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Recognizing the benefit to the industry, this brochure presents selected abstracts of the articles published in March, June & December 2024 issue of Journal of the National Science Foundation.

Research for Industry

*Selected abstracts
from the JNSF
March, June & December
2024 Issues*

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The modified control charts for monitoring the error detection of process control under different estimators

Statistical Quality Control

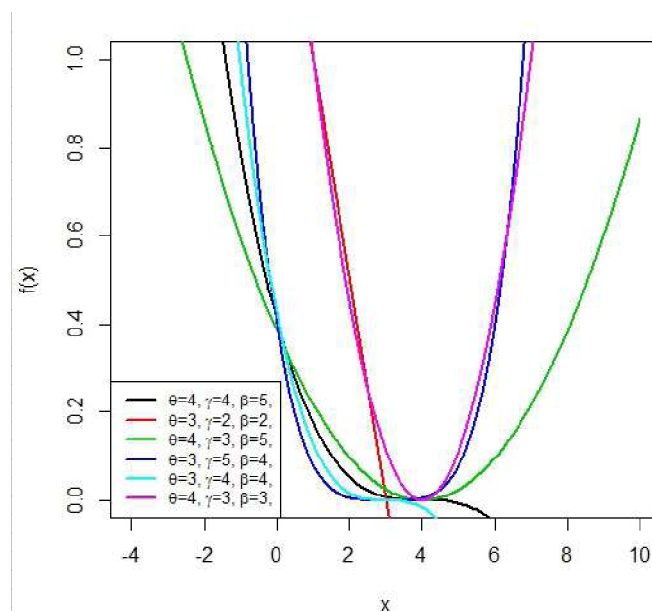
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Abstract

The reflected power function distribution (RPFDF) has increasing importance in practical life due to its application in diversified fields of life. Organisations often face difficulty monitoring operations to identify and remove errors during production. That is why there is a need to introduce control charts that effectively monitor the processes, mainly when the number of errors follows RPFDF and the manufacturing process is in control. The current study suggested memory-based control charts as a solution to the problem. The control charts are based on the estimation methods and play a remarkable role in enhancing the machine process reliability. The parameters of RPFDF are evaluated through the percentile estimator (PE) and modified maximum likelihood estimator methods (MMLM). Further, we create memory-based control charts, i.e., hybrid exponentially weighted moving average (HEWMA) and extended exponentially weighted moving average (EEWMA), using the PE and MMLM. The findings reflect that HEWMA control charts based on PE provide a better result in estimating the defects. The implications of the study will be helpful for practitioners and policy makers from reliability engineering, management sciences, and statisticians.



PDF plots for RPFDF

Link: <https://www.nsf.gov.lk/index.php/component/content/article/46-jnsf/586-jnsf-volume-52-no-1-march-2024?Itemid=101>
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A preliminary study on milk composition of three buffalo breeds located in Polonnaruwa, Sri Lanka

Dairy Science

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Abstract

Buffaloes have great potential to be developed as one of the main dairy animals in Sri Lanka because of their higher adaptability to local conditions compared to European dairy cattle breeds. Processing dairy products such as curd, cheese, and yoghurt from buffalo milk has several advantages due to its greater quantities of total solids, solid-nonfat, and protein. However, milk composition and coagulation properties largely depend on the breed. Therefore, this research aimed to investigate the milk composition of three major buffalo breeds in Sri Lanka. The milk of the Lanka buffalo contained 18.1% total solids, 10.7% solid non-fat (SNF), 7.5% fat, 4.9% protein, 4.9% lactose, and 0.9% minerals. The milk of the Murrah crossbreed contained 15.4% total solids, 10.1% SNF, 5.3% fat, 4.2% protein, 5.1% lactose, and 1.1% minerals. The milk of the Nili-Ravi crossbreed contained 16.6% total solids, 10.2% SNF, 6.4% fat, 4.1% protein, 4.9% lactose, and 1.1% minerals. The results indicate that milk composition varies among the breeds in which the milk of the Lanka buffalo has significantly higher amounts of total solids, SNF, and fat. Protein, lactose, and mineral contents do not vary significantly.

