thermally most tolerant species. Coral reefs of Mauritius are not spared from global warming-linked mass coral bleaching and mortality events with different corals possessing variable bleaching tolerance. However, Mauritius Island witnessing a fast coastal development during the past decades has its coral reefs exposed to multiple potential anthropogenic stressors and pressures. However, the anthropogenic impacts on thermally tolerant coral species to bleaching are still to be thoroughly investigated. This study aimed at comparing status of the thermally tolerate *Porites* spp. at two sites namely Albion (AL) and Flic-en-Flac (FEF) around Mauritius, with varying environmental conditions, which were characterized using temperature and light data loggers set out for the months of October-November 2012 and quantifying nitrate and phosphate levels in October 2012. The status of the *Porites* spp. at AL and FEF were assessed by density of live and dead colonies. The conditions of and the prevailing stressors on the colonies were determined as follows: 1) Predation level using percentage colonies with *Drupella* sp. and fish bites; 2) percentage colonies invaded by the coral-killing sponge *Terpios hoshinota*; 3) percentage colonies exhibiting stress-related immune response of corals as pink pigmentation responses (PPR); 4) percentage colonies with unusual localized bleaching conditions (ULBC); and 5) *in hospite* symbiont photo-physiological parameters such as effective quantum yield at photosystem II (Φ_{PSII}), maximum relative electron transport rate ($rETR_m$) and maximum non-photochemical quenching (NPQ_m , a measure of dissipation of heat in a non-harmful way at PSII). Belt transects ($50 \times 10 \text{m}^2$) ($n=4$) used to quantify the density and percentage colonies for respectively assessed parameters.

Density of live thermally-induced bleaching tolerant *Porites* spp. colonies was ~1.5-fold higher at AL (53.3 ± 4.6 colonies per 500m^2) than at FEF (35.0 ± 5.3 colonies per 500m^2), while density of dead colonies followed the reverse trend, i.e ~3.9-fold higher at FEF (8.8 ± 2.2 colonies per 500m^2). Temperature ($23.5\text{-}28.2^\circ\text{C}$) and light ($0.0\text{-}3350.8 \mu\text{mol quanta m}^{-2}\text{s}^{-1}$) during the month of October 2012 tended to be more fluctuating and higher at FEF than AL. Seawater nitrate and phosphate levels were ~12.8- and 2.9-folds, respectively, higher at FEF ($6.7 \pm 0.5 \mu\text{M}$) than at AL ($0.5 \pm 0.2 \mu\text{M}$). Percentage colonies predated by *Drupella* sp. and damaged through fish bites were ~8.9- and 1.9-folds, respectively, higher at FEF ($16.9 \pm 5.0\%$ for *Drupella* and $70.8 \pm 8.8\%$ for fish bites) than at AL ($1.9 \pm 1.6\%$ for *Drupella* and $36.7 \pm 1.8\%$ for fish bites). While at FEF $16.9 \pm 4.8\%$ of the *Porites* spp. colonies were invaded by the boring sponge *T. hoshinota* at AL none was observed. Approximately ~11.9-fold higher percentage colonies showed PPR at FEF ($43.4 \pm 4.9\%$) compared to AL ($3.6 \pm 2.7\%$). Percentage colonies with ULBC were ~27.5-fold higher at FEF ($13.7 \pm 3.4\%$) than at AL ($0.5 \pm 1.0\%$). Using a Diving Pulse-Amplitude-Modulated fluorometer the photo-physiological parameters Φ_{PSII} , $rETR_m$, and NPQ_m were determined ($n=5$) for healthy *Porites*

spp. at FEF and AL, and coral adjacent to and on the fish bites, PPR, *T. hoshinota* invasion and ULBC at FEF. The Φ_{PSII} in healthy colonies at FEF and AL was normal. However, it was significantly reduced for fish bites and PPR while in ULBC it declined both at the adjacent and directly on affected tissue. *T. hoshinota* had higher $rETR_m$ than healthy *Porites* spp. which had similar $rETR_m$ as at positions adjacent to fish bites and *T. hoshinota* invasion. $rETR_m$ was lower than normal *Porites* spp. values at other measured spots. Heat dissipation at PSII (NPQ_m) was higher at spots on and adjacent to PPR and ULBC compared to the rest which was normal.

These findings are indicative of the thermally-tolerant massive *Porites* spp. colonies facing other stressors at FEF compared to those at AL. Parameters such as predation (*Drupella* and fish bites), pink pigmentation responses, *T. hoshinota* invasion, unusual localized bleaching conditions, and photo-physiological performance of *in hospite* symbionts comprise different possible ways of how *Porites* spp. could have been stressed at FEF. These stressors might partly explain the lower and higher densities of live and dead colonies, respectively, of *Porites* spp. at FEF and might have coral management and conservation implications.

Keywords: fish bites, pink pigmentation responses, *Porites*, sponge invasion, unusual localized bleaching

Application of Geophysics to Map Seawater Intrusion in Basaltic Formations

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Abstract:

As a small island developing state, Mauritius is highly vulnerable to the threat of climate change and water scarcity is a highly debated issue on the island. All important aquifers of the island are in hydraulic contact with the sea and are under the influence of seawater intrusion. This phenomenon is expected to intensify with the adverse impacts of climate change and is consequently a serious threat to the local aquifers as approximately 50% of the island freshwater supply is obtained from groundwater resources. Also, as a means to combat water scarcity, the Government has recognised that inland desalination of brackish water should become an integral resource for the local freshwater supply system – more specifically to the tourism industry in the coastal regions. Therefore, with the aim of providing valuable information on the status of seawater intrusion in the basaltic aquifers of Mauritius for the two aforementioned issues, electrical resistivity soundings were carried out at five sites using the Schlumberger array, with current electrode spacing varying between 4 to 200 m. The sites chosen were Flic en Flac, Pointe aux Sables, Grand Bay, Poste Lafayette and Gris Gris. These sites were chosen based on different geological set up and hydraulic gradient so as to understand the effect of these physical parameters on the status of seawater intrusion. The resistivity measurements were conducted at a single location at each studied site and the observed field datasets were analysed using the Inverse Slope method to produce a 1D geoelectrical log of the underlying subsurface, with distinct geoelectrical layers. The logs illustrate the thickness and true resistivity of each layer constituting the subsurface. Correlative studies were also made to establish the relationship between the geoelectrical layers with the resistivity ranges of local geological materials and the results were compared with available borehole information, wherever possible. In general, the presence of five distinct resistivity zones was delineated in the coastal terrains viz.: top soil, freshwater zone, saline zone, saturated clay and impermeable bedrock. The saline zone was indicated by true resistivity values ranging from 1.7 to 16.1 Ωm and was detected at depth ranging from 4.0 to 33.3m below ground level. The results confirm the heterogeneity of the coastal zones, whereby seawater intrusion is found to vary from one place to another, depending on the structural geology, hydraulic gradient plus on the effect of nearby pumping activities. Interpretation of the field data also led to deduce that the main aquifers of the island are under unconfined, confined or semi-confined conditions, depending on the regional geology of the aquifer under consideration. The results also validate that resistivity sounding can be used as a non-invasive technique to map areas invaded by seawater intrusion for climate change studies and to guide in the positioning of an intake borehole that will be used to abstract brackish water. Eventually, the findings of the study show that hydrogeophysical information can influence decisions to support and amend existing PPG on desalination for Mauritius – as currently there are no scientifically set guidelines to ensure minimum impacts of brackish water exploitation on aquifer salinisation.

Keywords: Basaltic formations; brackish water development; salinity mapping; Schlumberger resistivity soundings

Recent acceleration of Sea level rise in Mauritius and Rodrigues

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Abstract:

One of the direct consequences of Climate Change is Sea level Rise (SLR). This poses one of the most widely recognized climate change threats, particularly to small islands such as Mauritius and Rodrigues.

Some studies (e.g. Church and others, 2011; Palanisamy and others, 2014) found that SLR from 1950 to 2001 period was 1.5 and 1.3 mm yr⁻¹ at Port Louis (Mauritius) and Rodrigues Islands. However, in recent years, at global level, an accelerated SLR has been observed.

The main objectives of the study are to update the SLR study conducted in 2006 (Ragoonaden, 2006); investigate whether an accelerated SLR is also occurring over the Mascarenes Islands as observed globally; determine any linkage between ASLR and enhanced coastal erosion; and propose policy options to address the issue.

Two floating type sea level stations were established in Port Louis at the Fishing Port and Rodrigues at Port Mathurin Seaport in 1986. Continuous monitoring was originally recorded on a recording sheet, which was changed every week for computation at Meteorological Service. This has been updated and sea level instantaneous record is now transmitted in real time to University of Hawaii every 15 minutes.

Monthly Research Quality Assured SLR Data from August 1986 to December 2012 for the two stations was retrieved from the Hawaii Sea Level Centre. Fast mode SLR data up to date is also available but has been used as they are not yet quality controlled. Statistics analysis was carried out and the monthly average values were plotted and lines of best-fit regression and 5-month moving average were then superimposed on the plots.

In a 2006 study (Ragoonaden, 2006), it was concluded that a slight fall from 1986 to 2003 could be occurring at Mauritius and Rodrigues. This was also demonstrated from Sea level trend from altimetry data of 1993 – 2003. However, the present study shows that the SLR has been accelerating since the beginning of this century at both Mauritius and Rodrigues at a rate of 5.6 mm yr⁻¹. An updated published map of Sea level variation from altimetry data over the Mascarenes region indicates a similar trend (NOAA, 2016).

The timing of the global acceleration corresponds to similar sea level trend changes associated with upper ocean heat content and ice melt. Most of this heat is absorbed by the ocean through large depth. Evidence of sub surface ocean temperature increase has been obtained recently by the Argo fleet which is scattered across the globe measuring temperature down to 2,000 meters. Satellite Observations also show accelerated ice melt from changes in glaciers (0.76 mm yr⁻¹), Greenland ice sheet (0.33 mm yr⁻¹), Antarctic ice sheet (0.27 mm yr⁻¹), and land water storage (0.38 mm yr⁻¹).

Most recent findings warned that if fossil fuel emissions continue on a business-as-usual course, rapid large SLR may begin sooner than generally assumed and there is near certainty of eventual SLR of at least of 5–9 m with numerous severely disruptive consequences for human society and ecosystems (e.g. Hassen and others, 2015). This would highly be dangerous particularly for small island States, threatening vital coastal ecosystems and resources.

This recent trend deserves focused attention. It has been shown, in theory and from records, that there is a definite link between SLR and coastal erosion ((Lee, 2015; Romine and others, 2013). Consequently, in Mauritius and Rodrigues more precautionary and proactive measures should be taken to protect coastal infrastructure and resources to sustain the goods and services of coastal ecosystems. Otherwise, the consequences could be far reaching.

Some policy options and measures include: (i) Precautionary and proactive measures such as to consider SLR of 1 m in planning of appropriate projects, increase set back distance from the current 30 m; a continuous, harmonized and regular monitoring of vulnerable beaches to obtain long term series of data to quantify beach erosion for informed decision (ii) Downscaling of Global Sea level Models for SLR projection for SIDS application and (iii) Data archival and open accessibility for research purposes.

Keywords: Sea level Rise, Mauritius, Rodrigues

Density and Diversity of Marine Molluscs at a Sheltered and an Exposed Mauritian Coast

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Abstract:

Marine molluscs are highly successful invertebrates occupying a major part of nearly all habitats around the world. The oceanic waters of Mauritius harbour various species of marine molluscs; however, very few studies have indicated changes in their distribution over the years. These organisms have been overexploited from the shores of Mauritius mainly for their flesh as a source of protein along the coastal zones and as bait for artisanal and recreational fishing. More importantly, marine molluscs have been excessively removed from Mauritian waters for their attractive shells, which are used as jewellery and other decorative items. With other stressors in action such as, climate change-induced ocean acidification, a decline in marine molluscan diversity and density over the years in our coastal waters may be predicted. In addition to this, it has also been reported that with strong waves prevailing, marine molluscs such as gastropods cannot remain attached to the substrate and their growth rates are adversely affected. It is worth noting that with sea-level rise linked to climate change, many coasts around the world will be faced with higher wave actions leading to potential coastal erosion. Mauritius, as a small island, is not spared from such impacts.

It is recognized that there is an alarming lack of reliable and validated baseline information on the distribution of marine molluscs as they have not been thoroughly investigated in varying hydrodynamic conditions in the coastal waters of Mauritius, despite of their wide distributions. This work aimed at comparing the spatial variation in the density and diversity of marine molluscs along the intertidal zone of a sheltered (relatively low wave activity) and an exposed (relatively strong wave activity) coastal sites in the end of summer (May) 2016. Belle Mare (BM), located on the east coast and Gris Gris (GG), located on the south coast of Mauritius were chosen as sheltered and exposed intertidal zones, respectively. Both intertidal zones are characterised by stretches of sandy and rocky substrata along the shoreline. Random quadrat method was employed to determine the density and diversity of marine mollusc species. 10 randomly set transects were surveyed at each site. Each transect was divided into 3 zones namely the supra-littoral (normally not completely submerged), eulittoral (intermittently submerged) and sub-littoral (submerged), and each zone was surveyed using a 1 m x 1 m quadrat (n=30). The number of individuals for each marine mollusc species encountered was quantified within the quadrat and the density was expressed as mean \pm standard error. The Shannon-Wiener Index (H) was used to assess the diversity of intertidal marine molluscs at both sites. Water samples were collected for physico-chemical analyses and sediment samples for grain size analysis.

This study revealed a contrasting diversity and density of marine molluscs at the two study sites. BM harboured a higher molluscan diversity as compared to GG with 16 species of intertidal marine molluscs (12 species on rocky substratum and 4 on sandy substratum) recorded at BM and 7 species (6 species on rocky substratum and 1 on sandy substratum) at

GG. BM was dominated by the marine snail *Planaxis sulcatus* (514.42 ± 221.63 individuals per m^2), exclusively found on rocky substratum at the surveyed transects. On the sandy stretch of BM, species such as *Cypraea annulus* (8.50 ± 5.36 individuals per m^2), *Canarium mutabile* (1.28 ± 1.22 individuals per m^2) and *Pinna muricata* (0.33 ± 0.24 individuals per m^2) were commonly spotted. GG harboured a lower density of marine molluscs. The gastropod *Turbo setosus* (1.20 ± 0.20 individuals per m^2) was found in highest density on rocky substratum. The only live species found on the sandy substratum was *Conus corronatus* (0.08 ± 0.80 individuals per m^2). Sediment grain size analysis revealed that the sediment at GG is coarser than that at BM. This is indicative of a relatively harsher wave condition prevalent at GG compared to BM. This study clearly indicated that GG has a poor marine molluscan diversity as compared to BM. Rich molluscan diversity at BM possibly signifies suitable physical conditions for the growth and survival of molluscs.

Keywords: marine molluscs, density, diversity, intertidal zone, Mauritius

Effect of Environmental Stress on Hard Corals of Mauritius and its Photo-physiology: Field- and Laboratory-based Perspectives.

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Abstract:

Coral bleaching and subsequent mortality is becoming more frequent and intense worldwide. The island of Mauritius is surrounded by 150 km of fringing reefs except with breaks on the southern and western coasts. Coral reefs of Mauritius narrowly escaped the widespread mass coral bleaching/ mortality phenomenon in 1998. However, recent records of coral bleaching and mortality have increased mostly due to climate-induced thermal stress and other anthropogenic pressures. This study aimed to assess the effects of environmental stressors – both thermal and chemical - on the photo-physiology, mortality and recovery of selected reef-building corals of Mauritius. This was done by means of field observations/ surveys and laboratory investigations using coral tissue balls as a miniaturized model. Field observations were made *in situ* at the lagoon of Belle Mare on the west coast of Mauritius at four permanent transects running from the beach to the coast, each comprising of 3 stations at the nearshore, mid-lagoon and back-reef habitats. Survey was done by snorkeling, skin diving and photo-recording. Chlorophyll *a* fluorescence was measured with a Pulse-Amplitude Modulated (diving PAM) fluorometer. The initial fluorescence (F_o) was measured by applying pulses of weak red light ($< 1 \mu\text{mol quanta m}^{-2} \text{s}^{-1}$) and a saturating pulse ($8000 \mu\text{mol quanta m}^{-2} \text{s}^{-1}$, 0.8-s duration) was applied to determine the maximal fluorescence (F_m). The ratio of the change in fluorescence ($F_v = F_m - F_o$) caused by the saturating pulse to the maximal fluorescence (F_m) in a dark-adapted sample, has been shown to be a good measure of the maximum quantum yield of Photosystem II (PSII) functioning in zooxanthellae symbiont of corals. Field observations made during a bleaching event in 2009 indicated that the tabular corals *Acropora cytherea* and *Acropora hyacinthus* were most susceptible to thermal stress compared to *Pocillopora eydouxi* and *Fungia sp.*, which were among the most robust. There were variable responses among the eight studied coral species and the order of susceptibility/ mortality was as follows: tabular *Acropora* > branching *Acropora* > massive-like corals / solitary corals. In susceptible corals (tabular and branching *Acropora*), zooxanthellae had the lowest F_v/F_m (< 0.3) indicating damage to their photosynthetic machinery. In a comparison between the pre-bleaching and post-bleaching physiology of these corals, a pre-disposition or susceptibility of the *Acroporids* to elevated sea surface temperature was noted. Thermal stress experiments on coral tissue balls as miniaturised models under laboratory conditions revealed that higher temperatures (28°C and 31°C), tended to have negative effect on the density of coral tissue balls mostly in *Acropora muricata* as compared to *Pocillopora damicornis*. In the third part of the study on the effect of crude extracts on coral tissue balls, three sponge species namely *Adocia sp.* (AS), *Haliclona sp.* (HS) and *Lissodendoryx sp.* (LS) and the one ascidian species *Didemnum molle* (DM) were selected for study, all of which were collected from the lagoon of Ile D'Ambre, Mauritius. The coral tissue balls provide an excellent experimental miniature system to study the effects of stress. Dissociated coral cell aggregates usually form spherical bodies that rotate by ciliary movement, but can stop rotating and disintegrate when exposed to stress factors. A combination of thermal stress and crude sponge or ascidian extracts had an increased negative effect on the density of coral tissue balls, with ascidian *D. molle* being most harmful to coral tissue balls in *Acropora muricata*,

Fungia repanda, *Pavona cactus* and *Pocillopora damicornis*. High concentrations of AS, HS and LS extracts generally caused increased negative effect by reducing the density of TBs and this affect was more prominent at 30⁰C. AS and HS had least and most effects, respectively. In presence of DM extract, no TBs were formed in tested corals except in controls (with no added extracts), indicating a high toxicity/ interference with TBs formation. The observed differential susceptibility to temperature and/or sponge/ascidian extracts among tested corals reveals physiological damage at the level of the symbiont and/or host cells. The results of this study suggest that there may be possible implications for the ecological and chemical interactions of coral reefs in the wake of a warming ocean.

Keywords: coral tissue balls, Mauritius, PAM, scleractinian, thermal stress

POSTER PRESENTATIONS

An Evaluation of Performance of Business Incubator Initiatives in Mauritius

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Abstract:

Business Incubators (BIs) are perceived to be playing an essential role in inculcating an entrepreneurial culture in many countries. According to Hachett and Ditts (2004), a “*Business Incubator is a shared office space facility that seeks to provide incubates with a strategic value, adding intervention system of monitoring and business assistance*”. To Bruneel et al (2012), Business Incubators (BI’s) typically support new structures in the hope they will latter develop into self-sustaining, thriving companies ensuring that the national resources are used effectively.

A benchmark study of the European-Commission (2002) revealed that survival rate of incubator tenants was significantly higher with 80 to 90% still existing after 5 years as compared to business success rate amongst the wider Small and Medium Enterprise (SME) community with 50 to 60% not surviving the seventh year (Aerts.K et al, 2007).

Considering the great credence for and often large amount of money invested in incubators by government, Universities, research institutions and private bodies, the question of what society gets on these investments has been raised (Bergete and Norman, 2008). The BI actors and direct stakeholders have been identified as being the financial support providers for incubator set-up, the Managers (design and operation of incubator models) and the Entrepreneurs (idea owners). Otherwise, extant literature seems to be lacking in terms of research on BI performance from a developing country perspective.

The first BI initiative (now closed) was started by the then Ministry of Commerce and Industry in 2003 as a specialised IT incubator run by the National Computer Board (NCB) to promote entrepreneurship in the ICT sector. Several initiatives followed in different forms, namely by SMEDA, the NWEC and a few recent private ventures like Eclosia (FAIL) and Vivea Business Park. The present study will take an evaluative approach to identify the reasons for success/failure of local BI initiatives.

Since BI’s have the potential of sustaining new venture birth and preliminary growth, they cost an amount of resources that should normally give return on investment. This research shall probe into the objectives and outcomes of such BI initiatives to identify reasons of success and failure. The findings of the study may then inform decision makers on the frameworks/criteria/models to adopt in order to reduce failure and improve performance of BIs in future.

The objectives were to identify the different BI initiatives and their respective models, to evaluate performance/outcomes based on initial objectives of each initiative, to identify and classify the factors of success and failure and to inform future B.I initiatives on potentially successful BI models.

Since there is a relatively small number of BI initiatives in Mauritius, we propose to conduct a census survey of incubators in Mauritius, namely NCB, SMEDA, NWEC and the private sector incubator Models. Qualitative research methodology is preferred as it gives a deeper understanding and local contextualisation of the study.

We shall use semi-structured face-to-face interviews with key personnel of BIs including BI managers, entrepreneurs and funders. Interviewing multiple informants per BI allows triangulation of data (in addition to secondary data brochures, websites etc.) to ensure validity and/or discover and competing objectives.

Interviews will be structured around a number of dimensions influencing BI performance as informed by the literature. These include selection criteria (of incubate: age/sex/type of business etc.), business support services (financial and non-financial), mediation (internal and external) and exit policy (time limit, turnover, disincentives).

Open-ended questions will provide triggers and probes for deeper insights leading to understanding of reasons of performance/failure. A factor analysis may be carried out to classify dimensions/factors in order of importance and/or to identify 'clusters' of performance/failure determinants.

Given the high rates of failure among new ventures and the impact of such failure on the national economy, incubators carry the promise to enable/ease birth and early growth of SME's. However, the success rate of local BI's is mitigated.

This study will provide insights on the success factors and reasons for failure of BI's in the context of a developing economy, thereby informing stakeholders' decisions on future BI endeavours so as to ensure business growth and sustainability. It will also contribute to the on-going research on BIs and entrepreneurship.

Keywords: Business Incubators, entrepreneurship, business facilitation, business growth performance indicators

Identification of Membrane Progestin Receptor Interacting Compounds from Coastal Seawater

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Abstract:

Progesterone has been identified as a natural progestin in the human body that acts as a key regulate factor in controlling the reproductive tissues. Synthetic progestins have been produced and are frequently used for medical purposes. Progesterone is a well-known steroid that is produced by the ovary depending on the physiological conditions of the ovary and gonadotropin levels. It generates a number of physiological effects in different tissues through various mediating mechanisms in each tissue. Although the physiological effects of progesterone have been known to be mediated by the regulation of gene expression associated with nuclear progesterone receptors, new insight on the activity of progesterone is provided by the identification of membrane progestin receptors (mPRs). Certain nongenomic effects of progestins, such as oocyte maturation, are mediated by mPRs on the plasma membrane and induce rapid intracellular changes. Oocyte maturation-inducing steroids (MISs) are produced in response to luteinizing hormone (LH) in the follicular envelope in fish. This progestin-induced nongenomic activity in oocytes mediated by mPR causes the cells to proceed through meiotic cell cycles. Based on phylogenetic analysis, mPRs can be categorized into a new protein family of G protein-coupled receptors (GPCRs), the PAQR (progestin and adipoQ receptors) family. This family contains three subordinate types termed mPR α , β and γ (corresponding to PAQR7, 8 and 5, respectively). Based on the analysis of proteins expressed in human breast cancer cells, PAQR6 and 9 were also categorized as new subtypes of mPR (mPR δ and ϵ , respectively). The expression of mPR mRNAs has been observed in reproductive tissues (ovary, testis, uterus and placenta) and in non-reproductive tissues (kidney, brain and intestinal tissues) in the human body. The broad distribution of mPRs in different tissues suggests that mPRs perform various functions in a large range of target tissues. Thus mPRs are attractive pharmaceutical targets, and very recently high expression levels of mRNA for mPRs have been reported in ovarian cancer cells and breast cancer cells. Homologues in yeast have been identified as an antifungal protein, osmotin, receptor. Thus mPR homologues in fungus are possible targets for anti-fungal drugs. Additionally, mPRs could serve as a target for endocrine-disrupting chemicals (EDCs). Although the distinct role of mPRs remains under investigation, mPRs could be a target for a novel class of pharmaceuticals and EDCs.

Based on the competitive binding of chemicals and progestins, we can evaluate the relative binding affinity of chemicals on mPR protein. By this method, we screened chemical compounds dissolved in seawater that interact with mPRs. In 2012, when we tested the activity of compounds concentrated in seawater from coral reefs of Albion, we found the activity in steroid binding assay. We sampled three different areas (coast, lagoon and surf) at Albion. Higher binding activity was detected in lagoon and surf area samples. Thus we speculated that natural hormonal compounds were produced in coral reef areas and

accumulated in seawater under special conditions at Albion. We then sampled in winter (end of July to early August) and in summer (March) of 2015. Although a relatively large amount of seawater was filtered, samples collected in winter season showed almost no activity. These results suggest that the target compounds were not detected or in negligible amounts in winter. On the contrary, the samples from the summer season showed relatively higher activity. To identify the chemical that showed the activity, we conducted fractionation by HPLC. Some peaks representing binding activity against mPR were obtained. From the peak area, we can estimate the amount of chemicals. Taken together, these results suggest that relatively large amount of seawater samples is necessary to determine the chemical structure of this compound. Further investigation is warranted to thoroughly determine the activity and chemical structure of the targeted hormonally active compound that interact with mPR.

Keywords: coral seawater, membrane progesterin receptor, natural hormonal compound, progesterone

Application of Geophysics for Groundwater Exploration of the Eastern Aquifer

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Abstract:

Groundwater is an important source of fresh water that needs to be monitored so as to avoid over-exploitation and poor water quality. In Mauritius, groundwater contributes largely in potable water supply. However, aquifer exploitation is reaching saturation with increase in water demand by 6% annually. There are also several other factors affecting groundwater supply such as changes in consumption patterns, a decrease in groundwater recharge due to urbanisation, pollution and climate change. Thus, there is a need to develop an adequate method of groundwater exploration and monitoring.

Previous studies have shown that seawater is present at some 2 to 3km from the East Coast of the island. This can affect the groundwater quality of the Eastern Aquifer. The aim of this research is to conduct a preliminary study in order to identify and implement a non-destructive method of groundwater exploration for the Eastern Aquifer. This involves the use of geophysics. Geophysics has been used in the past in Mauritius, in order to detect underground water. However, its current use is still on a small-scale basis. On the other hand, destructive methods such as drilling are still preferred for large-scale groundwater investigations.

The main objectives of the research were to locate areas where coring have been conducted for the Eastern Aquifer, assess and apply the Electrical Resistivity method for field investigations at these locations and compare data collected for interpretation.

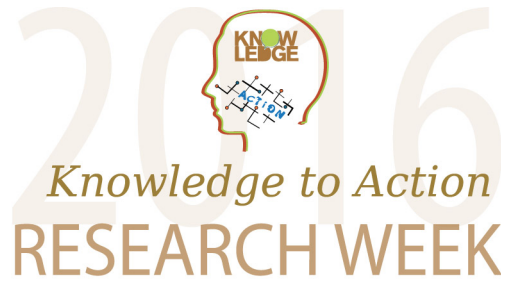
The research involved an in-depth literature review on the different methods of geophysics, past studies conducted in Mauritius involving the use of geophysics and the hydrogeological characteristics of the Eastern Aquifer. This was followed by on-site electrical resistivity investigations in the East and data collection. Three study areas were chosen namely, Constance, Bonne Mère and Clémencia. Data collected through this research was then compared to existing core logs available for these regions, as well as results obtained from past electrical resistivity surveys carried out at locations other than the Eastern Aquifer.

Comparison showed that different subsurface properties will give different ranges of measured resistivity as a result of variances in soil type, permeability and porosity. For example, the study area at Bonne Mère was prone to a vesicular basaltic subsurface and showed successive rise and fall in resistivity values as a result of infiltrated water within permeable rock strata. This indicated a clear difference in the level of resistivity of rock as compared to groundwater. Furthermore, the electrical resistivity method also allows differentiation between freshwater and seawater. Such information allowed the water table level to be estimated for each study areas.

It was concluded that geophysics is meant to be used as a tool in conjunction with other hydrogeological data for better understanding because there are many variables involved. However, the Electrical Resistivity method remains suitable for soil of heterogeneous and volcanic origin as it is the case in Mauritius. It is a cost effective tool that can be used not

only to detect groundwater but also to identify subsurface geological properties, as well as any risks of contamination or seawater intrusion. Further electrical resistivity measurements need to be carried out in the East for more detailed information on the groundwater flow pattern for the region.

Keywords: Aquifer, Electrical Resistivity, Geophysics, Groundwater



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**ORAL
PRESENTATIONS**

Option Valuation with Discrete Dividend Payments

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Abstract:

The valuation of options written on stocks that pay out fixed cash dividends at discrete time points between the purchase date and expiry date of the derivative presents a challenging problem that is yet to be satisfactorily answered in spite of the fact that existing financial literature treats the problem in terms of both analytical and numerical approximations. Empirical studies point towards the occurrence of expected negative jumps of magnitude equal to the dividend size when the stock starts trading ex-dividend. This phenomenon is correctly captured by the piecewise lognormal model, where the stock price evolves as a geometric Brownian motion in between ex-dividend dates, punctuated by finite jumps at each ex-dividend date.

Integral representation formulae have been derived for European and American call options under the piecewise lognormal model but they are analytically intractable. Lattice methods are popularly employed to approximate the unknown analytical solution. However, the discrete nature of the dividend causes the structure of the tree to transform into a non-reconnecting one. At each ex-dividend date, the valuation of the option corresponding to any ex-dividend asset price requires the computation of a distinct sub-tree which fails to recombine with other sub-trees that originate from the same time level. As a result, the total number of nodes in the tree grows exponentially with the number of discrete dividends. From a computational point of view, such methods are extremely inefficient as they entail a tradeoff between accuracy and the timely computation of option prices. These problems worsen when the stock pays out several discrete dividends as the tree fails to recombine multiple times before the option expires. In contrast, available analytical approximations generate fast option prices but their naïve implementation generates inaccurate solutions and their lack of robustness often lead to arbitrage opportunities.

We present a fast, accurate and robust numerical procedure to treat the discrete nature of dividends in option pricing. Non-recombining trees preclude the risk of arbitrage opportunities and generate approximation errors that are independent of the size and timings of dividends but their convergence is slow. In this context, we identify some acceleration techniques to speed up their execution time and convergence speed for European options in the presence of multiple dividends. In particular, we propose the use of range-curtailing techniques to speed up the evaluation of the trees. Significant reductions in execution times provide the convenience of implementing smoothing and extrapolation techniques in view of enhancing the accuracy of the trees.

