

## [International Agricultural Engineering Conference \[IAEC2024\]](#)

| Sl. No. | Title   | Session Topic                                  | Authors  | Presenting Author Contact email | Organization                                   | Country   |
|---------|---|--|--|---------------------------------|--|-----------|
| 1       | Portable Smart Solar Tunnel Dryer: A Green Technology for Small and Marginal Farmers  | Post-Harvest Processing                        | Shiddanagouda Yadachi<br>Srinivas Girijal<br>Kiran N &<br>Thippanna KS                           | shiddu86@gmail.com              | DSLDCollege                                    | India     |
| 2       | Design and experiment of attitude adaptive adjustment system for driving device   | Agricultural Machinery & Equipment             | 糜 泽荣   | 1072652942@qq.com               | Guangxi University                             | China     |
| 3       | Performance evaluation of a multi-rotor unmanned aerial vehicle for chemical application in groundnut crop                                  | Agricultural Machinery & Equipment             | Yallappa D<br>M. Veerangouda,<br>Vijayakumar Palled,<br>Devanand Maski, &<br>Sushilendra, Ravi Y | yallappa.raravi@gmail.com       | University of Agril Sciences, Raichur          | India     |
| 4       | Integrated Biomass Supply Chain Modeling for Delivery Logistic of In-field Paddy Straw to Biorefinery Plants                                | Agricultural Machinery & Equipment,            | Devanand Maski,<br>Neeraja J., Vijaykumar P., Nidoni UR; &<br>Prakash KV                         | dmaski@gmail.com                | University of Agril Sciences, Raichur          | India     |
| 5       | Bioremediation of petroleum hydrocarbon contaminated soil with simultaneous bioelectricity generation in a microbial fuel cell              | Soil & Water Engineering                       | Meshack Imologie Simeon,<br>Abubakar Sadeeq Mohammed,<br>Felix Uzochukwu Asoiro                  | s.imologie@futminna.edu.ng      | Federal University of Technology               | Nigeria   |
| 6       | Effect of Digital Transformation of Agriculture Production System on Climate change mitigation and Resilience                               | Agricultural Systems (Logistics, Supply chain) | Anbumozhi Venkatachalam  | v.anbumozhi@eria.org            | ERIA&EA  | Indonesia |
| 7       | Development of Tractor Operated On farm Pelleting Machine for Densified Fuel Production from Argo residues                                  | Energy & Environment                           | SR Kalbande Abole Jagtap   | Surenkalbande@gmail.com         | PDKV, Akola                                    | India     |
| 8       | Soil Moisture Dynamics under Sensor-based Drip Irrigation using HYDRUS (2D/3D) Model under Vertisols of North Eastern Dry Zone of Karnataka | Soil & Water Engineering                       | Anand Gouda  | anandgouda0311@gmail.com        | University of Agril Sciences, Raichur          | India     |
| 9       | Non-destructive quality assessment of blanched black pepper using FT-NIR spectroscopy   | Post-Harvest Processing & Food Engineering     | S Sunoj<br>R Visvanathan   | drviswanathan@gmail.com         | Tamil Nadu Agricultural university, Coimbatore | India     |
| 10      | Pulsed Light Decontamination and Modeling of Salmonella on Pecan Halves   | Post-Harvest Processing & Food Engineering     | K. Talari,<br>HL Degala,<br>AK Mahapatra,<br>R Gyawali,<br>RM Gosukonda, &<br>TH Terrill         | mahapatraa@fvsu.edu             | Fort Valley State University                   | USA       |
| 11      | Comparative Performance Analysis of Machine Learning and Regression Models for Predicting the Angle of Repose of Sericea Lespedeza Seeds    | Computers and Electronics in Ag. Engineering   | RM Gosukonda,<br>A Siddique, &<br>AK Mahapatra   | Gosukonr@fvsu.edu               | Fort Valley State University                   | USA       |

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| 12 | Effect of Yeast Concentration on Quality Parameters of Ber (Ziziphus mauritiana) Fruit (cv. Umran) Wine during Ageing  | Post-Harvest Processing & Food Engineering   | Rachana MN  | mnrachana93@gmail.com              | University of Agril Sciences, Raichur                | India       |
| 13 | Climate Smart and Pathogen Impact Limiting Sericea Lespedeza Fodder Production Spatial Suitability Analysis in the Southern African Development Community Countries with Geospatial Engineering and Technology Support | Computers and Electronics in Ag. Engineering | Sudhanshu Panda<br>Thomas Terrill,<br>Ajit Mahapatra,<br>Eric Morgan,<br>Aftab Siddique, &<br>Jan Van Wyk                       | sudhanshu.Panda@ung.edu            | University of North Georgia                          | USA         |
| 14 | Hydroponic Farming : New Business avenue for Entrepreneurs   | Control Environment Agriculture              | Suchita V Gupta,<br>SR Kalbande,<br>Bhagyashree N. Patil,<br>Mrudulata M &<br>Deshmukh  | suchitavgupta@yahoo.co.in          | PDKV, Akola  | India       |
| 15 | Sustainable Corn Pest Management: A Systematic Review of Fall Armyworm in the Philippines  | Agricultural Systems (Agrl. Management)      | Hensly Joy Labonete   | henslyjoy.labonete@g.msuiit.edu.ph | Mindanao State Univ.                                 | Philippines |
| 16 | Role of computer vision and Internet of Things in Export of High value agricultural produce  | Computers and Electronics in Ag.Engg         | Bhagyashree Patil<br>SR Kalbande,<br>Suchita Gupta &<br>Mrudulata Deshmukh  | bhagyashreepatil21@gmail.com       | PDKV, Akola  | India       |
| 17 | Application of Artificial Intelligence and Internet of Things in mechanization of Indian Agriculture   | Agricultural Machinery & Equipment           | Mrudulata Deshmukh,<br>SR Kalbande,<br>Suchita Gupta &<br>Bhagyashree Patil   | deshmukhmrudulata@gmail.com        | PDKV, Akola  | India       |
| 18 | Design, Development and performance evaluation of self-propelled chilli harvester  | Post harvest processing & Food engineering   | Yella Swami   | yellaswami@gmail.com               | ICAR-IIHR  | India       |
| 19 | Performance evaluation of an on-grid solar-powered greenhouse with a fan-chiller-tube-bank cooling system  | Control Environment Agriculture              | Ohood, Al-Ghadani<br>Talal Al-Shukaili,<br>Hemantha Jayasuriya,<br>Pankaj Pathare,<br>Ahmed Al-Busaidi &<br>Mohammed Al-Belushi | s123937@student.squ.edu.om         | Sultan Qaboos University                             | Oman        |
| 20 | Quantification of Sorghum Crop Irrigation Water Requirements In Semi-Arid Region of Maharashtra  | Soil & Water Engineering                     | Vishal Ingle  | vkingle@vnmkv.ac.in                | Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani | India       |
| 21 | Land and water resources characteristics of the Jamrani Dam Command using GIS and Remote Sensing.  | Soil & Water Engineering                     | RK Singh<br>HC Sharma   | singhraj37048@gmail.com            | RPCAU Pusa Bihar                                     | India       |
| 22 | Climatic Variability and Groundnut Crop Yield: Unveiling the Scenario in Anantapur, India  | Soil & Water Engineering                     | Fawaz Parapurath<br>Kumar Veluswamy   | faazzz96here@gmail.com             | Tamil Nadu Agricultural university, Coimbatore       | India       |

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| 23 | Defluoridation of groundwater using Boron-doped and nondoped activated carbon derived from Pterocarpus Marsupium                     | Soil & Water Engineering                   | D Sivakumar,<br>V Kumar &<br>B Baranitharan  | shri.sivakumar1974@gmail.com                         | KARE,<br>Krishnankoil                             | India  |
| 24 | Impact of Check Dams on Groundwater Recharge and Quality in Upper Vaigai Sub-Basin, Tamil Nadu, India                                | Soil & Water Engineering                   | K Keerthy,<br>S Chandran &<br>V Kumar  | kkciv@tce.edu  | TCE, Madurai                                      | India  |
| 25 | Development of an experimental test rig for quantifying the chemical deposition on plants  | Agricultural Machinery & Equipment         | Jayashree GC<br>R Thiyagarajan   | jayashreegc@gmail.com                                | University of Agricultural Sciences,<br>Bangalore | India  |
| 26 | Development of pneumatic operated protray seeder for pelleted seeds  | Agricultural Machinery & Equipment         | R Thiyagarajan<br>B Suthakar,<br>R Kavitha, &<br>A.Surendrakumar                     | drthiyagarajan@gmail.com                             | Tamil Nadu Agricultural university,<br>Coimbatore | India  |
| 27 | Effect of selected blades on rake angles with respect to selected speeds in harvesting efficiency                                    | Agricultural Machinery & Equipment         | NK Sathish Kumar<br>R Thiyagarajan   | drthiyagarajan@gmail.com                             | Tamil Nadu Agricultural university,<br>Coimbatore | India  |
| 28 | Adoption of Conservation Agriculture (CA) in Iran: Present Trends and Future Prospects   | Agricultural Machinery & Equipment         | Mohammad Esmaeil Asadi   | iwc977127@yahoo.com                                  | Pangan Kariz Rayan                                | Iran   |
| 29 | Bio-oil production from pine cones   | Farm Machinery & Power Engineering         | Jayant Singh<br>Priyanka Chand   | jayantsingh07@gmail.com                              | Ag. University                                    | India  |
| 30 | Performance Evaluation of Tractor Operated Multifunctional Vegetable Transplanter  | Agricultural Machinery & Equipment         | Sandip Nage<br>SM Mathur   | nagesandip91@gmail.com                               | PDKV,<br>Akola                                    | India  |
| 31 | Devices for carp and other Cyprinids preprocessing in small plants   | Post-Harvest Processing & Food Engineering | Mariusz Kosmowski,<br>Andrzej Dowgiałło &<br>Jozef Grochowicz                        | Jozef@jozefgrochowicz.com;<br>techmech@mir.gdynia.pl | NMFRI,<br>Gdynia                                  | Poland |
| 32 | Nutrigardens – using Bamboo Shed-Net house: A Solution to Address Better Nutrition and Entrepreneurship for Small Farmers            | Control Environment Agriculture            | Narendra G Shah  | prof.narendra.shah@gmail.com                         | IIT Bombay  | India  |
| 33 | Color spaces for quality prediction of impact damaged and stored banana fruit  | Post Harvest Processing & Food Engineering | Pankaj B. Pathare,<br>Mai Al-Dairi &<br>Hemanatha Jayasuriya                         | pankaj@squ.edu.om;                                   | Sultan Qaboos University                          | Oman   |
| 34 | Mangroves for Pollution Control, Climate Mitigation and Food Security – Engineering challenges and opportunities for coastal economy |  | Toqa Allah Waleed,<br>Yasmine Abdel Maksoud,<br>Hani Sewailam, &<br>Rameshwar Kanwar | rskanwar@iastate.edu                                 | Iowa State University                             | USA    |
| 35 | Effect of hermetic storage in the super grain bag on seed and milling quality of rice in Assam, India                                | Post Harvest Processing & Food Engineering | Suryakanta Khandai<br>Vipin Kumar,<br>Saurajyoti Baishya,<br>Jami Naveen,            | s.khandai@irri.org                                   | IRRI  | India  |

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|    |  |  | Virendar Kumar,<br>Rabe Yahaya &<br>Sudhanshu Singh  |   |   |          |
| 36 | Calibration and validation of AquaCrop model for drip irrigated cabbage under semi-arid region of Maharashtra  | Soil & Water Engineering                     | SB Jadhav,<br>VK Ingle,<br>UM Khodke &<br>HW Awari   | sbjadhav.aep@gmail.com                    | Vasantrao Naik<br>Marathwada<br>Krishi<br>Vidyapeeth,<br>Parbhani | India    |
| 37 | Design Development and Performance Evaluation of Animal Lifting Device   | Agricultural Machinery & Equipment           | Smita Solanki  | rtramteke18@gmail.com                     | Vasantrao Naik<br>Marathwada<br>Krishi<br>Vidyapeeth,<br>Parbhani | India    |
| 38 | Development and application of biodegradable spray coatings impregnated with oil encapsulated starch nanoparticles for shelf-life extension of fruits and vegetables | Post-harvest processing and Food engineering | Rahul Islam Barbhuiya,<br>Sivaranjani Palanisamy Ravikumar,<br>Charles Wroblewski,<br>Abdallah Elsayed,<br>Jayasankar Subramanian,<br>Gopu Raveendran Nair &<br>Ashutosh Singh | rbarbhui@uoguelph.ca                      | University of<br>Guelph   | Canada   |
| 39 | Development of Turmeric Processing Machinery   | Post-harvest processing and Food engineering | S Ganapathy,<br>T Pandiarajan,<br>M Balakrishnan,<br>IP Sudagar &<br>R Arulmari  | ganapathy.s@tnau.ac.in                    | Tamil Nadu<br>Agricultural<br>university,<br>Coimbatore           | India    |
| 40 | Leaf Spectral Analysis for The Identification and Distinction of Bacterial Heart Rot Disease Severity Levels in Pineapple  | Computers and Electronics in Ag. Engineering | Nazmi Mat Nawi,<br>Siti Nooradzah<br>Adam  | nazmimat@upm.edu.my<br>snadzah@upm.edu.my | Universiti Putra  | Malaysia |
| 41 | Development of nanocellulose-based biodegradable nanocomposites for food packaging   | Post-harvest processing and Food engineering | Sivaranjani Palanisamy Ravikumar   | palaniss@uoguelph.ca                      | University of<br>Guelph   | Canada   |
| 42 | AI, IoT and Sensor Operated Smart Urban Farming Industry   | Control Environment Agriculture              | Murtaza Hasan,<br>Vinayak Paradkar,<br>Kishor Pandurag<br>Gavhane, Adarsh<br>Gopalakrishna Bhat<br>& Rongali Mahesh  | hasaniari40@gmail.com                     | ICAR IARI   | India    |
| 43 | Estimating Leaf Area Index, Biomass and Yield of Rice Across Diverse Irrigation and Fertilizer Rates Using UAV and Machine Learning Algorithms                       | Computers and Electronics in Ag. Engineering | Sumit Kumar<br>Vishwakarma,<br>Kritika Kothari &<br>Ashish Pandey  | sumitk_vishwakarma<br>@wr.iitr.ac.in      | Indian Institute<br>of Technology                                 | India    |
| 44 | Development and application of iron oxide nanoparticles to improve soil quality and improve agricultural sustainability  | Soil & Water Engineering                     | Charles Wroblewski   | wroblewc@uoguelph.ca                      | University of<br>Guelph   | Canada   |
| 45 | Enhancing Water use Efficiency with Micro Irrigation in Canal-Dominated Agricultural Region  | Soil & Water Engineering                     | Sandeep Kumar<br>Chourasia   | schourasia.ce@gmail.com                   | Indian Institute of<br>Technology                                 | India    |