Proposed mix design improvements of compressed stabilized earth blocks (CSEB) with particle packing optimization and coir reinforcement

Germplasm Characterization

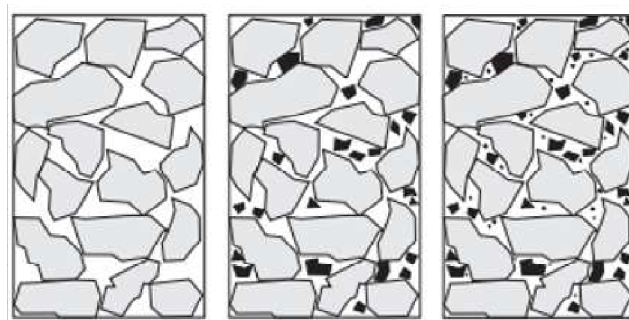
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Abstract

The use of the earth as a building material has been practiced since the beginning of human civilization. Unburnt bricks, rammed earth, adobe, and burnt bricks are some of them. As a result of technological development, adobe has developed into a compressed stabilized earth block (CSEB). The clay percentage of the soil significantly affects the strength of the CSEB. This study focused on controlling the clay percentage by adding larger particles externally using building construction waste and reinforcing them with coconut coir. Different coir amounts by weight from 0.1% to 0.5% with different lengths of 2 cm, 4 cm, 6 cm, and 8 cm were considered for block production. For dry compressive strength and wet compressive strength, the combination of 0.3% coir amount with 6 cm coir length gave the maximum strength, and it also satisfied the required water absorption limit as per the Grade 1 category of the SLS 1382, part 1. After that, using the above combination, the industrial scale (350 × 100 × 175) mm size block was prepared, and its strength also satisfied the SLS 1382 Grade 1 requirements. According to the study, the manufacturing cost for the CSEB is lower than that of cement blocks and clay bricks. The cost for a 1 m² wall panel preparation using CSEB is 41.52% lower than preparing using burnt clay brick and 8.56% lower than preparing using cement blocks. Therefore, the CSEB can be used as a load-bearing walling material at a low cost and with eco-friendliness.



Particle p16ept (Senthil & Santhanam, 2003)

Link: <https://www.nsf.gov.lk/index.php/component/content/article/46-jnsf/663-jnsf-volume-52-no-2-june-2024?Itemid=101>
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Meta-heuristic method to schedule vehicle routing with moving shipments at the cross-docking facility

Operations Research

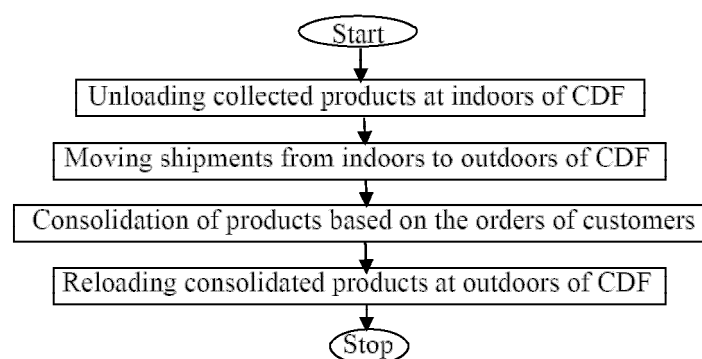
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Abstract

Cross-Docking (CD) is a modern distribution strategy in a supply chain. The optimal scheduling of vehicle routing, known as the Vehicle Routing Problem (VRP), is one of the influential factors of the efficiency of a supply chain. In recent years, researchers and business consultants in different organizations have been interested in integrating the VRP with CD (VRPCD). Since VRPCD is a NP-hard problem, heuristic or meta-heuristic methods are always recommended to solve large-scale VRPCD. The Genetic Algorithm (GA) is a population based meta-heuristic algorithm and also, it is based on the principles of genetic and natural selections. The GA is capable of finding near optimal solutions to large-scale optimization problems which are extremely difficult to solve using traditional optimization algorithms. Therefore, in this study, a meta-heuristic approach based on the GA is proposed to solve the vehicle routing problem with moving shipments at the cross-docking facility (VRPCD&MS). The data are extracted from benchmark instances in the literature. The optimum solutions obtained to small-scale instances by the GA are compared with the exact solutions obtained by the Branch and Bound (BB) algorithm, which is a traditional algorithm to solve problems of this nature. The GA and BB algorithms are respectively coded in MATLAB and LINGO. The results reveal that the relative difference between the exact solution and the near-optimal solution is below 5%. Therefore, it can be concluded that the proposed GA is a better alternative method, considering its overall performance, to solve the VRPCD&MS models. Moreover, since the computational time is low, the proposed GA can be used to schedule the vehicles to the routes of VRPCD&MS at the last moment prior to the start of the time horizon.