Numerical examples indicate that this research brings significant contribution to existing literature as the non-recombining trees accelerated with our proposed techniques are capable of generating robust and accurate solutions in a timely manner. The pricing is done in conformity with empirical observations and thus, approximation errors are independent of the size and timings of dividends. In addition, the selected enhancements can be applied to any non-recombining tree due to their independence of parameters. As such, bearing in mind the

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accuracy boost and gains in computational time generated by the selected enhancements, it is seen that this research allows for the efficient use of non-recombining trees for the pricing of European options in the presence of discrete dividends. In a highly competitive industry where the timely valuation of contingent claims is of utmost importance, the content of this research can be used to boost market efficiency by making relevant option information available on time.

Keywords: Discrete Dividends, Non-recombining trees, Range-curtailling

Partial differential equation framework for pricing discretely sampled variance swaps

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Abstract:

Volatility is a measure of risk that is likely to grow when uncertainty increases. Being a key parameter to consider while investing, it is important to grasp the nature of changes in volatility and eventually, to cope with it efficiently. Consequently, volatility derivatives have been introduced in financial markets to help financial investors manage their exposure to volatility risk. Such types of derivatives can also be used to speculate directly on the future levels of volatility. Among all the volatility derivatives products, the variance swap is most popular and has been actively traded on the market due to its possible replication by a portfolio of call and put options. As such, there is a need to correctly price these swaps.

The realized variance is defined in the contract and can take several definitions. It can be continuously sampled as well as discretely sampled. The continuously sampled realized variance has long been used to evaluate variance swaps but it is plagued by the fact that the realized variance is always evaluated on a set of discrete points in practice. Therefore, we consider the discrete case for which we have two definitions for the realized variance; one is based on actual returns while the other one is based on logarithmic returns.

There exist two ways to price these discrete variance swaps, namely the analytical approach and the numerical approach. The literature contains several analytical solutions. However, it has been seen that the analytical methods vary as we alternate the definitions of the discrete realized variance and as we change the pricing model under consideration. Therefore, we opt for a numerical approach that can be easily extended to all types of realized variance and pricing models. Among the numerical techniques that exist, the Monte Carlo simulations approach is seen to provide a universal approach but it is well-known to be computationally costly and to have a low rate of convergence. Therefore, we consider a partial differential equation approach which also provides a unifying framework as pricing equations can be easily derived using Feynman–Kac theorem under any pricing models.

There are two partial differential equation frameworks that can be used to price variance swaps. One consists of introducing two additional spatial variables with one representing the stock price at the previous observation date while the other spatial variable denotes the average squared returns observed to date. Then, the methodology involves solving the partial differential equation while updating these new variables at the observation dates. As for the second method, we need to introduce only one new variable and to index the solution to the partial differential equation on each computational grid node in this new variable's domain.

In this work, we are able to improve the second partial differential equation approach by providing an efficient finite difference algorithm and applying appropriate spatial transformations that lead to super-convergent solutions for both discrete realized variances. In our numerical experiments, we demonstrate the gain in computational efficiency as we compare the solutions from the existing partial differential equation methods.

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Consequently, we have been able to use and enhance our knowledge about finite differences to efficiently price discretely sampled variance swaps under different pricing models. Eventually, these variance swaps can be used as hedging instruments by investors and other potential users like insurance companies.

Keywords: Variance swaps, partial differential equations, finite difference

A single currency for East African Countries (including Mauritius): An SVAR analysis

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Abstract

With Africa rapidly on the rise, African leaders are looking to safeguard a future of sustained growth and economic development. According to the African Business Magazine, a single eastern African currency for the East African community (EAC) appears to be 'en vogue'. Thus, the purpose of this study is to examine whether a single currency is feasible and beneficial for the development of the EACs including Mauritius. A study done by the British Broadcasting Corporation in 1997 shows that prior to the formation of the Euro, a tourist visiting all the countries in the European Union would lose almost half of his money solely in transaction charges. With a single currency, the cost of converting currencies is eliminated. Furthermore, a monetary union increases price transparency, competition, intra-trade between countries and eliminates the uncertainty in the exchange rates. The few disadvantages of the currency union are that member countries lose their independence on their monetary policy and sometimes the transition costs may be high.

Pioneered by the Optimum Currency Area (OCA) theory, it is believed that countries experiencing similar economic shocks are considered as theoretically suitable partners in a currency union. In this study we assume that the economy is affected by two types of shocks; demand shocks and supply shocks. If the EACs are affected by demand shocks and supply shocks in the same manner then it strengthens the claim that a currency union among the EACs can be established. The Structural Vector Autoregression (SVAR) and the Vector Autoregression (VAR) methodology are used to identify and compare demand and supply shocks. Over a time period ranging from 1980 to 2015 of quarterly data, Gross Domestic Product growth (GDP growth) as a measure of the financial health of the country and Consumer Price Index (CPI) as a measure of inflation, are used to extract those shocks.

The theory behind the interpretation of the shocks is that if two countries have a high positive correlation, and if that correlation is significant, then they are said to be symmetric, else they are said to be asymmetric. The results show that most of the shocks were uncorrelated or insignificant. The impulse response function (IRF) is applied and conveys the reaction of inflation/GDP to a positive one unit of demand/supply shocks and if the magnitude of the countries' shocks is small, and the countries have high speed of adjustment, then it is a boon for the currency union. However the results were dissimilar. Most of the economies displayed different reactions. The final verdict does not support the establishment of a potential monetary union among all the EACs (including Mauritius) combined.

The time is not ripe for all the EACs including Mauritius to embark into a single currency. However, if the Government is adamant on implementing a currency union, what appears more possible is the creation of smaller sub-groupings between countries that obtained a high positive correlation coefficient and experienced similar response over time. Countries like Tanzania and Kenya or Mauritius and Uganda can create a monetary union partnership between them. This can be a start to analyse how the single currency work out and to eventually accommodate for the less enthusiastic economies of the region. The sine qua non

piece in the formation of any currency union is political will, an argument which has been proclaimed by (Feldstein, 1998) as one of the main incentive for the European monetary union. The good news is that this political will is of growing interest across the East African countries.

Keywords: East African Community, Optimum Currency Area, Single Currency.

Modeling and Forecasting of Exchange Rates using ARIMA, ANN and ANFIS

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Abstract:

The foreign exchange market is one of the most traded markets in the world, thus discriminating the importance of forecasting foreign exchange rates. However, this is a milestone yet to be achieved in the financial world and the search for an accurate forecasting model is still ongoing. The aim of this paper is to contribute to this search by modeling and forecasting the Mauritian rupee (MUR) against Euro (EUR), British Pound (GBP) and the US Dollar (USD) using exchange rate data ranging from 16 April 2002 to 26 October 2015 totaling to 3530 observations. To meet the objectives, three different forecasting models are studied: ARIMA, ANN and ANFIS. The data used to build these models is partitioned into training and validation sets in the ratio 70-30%. The first model considered is the linear ARIMA (p, d, q) model which is implemented for the three currency data sets with the corresponding parameters. The integrated parameter (d) required to make the data stationary is determined using ADF test, while the autoregressive parameters p and q needed to correct any autocorrelation remaining in the differenced series are found using the least AIC-BIC criteria. The next forecasting model considered is the non-linear ANN model which is structured using a multilayer perceptron with a feed-forward network of 1 hidden layer and 5 neurons. The default tan-sigmoid is used as transfer function in the hidden layer, while the linear function is used in output layer. Input selection for this network includes 5 lagged exchange rates values and two macroeconomic variables. The external inputs used for the implementation are the international prices of one troy of gold and 1 barrel of oil in USD. The network is then trained using Levenberg-Marquardt Backpropagation as training algorithm to produce appropriate outputs. The third model explored is a hybrid of the ANN model with Fuzzy Inference System (FIS). The resulting non-linear ANFIS model makes inferences from inputs and based on sets of rules, the output is determined. In particular, our network is designed using 3 lagged exchange rate observations with gold and oil prices as inputs. The membership function used is the default 'gbellmf'. To train the network, an initial single-output Sugeno type FIS is created using grid partitioning. The system is optimized with minimization of the error function by adaptation of the antecedent and consequent parameters of the IF-THEN rules. The network is then trained using a hybrid of least squares and back propagation descent algorithms to determine the membership parameters of the single output Sugeno type FIS. These parameters are then used to model given inputs so as to forecast an output. The out-sample forecasts obtained from the three models are finally analysed to conclude the adequacy of each forecasting model. The performance of the three models is compared using the RMSE performance metric. The results conclude that the non-linear models ANN and ANFIS perform better than the linear ARIMA model because of the latter's inability to deal with the non-linearity present in the exchange rate data. Eventually, the superiority of the ANFIS model to forecast the Mauritian exchange rates under study among the two non-linear models is justified by a smaller RMSE value. These findings will add to the plethora of models that market forecasters adhere to help forecast exchange rates.

Keywords: Exchange Rates, ARIMA, ANN, ANFIS, RMSE

Assessing the feasibility of SADC currency union

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Abstract:

Interest in regional currency unions in Africa received a boost with the West Africa and Central Africa adopting the single currency: West African CFA franc and Central African CFA franc respectively. Following in the step of the aforementioned regional blocs, the Southern African Development Community (SADC) has on its agenda the adoption of a single currency by 2018. This study assesses the feasibility of SADC currency union by checking whether SADC is a feasible optimum currency area (OCA) which serves as pre-requirement for adoption of a single currency. We make use of the economic convergence criterion which stipulates that to form an OCA, the member states must have convergent economies.

To empirically check for economic convergence the nature of shocks affecting the countries' economies is examined whereby symmetric shocks indicated by positively and statistically significant correlated shocks relate to convergent economies. The study does not content itself with only the analysis of correlation of shocks but a structural analysis, notably the impulse response and forecast error variance decomposition is also carried out for better evaluating the resonance of the shocks to the variables. A bivariate Structural Vector Autoregression (SVAR) model premised on the Aggregate Demand-Aggregate Supply (AD-AS) framework, is employed to recover the supply and demand shocks affecting the two macroeconomic variables, gross domestic product (GDP) growth rate and average inflation rate used to measure changes in output and prices respectively. The SVAR long-run parameters are estimated using the AD-AS framework which provides the restriction that demand shocks do not have a long-run effect on output. Once identified, the underlying shocks are analysed and the difference in size and frequency of the shocks for each country is consonant to the heterogeneity of the countries' economic structures.

The correlations of the contemporaneous shocks are mostly asymmetric or insignificantly symmetric which is not supportive of a currency union at the moment. The impulse response functions show that the magnitude and speed of adjustment of the macroeconomic variables to the shocks are within close range across the countries with the exception of Mauritius, Angola and Democratic Republic of Congo (DRC). The difference in impulse response functions of Mauritius with the rest of the region is due to the fact that Mauritius trade more with European and Asian countries than with other SADC member states whereas for Angola and DRC, it is due to their non-participation in SADC Free Trade Agreement. It can thus be concluded that intra-trade favours the possibility of a currency union.

The impulse response analysis indicates a possible currency union excluding Mauritius, Angola and Democratic Republic of Congo but only after rigorous economic adjustments due to low speed of recovery from shocks which may be due to low flexibility of labour market across the region. The variance decomposition analysis shows that the causes of shocks vary across the country though variability in output by supply shocks show similar pattern across some countries. This idiosyncratic result points out that setting up of adjustment strategies like economic policies to encounter disturbances will not be favourable to all countries at

once if they are to form a currency union. However, the few significantly symmetric shocks which are in accordance with trade flows among SADC countries underscores hope for a successfully sustained currency union in the future if more economic integrations such as customs union and common market are implemented in the region.

This will promote intra-trade and thus reduce asymmetry of shocks to converge the economies for a “one-size-fits-all” approach of the currency union.

Keywords: single currency, currency union, OCA, SVAR

Predicting the Performance of the S&P 500 Using Hybrid Neural NetworksM. Samnath^{1*} and N. U. H. Sookia¹¹Department of Mathematics, Faculty of Science, University of Mauritius, Réduit, Mauritius* Corresponding Author. E-mail: meenakshi.samnath@gmail.com**Abstract:**

Stock index forecasting is nowadays not only a compulsory exercise for investors but is also a fundamental cushion against stock market crashes. Recently, the complex nature of stock index forecasting has urged the combination of traditional analysis and conventional statistical techniques with new soft computing approaches, leading to the creation of hybrid stock prediction models. This paper aims at assessing the performance of two hybrid models, the multivariate-ANN and the ARMA(1,1)-GARCH(1,2)-ANN networks, to model and predict daily closing S&P 500 index ranging from 25 October 2011 to 15 October 2015 making a total of 1000 observations. There are 5 steps for designing a neural network which are input variables selection, partitioning of input and output data into the training, validation and testing subsets, choice of the neural network architecture, choice of the training algorithm and choice of the evaluation criteria. For the Multivariate-ANN model, 25 variables from fundamental and technical analysis, market sentiment and macroeconomic indicators have been chosen as inputs. Highly correlated inputs which produce biased effects during neural network training were screened out using principal component analysis. The input data is eventually reduced to 8 principal components after which it is divided into the training, validation and testing subsets in the ratio of 70:15:15 respectively. We select the feedforward structure, Multi-Layer Perceptron (MLP) and Non-linear Autoregressive network with Exogenous outputs (NARX) as the neural network architectures. In the next step, we choose to train the Multivariate-ANN models by means of Resilient Backpropagation. For the ARMA(1,1) – GARCH(1,2)– ANN model, lagged residual terms obtained after fitting an ARMA(1,1)-GARCH(1,2) model to the in-sample S&P 500 index have been used as inputs to the neural network. The input data is then divided into the training, validation and testing subsets in the ratio 70:15:15 respectively. Again the FFNN, MLP and NARX have been chosen as the neural network architectures whereas we choose to train the ARMA(1,1)-GARCH(1,2)-ANN models by means of Levenberg-Marquadt algorithm. Two forecast evaluation criteria have been used for both models which are namely, MAPE and NMSE. Considering the in-sample and hold-out sample performances of the Multivariate-ANN architectures, we note that the MLP structure excels the FFNN structure. We therefore conclude that an increasing number of hidden layers enhance the modeling and forecasting performance of the neural network. At the same time, NARX network has produced more accurate approximations of the S&P 500 than MLP. This can be explained by the internal memory states of NARX networks, which captures previous information to better predict future values of the series. Taking the performances of the ARMA(1,1)-GARCH(1,2)-ANN architectures into account, we find that again the MLP presents better results than the FFNN, as expected. However, MLP and NARX structure show comparable results with a slight advantage for MLP for in-sample forecasts and a slight advantage for NARX for out-of-sample forecasts. The weakening performance of the recurrent NARX network, compared to the static MLP, can be attributed to the inherent recurrent nature of inputs used for the networks. NARX networks hence do not have any peculiar advantage with respect to their internal memory states. Overall, MAPE and NMSE, show unanimous results. ARMA(1,1)-GARCH(1,2)-ANN model outperforms the Multivariate-ANN model. In terms of MAPE, the

percentage improvements of the ARMA-GARCH-MLP over the Multivariate NARX are 25.93% and 11.11% respectively for in-sample and out-of-sample performances. Following these results, we conclude that by combining statistical models such as ARMA and GARCH with neural networks, both the linear and non-linear behaviour of time series can effectively be addressed for more effective forecasts. Further, our results here should prompt investors to use predicted stock indices from hybrid neural networks to identify potential buying and selling strategies. Monetary policy makers can as well gain better understanding of the interaction between macroeconomic variables and stock indices through neural networks, thereby fostering more effective policy actions.

Keywords: Neural Networks, Forecasting, Stock Index, ARMA-GARCH

A hybrid model approach to estimate value at risk for Frontier stock market indexes

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Abstract:

The heightening market volatility is a major setback for financial institutions. One such example would be the collapse of the Barings Bank in 1995 in London in which investors wrongly betted on future market movements. Market volatility or market risk arises from adverse fluctuations in exchange rates, commodity prices, equity prices, interest rates. It sets new, coarse challenges to risk managers in their effort to cushion their portfolios from negative financial shocks. Controlling and measuring financial risk has become essential for financial institutions and one way of doing it is by estimating Value at Risk (VaR). VaR has received widespread accolades from banks and financial institutions alike and is mostly sought to forecast future market risk.

Chou & Hseih (2008) have used the hybrid model to forecast the daily closing price of Shanghai stock market and to find VaR. Comparison of the hybrid method, with the conventional methods (Historical simulation, Monte Carlo simulation and variance/covariance) did not increase accuracy but is superior in terms of conservativeness. The main objective of this study is to evaluate the accuracy of the hybrid model, consisting of the autoregressive moving average (ARMA) and the artificial neural network (ANN), in estimating value at risk of the Frontier stock market. We consider the closing price for 4 indexes (Tunindex, SEMDEX, CROBEX and CSE index) with data ranging from March 1, 2005 to December 31, 2015. In previous research, VaR for the Frontier markets has been forecasted by considering the return of the index in the GARCH model. However, in this study, we have employed a hybrid model to forecast the return of the index and then used those return in the GARCH model for volatility forecasting. Our methodology is as follows: initial statistical tests are performed to check which ARMA model is appropriate for each index, this is followed by the application of the Dickey Fuller test to test for stationarity prior to regressing with the ARMA model. The ARMA model is used to identify which input parameters: moving average, moving average convergence divergence, relative strength index, raw stochastic and the opening price of each index, are appropriate for the neural network. The latter are used to forecast the closing price of all 4 indexes. The forecasted closing price is converted into logarithmic return which is used in the GARCH model. A GARCH (1,1) model with normal distribution is initially considered to forecast the value at risk. Application of the Jarque-Bera test to the forecasted data from the ANN model revealed that the innovations do not follow a normal distribution. Thus the normal distribution is substituted by the Student's-t and GED distribution for the innovations and we verify whether they support the result obtained when assuming a Normal distribution. The most accurate models are identified through the backtesting process by using the Kupiec's proportion of failure test and the Christoffersen's interval test.

It is found that most models are insignificant under normal assumptions, apart from Tunindex. However, for student-t innovation, all models have been rejected. When the GED innovations are considered only the model for Tunindex has been accepted. The failure of the

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hybrid model can be explained by the fact that data during the financial crisis have been considered to estimate the parameter of the GARCH model or by the fact that previous research has used actual return rather than forecasted return. Another factor that may explain the poor performance of the hybrid model is the fact that technical indicators have been considered in lieu of the returns to directly predict the future returns. A comparison of results using the returns directly as input of the ANN model can be considered as future work to test the hypothesis put forward.

Keywords: Backtesting, GARCH model, Hybrid model, Value at Risk

Volatility Spillover Effects across the Stock Markets of the BRICS Countries: A Multivariate GARCH Approach

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Abstract:

Globalizing and diversifying stock market activities have led to an increase in international portfolio investment and global investment funds over time. In relation to worldwide technological improvements, it seems that the expansion of stock markets occurs at a fast pace. As such, strong financial and economic linkages are established in the course of cross-market capital flows, giving rise to interdependency of the stock markets. The dark side of those linkages and market interdependence is that they engender a systemic threat for market shocks to go across boundaries and affect financial performance of other equity markets, resulting in financial market downturn or even crisis. This occurrence is commonly referred to as market volatility spillover, where volatility in one stock market affects volatility in one or more other markets. In this study, we aim at investigating the existence and significance of volatility transmissions across the stock markets of the BRICS countries, and we also discuss the implications in the context of portfolio diversification. We use the daily closing stock index prices for Brazil (IBOVESPA), Russia (MICEX), India (SENSEX), China (SSEC), and South Africa (JSE Limited) spanning over the period of January 2001 to November 2015. The stock index prices are converted to returns for stationary purposes and we find that all the returns display a leptokurtic distribution and have the statistical property of heteroscedasticity which is fundamental for the application of volatility models. We make use of the mathematical multivariate BEKK-GARCH (1, 1) model as it is characterized by important constraints for the investigation of volatility spillover across stock markets. The BEKK model consists of three specific parameter matrices which are estimated. Two cases of the BEKK model are studied; bivariate and trivariate respectively. The significance of each parameter of the BEKK model is tested as the parameters depict information about own and cross-market volatility influence. The stock markets of Brazil and China are influenced by their own past shocks respectively, while this is not the case for Russia, India and South Africa. On the other hand, all conditional variances of the stock indexes of the BRICS countries are highly significant. The results show interdependence among the stock markets, and financial linkages exist between the economies which contribute to the effect of volatility spillovers. There exist bidirectional volatility transmissions between the stock markets of Brazil and China, with the transmissions from Brazil to China (10.96%) being higher than from China to Brazil (0.408%). The bivariate BEKK results show unidirectional volatility transmissions from Brazil to India, from Russia to China and South Africa, from India to South Africa, and from South Africa to China. The trivariate BEKK results demonstrate bidirectional volatility transmissions between the stock markets of Russia and China, Brazil and India, and India and South Africa. Another important result of this study is that the risk of imbalances or even crises can be contagious through cross-market volatility transmissions and can end up affecting all the stock markets used in this study. While most financial literature focuses on volatility transmissions from other equity markets to the BRICS countries, this study provides new information which relates to the persistence of inter-volatility transmissions within the BRICS' alliance itself. The outcomes of this study are that under the bivariate and trivariate BEKK model, a detailed outlook of the existence of volatility spillover effects across the stock markets of the BRICS countries is provided and

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this contributes to ongoing research on the BRICS' alliance. The results have implications in the field of global portfolio diversification. The stock markets of the BRICS countries affect each other and investment in only their respective stock indexes may not lead to a reduction in portfolio risk. Alternative investment strategies may be required, while paying attention to the stock markets of developed countries as well.

Keywords: Market Interdependence, Volatility Spillover, BEKK

A Comparison of American Option Pricing Techniques under a Markov Modulated Model

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Abstract:

Option valuation techniques used in today's financial markets are in one way or the other related to the celebrated Black-Scholes partial differential equation (PDE). However, according to empirical data, it has been well documented that this model does not give a correct description of the financial market behavior due to its unrealistic assumptions. To remedy these restrictive assumptions, much effort has been devoted to produce more realistic option valuation models. One of the recent trends which is gaining overwhelmed popularity is the Markov (regime)-switching model. Apart from being simple and easy to understand, the regime-switching model proves to be an effective alternative to better reflect the true evolution of stocks. The rationale behind this framework is that the market parameters such as volatility and interest rate are allowed to switch randomly amongst a finite number of states according to a continuous time Markov chain. Due to their empirical successes, Markov-switching models have naturally received much attention among researchers and practitioners for the valuation of financial derivatives.

Among the most commonly traded options, obtaining closed form solutions for American put options still remains a challenging task. Usually the American put option pricing problem can be formulated either as a linear complementarity problem (LCP) or as a free boundary problem and development of efficient and accurate numerical techniques is still evolving. Generalizing the classical Black-Scholes model to incorporate Markov-switching properties, we consider several methods to solve a set of coupled PDEs to price American put options. Many algorithms have been proposed to price regime-dependent American options. In this study, a thorough comparison of some numerical schemes to price American options in terms of computational speed and convergence orders is carried out.

We consider the lattice method, the classical finite difference method, the cubic B-spline collocation method, the Fourier time stepping (FST) technique and the Galerkin finite element method to price American put options. Although these numerical schemes are not new in literature, no such comparison has been carried out. For the cubic B-spline collocation method, the approximation of the exact solution can be expressed as a linear combination of cubic B-spline basis functions. Using the Crank-Nicolson (CN) scheme, tridiagonal linear systems can be obtained and solved easily with linear computational effort. In the case of American options, the operator splitting method is applied to solve for the LCP in each regime and second order convergence can be obtained. The FST method consists of applying a continuous Fourier transform to the set of PDEs and transforms it into a linear ordinary differential equation (ODE) into the Fourier space. Based on a penalty method, the FST method is also extended to price the regime-switching American options.

Most numerical techniques considering the PDE approach to price options under a regime-switching economy can only achieve second order convergence as this is the case for the cubic B-spline collocation scheme. Also for American options, methods based on finite difference approximations suffer from low convergence rates. In the setting of the finite

element method, linear and quadratic basis functions are considered for the spatial discretization of the system of PDEs and for the temporal discretization, we use an exponential time integration (ETI) scheme where fast computation of the matrix exponential is achieved using Carathéodory-Fejér points. By again applying the operator splitting method, our numerical results demonstrate that with the combination of the quadratic finite elements and the ETI scheme, the finite element method outperforms all of the above mentioned techniques where fourth order convergence can be reached for the American options under the Black-Scholes Markov modulated model. Comparing the time marching schemes, results also show that the ETI scheme outperforms the CN scheme. This comparative study can be highly significant to practitioners in the industry who strongly rely on fast and accurate derivative valuation when taking optimal investment decisions in a highly competitive market.

Keywords: Markov modulated, American options, collocation method, FST method, Finite element method

A Univariate Approach to Modelling and Forecasting USD/MUR Exchange Rates

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Abstract:

Anticipating the USD/MUR exchange rate is beneficial for the Mauritian economy and investors as well since an effective forecast allows for an improved decision-making process. Over the past few years, several studies have been made on the modelling and forecasting of exchange rates using both univariate and multivariate time series models as well as neural network approaches. Along this line, our study aims at evaluating the forecasting performance of some linear and non-linear univariate time series models on the daily USD/MUR exchange rate for the period January 3, 2002 to January 6, 2015. The stationary properties of the time series data are tested using the Augmented Dickey Fuller (ADF) test whereby the series is found to be stationary at first differences. The sample is subdivided into two parts: the first 2500 observations are used for estimation while the remaining 730 observations are used for forecast evaluation. Different autoregressive moving average (ARMA) models are employed. We also include those models where the variance of the residuals are allowed to vary over time, following generalised autoregressive conditional heteroscedastic (GARCH) processes. As such, ten models for AR (p) and MA (q) models ($p = q = 1:10$) and thirty-six models for ARMA (p, q) models ($p = q = 1, 2, 3, 4, 5, 6$) are applied using the Least Squares method. As for the estimation of ARMA models in which the variance of the residuals are allowed to vary, the following conditional mean models are used as mean equations: AR(p) [$p = 4:8$], MA(q) [$q = 6:10$], ARMA(1,2), ARMA(1,3), ARMA(2,1), ARMA(2,2) and ARMA(3,1). For the GARCH (p, q), four models [$p = 0, 1$ and $q = 1, 2$] are estimated using the Marquardt algorithm. Moreover, the models are selected based on the Schwarz information criterion (SIC). Before selecting the most parsimonious models for forecasting exercises, statistical tests, such as, Ljung-Box and Engle's ARCH tests are performed to check for model adequacy. In addition, we provide both short and long term ahead forecasts (one up to seven hundred and thirty days). The forecasting performance of the different time series models are compared using the Root Mean Square, Mean Absolute and Mean Absolute Percentage Errors. Based on the RMSE criterion, we find that moving average models provide superior forecasts for short time horizons since MA(6) model was selected for one day ahead forecast and MA(8) model for seven and fifteen days ahead forecast. On the other hand, an AR(6)-GARCH(0,2) model and an ARMA(1,3)-GARCH(1,1) model are most accurate for thirty days ahead forecast and for 180 and 365 days ahead forecast respectively. Moreover, for 730 days ahead forecast, the AR(4)-GARCH(1,2) outperforms the other models. Generally, the importations of Mauritius as well as foreign debts taken by the government are paid in US Dollars; hence it is believed that this work may improve and contribute to existing research involving univariate approaches to forecasting exchange rates, thus benefitting the Mauritian economy. Also, since the United States is Mauritius' third largest export market, fluctuations in the USD/MUR have quite an impact on the Mauritian economy. Undoubtedly such an accurate forecasting method of the USD/MUR exchange rate will be useful.

Keywords: USD/MUR, Forecasting, ARMA, GARCH.

DFT Exploration of [3+2] Cycloaddition Reaction

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Abstract:

Cycloaddition reactions are considered among the most common reactions in the synthesis of cyclic and heterocyclic compounds, due to their complete atom economy and high functional group compatibility. Among the different classes of cycloaddition reactions, the [3+2] cycloaddition (32CA) reaction as proposed by Huisgen in 1960s, has found its applications towards heterocycles, natural products and bioactive molecules. This is mainly due to interesting attributes such as regio-, chemo- and stereoselectivity, which have been determined by experiments.

The 32CA reactions of pyridinium-3-olates as a three-atom-component with various ethylene derivatives were first carried out by Katritzky's group in the 1970s and have received considerable attention. Particularly, the reaction of 1-methylpyridinium-3-olate with methyl acrylate has been studied experimentally and interpreted by using valence bond theory and frontier molecular orbital treatments. In 2010, the experimental work performed by Katritzky's group was theoretically investigated. It was reported that the theoretical findings of both the stereo- and regiochemical pathways are in accordance to the experimental observations [1].

In continuous to the study performed on pyridinium-3-olates, the 32CA reaction of 1*H*-phosphorinium-3-olate and 1-methylphosphorinium-3-olate with methyl acrylate was studied by using density functional theory (DFT) method at the Becke, three-parameter, Lee-Yang-Parr (B3LYP) functional and the 6-31G(d) basis set. The 6-ester/7-ester regioisomers and *endo/exo* stereoisomers were analysed kinetically as well as thermodynamically. The vibrational frequencies were computed to establish the nature of stationary points. In addition to the gas phase, the 32CA was also studied in the solvents namely, tetrahydrofuran and ethanol. The geometrical parameters indicate that the transition states (TSs) are slightly more advanced and asynchronous in ethanol. The intrinsic reaction coordinate computations starting at the saddle points of the TSs were carried out to check the connections between the reactants and the products. The electron localisation function topological analysis of the changes of electron-density was performed to understand the bonding changes along the most favourable reaction pathway. This 32CA reaction of 1*H*-phosphorinium-3-olate with methyl acrylate takes place through a *two-stage one-step* mechanism via highly asynchronous TSs. The analysis of the electrophilic P_k^+ Parr functions accounts for the asynchronicity in the bond formation to favour the formation of the first *pseudoradical* centre at the most electrophilic site of the electrophile molecule. The non-covalent interactions analysis of the most stable *exo* TSs (TS6x-H) reveals the existence of weak hydrogen bonding enabling to explain the regioselectivity found in this low-polar *zwitterionic-type* 32CA reaction. The analysis of global and local indices at ground state of the reactants was performed to understand the regioselectivity of the studied reactions [2].

On comparing the findings of phosphorus compounds with those of their nitrogen analogues, it is found that the formation of the cycloadducts obtained from 32CA reactions of phosphorinium-3-olates is kinetically and thermodynamically more favourable than that of

pyridinium-3-olates. Therefore, the results from this work can provide incentives to experimentalists for the synthesis of phosphorus containing heterocycles.

Keywords:

Zwitterionic-type [3+2] cycloaddition reaction; DFT; Phosphorinium-3-olate; Methyl acrylate; Asynchronicity.