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| 46 | Development of Real-Time Microcontroller Based Monitoring System for Pulsed-Microwave Finish drying of Neem leaves ( <i>Azadirachta indica</i> )     | Post-harvest processing and Food engineering | Arun Prasath Venugopal, Piyush Sharma & Parag Prakash Sutar  | arun16foodengg@gmail.com     | National Institute of Technology            | India    |
| 47 | Development and Validation of a Three-Dimensional Freezing Model for Cow Milk Kulfi using Computational Fluid Dynamics                               | Post-harvest processing and Food engineering | Kiran Nagajjanavar   | kirannagajjanavar@gmail.com  | Horticultural engineering & food technology | India    |
| 48 | Development of appropriate technological tools and techniques for processing and storage of ginger in Nepal  | Post-harvest processing and Food engineering | Suranjan Panigrahi, GR Burniske, JM Bello-Bravo, S Duval, KA Mckibben, & AL Williamson.                        | spanigr@purdue.edu           | Purdue University                           | USA      |
| 49 | Optimizing Agricultural Water Management: A Cloud-IoT-AI-Based Smart Irrigation Model  | Computers and Electronics in Ag. Engineering | Yogesh Kumar Kushwaha  | ykumarkushwaha@wr.iitr.ac.in | Indian Institute of Technology              | India    |
| 50 | Commercialization of photosynthetic mass in crop farms: A novel approach to harness solar energy for resource circularity                            | Energy & Environment                         | D C Baruah   | baruahd@tezu.ac.in           | Tezpur University                           | India    |
| 51 | The Prospect of a Small-Scale Biogas System as a Viable Rural Entrepreneurship in Rural India  | Energy & Environment                         | T Sarmah, I Rasul & DC Baruah  | baruahd@tezu.ac.in           | Tezpur University                           | India    |
| 52 | Digitalisation in Agriculture- Global Food security  | Industrial Innovations                       | Nitin Tikamchand Agrawal   | agrawalnitint@gmail.com      | International Tractor Ltd                   | India    |
| 53 | Infrared Thermal Imaging and Image Processing Techniques to Detect Apple Snails ( <i>Pomacea</i> spp) at Different Water Depths and Turbidity Levels | Computers and Electronics in Ag. Engineering | Nik Nor Asyikin Raja Ismail, Nazmi Mat Nawi, Ya'akob Mansor & Anis Syahirah Mokhtar                            | asyikinrajaismail@gmail.com  | Universiti Putra                            | Malaysia |
| 54 | Interannual rainfall variability and its relationships with El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) in Thailand        | Soil & Water Engineering,                    | Mallappa Jادیappa Madolli, Sajjad Hasnain Md Haikel, Shubham Anil Gade, Avishek Datta, & Sushil Kumar Himanshu | st124508@ait.asia            | Asian Institute of Technology               | Thailand |
| 55 | Deep Learning and Drone Imagery-Based Automated Recognition of Coffee Plant Varieties  | Computers and Electronics                    | Chime Wangmo   | st123148@ait.asia            | Asian Institute of Technology               | Thailand |
| 56 | Temperature variability and its relationships with the Indian Ocean Dipole (IOD) in Thailand   | Soil & Water Engineering                     | Mallappa Jادیappa Madolli, Sajjad Hasnain Md Haikel, Shubham Anil Gade, Avishek Datta & Sushil Kumar Himanshu  | sushil-kumar@ait.asia        | Asian Institute of Technology               | Thailand |

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| 57 | Development of an artificial intelligence based identification system for industrial sorting of big onion  | Computers and Electronics                    | Sunimali Attanayake, KSP<br>Amaratung,<br>KP Chathumal                                      | sunimaliattanayake@gmail.com | University of Peradeniya   | Sri Lanka |
| 58 | Study of drainage characteristics and its implications for watershed management—A case study of the Dharma River basin, Karnataka state, India             | Soil & Water Engineering                     | Umesh J Madolli,<br>JT Gudaguru,<br>Krishnareddy, GS &<br>Mallappa JM                       | krishnareddygs14@gmail.com   | University of Agricultural Sciences,<br>Bengaluru                | India     |
| 59 | Efficacy of herbicide application for weed management in soybean by Drone  | Agricultural Machinery & Equipment           | Bhagwan Asewar<br>MP Jagtap,<br>Chaitanya Hiremath,<br>GU Shinde &<br>Indra Mani            | asewarbv2007@gmail.com       | Vasantao Naik<br>Marathwada<br>Krishi<br>Vidyapeeth,<br>Parbhani | India     |
| 60 | Comparative Study of Weather Based Normalised, FAO and Digital Lysimetric Crop Coefficient of Rabi Sorghum for Semiarid Climatic Conditions of Maharashtra | Soil & Water Engineering                     | HW Awari,<br>VK Ingle,<br>UM Khodke   | hwawariaep@gmail.com         | Vasantao Naik<br>Marathwada<br>Krishi<br>Vidyapeeth,<br>Parbhani | India     |
| 61 | Solar Energy Forecasting based on weather parameters using Tensorflow  | Energy and Environment                       | Jagannath Rabindra<br>Sahoo,<br>R Mahendiran,<br>Balaji Kannan &<br>A. Eswari               | sahoojagannath173@proton.me  | Tamil Nadu<br>Agricultural<br>university,<br>Coimbatore          | India     |
| 62 | Mass Transfer Modulation by Cold Plasma Pre-treatment in Oyster Mushroom Processing  | Post-harvest processing and Food engineering | Brijesh Srivastava,<br>Meghmilan Pathak,<br>Sasanka Sutradhar,<br>S Dinakaran &<br>Reshma C | brijesh@tezu.ac.in           | Tezpur<br>University,<br>Tezpur                                  | India     |

**IAEC-01**

**Portable Smart Solar Tunnel Dryer: A Green Technology for Small and Marginal Farmers**

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Drying is an excellent way to preserve food and the challenge is to remove moisture from produce as quickly as possible with very simple convenient method. Every farmer can't afford to buy and install dryers of huge capacity required for drying farm produce. Very few dryers are available which are portable and smart enough to control both temperature and Rh inside the drying chamber. Hence, the small portable smart solar dryer was developed and performance was evaluated for red chilli. Dryer was tested under no load and full load conditions. At no load and full load conditions, the pre-set temperature of 50°C and Rh of 35% were successfully monitored by control panel. The developed Smart Portable Dryer (SPD) took only 4 days to reduce moisture content of product from 83.73% to 9.32% and could save 5 days (55.5 per cent of total drying time) compared to Open Sun Drying (OSD) and 1 day (20%) over Solar Tunnel Dryer (STD) to attain same moisture level. SPD has net savings of 43.10 per cent drying cost over OSD and 23.58 per cent over STD. The prototype SPD has a BEP of 460 h/year and payback period of only 12-14 months (1.10year). The retention of ascorbic acid was significantly higher in SPD (325mg/100g) followed by STD (258.33mg/100g) and OSD (200mg/100g). The overall quality of dried chilli was significantly higher than that of OSD and STD. The prototype (solar-powered & portable), with a cost of operation of Rs.512/day, 460 hours of BEP, and 14 months of PBP, could benefit the small farming community with higher profits.

**Keywords:** Smart dryer, Tunnel dryer, prototype, Portable dryer, Chilli drying.

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**IAEC-02**

**Design and experiment of attitude adaptive adjustment system for driving device**

糜 泽荣\*

Hilly Mountain Agricultural Mechanization and Intelligent Equipment Innovation  
Research Center, Guangxi University of Science and Technology, Guangxi University  
Liuzhou, China

Aiming at the safety and comfort problems such as lumbar muscle strain caused by the tilting of agricultural machinery caused by the ground or the type of operation in hilly and mountainous areas, a driving device attitude system which can adapt to the lateral posture of the vehicle independently of the transmission system is designed. The system is formed by combining the steering wheel, pedals and seats in the original tractor and increasing the freedom of lateral adjustment. While changing the transverse posture of the driving device, the contact mode between the walking system and the ground and the three-point suspension is not changed, and the traction performance and the ability of copying operation are taken into account. The corresponding control system is developed based on MCU and PID control methods, and the automatic control algorithm based on the driver's ride comfort and speed segmentation PID is proposed. The angle range of the leveling control is  $\pm 15^\circ$ , the control accuracy is  $0.45^\circ$ , and the subjective evaluation test determines the upper limit of operator comfort when the leveling speed is  $2.4^\circ/s$ . Compared with other attitude adjustment systems, this system has the advantages of low cost and high reliability, and provides a reference for other mountain and agriculture autonomous vehicle attitude adjustment.

**Key words:** Multifunctional operating platform; Slope adaptive; Steering gear; Control system

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IAEC-03

**Performance Evaluation of a Multi-Rotor Unmanned Aerial Vehicle for Chemical Application in Groundnut Crop**

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Recently, multi-rotor unmanned aerial vehicles (UAVs) have become one of the dominant approaches, especially for crop spraying operations. Researchers and manufacturers have been quite interested in the performance of battery-operated hex copter UAVs. In this study, developed six-rotor battery-powered UAV sprayer was used to assess the performance at the groundnut research field (16.2051° N, 77.3303° E), University of Agricultural Sciences, Raichur, Karnataka. The Chlorantraniliprole (a.i. 18.5% SC) insecticide mixed with water in a ratio of 6.0 mL L<sup>-1</sup> was sprayed with a UAV sprayer. Water-sensitive paper samples were kept on the leaves to study the spray characteristics. The UAV sprayer was operated with optimised operational parameters and spray droplet characteristics, viz., spray deposition rate ( $\mu\text{l cm}^{-2}$ ), spray droplet size ( $\mu\text{m}$ ), spray deposition density (No's.  $\text{cm}^{-2}$ ) and spray deposition uniformity (%) were analysed using USDA Deposit Scan software. The biological efficacy was measured by taking the number of insects present before the spraying and the number of insects present after 1 day, 3 days and 7 days. The powerful downwash airflow produced by the propeller of the UAV sprayer has positive impact on the spray droplet deposition rate. Showed better results in spray droplet deposition rate and spray coverage per unit area. The information obtained from these experiments provided valuable insight into the feasibility of multirotor UAVs for chemical application and also improved the efficiency of UAV chemical spraying in terms of large-scale application in groundnut crops.

**Keywords:** Bio-efficacy, Chemical spray deposition, Droplet size, UAV sprayer, Water sensitive paper

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IAEC-04

**Integrated Biomass Supply Chain Modeling for Delivery Logistic of In-field Paddy Straw to Biorefinery Plants**

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The efficient management of the biomass supply chain is pivotal in ensuring the seamless flow of paddy straw from agricultural fields to biorefinery plants. This involves a complex interplay of factors such as harvesting, transportation, storage, and processing. The complexity of biomass supply chain affecting quality and quantity of feedstock to the bioenergy plant within time domain has not been clearly understood. An integrated biomass supply chain modeling is crucial for analysing complex sequential logistical operations interacting with machine, crop and weather parameters. The main objective of this research is to optimize biomass supply chain logistics to deliver a specified quantity and quality of paddy straw feedstock to the gate of biorefinery plant at a competitive price with enhanced environmental sustainability. A computer simulation model has been developed based on the framework of integrated biomass supply chain logistic. The model has been built in ExtendSim software, which consists of a network of operational modules threaded into a complete supply chain system. Identified model critical input parameters including field data, crop data, harvest schedule, equipment data and weather data. The equipment data set consists of details of harvesters, balers, loaders, transporters, handlers, and tractors. Based on the analysis of the model results for harvesting of paddy straw with conservation allowance (CA 0%) the following conclusions are drawn: a) For the optimal machine combination of 2H+1B+7L+20T+3UL reported the least biomass delivery cost for both tonne and dry tonne of about 6076 Rs.  $t^{-1}$  and Rs.10686  $dt^{-1}$ , respectively. b) Among various operations of supply chain, the transportation cost was highest for both tonne and dry tonne of biomass delivered was about 3176 Rs.  $t^{-1}$  and 5585 Rs.  $dt^{-1}$ , respectively. Whereas, harvesting cost was lowest for both tonne and dry tonne of biomass delivered was about 182 Rs.  $t^{-1}$  and 320 Rs.  $dt^{-1}$ , respectively. c) Among various operations of supply chain, the energy consumption for transportation was highest for both tonne and dry tonne of biomass delivered was about 740.6 MJ  $t^{-1}$  and 1302.36 MJ  $dt^{-1}$ , respectively. Whereas, for harvesting was lowest for both tonne and dry tonne of biomass delivered was about 112.87 MJ  $t^{-1}$  and 198.48 MJ  $dt^{-1}$ , respectively. d) Among various operations of supply chain, the carbon dioxide emission for transportation was highest for both tonne and dry tonne of biomass delivered was about 16.22 Kg  $t^{-1}$  and 28.36 Kg  $dt^{-1}$ , respectively. Whereas, for harvesting was lowest for both tonne and dry tonne of biomass delivered was about 2.47 Kg  $t^{-1}$  and 4.35 Kg  $dt^{-1}$ , respectively. e) The overall supply chain duration right from harvesting to unloading operation was found to be 126 days. The outcomes of this research can guide the development of strategies and practices that enhance the sustainability, cost-effectiveness, and overall viability of utilizing paddy straw in the emerging bioenergy sector.

**Keywords:** Biomass supply chain; Delivery logistic; Paddy straw management; Bioenergy feedstock.

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IAEC-05

**Bioremediation of Petroleum Hydrocarbon Contaminated Soil with Simultaneous Bioelectricity Generation in a Microbial Fuel Cell**

\*Meshack Imologie Simeon<sup>1</sup>, Abubakar Sadeeq Mohammed<sup>1</sup>, Felix Uzochukwu Asoiro<sup>2</sup>

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Soil contamination has a significant impact on soil fertility, plant growth, crop quality and ultimately on human health and ecosystems. Non-volatile petroleum hydrocarbons are among the most recalcitrant soil contaminants. Among the methods currently used to improve soil pollution, the microbial fuel cell (MFC) is one of the most promising technologies due to its cost-effectiveness and high efficiency. Although the potential of MFCs to remediate petroleum hydrocarbon contaminated soils while generating electricity has been described by many researchers, most of these studies used simulated contaminated soils, while others used MFC configurations that are not suitable for on-site use. In this study, the bioremediation of aged petroleum hydrocarbon contaminated soils in MFCs was investigated using the soil's indigenous microbial communities. The MFC used was constructed with four or six cells to mimic field plots. The electrodes were made of stainless steel mesh coated with carbon black and the MFCs were operated in open- and closed-loop. The electrochemical performance of the MFCs showed that after 16 days of operation, a power of 50  $\mu$ W was achieved at a cell voltage of 174.91 V and a current of 0.31 mA. Analysis of the total petroleum hydrocarbon (TPH) content of the soil showed that 24.26%, 11.04% and 5.34% of the TPH was biodegraded with the closed-loop, open-loop and natural attenuation cells, respectively, within 24 days. The adapted mixed culture was dominated by the strain of Proteobacteria (73.1%), divided into two classes: Alpha Proteobacteria (20.33%) and Gamma Proteobacteria (79.67%). *Shewanella oneidensis*, which belongs to Proteobacteria, and *Lactococcus lactis*, which belongs to Firmicutes, were among the identified electroactive bacteria in the soil while *Thermobifida fusca*, *Mucilaginibacter* sp., *Thermoactinomyces* sp., and *Acidocella* sp. were among the hydrocarbon degraders enriched in the soil. This result shows that bioelectrochemical stimulation enhances the biodegradation of petroleum hydrocarbon contaminants in soil by indigenous microbial communities. The successful application of the cell design in this study indicates that the application of this technology is feasible in practice. However, for better performance in practice, improvement of the SMFC design is required to overcome the system limitations due to moisture loss.

**Keywords:** soil, bioremediation, microbial fuel cell, bacteria, power generation.

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IAEC-06

**Effect of Digital Transformation of Agriculture Production System on Climate change mitigation and Resilience**

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The world's agri-food system has the potential to help reduce poverty, improve nutrition, and provide vast environmental benefits. The global food supply is enough to feed the world population, but it is deeply inequitable. Moreover, undernourishment has been rising. Poverty rates are also on the rise. Furthermore, agriculture and the production of major crops remain a major contributor to negative environmental outcomes such as soil erosion, water pollution, and methane emissions.

Digital technologies demonstrate opportunities to transform the agri-food systems in ways not previously seen by drastically lowering information asymmetries and transaction costs in the systems. Digital and geospatial technologies also help to monitor, assess, and manage soil, climatic, and genetic resources and offer opportunities to meet sustainability challenges of food production. Unlike past technological revolutions in agriculture which began on farms, this digital revolution, is happening on multiple fronts at a stunning speed along local, regional, and global food value chains. The change is driven by the agricultural and food system's ability to collect, use and analyze massive amounts of machine-readable data about practically every aspect of the value chain—from crop production, processing to consumption, and by the emergence of digital platforms disrupting agri-business models and new start-up systems. Ultimately, digital technology could ensure inclusive and sustainable growth.