Flow chart for the part 2 of the proposed Genetic Algorithm

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Impact of climate on tea yield: an empirical investigation from Sri Lanka

Agricultural Economics

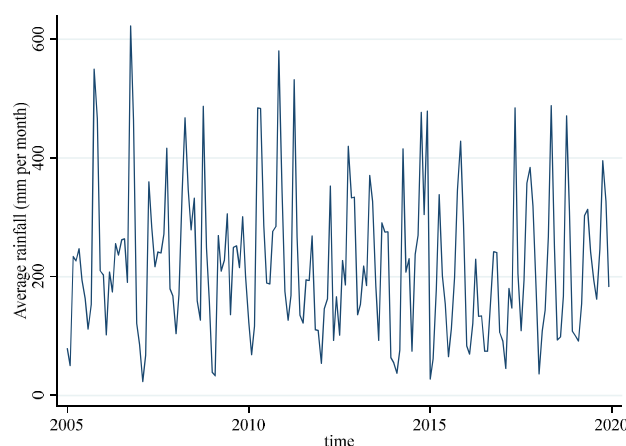
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Abstract

Agriculture is heavily climate dependent. Tea cultivation is of no exception. Tea is cultivated in many developing nations around the globe and the climate change impact is to be mostly felt by developing nations in comparison to the developed. In countries such as Sri Lanka, where the major portion of export earning from agriculture comes from the tea industry, the climate change impacts would harm its progress. Hence, understanding how climate has been linked with production would pave the way for development of a country specific policy. To this end, this research attempted to measure the long-run relationship of the climate with the yield per hectare, using monthly data from 2005 to 2019. A panel Autoregressive Distributed Lag model (ARDL) was used to obtain long-run cointegration between minimum and maximum temperatures and the amount of rainfall received. Data on production and input variables were obtained from records kept at 37 large-scale tea estates at monthly intervals. Monthly temperature and rainfall data were obtained from the Meteorological Department of Sri Lanka. Panel cointegration tests indicated that there is a coexisting long-run relationship between climate variables and the tea yield. Maximum temperature had a positive relationship with yield, but minimum temperature shows a long-run negative relationship. Rainfall is positively related. Production inputs show a long-run positive impact. Thus, the possible negative impacts of rising minimum temperature could be overcome if proper management practices are adopted in the long-run.



Flow chart for the part 2 of the proposed Genetic Algorithm

Link: <https://www.nsf.gov.lk/index.php/component/content/article/46-jnsf/663-jnsf-volume-52-no-2-june-2024?Itemid=101>
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Determination of noise level and acoustic analysis of toys for children in Sri Lanka market

Acoustics

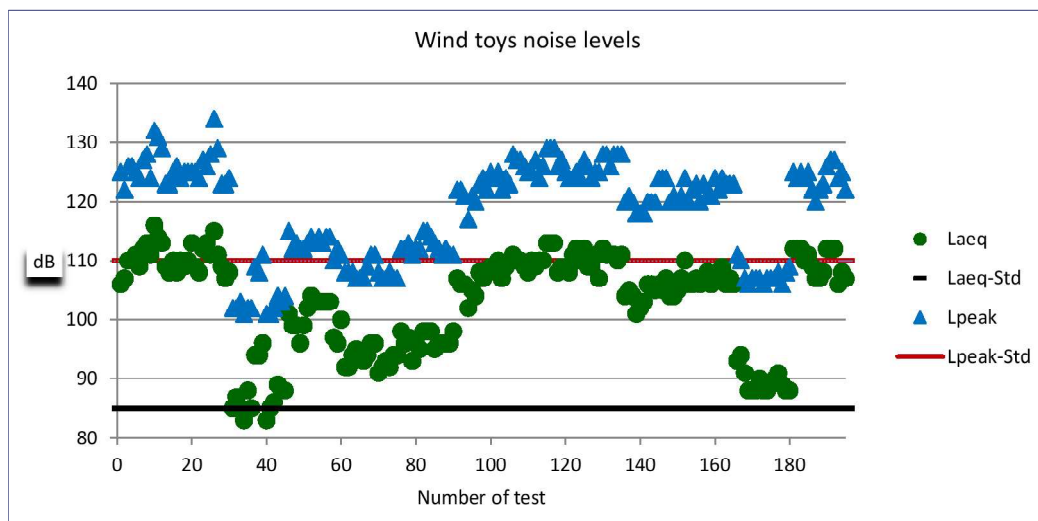
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Abstract