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Understanding S_N2 Reaction – A Theoretical Study

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Abstract:

Chemical reactions are ubiquitous in nature. One class of reaction, namely bimolecular substitution (S_N2) reaction, occurs in many organic, inorganic and biological processes. Examples include the synthesis of anti-tumour drugs and improved diabetic drugs. In the body, the S_N2 reaction is involved in the conversion of noradrenaline to adrenaline as well as the synthesis of adenine triphosphate (ATP). The S_N2 reaction consists of the replacement of one group of atoms by another at a positive centre. In order to understand complex reactions, simple molecules are studied both experimentally and theoretically. Computational studies have complemented experimental investigations by providing an accurate and reliable way to model S_N2 reactions. The attacking group, that is the nucleophile, can attack a positive centre on the substrate either from the back or from the front relative to the leaving group Y. The backside (S_N2-b) reaction goes with an inversion of configuration and is known as “Walden inversion”. In the frontside (S_N2-f) reaction, the configuration is retained and the S_N2-f reaction generally proceeds with a higher energy barrier than the S_N2-b reaction. Tuning the reaction can lead to stereochemical control with significant economic and energetic benefits. The S_N2 reaction is characterised by a potential energy surface (PES) which proceeds from the reactants to the products via transition states and complexes. Several types of PESs exist although the single-well PES is the one most widely known. For example, S_N2- reaction involving free anions are characterized by a double-well PES. A large number of studies has been carried out on the S_N2 reaction and new findings are still being made. Of the factors affecting the S_N2 reaction, the effects of ion-pair nucleophiles, solvents and cations stand as potential areas of investigations. Many of the studies on S_N2 reactions focus on the free anions although the latter are necessarily accompanied by a cation. In this context, the reactions of CH₃Cl with the free nucleophiles Nu⁻ (Nu⁻ = F⁻ and OH⁻) and ion pair nucleophiles MNu (M⁺ = Li⁺, Na⁺, K⁺ and MgCl⁺) were studied in the gas phase and in tetrahydrofuran solvent for both the S_N2-b and S_N2-f reactions [1,2]. The intrinsic reaction coordinates were further analysed using the activation strain model of chemical reactivity. The latter is a fragment approach to study reactions where the energy of the system is decomposed in the strain energy and interaction energy. The strain energy is associated in the deformation within the reacting species while the interaction energy is related to the bonding capacities and mutual interaction between the deforming species. The interaction between the cation and the leaving group proves to be a determining factor in favouring the S_N2-f reaction. A highly charged cation binds with the leaving group more strongly, which destabilises TS-b, the TS of the S_N2-b reaction, and this causes the otherwise linear TS-b to adopt a cyclic structure. This destabilisation does not occur in TS-f, the TS of the S_N2-f reaction as the TS is already cyclic. The effect of cation is reduced in the presence of a stronger nucleophile. Apart from retarding the reaction, solvent opposes the formation of the cyclic TS-b which prevents the preference of the S_N2-f reaction.

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Keywords: S_N2 , Substitution Reactions, Ion Pair, Hydroxide, Nucleophiles

Coordination of Azamacrocycles to Alkali Metal Ions – A DFT Approach

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Abstract:

Supramolecular chemistry is often termed as “chemistry beyond the molecule”. It is simply the coordination of two or more chemical species held together through weak and reversible non-covalent forces of interaction. With the rapid development of computational science, *ab initio* quantum chemistry has emerged as an indispensable tool in the field of supramolecular chemistry. Among the various quantum chemical methods available, density functional theory (DFT) method has demarcated itself in the mainstream of supramolecular chemistry, owing to its good interplay between the accuracy of results obtained and computational efficiency.

Supramolecular chemistry rests on the shoulders of several macrocyclic systems such as spherands, crown ethers, cryptands, azamacrocycles, and cyclodextrins. Azamacrocycles are special class of nitrogen bearing ambivalent cyclic compounds (macrocycles) capable of recognising or sensing cationic, anionic, and polar entities. They can even bind to neutral guest species as complex as the human immunodeficiency virus (HIV) type 1 regulatory protein. Interest in azamacrocycles arises due to their unusual coordination chemistry, basicity, and redox behaviour.

The *N*-donor atoms of azamacrocycles can easily be functionalised and this leads to a wide range of substituted hosts. The nature of the pendant side-arm group plays an important role into the selective and efficient binding of metal cations. Metal complexes of *N*-functionalised azamacrocycles are of increasing interest among the scientific community. Their usefulness in fundamental studies as well as their countless possible applications ranging from biomedicine, catalysis, enzyme mimicking, molecular sensing, and chirality signaling, have rendered them attractive. Likewise, alkali metal ions are interesting guests which are prevalent in several aspects of life on earth, in the oceans, and within biological systems. Their selective detection and uptake is of utmost importance.

The coordination of *N*-functionalised azamacrocycles to alkali metal ions was known as early as the 1980's. Nonetheless, the side-arms consist mainly of *O*-donor functional groups, such as -OH, -CO₂R, and -CONR₂, which often enhance the stability of the alkali metal-azamacrocyclic complexes. The -CH₃ group is one of the smallest side-arms and unlike the ester and amide functional groups do not coordinate to the metal center. As a matter of fact, few structures consisting of methylated azamacrocycles coordinated to alkali metal ions have been reported in literature. A question of fundamental interest is how methylated azamacrocycles stabilise alkali metal ions. In quest to answer this question, the coordination chemistry of three methylated azamacrocycles, namely, Me₃[9]aneN₃ (Me₃tacn), Me₃[12]aneN₄ (Me₄cyclen) and Me₆[18]aneN₆, was herein studied.

In this study, the alkali metal complexes of Me₃tacn, Me₄cyclen and Me₆[18]aneN₆ were predicted using the BP86 and B3LYP functionals with the 6-311G(d,p) basis set; where the

alkali metal ions (Li^+ , Na^+ , K^+ , Rb^+ , and Cs^+) are acting as the guests and the azamacrocycles as the hosts. Geometrical, electronic, and thermodynamic parameters were obtained to have a profound insight into the nature of the bonding and hence, the stability of the alkali metal-azamacrocyclic complexes. The results obtained using the BP86 and B3LYP functionals are comparable. The DFT optimised structures were also compared with corresponding X-ray crystal structures [1]. The experimental data agree satisfactorily with the DFT results.

Keywords:

Supramolecular chemistry, azamacrocycle, density functional theory, alkali metal, coordination chemistry

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Effects of altered nutrient levels on the level of phenolic contents, antioxidant activities and photo-physiological performance in macroalgal species

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Abstract:

The negative impacts of human activities on physiological processes of marine organism are becoming more conversant. Nevertheless, limited studies have described the effects of altered nutrient levels on antioxidant activities of different macroalgal species. The study has on the one hand assessed the effect of high nutrient conditions, on the levels of non-enzymatic antioxidant activities and phenolic contents seven seaweed species collected in May 2015 and on the other hand assessed the enzymatic antioxidant activities of three seaweed species collected in May 2016. The marine organisms were sampled sites at with low nutrient levels (LNS) (Gris-Gris) and site with high nutrient levels (HNS) (Bain Boeuf) around the coast of Mauritius at comparable depth. A transplantation experiment was also carried out, whereby six seaweed species from HNS sites were transplanted in the LNS sites and vice versa. After 5 days of exposure period, the chlorophyll *a* stress photo-physiology of the specimens was measured using the D-PAM fluorometer and their antioxidant levels were determined. The physico-chemical parameters and nutrient levels such as nitrate and phosphate concentrations were analysed at the study sites. Non-enzymatic antioxidant activities were determined using five antioxidant assays: di(phenyl)-(2,4,6-trinitrophenyl) iminoazanium (DPPH) scavenging assay, superoxide scavenging assay (SOS), nitric oxide scavenging (NOS), ferric reducing antioxidant potential (FRAP) assay and iron chelating assay (ICA). The enzymatic antioxidant levels were determined using superoxide dismutase (SOD), Glutathione Peroxidase (GPx) and catalase (CAT) activities assay kit. The total phenolic content (TPC) and the Total flavonoid content (TFC) of the species were also determined. Most tested species from HNS site, except of *Halimeda discoidea* and *Amphiroa rigida* exhibited higher non enzymatic antioxidant activity, for instance, DPPH scavenging activity, SOS, NOS, ICA, TPC and TFC content compared to those from LNS site. Likewise, the enzymatic antioxidant activities were higher in HNS site compared to LNS sites, for instance, SOD activity was 1.4 fold higher, GPx activity was 1.3-1.7 fold higher and CAT level was 1.3-2.9 fold higher in the HNS site. A strong correlation was found between TPC & FRAP (0.692^{**}), TFC & FRAP (0.633^{**}) and a moderate correlation was found between TPC & iron chelating activity (0.463^{**}). The transplantation experiment generally revealed that the photo-physiology and antioxidant status reflected the prevailing environmental conditions they were exposed to, indicating that nutrient levels influenced both the photo-physiology and antioxidant activities in tested species. The high amount of phenolic contents and antioxidant activities observed in the HNS sites may be attributed to higher nutrient contents and other prevalent stressful conditions. Macroalgal species may thus be used as sensitive indicator species for stressful conditions present due to increased nutrient levels at certain sites, which may help as an important tool in the management of the coastal ecosystems.

Keywords: HNS (sites with high nutrient level), LNS (sites with low nutrient level), antioxidants, TPC and photo-physiology.

Importance of hormonal changes and physical activity in prevention of low back ache in women.

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Abstract:

Sedentary lifestyle has been increasingly reported to be associated with various types of health complications, among which, low back ache (LBA) is one. Given that women are mostly affected by LBA, this study investigated the various factors which could affect LBA in women. The level of physical activity was also studied by using the WHO recommendations on physical activity for health, which is either 150 minutes moderate-intensity physical activity or 75 minutes of vigorous-intensity physical activity. **Methods:** A total of 600 women were recruited. A questionnaire was used for the interview, which was a combined and modified form of the Global Physical Activity Questionnaire from World Health Organisation and the Nordic Musculoskeletal questionnaire. The participants were asked about their demographic details, physiological details on musculoskeletal pain, LBA in the last 12 months, physical activity and hormonal changes. **Results:** The prevalence of LBA in the last 12 months was 65.7%. The duration of the LBA was 1-7 days and resulted in limitation of leisure and work activities for up to 7 days. Furthermore, 12.2% had to change job, 41.4% reduced their work activities and 38.3% decreased their leisure activities and were 2.08 times more likely to suffer from LBA at the time of survey ($p=0.00$; 95% CI: 1.88-2.30). Age, number of children, type of delivery and BMI status did not affect LBA ($p>0.05$). Those suffering with LBA spent more time on physical activity compared to those without LBA (150 vs 132 minutes; $p=0.06$). Furthermore, less than 150 minutes of moderate intensity physical activity weekly was associated with increased risk of LBA (OR=1.43; $p<0.05$; 95% CI: 1.09-1.87). Women who had already reached menopause had higher prevalence of LBA compared to those who had not reached that stage (68.0% vs 59.4%; OR= 1.49; $p=0.03$; 95% CI: 1.03-2.15). A statistical significant relationship was noted between level of physical activity and number of hormonal changes in the LBA group ($p=0.01$) but not in the non-LBA group ($p=0.61$). A higher risk for LBA was noted among professionals compared to administrative workers (OR=1.61; $p<0.05$; 95% CI: 1.09-2.37) and among smokers than non-smokers (OR= 2.76; $p<0.05$; 95% CI: 1.41-5.40). **Conclusion:** LBA and physical inactivity were highly prevalent among women. LBA were significantly associated with Moderate intensity physical activity, smoking, menopause and professions. Women who had reached menopause stage and did physical activity, had less risk of developing LBA.

Keywords: low backache, hormones, physical activity, age

DNA barcoding of selected oysters of Mauritius

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Abstract:

Bivalves are among one of the largest classes in the phylum Mollusca, which is known to compromise sessile invertebrates living in the ocean bottom. Being recognised as filter-feeders, bivalves play a major role as a biological-filter in the marine ecosystem. Oysters (Family: Ostreidae) include about 75 species of high economic importance as food sources, for medicinal purposes and as shell craft material. Due to the decline of the Mauritian's economy in the traditional textiles and sugar industries, and in fisheries from the wild, the government's vision is to promote marine aquaculture. For this purpose, accurate species identification is essential. However, phenotypic differences and the existence of closely related taxa render identification through traditional morphological examination difficult to distinguish between bivalves. Molecular species identification is a technology based on sequencing that involves sequence comparison and similarity search methods. Recent studies in taxonomy have proposed that a DNA-based identification system may help the resolution of animal diversity and classification by the use of genome sequences and phylogenetic links. A genetic "barcode" in each single species is characterized by a unique gene sequence, which is embedded in every cell. DNA barcoding uses short DNA sequences as a problem-solving biomarker for species and is a uniform approach to characterize organisms. To complement tentative morphological identification, DNA-based taxonomy is performed as it is known to display conspicuous differences within morphologically identical species. It is a useful tool for rapid and unambiguous identification of cryptic animal species, such as bivalves, based on mitochondrial cytochrome c oxidase I gene (COI) sequences. This study aims at evaluating the potential of barcoding the mitochondrial cytochrome oxidase 1 gene (COI) for identification of oysters in Mauritius. In this work, 18 oysters dwelling in the coastal zones of Mauritius were characterized morphologically according to published keys and at the molecular level at three study sites namely Trou d'Eau Douce, Poste de Flacq and Quatre Soeurs. According to morphological analyses, the oyster specimen were categorised into three genera and four proposed species, namely, *Saccostrea cucullata*, *Ostrea edulis*, *Crassostrea gigas* and *Crassostrea virginica*. To initiate molecular analyses, DNA was extracted from the adductor muscle of each specimen using a modification of a published salt-based extraction protocol. The concentration and purity of DNA extracts was estimated spectrophotometrically. To amplify a fragment of the COI gene, DNA extracts were subjected to the polymerase chain reaction (PCR) using the Folmer primers HCO2198 and LCO1490 and *Taq* DNA Polymerase. Amplicons of the expected size were subsequently purified to eliminate primer-dimers. After purification, six of the amplicons from morphologically different specimen were sequenced using the Big Dye Terminator system and capillary gel electrophoresis. Sequences were edited and compared to online databases for identification of barcodes. Subsequently phylogenetic trees were constructed using the BOLD SYSTEMS. The closest matches for the barcodes of the six oysters was *Saccostrea cucullata* with a score ranging from 90.28% to 99.32%. Only one of the morphologically identified oysters matched the DNA barcode result with 99.32% identity, supporting the notion that traditional taxonomy analyses are not accurate for bivalve identification given that the other five did not match. The other five specimen represented genetic variants that

warrant further phylogenetic analyses to determine whether they constitute unknown species or genera. Overall, the molecular approach shows that the COI marker can efficiently reveal variation masked by phenotypic plasticity.

Keywords: Ostreidae, morphological analyses, DNA barcoding, mitochondrial COI gene, BOLD SYSTEMS,

The ecology of Red Whiskered Bulbul (*Pycnonotus jocosus*) at Mt Camizard and implications for conservation

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Abstract

Given the large-scale extinctions of the avifauna on oceanic islands, introduced bird species may have important ecological roles in island ecosystems. It is important to be conscious of whether introduced birds could serve as functional replacements for ecological interaction such as seed dispersal. Red-Whiskered Bulbul (*Pycnonotus jocosus*) is one of the most widespread invasive birds in Mauritius and could be a potential candidate in restoring lost ecological interaction. The Red-Whiskered Bulbul has a versatile diet, consisting of fruits with small diameter seeds, nectar, buds and insects. This may have contributed to its survival in area where there is seasonal fruit abundance. Previous studies in Mauritius on the diet of *P. jocosus* concluded that it feeds mostly on fruits of invasive alien plants and disperses their seeds. But these studies did not account for the plant community composition. Our study explores this gap by comparing the diet of *P. jocosus* in two different habitat types, and in particular by setting two research questions: 1) Does *P. jocosus* disperse seeds of native plants? 2) Would the *P. jocosus* shift its diet to native fleshy fruit if invasive alien plants are controlled by weeding?

To document seed dispersal by *P. jocosus*, point count census was conducted to document the density of Red-Whiskered Bulbul in the weeded and non-weeded areas; where bird foraging observations were also carried out. Finally, seed rains were compared between the two contrasting forest types using seed traps.

Results show that the mean density of Red-Whiskered Bulbul was higher in the weeded area (mean = 6.75 ± 0.75 SE) compared to the non-weeded area (mean = 4.00 ± 0.41 SE). In the weeded area *P. jocosus* was observed feeding on the fruits of the native pioneer plant *Harungana madagascariensis* and attacking insects. Seed rain in the weeded area (mean = 18.57 ± 12.47 SE) was significantly higher than in the non-weeded area (mean = 8.94 ± 14.35 SE) ($U_{58.5}$; $P < 0.05$). Seeds from only two bird-dispersed species were collected in seed traps; the native *H. madagascariensis* and the alien *Litsea monopetala*. *Litsea* made up 63.5 % and *Harungana* 36.5 % of the total seeds collected. Seed rain composition in the weeded area consisted of 47.5 % *Litsea* seeds and 52.5 % *Harungana* seeds; and 100 % of seeds in the non-weeded area belonged to *Litsea*.

Our results show that the Red Whiskered Bulbul is dispersing seeds of both natives and invasive alien plants. However, the mean density of the bird indicates that it prefers the weeded forests. This could be due to the higher plant species diversity due to forest restoration which in turn results in a wider food resource breadth for the bird. Dominance of *Litsea* seed could be due to 1) the dominance of *Litsea* tree in surrounding non-weeded forest; 2) its larger fruit crops thus, increasing its probability of being seen and removed by frugivorous birds; and 3) and difference in fruiting phenology that gives *Litsea* an advantage on other plants. From the presence of *Litsea* seeds in the seed rain of both forest types, it can be deduced that the birds tend to move predominantly from the non-weeded to the weeded areas. The gape size of *P. jocosus* (12 - 13 mm) suited the bird well to feed on fruits of both

Litsea (spherical fruits of 5.0-7.0 mm in diameter) and *Harungana* (spherical fruits of 3-4 mm in diameter). Our results suggested that invasive alien plants might be benefiting from seed dispersal by introduced birds. However, the presence of seeds of a native pioneer plant in the bird's diet indicates that if weeding is carried out, *P. jocosus* would also include fleshy fruits of native plants in its diet.

Further studies could analyse the link between habitat type and foraging behaviour of Red Whiskered Bulbul, throughout a complete annual cycle so that seasonal variation may be characterised. Concurrently, analyses of faecal samples from Red-Whiskered Bulbul and other birds are warranted to compare proportion of native and non-native seeds therein. Finally, germination tests would be useful to determine whether passing through the bird's gut influences germination rate and speed for plants whose fruits are swallowed by the bird.

Keywords: *Harungana madagascariensis*, *Litsea monopetala*, *Pycnonotus jocosus*, weeded area, non-weeded area

Aspects of the reproductive ecology of the Mauritius Kestrel (*Falco punctatus*)

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Abstract

Once the rarest bird globally, the Mauritius Kestrel (*Falco punctatus*) was on the brink of extinction with only four individuals known in 1974. Following an intensive restoration program, the species recovered to almost 800 individuals by 2005. However, in 2014, the species' conservation status was reassessed from 'Vulnerable' to 'Endangered' because the population had dropped below 400 birds, stressing the need for further research into the species' ecology to inform its long-term conservation. Food intake is a crucial determinant of breeding success but little is known on this aspect concerning the Mauritius Kestrel. Our study aimed to better characterise the influence of diet composition of the Mauritius Kestrel (in terms of food quantity and quality) on its breeding success. We also investigated the possible link between invasion extent by the Traveller's palm, *Ravenala madagascariensis*, and the bird's diet and breeding success. The results may contribute towards informing conservation management actions needed to stem the decline in the Mauritius Kestrel population.

A sample of 28 Kestrel pairs was observed in the Bamboo mountain range. Diet components were identified by direct observation of prey item type and food quantity in food passes (made by the male to female and offspring). Nutritional composition analyses (in terms of biomass and moisture, calcium, and lipid content) of the prey items were carried out to assess food quality. The extent of *Ravenala* invasion in the hunting range of each pair was estimated using Google Earth Pro tool. A principle component analysis (PCA) with breeding success as explanatory factor, was run for data reduction and identification of the main variables influencing breeding success. Linear regressions were used to determine significance of the correlations.

Results showed that the Mauritius Kestrel's diet is composed of day gecko (*Phelsuma* species), bird, agamid, shrew and insect (Order Odonata). The gecko was the commonest component of the diet, but was the least nutritious prey item except for its calcium content. Both the frequency of gecko brought to nest and the overall food pass frequency positively correlated with invasion extent. Food quantity (in terms of overall frequency of food pass) positively correlated with breeding success whereas food quality showed no significant relationship. Moreover, *Ravenala* invasion extent correlated positively with the breeding success of the Mauritius Kestrel.

Food quantity available to mother and offspring is a vital determinant of breeding success, whereby the higher the food pass frequency, the greater the amount of energy and nutrients made available to the mother (during egg development) and to the chick (during development to fledgling stage). The lack of link found between food quality and breeding success warrants confirmation through a more exhaustive nutritional analysis of all prey items. The prominence of geckos in the diet is likely to be linked with its abundance in the area, its apparent easy capture, its high digestibility for the chicks or its high calcium content (being essential during egg and chick development). Furthermore, the positive correlation between

Ravenala invasion extent and frequency of gecko brought to nest suggests that *Ravenala* presence may either increase gecko density or it may increase detectability and capture by Kestrel, or both. In fact, the fan-like *Ravenala* foliage and its wide bracts may provide higher detectability of the day gecko and the large bracts also offer a planar structure allowing easier capture of prey by the Kestrel. Finally, the positive correlation between *Ravenala* invasion extent and Mauritius Kestrel's breeding success may be mediated by the influence of *Ravenala* on gecko's abundance and/or detectability by kestrels.

Additional investigations are required to better understand the link between habitat type, prey abundance and breeding success of the Mauritius Kestrel. Further observations and survey of abundance of day gecko in *Ravenala* invaded areas and a focused study on the occurrence and impact of *Ravenala* on the Mauritian ecosystem and the broader native biodiversity are warranted. Characterisation of the different types of habitat available to the Mauritius Kestrel over the island and evaluation of prey availability therein, may help identify the best sites for future reintroduction and maintenance of the Mauritius Kestrel to enhance its long term conservation.

Keywords: Mauritius Kestrel (*Falco punctatus*), diet, breeding success, impact of alien plants, *Ravenala madagascariensis*

Population density of giant clams at selected sites around Mauritius

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Abstract:

Giant clams, commonly known as Tridacnids and belonging to the family Cardiidae (sub-family Tridacninae), are the largest sessile molluscs known to live in the ocean. Some species can live for more than hundred years and grow up to over 150 cm in length. However, unlike other marine molluscs which filter feed on plankton from the seawater column, giant clams achieve their large size through the photosynthate supplied by the dinoflagellate algae (*Symbiodinium*) that live in their mantle tissues. Giant clams provide shelter to the *Symbiodinium* by protecting them from predators and allowing them to photosynthesise during the day by opening their shell for exposure to sunlight. The distribution of the different species of giant clams has been reported in the South Pacific and Indian Oceans. These marine invertebrates contribute to the proper ecological functioning of coral reefs. Although most of the Tridacnid species are protected under Appendix II of the CITES, not much information on the status and dynamics of their population density are available in the Western Indian Ocean including Mauritius. This study aimed at investigating the status of the population density of *Tridacna maxima* and *Tridacna squamosa* in the North and West of Mauritius. Five different sites were selected, which included: Ile aux Bénitiers, Black River and Flic-en-Flac from the West, and Trou aux Biches and Ile D'Ambre from the North. The field surveys were conducted at the end of summer (April and May) 2016 at three different zones (Reef, Lagoon and Near-Coast) at each site. Triplicate (n=3) belt transects of 50m x 5m were surveyed at each zone. The individuals of *T. maxima* and *T. squamosa* were morphologically identified *in-situ*, enumerated and classified into juveniles ($\leq 50\text{mm}$) and adults ($\geq 51\text{mm}$). *T. maxima* was identified by its close-set scutes. It is known to grow up to 35 cm and tends to bore partially into reef substrates. *T. squamosa* was identified by its large, well-spaced scutes and is known to grow up to 40 cm. Seawater samples were also collected to determine the nitrate and phosphate levels at the different surveyed zones and sites.

In this study, both *T. maxima* (Fig. 1A) and *T. squamosa* (Fig. 1B) were observed at Black River and Trou aux Biches. At Flic-en-Flac only *T. maxima* was observed while Ile aux Bénitiers and Ile D'Ambre had only *T. squamosa*. The highest density of adult *T. maxima* was recorded at the Black River reef (8.67 ± 6.43 per 250m^2) and the highest density of adult *T. squamosa* occurred at the reef of Ile aux Bénitiers (3.33 ± 4.93 per 250m^2) and in the lagoon of Ile D'Ambre (3.33 ± 2.89 per 250m^2). The highest density of *T. maxima* juveniles was recorded in the lagoons of Black River and Trou aux Biches (0.67 ± 0.58 per 250m^2 for both) and the highest density of *T. squamosa* juveniles was found in the lagoons of Trou aux Biches and Ile D'Ambre (0.33 ± 0.58 per 250m^2 for both). None of the *Tridacna* species was recorded at the near coast zone of all the suited sites.

A general trend of a lower density of juveniles as compared to the adults, for both *T. maxima* and *T. squamosa*, was noted. This could suggest a possible decrease in the reproductive ability or survival of juveniles of both *T. maxima* and *T. squamosa* due to prevailing environmental and anthropogenic stresses that occur in these regions of Mauritius. However, the high population density at the reef zone of Black River is coherent with previous studies which have indicated a

strong relationship between corals and giant clams. Additionally, it is worth noting that the Black River study site is part of a declared Fishing Reserve whereby less stresses, especially anthropogenic, occur at the reef. Nevertheless, further investigations on impacts of exploitation and environmental changes at these sites are needed to identify the causes affecting the population density for both juveniles and the adult categories of the two identified Tridacnid species. Even though both species are classified as “least concern” under the IUCN list, these findings demonstrate a low population of both species, which may be an indication to initiate their proper management and conservation in the Mauritian waters.

Keywords: Giant clams, *Tridacna maxima*, *Tridacna squamosa*, population density, Mauritius

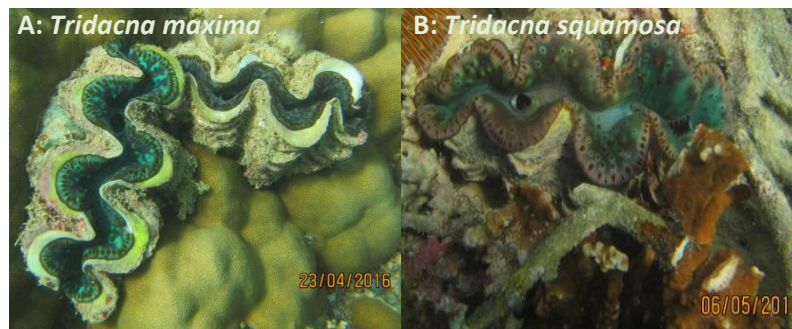


Figure 1. A: *Tridacna maxima* at Black River reef and B: *Tridacna squamosa* at Ile aux Bénitiers reef

Reassessing the negative impact of an alien nectar robber on an endemic plant-gecko mutualism

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Abstract:

Pollination and seed dissemination are key reproductive processes of most flowering plants. While plants often recruit generalist animal pollinators and seed disseminators, a number of cases exist where the ecological interaction is more species-specific involving a few or a single known animal mutualist. One such example is the Mauritius endemic mono-specific *Roussea simplex* whose sole known pollinator is the endemic day gecko *Phelsuma cepedianana*, which also acts as its seed disseminator. However, such systems, particularly on oceanic islands like Mauritius, are now often subject to alien species invasion and impacts. *Roussea simplex* has been studied in this context and was found to be negatively impacted by the alien white-footed ant (*Technomyrmex albipes*). From the work of Hansen and Muller in 2009, this ant is not only a nectar thief of *R. simplex* and presumably therefore reduces its attractiveness to its pollinator, but also exerts interference competition with the gecko reducing its visitation rate and duration of visits. These authors found this competition to ultimately lead to reduced seed set which in turn may be a contributing factor to the observed decline of the plant which was common in the 1930's, but is now extremely rare. However, alien invasions and their impacts are known to sometimes vary through time and space. Consequently it matters for conservationists to characterize any such variation if they are to devise effective management measures for the conservation of *R. simplex*, and this forms the overall objective of our study. More specifically, we sought to quantify 1) the spatial variation of infestation rate of *Roussea* flowers by ants by sampling four natural populations, and 2) the temporal variation of infestation at the same two sites studied by Hansen and Muller about 10 years previously. For the temporal study, the two sites chosen were Le Pétrin and Bassin Blanc. All 46 flowers found were observed for presence of ants and when present, the species was identified and the flower infestation was determined by counting the number of individuals. The minimal possible distance travelled from the ground to the flower was also measured (referred to as 'ant-distance'). A baiting experiment was set up, using a sugar and peanut butter mix (weight ratio 1:18) to characterise the relationship between ant abundance and vegetation height. At each site, we placed 120 vertically arranged sticks randomly in the vegetation within the habitat of the *Roussea* and baited each at a single height at 50, 100, 150 and 200 cm above ground, giving 30 replicates per height per site. The sticks were baited in early morning and revisited four hours later to identify and count ants on baits. Flower observations revealed a low infestation rate (4.3%; N=46) and the first record of the invasive alien ant, *Anoplolepis gracilipes*, robbing nectar (at Bassin Blanc). Two ant species were sampled at Le Pétrin in the baiting experiment: the alien *T. albipes* and the native *Plagiolepis madecassa*. However, at Bassin Blanc, *T. albipes* was absent from baited sticks where *A. gracilipes* occurred, which suggests displacement by *A. gracilipes* as a putative explanation for the low abundance of *T. albipes* compared to previous studies. Baiting revealed a higher density of ants at Bassin Blanc (mean density = 98.24; SD = ±29.2) compared to Le Pétrin (mean density = 6.68; SD ± 5.4) (χ^2 -test: $p < 0.05$). The 'ant-distance' is positively correlated with the vertical height from the ground (one-way ANOVA; $p < 0.001$). The baiting experiment also showed that ant density decreases with vegetation height. This suggests that *R. simplex* may become more

accessible and sustain higher alien ant infestation as a result of alien plant invasion. Indeed, the latter is known to increase mortality of native trees, which themselves often serve as host to *R. simplex*. Death of host plants would cause *Roussea* to collapse to a position closer to the ground where alien ant infestation would be higher, creating a situation of invasional meltdown. Our study suggests that alien ants *per se* may be less biologically significant than shown previously, also because of major fluctuations in their population densities. We recommend that more attention be given instead to other more important threats, like that posed by alien rats, which destroy most flower buds and flowers.