However, there are challenges for digital technologies to maximize the intended socio-economic and environmental benefits. The cost of transition -including setting up and maintaining new digital infrastructure, both hardware and software can affect the ability to achieve the environmental sustainability benefits and climate resilient agriculture. Access to digital technologies is also unevenly distributed across geographic locations, industries, firms, and individuals. Challenges are also observed at the global level to ensure how to make the most out of the digital transformation particularly to achieve climate resilience. Opportunities to harmonize strategies, and share international experiences are evident but remain sub-optimal. To this end, this paper focuses on the ways to increase the participation and contribution of smallholder farmers and other actors including new young and women entrepreneurs by improving the policy and regulatory environment using the public investments to crowd in private investment and mitigate the risks arising from the digital agriculture transformation.

Key policy action areas include: (i) Specific actions at the project level or territorial approaches to enhance digital investment and adoption with particular reference to the context of developing countries in ASEAN (ii) Strategies to improve enabling environment at the agriculture sector level to enhance the supply and demand for digital solutions to enhance productivity, inclusivity, and sustainability; (iii) Cross-cutting sectoral actions (including but not limited to the sectors and issues of the ICT, trade, sustainability, and finance) to deepen and extend digital transformation in agriculture and food systems; (iv) International/regional cooperation and governance architecture to optimize the role of digital transformation in achieving sustainable and inclusive growth.

**Key words:** Climate change, Mitigation, agriculture, digital

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IAEC-07

**Development of Tractor Operated On farm Pelleting Machine for Densified Fuel Production from Argo residues**

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India is a fast-developing country; with high economic and industrial growth, energy demand is also growing. The major sources that fulfil the energy requirement of India are oil and coal. However, there are many disadvantages of using non-renewable energy resources as they have limited existence on the earth, are non-eco-friendly and not economical as India imports all these types of energy resources. Hence efficient utilization of bioenergy is one of the options to fulfil the energy demand by adopting various techniques. Densification of loose agro residues by using pelleting machine can be adopted for ease in handling, storage and transportation. Most of the pelleting machines are operated using the electricity supply with an electric motor connection but the rural electricity supply in India is suffering both in terms of availability for a measured number of hours and penetration level. Due to uneven supply of electricity and non-availability of electrical power at village level and alternate mechanism to operate pelleting machine is an urgent need. Most of the farmers utilized tractor as a power source at village level for performing field operation. Hence the tractor power source can be utilized for conversion of agro residue into pellets. A power transmission mechanism from tractor PTO to operate pelleting machine can overcome the problem of uneven availability of electricity. Considering above fact, tractor operated pelleting machine was developed in order to utilize agro residue at the farm level and convert it into pellets with objectives to design and develop tractor operated flat die type pelleting machine for the production of pellets from agro-residues to evaluate the performance of tractor operated agro-residue based pelleting machine, characterize the fuel properties of agro-residue pellets and assess the economic feasibility. The tractor operated flat die type pelleting machine was operated for 50 kg/h capacity. The performance of tractor operated pelleting machine was evaluated using soybean straw and cotton stalk. The experiments were designed using the statistical model Box-Behnken design for performance evaluation of developed tractor operated pelleting machine. The preliminary test was conducted for the pellet machine developed by supplying power through the tractor PTO. The independent parameters were selected moisture content 20, 25 and 30%, particle size 4, 6 and 8 mm, speed of shaft 150, 200 and 250 rpm respectively. The pelleting efficiency, pelleting capacity, pellet density and fuel consumption were observed 88.2%, 43.9 kg/h, 615.3 kg/m<sup>3</sup> and 1.12 lit/h respectively for soybean straw and 87.0%, 41.6 kg/h, 613 kg/m<sup>3</sup> and 1.13 lit/h respectively for the cotton stalk. The calorific value of soybean pellets and cotton pellets were found to be 4494.19 kcal/kg and 4519.19 kcal/kg and shattered index 93.9% and 92.8%, resistance to water penetration 86.4% and 84.3% were recorded. The net present worth of the developed machine was found Rs. 20,41,267/- for 10 years assumed the life of the developed machine. The benefit-cost ratio was found to be 1.63 with a payback period of 17 month for 250 operational days in a year for soybean straw and cotton stalk.

**Keywords:** Densification, biomass, pellets, efficiency, renewable energy, cotton stalk, soybean straw

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**IAEC-08**

**Soil Moisture Dynamics under Sensor-based Drip Irrigation using HYDRUS (2D/3D) Model under Vertisols of North Eastern Dry Zone of Karnataka**

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A field experiment was conducted on Ridge gourd during Rabi season of 2021-22 and 2022-23 at the Experimental Research Plot Soil and Water Engineering, CAE, Raichur. In the present study, it is envisaged to collect the data pertaining to water distributions under mulched and non-mulched sensor-based drip irrigation system (SDIS) with a horticulture crop, i.e., ridge gourd. The HYDRUS (2D/3D) model was selected for the simulation of water under drip irrigation in mulched and non-mulched conditions. The water pattern in the entire study area was analyzed, by considering the transient 2D infiltration processes around an emitter. The statistical indicators showed good agreement between model predictions and observed data at different crop growth stages (30, 60, 90 and 103 DAS) in treatments pertaining to irrigation at 100% FC and 100% ET under mulched and non-mulch conditions. The coefficient of determination ( $R^2$ ) and index of agreement (IA) varied between 0.78 to 0.97 and 0.70 to 0.98 in different treatments for soil water distribution. The error estimates (RMSE and MAE) recorded was in the range of 0.21 to 1.66  $\text{cm}^3 \text{cm}^{-3}$  for soil water movement. The use of sensor-based irrigation at 100% field capacity under mulched has shown positive outcomes, leading to a significant conservation of irrigation water, with savings of approximately 12.3%.

**Keywords:** drip irrigation, soil moisture, sensor, Hydrus

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IAEC-09

### **Non-Destructive Quality Assessment of Blanched Black Pepper using FT-NIR Spectroscopy**

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Pepper (*Piper nigrum* L.) is a vinyl perennial plant producing berry-like, aromatic pungent fruits, which belongs to Piperaceae family. Traditionally, the pepper is harvested in the form of pepper vines when matured and started to change from green to red and yellow, threshed to remove berries from the stalk, blanched in hot water and dried under the sun. The effect of blanching and drying methods were assessed following the standard analytical procedures and nondestructive method using Fourier transform near-infrared (FT-NIR) spectroscopy. Well matured pepper berries (var. Panniyur-1) harvested at optimum stage and threshed using mechanical thresher were subjected to hot water and steam blanching at 100°C for 1, 2, and 3 min., traditionally followed to obtain quality final product, followed by tray drying at 50°C (air velocity 0.75 m/s) and sun drying (28 to 32°C; 65 to 75% relative humidity). From the initial moisture content of 170% (d.b.), the pepper berries were dried to a final moisture content of 11% (d.b.). The effect of blanching and drying methods of pepper was assessed from the essential oil, oleoresin, and piperine content following the standard analytical procedures. Blanching methods, blanching duration and drying methods had a significant effect ( $p < 0.05$ ) on quality parameters of pepper. The essential oil content ranged 2.6 to 3.2%. Sun drying and blanching for shorter durations resulted in higher values of essential oil. Oleoresin content was in the range of 8.51 to 9.19%. Steam blanching and hot water blanching for short duration retained higher oleoresin content under sun drying. The piperine content varied from 3.28 to 4.29%. Steam blanching for lower durations and tray drying yielded higher piperine content. A nondestructive method was developed for assessing the quality parameters such as essential oil, oleoresin, and piperine content in blanched black pepper using Fourier transform near-infrared (FT-NIR) spectroscopy. The spectra of the pepper samples were recorded using an FT-NIR instrument in the diffuse reflectance mode between 12500 and 3600  $\text{cm}^{-1}$ . The raw spectra were processed using different spectral preprocessing techniques to remove noise. The preprocessed spectra were used to build partial least square (PLS) regression calibration models for each quality parameter. The combination of best spectral preprocessing and the PLS model were chosen based on the highest coefficient of determination ( $R^2$ ), and the lowest root mean square error of cross validation (RMSECV). The results showed the highest accuracy for predicting oleoresin ( $R^2=0.88$ ; RMSECV= 0.07), followed by essential oil ( $R^2=0.86$ ; RMSECV=0.05), and piperine content ( $R^2=0.83$ ; RMSECV=0.19). The traditional method and FT-NIR methods were well correlated ( $r > 0.91$ ) in estimating all the quality parameters. The quality assessment using the FT-NIR method took less than 1 min to predict the quality parameters in black pepper, while the conventional method took approximately 35 h for laboratory analysis. The promising results suggest that the FT-NIR could be used as a rapid nondestructive tool for the general screening of pepper quality.

**Key words:** pepper; blanching and drying; oleoresin, piperine, essential oil; FT-NIR spectrometry.

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**IAEC-10**

**Pulsed Light Decontamination and Modeling of Salmonella on Pecan Halves**

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Pecans are associated with numerous foodborne illness outbreaks and recalls. Pasteurization has been the traditional method of sterilization of tree nuts. Pulsed light (PL) has been proved an inexpensive, efficient, and environmentally friendly nonthermal processing methods for several foods. However, this technology has not been explored enough in tree nuts. In this study, the efficacy of PL in inactivating Salmonella Typhimurium (ATCC 14028) on pecan halves was investigated. A Z-1000 sterilizing system was used to treat pecan samples at 7, 11, or 15 cm distance from the quartz window in the PL chamber for 1, 5, 10, or 15 s. Each treatment included three pecan halves placed at the same time in the sterilization chamber. Experiments were repeated three times for each treatment time and distance and then were analyzed using the GLM procedure of SAS. The PL delivered to the surface of pecan halves achieved a maximum log reduction of 1.69 CFU/g for treatment duration of 15 s at 7 cm distance. The treatment with the highest log reduction was chosen to determine the pecan halves' quality characteristics. Significant reduction in moisture content in pecan samples was observed immediately after treatment. However, after storing at 4 °C for 24 h, no difference in moisture content was observed between treated and untreated samples. Changes in color ( $a^*$  and  $b^*$  values) were observed in treated pecan samples immediately after treatment (0 h), but they regained their color after 24 h. The total color difference ( $\Delta E$ ) between untreated and treated pecan samples was not significant, indicating that the treatment did not adversely affect the overall appearance of the pecan halves. Similarly, there were no differences in hardness values between treated and untreated pecan halves. This study demonstrates that PUVL can be used as an effective sterilizing method for Salmonella. Artificial neural network (ANN) prediction models were developed for predicting the PL Salmonella inactivation on pecan halves as a function of distance and treatment time using the Backpropagation (ANN-BP) and Kalman Filter (ANN-KL) learning algorithms, and their performance was compared with that of regression models. Various statistical indices, including R between actual and predicted outputs, were evaluated for selecting the best models. Prediction plots for log reduction values indicated that both the ANN-BP and ANN-KF models demonstrated robust accuracy, with R values of  $0.784 \pm 0.390$  STDEV and  $0.802 \pm 0.391$  STDEV, respectively, in predicting from new unseen patterns, compared to the performance of the regression models ( $R=0.602 \pm 0.371$  STDEV). The results indicated that ANN models could give a good prediction of the Salmonella population.

**Keywords:** Salmonella; pecan; decontamination; pulsed light; Artificial neural network

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**IAEC-11**

**Comparative Performance Analysis of Machine Learning and Regression Models for Predicting the Angle of Repose of Sericea Lespedeza Seeds**

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Flow properties play an important role in handling and processing of food products especially while flowing from hoppers, mixing, transportation, compression, and packaging. In recent years, machine learning (ML) has gained popularity in modeling complex and nonlinear processes. The objective of this study was to develop ML models for predicting the angle of repose of sericea lespedeza seeds as a function of cultivar and seeds' moisture content, length, width, thickness, and weight. Models were developed using support vector machine (SVM), Random Forest, Decision Tree, Backpropagation, and K-Nearest Neighbor (KNN) learning algorithms and their performance was compared with that of regression models. The data used in modeling were obtained from an experimental study conducted in the Food Engineering Laboratory, Fort Valley State University, in which seed properties were inputs and angle of repose was the output. Data preprocessing was performed to meet the format requirements of ML models. The model was validated using a five times k-fold cross-validation technique to avoid underfitting and overfitting. Various statistical indices, including R between actual and predicted outputs were evaluated for selecting the best models. Prediction plots for angle of repose values indicated that the ML models had robust accuracy ( $R=0.97$ ) as compared to regression analysis ( $R=0.62$ ). Further, ML models were able to better generalize and interpolate unseen patterns within the domain of training. The analysis reveals that AI has the potential for improving predictions in nonlinear decision contexts without sacrificing performance in linear decision contexts.

**Keywords:** Machine learning; prediction models; sericea lespedeza; angle of repose

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IAEC-12

**Effect of Yeast Concentration on Quality Parameters of Ber (*Ziziphus mauritiana*)  
Fruit (cv. Umran) Wine during Ageing**

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The present investigation was carried on for production of ber wine using yeast (*Saccharomyces cerevisiae* var. *ellipsoideus*) for fermentation. The quality parameters of ber wine were predicted by Design-Expert 7.7.0 software for optimizing the process parameters. The results obtained at T4 treatment (5 % inoculum) were encouraging with TSS (7.61 Brix), pH (4.06), residual reducing sugars (5.22 %) and alcohol (10.92 %) on 0th day of ageing with desirability factor of 0.95 followed by the results obtained on 90th day of ageing for T4 treatment (5 % inoculum) were TSS (6.27 °Brix), pH (4.22), residual reducing sugars (4.71 %) and alcohol content (12.07 %) with desirability factor of 0.93.

**Key words:** Ber Fruit; wine; yeast

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IAEC-13

**Climate Smart and Pathogen Impact Limiting Sericea Lespedeza Fodder Production Spatial Suitability Analysis in the Southern African Development Community Countries with Geospatial Engineering and Technology Support**

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Apathy of professionals towards rural communities has severe repercussions with respect to healthcare for both humans and animals. It is observed among the small ruminant (goats and sheep) production community (farmers, research scientists, veterinary doctors, and managers) in the Southern African Development Community (SADC) countries that sericea lespedeza (SL; *Lespedeza cuneata*), a drought-tolerant fodder, has nutraceutical (nutritional + health) value as a forage for goats and sheep. One of the climate changes (CC) consequences, due to global warming (GW), is the development of erratic droughts in a temporal manner worldwide. A positive impact of CC is the availability of more land for SL cultivation (due to its high drought tolerance) and increased farmers' interest towards small ruminant rearing in lieu of cattle. The goal of this study is to develop a geospatial engineering and technology supported SL production suitability model to determine potential areas for cultivation to support profitable small ruminant production in SADC countries. Although SL fodder is a low-maintenance and less climate-, terrain-, and soil quality-sensitive crop, its successful cultivation has specific requirements with respect to weather suitability, such as higher minimum temperature, soil characteristics, such as non-clay soil with lower bulk density, and open land cover. As the preliminary objective, an automated geospatial model was developed in ArcGIS Pro ModelBuilder platform to determine SL production spatial suitability. It was being observed by our research team that *Hemonchous Cantortus*, a common parasite and one of the most pathogenic nematodes of small ruminants are growing at a faster rate as an impact of global warming. As the second objective of this study, we developed a basic reproduction quotient (Q0) model for SADC countries to observe the spatial growth of the pathogen. As a third objective, we established a correlation model between the spatial SL production suitability areas and the corresponding Q0 values to suggest that better SL production locations will be helping in eradicating the impact of the *Hemonchous* pathogen in small ruminants. Thus the small ruminants production would thrive. A webGIS site was developed as an ArcGIS Online dashboard format, so that farmers interested in switching to small ruminant production in lieu of cattle farming can obtain the SL production suitability decision support and information on Q0 for their land in SADC countries. This fodder production suitability study in CC scenario would support pasture managers of other countries in the world with similar environmental (weather, climate, soil, and land use) characteristics, as mentioned.