This study was conducted to determine the existing noise levels and perform acoustic analysis on different toys in the Sri Lankan market. The study was carried out using international references, and the noise level descriptors L_{pAeq} , L_{pCpeak} , and L_{pAFmax} were recorded during measurement. A total of 205 toys were selected, and 1986 measurements were taken for analysis. The study reveals that 59 (28.8%) of the 205 toys in different categories had noise levels that exceeded two parameters, and 35 (17.1%) exceeded one parameter, considering the L_{pAeq} , L_{pCpeak} , and L_{pAFmax} parameter values as described in BS EN 71-1:2011+A3:2014 Safety of toys. Measurements indicate that cap firing, wind, and squeeze toys have higher noise levels than international standards (reference values for cap firing: 125 dB, squeeze and cap firing: 110 dB). The study clearly indicates that when measuring noise levels in the frequency range compared to our normal reference hearing range (150 Hz to 5 kHz), it may affect the hearing levels. The study demonstrates the necessity for awareness, warning signs, and enforcing toy acoustic standards and regulations to improve the situation in Sri Lanka.



The variation of wind toys noise levels

Link: <https://www.nsf.gov.lk/index.php/component/content/article/46-jnsf/663-jnsf-volume-52-no-2-june-2024?Itemid=101>
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Decadal trends in antimicrobial susceptibility of *Escherichia coli* and *Salmonella* spp. in chicken from small-scale farm shops in Kandy district, Sri Lanka

Food Microbiology

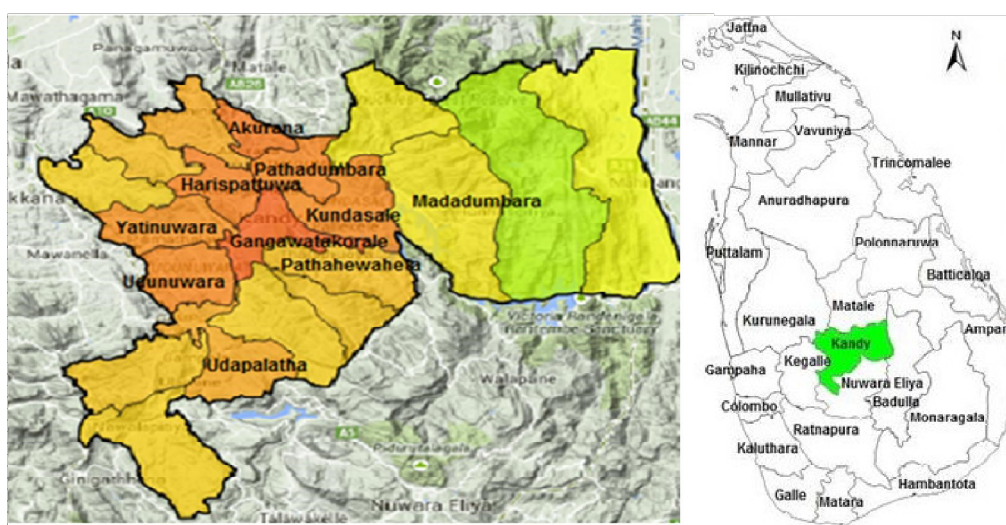
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Abstract