Keywords: *Anoplolepis gracilipes*, invasive ants, nectar robbing, *Roussea simplex*, *Technomyrmex albipes*

Molecular Characterisation of Culturable Marine Microorganisms from The Marine Sponge, *Neopetrosia Exigua*

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Abstract:

Background: Sponges (Porifera) are multicellular sessile animals commonly known to be one of the most diverse phyla of the oldest lineage of all metazoans. They live predominantly in marine habitats, basically in the benthic communities of tropical oceans in great abundance but also occur in temperate waters and freshwater/lagoon. Sponges harbor diverse eukaryotic and prokaryotic microbes (archaea, bacteria, cyanobacteria, microalgae, protozoa). Sponge associated fungi represent a potential source of marine natural products, but studies about the diversity of sponge associated-fungi is still scarce, especially in the Mauritian sea sponge. The genus *Neopetrosia exigua* (*N. exigua*) belonging to the phylum Porifera, a tropical marine sponge, has been well explored for its natural product chemistry. These species constituents have shown great diversity by the continual discovery of new bioactive and secondary metabolites alongside some potent antibacterial activities from its crude extract. The study aims at isolating and identifying endophytic bacteria and fungi from local sponge *N. exigua* by culture-dependent techniques and molecular characterisation.

Methodology: *N. exigua* was sampled from the southern coastal water of Mauritius in less than 4 m depth. The isolation of cultured microorganisms was carried on different media and a standard Chelex® 100 protocol was chosen as DNA extraction method. PCR were carried out in 25 µl volumes using 16S rRNA and Internal Transcribed Spacer (ITS) primers. Phylogenetic analysis of the sequences was carried using PAUP® software. Antimicrobial activity bioassays using disc diffusion were carried and hence minimum inhibitory (MIC) concentrations were determined.

Results: Our findings reported a higher endophytic fungal isolation frequency (77%) as compared to sponge-associated bacterial isolation frequency (23%). Fungi belonging to *Trichocomaceae* and *Polyporaceae* family; and bacteria from *Bacillaceae* family were isolated in larger number. *Aspergillus* and *Hypocreales* sp. had exhibited the widest range of antibacterial activity against the human pathogenic bacterial strains (Methicillin-Resistant *Staphylococcus aureus*-MRSA, *Enterococcus faecalis*, *Proteus mirabilis*, *Vibrio Parahaemolyticus*) used. Our research was also the first to report the genera *Aspergillus*, *Epicoccum* and *Phoma* as endophytes in subtropical region.

Conclusion: During this study molecular characterisation helped in the identification of cultured bacteria and fungi from *N. exigua*. Hence, it was observed that *N. exigua* collected from Mauritius Island is a unique rich niche of diverse fungal cultured isolates from different families with potential antimicrobial properties which can contribute in providing cure in humans.

Keywords: *Sponge (Porifera), Neopetrosia Exigua, Endophytic fungi, Sponge-associated bacteria, Phylogeny, Taxonomy, Molecular Characterisation, Antimicrobial Activities, Disc Diffusion and MIC*

Morphological And Molecular Identification Of Fungi Associated With Benthic Dinoflagellates And Their Potential Antibacterial Properties

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Abstract:

Background: Dinoflagellates (Eukaryota; Alveota; Dinophyceae) are unicellular protists that are important primary producers in marine and estuarine ecosystems but are also implicated in many toxic outbreaks such as harmful algal blooms and seafood poisoning. Benthic dinoflagellates of the genera *Amphidinium*, *Coolia*, *Gambierdiscus*, *Ostreopsis* and *Prorocentrum*, are more prevalent in tropical and subtropical regions; with highest abundance of the genera *Prorocentrum* in the Mauritian waters. They are known for their toxicity to cause ciguatera fish poisoning, the most frequently reported seafood-toxin illness in the world, which affects the digestive, muscular and/or neurological systems in humans. Studies have demonstrated that bacteria associated with these toxic benthic dinoflagellates play a role in ciguatoxin production and that different clonal cultures harbor different culturable bacteria. But few studies have reported the association of fungi with dinoflagellates. Hence, this study aims at isolating and identifying fungi and bacteria associated with benthic *Prorocentrum* species by culture-dependent and molecular techniques in Mauritian waters.

Methodology: The benthic dinoflagellates, *Prorocentrum* species were sampled from macroalgae of the genera *Ulva* and *Turbinaria*, and dead coral, *Acropora* sp. by carrying out a stratification of the reef zones and a depth profiling at two different locations on the West coast of Mauritius. Molecular identification and phylogenetic relationships of the bacterial and fungal isolates were inferred from nucleotide sequences in 16S regions and ITS regions respectively. Antibacterial activities of selected fungal isolates were carried out against human pathogenic bacterial strains by disc diffusion test and MIC.

Results: This study resulted in a higher fungal isolation frequency (59.1%) compared to bacterial isolation (40.9%) in association with the benthic *Prorocentrum* species. Culture-dependent fungi were represented by eight genera with *Pestalotiopsis* sp. and *Phoma* sp. in larger number while the culture-dependent bacteria were represented by six genera with *Vibrio* sp. and *Providencia* sp. in higher frequency. The ethyl acetate extracts of *Phoma* sp., *Pestalotiopsis* sp. and *Pichia* sp. were shown to possess high antibacterial activity against pathogenic bacterial strains Methicillin-resistant *Staphylococcus aureus*, *Enterococcus faecalis*, *Vibrio parahaemolyticus* and *Proteus mirabilis*.

Conclusion: *Prorocentrum* sp. harbor not only bacteria as mentioned in previous studies but also fungi that were identified molecularly to determine their relationship with ciguatoxin production. It was also observed that the therapeutic potential of the fungal isolates can be an effective source in curing bacterial diseases in humans.

Keywords: *Benthic system, Ciguatera Fish Poisoning (CFP), Harmful Algal Blooms (HAB), Benthic Harmful Algal Blooms (BHAB), Dinoflagellate, Prorocentrum species, Phylogenetic analysis, Antibacterial activity*

Bioprospecting Mauritian endemic plants from the Arecaceae family for antioxidant, enzyme inhibition and cytotoxic activities

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Abstract:

The emerging interest in traditional medicines has prompted research in the screening of biologically active molecules from plants. The array of the Mauritian flora, notably, the endemic plants, is a rich source of secondary metabolites which possess prophylactic effects. However, little scientific investigation has been done to evaluate the pluripharacological properties of the endemic plants which ascribe from their vast polyphenol content. It is a known fact that plants accumulate important secondary metabolites through evolution as a natural means of surviving in a hostile environment. Considering the varying level of sunlight and temperature change throughout the year in Mauritius, these endemic plants are said to produce huge amount of secondary metabolites. The Arecaceae species *Dictyosperma album var. conjugatum*, *Hyophorbe lagenicaulis*, and *Latania loddigesii* are monocotyledons that produce low molecular weight phenolics that are of immense interest since they are easily absorbed into the body and can exhibit systemic effects successfully. Therefore, the aim of this study was made to assess the biological activities namely antioxidant, enzyme inhibitory and cytotoxic potential of the endemic crude, aqueous and organic extracts of the three Arecaceae species.

Crude extracts were fractioned into aqueous and organic layers. The extracts were subjected to quantification and analysis of their polyphenols. The polyphenolic content of the Arecaceae extracts was determined spectrophotometrically by Folin-Ciocalteu assay, $AlCl_3$ method and modified acid/butanol assay. Antioxidant properties were assessed by measuring the reducing power, metal chelating activity and scavenging potential. Moreover, enzyme inhibition abilities of the extracts were evaluated against xanthine oxidase and acetylcholinesterase enzymes. In addition, the anti-proliferative effects of the Arecaceae extracts were investigated against human liposarcoma SW872 cell line by the 3-(4, 5-dimethylthazol-2-yl)-2,5-diphenyl tetrazonium bromide (MTT) assay. Statistical analyses were performed using SPSS.

The crude extracts had the highest polyphenolic content followed by the aqueous and organic fractions. The IC_{50} of iron (II) chelating potential ranged from 3.12 to 6.23 mg/ml for the crude extracts with *L. loddigesii* showing highest activity. Deoxyribose degradation assay showed dose-dependent activity ($P < 0.05$) and their IC_{50} was between 84.92 to 850.04 mg/ml with the organic fraction of *L. loddigesii* being the uppermost hydroxyl scavenger. Concentration dependent relationship was also observed in enzymatic assays ($P < 0.05$) and the IC_{50} of xanthine oxidase and cholinesterase inhibition potential ranged from 9.16 to 317.29 mg/ml and from 28.35 to 721.54 mg/ml with *L. loddigesii* organic fraction showing the highest inhibition potential respectively. Anti-proliferative assay suggested that *L. loddigesii* possess high cytotoxic properties against SW872 liposarcoma with an IC_{50} of 0.015 ± 0.004 mg/ml. The overall order of biological properties was in a decreasing order from *L.loddigesii* > *H. lagenicaulis* > *D. album*.

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This study has gathered interesting and profound scientific information on the antioxidant, enzyme inhibition and cytotoxic properties of the Arecaceae species. Nonetheless, there are still many major challenges that need to be overcome and addressed for further investigation in the bioactivity of these species such as the selectivity of *L.loddigesii* for its cytotoxic properties. Overall, this study has opened many more avenues for supplementary analysis of the potential of the three species in preventing and treating diseases.

Keywords: antioxidant, enzyme inhibition, cytotoxic

A study investigating the perceptions and attitudes of community retail pharmacists and private clinicians towards generic medicines in Mauritius

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Abstract:

A generic medicine is an off-patent pharmaceutical product that is manufactured and marketed without the necessary authorisation from the originator/brand company. Generic medicines are known to be multisource formulations, that is, these can be marketed under a non-proprietary name or a brand name. The usage of generics and/or generic substitution (GS) has become a common practice as a means of reducing cost and allowing easy access to medication mainly due to their lower cost in comparison to brand drugs. Pharmacists and physicians are considered key figures in promoting access of generics to the population since they are the main channels through which the public gets medication. Therefore, good awareness and attitudes of health professionals towards the use of generics are expected from them to encourage use of generics. However, controversies do remain concerning the quality, efficacy and safety of generic drugs resulting in an evident dearth of awareness in relation to the quality, efficacy and safety among pharmacists and clinicians.

The study highlights the knowledge, understanding, perceptions and attitudes of community retail pharmacists and private clinicians concerning generic medicines in Mauritius, their views on quality, efficacy and safety, the will of pharmacists to recommend and/or dispense and clinicians to prescribe generics and their views on GS.

An extensive literature review stressing on generic medicines was conducted using electronic databases such as Science Direct, Medline, Springer Link and Biomed Central to identify relevant materials and bibliographies of the retrieved journals were also reviewed. Two questionnaires addressing the aims and objectives of the study were designed for the pharmacists and clinicians. A cross-sectional survey was then conducted among 150 community retail pharmacists and 55 private clinicians who were randomly selected from different urban and rural areas of the island. The data collected and results were analysed using Microsoft Excel 2013 and SPSS version 20.

A response rate of 44.7% and 74.5% was achieved for the community pharmacist and clinicians respectively. Males and participants with greater working experience were found to have better understanding on generics ($p < 0.05$) in both pharmacist and clinicians cohort. Clinicians above 30 years ($p < 0.05$) and who graduated from foreign countries showed better knowledge on generic medicines than those graduating from Mauritius ($p < 0.05$). Most of the pharmacists agreed that a generic is bioequivalent (71.6%) and therapeutically equivalent (73.3%) to its brand version. Clinicians also showed good knowledge on bioequivalence (78%) and therapeutic equivalence (73.2%). Both cohorts were observed to have mixed perceptions on the quality, efficacy and safety of generics. Nevertheless, a positive attitude was observed among pharmacists and clinicians since they were found to actively recommend and/or dispense (79.1%) and prescribe (85.4%) generic medicines respectively. Furthermore it was found that pharmacists with increasing working experience ($r = -0.307$, $p < 0.05$) and those who graduated from foreign countries ($r = -0.371$, $p < 0.05$) were less likely

to recommend and/or dispense generics. The study showed that with increasing age ($r = 0.497$, $p < 0.05$) and working experience ($r = 0.388$, $p < 0.05$), their will to prescribe generics increased. Both pharmacists (77.6%) and clinicians (61%) were found to support generic substitution mainly due to lower cost to patients. However, when participants were asked on pharmacist's right to perform GS, 77.6% of pharmacists and only 36.6% of clinicians agreed to this.

The findings of this study show that pharmacists and clinicians had a sound understanding of generics and brand medicines and pharmacists and/or clinicians with greater years of practice showed better awareness. However, gaps in the knowledge of both pharmacists and clinicians were identified which reflected the concerns raised on their perceptions regarding quality, efficacy and safety of generics. Also, clinicians were found to have poor understanding of GS in comparison to pharmacists. This calls for an urgent intervention of educational programs for healthcare professionals in relation to generic medicines so as to increase their proper awareness in this field.

Some limitations in the study included scarcity of literature material, time and budget constraint and lack of response from participants.

Keywords: Generics, Pharmacists, Clinicians, Perceptions, Attitudes

Potential risk factors for kitchen-home based foodborne illnesses.

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Abstract:

Background: Home-based foodborne illnesses are under-reported. Cross contamination and lack of hygienic practices could contribute for such outbreaks. The aim was to study the bacterial load and isolate potential pathogens from kitchen towels and kitchen tables, including preparation tables and dining tables. This study also investigated factors such as kitchen set up, hygienic practices and food safety knowledge which could affect the presence of the potential pathogens and food spoilage bacteria.

Methods: A total of 100 kitchen towels were collected after one month of use and 212 table samples were collected by swabbing over an area of 5cm by 5cm. The samples were processed for bacterial count which was read as colony forming units (CFU), followed by isolation and identification of potential pathogens.

Result: Knowledge on hygiene was not always put into practice. Coliforms, *Enterococcus* spp., *Pseudomonas* spp., *Proteus* spp. and *Staphylococcus aureus* were detected from both dining and preparation tables. The mean CFU and presence of potential pathogens were significantly affected by the hygienic practices of the main food handler of the house, materials of kitchen tables, use of plastic covers, time of sample collection, use of multipurpose sponges/towels for cleaning and the use of preparation tables as chopping boards ($p < 0.05$). *S. aureus* was isolated at higher rate from families of lower socio-economic status ($p = 0.00$) and those with children ($p = 0.01$). Multipurpose towels had higher CFU than single use towels (1.31×10^7 vs 6.60×10^4 ; $p < 0.05$) and humid towels had higher CFU than dry ones (4.8×10^5 vs 0.5×10^5 ; $p < 0.05$). Coliform was detected at higher levels from multipurpose towels than single purpose (53.3% vs 10.5%; $p < 0.05$: OR=2.01: 95% CI 1.29-2.99).

Conclusion: Kitchen tables and towels could be very important source of potential pathogens causing foodborne diseases. The use of plastic covers, multipurpose sponges and towels should be discouraged. Families with children should pay more attention to kitchen hygiene.

Keywords: hygiene, kitchen, bacteria, cross-contamination.

Past and current distributions of the relictual, Mauritius endemic plant species, *Roussea simplex*

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Abstract:

A species' geographic range and its variation through time constitute some of the key ecological characteristics of flowering plants, which furthermore often have evolutionary implications and help shape intraspecific diversity. It is also considered as a valuable parameter for conservationists as it is often a good predictor of extinction risk and represents a vital piece of information for enabling conservation management. Plants endemic to oceanic islands often have naturally small geographical range and populations. These are however exacerbated by threats like anthropogenic habitat destruction and fragmentation which often reach extreme levels on islands, as exemplified by Mauritius. Consequently, many plant species of oceanic islands often decline to a highly restricted distribution, which itself helps trigger an extinction vortex alongside concurrent impacts such as herbivory, seed predation or competition by invasive species. This creates heightened conservation challenges and urgency. Here, we use the Mauritius endemic mono-specific scrambler, *Roussea simplex* as a model of oceanic island plant to investigate and quantify the extent to which geographical range would have changed since human colonization. Previously recorded as abundant, the plant is now known from isolated patches principally in habitat remnants on mountains and ridges. While this species has already received significant scientific attention, no study has as yet quantified the change in its distribution range through time despite this being paramount in assessing its risks of extinction. Here we review the temporal changes that have occurred in the geographic distribution of *R. simplex* through the measurement of its past and current range sizes, so as to characterize the trend and speed of change. Beyond its usefulness as a model for other island plant endemics, this information would also be useful for determining the species' Red List Category as per the guidelines of the International Union for the Conservation of Nature. We compiled all records and dates of collection of the species during the 215 years since its description in 1789 using the available literature, as well as herbarium specimens from local and foreign herbaria for comparison with distribution data obtained through recent surveys from 2005 to 2016. For each record, the latitude and longitude data were extracted from Google Earth after localising the collection site. The records were mapped using the geographical information system, GeoCAT, which also measured two parameters required to determine the Red List criteria of the species: extent of occurrence (EOO, the land area contained within the minimum convex polygon containing all points of occurrence), and area of occupancy (AOO, area estimated by superimposing a grid onto occurrence points and calculating the cumulative area of 2x 2 km cells occupied). The differences between past and present distribution were then calculated. The literature survey revealed 17 distinct locations for *R. simplex*, with currently only seven extant populations (Bar le Duc, Bassin Blanc, Grand Bassin, Le Pétrin, Le Pouce Mountain, Piton Savanne and Trou aux Cerfs). The current EOO is 146.649 km² and AOO is 28 km² showing approximately 60% and 53% decline in these respective parameters relative to the maximum known distribution. Based on this information and on other threats the species should be considered as "Endangered". The seven known locations fall within protected areas, though only that of Le Pétrin receives conservation management. The last published population size was 85-90 individuals by Hansen and Muller in 2009. The latest counts

(2011-2016) indicate over 200 plants, since previous surveys missed a number of plants. The range of *Roussea simplex* is declining and there is little hope to see the trend reversed unless with active conservation management. The declining distribution is linked to habitat transformation to plantations or hunting grounds but also to the impacts of alien invasive plants such as *Psidium cattleianum*, *Ligustrum robustum* and animals, including rats, monkeys and, to a smaller extent, ants, which hinder the species reproduction. Our study objectively quantifies the change in distribution of an island endemic plant that was once common and is now in danger of extinction. Resolute conservation management seems to be warranted to save this and similar species from extinction, since location in a protected area clearly does not stem the species' decline.

Keywords: *Roussea simplex*, distribution, IUCN status, oceanic island

Bio-mining the medicinal treasures of the Mauritian sea: Antioxidant and Epigenetic activities of marine sponges collected from Mauritian waters

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Abstract:

During the last two decades, the marine biome has blossomed as a quasi-inexhaustible goldmine of structurally unique and highly pharmacologically active natural products, several of which have entered the global pharmaceutical pipeline as Food and Drug Administration (FDA) registered anticancer drugs. Among marine organisms, reef's invertebrates are the most prolific producers of bioactive extracts and are, therefore, preferential targets in the search for novel drugs. In this vein, this study was undertaken to explore the anti-oxidant, cytotoxic, and epigenetic activities of some selected marine sponge species with the aim to identify bioactive extracts that can spawn potential avenues in the global hunt for novel anti-carcinogenic chemotherapeutics. In this work, marine samples including four sponge species (*Neopetrosia exigua*, *Aaptos chromis*, *Iotrochota birotulata* and *Haliclona tuberosa*) were collected from geographically different coastal areas of Mauritius. The total crude extracts (CE) were obtained from the sponge species using a mixture of dichloromethane and methanol (1:1) followed by liquid-liquid partitioning with hexane (HF), ethyl acetate (EAF) and water (AF). Subsequently, using an array of established *in vitro* biological and chemical models, the marine total crude and fractionated extracts were screened for their (i) anti-oxidative propensities in terms of their radical scavenging, iron reducing and metal chelating potentials (ii) cytotoxic effects on six human cancer (Oesophageal (OE 33, OE 19, FLO-1, KYSE 30), Colorectal (HCT 116) and HeLa) cell lines via the AlamarBlue Metabolic Assay (iii) epigenetic effects in a HeLaGFP model and (iv) total phenolic and flavonoid content as potential indicators of their biological activities. Remarkable diversity in the level of polyphenolic content and antioxidant capacity depending on marine species and solvent extracts were observed. The total phenolic (TPC) and flavonoid (TFC) content varied widely from 2.00 ± 0.19 to 37.09 ± 0.64 mg GAE FDW/g and 0.23 ± 0.04 to 12.33 ± 0.53 mg QE FDW/g, respectively. In particular, highest amount of TPC and TFC was measured in EAF of the sponge *N. exigua* (TPC: 37.09 ± 0.64 mg GAE FDW/g; TFC: 12.33 ± 0.53 mg QE FDW/g) ($P < 0.05$). Concurrently, maximum antioxidant activity was recorded in EAF of *N. exigua* by virtue of its ability to scavenge ABTS^{•+} (91.46 ± 1.08 μ Mol TE/g FDW), nitric oxide (IC₅₀: 0.44 ± 0.06 mg/ml) and hydroxyl (IC₅₀: 0.56 ± 0.05 mg/ml) radicals. The iron chelating (IC₅₀ 0.14 ± 0.01 mg/ml) and ferric reducing activities (45.69 ± 1.15 μ Mol Fe (II)/g/FDW) were also highest in EAF of *N. exigua*, thus suggesting its ability to be a peroxidation protector. On the other hand, EAF of *A. chromis* displayed the highest superoxide radical scavenging activity (IC₅₀: 0.26 ± 0.03 mg/ml) ($P < 0.05$). Cellular studies demonstrated that the marine extracts exhibited a dose dependent cytotoxic activity. An overall pronounced cytotoxic activity was recorded by EAF of *N. exigua* particularly against FLO-1, and HeLa cell line. The ability of the sponge extracts to re-activate tumor suppressor

genes was also assessed in a HeLaGFP model. Amongst, the CE of *N. exigua* re-activated GFP expression in 82.8% of the HeLa cells, hence showing epigenetic activity that warrants further investigation at molecular level. Results reported herein suggest that the marine sponge *N. exigua* has high potential as a source of chemopreventive agents. However, overall weak to moderate correlation coefficients infer that polyphenols were not major contributors to its tested biological activities. In this perspective, further characterisation of the active constituents and in-depth investigations at the molecular level are warranted.

Keywords: Antioxidant, Cytotoxic, Epigenetics, Sponges, Polyphenolics

Association of *ApoA5* (-1131T>C) polymorphism and risk for CHD in a Mauritian subpopulation

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Abstract:

Coronary heart disease (CHD) is the leading cause of mortality across the world, with an estimated 7.4 million people dying from this disease in 2012 (WHO, 2016). According to Health Statistics for 2012, 17.9% of total deaths in the Mauritian population were attributed to cardiovascular diseases.

CHD is a complex disease characterized by lipid accumulation with plaque formation in the coronary arteries. It is caused by a combination of genetic and environmental factors. Numerous risk factors influence the development and severity of the disease including diabetes, hypertension, dyslipidemia, and obesity.

In addition to environmental factors, genetic mechanisms play an important role in determining susceptibility to dyslipidemia. *ApoA5* forms part of a gene cluster together with *ApoA1*, *C3* and *A4* located on chromosome 11q23 and this gene cluster has been identified as a candidate region for hyperlipidemia. *ApoA5* is a key gene involved in the regulation of plasma triglycerides levels. Variants in *ApoA5* gene have consistently been associated with hypertriglyceridemia in various populations including Caucasians, Chinese, and Indians. On the other hand, conflicting results have been reported with CHD: Studies in Chinese and Hungarian populations reported significant association of *ApoA5* variants with CHD whereas studies involving Caucasians and Asian Indians revealed a lack of association.

The present study was carried out to investigate the contribution of *ApoA5* gene to increased susceptibility to coronary heart disease in Mauritian population of North Indian origin.

A case/control design was used to test for association between *ApoA5* and CHD in Mauritians of North Indian origin. For this study, we chose to genotype the *ApoA5* (-1131T>C) variant, found in the promoter region of the gene. It is one of the most studied *ApoA5* variant and was found to be associated with CHD and/or hypertriglyceridemia in different populations.

A total of 352 CHD patients and 239 healthy controls were genotyped using Polymerase Chain Reaction/ Restriction Fragment Length Polymorphism (PCR/RFLP) technique: DNA samples were amplified by PCR, followed by digestion with restriction enzyme *Mse*I. The digested products were then separated by electrophoresis on agarose gel and visualized under ultraviolet light.

Statistical analysis was carried out using Epi info software (Version 3.5.1, CDC, Atlanta, August 2008, www.cdc.gov/epiinfo). Two-by-two tables were used to explore associations between allele frequencies and phenotypes and two-by-three tables were used to compare genotypes between affected and unaffected groups.

We applied Bonferroni correction for multiple testing since this variant was one of a total of 16 genetic variants genotyped within a larger study carried out to search for potential candidate gene(s) that may contribute to increased risk to CHD in the Mauritian population. A p-value of <0.003 was thus considered as statistically significant.

Allelic frequency analysis showed no difference in allelic distribution between CHD patients and controls ($p=0.67$), even when stratified by sex ($p=0.94$; 0.83 in male and female respectively). Similarly, genotype analysis revealed no association between (-1131T>C) polymorphism and CHD phenotype in our study population ($p=0.53$).

Further data analysis showed significant association between (-1131T>C) polymorphism and triglycerides levels in male CHD patients ($p=0.0006$) with CC genotype being associated with higher levels of plasma triglycerides (3.2 ± 2.6 mmol/L) as compared to CT genotype (2.7 ± 3.5 mmol/L) or TT genotype (1.9 ± 1.3 mmol/L). No association was observed in the female CHD patient group ($p=0.26$).

Our present study did not find any association between the *ApoA5* (-1131T>C) variant and increased risk to CHD in the population studied. However, this variant was found to be associated with increased plasma triglycerides levels in male CHD patients. Our results are quite similar to results from another study involving Asian Indians whereby *ApoA5* variants were found to be associated with elevated triglycerides levels and not with CHD.

To conclude, *ApoA5* (-1131T>C) variant does not contribute to increased susceptibility to CHD among Mauritians of North Indian origin but influences plasma triglycerides levels in male CHD patients, suggesting a gender-specific interaction.

Keywords: Coronary heart disease, dyslipidemia, hypertriglyceridemia, *ApoA5* (-1131T>C) polymorphism, North Indian

DNA sequence analyses of *Colletotrichum*, a pathogenic fungus

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Abstract:

Background: The genus *Colletotrichum* comprises common phytopathogenic fungi, causing anthracnose disease in various hosts specially economically important crops worldwide. Therefore, accurate *Colletotrichum* species and subspecies identification is crucial for disease management and pathogen control. Traditional methods, e.g. morphological characterisation and host specificity, were the initial methods of identification and phylogenetic classification but their recurrent failure to resolve several taxa has led to the introduction of molecular techniques (DNA sequence). The Internal Transcribed Spacer (ITS) region, the current fungal DNA barcode, is the most famous phylogenetic marker, but there has been several records of ITS unreliability to resolve *Colletotrichum* phylogeny, accounting for an increase use of other markers such as β -tubulin (TUB2) and actin (ACT) and use of methods such as multi-gene phylogeny instead of single-gene phylogeny. The aim of this study was to analyse DNA sequences, such as ITS, β -tubulin (TUB2) and actin (ACT) to understand/resolve *Colletotrichum* phylogeny and to assess their reliability as phylogenetic markers.

Methodology: Gene sequences of 179 species were retrieved from the National Institute of Health (NIH) genetic sequence database, GenBank. Four different datasets were generated during the alignment process with the CLUSTALW software; ITS, TUB2, ACT and a combined (ITS-TUB2-ACT) dataset. Phylogenetic analyses were performed using MEGA 6.06. Microsoft Excel 2007 software was used to tabulate any additional data.

Results: The ITS phylogenetic tree were not properly resolved with very poor statistical support and no intra- or inter-specific resolution. The two other genes, ACT and TUB2, resulted into statistically more supported and more resolved trees. Phylogenies from the combined dataset analyses were found to be more appropriate, with highest resolution at both inter- and intra-specific level and high statistical support. A new clade A, unknown to literature, is proposed herein. 5 species are accommodated in this new classification from ITS based phylogenies; *C.brevisporum*, *C.orchideanum*, *C.cliviae*, *Colletotrichum* sp LL-2015 isolate LJTJ30 and *C.lagenarium*. Further investigations showed that *C.lagenarium* was a case of misidentification based on a BLASTN similarity search and that *C.brevisporum*, *C.orchideanum* and *C.cliviae* shared conidial morphology similarity. It was also found that taxon misidentification and mislabeling can be very common in GenBank.

Conclusion: This study has demonstrated that ITS failed to resolve *Colletotrichum* genus phylogeny despite being the current fungal barcode. Also, the two other gene sequences, ACT and TUB2, were phylogenetically more informative, with higher phylogenetic signal. Moreover, multi-locus dataset proved to provide the most statistically supported phylogeny with the best resolution at both inter- and intra-specific level. The importance of molecular techniques and barcoding in species classification cannot be ignored. In fact, the advances in molecular techniques nowadays should be used as an asset to solve phylogeny of other species, not only limited to the fungal world, but other microorganisms such as the bacterial species. On the other side, due to risk of taxa misidentification and mislabeling, it is

recommended to verify any sequences retrieved from GenBank or any public database prior to its use in a study.

Keywords: *Colletotrichum*, anthracnose, DNA sequence, ITS, molecular phylogeny

Gene expression biomarkers of heat stress in scleractinian corals: Promises and limitations

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Abstract:

Scleractinian corals are the principal habitat builders of modern coral reefs. As such, they are critical components of one of the most diverse ecosystems on Earth. Corals are delicate symbioses between an animal host and diverse dinoflagellate algae in the genus *Symbiodinium*. Climate change, overfishing, nutrient pollution, disease, ocean acidification, and coastal development are among the escalating direct and indirect human pressures contributing to reef decline and many of these varied stressors can result in coral bleaching through the expulsion of algal symbionts, or through reduction in their per-cell pigment concentrations. Sustained periods of elevated sea surface temperatures, usually in shallow areas where the incident solar irradiance is also high, are now recognized as the principal factor driving contemporary mass coral bleaching events. Severe episodes of mass coral bleaching usually result in high coral mortality, leading to decreases in coral cover.

Although conservation of coral reefs is a global environmental concern, the tools for implementing proactive management solutions are currently lacking, particularly for evaluating health *in situ* and for predicting response of corals to stressors. The advent of molecular tools and resources for corals has highlighted the possibility to develop gene expression biomarkers (GEBs) as a means of detecting and quantifying coral stress even before the onset of symptoms. Gene expression biomarkers are emerging as powerful diagnostic tools for identifying and characterizing coral stress. Their capacity to detect sublethal stress prior to the onset of signs at the organismal level that might already indicate significant damage makes them more precise and proactive compared to traditional monitoring techniques. A high number of candidate GEBs, including certain heat shock protein genes, metabolic genes, oxidative stress genes, immune response genes, ion transport genes, and structural genes have been investigated, and some genes, including *hsp16*, *Cacna1*, *MnSOD*, *SLC26*, and *Nf-kB*, are already showing excellent potential as reliable indicators of thermal stress in corals.