**Keywords:** Sericea Lespedeza (SL), ArcGIS Pro ModelBuilder, Production Suitability Model. WebGIS; Climate Change, gSSURGO, PRISM Climate, *Hemonchous Cantortus*, Basic Reproduction Quotient (Q0) Model, and Southern African Development Community (SADC)

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**IAEC-14**

**Hydroponic Farming: New Business Avenue for Entrepreneurs**

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Hydroponics, a blend of agriculture and technology, is a modern way used to increase yield, quality and profitability. In the contemporary times, the Hydroponics market is flourishing and contributing in shaping the future of the agriculture industry. With land being limited and a rising population in need of proper housing facilities, a method of farm production that enables production without land use can be of great value for India where agriculture still serves as a primary livelihood source for a majority of citizens. As entrepreneurs implement various controlled-environment agriculture (CEA) technologies, including hydroponic, vertical farming, nutrient film technique (NFT), Internet of Things (IoT) and polyhouses, investors too are showing increased interest and involvement in the sector. Green hydroponic structure showed best results followed by white net and open field hydroponic structure however temperature of white structure greater the 1-3°C as compared to green colour hydroponic structure. Temperature inside the green net, white net hydroponic structure was found 5-60C less than the outside temperature. The relative humidity inside the green net hydroponic structure was observed in between 30-82% in month of August and September. The relative humidity inside the white net and open field hydroponic structure was observed in between 30-41%. The Relative humidity inside green net hydroponic structure was found 40-42% more as to white net and open field hydroponic structure. But as we compare green and white net hydroponic structure relative humidity inside the green net hydroponic structure was found 1-2% more than white hydroponic structure. The light intensity in open field hydroponic structure was observed in between 50-60% more as compare to green net hydroponic structure. Light intensity inside the green net hydroponic structure was found 5-15% less than white net hydroponic structure.

**Key words:** Hydroponic, Spinach, Entrepreneurs, structures

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IAEC-15

**Sustainable Corn Pest Management: A Systematic Review of Fall Armyworm in the Philippines**

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The introduction of fall armyworm (FAW) *Spodoptera frugiperda* in the Philippines has caused significant threats to the agricultural sector. As of December 2020, FAW infested 70 out of 79 provinces providing severe destruction on corn crops. This study provides a qualitative systematic review using the PRISMA 2020 guidelines. Thirteen (13) unique peer-reviewed journal articles from 2018 to 2023 were selected from electronic searching databases and expanded search and were classified through three phases of a filtering process involving identification, screening, and eligibility assessment. Results show that the primary host preference of fall armyworm is corn (*Zea mays*), although with a significant aversion to Bt corns. Widespread damage in maize crops specifically the seedling to late-whorl stages, spanning vegetative growth that have significant impact to small-scale farmers, food security, and overall economic stability of the country. Ecological adaptability and a broad range of host utilization were evident, suggesting the presence of refuge host species like common weeds surrounding cropping areas. It was evident that FAW is an understudied topic in the Philippines, with adequate morphological information yet only one report on the molecular identification of *S. frugiperda* strains. Pest management mainly focuses on the utilization of entomopathogenic fungi such as *Metarhizium* sp. (*Metarhizium rileyi* and *Metarhizium anisopliae*) and *Beauveria* sp. (*Beauveria bassiana*), biochemical compounds such as wettable powders (kaolin clay), and Bt corn hybrid accession Bt Cry1Ab. This study emphasizes the urgency of understanding and managing FAW in the Philippines, calling for expanded research coverage and exploration of uncharted aspects like organic pesticides and resistance mechanisms.

**Keywords:** Corn pest, *Spodoptera frugiperda*, PRISMA

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IAEC-16

**Role of Computer Vision and Internet of Things in Export of High Value Agricultural Produce**

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Computer vision is a reliable, sophisticated method of processing images that has great promise and positive results. It was discovered during a review of previous studies on the application of computer vision to horticultural products in the fruit and vegetable. The fruits and vegetables among the different horticulture products of agriculture fields, a specific model, data pre-processing, data analysis method, and overall value of performance accuracy by utilizing a particular performance measure are all examined in this study in a wide sense. Computer vision is a non-destructive testing technology that is fast, easy to use, and requires less sample preparation. It is frequently used to evaluate agricultural products for quality issues such size, shape, color, flaws, and freshness. Using visual technology to replace human labor in food inspection and agricultural product development has become the norm. The digital image processing approach may achieve the non-contact and non-damage treatment of agricultural products and foods by extracting their size, shape, color, texture, and other properties, and combining them with the prediction model. This paper provides an overview of computer vision technology's application research and development for both domestic and international food and agricultural product export and processing.

**Key words:** computer vision, fruits and vegetables, non-destructive technology

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IAEC-17

**Application of Artificial Intelligence and Internet of Things in Mechanization of Indian Agriculture**

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Technology adoption is the need of the hour as our current traditional farming practices would not be sufficient for meeting the food demand. Internet of things and artificial intelligence has already started capitalizing across all the industries including agriculture. Advancement in these digital technologies has made revolutionary changes in agriculture by providing smart systems that can monitor, control, and visualize various farm operations in real-time and with comparable intelligence of human experts. AI in agriculture offers numerous opportunities to farmers, including improved crop health monitoring, precision farming, and weather forecasting. AI is used to find patterns and connections, machine learning algorithms process enormous volumes of data gathered from sensors, satellites, and drones. This data-driven knowledge equips farmers to take precise actions by enabling them to comprehend the specific requirements of their farms. The potential applications of IoT and AI in the development of smart farm machinery, irrigation systems, weed and pest control, fertilizer application, greenhouse cultivation, storage structures, drones for plant protection, crop health monitoring, etc. are discussed in the paper. AI combined with autonomous tractors and IoT helps to solve the common problem of labor shortages. Robotics are also important - agricultural robots are already being used for manual tasks like produce picking. Robots are more advantageous for farm work purposes due to their ability to work longer hours, enhanced precision on top of reduced susceptibility to errors. The main objective of the paper is to provide an overview of recent research in the area of digital technology-driven agriculture and most prominent applications in the field of agriculture engineering using artificial intelligence and internet of things.

**Key words:** Artificial intelligence, robotics, IoT, mechanization

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**IAEC-18**

**Design, Development and Performance Evaluation of Self-Propelled Chilli Harvester**

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Chilli (*Capsicum annum L*) is an important vegetable cum spice crop grown in the tropical, subtropical as well as temperate regions. India is the largest producer of dry chilli fruit in the world. During 2022-23, India produced approximately 19.57 lakh tonnes of chillies from an area of 8.52 lakh ha and the productivity was 2.30 tonnes ha<sup>-1</sup>. Traditional manual harvesting practices is time consuming method and unavailability of labour during the harvesting season causes a delay in the harvesting period which directly imparts poor-quality product. Hence it was felt necessary to design and develop a suitable chilli harvester. A purposive survey was conducted to know the status of adopted method for harvesting of chilli fruits. Morphological attributes and engineering properties of chilli plant and fruits were observed to know the behavior of the chilli crop in the field as well as after harvesting. In survey, various problems during harvesting of chilli crops by different adopted methods were collected.

The self-propelled chilli harvester was designed and developed successfully with 4.4 hp diesel engine, main frame support, harvesting rotor, collecting tray, plant guide at IIHR (ICAR), Bangalore. It was found that spike teeth rotor with three rows on rotor and 50 mm gap between the spike teeth, 60° angle of inclination, rotational speed of rotor 300 rpm at a planting distance 600 mm at semidry maturity stage the performance was observed to be highest with harvesting efficiency of 94.44%, unharvested chilli fruits (5.56%) ground fall of chilli fruits (2.87%) mechanical damage of chilli fruits (1.23%) and successfully harvested chilli fruits (79.02%). Very less chilli fruits with twigs 6.13% chilli fruits with branches 5.19% were obtained which may be clean afterwards. The machines effective field capacity was observed to be 0.14 ha/h, cost of operation for harvesting was observed to be ₹ 3058 ha<sup>-1</sup>, 3 ₹/kg with a saving of 86% in cost as compared to traditional manual plucking method. The breakeven point and payback period also calculated and found to be 53.55 hour per year and 1.08 year, respectively. An evaluation of ergonomics was conducted for a self-propelled chilli harvester prototype. It was found that the mechanical vibration, it was recorded at three different places with three different engine rotational speeds, ranged between 115 and 183 μm. The sound pressure level that was obtained at various engine rotational speeds was within a specified noise threshold. The workload for harvesting with a self-propelled chilli harvester was determined to be moderate. An energy expenditure rate of 9.41 kJ min<sup>-1</sup> and a physiological cost of work under a controlled limit of 34 beats per minute were noted, allowing the operator to run the built prototype continuously for eight hours. The overall discomfort rate (ODR) was obtained maximum in manual harvesting (6.49) (which falls under the severe to very severe work) whereas, in case of the developed harvester it was only 3.28 which comes in the category of moderate work. It was also observed that the percent in decrease in the BPDS in many parts of the body was found as 49.46 % reduction due to the developed harvester as compared to the manual hand plucking method.

**Key words:** Chilli harvester, self-propelled, ergonomics

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IAEC-19

**Performance Evaluation of an On-Grid Solar-Powered Greenhouse with a Fan-Chiller-Tube-Bank Cooling System**

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Greenhouse farming is one of the best solutions to overcome the harsh environmental conditions in arid countries like Oman. However, the efficiency of the cooling system can be affected during the summer season. The Fan-Pad cooling system is the most common cooling system used and the increased humidity from the evaporative pad can cause plant and soil pathogen issues. This study aimed to evaluate the performance of a greenhouse developed with a new concept of an on-grid solar-powered, fan-chiller-tube-bank cooling system by cultivating pot-grown Okra. Having on-grid solar system, the income comes from the crop and sale of excess electricity to the grid. The growth set-up was developed with a Quonset side-walled single-span prototype greenhouse and pot-based Okra cultivation with an automatic scheduled irrigation system and similarly treated control pots in an open-field condition. The greenhouse and cooling system was set up with sensors and a data logging system to measure Humidity and Temperature variations. The growth parameters of Okra and environmental parameters were measured and analyzed. The water consumption and electricity consumption were measured, and the excess energy supplied to the electricity grid was also estimated. In the performance evaluation, crop growth parameters were compared with the control plots, and efficiency parameters such as crop yield, water-use efficiency of irrigation system (WUEI), water-use efficiency of cooling system (WUEC), and energy-use efficiency (EUE) were evaluated. The results showed statistically significant differences between the growth parameters of greenhouse and control Okra plants, in which the greenhouse plants showing superior growth performances. The greenhouse system possessed an energy surplus of 1043 kWh per season and a water use efficiency (WUE) of 50.6 kg/m<sup>3</sup>. In addition, solar power systems provided 62.7% of the total earnings, ensuring economic stability. This study recommends further research with this system for Oman's seasonal effect to optimize the size of the solar panel bank, fan, and the chiller tube bank system to see how the energy and other efficiency components will be varied.

**Keywords:**

Greenhouse cultivation, fan-chiller-tube-bank cooling system, energy use efficiency, water use efficiency, crop growth parameters sustainability.

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IAEC-20

**Quantification of Sorghum Crop Irrigation Water Requirements in Semi-Arid Region of Maharashtra**

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This study focuses on determining reference evapotranspiration (ET<sub>o</sub>) using the Penman-Monteith method over a 31-year period in eight districts of the Marathwada region. Adopting crop coefficients from the FAO 56 procedure, adjusted to local climatic conditions, the daily crop water requirement (ET<sub>c</sub>) for sorghum was calculated. Results reveal a consistent ET<sub>c</sub> in the initial stage (1st to 5th crop week), a slight increase in the mid-season (6th to 11th week), and a significant rise in the seasonal stage (12th to 16th week). Dharashiv, Latur, Nanded, Beed, Parbhani, Sambhajinagar, and Jalna exhibit higher water requirements, while Hingoli has the lowest. Mean water requirement (ET<sub>c</sub>) for kharif sorghum varies across stages, decreasing in initial and late-season, increasing in the developmental, and peaking in the mid-season. Total water requirements range from 399 mm in Sambhajinagar to 436 mm in Parbhani. Spatial distribution maps of irrigation water requirement (IWR) reflect ET<sub>c</sub> trends. Higher IWR is observed in the southwestern part of Dharshiv and the western part of Parbhani, with lower IWR in the western part of Parbhani district. The study provides crucial insights into spatial and temporal variations in sorghum water requirements, offering practical implications for local agriculture. Aligned coefficients with regional climatic conditions guide water optimization in sorghum cultivation, forming a foundation for informed decision-making by farmers and policymakers. Future research could extend this methodology to other crops or assess climate change impacts on agricultural water needs, contributing to sustainable agricultural practices in the region.

**Keywords:** Evapotranspiration, crop coefficient, crop water requirement, spatial map, interpolation techniques, IWD, Marathwada.

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IAEC-21

**Land and Water Resources Characteristics of the Jamrani Dam Command Using GIS and Remote Sensing**

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Present study was conducted with an aim to assess the groundwater inventory in Jamrani Dam Command situated in Uttarakhand and Uttar Pradesh. Groundwater inventory was prepared for different blocks of Udham Singh Nagar, Rampur and Bareilly districts in Jamrani Dam Command from 1988 to 2010 at an interval of five years. Over exploitation of groundwater has created an alarming situation in few blocks of Rampur and Bareilly districts in Jamrani Dam Command. In the year 2010, Bilaspur, Baheri, Gadarpur and Rudrapur blocks of the study area were found under safe category; Swar and Meerganj blocks were found under critical category whereas Milak and Shergarh blocks were found under over exploited category. The maximum and minimum stages of development were found 109% and 59.3% at Shergarh and Rudrapur blocks, respectively. The overall stage of development for the study area was 68.4% and the area as a whole may be put under semi critical category for the year 2010.

In the present study, the physico-chemical properties of groundwater of shallow aquifer and their suitability for drinking, irrigation and industrial uses were studied. The physico-chemical properties of ground water of study area were determined using standard methods of water quality analysis. Comprehensive and proper groundwater recharge plan for the identified landforms with their prevailing geomorphic features in the study area has been suggested to maintain the groundwater at a safe and desired level in future in the Jamrani Dam Command. Various water recharging structures namely: series of check dams, percolation tanks, farm ponds and nallah bunds are most possible techniques for recharging groundwater aquifer by utilizing excess water available during monsoon season in the form of runoff obtained from the land surface. Geographic information System (GIS) and Remote Sensing were applied to the study area to delineate different land uses from the satellite imageries (IRS-1D). The study area delineated from the S.O.I. toposheets was also classified into nine land use classes' i.e. agricultural land, grass land, water body, scrub land and forest etc.

**Keywords:** Groundwater, Recharge, command area, GIS, Remote sensing

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IAEC-22

**Climatic Variability and Groundnut Crop Yield: Unveiling the Scenario in Anantapur, India**

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Climatic fluctuations play a pivotal role in generating significant meteorological variations throughout the seasons from year to year, because of which the magnitude and frequency of changes in climate that may impact crop production appear to rise, with expectations of further escalation at both regional and global scales. In this study, an analytical approach has been attempted to find the variations in productivity of groundnut (kharif) grown under arid climate of Anantapur in Peninsular India over 2001-2020. Primarily, the yield was detrended using the FAO approach, to generate a stationary time-series yield data. Further, a non-parametric test known as Mann-Kendall (MK) test and Sen's slope estimator were used to compute the trends in yield using "modifiedmk" package in R. The Soil Moisture Index (SMI), Moisture Availability Index (MAI), Aridity Index (AI) and Normalized Difference Moisture Index (NDMI) were used as the parameters to establish the relationship between yield dynamics and climatic variability. It was observed that the yield is increasing at a rate of 1.123 kg/ha concurrently with increasing wetness, notably the volume of rainfall and the MAI (wetness parameter) reflected a rise by 2.52 mm and 0.01%, respectively. Conversely, AI (dryness parameter) displayed a declining trend by 0.28 %. Additionally, there was a substantial reduction in consecutive dry days (two, three and four days) throughout the study period. A significant positive correlation was observed between SMI and yield (0.604\*\*), followed by MAI and yield (0.56\*), while AI versus yield exhibited a negative correlation (0.557\*). These indicated that the significant increase in groundnut yield at Anantapur was mainly due to the increase in wetness component (increase in RF and MAI) and more substantial decrease in the dryness component (decrease in AI and Consecutive dry days for 2, 3 & 4). However, the NDMI lows and highs observed a significant increase from - 0.36 to - 0.60 and 0.76 to 0.81 respectively, giving more strength to the findings. Thus, climate data analysis plays a critical role in lowering the susceptibility to climate change through processes of adaptation and mitigation. More pronounced results can be discerned by narrowing the focus to specific dry spell durations within distinct critical crop growth phases. Further, the scope of this study can be broadened to encompass a variety of crops and agroclimatic regions.

