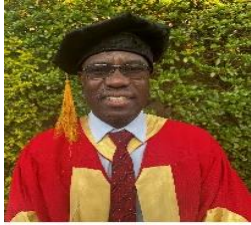


Conference Book of Abstracts

Abstracts Organised by Conference Theme and Sub-Theme

FOREWORD



Professor William. M. Goriwondo

Acting Vice Chancellor

The Technology-Enterprise Nexus: Partnering for Innovation, Rural Industrialisation and Community Impact conference coincides with Chinhoyi University of Technology's 25th (Silver Jubilee) Anniversary. Twenty-five years is an opportune milestone to pause and reflect on the journey traversed to date. As a University that treasures Heritage-based Education 5.0, this conference showcases cutting-edge research and innovations. The convergence of technological innovation and enterprise development is poised to pivot the industrialization mandate.

This conference defies academic provincialism and breaks down the silos of agriculture, health, engineering, business, and other disciplines as it promotes interconnected, data-driven multi-disciplinary ecosystems. This dynamic interplay of disciplines aims to deliver seamless collaboration and cross-disciplinary complementarity.

The book of abstracts presents a wide range of themes as captured below:

- Green Technologies, Digital Innovations, AI and Industry 4.0 for Rural Industrialisation: Smart Automation, Cleantech and Rural Digitization
- Innovation, Enterprise and Rural Industrialisation: Designing Financing and Commercialising Technologies and Enterprises
- Smart Agriculture Agro-Industrial Systems: Technologies, Value Chains, Climate-Smart Systems and Food Security Solutions
- Sustainability, Climate and Environmental Systems: Conservation Technologies, Renewable Energy, Sustainable Tourism, Water Systems and Circular Economy, and Resilience
- Health, Biotechnology and Human Well-being: Medical Technologies, Public Health Innovation, Bioengineering and Health Systems Strengthening
- Society, Governance and Inclusive Development: Policy, Ethics, Social Innovation, Community Participation and People-centred Design, and
- Creativity, Design and Cultural Innovation: Industrial Design, Creative Technologies, Digital Arts, and Innovation Ecosystems.

The areas covered bear testimony to the University's preoccupation with life-changing research aimed at transforming lives in cities and in hitherto marginalized rural communities. The thrust is to mainstream rural communities in the development and industrialization agenda.

Besides the presentation of papers and the cross-fertilization of ideas that characterize the conference proceedings, the event presents an opportunity for postgraduate students to showcase their innovations, research, and prototypes through poster presentations. Likewise, a platform was created for industry and start-ups to showcase their offerings and forge vital linkages with the academic community for greater synergy and collaboration.

This book of abstracts is a veritable source of ideas to scale up sustainable enterprise development in marginalized communities through smart agriculture, climate-resilient food systems, and sustainable tourism.

CONFERENCE ORGANISING COMMITTEE

Prof. R. Musundire	Director: Research & Graduate Studies
Prof T. Mwedzi	Chairperson
Dr M. C. Mwando	Vice Chairperson
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GUEST SPEAKERS



Prof. Dr. Eng. Arthur G.O. Mutambara is Director and Full Professor at the University of Johannesburg's Institute for the Future of Knowledge (IFK) in South Africa. He is a world-renowned thought leader, control systems specialist, roboticist, academic, author, and technology strategist. Engineer Mutambara previously taught and conducted research in Control Systems, Robotics, and Mechatronics in the Aeronautics and Astronautics Department at the Massachusetts Institute of Technology (MIT). He was also a Research Scientist at the National Aeronautics and Space Administration (NASA), a Visiting Professor at MIT, and a Visiting Research Professor at Carnegie Mellon University's Robotics Institute. He is a Chartered Engineer, a Fellow of the Institution of Engineering and Technology (IET), a Professional Engineer, a Fellow of the Zimbabwe Institution of Engineers (ZIE), a Fellow of the Zimbabwe Academy of Sciences (ZAS), and a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE). Prof. Mutambara is a distinguished and prolific author of eight books, including three on Artificial Intelligence.