However, despite more than a decade of research, it is unclear how accurately the occurrence of stress factors can be predicted based on changes in the expression of coral and symbiont genes. There is still no universally accepted biomarker of thermal stress, the molecular response of corals to heat stress is still unclear, and biomarker research in *Symbiodinium* still lags behind that of the host. This study synthesizes the current state of knowledge of scleractinian coral GEBs and highlight gaps in our understanding to identify directions for future work. We also address the underlying sources of variation that have sometimes led to contrasting results between studies, such as differences in experimental set-up and approach, intrinsic variation in the expression profiles of different experimental organisms (such as

between different colonies or their algal symbionts), diel cycles, varying thermal history, and different expression thresholds.

We propose *hsp16*, *Cacna1*, *MnSOD*, *SLC26*, peroxidase-like protein, *CaM* and *NF- κ B* as having high potential as heat stress biomarkers for coral hosts, and cytochrome P450 as a potential heat stress biomarker in *Symbiodinium*. Since different coral individuals might respond in different ways the use of a single universal GEB might be insufficient, and instead rather a suite of GEBs might be needed to assess heat stress. Among the identified gaps, stress specificity is a priority research gap that needs to be filled for these genes. Future work needs to establish whether expression patterns of these GEBs can indeed be correlated with a specific stressor and if their expression is consistent across coral taxa. If gene expression biomarkers are to be useful, these issues must be addressed in the development of suitable markers. We also outline a framework for the direction of future research for the rapid translation of acquired knowledge of coral GEBs into a practical approach that could be used by reef managers around the world.

Keywords: coral, bleaching, gene expression biomarkers, thermal stress, molecular diagnostics

Iron-Deficiency Anaemia in Pregnancy: Knowledge, Attitudes and Practices of Pregnant women in Mauritius

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Abstract:

Iron-deficiency anaemia is known to be the most frequent case of anaemia in the world and highly affects pregnant women. Indeed, it has been shown that among the 56 million cases of anaemia registered in the world, 50% are due to iron deficiency. Seeing that the knowledge, attitudes and practices of pregnant women towards this particular topic can largely help to prevent IDA, it is therefore important to investigate on them, especially in Mauritius where there is a lack of studies on anaemia. The aim of the study is to evaluate the knowledge, attitudes and practices of pregnant women in Mauritius towards Iron Deficiency Anaemia (IDA). The objectives of the study are to analyse the level of knowledge, attitudes and practices of pregnant women in Mauritius towards IDA during pregnancy and also to determine whether their knowledge level has any effect on their practices.

A survey was carried out mainly in prenatal private consultations in Mauritius whereby 200 pregnant women were asked to fill a self-designed questionnaire concerning a set of questions related to the topic. The results were analysed in four parts; the personal information of the participant, the knowledge based answers, the attitude based answers and the practices based answers. SPSS (Statistical Package for Social Sciences) software was used to examine the data collected. Frequency tests as well as cross-tabulation and correlations were performed using the software. During this study, it was found that 34% and 33% of the pregnant women have high and medium knowledge level respectively while 33% showed low knowledge level. A 23% of the women acknowledged of being unaware of IDA. Those that are familiar with IDA agreed that poor nutrition is the main cause of this condition but are quite unknowing about the complications of anaemia during pregnancy. The women displayed satisfactory practices and attitudes in relation to the importance of iron supplements and consumption of appropriate food products that can help to avoid IDA. 36% and 38% have high and medium attitude level respectively while 28% have a high level of practice and 38% have medium practice level. Iron bioavailability seems to be a neglected factor by the women during their meal. It was found that the women consumed non-heme iron more than heme iron based on statistical values where it was shown than 70% consume fruits more than once a day while only 29% consume meat more than once a day. Finally, the study showed that there was a positive correlation (r value: 0.048) between the level of knowledge and the level of practice of the women towards IDA.

It can be concluded from the study that pregnant women in Mauritius have satisfactory level of knowledge, attitudes and practices in regards to IDA. Also, it was found that the highly knowledgeable they are towards IDA, the better are their practices in order to maintain a better health during pregnancy and hence reducing the risk of developing this type of anaemia. Important factors like iron tablets, food consumption and pregnancy intervals should not be neglected during pregnancy which is why it is important for every woman to gather the appropriate information to prevent any risk of IDA. Anaemia during pregnancy can be critical for both mother and foetus. Statistics have shown than 20-40% of maternal mortality cases is due to anaemia. Therefore the results of such a study provide a clear insight

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mostly on the knowledge of pregnant women on IDA in Mauritius. Furthermore, appropriate measures can then be taken to ensure that the correct information on IDA reaches all the concerned women.

Keywords: Iron –deficiency anaemia, pregnancy, knowledge, attitudes, practices.

**POSTER
PRESENTATION**

Monitoring and Analysis of CO₂ and NO₂ levels in a tropical city

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Abstract:

Air pollution is an environmental phenomenon where there is contamination of the air by any chemical, physical or biological agent that alters the natural chemistry of the atmosphere. The extent of air pollution depends on the point sources which can be household combustion, motor vehicles, industrial plants and forest fires. The most important pollutants causing major harm to public health are, carbon dioxide, carbon monoxide, ozone, oxides of nitrogen and sulfur and particulate matter. Both outdoor and indoor air pollution affect negatively the human health. Hence monitoring of the air quality is crucial in order to verify whether the air pollutants are within the limits set by the World Health Organization (WHO).

As a preliminary study the air quality in Port-Louis, the capital city of Mauritius is monitored. This city is highly visited during the day. Recent figures show that an annual average daily traffic (AADT) of 90,000 enters the capital. Four sites are chosen namely on the rooftops of State Bank of Mauritius (SBM) Building, Air Mauritius Building, Mauritius Telecom Tower and Sun Trust Building. The gases monitored are carbon dioxide (CO₂) and nitrogen dioxide (NO₂). The period of monitoring started from February 2015 for CO₂ monitoring while from September 2015 for NO₂ measurement. The monitoring for CO₂ lasted for one year while for NO₂ it lasted for six months. From the time-series data it is noted that the CO₂ concentrations vary from 400 to 950 ppm whereas those for NO₂ vary from 40 to 100 ppb. The peak values for both sets of data are recorded during the early traffic peak hours.

The Ensemble Empirical Mode Decomposition (EEMD) method is employed to analyze the trends in the time-series data by decomposing them into several Intrinsic Mode Functions (IMFs) with different characteristic scales and a residue. The CO₂ levels increases monotonically while the NO₂ levels decreases linearly with an average gradient of 1.0174 ppb/day. Overall, it can be concluded that the air quality in the capital is still of good quality. However, care must be taken to make sure that over time the concentration of these gases do not increase any further.

Keywords: EEMD, Trend Analysis, Carbon Dioxide, Nitrogen Dioxide.

Comparative analysis of nucleic acid extraction methods from marine molluscs of Mauritius

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Abstract:

Marine molluscs are among the oldest invertebrates on Earth. Besides being ecosystem engineers among benthos, they have been useful to man, but, since the past decade, they have been threatened by overexploitation, pollution, and climate change. To review and monitor the status of marine molluscs of Mauritius, molecular techniques, e.g. sequencing, can be used to exactly identify species and determine their distribution patterns and diversity which have implications for conservation. The primary step of any genetic study is the extraction of high molecular weight, good quality and quantity of DNA. Since molluscs tissues contain mucopolysaccharides and phenolic proteins that co-purify with DNA, various nucleic acid extraction methods, e.g. salting-out and phenol-chloroform based methods, have been developed. However, their efficiency seem to vary across genera as differences in quantity and quality of nucleic acids are reported when same methods are used on different genera of molluscs, limiting the availability of optimised DNA extraction protocols. In this study, four nucleic acid extraction protocols reported to work on marine organisms were tested on the genera: *Planaxis*, *Cypraea* and *Drupella*. Individual molluscs handpicked at Pointe-aux-Piments and Flic-en-Flac were placed in ice till laboratory. The protocols: Sokolov (2000) (Method I), Zamoum and Furla (2012) (Method II), Geist *et al* (2008) (Method III) and QIAGEN[®] DNeasy Blood and Tissue kit (Method IV) were conducted in at least triplicates for each genus and the integrity, purity and percentage yields of nucleic acids were compared to eventually determine which one works best on each genus. Weighed samples of foot muscle tissue from each individual marine mollusc were removed and homogenised (Method I only). Then, they were incubated in their respective lysis buffers, as per the incubation temperature and times mentioned by each protocol. For Method II, tissues had to be incubated in sodium hydroxide before lysis and Method I involved the addition of saturated potassium chloride to further remove muco-polysaccharides. Method I featured two phenol-chloroform extraction steps, while Methods II and III featured only one, followed by chloroform extraction in Method III. For Methods I, II and III, the nucleic acids were precipitated using ice-cold isopropanol and the resulting pellet was washed with 70% ethanol before eluting in an appropriate amount of storage buffer. Method IV was carried out according to the manufacturer's specifications. The nucleic acids extracted were assessed for DNA integrity by agarose gel electrophoresis and UV-spectrophotometry at 260 and 280nm to determine the percentage yield, concentration and purity. The results show that Methods I and III can extract high molecular weight (>10,000bp) but degraded nucleic acids as oxidised phenol is reported to degrade the latter. All protocols tested effectively extract pure DNA with ideal purity values (1.8-2.0). The difference in efficiency of methods in each genus lies in percentage yields as statistically significant results were obtained and degree of degradation of nucleic acids. The best protocols are those which yield high amounts of comparatively least degraded nucleic acids. The best protocol for *Cypraea* and *Drupella* is Method I whereas for *Planaxis*, Method III although being time-consuming. Method II does not extract high molecular weight nucleic acids but this protocol involves steps important for

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the stability of DNA in the long run. Method IV is the safest and fastest method as no phenol is used, but extracts lowest yields of nucleic acids which is inappropriate if rare marine molluscs are to be genetically characterised. We can therefore conclude that, the efficiency of nucleic acid extraction protocols is genus-specific. Although Methods I and III are timewasting, they extract relatively less degraded nucleic acids in high yields. If Methods I and III are to be used on marine molluscs, it is recommended to use fresh tissue samples and store nucleic acids in aliquots at -20°C to minimise degradation. To optimise Method I, we recommend a threefold increase in incubation time in lysis buffer and perform one phenol-chloroform and one chloroform-only extractions as the latter is reported to remove residual phenol. If Method III needs to be used faster, it is advised to use a lysis buffer containing strong detergents, e.g. Sodium dodecyl Sulphate and/or Cetyl Trimethyl Ammonium Bromide, and 20 μl Proteinase K. For downstream applications, the nucleic acids extracted should be purified using RNAase to obtain DNA only.

Keywords: Nucleic acid extraction, marine molluscs, *Cypraea*, *Drupella*, *Planaxis*, Mauritius

Investigating the sensitivity of *Staphylococcus aureus* and *Escherichia coli* to novel antimicrobial derivatives.

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Abstract:

The emergence of multi-drug resistant bacteria has become a major problem worldwide, affecting the efficacy of currently available antibiotics. Antibiotics that were once very effective eventually act as a selective pressure for microbes, thereby initiating their natural biological response, that is, evolution. We are now on the brink of a “post-antibiotic era” due to the overuse and inappropriate prescription of antibiotics, and the present demand for antimicrobials with novel mechanisms of action against new targets is alarmingly increasing. The DNA-targeting aptitude of metal complexes and the discovery that some antibiotics are more active when administered as metal complexes instead of organic molecules, have made synthesis of metal complexes a subject of great interest. The goal of this study was to explore the antibacterial activities of the Schiff base ligand *o,o'*-(*N,N'*-dipicolinyldene)diazadiphenyl disulfide (PAPS) and its metal complexes (Pd and Cu) as well as a Pd thiosalicylate complex, which have been previously synthesized *in vivo* and *in vitro*. Considering the fact that several *Escherichia coli* and *Staphylococcus aureus* strains are sources of many serious infections around the world and have displayed multidrug resistance capacity, these bacteria were chosen for this antimicrobial sensitivity study. Furthermore, they are likely to reflect a broader view of the metal complexes' activities on both Gram-negative and Gram-positive bacteria in general. High quality genomic DNA (gDNA) was extracted from *E. coli* and *S. aureus* using the ZR Soil Microbe DNA MiniPrep Kit. The gDNA extracts were incubated with varying concentrations of the compounds and the effects were observed by agarose gel electrophoresis. Cu PAPS and Pd thiosalicylate effects on gDNA were found to be concentration-dependent, whereas Pd PAPS was found to be approximately 50- to 100-fold more reactive as it could degrade bacterial gDNA even at a low concentration of 25 µg/ml. In parallel, spectrophotometry was used to analyse the effects of selected metal complexes on live *E. coli* and *S. aureus* cells by plotting bacterial growth curves and by analysing any changes with respect to the control used. The bacterial cells cultured in liquid media were subjected to the test compounds in their early exponential phase and aliquots from the test and control flasks were taken every 30 minutes to measure absorbances at 600 nm. Plate counting was carried out alongside spectrophotometry to strengthen reliability of results. An alteration of the bacterial growth curve was only observed when *S. aureus* was treated with Pd PAPS. *S. aureus* was found to be more sensitive to the metal complexes compared to *E. coli*, which could be due to differences in their envelope structure. The colony counting method tallied with the inhibitory effect of Pd PAPS demonstrated by the *S. aureus* growth curve in that a much lower number of colonies were observed from cultures treated with this metal complex as compared to the control culture. Cu PAPS and Pd thiosalicylate were effective in degrading bacterial gDNA at higher concentrations *in vitro*. However, further experimentation is required to test whether these metal complexes can penetrate the bacterial cell membrane for proper evaluation of their antimicrobial activities. Pd PAPS could be viewed as a potential antimicrobial considering its efficiency in degrading gDNA *in vitro* and its ability to markedly inhibit the *in vivo* growth of *S. aureus*. However, further studies should

be carried out to investigate the toxicity of this compound to human cells. These findings could possibly provide an insight into design of novel antimicrobials that could be used to treat bacterial infections.

Keywords: *Staphylococcus aureus*, *Escherichia coli*, antimicrobials, metal complexes, *o,o'*-(*N,N'*-dipicolinyldene)diazadiphenyl disulfide

Chemical and Biological Profiling of *Mangifera indica* Leaves

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*Corresponding Author. E.mail: mbhowon@uom.ac.mu; sabina@uom.ac.mu**Abstract:**

Mauritius a small island state relies heavily on importation of meat and dairy products. Local production of cattle and goat are limited and not well organized. Pasture fields are limited and are on decline. Meadow lands are continuously being converted into residential areas, shopping centers and for setting up of new hotels or industrial zone. Small livestock breeders need to look for alternative feed sources for their animals especially during the dry months of the year. One option could be to use mango leaves as fodder. Mango tree is an evergreen plant present naturally all around Mauritius and grown in many backyards and it withstands the dry period very efficiently. However, the problem is that very little research has been carried out to test for the suitability of mango leaves to be used as fodder. The aim of the present work is to evaluate the nutritional content of mango leaves and to investigate whether the leaves could be used as a source of fodder for ruminants. Dried and powdered leaves of *Mangifera indica* (Dauphiné variety) were analyzed for different chemical constituents using the proximate analysis. The ash, crude fat, neutral detergent fiber, acid detergent fiber and acid detergent lignin contents were 12.61, 3.92, 35.32, 34.98 and 12.86% respectively and these parameters were within the range of values reported for major fodder trees. The calcium content (2.15%) was above the normal requirement range and slightly above what is considered to be the maximum tolerable limit (2%). Nevertheless, a few major fodder trees have been reported with calcium% higher than that measured for the mango leaves. The phosphorus content (0.12%) was within the normal requirement range of common fodder. The only drawback was the relative low crude protein content (7.37%). The phytochemicals screening of the hexane, ethyl acetate and methanol extracts of the mango leaves revealed the presence of several classes of secondary metabolites. Saponins, alkaloids, phenols, tannins and flavonoids were present in the ethyl acetate and methanolic extracts. Steroids were detected in the methanolic extract while coumarines were found in the hexane extract. Diterpenes were found in the hexane and ethyl acetate extracts. The total phenolic and flavonoids contents of the different extracts were determined using Folin-Ciocalteu's method and aluminium chloride colorimetric method respectively. The concentration of phenolic compounds and flavonoids in the ethyl acetate extract were 186 and 191mg/g compare to 99 and 45mg/g in the methanolic extract. The overall phenolic content and flavonoid content were calculated to be 3.3g per 100g of leaves and 2.2g per 100g of leaves respectively. The antioxidant property of the extracts was determined using DPPH assay. The SC₅₀ values for ethyl acetate extract was 80µg/ml and that of methanol extract was 313µg/ml. Mango leaves can therefore be used as a supplementary fodder but due to its low crude protein level, feeding animals with the mango leaves alone would not be enough to satisfy the protein demand of the animal. It would be more correct to mix the mango leaves with other forages that are relatively rich in crude protein level before being given to the animals. Ruminants feeding on mango leaves could benefit from secondary metabolites and antioxidants present in the leaves that have been demonstrated to be involved in the prevention of several diseases and the promotion of health.

Keywords: *Mangifera indica*, metabolites, anti-oxidant, fodder, phytochemical

A study on the use and sale of common Ayurvedic medicines on the Mauritian marketN. Elaheebocus¹ and F. Mahomoodally^{1*}¹Department of Health Sciences, Faculty of Science, University of Mauritius, Réduit, Mauritius*Corresponding Author. E-mail: f.mahomoodally@uom.ac.mu**Abstract:**

Ayurvedic medicine (AM) is a legalized medical system in Mauritius and is now practised by many registered Ayurvedic practitioners. It is seen as a flourishing and successful business by the increasing number of Ayurvedic outlets across different regions of the island offering a wide range of Ayurvedic medicines. These outlets are visited by many Mauritians seeking an Ayurvedic treatment against their respective diseases. AM is considered as a significant system which is widely exploited by a large population in Mauritius. Nonetheless, until now, no documentation has geared towards exploring the use and the sale of AM in Mauritius.

The present study aims at exploring the sale of Ayurvedic medicines in Mauritius and at documenting common Ayurvedic products used in the treatment and management of diseases available on the Mauritian market.

This study took a survey based approach whereby a semi structured questionnaire of close and open ended questions was used as survey instrument. Ayurvedic outlets situated in different regions of Mauritius were identified through the help of health care professionals, families, friends and other acquaintances and additionally through the use of Mauritius Telecom Yellow Pages, multiple online sources available to the Mauritian public and newspapers. Ayurvedic outlets consenting to participate were visited whereby face-to-face interviews were undertaken with Ayurvedic practitioners/directors/dispensers. Relevant data on Ayurvedic product containers were recorded for the purpose of documentation. The products dispensed to patients were classified according to the International Classification of Diseases 10.

A total of 16 Ayurvedic outlets were surveyed, including pharmacies (n=3), clinics (n=2), shops (n=5) and centres (n=6). Among the outlets, there were private establishments (n=11), government-owned centres (n=3) and parastatal bodies (n=2). Ayurvedic medicines are dispensed freely in the three governmental health centres while they are charged in the private and parastatal Ayurvedic centres. The Mauritian market offers a panoply of both Ayurvedic formulated products (Punarnavarishta, Septiline®, Madhunashini vati, Mansyadi kashaya, Ekangvir ras, Triphala churna, Koflet®, Kanchnar guggulu) and single herb products (Giloy satva, Gymnema, Brahmi, Amla churna, Liquorice, Bakuchi churan) to patients for the purpose of treating and managing a large variety of diseases like cardiovascular diseases, metabolic disorders, mental and behavioral disorders, digestive disorders, diseases of the musculoskeletal system and connective tissue amongst others. Besides, one local manufacturer formulating his own products without GMP guidelines was encountered during the study. Ayurvedic medicines are dispensed in the form of tablets (*vati*), powders (*churna*, *bhasma*, *mandooora*, *parpati*), syrups (*arista/asava*), decoction (*kwath*), oral and topical oils (*taila*). Diabetes, high blood pressure, hyperlipidaemia, joint pain associated with arthritis, heart diseases, skin diseases, weight loss, sexual dysfunction and liver disorders are examples of health complications where Ayurvedic treatment is being adopted. It was also found that six outlets dispensed AM strictly on prescription while the remaining offered AM both on prescription and over-the-counter.

Ayurvedic medicines are extensively used by a significant number of Mauritians. There is already a wide range of Ayurvedic products on the local market available to the population. Ayurvedic treatment is being daily sought to treat a number of chronic health complications. As such Ayurvedic medicines have to be used, dispensed and sold in a regulated and healthy way so as not to jeopardize people lives. The current regulatory regime of Ayurvedic medical system is weak and thus has to be reinforced to integrate it fully into the healthcare system.

Keywords: Ayurvedic outlets, Ayurvedic medicines, sale, use, dispensing, Mauritius.

A Study to Investigate the Perceptions and Attitudes of Adult Diabetic Patients towards Generic Medicines in Mauritius

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Abstract:

Around the world, approximately 347 million people are affected with diabetes. The most affected are low and middle income countries with about 80% of deaths resulting from diabetes. According to World Health Organisation, Mauritius holds the second position worldwide with a percentage of 21.3% of affected individuals. Mauritius being a middle income country, health management using the minimum cost is essential. Therefore, it is important to promote the use of generic drugs in people with major health issues, one of the most prevalent diseases in Mauritius – diabetes. The aim of this study was to investigate about the perceptions and attitudes of diabetics towards generic medications in the Mauritian population; the knowledge of diabetics have about generic drugs; the generic and brand drugs most commonly used and what they do to manage their disease.

This research was a survey-based study where 258 diabetics were interviewed using a face-to-face semi-structured questionnaire. The inclusion criteria were: (1) diabetics from nursing homes; (2) those coming to pharmacies; and (3) ambulatory patients while the exclusion criteria were: (1) pregnant women and (2) pre-diabetic patients. The survey was conducted among randomly selected diabetic individuals from October 2015 to mid-February 2016 and the interviews were done mostly in Creole and French. The questionnaire was formulated to evaluate the health status of the patient; knowledge, perceptions and attitudes towards generic drugs; medication intake and management of diabetics. The data collected was analysed using statistical tools such as Statistical Package for the Social Sciences (SPSS) and Microsoft Office Excel version 2007. Spearman's correlations were performed since the distribution was non-parametric. The significance level was at 0.05 ($p < 0.05$).

Major findings of the study were as follows: 38.9% of diabetic patients had the knowledge on generic drugs. While assessing the perceptions on generic drugs, respondents considered generics to be safe (70.4%); less costly (72.1%); and equal in quality (18.0%). However, 56.1% were indecisive if generics had more side-effects as compared to brand drugs while 51.6% of the patients were also uncertain whether generics had the same effectiveness as brand medications. Moreover, the results obtained while assessing the attitudes of diabetics revealed that participants agreed they should have an option in choosing between generic and brand drugs (58.2%). Age was found to be inversely correlated to the attitude of 'option in choosing between generic and brand medications' ($r = -0.203$, $p < 0.05$). This implies as age increases, patients more strongly believed that they should have an 'option in choosing between generic and brand medications'. The other attitudes assessed were that generics provide the respondents with significant savings (75.5%); 48.4% of the participants did not mind substitution to generics by the pharmacist; and the willingness to take generics as opposed to brand drugs was almost the same. In addition, 67.7% of the participants used generic drugs while 32.3% used brand medications. The most commonly used generic were metformin (44%) and gliclazide (23%) as opposed to the brand drugs Glucophage[®] (4%) and the insulin injection Actraphane[®] (4%). Furthermore, oral hypoglycemic medications and

controlled diet (21.3 %) are most commonly used as therapy to manage their diabetes. Also, a high rate of physical inactivity was observed (70.1%) among respondents.

A large proportion of diabetics were indecisive while assessing the perceptions and attitudes on generic medicine. This could be due to the relatively low knowledge about generics in Mauritius. Hence, education about generics must be increased to give the population the required knowledge so that they can easily take a decision and implement the use of generic medications more frequently. Along with education, policies should be developed and implemented to help ensure the success of generics. The main limitation of the survey was that the level of understanding of the patients was low since most of the respondents interviewed were elderly people. Also, other limitations included data was collected only for two months due to limited time and budget constraint.

Keywords: Generics, Perceptions, Attitudes, Knowledge, Diabetes

Synthesis, Physicochemical and Biological Studies of Cyclic Amino Based QUATS in Single and Mixed Micellar Systems

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Abstract:

Surfactants are considered to be a fundamental ingredient in detergents, consisting of up to 40% of the total detergent formulations. With this view, the demand of the detergent industry towards the development of soap formulations with improved detergency in the past few years has been a major driving force for the synthesis of new surface active agents as potential ingredients in cleaning agents. Conventional surfactants that are used in detergent compositions have been found to possess interesting physicochemical behaviour such as good interfacial, surface activity and foaming abilities. With the increase in environmental awareness among consumers, the development of biodegradable and less toxic surfactants having good interfacial and biological properties for potential use in biomedical applications have become an important area that need to be addressed. In this perspective, amino acid surfactants have emerged as a much safer and environmentally friendly alternative to conventional surfactants over the last decades. Among the 20 amino acids, proline consists of a cyclic secondary amine structure which gives it an exceptional conformational rigidity. Proline based surfactants have been found to possess interesting physicochemical as well as biological activities. Optically active as well as racemic mixtures of *N*-acyl proline based surfactants have been found to aggregate spontaneously in aqueous solutions. Proline based surfactants bearing ester and amide linkage have been found to interact strongly with DNA.

In this study, a series of quaternary ammonium compounds (QUATS) with varying chain lengths (C₈-C₁₄) derived from *L*-Proline were synthesised. The physicochemical and biological properties of the proline QUATS were evaluated in both single as well as in sodium dodecyl sulphate (SDS) mixed systems, with a view of enhancing the properties of the individual surfactants as potential ingredients in detergent formulations. The critical micelle concentrations (CMC) of the proline QUATS in single and SDS mixed systems were determined by conductivity method. The antibacterial activities of the proline QUATS in both single and SDS mixed systems were determined using the broth dilution method and their activities were expressed as the Minimum Inhibitory Concentration (MIC) with respect to the gram positive and gram negative bacteria tested. The foaming ability of selected proline surfactants as well as their ocular irritancy was investigated to evaluate their use in cosmetics and detergent formulations. The presence of the quaternary ammonium moiety and an increase in alkyl chain length were found to enhance the antibacterial activity of the proline QUAT derivatives. The foaming ability of the QUATS was found to increase with the hydrocarbon chain length. QUATS with longer alkyl chains tend to form more stable monolayers compared to those with shorter chains, giving rise to stable foams. The antibacterial activity of the mixed system was also found to be governed by the monomers rather than the micelles. The SDS-C₁₄ proline QUAT mixed system displayed good antibacterial activity with optimum activity at mole fractions α_{QUAT} : 0.4 and 0.6 and also showed moderate ocular irritancy which makes them potential candidates as detergents.

Keywords: Proline, Surfactants, Antibacterial, Foaming, Ocular irritation

***Phytophthora infestans* mitochondrial haplotypes II and Ib detected in Mauritius**

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Abstract:

Phytophthora infestans is the disease responsible for severe late blight in potato and tomato worldwide. Tubers are easily infected and with the worldwide distribution of seed tubers, the pathogenic oomycete has been propagated across the five continents. New exotic strains of the oomycete have also recently made their appearance in several potato- and tomato-growing regions, and these new strains are far more virulent and fungicide-resistant. In order to understand the epidemiology of this economically important disease and for better disease management, it is of primordial importance to phenotypically and genotypically characterise the existing strains of *P. infestans* that cause disease outbreak on the island every year. The most common characterisation methods used worldwide include sensitivity to metalaxyl, mating type analysis, isozyme analysis, virulence tests and mitochondrial haplotyping. Polymorphisms in mitochondrial DNA (mtDNA) is a particular useful method used to monitor the population as they can be easily detected. mtDNA are uniparentally transmitted to offspring and are considered as ideal genetic markers to trace back the specific lineage of the pathogen. In this study, mitochondrial haplotyping was used for the characterisation of the pathogen into the four different haplotypes Ia, Ib, IIa and IIb. Basically type I and II of *P. infestans* mtDNA can be categorised by means of polymorphism lengths caused by an ~2 kb insertion, which can be detected via restriction enzyme digestion. Previous mitochondrial haplotype studies in Mauritius indicated a great genetic diversity in the local late blight pathogen population. In these previous works, it was also found that the island has a very diverse population, but Ia had not yet been detected despite Ia haplotype being globally distributed. In this study, five different *P. infestans* isolates (TS1: collected at Réduit from infected tomato foliage; PR1: collected at Réduit from infected potato foliage; ML: collected at Mare Longue from infected potato foliage; T11: collected at Réduit from infected tomato foliage; PS1: collected at Plaine Sophie from infected potato foliage) were used and isolated from different locations around Mauritius during the blight season of 2015 and isolated on potato substratum and then sub-cultured on antibiotic-containing pea agar medium. DNA was then extracted from pure mycelium culture plates using the GeneJET Genomic DNA Purification kit (ThermoFisher Scientific). After DNA extraction, four different primer sets (F1 and R1, F2 and R2, F3 and R3 and F4 and R4) were used for PCR amplification of the mitochondrial genome, as per the protocol published by Griffith and Shaw (1991), generating products P1, P2, P3 and P4. Product P2 cut with *Msp* I uniquely identifies haplotypes Ib and IIa, while types Ia and IIb are differentiated by digestion of product P4 with *EcoR* I and digestion of products P1 (with enzyme *Cfo* I) and P3 (with enzyme *EcoR* I) give results similar to that with digestion of P4. Our results indicate that TS1 and PR1 belong to haplotype Ib, while isolates ML, T11 and PS1 belong to haplotype II. This is the first report of the existence of haplotypes Ib and II in Mauritius, and contribute to the genetic characterization of the local population of *P. infestans*.