E. coli and *Salmonella* spp. are two important foodborne pathogens that rapidly develop antimicrobial resistance (AMR) and frequently contaminate animal products, particularly chicken meat. In Sri Lankan small scale poultry operations, substandard hygienic practices are common. The current study reports and compares two consecutive studies conducted in 2010-2011 and 2020-2021, which investigated AMR *E. coli* and *Salmonella* spp. contamination in chicken meat sold at small-scale farm shops in the Kandy district, Sri Lanka. The first study included 72 chicken meat samples collected from 10 out of the 20 divisional secretariat divisions (DSDs), while the second study included 37 meat samples from the same DSDs, collected 10 years later. *Salmonella* spp. and *E. coli* were isolated and identified, and AMR profiles were obtained using disc diffusion assay and CLSI guidelines. The first study reported 100% *E. coli* contamination in chicken meat, but a decade later, the percentage had significantly decreased to 70.3%. In both studies, *E. coli* isolates demonstrated resistance to more antimicrobials than *Salmonella* isolates, and the proportion of multidrug-resistant (MDR) *E. coli* isolates (defined as resistance to five or more antimicrobials) was higher than that of the *Salmonella* spp. isolates. Significantly lower MDR *E. coli* isolates were detected in the recent study. However, tetracycline resistance among *E. coli* isolates was higher compared to the previous study. Despite these improvements, the contamination level of chicken meat in small-scale retail shops remains concerning. Therefore, it is crucial to promote prudent antimicrobial use and ensure proper food processing practices at all levels of production in Sri Lanka.



Divisional Secretariat Divisions (DSDs) of Kandy district of Sri Lanka sampled during two studies

Link: <http://www.nsf.ac.lk/index.php/home-7-22/journals/jnsf/46-jnsf/751-jnsf-volume-52-no-3-september-2025>
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Optimizing the alkaline concentration for coir fibre treatment and estimation of lifetime

Environmental Chemistry

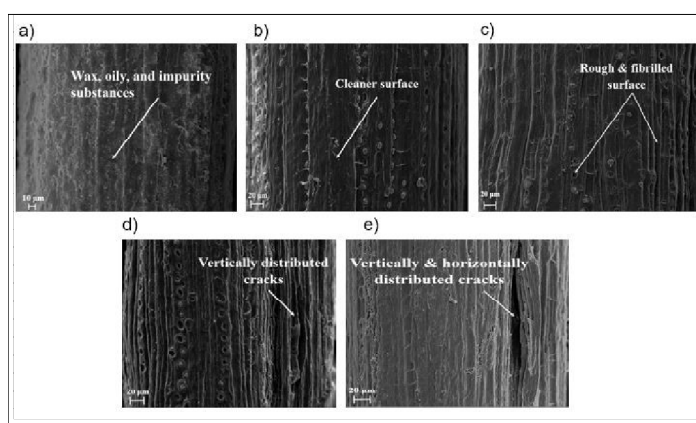
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Abstract

Researchers are developing sustainable insulation composite materials using lignocellulose fibres, particularly coir fibres, which have low thermal conductivity, low density, high moisture resistance, and excellent thermal stability. However, these fibres naturally contain waxy, gummy, oily substances and impurities on their surfaces, necessitating a pre-treatment process to remove these contaminants before manufacturing. Alkaline treatment is an effective method for this pre-treatment, however, selecting the appropriate concentration is critical. Furthermore, thermal decomposition of fibres may occur during composite manufacturing making it essential to assess fibre longevity. In this study, coir fibres were treated with NaOH solutions at concentrations of 0%, 2%, 4%, 6%, and 8%. The effects of alkaline treatment on surface roughness, chemical composition, and thermal stability were analyzed using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and differential scanning calorimetry (DSC). The activation energy (E_a) for the thermal decomposition of lignocellulose substances was analyzed using the Flynn-Wall-Ozawa (FWO), Kissinger-Akahira-Sunose (KAS), and Friedman methods over a temperature range of 25 °C to 700 °C. The fibre lifetime was estimated using Toop's equation. The results indicated that the 4% NaOH-treated sample exhibited superior surface roughness and thermal stability compared to other concentrations. The decomposition of lignocellulose substances began at a conversion rate of 0.2, with an E_a of 128.88 kJ/mol. The estimated fibre lifetime is approximately 6.55×10^6 hours at 25 °C. The lifetime of coir fibre decreases as temperature increases. Therefore, it is crucial to highlight the necessity of controlling the temperature during the fabrication of composites using coir fibers to prevent thermal degradation.



Plane view of coir fibres ($\times 750$), a) untreated fibre, b) 2% NaOH treated fibre, c) 4% NaOH treated fibre, d) 6% NaOH treated fibre, e) 8% NaOH treated fibre.

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