**Keywords:** Anantapur, Groundnut, climatic variability, Analytical & FAO approach

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IAEC-23

**Defluoridation of Groundwater using Boron-Doped and Nondoped Activated Carbon  
Derived from *Pterocarpus Marsupium***

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Fluoride contamination can arise from both natural and man-made sources, similar to other forms of pollution. It is considered beneficial when present at concentrations of 0.8 to 1 mg/L. However, excessive levels of fluoride in potable water, exceeding 1.5 mg/L, have been associated with dental issues such as mottled teeth. The Indian standards for fluoride in drinking water are set at 1.0 mg/L.

In this particular study, the researchers examined the effects of undoped and boron-doped activated carbon derived from a novel source called *Pterocarpus Marsupium*. They investigated various parameters including dosage, speed, temperature, and particle size. The undoped activated carbon was designated as control group 1 (n = 20), while the boron-doped activated carbon was considered experimental group 2 (n = 20). A total of 40 samples were analyzed using these parameters to determine the percentage of fluoride removal in groundwater for drinking purposes.

The findings revealed that the combination of different parameters yielded the best results (run 4) for undoped Novel *Pterocarpus Marsupium* activated carbon, with a fluoride removal percentage of 93.75%. On the other hand, the boron-doped Novel *Pterocarpus Marsupium* activated carbon achieved a fluoride removal percentage of 97.5%. The boron-doped method also exhibited a higher mean value (89.88) compared to the undoped method (80.64). These differences between the two groups were statistically significant, with a p value of 0.012 (p<0.05).

Based on this study, it can be concluded that boron-doped activated carbon is more effective than undoped activated carbon in removing fluoride from groundwater.

**Keywords:** Boron Doped, Dental, Groundwater, Fluoride Removal, Novel *Pterocarpus Marsupium* Activated Carbon, *Pterocarpus Marsupium* Sawdust

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IAEC-24

**Impact of Check Dams on Groundwater Recharge and Quality in Upper Vaigai Sub-Basin, Tamil Nadu, India**

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Groundwater plays a significant role in the environment because it is an important water source for agricultural practices, domestic and industrial sectors, etc. This research was done to determine the suitability of groundwater for various uses and to comprehend how the check dams impact groundwater quality in the upper Vaigai sub-basin, Theni, Tamil Nadu, India. The groundwater samples were collected and analyzed for pH, TDS, EC, Ca, Mg, Na, K, Cl, SO<sub>4</sub>, CO<sub>3</sub>, HCO<sub>3</sub>, F, and SAR. The quality of groundwater before and after the construction of the check dam (Mayiladmparai, Ambasamudram, Ammachiapuram) is established by considering the electrical conductivity, sodium Adsorption ratio, sodium percentage, concentration of ions through Wilcox plot, USSL plot, Piper Trilinear Plot. The results obtained from these plots stated that the groundwater quality has improved after the construction of the check dams, and it is suitable for irrigation purposes, whereas, in the case of drinking water, the groundwater sample taken within 5 KM is suitable for drinking water purposes. The impact of three check dams on groundwater level and its trend was established by adopting Mann Kendall, Sen Slope Estimator, and Innovative trend analysis method. The trend analysis has shown that groundwater levels taken near the three-check dams show a decreasing trend, which indicates that groundwater levels measured from the surface were decreasing.

**Keywords:** Check dam, Drinking water quality, Irrigation water quality, Trend Analysis.

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**IAEC-25**

**Development of an Experimental Test Rig for Quantifying the Chemical Deposition on Plants**

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The laboratory experimental test rig for optimizing the various parameters influencing the amount of chemical deposited on the plant was developed with a compressor to maintain the desired pressure in chemical and carrier liquid tank and two solenoid valves to control the flow of carrier liquid and chemical. In this test rig simulation plates of different size representing the width of crop canopy were fixed on the canvas belt and allowed to move under the sensor fixed at desired height. The speed of the belt conveyor represented the forward speed powered by a DC motor and regulated through a voltage regulator. The levels of variables selected for determining the quantity of spray deposition are Speed of operation (1.5, 2.5, 3.5, km h<sup>-1</sup>), Height of sensor from target (100, 150, 200, 250, 300 mm), Concentration of spray chemical (50 %) and Simulation Plate Width or artificial canopy (100, 150, 200, 250 mm).

When the travel speed was increased from 1.5 to 3.5 km h<sup>-1</sup> for the simulation plate width of 100 mm at a concentration of 50 per cent, the amount of chemical delivered decreased from 2964 to 1076 µl, 2917 to 1038 µl, 2885 to 1023 µl, 2829 to 994 µl and 2788 to 985 µl at sensor height of 100, 150, 200, 250 and 300 mm respectively. Similarly for simulation plate width of 150 mm these values were 4050 to 1976 µl, 4006 to 1907 µl, 3977 to 1844 µl, 3946 to 1809 µl and 3908 to 1794 µl for different height of sensor under the study. And for the simulation plate width of 200 mm these values were 5116 to 2999 µl, 5088 to 2964 µl, 5009 to 2952 µl, 4965 to 2914 µl and 4921 to 2889 µl for the of sensors under study. For 250 mm simulation plate width these values were 5982 to 3981 µl, 5947 to 3946 µl, 5897 to 3918 µl, 5869 to 3886 µl and 5840 to 3858 µl for the height of sensors under study.

From the study it is observed that the amount of chemical delivered was reduced to one third for all heights of sensor for 100 mm simulation plate width when the speed was increased from 1.5 to 3.5 km h<sup>-1</sup>. For simulation plate width of 150 mm, it was reduced to about 50 per cent for all concentrations and heights of sensor. For simulation plate width of 200 mm, it was reduced to about 58 per cent for all concentrations and height of sensor. For simulation plate width of 250 mm, it was reduced to about 34 per cent for all concentrations and heights of sensor. The reduction in the amount of chemical delivered with increase in speed was due to the fact that the duration of exposure of the simulation plate to the sensor was reduced as the speed was increased.

**Key words:** Sensor, solenoid valve, canopy, simulation plate, forward speed

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IAEC-26

**Development of Pneumatic Operated Rotray Seeder for Pelleted Seeds**

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The Protray nursery is an upcoming technique for quality vegetable seedling production, where seedlings are produced under shade net and such seedlings have better germination, appears healthy and are protected from pest and diseases and build up well developed root system within 25-30 days. The farmers are supplied with protray raised seedlings that are grown inside green houses. These seedlings are not affected by heavy rains and the farmers get assured supply of quality seedlings all year round. Growing media filled protrays are dibbled and seeded manually. This process is very tedious, labour intensive, time consuming and drudgery. With this background, the existing semi-automatic manual operated needle type tray seeder developed under AICRP on Farm Implements and Machinery, TNAU centre, is taken for this study and to automate the needle type tray seeder and to increase the capacity of the machine. To automate the needle type protray seeder, the manual moving of tray arm was replaced with 12 V 5A DC powered geared motor to actuate automatically for picking up the seeds from a feed tray and to drop them into the protrays and vice versa. The forward and reverse movement is automatically actuated with the limit switch provided at the ends of the protray. The speed of the motor was controlled with variable speed drives (VSDs). The pneumatic protray seeder concept is based on the suction principle; here a vacuum cleaner is used to create the suction pressure for picking up the pelleted seeds. An AC 220 V push/ pull type solenoid valve with the stroke length of 15 mm and 1 kg force was fixed between the vacuum cleaner and the tank so as to automatically close and open the plate to cut-off the suction pressure at the time of dropping the seeds in the protray. The capacity of the developed automatic needle type tray seeder is 360 trays/h which is 3.5 times higher than the existing semiautomatic protray seeder.

**Key words:** Automation, Variable speed drive, gear motor, protray, solenoid valve, limit switch

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IAEC-27

**Effect of Selected Blades on Rake Angles with Respect to Selected Speeds in Harvesting Efficiency**

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Proper design of functional components greatly influences the performance of groundnut harvester. Functional components of groundnut harvester are main frame with three-point linkage, rake angle adjustments (5, 10, 15 and 20°) and blades (Straight and V type) were developed and evaluated in the actual field conditions to achieve the higher harvesting efficiency. From the field evaluation it was observed that harvesting efficiency decreased with increase in forward speed of the tractor from 1.5 to 2.5 km h<sup>-1</sup> for both the blades. Straight blade obtained higher harvesting efficiency of 100 % at speed of 1.5 and 2 km h<sup>-1</sup>, 97.3 % at speed of 1.5 km h<sup>-1</sup>, 88.4 % at speed of 1.5 km h<sup>-1</sup> and 76.6 % at speed of 1.5 km h<sup>-1</sup> and lower harvesting efficiency of 62.7 %, 60.8 %, 31.5 % and 20.6 % at speed of 2.5 km h<sup>-1</sup>. V blade also obtained higher harvesting efficiency of 78.2%, 68.8 %, 39.9 % and 34 % at speed of 1.5 km h<sup>-1</sup> and lower harvesting efficiency of 28.6 %, 17.6 %, 8.4 % and 5.8 % at speed of 2.5 km h<sup>-1</sup> with respect to different rake angle adjustments (5, 10, 15 and 20°). From the results it is concluded that, when speed of operation increases, blades are failed to engage with groundnut plants for effective digging. Increasing the speed of operation can cause the digger to bounce or vibrate, making it difficult to effectively penetrate into the soil and extract the groundnuts. This can result in incomplete extraction, leaving some of the groundnuts in the soil and reducing overall efficiency. Hence forward speed of 2 km h<sup>-1</sup> was optimized due to increase in field capacity when compared to forward speed of 1.5 km h<sup>-1</sup>. From the results, it was found that harvesting efficiency was more in straight blade with a rake angle of 5° when compared to other blade and rake angles.

**Key words:** Blades, rake angle, digger, groundnut, forward speed

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IAEC-28

**Adoption of Conservation Agriculture (CA) in Iran: Present Trends and Future Prospects**

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Iranians are living in an arid and semi-arid belt of the world with limited access to water resources—in addition to their declining groundwater reservoirs they receive just one third of the average global rainfall. Water shortages and a decade long drought are mobilizing Iran to find new approaches to agriculture. Agricultural sector in Iran is facing low productivity due to drought, soil erosion, soil salinity, climate change and desertification. Meanwhile, total grain imports remain high to meet local demand. Agriculture accounts for 90 percent of Iran’s water usage—more than 60 percent of which is wasted in agricultural irrigation according to government estimates. Conservation Agriculture (CA) approach and practices can ensure a food secure Iran. Promoting CA farming practices that involve minimal soil disturbance, permanent soil cover and the use of crop rotation, increase profits and protect the environment—is a keystone of Iran’s Agriculture’s current strategy to conserve water and make farming more sustainable. Since 2000, no tillage seeders have begun to be produced by private manufacturers within the country. Currently CA coverage area in Iran are 500000 ha. To increase this level in future, continued investment in CA cropping systems as a sustainable strategy will be necessary to mitigate Iran’s water crisis, adapt to new climates and be resilient against other political and environmental shocks. Growing evidence exists of the productivity, economic and environmental benefits that can be connected from using CA practices in Iran, but several challenges need to be addressed. These challenges include the need to: organize policy and institutional support, facilitate the change of the tillage mind-set, and develop the skills to operate CA equipment, make CA tools available and accessible, and to develop the expertise and information for crop residue and weed and pest management.

**Key words:** Agriculture, cropping system, Conservation agriculture, Iran

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IAEC-29

**Bio-Oil Production from Pine Cones**

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Pine cones are a non-grain lignocellulosic biomass resource which can be converted into an advanced hydrocarbon biofuel known as bio-oil. Pine cones used in this study were collected from the Chir pine (*Pinus roxburghii*) or the Himalayan longleaf pine trees found abundantly in the Himalayan range of Uttarakhand, India. Pyrolysis is the process of heating biomass in the absence of oxygen to convert it into liquid bio-oil, solid biochar, and pyrolysis gas. In this work, pine cones were pyrolyzed at temperatures ranging from 450 °C to 550 °C in a fixed-bed batch-type slow pyrolysis reactor. The maximum bio-oil yield of 40% (by wt.) was obtained at a temperature of 500 °C. Bio-oil is a complex oxygenated mixture of several compounds comprised of water, water-soluble compounds, such as acids, esters, etc., and some water-insoluble compounds. The bio-oil was further upgraded using solvent extraction and distillation to enhance its fuel properties. The characteristic fuel properties of distilled pine cone bio-oil such as relative density, kinetic viscosity, high heat value, cetane index, ash content, carbon residue, flash point, fire point, pH, and copper strip corrosion were analyzed and compared with diesel to establish its suitability as fuel for CI engine. The calorific value of distilled pine cone bio-oil was 38 MJ/kg. The results show that the blends of distilled pine cone bio-oil and diesel have the potential for use as fuel in CI engines.

**Keywords:** pine cone, lignocellulosic, biofuel, pyrolysis, bio-oil

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IAEC-30

**Performance Evaluation of Tractor Operated Multifunctional Vegetable Transplanter**

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The manual vegetable transplanting on raised bed, mulch and drip laying is time-consuming, laborious and increasing the cost of cultivation. To address this, a twin-row vegetable transplanter to be coupled with a tractor-operated bund forming, mulch and drip laying unit was developed. For the study, Chilli and Tomato seedlings of six weeks age was selected and their physical properties like plant weight, plant height, stem diameter, and plant canopy were determined before the experimental run. The physical properties of Chilli and Tomato seedlings were desired for design and selection of machine component.

The experimental results revealed that the developed machine at forward speed of 0.8 km/h and plant spacing of 300 mm could be operated for the minimum Seedling Miss Index and Multiple Indexes with albeit sacrificing field efficiency. The developed machine significantly reduced labor costs by approximately 87 percent compare to traditional methods. The operation cost was calculated based on time and area, resulting in 1053 Rs/h and 12015 Rs/ha, respectively, with a payback period of 1.31 years. The twin-row vegetable transplanter saved 8219 Rs/ha (40.6 percent) compared to conventional methods. In conclusion, this machine successfully transplants the vegetable seedlings and is suitable for farm mechanization, providing cost savings and improved efficiency compared to the conventional methods.

**Keywords:** Vegetable transplanter, mulch laying, drip laying, Seed miss index and multiple index.

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IAEC-31

**Devices for Carp and other Cyprinids Preprocessing in Small Plants**

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In the history of aquaculture, carp is among the oldest species cultivated in freshwater and is an important segment of global aquaculture. The amount of carp (*Cyprinus carpio*) produced worldwide in 2018 was 4.2 million tons (FAO, 2020. The state of World Fisheries and Aquaculture 2020). Preprocessing of such a large number of carps into the form of commercial semi-finished products is often made by hand, especially in small plants. In Poland it resulted from the inability to mechanize preliminary operations - there was a lack of simple and inexpensive appropriate devices for preprocessing. To change this, the MIR implemented a several-year program financed by the European Union. Within it morphometric measurements of carp were carried out, concepts of individual devices were developed and their physical models were built. Based on the results of experiments with physical models, the following devices were developed, constructed, built and tested in industrial conditions: deheading machine with laser indicator installed in the knife housing, vacuum gutting machine for whole or deheaded carp, piece cutter, semi-filleting machine, fishbone cutter for deheaded and gutted carp, fishbone cutter for fillets, device for cutting fresh and frozen fish fillets into strips, kidney cutter and descaler (for cyprinids with scales). Their characteristic features are small dimensions and simple structure, which facilitates their use in small processing plants. These devices were awarded at numerous innovation exhibitions and are currently being implemented in small processing plants.