Keywords: Late blight disease, *Phytophthora infestans*, haplotypes, mitochondrial DNA

Sensitivity of the Oomycete *Phytophthora infestans* to Various Fungicides Commonly Used to Treat Potato Late Blight Disease in Mauritius

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Abstract:

Late blight disease, caused by the oomycete *Phytophthora infestans*, is an economically important disease that affects the Solanaceae plants, mainly potato (*Solanum tuberosum*) and tomato (*S. lycopersicum*). Chemical control, using fungicides remains one of the most widely used management strategy to control the populations of the pathogen. Originally the sprays were of copper compounds but these were superseded by the dithiocarbamates and organotin in the 1960s. The introduction in the late 1970s of the phenylamides brought a new dimension to blight control but there was a rapid development of resistance in the blight pathogen. This quickly brought about a change in the fungicide spraying schedule. Due to the rapid rate of mutation in this pathogen, fungicide-spraying strategies to control the disease have to be constantly reviewed in each specific location where the disease causes severe outbreaks. The current fungicide spraying schedule advised by the Food and Agricultural Research & Extension Institute (FAREI) in Mauritius involves the use of three different types of fungicides: contact, systemic, and local systemic. However, in the field, the fungicides are used against diverse pathogens, without means of knowing exactly how these fungicides are affecting *P. infestans* growth alone. The aim of this study was to assess the resistance of *P. infestans* individually to Metalaxyl (not recommended by FAREI, but still used worldwide as a curative measure) as well as one contact fungicide, Dithane M 45, one systemic fungicide, Infinito 687.5 SC, and one local systemic fungicide, Acrobat MZ WG. The sensitivity test was carried out *in vitro* using an agar-based assay to assess the efficacy of these particular fungicides on the independent growth of *P. infestans*. A total of four isolates (PR1: collected from Reduit on infected potato leaves; TR1: collected from Reduit on infected tomato leaves from cultivation plot 1; TR2: collected from Reduit on infected tomato leaves from cultivation plot 2; and PC1: collected from Cascavelle on infected potato leaves) were used for this study; these isolates were sub-cultured a first time onto agar medium amended with antibiotic mix and a second time onto agar medium amended with both antibiotic mix and fungicides at three different concentrations (0, 5, 100 µg/ml) for Metalaxyl and five different concentrations (0, 0.1, 1, 10, 100 µg/ml) for the other three fungicides respectively. The effectiveness of each concentration of fungicide on *P. infestans* was then assessed by measuring the radial diameter of growth of the oomycete on the agar medium daily for 14 consecutive days. The results show that Metalaxyl was effective in controlling growth of the oomycete in only two (PC1 and TR1) out of the four isolates and ineffective in the other two (PR1 and TR2). It even stimulated growth in the isolate PR1. Dithane M 45 was effective in controlling growth of the oomycete in three (PC1, TR1 and TR2) isolates, and Acrobat MZ WG was effective in all four isolates. The systemic fungicide Infinito 687.5 SC was largely ineffective in controlling growth of the oomycete, with two isolates (PC1 and TR2) being completely resistant and oomycete growth being stimulated in the other two (PR1 and TR1). The results of this research shows that Metalaxyl and Dithane M 45 can still be used as a late blight control measure in Mauritius, although it is highly likely that existing fungicide-sensitive strains will quickly develop resistance in the future. The systemic fungicide Infinito 687.5 SC is not an effective control measure as it stimulates the rate of growth of the

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pathogen rather than inhibiting it, therefore not recommended in fields infected with late blight only. In case of the local systemic fungicide Acrobat MZ WG, all isolates tested were sensitive with no signs of resistance yet, thus indicating that it can be used as an effective fungicide to control late blight in Mauritius. The results obtained provide direct experimental support for continued vigilance regarding further introductions of exotic strains of *P. infestans* into Mauritius and a constant revision of fungicide-spraying schedules in late blight-susceptible fields.

Keywords: Late blight control, *Phytophthora infestans*, Fungicides, Resistance.

A study on the pharmaceutical care in geriatric patients in Mauritius

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Abstract:

Pharmaceutical care (PC) includes the provision of safe and patient-oriented care and monitoring of drug therapy by pharmacists. It deals with patients' welfare, medication counselling and management of side-effects. PC is affected by poor communication, lack of time and privacy, drug-related problems and patients' expectations. Geriatrics, who refer to persons aged 60 years and over, are mostly associated with diseases, physical disabilities and memory disorders and thus, need close monitoring. The PC assessment of elderly patients by pharmacists monitors medical therapy, improves communication and adherence and prevents medication errors. Besides, the supervision of geriatrics' medication safety reduces the high risk of polypharmacy and adverse drug reactions (ADRs). In order to regulate PC provision, the International Pharmaceutical Federation and World Health Organisation have established guidelines and standards to help pharmacists in their daily responsibilities. However, the level of PC still varies in each country despite of legislation modifications undertaken especially in European countries. The objective of this study was to assess the level of PC provided by community pharmacists to geriatric patients in Mauritius by evaluating patients' satisfaction and compliance, assessing the relationship between pharmacists and patients and identifying ADRs.

A cross-sectional survey was carried out in different urban and rural regions of Mauritius from November 2015 to January 2016. Data was collected with two sets of questionnaires designed for healthcare providers and elderly patients respectively. The total sample size consisted of 59 community pharmacists and 92 geriatric patients and statistical analyses were performed through SPSS version 20.0 using bivariate correlations and chi-square tests and Microsoft Excel 2010 software.

Major findings included the general satisfaction of elderly patients with PC delivery at retail pharmacies. Geriatrics (96.5%) also perceived the importance of pharmacists and their indispensable and effective roles in the healthcare system. Moreover, community pharmacists were generally unsatisfied of the actual PC delivery in Mauritius as only 34.5% declared that the current PC practice is positive and consequently, 98.3% emphasised on the need for continuous PC education in the country. PC provision is actually controlled in Mauritius by the Pharmacy Board which acts as the authoritative source. Concerning patients' compliance, all pharmacists certified to counsel patients where 94.8% assessed health problems and 94.9% explained to patients what is expected from their drug therapy. The relationship between geriatrics' adherence and their approach with pharmacists was statistically significant ($p < 0.05$) as elderly patients affirmed to understand more their drug therapy with better communication. Besides, the communicative relationship maintained between pharmacists and geriatrics regarding drug-related issues was mutually favourable. The link between the patient-pharmacist communication and the number of years of work experience of pharmacists in the healthcare field was statistically proved ($p < 0.05$). Surprisingly, 72.4% of private pharmacists were unsatisfied of their collaboration with physicians. Furthermore, 44.1% of pharmacists had ADRs reports from geriatrics and 52.7% attempted to identify drug-related problems in elderly patients. In case of ADR report, community pharmacists

either referred it to the pharmacovigilance unit or contacted the prescriber. On the other side, 40.3% of geriatrics were informed of side-effects. 20% have encountered ADRs where 58.8% reported them mostly to their doctors.

Mauritian pharmacists are gradually providing patient-centred care by applying PC concept in their daily duties. However, there are limited laws and regulations and a lack of additional training and pharmaceutical education that influence PC in Mauritius. Hence, patient-pharmacist communication should be enhanced to promote medication safety and there is an imperative need for PC improvements in the healthcare system of Mauritius.

Keywords: pharmaceutical care, geriatric patients, pharmacists, communication, adverse drug reactions

Studies on antimicrobial properties of microorganisms isolated from mangrove wetlands in Mauritius

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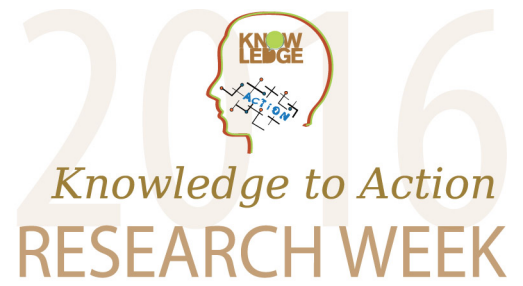
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Abstract:

Mangroves are forests of salt-tolerant shrubs and trees that grow in shallow tidal waters of estuaries and coastal areas in tropical and subtropical regions. Mangroves are amongst the world's most productive ecosystems and host a rich variety of marine organisms including other plants, animals, fungi and prokaryotic organisms. Marine microorganisms are of considerable importance as potential sources of a huge number of biologically active products. Due to the constant variation of environmental conditions, the microorganisms present in marine environment are more suitably adapted to adverse conditions, and produce structurally complex natural products of biotechnological interest. Marine actinobacteria, including *Streptomyces*, *Actinomyces*, *Arthrobacter*, *Corynebacterium*, *Frankia*, *Micrococcus*, *Micromonospora* are reported to be the most economically and biotechnologically invaluable prokaryotes. Actinobacteria belonging to the family Actinomycetaceae are well known for their ability to produce secondary metabolites many of which are active against pathogenic microorganisms. They produce a wide range of bioactive secondary metabolites such as antibiotics, anti-tumour agents, immune suppressive agents and enzymes and these metabolites are known to possess anti-bacterial, anti-fungal, neuritogenic, anti-cancer, anti-algal, anti-malarial and anti-inflammatory activities. Traditionally, actinobacteria have been isolated from terrestrial sources. Microbes of mangrove ecosystems as a source for biologically active secondary metabolites are largely unexplored though they potentially offer a rich resource for the discovery of novel pharmaceutical drugs to counter and reverse the spread of drug resistant pathogens. This study aims at investigating the antimicrobial and cytotoxic activity of microbial isolates from the mangrove wetlands at the Ramsar site of Pointe d'Esny, Mauritius which houses the two mangrove species reported in Mauritius i.e. *Rhizophora mucronata* and *Bruguiera gymnorhiza*. Sampling was carried out at the proximity of representatives of each of the mangrove species in a zone where the substrate is covered by water levels between 0-30 cms at high tide. The microbes were extracted from the samples using double distilled autoclaved water, filtered double distilled autoclaved seawater, and dilute sterile Ringer's solution. The latter were plated on two different medium namely Zobell marine agar and rich nutrient agar. At the sampling sites, the pH varied between 7.5 - 8 corresponding to the pH of sea/brackish water. The salinity was lower than average ocean salinity (35 ppt). Under such conditions, we expect to find moderate halophiles or halotolerant organisms. Extraction using seawater and Ringer's solution were found to yield more colonies than extraction with unsalted water. We observed a total of eleven phenotypes including white colonies, creamy white colonies and orange colonies of different morphology, and mycelium type creamy colonies. Representatives of each of the colonies were further streaked out for generation of eleven isolates. Total genomic DNA was extracted from the six sediment samples and from the eleven isolates. Fragments of the bacterial 16S rRNA gene were amplified from each DNA extract by the polymerase chain reaction. These fragments were ligated into the pJet1.2 vector for transformation of *Escherichia coli* for production of recombinant clones. The recombinant clones were isolated and DNA purified for sequencing. Once the isolates are

identified through the sequence of their ribosomal gene fragment and ensuing phylogenetic studies, they will be assessed for their antimicrobial activities or other biotechnological potential.

Keywords: Mangrove wetlands, bacteria, antimicrobials, 16S rRNA



Faculty of Social Studies and Humanities

Transitions: Challenges and Implications



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**ORAL
PRESENTATION**

Le phénomène de l'insécurité linguistique : le cas de l'île Maurice.

P.Ahtoy*

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Résumé:

L'île Maurice est un pays plurilingue où les deux langues principales, l'anglais et le français foisonnent avec la langue nationale (le créole mauricien) dans une dynamique de contact, à tel point que les locuteurs eux-mêmes en viennent à entretenir un rapport ambivalent et parfois même conflictuel avec les langues. Alors que le français fait figure de langue maternelle pour certains : c'est en effet la première langue parlée à la maison- car associée à la langue du prestige, de l'avenir- (le créole est souvent proscrit, car c'est une langue minorée, « qui ne servira pas »), il est évident que c'est souvent un « français mauricien » qui est usité, assez loin des normes du français standard, ce qui peut être source d'insécurité, parfois même d'incompréhension, lors de contacts avec d'autres communautés linguistiques francophones. Bien que les manuels scolaires soient tous rédigés en anglais, l'enseignement à Maurice est assuré tantôt en anglais, tantôt en français ou même en créole. A la fin de leur scolarité, les Mauriciens se revendiquent donc plus ou moins « bilingues », voire trilingues.

Cette situation diglossique assez conflictuelle renforce donc ce sentiment d'insécurité linguistique (Van den Avenne.) L'insécurité linguistique provient essentiellement de la forte conscience de la norme, de la langue standard qui tend à prévaloir, au détriment de la « langue locale ou régionale », ce qui peut engendrer un sentiment d'infériorité ou de dévalorisation linguistique chez le locuteur. Ainsi, cette notion d'insécurité linguistique est essentiellement liée à la norme et à la communauté linguistique.

Dans cette petite île majoritairement francophone, comment est-ce que les locuteurs du français perçoivent-ils la langue française? Maurice est l'un des seuls pays au monde, où le français est toujours aussi vivant et en progression constante. Comme le souligne Le Monde diplomatique dans son dernier numéro de septembre 2014, qui cite la « francophonie paradoxale »- titre de l'ouvrage de Didier de Robillard et de Daniel Baggioni, le français demeure « l'un des idiomes les mieux compris et parlés par la majorité des citoyens — même si beaucoup le maîtrisent mal.

Ce projet de thèse s'inscrit donc dans une volonté de mieux comprendre la place qu'occupe la langue française à Maurice et l'insécurité linguistique provoquée chez ses locuteurs. Il s'agira d'établir dans un premier temps la définition de l'insécurité linguistique par rapport à la situation particulière du français à Maurice. Nous ferons dans une deuxième partie une étude diachronique de la construction des identités francophones et des rapports à la langue française par une étude de terrain effectuée auprès d'un échantillon varié de la population. L'approche retenue sera celle d'une approche qualitative avec une posture empirico-réflexive. Enfin, cette réflexion critique se propose d'aboutir à la mise en place d'une proposition pour réduire l'insécurité linguistique ressentie par les locuteurs et viser l'amélioration de la formation des enseignants de français, car ils représentent les acteurs principaux de la présence du français à Maurice.

Mots-clés: Sociolinguistique, didactique des langues, plurilinguisme, francophonie, variations.

Prédicats d'état, adjectifs et verbes statifs en mauricien

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Résumé:

L'objectif de cet exposé est de proposer des sous-classes des prédicats d'état selon des critères syntaxiques. Cette ébauche de classement est une contribution au débat sur l'existence d'une classe adjectivale en mauricien. En effet, la majorité de ces prédicats appartiennent à la catégorie des adjectifs dans la langue lexificatrice du mauricien, le français.

L'étude des propriétés distributionnelles des lexèmes en question fait apparaître très clairement qu'il ne s'agit pas d'une classe homogène. Le classement est basé sur trois critères :

- (i) la compatibilité avec le verbe *vinn* qui veut dire 'venir' ou 'devenir'. Ce test permet d'isoler les prédicats d'état des verbes dénotant des procès.
- (ii) la compatibilité avec le perfectif (*f*)*inn*.
- (iii) la compatibilité avec la marque du progressif.

Dans tous les cas où un lexème est compatible avec le progressif, il est aussi compatible avec le perfectif (*f*)*inn*. La première sous-classe est celle des items [- perfectif] et [+*vinn*], c'est-à-dire des prédicats d'états les moins 'verbaux'. Comme ils ne peuvent jamais se combiner avec une marque d'aspect, je propose d'appeler cette classe les adjectifs proprement dits.

La deuxième sous-classe est celle qui admet le perfectif et le progressif et qui est incompatible avec *vinn* : [+aspect], [-*vinn*]. Elle comprend les lexèmes *malad* et *fatige* qui sont des prédicats d'état temporaire et les verbes psychologiques. Je propose l'étiquette 'verbes statifs' pour cette classe.

Les items de la troisième sous-classe [+aspect], [+*vinn*] sont compatibles à la fois avec *vinn* et avec une marque aspectuelle. Elle ne comprend que les mots suivants : *mir* 'mûr/mûrir', *fay* 'frêle/s'affaiblir', *fre* 'froid/refroidir' et *fou/ toke* 'fou' (cf. Alleyne 1996: 64 and Véronique 1983: 208). Je les analyse comme des items sans catégorie (prédicats acatégoriels), et dont la catégorisation s'effectue en syntaxe.

La quatrième sous-classe comprend les items qui sont [+*vinn*], [+perfectif] et [-progressif]. Ce sont des prédicats d'état qui produisent une interprétation résultative lorsqu'ils sont combinés avec *finn*, et qui n'admettent pas le progressif. De nombreux lexèmes en font partie, tels que ceux désignant la dimension physique ou la couleur.

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Mots-clés: syntaxe, adjectif, prédicat d'état, grammaire

La traduction : du vocable au concept (pratique, art, discipline scientifique)

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Résumé:

Dans un monde désormais défini par la mouvance et la globalisation, les frontières langagières (telles qu'elles étaient alors appelées) sont devenues aujourd'hui sinon obsolètes, du moins en quête de redéfinition. Quant aux langues, elles ne peuvent plus se permettre d'être hermétiques face aux changements qui s'opèrent. La traduction serait un catalyseur de l'évolution et des progrès à divers niveaux : social, économique, technologique, culturel, linguistique, entre autres. Selon un rapport réalisé en 2010 par Euréval pour la Commission européenne, la traduction est un élément clé dans la préservation de la diversité linguistique et culturelle dans une société multilingue qui peut éventuellement permettre le maintien d'un équilibre entre les différentes langues, sans rapport de force entre elles, ce qui pourrait nous ramener à l'affirmation de Umberto Eco : « *la lingua dell'europa è la traduzione* » (la langue de l'Europe est celle de la traduction). Cependant, la traduction n'a pas toujours la place qui lui revient de droit.

Comment alors définir ce 'catalyseur' qu'est la traduction ? Nous tenterons au cours de cette communication, de démontrer la dimension polysémique et la diversité référentielle de la traduction. Vocables aux déclinaisons multiples, la traduction en tant que concept renvoie tantôt à une pratique, tantôt à un art ou encore à une science. Selon Bassnet (1980), les positions à l'égard de la traduction et des concepts traductionnels dépendent de l'époque à laquelle ils ont été produits. Mais c'est surtout le rôle et la fonction des traductions et des traducteurs selon les époques, qui lui ont donné ou qui lui ont privé, de ses titres de noblesse. Considérée comme une pratique avant d'être étiquetée science ou encore étude scientifique, la traduction a transcendé les millénaires. Discipline pluridisciplinaire, la traductologie n'est pas une science exacte mais oscille entre sciences humaines et sciences naturelles. Contrairement aux sciences exactes, la traductologie en tant qu'activité de théorisation et pratique d'écriture, ne peut se poser comme une éthique respectant des valeurs dogmatiques. L'épistémologie de cette discipline est donc cinétique, et paradoxalement, c'est cette mouvance qui permet à cette discipline scientifique en mal de reconnaissance de se développer. Nous tenterons au cours de cette communication de voir les différents aspects de la traduction : du vocable au concept (pratique, art, discipline scientifique).

Mots-clés: Semaine de la recherche, Université de Maurice, traduction, vocable, concept

From an *Ausbau* to an *Einbau* language: The ethnolinguistic dimension of status planning in Pandit Atmaram's *Hindu Mauritius* (1936)

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Abstract:

Following Fishman (2000, 2006), this paper explores the ways in which language planning, more specifically status planning, can result in the subsuming of an autonomous language variety with low social valence into one perceived to be more prestigious. Defined as "the engine which pulls the language planning train" (Fishman, 2000: 43), status planning enhances the social appeal of a language, ascribes functional goals to it and earns it the political support necessary to ensure its longevity. Involving the selection of one language or language variety at the expense of others, status planning is, in contrast to both corpus and acquisition planning, quite understandably, deemed to be more "politically encumbered" (Fishman, 2000: 44).

Indeed, while such political pressure can give rise to an *Ausbau* (a 'building away') process which promotes the structural autonomy of a specific variety, it can also culminate in the creation of an *Einbau* ('building together') language (ibid). Having as its goal the eventual fusion of two mutually intelligible language varieties, the *Einbau* process is often spearheaded by dominant social, political or ethnic factions (Fishman, 2006). The move from an *Ausbau* to an *Einbau* language is, thus, particularly relevant in multilingual and multiethnic communities where linguistic insecurity coupled with the tenuous co-existence between different ethnic groups can result in instances of status planning which are "partial, contestable and contested, and interest-laden" (Woolard and Schieffelin, 1994: 58).

In keeping with the above theoretical perspective, this paper focuses on Mauritian Bhojपुरi (MB) and the relationship of co-dependence that it shares with Hindi. Indeed, in 2012, while Mauritian Creole (MC) was successfully integrated within the primary education system as an 'optional' subject, the official status attributed to MB by the Ministry of Education and Human Resources was that of a "corollary of Hindi" (MOEHR, 2014: 25). Defined by the *OED* as a supplementary or in some cases, even an ancillary issue attached to a more important cause, a 'corollary' can, in the long run, be overlooked by decision-makers. By extension, the fate of a corollary language is also bound to be an uncertain one: denied the stability and mass recognition that *Ausbau* status could have provided it, it exists in the precarious position of being either totally or partially swallowed up by a more powerful *Einbau*. So far as MB is concerned, therefore, its newly-acquired status as a 'corollary' language implies that far from existing in a diglossic relationship with Hindi (cf. Siegel, 1990; Eisenlohr, 2006), it appears to be gradually ceding its *Ausbau* status to the latter.

As this paper further argues, this move from a MB *Ausbau* language to a Hindi/MB *Einbau* merger is one whose origins can be traced back to the period of British colonisation as descendants of the Indian indentured labourers brought to the island following the abolition of slavery attempted to preserve their linguistic heritage. Drawing from Pandit Atmaram's book *Hindu Mauritius* (1936), this paper seeks to correlate the loss of the *Ausbau* status of MB to decisions, both formal and informal, taken during the British colonial period by Indo-Mauritians of Hindu faith. A key figure in the field of literature in Hindi in Mauritius, Pandit

Atmaram was the first Indian immigrant to author two books offering an insider's perspective into the trials and tribulations of the Indian indentured labourers in Mauritius. Focusing specifically on his second book namely *Hindu Mauritius* (1936), this paper views the promotion of Hindi as an overarching *Einbau* language as being a means through which MB could be protected from lexical borrowing from other languages such as MC. In keeping with Fishman (2000: 47), it views these attempts at status planning as being a product of the apprehension vis-à-vis "a particular contaminant which has especially unsavoury historical, political, and ideological overtones and elicits painful memories." In the final instance, this paper looks at the far-ranging implications which his tentative set of observations and recommendations regarding status planning appear to have had in the field of language policy and planning in contemporary Mauritius.

Keywords: Status planning, *Ausbau* language, *Einbau* language, Mauritian Bhojpuri.

The Ethics of Citizen and Online Media in Mauritius.

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Abstract:

The rise of online social media has contributed to major transformations and inevitably heated debates in the field of journalism as more and more citizens undertake to produce and disseminate news at many different levels and scales. The most common criticism levelled against citizen journalism is an alleged lack of professional ethics in the process of news gathering, verification, production and publication. This paper aims at examining the practice of real-life citizen journalists in Mauritius to provide an assessment of such claims. It also interrogates the worldview of professional journalists with respect to citizen journalism and their own new approaches to journalism which incorporate the use of whistle-blowers and audience contribution in the process of news gathering and interpretation.

Keywords: citizen journalism, online media, professional journalism, ethics

A study of the factors influencing voting of youngsters in Mauritius

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Abstract:

As quoted, ‘ *from Aristotelian times, political communication and specifically ‘ political talk ’ has been seen as a form of democratic participation* ’ (Waller, 2013, p. 1). Yet today, around the world, the level of political activism, not only in democratic countries but beyond, is far from being promising. Conventional wisdom has it that the young people are not interested, unconcerned and not responsive to political matters. A local study *asserted youth political apathy as well*. This is problematic because it is still strongly believed that voting remains one of the most influential and apparent form of conventional political participation. As Moscovici said ‘ *voting has been described as the last religious act in a secular age* ’ (Bull, 2005, p. 266).

This paper focuses on the young Mauritian people as they are representatives of tomorrow. They are the future leaders. Accordingly, the aim of the study is to figure out the political engagement of the Mauritian youth, through voting. The review of literature identifies the pioneered models (sociological model, psychological model and rational model) and the age effects (life-cycle effect, generational effect and period effect) of voting behaviour, in view to develop a theoretical framework to interpret the data obtained through questionnaires and interviews.

Self-administered questionnaires were carried out on a limited sample of 100 respondents. The participants were sampled according to their gender, age, region, educational level, occupation, religion and ethnicity, highlighting, through sections, their electoral indicators, voting behaviour, level of political participation and culture. The online interviews were planned for a group of five participants, sampled according to their age and engagement in politics.

It has been eventually uncovered that issue orientation (policies and reforms) has been the leading factor influencing the youngsters in Mauritius. Religion and ethnicity have been ranked last in determining the behaviour of youngsters while casting their vote, despite the ethnic mosaic structure of Mauritius. Moreover, it has been observed that, the Mauritian youth are essentially politically engaged through voting, thus backing what Moscovici claimed.

The results suggest the need for more research to explore other voting behaviour and political participation variables of the youngsters. Nonetheless, considering the 10% of the sampled youngsters, who do not participate at all politically, it can be concluded that the level of youth political apathy in Mauritius is not so threatening to the democratic state of the country.

Furthermore, according to the life-cycle effect, youth political apathy is viewed to be a normal process since the level of participation will increase as the youngsters grow older. As the leader of the Young Wing of the Mauritian Labour Party, Neeta Deerpalsing confirmed, ‘ the youth are building their future: they are at school, at university, are entrepreneurs. And it takes time to be politically engaged .. I, personally, would not appreciate the fact that there is

a minister of 23 years old. For me, a young person can have the potential. But, ruling over a country, this is a complete different matter ! ' (Cowalessur, 2014).

Keywords: Mauritian Youth, Voting Behaviour, Political Engagement, Models of Voting Behaviour, Age Effects

Does a Rising Tide Lift All Boats in Sub-Saharan Africa? A Comparative Analysis of Employment Levels and Income Distribution

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Abstract:

Sub Saharan Africa (SSA) has witnessed a decade of unprecedented economic growth. Growth rate averaged 5.5 percent between 2004 and 2015. However, over the last decade, the region had the second highest level of income inequality in the world, after Latin America and the Caribbean (IMF, 2015). Income inequality negatively affects growth and macroeconomic stability over the long term (Ostry *et al.* 2014). Hence, even if growth has been on an upward path in SSA, only a small percentage of the Sub Saharan Africans may in fact be benefiting from this growth, with the majority of people still suffering in poverty (Arndt *et al.* 2016).

From both the theoretical and empirical perspectives, employment and income inequality have been mainly studied as two separate strands of the literature. On the one hand, the theory on employment has focused on the relationship between employment and inflation linked to monetary policy (Phillips, 1958). On the other hand, the literature on income inequality has paid more attention to its relationship with economic growth and efficiency (Kuznets, 1955). The role of employment for a more equitable distribution of income has not been sufficiently studied. Policy makers believe that creating jobs for the unemployed is enough for helping people earn an income and lift them out of poverty and hence contributing to inclusive growth. However, this is certainly not true if there is unavailability of skill-compatible employment opportunities, where the economy is not providing the types of jobs that poor people can fill (Page, 2014).

The main aim of this study is to investigate the relationship between employment levels and income inequality in SSA. In particular, the study probes further into the employment and inequality nexus for SSA countries. This study analyses whether high employment levels in the region have led to a reduction in inequality. Existing empirical studies of income inequality have been limited to single country or region-specific cases (Förster, 2010). SSA is well suited for such an analysis since it has a large and heterogeneous group of countries. More specifically, by classifying countries according to their development level, the analysis examines to what extent income inequality tends to vary in SSA countries in the context of employment levels, depending on their development stage. This relationship is also analysed by disaggregating employment data into female and youth employment.

Furthermore, we extend the above analysis by investigating the relationship between employment levels and inequality by considering a sectoral perspective of the SSA countries. With globalisation, there has been a major shift from agriculture to manufacturing and finally to a service-based economy across many nations. However, Africa is an exception as it has been a tale of structural change without industrialization (Carmignani and Mandeville, 2014). Since Africa has skipped the manufacturing phase and shifted directly to service, this makes Africa a unique case study. Productivity growth and technological advancement lie at the

root of economic development and technological breakthroughs have been associated with the manufacturing sector (Change *et al.*, 2013). Specifically, we investigate whether employment levels in different sectors affect income levels after controlling for other fundamental determinants of income inequality.

The study uses econometric techniques where income inequality is used as the dependent variable and explanatory variables include employment level, trade openness, investment and economic growth from 1990 to 2014. Data for the 48 countries is obtained from World Development Indicators (2016), Solt (2014) and various Human Development Index reports. Random and fixed effects estimation techniques are applied to the panel data analysis. Generalized Method of Moments is used as it takes into account both individual-specific heterogeneity and potential endogeneity of regressors.

With the scant existing empirical evidence, this study innovates by probing deeper into the link between employment and income distribution. Understanding labour outcomes in SSA countries offers new perspectives for policy makers to unmask chronic problems on the continent.

Keywords: Employment, Inequality, Stages of Development, Sectors, Sub-Saharan Africa

Assessment of Mauritian Electoral System in line with democratic principles.

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Abstract:

The basis of any liberal democracy is regular free and fair elections (Farnsworth, 2001). When it comes to Africa, elections are still a process in the making and too often the fairness of electoral process is questioned. An acknowledged African leader in the field of good governance, Mauritius tend to have shown commitment for democracy and to a large extent produced free and fair elections. It is often cited as an example for the fairness of its electoral system despite having a heterogeneous society, which had its share of social and economic crises. (Prayag, 2012).

Mauritius has sustained political stability since it gained its independence in 1968 and the process of election and its results are accepted. Mauritius has never been through violent contestations of elections comparable to Kenya in 2007, which caused the death of 1100 people and the displacement of 650 000 people. While many other ethnically diverse African countries have been the scene of ethnic tensions, Mauritius has always been considered as a stable country with a good record of multi-party democracy (Bunwaree, 2008).

However the island has been under pressure for a reform of its electoral system. The latest being the ruling of the UN Human Rights Commission, which recognized that there are some deficiencies in the Mauritian Electoral system violating the basic human rights of citizens aspiring to contest elections.

In any democratic state the electoral system is considered as one of the most crucial institution. This democratic institution shapes the political game played by politicians as it determines who will be elected ones, the functioning of the campaigns, the functions of political parties and who governs (Reynolds, 2005). Moreover, it has been proved that electoral system helps boost political participation in a split society.

The tiny island of Mauritius is the most developed, best administered country in Africa and the World Bank ranks it first in African economies (Reynolds, 2002).

The objective of this study was to make an assessment of Mauritian electoral system along the principles of government effectiveness, responsive and accountable government, fairness to minor parties, social representation and lastly comprehensiveness and inclusiveness.

For the methodology, both qualitative and quantitative data have been used. Interviews and a group discussion with 3 samplings were conducted. Articles, reports and journals were used to assess the views of whether Mauritian electoral system is democratic or not.

From the interviews and group discussions conducted, it can be observed that undoubtedly, Mauritius has a democratic culture whereby it is a constitutional right to choose a representative for instance, however there are many deficiencies instilled in the electoral system. Under-representation of women and minor groups in parliament, unstable government, and issue in political funding are some of the drawbacks of the Mauritian electoral system.

Research Week 2016

To sum up, it can be said that Mauritius, a ‘rainbow society’ is undoubtedly an epitome of democracy since it has secured fundamental rights to its citizen. Mauritians are proud for being part of their smiling nation and have trust in the democratic institution. Compared to other countries, it can be observed that Mauritius maintains well-developed and well-functioning welfare regime as well. Since independence, the Mauritian electoral system has been trying to consolidate democratic ideals to promote an effective and liable structure, however, it can be said that Mauritius is still under the progress to strengthen a firm system.

Keywords: Democracy, Elections, Electoral System

**Histoire, oubli et anamnèse :
les bagarres raciales péri-indépendance à Maurice**

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Résumé :

Les bagarres raciales autour de l'indépendance constituent un pan très sensible de l'Histoire de Maurice. Cependant, il a fallu attendre plus de quarante ans après les événements pour qu'une floraison des textes littéraires revienne sur ces épisodes (*Légère approche de la haine* (2009) et *J'attendrai le bout du monde* (2016) d'Alain Gordon-Gentil, *Le Sari vert* (2009) d'Ananda Devi, *Made in Mauritius* (2012) d'Amal Sewtohul, *Le chant de l'aube qui s'éveille* (2012) de Brigitte Masson).