As the Vice Chancellor of the Harare Institute of Technology, Prof Kanhukamwe is responsible for providing strategic leadership for the University, addressing all academic, research and development, and administrative matters, as well as rallying staff towards realising the University's mandate of technology development, incubation, transfer, and commercialisation. Professor Kanhukamwe has a PhD in Mechanical Engineering and has over 30 years of experience in academia, where he began his career as a lecturer at the National University of Science and Technology (NUST) in 1992, and later, Chairman of the Industrial Engineering Department, Dean of the Faculty of Industrial Technology, and Technopark Director Designate. In 2003, he was seconded to HIT as a national assignment to oversee its transformation from a technical college to a university, a processes that culminated in the enactment of the Harare Institute of Technology Act (25:26) of 2005, establishing it as a fully-fledged university. He then served as its inaugural Director, Pro-Vice Chancellor, and subsequently Vice Chancellor, a position he currently holds. His research interests include techno-parks, Science Parks, and the Internationalisation of Curriculum, as well as foundry production systems and Technology Management (including development transfer and commercialisation). Prof Kanhukamwe has over 60 publications in refereed journals, conference proceedings and book chapters.



Dr. Comfort Manyame is the Director of Geospatial Research & Development at EMPACT Engineering, a leading U.S. engineering consultancy. A distinguished geospatial science technologist, Dr. Manyame has spent over a decade shaping technology and research strategies for the electric distribution industry in Texas. Notably, he pioneered the use of unmanned aerial vehicles (UAVs), LiDAR, and multispectral imagery for advanced vegetation management within utility corridors. Prior to his current role, he spent nearly a decade at Corteva Agriscience as the Digital Ag Platform Strategy, directing the development of global data science and digital tools for production agriculture. Dr. Manyame holds a Ph.D. in Soil Physics from Texas A&M University, as well as a Bachelor of Science and a Master of Philosophy in Soil Science from the University of Zimbabwe. A frequent speaker and published author, his work continues to drive innovation at the intersection of remote sensing, data analytics, and infrastructure reliability.



Professor Mwenda Ntarangwi-

Professor Ntarangwi is a scholar, teacher, researcher and administrator of international repute whose experience and expertise span three decades and cut across diverse geographical locations and institutions. Trained in language education (Kenyatta University) and cultural anthropology (University of Illinois), Prof. Ntarangwi has been keen to apply his research interests and focus to teaching and administration. He has taught in universities in Kenya, the United States, and Liberia; carried out research in Kenya, Uganda, Tanzania, the United States, and Zimbabwe. Prof. Ntarangwi's teaching and administrative experiences include serving as faculty at St. Lawrence University, Augustana College, and Calvin College (USA), Kenyatta University and Egerton University (Kenya) served as CEO at the Commission for University Education (CUE), Kenya, and as the Deputy Principal in charge of Academics, Research and Student Affairs at NIRUC (a constituent college of the National Defence University, Kenya). He currently serves as the Vice Chancellor of the United States International University-Africa (USIU-Africa) where he is spearheading the university's mission to prepare the next generation of effective, engaged, and ethical leaders for the fast-changing African and global context. Prof. Ntarangwi's research and publications straddle the larger field of performance, ranging from popular culture especially music, the practice of anthropology, religious practices, and their intersections with you. His publications include 50 journal articles, book chapters, and encyclopedia entries; 146 conference paper presentations and/or keynote speeches; and 20 conferences/workshops organized or facilitated around the world. More available at <https://www.usiu.ac.ke/about-us/governance/vice-chancellor/> and <https://sites.google.com/site/mwendantarangwi/home>.