**Key words:** Carp, preprocessing, equipment, small scale

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IAEC-32

**Nutrigardens – using Bamboo Shed-Net house: A Solution to Address Better Nutrition and Entrepreneurship for Small Farmers**

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Bamboo Shednet house was designed and 10 prototype units were built to demonstrate the Concept in State of Maharashtra, India. Size of the Unit was 128 sqm (1377 sq. ft) costing IRs 1,50,000. This small sized structure is conceptualized to help small and marginal farmers to grow vegetables year-round (at least 4 cycles in a year) in an entrepreneurial mode. Bamboo is used as structural material instead of galvanized iron pipes because of its availability at lower cost. Bamboo poles were CCB treated to avoid borer-attack and lengthen the life of structure. One of the drivers of this concept is to keep the capital cost of the Shed-net house as low as possible to make it attractive for small farmers to invest.

Heavy rainfall and high velocity wind often damages the crops grown in open-fields. Use of this protected cultivation structure will reduce such damage and help farmers ensure production of farm-fresh marketable commodities. One more benefit of growing vegetables in such units is enhanced photosynthetic efficiency because the chosen material of construction and design enables accumulate the carbon dioxide from plants (greenhouse effect) inside the structure which allows the plants to grow faster.

The Project activity can be disseminated through skill development training to the unemployed youth engaging skilled and unskilled labour in the villages. This can also be promoted as an activity for “Secondary-income” to farmers. Seven units were recently constructed in state of Maharashtra, India to create a demonstration effect. This presentation will provide project economics giving production data, payback period, tugged design principles used and method to create dissemination of the Concept developed. Author strongly believes that the units developed and demonstrated at farmer sites will help ease Malnutrition on account of below par consumption of fresh vegetables by rural farming communities.

**Key words:** bamboo, net house, skill development, Maharashtra

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IAEC-33

**Color Spaces for Quality Prediction of Impact Damaged and Stored Banana Fruit**

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Color is one of the key quality attributes that is highly utilized to describe the external quality of fresh produce. However, using color to predict other physiological quality attributes using modeling can facilitate the process of in-deep evaluations of fruit quality for researchers, scientists, horticulturists, etc. This paper is aiming to use three color spaces for the quality assessment of mechanically damaged banana fruit. By using the drop test method as a simulated handling practice, banana fruit were damaged by a 60 g stainless steel ball from a height of 60 cm by applying three repeated series (1, 3, and 6) on three different surface zones (top, middle, and bottom) on banana fruit. To compare the quality with non-damaged fruit, one set of banana fruit was kept as a control. The damaged and the control banana fruit were stored at 13 and 22°C. The total number of treatments was 20. A computer vision system was used to capture all images of the study and an image process technique was performed to evaluate the color, surface area ( $A_S$ ), and bruise area ( $BA$ ). Also, the weight loss % was calculated. The experiment lasted for 12 days. The obtained R (Red), G (Green), and B (Blue) color values were converted to X (component with color information), Y (lightness), and Z (component with color information) color space, and then finally to L\* (lightness and darkness), a\* (redness and greenness), and b\* (yellowness and blueness) color space (CIELab). The relation between each of these color spaces and changes in weight loss%,  $BA$ , and  $A_S$  of mechanically damaged fruit during storage at both conditions were analyzed. The results found that the repeated impact could statistically influence the  $BA$  of banana fruit. Bananas were more likely to change color at higher temperatures and under 6 times repeated impact. Weight loss % and  $A_S$  were temperature dependent. Storage at 22°C allowed for higher changes in the studied parameters. Using linear regression helped to predict the changes in weight loss %,  $BA$ , and  $A_S$  from RGB, L\*a\*b\*, and XYZ color spaces data. The accuracy of the regression model emphasized the importance of the skin color characteristics of bananas which can help to estimate other quality alterations during the postharvest supply chain.

**Keywords:** Color, prediction model, banana, color spaces, image processing

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IAEC-34

**Mangroves for Pollution Control, Climate Mitigation and Food Security –  
Engineering Challenges and Opportunities for Coastal Economy**

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Mangrove forests in coastal areas of the world are among the best Nature Based Solutions (NBS) that help in mitigating climate change because mangroves plants/trees can sequester carbon four times more carbon than any other tree/plant species on the planet. In addition, healthy mangrove plantations have the capability of treating coastal wastewater, environmental pollution control, protect coastlines from sea waves or cyclones/hurricanes, reduce coastal flooding, provide excellent nurseries for sea food and other wildlife, and can help revive economy of vulnerable people living in coastal areas. There are many societal and engineering challenges in maintaining sustainable mangrove forests. Therefore, the purpose of this paper will be to address some of engineering challenges in planting and maintaining sustainable mangrove forests as well as threats facing in rehabilitation of mangrove plantations in the world. This research will also present some of the regulatory framework and policies needed for mangrove plantation's rehabilitation in mitigation greenhouse gas (GHG) emissions and improve the livelihood of indigenous people living along the coastal areas of the world.

**Key words:** Mangrove, coastal economy, nature based solution

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IAEC- 35

**Effect of Hermetic Storage in the Super Grain Bag on Seed and Milling Quality of Rice in Assam, India**

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Post-harvest losses (PHL) are a major concern for the food systems. Due to the prevailing seeds damage, it caused undesirable losses in income of the farmers. PHL of rice is estimated to range between 10 -30% throughout its value chain. Seed storage is an important factor in PHL, where proper storage can help reduce losses. The losses in storage are mainly caused by improper drying techniques, exposure to various adverse conditions, and pest infestations, which mainly damage the seeds and reduce germination, milling quality, and viability. Seeds, when stored in traditional storage equipment like jute bags, drums, *bhoral*, *bhakheri*, *duli*, etc., result in poor seed quality due to insufficient hermetic storage and cannot be stored safely for longer durations. Therefore, to study and determine the post-harvest losses incurred during seed storage, an experiment was set with two different factors, including two storage equipment, i) gunny bags, and ii) super grain bags; and six storage period, i.e., T<sub>1</sub>: initial, T<sub>2</sub>: one month, T<sub>3</sub>: two months, T<sub>4</sub>: three months, T<sub>5</sub>: four months, and T<sub>6</sub>: five months, and designed with RBD factorial at two locations: Dikhowmukh in district Sivasagar, and Khanamukh in district Jorhat. Moisture content, germination percentage, live insect count, and dead insect count were recorded after the completion of each successive month for a period of 5 months. The observations were recorded keeping in mind the ambient temperature, outside humidity, and temperature. All the parameters were significantly influenced by storage equipment. However, the storage period significantly influenced only the live insect count and dead insect count. An increase in moisture content was not evident in super grain bags, but in traditional gunny bags there was a significant increase in moisture content. The super grain bag improved the seed germination ability by 11.21% over the gunny bag. Insect infestation percent was significantly reduced in the super grain bag as compared to storage in the traditional gunny bag. The highest live and dead insect counts were observed at the initial stage. In addition, super grain bags reduced broken grain percentage compared to the traditional bag. The experimental evidence clearly states that the use of a super grain bag for paddy storage is a good option at the farmer's level.

**Keywords:** super grain bag, hermetic seed storage, germination, moisture content, milling quality, ambient temperature, humidity

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IAEC- 36

**Calibration and validation of AquaCrop model for drip irrigated cabbage under semi-arid region of Maharashtra**

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A field experiment was conducted for two years at College of Agricultural Engineering, VNМКV, Parbhani to calibrate and validate an AquaCrop model for cabbage for varying irrigation schedules. Calibration of AquaCrop for drip-irrigated cabbage was tested for its performance under fully irrigated treatment. Part of the obtained field data *i.e.* data for full irrigation treatment (100% ET<sub>c</sub>) for first year was used for calibration of the model, while the data of second year was used to validate the model. AquaCrop version 6.0 was used in the study. The model was calibrated with harvesting index of 85% and water productivity 27 g/m<sup>2</sup>. After calibration, AquaCrop model was validated for its performance under deficit and fully irrigated treatments. Validation results indicates that AquaCrop model was predicted well, having only – 4.4 per cent average variation between observed and simulated yield with Nash Sutcliffe coefficient (R<sup>2</sup><sub>NS</sub>) value 0.88 and Coefficient of Residual Mass (CRM) value – 0.091, indicates that model overestimates the yield, likewise during calibration.

**Key words:** Drip irrigated cabbage, Aquacrop, deficit and full irrigation

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IAEC- 37

**Design Development and Performance Evaluation of Animal Lifting Device**

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AICRP on Utilization of Animal Energy

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One of the most challenging problems for veterinarians, Gaushala and small dairy farmers is the management and treatment of recumbent/downer animals, prolonged recumbency due to inadequately treated and unresponsive and may be due to illness, aging, during calving, slippery floors and so on. So to medically treat this condition we need to lift the animal with physical support and also to give confidence for sick animals. Considering all these things animal lifting device is designed that is suitable for all the Gaushala, veterinary hospitals and small dairy farmers. It is designed in such a way that it should be simple, easy to transport and operate, fewer people required, comfortable, lift weights up to 600 kg, the weight of the animal is equally distributed on a supporting frame, less injury to an animal, adjustable according to the size of animal and cost-effective compared to another method. The study of animal lifting device is conducted on sick animals of different age groups, disease conditions, breeds, species and sizes of animals. Thirty-one cases are recorded. The physical, physiological and visual parameters of animals and the engineering parameters of animal lifting device is recorded and presented in this paper. Animals respond well to the treatment and physiotherapy and can stand without the help of slings after complete recovery and almost 62% of cases were recovered till now from the trial taken. Out of 31 cases treated 20 animals were saved by using this device. The total cost of the device is Rs. 35,000/-. And life span of the device is 20 years.

**Keywords:** Animal lifting device, stability, laying down an animal, supporting sac

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IAEC- 38

**Development and Application of Biodegradable Spray Coatings Impregnated with Oil Encapsulated Starch Nanoparticles for Shelf-Life Extension of Fruits and Vegetables**

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Fresh fruits and vegetables are a desirable commodity providing a rich source of nutritional value, antioxidants, and vitamins to consumers. However, every year about 20% of fruits and vegetables are lost worldwide due to microbial damage, post-harvest ripening, metabolic respiration, color darkening and deterioration from moisture loss during preharvest and postharvest stage. Nanotechnology has made it feasible to deliver concentrated supplies of active ingredients such as plant nutrients, active components and pesticides with increased absorption capacity, efficiency, and application to reduce such loss. Therefore, in this study, a spray coating technique was used to synthesis essential oil encapsulated starch nanoparticles for shelf-life extension of fruits and vegetable. The antimicrobial potential of the developed nanoparticles was evaluated against common fruits and vegetable disease causing bacteria. The size distributions, shape, chemical contents of the nanoparticles were determined by examining scanning electron microscope images, dynamic light scattering data, and Fourier transform infrared spectroscopy spectrum. The sensory characteristics of the samples were assessed for a period of 7 days, at temperatures ranging from 4 to 21 °C. The evaluation included color analysis using the Lab scale, shear, and puncture tests, as well as visual inspection for the presence of mold or spoilage. The results provided a significant insight into the characteristics of these nanoparticles and their potential applications in the agri-food sector.

**Keywords:** Biodegradable Coating, Starch Nanoparticle, Fruits, Vegetables, Shelf-life Extension

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IAEC- 39

**Development of Turmeric Processing Machinery**

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Conventional practices of postharvest handling of turmeric yield low-quality dried fingers. To address this challenge, a set of machinery, namely a washer, boiler, dryer, and polisher, was designed and developed for postharvest operations of turmeric. All four pieces of equipment were integrated using conveyors to make a value chain. The washer had the features of jet spraying of recirculated water on the turmeric rhizomes moving inside a rotating perforated drum kept at 35 degrees inclination. The equipment has a 300 kg/h capacity and an operational efficiency of 95%. The washed turmeric was filled into a boiler vessel of 150 kg capacity, and the boiling operation was done in 10 minutes using steam at two ksc. This operation considerably improves the processing quality as the rhizomes are gelatinized in a hygienic enclosure, saving the boiling time by a factor of 4. The boiled turmeric was transferred to a rotary dryer of 400 kg capacity, equipped with an electric coil heater of 4 kW and powered by a motor of 5 hp. Effective drying of rhizomes is done in 36 h, yielding rhizomes at <10% moisture. The dried rhizomes are finally conveyed to a polisher of 800 kg capacity equipped with a dustproof cover over the body of the polisher. The polisher applies friction on the rhizomes owing to the perforations of the drum, and the batch operation is done in 40 min. Using this machinery, a typical turmeric farmer of western Tamilnadu state of India will require only about two days to complete the entire postharvest operations of 3 tonnes of fresh harvest. Farmers take about 20 days to do the drying operation alone on a farm yard with sun drying in a biologically unsafe environment. They do not currently practice washing operations. Their boiling operation is also done crudely in open drums. Therefore, they get an end product that is inferior and suitable for more than one type of processed product, namely curry powder. The developed machinery has the potential of a high-quality end product, thereby opening the vistas of high-value processed products from turmeric for pharma industries and other applications.

**Key words:** Turmeric processing, rotary dryer

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IAEC- 40

**Leaf Spectral Analysis for the Identification and Distinction of Bacterial Heart Rot Disease Severity Levels in Pineapple**

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Pineapple is one of the main non-seasonal tropical fruits for most countries in the Southeast Asian region. This fruit has high commercial value and export potential. However, diseases such as bacterial heart rot (BHR) can cause crop loss up to 40% in pineapple farms. Farmers can enhance disease management strategies and reduce disease loss by better understanding BHR's symptoms, severity, and spatial distribution. The current detection method, which relies on expertise and laboratory analysis, is laborious, time-consuming, and expensive. This study employed a set of 45 points of samples that represented five distinct severity levels; healthy, light, moderate, severe, and very severe. The leaf samples' spectral information was obtained through the employment of a visible shortwave near infrared (VSNIR) spectrometer. Using a SPAD meter, the chlorophyll content of the leaves was determined after the spectral analysis. Both calibration and prediction models were constructed exploiting the partial least squares (PLS) regression technique to calibrate spectral data with chlorophyll content. The levels that were substantially different were subsequently identified through a post-hoc comparison using least significance difference (LSD). The  $R^2$  and RMSEC values determined by this study were 0.97 and 2.44 respectively while the  $R^2$  and RMSEP values for the prediction model were 0.99 and 2.14, respectively. In summary, this research has established a dependable foundation for the utilisation of VSNIR in pineapple plantations to promptly identify the severity of diseases.

**Keywords:** pineapple, disease, spectroscopy, crop loss, BHR

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IAEC- 41

**Development of Nanocellulose-based Biodegradable Nanocomposites for Food Packaging**

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Extension of the shelf life of food products and utilization of eco-friendly packing materials are some of the crucial demands of the food industry. This study employs a nanocellulose based nanocomposite to extend the shelf life of fresh food. The cellulose was extracted from wrapping papers which are usually discarded as garbage owing to its limited options of reuse and recycle. The extracted cellulose was then used in the synthesis of nanocellulose nanocomposites by blending the nanocellulose with starch nanoparticles. Further, the nanocomposites were characterized through analytical techniques such as X-Ray Diffraction spectroscopy and Fourier Transform Infrared Spectroscopy to comprehend its structure and chemical composition. The thermal properties of the nanocomposite were evaluated through Differential Scanning Calorimetry. Scanning Electron Microscopy and Dynamic Light Scattering were performed to decipher the morphology and size of the nanocomposite respectively. Furthermore, the physical and mechanical properties of the nanocomposite films were examined including the tensile strength, color, thickness, water vapour transmission rate, moisture content, surface hydrophobicity, and light transmittance. The antimicrobial properties of the nanocomposite were also evaluated. Finally, the shelf-life study of fresh foods on employing the nanocomposite were studied.