Je tâcherai de démontrer comment ces romans, qu'ils soient totalement consacrés à la question ou qu'ils l'évoquent très rapidement, donnent à voir sans faux-semblants les tensions et affrontements ethniques qui ont marqué l'avènement de la nation afin de les interroger et de les interpréter. On assiste, avec ce dépoussiérage de la mémoire historique dans les textes littéraires, à la mise en place d'une pensée critique, voire quelquefois satirique, qui transcende les partis pris pour suggérer des voies de sortie hors des rapports interethniques ankylosés par la méfiance/violence. Nous mènerons aussi par la même occasion une réflexion sur l'écriture de l'histoire par le biais de la fiction.

Mots-clés : bagarres raciales, littérature mauricienne, roman historique

Négocier avec les complexités socio-contextuelles dans la conception des manuels scolaires : réflexions autour du manuel de français de la cinquième année du primaire.

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Résumé

Si la conception des manuels scolaires fait partie des mandats du *Mauritius Institute of Education*, il n'en est pas moins vrai que cette entreprise demande une conceptualisation d'envergure, tant sur le plan épistémologique, théorique que pratique. Cette contribution propose de faire état de la complexité impliquée dans la « fabrication » du manuel de 5^{ème} année de primaire avec une focalisation sur l'aspect théorique. Autour du processus de conception *stricto sensu* gravitent une multitude d'éléments, voire de sous-systèmes appartenant à différentes sphères connexes : l'aspect politico-éducatif, avec la réforme '*nine year continuous basic education*', la dimension éco(socio)linguistique, et les attentes du « public » au sens large du terme, entre autres. Chaque sous-système en question doit de ce fait être analysé et intégré à la réflexion autour du manuel, lequel doit s'inscrire dans la continuité du document cadre, c'est-à-dire le *National Curriculum Framework*. Les éléments théoriques de ce fait doivent prendre appui sur cette complexité en amont. Nous proposons donc d'aborder le versant théorique de cette phase de conceptualisation, en prenant appui sur les défis rencontrés dans la posture épistémologique à adopter face à « l'objet », surtout dans la tension épistémique entre une vision fixiste (LSDH ; Robillard, 2008) centrale au 'figement' impliqué dans la production de matériel scolaire et une conception dynamique (LICH ;) cadrant avec les réalités éco(socio)linguistiques. Nous aborderons également les choix opérés en matière d'organisation du manuel, que ce soit sur le plan textuel, grammatical ou discursif.

The Impact of Social Media on Politics in Mauritius

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Abstract:

Purpose

This study has as prime focus the use of social media in Mauritian politics during the 2014 elections. Social media has been extensively used as an electoral tool in 2014 and this research focuses on the reasons for using social media as a political strategy. The study analyzes the different means used by the parties throughout the 2014 elections and investigates the effectiveness of social media in diffusing the political discourse. Baudrillard explains that the future is illusory. Thus, it becomes impossible to distinguish between “*appearance and reality, hallucination and truth, superstructure and base.*” Politicians speak what the population wants to hear. ‘When it comes to politics the individuals turn out into a 4 year old kid insisting for a sweet. Make them hear what they want to hear and you are there’ (Brantlinger, 1990).

Methodology

The qualitative method of research has been applied for the purpose of this research. Influential people in the media and political sphere were approached so as to have a broader understanding of the future of politics with the advent of social media as political strategy. Secondary data has also been consulted for comparison. The end result of the study is that social media is one of the primary reasons why L’alliance Lepep won the 2014 election and has formed the Government of the country. However the study also shown that the population voted out of disgust for the outgoing government.

Originality/Value

The research underlines the impact of the use of social media sites in the political arenas of Mauritian politics. It studies the methods used by the political parties and its effect on electoral results. More precisely how these methods has helped in producing such results and whether the results obtained speak out for themselves or there are some dark figures behind.

Keywords: Social Media, Politics, Political Strategy, Electoral Results

Understanding the living experience and Educational needs of elderly in Mauritius

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Abstract:

Background of the study – The World Population Ageing Report 2013 asserts that Ageing is a dynamic process and that the planet’s population is greying at an alarming speed. The ageing phenomenon has been given a striking expression by the Pew Report. It has been described as the “silver tsunami” which has given rise to a huge number of silver foxes. (Pew Report, 2001 cited in summer, 2007).

Bruno Latour (1947), the French sociologist, has coined ageing as a “matter of concern”, instead of a ‘matter of fact’. Ageing has indeed become an area of major concern for both developed and developing world because of its multi-dimensional nature. It is therefore an absolute certainty that ageing has an impact on several dimensions of an individual’s life notably the social, cultural, demographic, medical, biomedical, economic and political. Therefore, understanding and providing for ageing is a primordial concern for the twenty-first century (Boulton-Lewis 2010).

Undoubtedly, ageing has major socio-economic consequences as the number of old people is expected to increase from 841 million to 2 billion in 2050. Mauritius is already an ageing society. It has an elderly population of around 13% which is expected to continue to increase in the years to come.

Moreover, in the context of any knowledge hub country, education is seen as a cardinal mechanism for innovation and development. In addition to, the book, entitled “Learning to be” by UNESCO (1972) has stated that education is not limited to a specific age or era. It should be made available and accessible to everyone in society with the main objective of unlocking human potentials and improving societal developments.

Havighurst (1972) has advocated that lifelong learning is crucial because of new formative assignment of life needs such as retirement, pension, housing, security, death of a partner and health conditions. Adult education therefore has a key role to play in assisting elderly to understand and overcome their daily challenges. McCarthy (1988) similarly pointed out that adult education guarantees that the knowledge, experience and aptitudes of older individuals are utilized for the welfare and betterment of the society in which they reside.

Objectives – The purpose of this study is to understand the living experiences and educational needs of the elderly population in Mauritius. The main research objectives are to take stock of the living experiences of the elderly population and to investigate the extent to which the educational need is a matter of concern to the elders, amongst others.

Design/methodology/approach – In this study, use of both primary and secondary data has been made. Research methods used include document analysis, internet search, review of journal articles and interviews with 20 persons, 12 women and 8 men, aged 60 and above.

Findings –The principal findings of this research indicate that older persons have a strong desire for learning, more particularly about new technology and how to use technological

devices. On the other hand, many respondents are of the view that the authority has to meet their basic educational needs enabling them to live as assets and to continue making positive contributions in the society.

Conclusion – It is worthwhile to note that the educational needs of elderly should not only be emphasized on the formal side of a particular curriculum but should rather encompass and focus on the daily life circumstances and challenges that are confronted by them during their lifetime. The educational needs should be in proper alignment to their development, wellbeing, and adaptation.

Research implications – The results of the study have much relevance in the fast developing ageing society like Mauritius which has a clear vision to become a developed nation. The authority may consider the results of this study while reviewing its strategies to address the educational needs of the older people in a more effective manner.

Originality/Value – This study is making a contribution to new knowledge, however small it seems to be, as it is addressing an important issue, like educational needs of the elderly people, which has lot of implications on the day to day living experiences and quality of life of the elderly population. This study also shows the emergence of a new concept ‘diamond foxes’.

Keywords: elderly, living experiences, educational needs, Mauritius. Diamond foxes.

A comparative study of political systems in post conflict countries: Egypt and Tunisia

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Abstract:

The waves of democratization have started in 1820s and the third wave began in 1970s where today there are 123 democracies out in 192 countries (Huntington 1991). The theory of consociational democracy and that of ethnic conflict were used in order to understand the importance of political consensus in fragmented societies. While Lijphart argued that it was the elites who maintained stability in a heterogeneous state, Barry disagreed with this and argued that stability was not necessarily maintained by elites (Barry 1975). The theory of ethnic conflict argued that members of fragmented societies voted according to their ethnicity (Horowitz 1985). However, ethnicity was not the only factor influencing people (Gilley 2004).

Egypt and Tunisia were chosen for this comparative study to understand what led both countries, which were once considered to be trapped in a culture of predetermined 'Arab exceptionalism' to be no longer untouched by the wave of democratization (Stanford 2004). The main focus was to assess whether the situation was better in Egypt and Tunisia after the Tahrir revolution and Jasmine revolution respectively.

Due to a lack of primary data, the researcher made use of secondary data like case studies. The case studies of Egypt and Tunisia were used to allow a better comparative study between the post- Egyptian and the post-Tunisian government. Three main research questions that were taken into consideration were to understand firstly how the revolution took place, secondly, what was the conflict about and lastly the situation after the revolution in Egypt and Tunisia.

The revolution in both Islamic states took place because the population in both countries could no longer accept the regime of Mubarak and Ben Ali respectively. The conflict was mainly about the quest for justice, freedom and human dignity in the both countries. The main focus was especially to understand what happened after the Tahrir revolution and the Jasmine revolution. Even if the Egyptian and the Tunisian population wanted to bring down the old regime created by Mubarak and Ben Ali, the results after the Tahrir revolution and the Jasmine revolution were not the same in both countries.

The broad findings of this study proved that the Tunisian democracy has been more successful than that in Egypt because power-sharing arrangement was possible among the members of different ethnic groups while in Egypt, power-sharing arrangement failed due to Islamist monopoly. Consociational democratic theory applied only to the Tunisian democracy because in Egypt, Islamists elites could not stabilize the political system. The theory of ethnic conflict applied only to the Egyptian politics where the people continued to vote according to their ethnicities. But, in Tunisia, there was no Islamist hegemon because secular parties like Nidaa Tounes during 2014 parliamentary elections (Szmolka 2015).

The situation in Egypt was even more problematic during post conflict period rather than during Mubarak's era, especially with the Supreme Council of the Armed Forces (SCAF) which continued to control the life of the Egyptians. Tunisia experienced freedom of press and freedom of association. Tunisians maintained their civil society organizations better than Egyptians. In short, Tunisia is moving towards a democracy while Egypt remains a 'liberalized autocracy'.

Keywords: 'Arab exceptionalism', Consociational Democracy, Democracy, Democratization, Ethnic Conflict

Free Press and its constraints: A Study of Mauritius

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Abstract:

Free press and free speech are intertwined and are both considered as agents of freedom of expression. Free speech and free press are the inherent desires for man to communicate, and enforce the right of people to interact freely within given community. Being the “lifeblood” of citizens’ freedom in society, this right is fundamentally essential to ensure human rights and dignity. Furthermore, it is also grandly referenced as the watchdog over the government and acts as a system of checks and balances. Consequently, as argued by Churchill (n.d cited in Beneth *et al.* 2015, p.42) free press is the “unsleeping guardian of every other right that free men prize; it is the most dangerous foe of tyranny”. It is no surprise that Thomas Jefferson (1787), in his letter to Edward Carrington stresses his preference for a free press without a government, rather than a government without a free press. Free press is therefore crucial to a healthy democracy and is only achievable when freedom of expression is maintained, and threatening the right of self-expression and free press *de facto* undermine the existence of other freedoms. Freedom of expression is therefore without any doubt a core for other rights to exist.

Freedom of the press is a worldwide issue, and it has known a significant decline over the past ten years due to repressive laws taken against the media sector, disabling the latter to carry out its duty as a watchdog of government. Criminal libel laws and defamation laws threaten journalists’ freedom to investigate and seek for information. Journals ownership or sponsorship by the state disfavour journalists in the publication of state matters. Additionally, censorship sophistication helps states to filter information and to curtail citizens and journalists’ right of freedom of expression. Although free press in Mauritius is not as repressive as compared to some other countries, it still observes severe libel laws against journalists. Previous clashes between the state and the press had led at some period to a climate of fear.

Therefore, this research highlights the progression but also the issue of free press in Mauritius. It aims to identify the key variables affecting freedom of the press in order to understand the press’s strengths and weaknesses. The study mainly focuses on the still on-going media laws and analyses to what extent the Mauritian press is free and democratic. The samples of documents used consist of primary data from conducted surveys and interviews. Secondary data consist of legal documents such as the Constitution (1968) and treaties but also of press reviews, reports, and articles. Findings underline internal as well as external threats faced by the press but also highlight the legal and non-legal strategies use by the State or owners of media outlets to curb journalists’ freedom. Lastly, the study also considers the effect of the change in the nature of politics on the press. It employs a comparative approach so as to analyse the different characteristics of each event and the reasons why they produce similar or different outcomes. Hence, while assessing the aspects of the press this research also provides recommendations which would help to improve the state of free press in Mauritius.

Keywords: Free Press, Constraints

Glass or Marble Ceiling? Leadership from a gender perspective in the Mauritian Banking and Hotel sectors

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Abstract:

Purpose

The primary aim of this study is to analyse the progress made by women during the last decade in terms of access to leadership position in the Mauritian business sector. This study provides useful information with regards to the extent to which women are entering the decision-making spheres. Even if the numbers show an increase in women participation at top position on the global scale, this representation with regards to men is highly disproportionate. For instance, the percentage of women in senior management in the United States is only 20 %, 19 % in the United Kingdom, 19 % in India, 11 % in Netherlands and a low 7 % in Japan (The Grant Thornton International Business Report, 2013). Thus, it is only by accessing those strategic positions that women will be able to improve the situation with regards to gender in the work setting. However, it is inevitable that women's access to the executive suites and the boardrooms will be impeded by institutional, structural and even cultural barriers. This study focuses on the situation in Mauritius, reviewing the progress made, and analyzing the way forward.

Methodology

For the purpose of this study, a mixed- methods approach will be applied (Puxty et al., 1987). This method helps to bridge the gap between quantitative and qualitative research (Onwuegbuzie and Leech, 2004a). Both primary and secondary sources of data will be used to take a deeper insight into the leadership position issues. As secondary data, a comprehensive review of the literature with regards to the glass ceiling, and its prevalence in the context of Mauritian organisations, and its evolution over the past decade will be compiled. And for primary data, a research instrument in the form of a structured interview schedule has been applied to a representative sample of the top Management and employees from the Banking and Hotel sector in Mauritius.

Key findings

Preliminary findings so far show that some progress has been made at the Top Management of banks, whereas it is not the case for the hotel sector. As far as the Board of Directors are concerned, the present situation is far from being satisfactory, in spite of the official discourse on the subject-matter. There is room for improvement, and we need to act fast, as Mauritius is very often referred to as a model to the African continent. In terms of gender, this is not presently the case.

Originality/Value

This work takes a deep insight into the elements contributing positively towards gender parity in leadership positions, as well as identifying the factors impeding on same. In that respect, also contributes at providing recommendations on ways to accelerate the move towards gender parity in the decision making spheres of leading business organisations, given the

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massive entry of women in the workplace. As such, this works shed light on the progress made by women in terms of breaking down the glass ceiling which has traditionally been preventing women from accessing the top management and the board of directors of leading companies.

Keywords: Gender, Marble-Ceiling, Hotels, Banks, Mauritius

Anti-Social Behaviour amongst the Youth in Mauritius

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Abstract:

Purpose

Youngsters are the future of tomorrow's society. However, many of them do not conform to the acceptable norms and values attached. This is a growing phenomenon, causing a lot of harm at societal level, and leading to even more wrong-doings & violence in society. The main purpose of this work is to investigate and determine the root causes of Antisocial Behaviour among youngsters in the Mauritian society. This study gives a broader overview of people's perception on antisocial behaviour and deviance in Mauritius among the youth, with regards to the activities they are engaged in and the consequences of such acts at individual and at community level.

Methodology

Anti-Social behaviour poses a threat to the proper functioning of society. For the purpose of this study, both primary and secondary data have been used. Secondary data were available from relevant books, scholarly journal articles and via other internet sources. On the other hand, primary data were mainly collected through Questionnaires and semi-structured interviews which include both open ended and closed ended questions. Interviews were carried out with rectors, directors, discipline masters and other members responsible for discipline at school. Parents from different social backgrounds were also involved. School educators were also queried with regards to this growing phenomenon.

Key findings

The main findings show the attitudes of individuals towards and how antisocial behaviour is perceived by Mauritians, the pattern of behaviour of such deviant youngsters and the causes of such occurrence in society. It seems that parents as role models are primarily responsible for the behaviour of their ward as no proper socialization was done. As a result, they have to face the consequences of their act which may affects them for lifetime. There is a general consensus that the situation is worsening over time and that the nature of cases being reported is becoming more serious as well. Whereas anti-social used to be associated with boys before, it is a growing issue amongst girls too. With regards the main reasons for shifts in pattern of ASB, easy access to technology, lack of coordination between the family and the school, lack of discipline, growing expectations and influence of peer groups, and exposure to media are amongst the main factors noted.

On a positive note, it was found that authorities are gradually improving the legal and institutional frameworks. There is also a growing awareness amongst the parents with regards to this social issue that can have disastrous impacts on the educational and career prospects of their children.

Originality/Value

This work contributes towards a better knowledge of deviant and antisocial behaviour among youngsters. It identifies the steps that need to be taken so as to deal with this growing social issue effectively. The active participation of all the stakeholders involved are needed in that respect.

Keywords: Anti-Social Behaviour, Youth, Mauritius, Schools

Cannabis as a gateway to hard drugs: The case of Mauritius

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Abstract:

Purpose: The aim of this study is to analyse whether cannabis smoking is a gateway to hard drugs among Mauritians. In order to reach this aim, this study assesses whether the lives of drug addicts were better while they were only cannabis consumers. The study is equally meant to analyse the link between the financial means for drug addicts to obtaining drugs, and to study the legal framework about cannabis and hard drugs in Mauritius.

Methodology: Various socio-economic factors have been taken into consideration for the purpose of this work. This includes elements such as gender, age. Whether the drug users have shifted from cannabis to hard drugs and the reasons behind it, changes in lifestyle of the drug addicts from being only cannabis consumers to being hard core drug addicts, financing issues and how they live the addiction. A semi-structured questionnaire has been used for this purpose, targeting the drug users in the northern and central region of the island. The sample consisted of male and female drug addicts varying from 18 to 60 years old. Given the nature of the subject under study, the data-collection was relatively complicated and time-consuming. However, it provided a deep insight into the subject matter. The various participants have been identified by cluster, stratified and snowball sampling. Graphic display and percentages have been used to analyse the data.

Key Findings: Findings have shown that to some extent, cannabis smoking has indeed acted as a gateway drug towards hard drug intake. This has been explained via the fact that most of the respondents have started with cannabis smoking at an early age then have shifted to hard drugs later on. On the other hand, some findings have further proved the contrary. This has been elaborated through the statement that cannabis does not cause addiction and provides less euphoria unlike hard drugs. Therefore, the idea that cannabis smoking has acted like a gateway drugs has been rejected because some respondents prefer the euphoric states that hard drugs provide instead of smoking a joint. The whole problem of drugs in Mauritius has increased considerably. With easy accessibility to any type of drugs across the streets, it has been observed that more and more youngsters are affected by the scourge of drugs at early ages.

Value/Originality: This work contributes towards a better understanding of cannabis smoking acting as a gateway drug among Mauritians. It gives a more practical overview of cannabis use as a common illicit substance. It also sheds light on the various aspects of cannabis and hard drugs effects and simultaneously on the aspects of how it can change people's addiction to drug in their day to day lifestyle. This work provides a deep insight into the subject, and contributes to the literature with regards to legal issues pertaining to soft and hard drugs in the country.

Keywords: Cannabis, Gateway, Hard Drugs, Mauritius

Perception and consumption patterns of cannabis amongst youth across socio-economic backgrounds

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Abstract:

Purpose

The main aim of the study is to show the pattern of cannabis consumption among youth across socioeconomic backgrounds, gender, age, employment status, education, youth perceptions and whether this difference is linked to the legal aspects associated to this issue. The objectives derived were to analyse the key theme which was cannabis consumption among youth across socioeconomic background. What are the other aspects linked to youth and cannabis consumption apart from socioeconomic, the perception of youth on both legal aspects and cannabis consumption? What are the legal implications applied to different categories of youth if they are caught consuming cannabis? These are the key elements that this study aims at investigating.

Methods

Both quantitative and qualitative methods have been used to show the results obtained for this study. 201 respondents were given questionnaires to fill in. They form part of the population being studied, namely youth who were consumers of cannabis. In addition, interviews were conducted among different stakeholders of 15 different institutions, including the police force, prisons dept, social workers and NGOs. These were the key informants for the research. The data gathering process was a tedious task, given the nature of the subject being investigated. However, the snowballing technique has been very helpful to gain access to cannabis consumers across the island. The officers from the different departments were reluctant to participate in this study as well. They had to be re-assured of the confidential nature of the study, and that it will be used solely for academic purposes.

Findings

Empirical findings are presented and primary findings are compared and contrasted with the literature review of this study. In this research it has been seen that more boys than girls consume cannabis, cannabis consumption rate is higher among those aged from 18-23 years old and is highly present among middle class people. The consumption pattern across regions remains the same. As cannabis consumption is rising steadily in Mauritius, it is important to take measures to control this issue. Solutions have been proposed with regards to drug policies in other countries which have been successful in building a drug-free society. Cannabis consumption has not been analysed from a demographic profiling but also relationships have been analysed to have a deeper insight of the study. All this will be explained in later chapters of this research.

Value/Originality

This study is a comparative study on the perception and consumption of cannabis among youth across socio-economic backgrounds has been built relying on the aim and objectives of the study. It is to be noted that no other research relating youth cannabis consumption and socioeconomic backgrounds have been conducted in Mauritius. This study demonstrates the

various aspects related to cannabis consumption and they are compares and contrasted with one another.

Keywords: Cannabis, Consumption, Youth, Mauritius, Socio-economic background

Outcomes of Pornography Use on Mauritian Men's Investment in their Romantic Relationship

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Abstract:

Pornography, defined as “sexually explicit material with a primary intention of arousing the viewer sexually” (Huppin, 1996, p.24), has been shown to have detrimental effects on the user. Pornography use in males has been associated with aggressive attitudes (Hald, Malamuth & Yuen, 2010) and sexual aggression towards women (Malamuth, Addison & Koss, 2000). Increased exposure to pornography in males leads to early sexual activity, more tolerance towards casual sex and risky sexual behaviors such as anal sex, having sex with multiple partners, using drugs or alcohol during sexual intercourse (Braun-Courville & Rojas, 2009; Brown & L’Engle, 2009; Peter & Valkenburg, 2007), and more positive attitudes towards extramarital sex (Omori, Zhang, Allen, Ota & Imamura, 2011). Additionally, males who view pornography perceive their partner’s body negatively (Albright, 2008); are less satisfied in their sexual relationship with their partner (Yucel & Gassanov, 2010) and are likely to be attracted towards relationship alternatives (Stack, Wasserman & Kern, 2004). Since pornography use is correlated with higher rates of infidelity, less love and trust and perceiving one’s marriage as a burden (Henline, Lamke, & Howard, 2007; Schneider, 2000; Stack, Wasserman, & Kern, 2004; Zillman, 2000; Zillman & Bryant, 1988), partners of chronic pornography users report a feeling of betrayal, a decline in intimacy and sexual activities, and doubt in their partner’s love (Bergner & Bridges, 2002). Since most research on the effects of pornography has been done in developed countries, and few have established its link with levels of investment in romantic relationships, this study aimed at investigating how pornography use affects the commitment level of heterosexual men in Mauritius (a developing country) in their intimate relationship. 180 males aged between 18 and 29 years responded to Szymanski’s and Stewart- Richardson’s (2014) Pornography Use Scale and Rusbult’s, Martz’s and Agnew’s (1998) Investment Model Scale (assessing relationship quality and functioning) on a self- report online survey created on Google Forms. Data was analysed using linear regression analyses. Results showed that pornography use significantly predicts commitment, $R^2=.032$, $F(1, 178) = 6.926$, $\beta = -.194$, $p < .05$; satisfaction, $R^2=.052$, $F(1, 178) = 10.73$, $\beta = -.238$, $p < .01$; investment size, $R^2=.039$, $F(1, 178) = 8.245$, $\beta = -.210$, $p < .01$; and quality of alternatives, $R^2=.130$, $F(1, 178) = 27.83$, $\beta = .368$, $p < .01$ in intimate relationships. In other words, as pornography use in males increase, their commitment, satisfaction and investment in their romantic relationships decrease, while their perception of attractive alternatives outside their relationship increases. These findings may be explained by Powell’s and Van Vugt’s (2003) results that the male pornography user does not sacrifice his liking of pornography for the welfare of his relationship. This decline in responsiveness and support towards their partner thus lowers the commitment level in his romantic relationship (Murray, Holmes, Griffin, Bellavia, & Rose, 2001); and results in an increased desire for sexual variety (Zillman & Bryant, 1988).

Keywords: Porn use, Investment model, Romantic relationships

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Happiness and Consumption in Mauritius

G. Rampersad

Abstract :

Mainstream economics perceive an individual as highly individualistic, presuming that he/she consumes goods in the most efficient way to optimise his/her level of happiness. This study attempts to explore the consumption behaviour in Mauritius. Material consumption and happiness are projected to be positively and strongly related. This is usually illuminated in terms of the increased possibilities to satisfy basic needs and other motives which additional spending provides. Other instrumental aspects of consumption, such as its relative, community-based and hedonic magnitudes will be accounted. Cross-sectional data, captured from a Mauritian household survey with a sample size of 1,015 observations, was engaged. For the sake of completeness, OLS, the ordered probit and the ordered logit approaches have been applied. The general conclusion was drawn upon the results that socio-demographic, economic, INDI, luxury motives including shopping enjoyment, brand consciousness, fashion innovativeness, hedonism and bandwagon effect, coupled with most of the personality traits are significantly related to people's happiness.

Migration and development in Mauritius: Migration Intentions

Ou. Roopchund

Abstract:

The dearth of data surrounding the phenomenon of migration, often due to its dynamic and complex nature often explains the fact that migration policy in Mauritius has remained ad-hoc until now. The objective of this paper is to empirically investigate the factors that affect the intentions to migrate of Mauritians.

Proper management of labour migration entails making migration into a catalyst for development, augmenting gains such as financial flows, technology transfer and entrepreneurship, and palliating adverse corollaries such as brain drain. In Mauritius, the design and promotion of a normative and institutional framework to allow for efficient governance of migration is still in its initial stages.

The main contribution of this study is to gain insight on the dynamics of Mauritian migration in order to arrive at concrete recommendations to feed the policy rhetoric and practice to better tap the positive impacts of migration for Mauritian development.

This first part of this paper will deal with the theoretical paradigms which have been used to analyse the link between migration and development. The second part of the paper will develop on empirical findings from a survey of 400 Mauritians, of varied socio-economic backgrounds both male and female, on their migration intentions. The process of migration is viewed as a decision made by a rational individual, in which three phases are identified, that is, deliberating on moving, organizing the movement, and another phase of fulfilling the move.

Indeed, individual characteristics are analysed jointly with country macroeconomic variables on migration intentions. Empirical data from this survey will shed light on

- i) A profiling of potential migrants,
- ii) Migration drivers: the personal and structural variables which influence the outward flow of migration, and determine the push and pull factors which govern migration in Mauritius.

The findings for this paper will be based on primary and secondary data. The secondary data will principally be from previous researches on Mauritian migration and official statistics on the Mauritian labour market, migration rates, education system and policy papers governing migration in Mauritius. The primary data will be collected through mainly, a survey of around 100 Mauritians on their intention to migrate, as well as semi-structured interviews with representatives of education system, Diaspora organizations, and key players in the Mauritian migration field. 5 top-up qualitative life story interviews will also be done.

An accurate profiling of migration in the Mauritian context is nothing short of a herculean task. This study aims at finding empirical data on the migration intentions of Mauritians, in a bid to arrive at a better understanding of the phenomenon and in turn, contribute concretely to the policy governing migration.

Keywords: Migration, Development, Push and Pull Factors, Migration Intention

Drinking Behaviour in a Small Island Economy: A Gender Perspective

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Abstract :

Consumption of alcoholic beverages forms part of many cultures for decades. The consumption and production of alcoholic beverages namely beer, wine and spirits are growing in virtually every part of the developing world (Perdrix *et al.*, 1999). Alcohol use among women in Africa has by tradition been quite low, and high rates of lifetime abstention persist in many African nations (WHO, 2004). However, population-based surveys have recently recorded alarming rates of alcohol use and harmful drinking among African women.

However, there is a paucity of research investigating African women's use of alcohol and associated factors at a country level, limiting our current knowledge of the different ways women consume alcohol in different African countries (Martinez *et al.*, 2011). For small island economies, in particular, the evidence on alcohol consumption is rather limited. Survey research on drinking patterns and problems in small island developing societies is also scant. For instance, from the 2009 Rodrigues Non-communicable disease (NCD) Survey, the prevalence of weekly alcohol consumption was 42.5 per cent and the prevalence of smoking stood at 40.9 per cent. Since then, alcohol consumption on the island has been on the rise. However, little is known about alcohol consumption patterns and the factors associated with drinking.

The objective of this paper is to investigate the convergence hypothesis which predicts that woman's drinking levels are increasing and are approaching those observed in men. Rodrigues as a small island economy is used as a case study to test the convergence behaviour. Hence, the innovation of this study rests on exploring the case of Rodrigues which is characterised by rampant unemployment and poverty rates, high level of social cohesion, limited leisure activities and a large informal sector.

Drinking practices of women and men were assessed in different parts of Rodrigues in 2015. Fifteen enumeration areas were randomly selected and Rodrigues was portioned into six regions of different sizes (household units). Our methodology rests on data collected on a sample of 138 alcohol dependent individuals. For the purpose of this study, a probabilistic sampling method was adopted and econometric techniques were used to support the analysis.

When analysing drinking behaviour among male and female alcohol dependents, a different picture initially emerges for women. The largest percentage of female alcohol dependents lives with a partner and has large families with four to five members. The drinking location also differs across both male and female. In addition, both male and female alcohol dependents tend to operate primarily in the informal sector. One major finding is that there are no differences in drinking frequency across gender in Rodrigues. There is further evidence of no significant differences in weekly alcohol expenditure across male and female

alcohol dependents, substantiating deeper the convergence hypothesis. In fact, no previous study has focussed on the problem of alcohol dependence in Rodrigues which is increasingly taking a gender dimension. Though, Rodrigues is a small and remote economy with specific social, cultural and religious characteristics, alcohol consumption is progressively becoming an issue for women, in particular, young single mothers.

Keywords: Alcohol Dependence, Gender, Convergence Hypothesis, Informal Sector, Poverty

The Influence of Land Holding Disparity and Job Diversity on Ethnic Diversity: An Empirical Study of Indian Villages

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Abstract:

The caste system is one of a unique system of Indian society. Indian society subdivides into innumerable castes under four varnas. These varnas are Brahmin, Kshatriya, Vaishya, and Shudra. The origin of this caste system is believed on their ancestral livelihood. The existence of caste system is still prevalent in Indian villages. For the purpose of appeal to the wider audience, we represent the word caste with the term ethnic in rest of the paper. This paper studies three important issues of Indian rural habitat. One, the determinants of the ethnic diversity in Indian villages, two, the extent to which land holding disparity among ethnic group influence it, and three, the influence of job diversity on it. Since the size of the habitat is one of the established contributors of ethnic diversity, we also use size factor in our model. Results suggest that all the three hypothesized factors are a significant contributor of ethnic diversity.