CHINHOYI UNIVERSITY OF TECHNOLOGY



Programme

SIXTH CHINHOYI UNIVERSITY OF TECHNOLOGY INTERNATIONAL CONFERENCE

CELEBRATING OUR SILVER JUBILEE

Theme

**The Technology - Enterprise Nexus: Partnering for Innovation,
Rural Industrialisation and Community Impact**

Venue

Chinhoyi University of Technology, Chinhoyi, Zimbabwe

Conference Dates

7 - 9 JULY 2026



DAY 1: 7 JULY 2026

PLENARY SESSION – The Technology - Enterprise Nexus: Driving Rural Industrialisation and Enterprise at the Technological Frontier Venue: Great Hall, Chinhoyi University of Technology Session Chair/Moderator: Eng Chawagarira Rapporteurs: Dr. W. Ruziwa	
Time	Activity
0745-0900	Roadshow: Drum Majorettes, Funfair and Pre-ceremony Celebrations
0830-0900	Arrival of Guests, Registration, Networking and Entertainment
0900-0920	Tea & Entertainment
0920-0925	Housekeeping announcements
0925-0930	Welcome Remarks: Prof T. Mwedzi (Chairperson- Conference Organizing Committee)
0930 - 0950	<i>Rising to the challenge: Anchoring Zimbabwe's Future at the Nexus of Innovation</i> - Dr. Comfort Manyame (EMPACT Engineering, Texas, USA)
0950-1010	The Technology-Enterprise Nexus: Embracing AI as the key Driver of Innovation and Industrialisation - Prof Arthur Mutambara (University of Johannesburg, South Africa)
1010-1030	The Role of RCZ -Embracing Research and Innovations for Sustainable Industrialisation - Dr. Partson Chikudza, Director RCZ (Research Council of Zimbabwe)
1030-1035	DISCUSSION SESSION

OFFICIAL OPENING CEREMONY Venue: Great Hall, Chinhoyi University of Technology Master of Ceremonies: Dr. S. Nembaware, Director of Communications and Public Relations (CUT) Rapporteur: Dr Rashidi, Deputy Registrar- Human Resources, Chinhoyi University of Technology	
Time	Activity
1000-1030	Arrival of guest of Honour and tour of exhibitions
1040-1045	National Anthem
1045-1050	Prayer: Rev. Dr. J. Hlatywayo (University Chaplain)
1050-1100	Introduction of Dignitaries: Prof T.B. Bhebhe (Registrar)

1100-1110	Welcome Speech: Hon. M. Chombo , Minister of State for Provincial Affairs and Devolution (Mashonaland West)
1110-1120	Introductory Remarks: Prof dr. Eng W.M. Goriwondo , Acting Vice Chancellor (CUT)
1120-1130	CUT's Silver Jubilee Reflections: Remarks by Dr. Eng. M. Manuhwa , Chairman of Council (CUT)
1130-1145	Solidarity Remarks by the Conference's Platinum Sponsor: Commissioner General Dr. M.C.N. Chihobvu , The Commissioner-General of the Zimbabwe Prisons and Correctional Service (ZPCS)
1145-1155	Entertainment
1155-1205	Introduction of the Guest of Honour: Prof F. Tagwira , Permanent Secretary (Ministry of Higher and Tertiary Education, Innovation, Science and Technology Development)
1205-1225	Keynote Address by Guest of Honour: Hon. Dr. F. M. Shava , Minister of Higher and Tertiary Education, Innovation, Science and Technology Development
1225-1230	Vote of Thanks: Prof. T. Bere, Pro-Vice Chancellor for Innovation, Enterprise Development and Industrialisation (CUT)
1230-1300	Dignitaries Photo Session (End of Official Opening Ceremony)
1300-1355	LUNCH

PARALLEL SESSIONS (1355 - 1635 HRS)

Session 1.1: Green Technologies, Digital Innovations, AI, and Industry 4.0 for Rural Industrialisation Venue: Robert Mugabe Auditorium Session Chairs: Dr C. Chihobo, Dr. T. Musora, Dr Sango, Dr Dikito Rapporteurs: Ms Shalom Nhika, Mr Aaron Chifamba, Ms. V. Mupindu		Session 1.2: Innovation, Enterprise and Rural Industrialisation Venue: Great Hall Session Chairs: Prof W. Mtangi, Dr M. Jengeta, Dr T. Dumbu, Ms P Bhariri Rapporteurs: Mr Lloyd Simango, Raymond Nyakudanga, Courage Muguta	
1355-1405	Artificial Intelligence Adoption in African SMEs: Opportunities, Constraints and Policy Implications - Masunda Tasaranago M, Simuka J, Masunda S, Madzimore GPK (HIT/UZ/CUT)	1355-1405	Design of a Plant for the Production of Essential Oil from Waste Lemon Peels with Potential Application in Antimicrobial Liquid Soap - Malcom T. Chahwanda, Elizabeth Ticharwa, Lee Moyo (HIT)
1405-1415	Empowering Rural Agriculture: An AI-Driven Livestock Monitoring Application for Enhanced Productivity and	1405-1415	A Credit Risk Framework for Hyperinflationary Environments: Empirical Evidence from Zimbabwe -