**Keywords:** Nanocellulose; Biodegradable; Shelf life.

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IAEC- 42

**AI, IoT and Sensor Operated Smart Urban Farming Industry**

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Smart Urban farming deals with modern, precision, smart and IT linked modules of protected cultivation. Its commercial modules are being widely adopted for growing high value horticultural crops inside energy active climate controlled protected structures and vertical farming. This type of farming is mostly being carried out with soilless, hydroponics and Aeroponic based system in multiple layers mostly with the aid of artificial light. The modern idea of smart urban farming use indoor farming techniques (Hydroponics, soilless, aeroponics), vertical farming and controlled environment agriculture (CEA) technology (Greenhouse/Protected Cultivation), where all environmental factors can be controlled. Greenhouse based urban smart farming cultivation technology deals with growing high value horticultural crops, herbs and seedlings in various types of inert soilless media, water and air inside greenhouse and other protected structures. It can be integrated with AI, modern sensors, automation system, IOT and DSS system and thus being popular among modern youths, farmers and entrepreneurs in the overall form of vertical farming. Machine learning, Internet of Things (IOT) and Artificial intelligence (AI) based automation have been the recent most successful approaches for controlling smart urban farming and its irrigation & fertigation for maximizing the quality crop production of high value vegetables, flowers and seedlings. These recent techniques incorporate and integrate the human expertise, sensors, online and in-situ data, softwares and hardwares from different sources for the efficient management of all the related inputs and maximize the output in terms of both quality and quantity. The future of smart, efficient and precision agriculture is mainly based on automation linked with IOT and AI. Keeping above in view series of experiments related to automation of irrigation system and protected cultivation have been carried out inside Green house, Net house and nursery with use of sensors and IoT. The conditional automated irrigation system and greenhouse production system outperformed non-conditional automated system in terms of water, nutrient and yield productivity. Thus the IoT and sensor operated urban farming modules are sustainable for future Indian agriculture. The automation of greenhouses and irrigation system with controllers, sensors, IOT and AI assisted softwares helped in overall efficient management of protected cultivation technology and smart urban farming. Automated Smart urban farming technology can be potential sustainable alternative in post covid era, were there is going to be continuous demand of fresh leafy and high value vegetables and herbs particularly in peri-urban areas in big cities. It has been emerged as growing industry with lots of entrepreneurship opportunities.

**Keywords:** Smart Farming, Machine learning, Internet of Things (IOT) and Artificial intelligence (AI)

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IAEC- 43

**Estimating Leaf Area Index, Biomass and Yield of Rice across Diverse Irrigation and Fertilizer Rates Using UAV and Machine Learning Algorithms**

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Rice above ground biomass (AGB) and leaf area index (LAI) are important parameters for monitoring crop health. The optimum yield is obtained by monitoring the crops during the growth period. Unmanned aerial vehicles (UAVs) are powerful tools for monitoring crop health and site-specific crop management. The main aim of the study was to predict and establish relationships between different vegetation indices (VIs) and AGB, LAI, and yield under a wide range of irrigation and nitrogen treatments. The experiments were conducted for rice crop using three water application techniques, and three nitrogen applications. AGB and LAI readings were collected at various crop growth stages. Unmanned Aerial Vehicle (UAV) was used for the collection of multispectral images of the study area. Machine Learning algorithms such as SVM, ANN, KNN, RF, and XG Boosting were used for the prediction of the LAI. Leaf Area Index prediction using ANN and RF were good with  $R^2$  values of 0.91, 0.91 and MSE 0.09, 0.08 respectively. The preliminary result shows that normalized green red difference index (NGRDI)-based model estimates LAI values with  $R^2$  of 0.86. Monitoring the rice field using UAV helps farmers and policymakers with better resource allocation and promotes precision agriculture.

**Keywords:** Unmanned Aerial Vehicle (UAV), Above Ground Biomass (AGB), Leaf Area Index (LAI), Crop Yield, and Vegetation Indices.

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IAEC- 44

**Development and Application of Iron Oxide Nanoparticles to Improve Soil Quality and Improve Agricultural Sustainability**

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Soil quality plays a critical role in agricultural sustainability and acts as a major sink for carbon dioxide (CO<sub>2</sub>) mitigating impacts of climate change. On major component of soil quality is soil organic matter (SOM) content which represents organic material at various stages of decomposition. As SOM decomposes it provides the necessary nutrients required for plant growth. Solids with high levels of organic material show enhanced water permeability, increased water retention capacity and increased resistance to erosion preventing the loss of vital nutrients. The work presented here has focused on the development and application of iron oxide nanoparticles as soil amendments with the intention of enhancing soil organic matter and retaining nutrients.

Keywords: Soil quality, organic matter, nanoparticles

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IAEC- 45

**Enhancing Water use Efficiency with Micro Irrigation in Canal-Dominated Agricultural Region**

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Water use Efficiency is an important metric for sustainable agriculture, as it can help ensure food security and conserve water resources for future generations. It helps farmers to maximize the efficiency of their water use and minimize their environmental impact. Water use Efficiency measures the amount of food or fibre produced per unit of water used in agriculture. Several factors can influence Water use Efficiency, including crop variety, the timing and amount of irrigation, soil type, and weather conditions. Farmers can optimize their Water use Efficiency and achieve higher yields with less water by carefully managing these factors. In canal command areas, tail-reach farmers receive water at the end of the canal network, which means that they often receive less water than farmers closer to the source. This unequal water distribution can lead to reduced crop yields and economic losses. It is essential to address these problems tail-reach farmers face in the canal command area to ensure sustainable agriculture and rural development. Improving irrigation systems, can ensuring equitable distribution of canal water among different user groups. Micro irrigation can be particularly effective because it can reduce water losses due to evaporation runoff and deep percolation that occur with conventional irrigation methods. The study involved field experiments conducted in the farmers' field in Upper Ganga Canal (UGC) command area. The study area was divided into two zones: one zone with conventional flood irrigation managed by farmers, and another zone with micro irrigation controlled by us. The crops selected for the experiment were wheat and sugarcane, which are the major crops grown in the region. Soil properties play a crucial role in irrigation scheduling as they directly affect the amount of water that can be stored in the soil and the rate at which water moves through the soil. Different experiments have been conducted in the study area for soil properties, such as soil type, bulk density, field capacity, permanent wilting point, and infiltration rate. Regular soil moisture at different depths has been monitored with a soil moisture profiler. Daily weather parameters were observed using Automatic Weather Station (AWS) installed within the study area. In flood irrigation, the discharge of the watercourse was calculated using the area velocity method, and flow velocity was measured by a digital velocity meter. Crop cutting experiment has been done in the field to determine yields from the whole area of the study area. The results of the study showed that micro irrigation significantly improved crop water productivity compared to conventional flood irrigation. The physical crop water productivity of wheat and sugarcane increased by 30% and 50%, respectively, in the micro-irrigation zone compared to the flood irrigation zone. The study also showed that micro irrigation reduced water use by 28% for wheat and 40% for sugarcane compared to flood irrigation. By using water more efficiently using micro irrigation, farmers can reduce the amount of water they need to grow crops, which in turn can help to conserve water resources and mitigate the effects of drought.

**Key words:** Canal command, WUE, micro irrigation

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IAEC- 46

**Development of Real-Time Microcontroller Based Monitoring System for Pulsed-Microwave Finish drying of Neem leaves (*Azadirachta indica*)**

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Neem leaves (*Azadirachta indica*) is often dried using conventional drying methods that have ineffective monitoring and least control during the drying process that affects the quality and physio-chemical properties of dried products. This study presents a novel real-time microcontroller-based drying monitoring system that predicts drying kinetics, moisture diffusivity and reduction in moisture content accurately. Experiments were conducted using low microwave power density with different pulsation ratios and moisture content was dried to < 10%. Quality and microstructural analysis were carried out and correlation with independent variables was studied. Different drying models were also developed and compared for their best fit using real-time data obtained from drying. Results show that the developed monitoring system precisely predicts the drying kinetics of the sample which reflects its potential to be used commercially.

**Keywords:** Neem leaves drying, Real time-monitoring, Microcontroller, drying kinetics and models, SEM analysis.

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IAEC- 47

**Development and Validation of a Three-Dimensional Freezing Model for Cow Milk Kulfi using Computational Fluid Dynamics"**

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A three-dimensional freezing model for the kulfi freezing process was developed using ANSYS - FLUENT. The model included an appropriately meshed physical geometry and governing equations for transport phenomena to predict temperature profiles during steady and transient states of kulfi cone freezing at three concentrations of cow milk kulfi samples (1.5:1, 2.0:1, and 2.5:1). The simulated freezing curve temperature profile was in good agreement with the experimental measurements. A transient state analysis produced spatial and temporal temperature profiles across two cross sections of the kulfi cone. The time required to reach three characteristic temperatures (initial freezing point,  $-10^{\circ}\text{C}$ , and  $-18^{\circ}\text{C}$ ) at the thermal center of the cone was found to be consistent with the experimentally observed times for the corresponding temperatures. Three empirical freezing time models (Pham, Cleland and Earle, and Salvadori and Masherani) were compared with the experimental predicted values for the three concentration levels of cow milk kulfi samples. Cleland and Earle model provided the best prediction of freezing time to reach an absolute center temperature of  $-10^{\circ}\text{C}$  compared to other models, with the least percentage error (5.01%) at 2.0:1 concentration. For freezing time to reach a final center temperature of  $-18^{\circ}\text{C}$ , the Cleland and Earle model consistently provided excellent predictions with an error between the experimental and predicted values at 4.25-5.06%. The Pham model and Salvadori and Masherani model also performed well in predicting the time required to reach centre temperature.

**Keywords:** ANSYS, Freezing, Kulfi, Model and Temperature

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IAEC- 48

**Development of Appropriate Technological Tools and Techniques for Processing and Storage of Ginger in Nepal**

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Ginger is an herbal and medicinal crop with extensive usage as spice for ethnic cooking. It has also high demand as a dietary supplement and an ayurvedic medicinal ingredient. Its consumption has increased in the western countries in recent years. Thus, ginger has become a cash crop. In Nepal, ginger is a popular cash crop and is being grown by both small, medium and large-scale farmers. Many of female members of the household in Nepal have been engaged in ginger production as a whole. However, many challenges still exist. Effective methods for storing and processing ginger to time the market for selling with increased profit important. Incorporation of technological advancements (computational, sensor, information) in an innovative way to develop appropriate and cost-effective tools and techniques are critical. This paper will discuss the development of a low-cost method for cleaning ginger in low-resource setting (as found in Nepal). The integration of sensing system for measuring specific environmental parameters in selected ginger storage methods will be discussed. The development of computer program ‘app’ on smart/cell phone for managing and controlling the storage condition of ginger will also be presented

**Key words:** Ginger, Nepal, processing and storage

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IAEC- 49

**Optimizing Agricultural Water Management: A Cloud-IoT-AI-Based Smart Irrigation Model**

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Smart agriculture is the use of Internet of Things (IoT) technologies to improve the efficiency, productivity, and sustainability of agricultural practices. This involves the integration of sensors, devices, and other technologies into the agricultural ecosystem to collect and analyze data on factors such as soil moisture, crop health, and weather conditions. The collected data can be used to optimize irrigation, automation, and other aspects of farming, leading to increased yields and cost savings. An IoT device is utilized in this research to gather information on agriculture, which is subsequently saved in a cloud database. Big data analysis enabled by the cloud is used to evaluate information on crop analysis, soil moisture levels, and soil temperature. To increase the amount of water used in agricultural irrigation, technology leads to smart irrigation systems that must be implemented. This system has the potential to be quite accurate, but it requires data about the soil and climate of the region in which it will be utilized. In this research, a cloud-based architecture and the Internet of Things are used to examine a smart irrigation system. This technology is made to monitor the temperature and moisture content of the soil before processing data into the cloud with several machine-learning approaches. The AI algorithms can analyze this data and determine the optimal watering schedule for the crops based on their current needs and the availability of water. This can help to conserve water and improve crop yields. The Cloud- IoT-AI-based smart irrigation system is discussed in this article based on numerous literary works where we can control irrigation water through the wireless irrigation network, including its architecture. This advanced irrigation system is based on a microcontroller and may control through wireless transmission from remote locations. In this approach, the sensors used for wireless sensing; can send required data and forward it through the network. The wireless sensors capture soil information with a microcontroller, and the user (farmer) can manage the soil's wetness, temperature, and humidity, as well as decision-making. This paper discusses the potential benefits and challenges of implementing smart agriculture IoT systems and presents the successful deployment of these technologies in actual field conditions. Furthermore, with these technologies, we can improve the agriculture sector to some extent. The data collected from all these types of networks are used for analysis purposes to solve water problems at the farm level. By reducing water losses in the watercourse and the irrigated region, we may use this technology for field monitoring in real-time and increase water use efficiency.

**Key words:** IoT, Sensors, Cloud computing, Machine learning

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IAEC- 50

**Commercialization of Photosynthetic Mass in Crop Farms: A Novel Approach to Harness Solar Energy for Resource Circularity**

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Net-zero emission commitment has overpowered many of the traditional considerations of development. Renewed attention on crop residue biomass for energy recovery and nutrient recycling can lead to emission reduction. The current practices of the utilization of crop residues have been limited to some non-commercial activities and thus these remain as non-sellable commodities. This paper reviewed several potential options viz., bioenergy, biochar, biomaterial, and biofertilizer concerning typical crop farms in India to assess the resource circularity and emission reduction prospects in Indian Agriculture.

**Key words:** non-zero emission, crop residues, circularity

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IAEC- 51

**Small-Scale Biogas System: Is it a Viable Rural Entrepreneurship in Rural India**

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In a typical rural Indian context, cooking fuel and organic fertilizer are commercial commodities, and a small-scale biogas system has the potential to generate both at household level. Thus, a household biogas system should be accepted as a viable business venture. However, in the existing venture of household biogas system, there is inadequate business sense despite involvement of fund, operating expenses, manpower and usable outputs (*viz.*, renewable fuel and organic fertilizer). There are various viable rural enterprises including dairy, poultry, piggery, and fishery contributing considerably to the Indian economy. Household biogas system can be considered as an equivalent production system as it is also input (feedstock) intensive and products (gas and digestate) have commercial importance. The feasibility of biogas as a rural entrepreneurship model has been demonstrated by the Department of Energy, Tezpur University where the biogas from a bio methanation plant is collected in reusable biogas balloon and supplied to a commercial eatery on wheel. In addition to biogas as a cooking fuel, organic fertilizer generated by the bio methanation plant is also used as commercial commodity. The small-scale biogas system which has been operated as business enterprise proved as a viable rural enterprise with some interventions *viz.*, reliable supply of feed and provision of gas and digestate upgradation.

**Keywords:** energy, Biogas, small scale, viability

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IAEC- 52

**Digitalisation in Agriculture- Global Food security**

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Agriculture is complex subject and has multiple variables associated with the final outcome in the form of farm productivity and profitability for the farmers. Data driven decision making can make a difference for the growers and is an important aspect for the global food security. Data related to farm, soil nutrition, moisture, humidity, pest attack and crop disease, harvest readiness, Harvesting and post-harvest, are critical points for decision making that too in time decision making. Custom hiring services connectivity and availability is another factor to get the work done in farms.

The technologies of sensing probes, and image processing, remote sensing data analytics, AI/ML are critical success factors for precision Agriculture. Connected machines and real time data support can help make agriculture improve along with the climate change impact and ensure that it is climate resilient. Skill development initiatives required to support these changing canvas of agriculture.

For global food security, Digitalisation in Agriculture is a must, earlier the better.