Introduction:

India is a land of diversity. The characteristics of these diversities are innumerable. People of various cultural origins are part of Indian society since thousand years. In long run these cultural diversities converted into various ethnicities that exist even today. This paper has three objectives. One, we study the determinants of the ethnic diversity (ETD) of rural India. Two, we attempt to find the extent to which employment diversity (EMD), land holding disparity (LHD), and habitat size (HS) influence it. Our research is important because of three reasons. One, in most of developing nation including India, villages is always very important for economic growth. Ethnic configuration in developing world has a very strong influence for the economic development of villages (Blackaby, Leslie, & Murphy, 1998; Miguel & Kay, 2005). However, the role of ED for it is not put forward. Two, in context of India rural part is more than two times bigger in population than urban. Three, the sectoral conflicts (ethnic and religion) is one of the biggest concerns of Indian government.

Methodology and Data:

This paper uses India Human Development Survey (IHDS) data prepared by the University of Maryland and National Council of Applied Economic Research, New Delhi (Desai, Vanneman, & National Council of Applied Economic Research New Delhi, n.d.). This data consist of information of 1501 villages of India spread across all its states. Based on our requirement we have converted this information to a usable form. For each of the village, proportion of each ethnic is given. ETD is calculated by the established formula of diversity calculation. $1 - \sum p_i^2$ P_i is the proportion of individual ethnicities in a village. In the data set for each of the village the various kinds of employments opportunities are mentioned. EMD simply represents the total number of employment opportunity with in the village. Data consists of the proportion of land holding by each ethnic segment. From these data we calculate the gini coefficient of each village and term as LHD. Considering all these factors we run the first OLS regression as represented in the following equation.

$$ETD = EMD + LHD + HS$$

Result and Analysis and Conclusion:

All the three hypothesized factors are found to be a significant predictor of ETD. This research contributes to the existing literature by finding the various antecedents of ETD in context of Indian rural Habitat. Our findings have very important policy implication for village policy makers of India. We found that land holding disparity significantly reduces the ethnic diversity of a village. Therefore, land reform policy towards equitable land allocation is beneficial for social inclusive growth of the village.

Reference:

Blackaby, D. H., Leslie, D. G., & Murphy, P. D. (1998). The ethnic wage gap and employment differentials in the 1990s : Evidence for Britain. *Economic Letters*, 58, 97–103.
Desai, S., Vanneman, R., & National Council of Applied Economic Research New Delhi. (n.d.). *India Human Development Survey (IHDS), 2005. ICPSR22626-v8*.

Keywords: Ethnic diversity, Rural Habitat, Land holding disparity, Job disparity, Indian villages

From being at school to being in school : Exploring how trainee teachers construct their experiences of Primary school contexts

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Abstract :

This paper focuses on an in-depth analysis of narratives of five pre-service trainees on what they construct as primary school context. The paper also unlocks the complexity of the participants' construction as they start questioning what they imagined as school context prior to training and what they live as trainees after their immersion to school-based training. I adopt a critical-interpretivist stance to read and analyse participants' construction. Findings horns on how construction of school context by trainees in time and space unlock the intricacies of teaching and learning practice on a daily basis. The study offers significant avenues to understand teacher socialisation in the Mauritian context.

Keywords: school context; primary education; teacher socialisation; construction; critical interpretivist approach

**POSTER
PRESENTATION**

A Direct Measurement of Corporate Financial Constraints For SMEs and Large Firms in Mauritius- A Firm Level Survey Analysis

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Abstract:

The measurement and determination of financial constraints (FC) are issues that have interested researchers in both developed and developing countries. Researchers have acknowledged that FC is a variable that is not directly observable or available on the balance sheet of companies. Up till now, there has been only a limited amount of research on the measurement and determination of FC. There is still a void in the literature concerning results in emerging economies like Mauritius. The majority of results available have mainly focused on the indirect measures of FC with little evidence available on direct measurements of same and no conclusive evidence. Moreover, the relative merits of the alternative approaches adopted by them to assess and measure FC have been questioned and severely criticized. Some authors have concluded on FC without making any empirical investigation/modeling. Alternative theoretical backgrounds have been adopted with no robust and established theory in the literature. Some authors have illustrated the impact of banks and stock markets on FC. Yet, empirical determinants of FC, including the impact of financial liberalization policies are still very limited. Most studies have concentrated on firms in the manufacturing sector and there is need to provide sensitivity of results in other economic sectors than the manufacturing sector. Given that FC is a variable that is not directly observable or available on the balance sheet, we extend the literature on FC and provide evidence on variables that directly measure the FC in a well-defined sample of Mauritian enterprises. These are: firms' dividend payment behaviour and perceptions on same; forms of dividend payments and policies adopted; preferred choice for financing long term projects and financing difficulties of firms & the sources of finance used. Both a deductive and quantitative strategies are adopted to provide for a direct measurement of FC. Data from a stratified sample of the top 100 companies as well as a unique firm level survey data obtained from a sample of 300 SMEs via simple random sampling are used. Results obtained from these samples serve the purpose of the research given that firms from two different extremes are studied as follows: the top largest 100 firms and the SME's. The top 100 firms are those with high asset values and financial position. They mainly belong to group structures and operate internal financial markets amongst sister companies. Hence, FC is expected to be low for such companies. In contrast, SMEs are basically small and medium enterprises and can be characterized as having difficult access to financial markets caused by excessive cost of finance due to asymmetric information and moral hazard. It is found that both large firms and SMEs are financially constraint, the degree of FC however varying on the corporate structure of firms.

Keywords: Financial constraints, direct measures, survey, deductive approach, dividend



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**ORAL
PRESENTATION**

Interactive Materials Development using the Rapid e-Learning Method: A Case –Study

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Abstract:

In this paper we present the rapid e-learning method that allows educators and practitioners to quickly develop curriculum-related interactive learning materials that they can use in classroom environment and also engage in a community-based sharing of learning resources. This technique does not need advanced ICT skills development and training and shortens considerably the development time of interactive resources if these were to be developed by on a core group of developers.

In Mauritius the Sankore project was implemented a few years ago with the support of the French and British government that embarked on equipping primary schools with one interactive whiteboard, such classroom commonly referred to as the Sankore classroom. At the same time, tablets were delivered in secondary schools to students and teachers alike and the tablet PC project is widely described today as a failure, while the Sankore project has been criticized by many educators for issues like faulty whiteboards, lack of technical support, and lack of resources covering the curriculum.

The paradox with technology implementation in schools is that the lifespan of technological gadgets is quite short and obsolescence is a major constraint as this requires constant investment resulting very often in unsatisfactory outcomes. The idea we promote in this paper is to decentralize content development process through empowerment of educators to develop and share their own resources as open educational resources. This will result in an exponential increase of the rate of development and release of resources to the schools to ensure maximum use of digital resources, using the existing equipment such as Interactive Whiteboards and Tablets.

Keywords: Curriculum-related interactive learning materials, Sankore project, Interactive Whiteboards, Tablets

Virtual Reality and 3D Tours as a pedagogical support to improve students experiences

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Abstract:

This paper discusses the experiences of fresh learners who have just embarked on a tertiary online course at the University of Mauritius. Online learning which is emerging as a promising market for the education industry is growing at a rapid pace in Mauritius, especially because it offers learners the opportunity in becoming highly independent and autonomous in their learning while at the same time promotes the earn while you learn concept. However, the difficulty lies in the fact that online learners are often off-campus and are not accustomed with the campus infrastructures and key areas for queries and information offices.

Sometimes, in their effort to locate either any particular office for queries or classroom for attending classes, or even to obtain "just-in-time" information at any office, students simply get confused, feel lost or misguided through inaccurate information given to them. This difficulty to adjust with such social integration to the institution, tends to give rise to learner anxiety and frustration which directly impact on their higher education. McCraty (2007) and McCraty *et al.* (2000) have demonstrated that learners' anxiety and confused state has a detrimental effect on their overall academic performance.

This paper reports the design and development process of a 3D Virtual Tour application for the University of Mauritius, to assist new students especially enrolled on DEOL programmes to better integrate the educational ecosystem of the University. We present the results of a first evaluation of the system done with a group of students through survey questionnaire and a focus-group discussion to gather feedback and perceived usefulness of such a system to enhance their educational experience on the campus.

Keywords: 3D Virtual Tour application, online learning, educational experience

Tablet Adaptation of the Flash-Based Edutainment Website UpToTen.com

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UpToTen.com is a kids fun learning website with a worldwide visibility deriving its major traffic from France, the US, Canada and India. By the end of the year 2013, 6% of the world population owned a tablet device. Mobile gaming has exploded in the five years since Apple and Google launched their App stores for iOS and Android platforms. User experience is at the centre of most modern and emerging technologies. The integrated environments proposed by IOS and Mac devices, Dropbox, and Google Environment provide a seamless user experience to the client and therefore brings in customer loyalty and adherence to a technology and service in particular. In this respect, instead of considering our users experience as a separate entity to the desktop user experience governed by different rules, content and game logic – we rather considered the tablet user experience as an attribute of the existing user experience. The goal is for our users to be able to see all the same content and use all the same features on their tablets as they can on a desktop computer.

The main problem is that in 2014, 80% of the new visitors to the site access it via a tablet or a smartphone. Given that the site is mainly in Flash and not tablet-compatible, such visitors spend only an average of 2 minutes and visit only 2 pages maximum on the site prior to opting out of it, compared to an average of 15 minutes and 15 pages when the site is accessed on a desktop/laptop computer. UpToTen has been struggling to maintain its customer base due to the exponential growth of tablet utilisation among its primary customers. Repurposing flash games on the web to be used on mobile devices is a real challenge in organizations. With the advent of mobile devices, flash games are no longer operational on these devices which basically work on HTML5. A number of companies have tried to provide the service of automatically converting their flash-based websites directly to HTML5 but the end result was not acceptable. Google Labs even came up with a tool called Swiffy which provides the possibility of converting flash files to HTML5 but very often, it was observed that only flash banners were being converted to HTML5 and not the flash games.

The aim of this project was to develop a rapid methodological process that could be applied on a large scale to re-adapt flash-based games to tablet-based environments. This would eventually help in improving the financial sustainability of the company by retaining its customer base through the development of a redesigned product that is responsive to their needs that is a tablet-compatible environment.

The creative and innovative aspect of this project was also to provide a process model and framework to address the issue of web pages /games that were not efficiently loading on mobile devices. If the project would be successful, the company could eventually develop the expertise through a novel process of converting and/or designing and developing web applications/games through a methodology that allows re-engineering existing environments and address a problem that many businesses are facing.

Keywords: user experience, UpToTen, flash-based games, tablet-based environments

User Experiences of Google Classroom as an online teaching and learning platform. A Case Study

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Abstract:

The 21st century is an age of change and innovation across various spheres of life worldwide. Global education systems are also part of this wave of change, evolution, transformation and innovation. It has been noticed that Information and Communication Technologies (ICT) has developed significantly since the last century, especially in establishing new digital instructional infrastructures for distance education at the tertiary levels worldwide (Bonk, 2006). Furthermore, contemporary e-learning systems and structures are characterized as a pedagogical shift in the provision of higher education globally (Stern, 2005). This shift involves a change from ‘top-down lecturing and passive students to a more interactive, collaborative approach in which students and instructor co-create the learning process. The instructor’s role is changing from “the **sage on the stage** to the **guide on the side**” (Stern, 2005). Thus increasing trends in the provision of post-secondary education through e-learning platforms observed today involve adherence to a more student-centered and constructive pedagogical approach (Stern, 2005).

Nowadays, e-learning platforms have gained popularity across different educational institutions worldwide. Google Classroom is a platform that allows dynamic virtual interactions between teachers and students. It offers different features to cater for the needs of educators and students while it provides opportunities for 21st century skill development (Keeler, 2015).

This case study seeks to investigate the opportunities and challenges associated to Google Classroom as an e-learning platform. In this study, user experiences on the platform, in the Mauritian context, have been the primary source of data. The study aims at evaluating the prospects for implementations of Google Classroom at tertiary levels across Mauritius. Moreover, it seeks to find out the extent to which it is convenient for students to carry out different activities on Google Classroom, the difficulties they encountered when using the different features on the platform, the learning opportunities available on the platform and the extent of appeal, flexibility and usability the learners experienced on the platform. It further probes into the potentials and limitations of Google Classroom for educators. A key aspect of this study is to gather the perspectives of users (students and teachers) as to the pertinence of implementing Google Classroom as an e-learning platform at tertiary levels in the Mauritian context.

A qualitative methodological approach has been used for this study. Data was collected through semi-structured interview, online questionnaires and focus group discussion with an opportunity sample population drawn from the University of Mauritius (UoM). Coding and content analysis revealed that the choice of using Google Classroom is subjective to the pedagogical needs of the tutor and institution in question but it does present considerable learning opportunities with manageable challenges on the platform.

Actually, it was noted that Google Classroom platform has several similarities with widely used e-learning platforms for e.g. Moodle. Moreover, learners’ perspectives revealed that the

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platform provided opportunities that met their needs and expectations. Having used the platform, they expressed a sense of achievement and accomplishment. Some significant challenges were also highlighted with respect to the process of running classes on Google Classroom. The participants argued that the platform was too 'googlish' and tends to be suitable for users of the Google Apps for Education (GAFE). Moreover, they explained that collaborative tasks were implemented with a lot of difficulty on the platform and so was the online grading system and feedback provision features.

While these challenges seemed to be considerable, the learners claimed to have enjoyed the activities on the platform. Moreover the interview with the tutor revealed that spite of having very little features it is quite an easy platform to implement and depending on the pedagogical needs and expectations of a tutor or an institution, the platform could be successfully implemented in Mauritian educational institutions. Thus this small scale study revealed the different learning opportunities and challenges of implementing Google Classroom as an e-learning platform at tertiary levels in Mauritius. However, this study is simply a stepping stone that can be used for further researches on the topic.

Keywords: Google Classroom, Opportunities, Challenges, E-Learning Platform

Can 'A' Level Biology students learn better with interactive E-book?

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Abstract:

E-Book has recently been the bedrock of the learning experience in all sectors of education in Mauritius. Academic E-book is being redefined to include interactive features such as audio-visuals, enhanced navigation features, 3Ds and Augmented Reality. This study explored the efficiency of using Interactive E-book (IEB) to improve performance of A-level Biology students (17 – 19 years) in Mauritius. According to the Mauritius Examinations Syndicate (MES, 2016), statistics have shown that there has been an increase in the number of failures for the Cambridge University Exams in 'A' Level Biology in 2014 and 2015 as compared to results of previous years. Figures also pointed out that there have been decrease in the number of students opting for 'A' level Biology during the last two years.

The IEB had three components: hardware (tablet, Mobile Phone – Bring Your Own Device as we are talking of M-Learning these days!), software (Kotobee: which was used in the development of the Interactive E- book) and "under-ware" (the pedagogy that underpinned its development!). The IEB was developed using the Kotobee Authoring Software.

A qualitative approach was used to carry out the investigation. It included data collection methods, focus groups (group discussions) and individual interviews, with face to face sessions with the concerned educators. The students were given the IEB to use. Action Research methodology was used to carry out a pre-test and post- test to figure out the performance of the students having used the IEB. The result of this study gives an insight of the advantages and disadvantages that the IEB provides. Besides, they also enumerate the various reasons as to why Biology students show preference for the usage of IEB when learning the subject matter.

The study revealed that, on average students scored 16 out of 40 for Questionnaire 1. The advent of the interactive e-book proved its worth since a notable 12.5 % rise was observed in the scores of the same students when the second Questionnaire was administered. The average score was 21 out of 40 for Questionnaire 2. This study has proved that 'A' level Biology students are seen to learn better with the IEB and teaching is rendered more meaningful and authentic. It also showed that learners participate actively when they feel motivated and encouraged. This study has revealed the transformed role of the educator from the all-doer to the facilitator of learning.

It also became clear from the statistics that IEB can undoubtedly support educators to improve the quality of their teaching in various sections of the subject. This new tool provided an insight over the effectiveness of the myriads of ways of instructing 'hard to teach' as well as 'hard to learn' sections of the said curriculum. Simple techniques helped improve and extend professional practice of reflective educators. In a deeper sense, the study delved minutely into details of engaging students through the delivery of high quality, interactive lessons through the promotion of constructive discussions thereby challenge thinking.

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There is no denial of the fact that this technological era is all set to alter the traditional textbook to favour IEB. However, the content therein still remains the same! It is worth pointing out that IEB should in no case be used at school to replace the (traditional) c-book. On the contrary, it should rather act as a complement to what already exists. As facilitators of learning, educators also have the gigantic responsibility of making the change happen instead of just relying on technology to do the needful. The Oscar moment of this study was when participants showed their doubled enthusiasm vis-à-vis the IEB experience. They found it so pleasurable that they fell proud to have been part of such a study and even wished to be there for similar endeavors in future. It is strongly believed that more and more studies like this one will provide the motivation necessary for stakeholders to genuinely consider the apt usage of IEB as an intelligent learning tool. Nevertheless, factors like cost, infrastructure and most importantly pupils' and teachers' willingness ought to be considered before the successful implementation of IEB in the classrooms of the near future.

Keywords: Interactive E-book, Biology, Kotobee

Measuring the effectiveness of using technological tools in STD IV Marathi Language classroom

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Abstract:

Marathi language is one among vast arrays of Oriental languages that we teach in Mauritius in both primary and secondary school. In our school, primary curriculum, the Marathi language is considered as foreign language. Learners find difficulties in grasping the concept from the basic skill itself; listening skills, thus enabling them to speak and talk properly. Furthermore, they cannot read or write if it is not acquired. The fact that learners are not properly exposed, there were not much social interaction thus resulting in insufficient acquisition of the language. Thus at the school N. B. G. G. S, it was decided to carry out a research, using various technological tools in the Marathi class. The Marathi teacher reported that during her three years at that particular school, children are still not motivated, and few among them are not willing to learn despite various teaching aids are stacked all around to enhance the learning process. The purpose of this research was to determine whether the use of technological tools in the Marathi classroom is effective in the teaching and learning process of Marathi language in STD IV class, and how far will the use of technological tools be effective in a Marathi classroom, and whether the use of technological tools help learners to better understand Marathi Language in the lesson 'Weather' for STD IV students, and finally can the use of technology promote interaction in the Marathi class?

The focus of this study was to investigate how far the web authoring tool, NVU could be used as a tool to promote understanding by learners and boosting up their motivation in the class. The design and development of this learning tool based on the lesson on 'weather' was carried out in this project. The learning tool consisted of videos, online quiz, images, text, questions and answers. This learning tool was especially designed to cater for the needs of the learners. It would show the students that in a Marathi class we can make use of technological tools to enhance learning and teaching. This learning tool created a dynamic and a user friendly environment. The development of the technological learning tools and its contents were further elaborated. The tool was further implemented in the STD IV Marathi language classroom as technology based approach. 18 students participated in the project which constituted of, four (4) high flyers, eight (8) average learners and six (6) slow learners. Only 9 students used the technology based approach, the other students carried out the project using the traditional approach. Learners were evaluated through formative and summative evaluation methods. In the technological approach, learners make use of the Ispring Quiz maker to do the evaluation whereas for traditional approach it was paper works. From the data analyzed after the implementation, we found that there is a difference of 12% from traditional to technology based, which means that using technological tools in the foreign language were indeed effective. Children were able to learn and understand the different concepts related to the lesson. Those who make use of the technology based approach were all exposed to the learning tool and all showed enhanced self-confidence, increasing level of communication, cooperation and shared leadership role more frequently and developed a positive attitude towards learning as compared to pupils taught using traditional methods.

Keywords: Marathi language, Foreign language, Technological tools, Traditional approach, Technology based approach.

Addressing Language Learning Difficulties of Pupils with Hearing Impairment through Interactive Whiteboard Technology

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Abstract:

Special Education Needs (SEN) pupils face learning difficulties or disabilities ranging from cognitive to physical or sensory impairments. One such disability is hearing-impairment. Among the learning difficulties that children with poor hearing face, there is the language deficit. The lack of a proper adapted curriculum for these pupils, such as the absence of visuals and sign language in school textbooks, makes teaching very tedious and causes much cognitive strain on learners struggling with abstract text. Deaf learners are challenged by the lack of auditory aptitude while teaching and learning mostly takes place through the main senses of sight and hearing. However, research on the cognitive underpinnings of deaf children has shown that if they are supported with the appropriate visual resources with sign language, these pupils have the same cognitive capacity as normal hearing pupils. Since the deaf child has no hearing, he mobilizes his vision to perceive changes around him.

One powerful technology that has been known to be beneficial for students with special needs is the interactive whiteboard (IWB). Taking advantage of the possibility to integrate multimedia materials, an action research was carried out to explore the potential of the IWB as a learning tool for the hearing-impaired context. In particular, language learning difficulties were addressed by implementing lessons using features of the IWB. Moreover, the current study attempted to give an insight into the main challenges faced by teachers while using the IWB in the hearing-impaired context as well as the arguments they put forward in favour of using IWB. The participants in this study were six standard three pupils with mild and profound hearing loss and teachers of the same hearing institute.

From the needs analysis to re-planning stage, this action research comprised of four cycles, with the collaboration of the class teacher. Reflections from each cycle were used to plan and implement the following one. Using the features of the IWB, six lessons on vocabulary and sentence-syntax components of language were delivered by the class teacher. Sign language was used and as far as possible, the norms of the hearing-impaired setting were respected. Looking at the current study from the cognitive orientation, the focus of the lessons were visuals (text and images in sign language), which are said to facilitate information processing in deaf learners. In order to evaluate how far the use of the IWB addressed the language learning difficulties, achievement tests were conducted at the end of each lesson. It was seen that using IWB for the hearing-impaired provided mixed results, although in general it increased pupil participation.

For viewing and reading, which are receptive components of language, the percentage of pupils achieving good results was high unlike for signing and writing which are expressive components. These mixed findings hence rejected the hypothesis that IWB leads to cognitive gain in language learning through visual processing in deaf children.

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The subsidiary research questions attempted to look into the challenges that teachers in this context face as well as the benefits they derive from using the IWB. Focus group as well as participant observation while implementing lessons led to the conclusion that teachers were mainly challenged by technical difficulties and the lack of adapted curriculum material like digital resources with sign support. However, they highly valued benefits like multi-modality and diversity of resources and above all they confidently claimed that the user-friendly aspect of the IWB software encouraged them to develop their own resources. More than a tool for cognitive learning, this study has found that the IWB is, in the given context, are very useful for facilitating teaching of the hearing-impaired pupils.

Keywords: SEN, IWB, Hearing-impairment, cognitive processing

Developing and Validating an Assessment Tool to Measure Preschool Children's Ideas about Basic Life Sciences

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Abstract:

Science is viewed as an important content area in preschool due to children's basic competence in science at an early age as well as their instinctive desire to know about the way the everyday world functions. Identifying children's understanding of basic life sciences at an early age, provides an understanding of the nature of scientific misconceptions and the reasons for their occurrence. Building on the fact that new knowledge is constructed based on prior knowledge and that misconceptions can be resistant to change, studying children's science understanding can assist in addressing scientific misconceptions and thus inform curriculum development and instructional design. Considering that as well as the fact that there is a lack of reliable and valid early science assessments, this study sought to develop and validate an assessment tool termed the Life Sciences Assessment (LSA) which can be used to probe into preschool children's understanding of basic life sciences. The hypothesis guiding this study was that four sub-constructs, each of which can be measured through a number of questions related to several colored photographs included in the assessment tool, would make a significant contribution to the latent construct of scientific thinking and reasoning, thus making the LSA a significant indicator of preschool children's understanding of basic life sciences. The two research questions were, "What is the contribution of each sub-construct to the latent construct on the LSA?" and "What is the technical adequacy of the LSA in measuring preschool children's conceptions of basic life sciences?" After initial development, the LSA was pilot-tested twice and relevant changes applied after each pilot test. The final instrument was administered to 124 preschool children identified through specific inclusion criteria and convenience sampling, from four accredited child care centers in Cincinnati, Ohio, USA, during the 2012-2013 academic year. In order to confirm the quality of the data as well as to check univariate and multivariate assumptions, data checking procedures were carried out using Statistical Package for the Social Sciences (SPSS) 21.0, following which, Confirmatory Factor Analysis (CFA) using Analysis of Moment Structures (AMOS) 21.0 was used to evaluate the hypothesized model. Analysis of the first research question revealed a good model fit: $\chi^2(1, N = 124) = 0.929$, $p = .335$; NFI = .992; CFI = 1.000; RMSEA = .000; ratio of the χ^2 to the degrees of freedom = 0.929. Furthermore, all factor loadings, which ranged from a moderate of .43 to a high of .98, showed statistical significance at $p < .001$ (2-tailed) and practical significance ($\beta > .3$). Analysis of the second research question was conducted by reliability and validity assessments. The LSA was found to be a reliable and valid measure for the sample of preschool children involved in this study. Internal consistency reliability as measured by Cronbach's alpha was .733 and construct reliability was .714. As for validity, content validity was addressed in a step-wise fashion as required; construct validity was determined by CFA indicating statistical significance at $\alpha = .001$ (2-tailed) and practical significance ($\beta > .3$); and internal validity was reached through successful minimization of potential threats. To sum up, it was found that the hypothesis that the four sub-constructs as measured by the four scales of the LSA, would make a significant

contribution to the latent construct and thus make the LSA a significant indicator of preschool children understands of basic life sciences, was confirmed.

Keywords: tool validation, science assessment, preschool, life sciences

Developing and Validating Algebra Curriculum-Based Measure to Assess Preschoolers' Sorting and Classifying SkillsM. I. Maherally¹ and U. N. Maherally^{2*}¹Public Affairs Section, Embassy of the United States of America, Mauritius²Centre for Innovative and Lifelong Learning, University of Mauritius Branch, Ebène, Mauritius* Corresponding Author. E-mail: uzma.mahe@gmail.com**Abstract:**

Young children's primary and fundamental mathematical knowledge occurs from the early developmental years of life. Children engage in play-based situations through exploration activities including shapes, spatial relationships, patterns, counting, and sorting and classifying among others. These activities are actually the daily experiences that prepare young children to engage in more advanced mathematics as they grow older. The National Council of Teachers of Mathematics (NCTM) emphasizes the importance of PreK-2 students to be able to sort, classify, and order objects by attributes such as size and number among others, in order for them to develop an understanding of relationships. The council further indicates that algebraic thinking ability is critical for all mathematics topics. Therefore, young children's algebraic reasoning skills can be enhanced by developing their sorting and classifying skills. With this in mind as well as the fact that there is an absence of reliable and valid assessment instruments to collect and examine preschool children's algebraic competence related to sorting and classifying, this study sought to develop and validate an assessment tool termed the Algebra Curriculum Based Measure (ACBM) that can be used to measure preschool children's sorting and classifying skills based on one attribute (color, shape, and size), and two attributes (color and shape) simultaneously, as well as their capacity to clarify their sorting and classifying strategies. The hypothesis relevant to this study was that five sub-constructs, measured by subjecting preschoolers to sorting and classifying activities and asking them to explain their sorting and classifying approaches, would significantly contribute to the latent construct of sorting and classifying, thus causing the ACBM to be a significant indicator of preschool children's sorting and classifying skills. The two research questions were, "What is the contribution of each sub-construct to the latent construct of sorting and classifying?" and "What is the technical adequacy of the ACBM in measuring preschool children's sorting and classifying skills?" After initial development, the ACBM was pilot-tested and relevant changes made to finalize it. It was then administered to 120 preschool children selected based on specific criteria and convenience sampling. These children were enrolled in four accredited child care centers in Cincinnati, Ohio, USA, during the 2012-2013 school year. The statistical software Statistical Package for the Social Sciences (SPSS) version 21.0 was used to verify data quality and to check univariate and multivariate assumptions. A Confirmatory Factor Analysis (CFA), using Analysis of Moment Structures (AMOS) 21.0, was used to evaluate two hypothesized models: one with raw data and one with square root transformed data. Analysis of the first research question revealed a good model fit between the corresponding hypothesized and measured models in both instances: $\chi^2(2, N = 120) = 0.882, p = .643$; NFI = .992; CFI = 1.000; and RMSEA = .000 for raw data, and $\chi^2(2, N = 120) = 0.749, p = .688$; NFI = .992; CFI = 1.000; and RMSEA = .000 for transformed data. Standardized regression coefficients ranged from .43 to .69 for raw data and from .44 to .63 for transformed data. In both instances, all standardized regression coefficients demonstrated statistical significance at the .001 level (2-tailed) and practical significance ($\beta > .3$). Analysis of the second research question revealed the ACBM to be a reliable and valid measure for the sample of preschool children assessed. In terms of reliability, internal consistency reliability as measured by Cronbach's alpha was .730;

construct reliability was .721 for the raw model and .700 for the transformed model; and an inter-rater agreement of 100% was obtained. As for validity, content validity was addressed in required stages; construct validity was determined by CFA showing statistical significance at $\alpha = .001$ (2-tailed) and practical significance ($\beta > .3$); and internal validity was successfully controlled by minimizing potential threats. In sum, the hypothesis was supported by this study causing the ACBM to be a valid and reliable assessment tool for sorting and classifying for this sample of preschool children.

Keywords: tool validation, mathematics assessment, preschool, sorting and classifying

A study of the impact of Work based Learning (WBL) placement on academic performance of students

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Abstract:

There has been a strong move from Universities to integrate WBL placement in their programme of studies over the recent years due to the changes experienced in the employment patterns which make graduate skills highly valued. WBL placement was incorporated as sandwich courses organised over full-time work experience which involves full-time learning at work settings. WBL placement has been identified as a means of responding to the needs of employers making students fit for purpose and practice. Employers view WBL as vital in developing students into professional workers. It is believed that one of the main benefits of doing a work placement is increased employability. While research confirmed that WBL placement enhances employability, its impact on academic performance of students is still being much questioned today. Some researchers expressed that there is a causal link between improvement in academic achievement after the completion of an integrated work based learning placement. They claimed that completing a placement significantly increases the chances of obtaining an upper second or higher degree class. They believed that students who have been on placement are potentially better equipped to complete their studies with better grades. Others did not find much correlation between the two entities claiming that there is no straight evidence that placement adds value to academic performance. Most studies carried out so far have based their investigation on anecdotal evidences or on sample which are rather small involving students from only one or two fields of study.

This paper aims to examine the relationship between the two entities, placement and academic achievement, based on a large sample of undergraduate students from various fields of study experiencing similar WBL placement. A comparative statistical analysis was carried out on students who did or did not undertake a WBL placement, their class of degree achieved was investigated. Secondary data was used where the degree classification obtained at the end of studies were analysed from students graduating over five years. The results revealed that there is a difference in academic performance of WBL students compared to those who have not undertaken WBL placement. It was found that students who undertook the WBL training had better chances of achieving higher academic standard which may lead to students graduating with better degree classifications. The paper concludes that WBL Placement has a positive influence on the academic performance of students.

Keywords: Placement, Academic Performance, Practice, Training, Degree Classification.