**Key words:** Industry, digitalisation, food security

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IAEC- 53

**Infrared Thermal Imaging and Image Processing Techniques to Detect Apple Snails  
(Pomacea spp) at Different Water Depths and Turbidity Levels**

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Apple snail is an invasive pest that can cause a serious impact on paddy. In recent times, chemical pesticides have become the most important way to control apple snails. However, these large-scale pesticides have been used without the ability to identify pest populations, resulting in environmental degradation, soil pollution, and high risk to human health. Therefore, precise detection of the pest is important to maximize the effectiveness of using chemical control by conducting targeted pesticide treatment. Thus, the objective of this study was to detect the presence of apple snails at different water depths and turbidity levels using infrared thermal imaging and image processing techniques. In this experiment, the small, medium and large apple snails were placed in an aquarium which later was filled with water of 3, 100, 140, 180 and 220 nephelometric turbidity units (NTU) at 2, 4, 6, 8, and 10 cm depths. The thermal images of apple snails were captured using infrared thermal imaging. A total of 75 images were analysed by blob detection algorithm and further classified by a confusion matrix. The results of the study indicate the detection performance of apple snails acquired achieved 60% accuracy, 62% recall, 24% precision and 34% F1-score and 40% error rate. In conclusion, this study has revealed that apple snails can be detected at certain levels of water depths using infrared thermal imaging technology.

**Keywords:** apple snail, detection, infrared thermal imaging, image processing

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IAEC- 54

**Interannual rainfall variability and its relationships with El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) in Thailand**

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Large-scale oceanic phenomena such as the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) have played significant roles in inter-annual variability of rainfall and temperature in Thailand. The present study examines the spatial and temporal variability of rainfall and temperature in Thailand during 1991-2023, using the Mann-Kendall test and Theil-Sen's slope estimator test. Additionally, this study investigated the influence of ENSO and IOD on rainfall and temperature variability using the Pearson correlation coefficient. Results showed that among 98 selected meteorological stations, 12.2% of the meteorological stations exhibited significant ( $p < 0.05$ ) positive trends in annual rainfall, while 63.3% showed non-significant positive trends. However, non-significant negative trends were observed in the remaining stations. This suggests a predominant shift towards increased annual rainfall over the past three decades in Thailand. Similarly, significant positive trends in annual mean temperature were observed in 90.1% of the selected meteorological stations, while non-significant positive trends were observed in 9.9% of the stations. The average mean air temperature over the study area has increased by 0.66 °C over the past three decades (0.02 °C per year). These findings suggest a warming trend in Thailand's temperature in recent decades. Further, results revealed a significant negative correlation ( $p < 0.05$ ) between ENSO and annual rainfall across the study area, with about 78% of stations showing this significant negative correlation. However, a non-significant relationship was observed between IOD and annual rainfall in 91% of the stations across the study area. Significant negative and positive correlations were observed only in 8% and 1% of stations. A significant positive correlation was observed between annual mean temperature with ENSO and IOD in 53.5% and 41% of stations, respectively, within the study area. The remaining stations across Thailand showed non-significant relationships. Overall, the findings from the present study could help policymakers in effective climate-water related planning and management in the study area.

**Key words:** Thailand rainfall, Trend, Temperature, ENSO, IOD

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IAEC- 55

**Deep Learning and Drone Imagery-Based Automated Recognition of Coffee Plant Varieties**

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Coffee, a globally traded agricultural commodity and one of the most consumed beverages worldwide, plays a significant role in generating millions of jobs and income. The expansion of the coffee industry driven by increased consumption and demand for specialty coffee necessitates innovative methods for accurately identifying and classifying coffee varieties. Traditional approaches based on physical characteristics and chemometric techniques face challenges as the number of coffee varieties grows. The present study examines the feasibility of employing the imagery captured by unmanned aerial vehicles (UAVs) equipped with high-resolution sensors for the automated classification of coffee varieties. The study proposed the integration of sophisticated computer vision techniques, particularly Convolutional Neural Networks (CNNs), to analyze drone-captured imagery and identify distinctive features of various coffee varieties. CNNs, known for their effectiveness in image-related tasks, can learn and adaptively recognize spatial hierarchies of features, offering a promising solution to the complex task of differentiating coffee varieties. The proposed approach leverages advanced technologies to streamline the classification process, with a focus on real-time drone imagery analysis and the development of tailored deep learning algorithms. The rationale for this study lies in the anticipated proliferation of coffee varieties due to technological advancements, posing challenges for traditional identification methods. The potential errors introduced during physical classification may result in unintended blending of coffee varieties, impacting overall quality. The present study seeks to provide a decision support tool for the automated recognition of coffee plant varieties, contributing to the enhancement of the coffee cultivation sector. The specific objectives include collecting, processing, and analyzing real-time drone imagery to improve automated recognition, as well as developing and fine-tuning deep learning algorithms specifically designed for identifying distinct coffee plant varieties. This study could revolutionize the coffee industry by offering a technologically advanced and efficient solution to the challenges associated with the growing diversity of coffee varieties.

**Keywords:** Coffee, UAV, Convolutional Neural Networks, Classification

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IAEC- 56

**Temperature variability and its relationships with the Indian Ocean Dipole (IOD) in Thailand**

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Indian Ocean Dipole (IOD) is a large-scale oceanic phenomenon which has played significant roles in inter-annual variability of temperature in Thailand. The present study examines the spatial and temporal variability of temperature in Thailand at annual and seasonal scale during 1991-2023, using the Mann-Kendall test and Theil-Sen's slope estimator test. Additionally, this study investigated the influence of IOD on annual and seasonal temperature variability using the Pearson correlation coefficient. Results showed that among 71 selected meteorological stations, significant positive trends in annual mean, summer, rainy and winter season temperature were observed in 90.1%, 33.8%, 91.5% and 91.5% of the selected meteorological stations, respectively. However, non-significant trends were observed at annual and seasonal scale in the remaining stations. The average annual mean, summer, rainy and winter season temperature over the study area has increased by 0.66 °C, 0.50 °C, 0.60 °C and 0.77 °C respectively over the past three decades. Further, results revealed a significant positive correlation ( $p < 0.05$ ) between IOD with annual mean, summer, rainy and winter season temperature about 41%, 2.8%, 1.4% and 91.5% of the selected meteorological stations, respectively. However, non-significant correlation was observed in the remaining stations at annual and seasonal scale. Overall, the findings from the present study could help scientists and policymakers to cope with the adverse effects of climate-induced hazards and advance understanding of the predictable dynamics of local climate variability in the study area.

**Key words:** Thailand, Climate variability, Trend, Temperature, IOD

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IAEC- 57

**Development of an artificial intelligence based identification system for industrial sorting of big onion**

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Sorting onions to achieve premium quality is a crucial aspect of agricultural production, especially when managing large quantities. Traditionally reliant on human labor, this process can now be significantly enhanced through the application of machine learning techniques in AI image processing. In recent years, the emergence of numerous Python modules has facilitated this development. This study investigates the synergistic potential of combining OpenCV and TensorFlow modules to optimize the sorting process. The classification of onions into distinct categories—good quality, doubled, rotten, and sprouted—serves as the foundation of this research. Training data consisted of images captured using a Raspberry Pi camera module integrated with a Raspberry Pi single-board computer. This setup enabled the collection of diverse and representative images necessary for effective model training. Transfer learning using SSD MobileNet V2 was employed to develop the classification model. MobileNet V2 is a pre-trained model with 267 layers that can run to detect objects in real-time at a rate of 30 frames per second. The developed model was converted to a TensorFlow Lite model to ensure seamless operation on devices such as Raspberry Pi and Android. Evaluation using test data revealed an overall mean Average Precision (mAP) of 77.94%. Specifically, the model achieved precision rates of 89.09%, 79.06%, 75.24%, and 68.37% for the classes of good quality onions, sprouted onions, rotten onions, and doubled onions, respectively.

**Key words:** Image processing, Onion, learning, devices

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IAEC- 58

**Study of drainage characteristics and its implications for watershed management—A case study of the Dharma River basin, Karnataka state, India**

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The present study is carried out to understand the hydro-geological process over the Dharma watershed by using drainage network characteristics and morphometric analysis. Aster DEM, NBSS & LUP soil data has been used in the present study. Morphometric parameters were estimated by using standard methods and Arc hydro extension tool of ArcGIS is used for the morphometric analysis. Fourth stream order basins from five sub-basin in the Dharma watershed were selected to understand the drainage characteristics. Results reveal that, watershed has elongated shape, gentle slope, low stream frequency, very low drainage density and coarse drainage texture. Morphometric parameters of Dharma watershed indicate that produced surface runoff requires longer duration to achieve the peak rate and runoff has lower peak. Further, study results reveal that Dharma watershed is less prone to soil erosion and flood hazards.

**Key words:** Dharma watershed, drainage characteristics, morphometric analysis, geomorphology

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**Efficacy of herbicide application for weed management in soybean by Drone**

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Soybean is major crop cultivated in globe on an area of 126 Mha with production of 370 MT and productivity 2.93 t/ha. In India it is cultivated on 12.07 Mha with production of 13.98 MT and productivity is 1.15 t /ha. Pre-emergence and post emergence application of herbicide is very effective method of weed control. Weeds are amongst the most impacting abiotic factors in agriculture, causing important yield loss worldwide. Integrated Weed Management coupled with the use of Unmanned Aerial Vehicles (drones), allows for Site-Specific Weed Management, which is a highly efficient methodology as well as beneficial to the environment. In recent years, drone technology has rapidly advanced. Due to lower-priced consumer drones enhanced flight efficiency, drone application research is commonly performed in agriculture for various purposes. Drone-based remote sensing helps us observe crop biomass, pest damage, and high-spatial-resolution weed conditions frequently. With these considerations a field experiment was conducted at Post Graduate Research farm at Department of Agronomy, VNMKV, Parbhani, M.S., India to study the comparative performance of different sprayers on weed management in soybean during *kharif* 2021 with objectives to evaluate the effect of different sprayers on weed management in soybean and to find out the effect of different sprayers on growth and yield of soybean. The experiment comprised of ten treatments in randomized block design replicated thrice. Treatments were T<sub>1</sub>- PE Herbicide application by knapsack sprayer, T<sub>2</sub>- PE and POE Herbicide application by knapsack sprayer, T<sub>3</sub> – PE Herbicide application by drone sprayer, T<sub>4</sub> - PE and POE Herbicide application by drone sprayer, T<sub>5</sub>- PE Herbicide application by boom sprayer, T<sub>6</sub>-PE and POE Herbicide application by boom sprayer, T<sub>7</sub>-Weed free, T<sub>8</sub>–Weed check, T<sub>9</sub> - Intercultural method of weed management (hoeing at 25 and 45 DAS) and T<sub>10</sub> - (30 % reduced herbicide dose+T<sub>3</sub>) The gross plot size of 7.2 m x 6.0 m and net plot size was 6.3 m x 5.4 m respectively. The spacing of sowing was 45 cm x 05 cm. The MAUS 158 variety was used for sowing. The observations on weed data, yield attributing and post- harvest observations were recorded and analyzed.

The results revealed that highest weed control efficiency and lowest weed index was observed with treatment PE and POE herbicide application by drone sprayer (T<sub>4</sub>). Followed by (T<sub>2</sub>) PE and POE herbicide application by knapsack and (T<sub>6</sub>) PE and POE herbicide application by boom sprayer. The time requirement for drone for one hectore area of spraying herbicide has been reduced by 99 % (0.34 hours) less than that of knapsack and boom sprayer used for herbicide spraying for this experiment. The use of drone reduction in labour requirement was 85% as compared to hand weeding. Labour requirement was saved by knapsack and boom sprayer over hand weeding was 35.7% and 38.9%. And the use of drone reduced the labour requirement by 50% and 60% as compared with knapsack sprayer and boom sprayer.

**Keywords:** herbicide, drone, knapsack, boom sprayer

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IAEC- 60

**Comparative Study of Weather Based Normalised, FAO and Digital Lysimetric Crop Coefficient of Rabi Sorghum for Semiarid Climatic Conditions of Maharashtra**

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Crop coefficient is important in agriculture for designing and managing irrigation systems. For accurate application of irrigation water as per crop growth advancement, the development of location specific crop coefficient (Kc) is necessary. However, locally determined Kc information is not available for many important crops of India. On health point, millets has its own importance in Indian diet but the productivity is very low under rain fed condition. To improve the productivity of millet crop like sorghum for proper irrigation management in semi-arid region of Maharashtra, a field experiments conducted during the Rabi season of 2022-2023 using digital automatic weighing-type lysimeter in semi-arid agro climatic zone of Parbhani, Maharashtra to develop coefficients. In addition, the FAO crop coefficients were normalize using local climatic condition and local crop growth parameter as suggested by FAO curve method and equations. The lysimetric, weather based and FAO crop coefficients were compare.

The lysimetric Kc values for Rabi Sorghum for initial (1-3 CW), development (4-8 CW), mid-season (9- 15 CW) and end (16-19 CW) stage were 0.37, 0.72, 1.16 and 0.65 respectively whereas normalized kc were estimated as 0.45, 0.86, 1.25 and 0.8 during initial, development, mid-season and late season stage respectively. The FAO Kc values were differ to that of lysimetric and normalized Kc values, which reported as 1.05 and 0.55 only for the mid-season and late season stage respectively. This indicates that the lysimetric Kc values are location specific which are very useful for design of accurate irrigation schedules and précised irrigation management. The lysimetric Kc values were considerably different, lower for all the stages than those normalized FAO 56 Kc values for Rabi Sorghum. The normalized Kc values were higher than the lysimetric and FAO Kc values during all the crop growth stages. Instead of using worldwide FAO Kc values, there is strong need to develop the lysimetric Kc values at regional basis for accurate irrigation water management of different crops of the region. For judicial management of water resources the special efforts are required. The findings of this would be helpful for the irrigation scheduling for the Rabi Sorghum semiarid region of Maharashtra.

**Keywords:** Sorghum, Crop coefficient, Reference evapotranspiration, Crop water requirement, Lysimeter, FAO Crop coefficient.

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IAEC- 61

**Solar Energy Forecasting based on weather parameters using Tensorflow**

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This research project develops a neural network software using Tensorflow with ML and AI capabilities to forecast solar energy production based on weather parameters. By analyzing historical solar energy production data and weather variables (solar irradiation), the software generates real-time solar energy predictions on production data, optimizing resource allocation for energy suppliers and grid operators. ML algorithms establish correlations between weather variations and energy production, providing accurate predictions for proactive decision-making. The software's adaptability and precision, achieved through extensive training and fine-tuning, enhance solar energy forecasting accuracy. The project's outcomes offer enhanced energy efficiency, cost-effectiveness, and support for the integration of renewable energy sources. By contributing to reduced greenhouse gas emissions, the research aligns with climate change mitigation efforts, fostering a more sustainable energy ecosystem. The developed neural network software serves as a valuable decision support tool for energy stakeholders, promoting a resilient and prosperous energy future.

**Keywords:** Energy Prediction, Neural Networks, Machine Learning, TensorFlow.

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IAEC- 62

**Mass Transfer Modulation by Cold Plasma Pre-treatment in Oyster Mushroom Processing**

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The oyster mushroom (*Pleurotus ostreatus*), popularly known as an edible mushroom with high nutritional value, supports the health of the heart and immune system. Cold plasma is a non-thermal technology that can expedite the drying process while maintaining the food items' nutritional content. This study aims to find the effect of hot air and vacuum drying on oyster mushrooms. Oyster mushrooms that had been pre-treated with cold plasma (15 kV for 1, 2, and 3 minutes) were dried at three different temperatures: 50, 60, and 70°C. Fresh mushrooms with a moisture content of 93.97%  $\pm$ 0.40 (wb) were dried at 110°C to find dry matter. It takes 4.2 h, 3.0 h, and 2.1 h, respectively, for tray drying at 50, 60, and 70°C to get a 10% moisture content. The rehydration ratio falls with increasing temperature. Shrinkage increases with rising temperatures. Ten empirical models were used to simulate drying in order to examine the drying behaviors of control and cold plasma-treated oyster mushrooms. The hot air-drying method's best-fit model was determined to be the Page model, which had a low root mean square error value (0.008) and a high R<sup>2</sup> value (0.999).

**Key words:** Oyster mushroom, Cold Plasma, drying behaviour