	Industrialization in Zimbabwe - Pride T Murwira, Rutendo Zindoga (NUST)		Lloyd Chimusakasa, Henry S Samambgwa, Thomas Musora (CUT)
1415-1425	Leveraging Digital Innovations for Decongesting Harare's Transport System - Silvester Ramwi (CUT)	1415-1425	Sustainable Supply Chain Systems and Circular Economy Practices for Climate-Resilient Rural Industrialisation - Pardon J Muzondo, Kudzanai Matowanyika, Nelson Chipangamate (MUAST/CUT/Wits)
1425-1435	Climate Economics and Sustainable Rural Industrialisation: Understanding the Role of Green Technologies - Feya Freedom, Podzo Fradreck (RCU)	1425-1435	Chatbot-Facilitated Last-Mile Logistics for Rural Agribusiness E-Commerce: A Design Science Approach - C. Nhema, N. Soraidema, V. Mushore, K. Chimwayi, T. Nyamugudza (HIT)
1435-1445	Digital Innovation for Safe and Sustainable Transport Systems: A Smart Passenger-Centred Speed Monitoring Model for Zimbabwe - Pardon J Muzondo, Everjoy Mukunga, Heniuck Mutisi (MUAST/CUT)		
1445-1510	DISCUSSION SESSION		
1510-1520	TEA BREAK		
1520-1530	Next-Generation Connectivity in the Zimbabwe and SADC Context: Integrating AI-Driven Analytics, SGP.32 Standards, and Gamified User Experiences in eSIM Ecosystems - Jakopo Gashirai (HIT)	1520-1530	Digital Entrepreneurship Ecosystems and AI-Driven Innovation for Rural Industrialisation in Emerging Economies - Everjoy Mukunga, Heniuck Mutisi, Pardon J Muzondo (CUT/MUAST)
1530-1540	Design, Implementation, and Subsystem Validation of a dsPIC30F4011 Controlled Bidirectional Dual Active Bridge Converter for Localized Energy Systems. Peter Bukelani Musiiwa, Engelbert Takawira Kapuya, Downmore Musademba. Doubt Simango	1530-1540	From Growth Points to Industrial Hubs: A Roadmap for Value Addition in Rural Zimbabwe - Brian Sibanda (CUT)
1540-1550	An approach towards Energy Intelligence over Artificial Intelligence: Case Studies on Energy Consumption and Water Exploitation on Adapting AI Based Systems - Dr. M.S. Sureshkumar; Eng. Nathan Jubilation Chifamba; Eng. Mildred Nyamunokora (HIT)	1540-1550	Theories and Aspects of Best Practice Measures in Tax Revenue Mobilisation: A Case of Bulawayo Micro-Small to Medium Enterprises – Paradzai Matuka (NUST)
1550-1600			
1600-1625	DISCUSSION SESSION & WRAP-UP		

Session 1.3: Smart Agriculture and Agro-Industrial Systems Venue: University Board Room Session Chair: Prof. C. Murungweni, Dr O. Svubure, Ms. T Murefu Rapporteurs: Ms. W. Nyoni, Ms. B. Maoneke, P. Moyo		Session 1.4: Sustainability, Climate and Environmental Systems Venue: GIS Lab Session Chair: Dr Mabidi, Dr. N.T. Mukomberanwa, Dr. Manyuchi Rapporteurs: P. Gudoshava, O. Munetsi, T. Masocha	
1355-1405	Resilient Agro-Industrial Supply Chains: Leveraging Smart Agriculture Technologies for Climate-Smart Food Systems – Pardon J Muzondo, Everjoy Mukunga, Heniuck Mutisi (MUA/ST/CUT)	1355-1405	Recovery of Lead from Lead Laden Cupels Generated in Precious Metal Extraction: An Enhanced Hybrid Approach Towards Long Term Environmental Pollution Control – Misheck Mujuru, Tavengwa Bunhu, Stephen Nyoni, Gadzikano Munyuki (CUT)
1405-1415	Options for support to agriculture and food security under climate change PL Mafongoya, MM Phophi, O Chipfunde, TR Mafongoya (UKZN, SA)	1405-1415	Stakeholders' perspectives of the ICM concept in Tokwe sub-catchment, Zimbabwe and applicable Government policy relating to the ICM concept – Kosamu Nyoni, Munyaradzi Mujuru, Munyaradzi Chitakira (GZU)
1415-1425	An Evaluation of the Contribution of Climate-Smart Indigenous Knowledge Systems to Agricultural Adaptation, Food Security, and Sustainable Rural Livelihoods – Handsen Tibugari, Sukoluhle Ganyani, Prudence Ganyani (Lupane State University)	1415-1425	Integrating the Arborloo Toilet Design and Indian Jujube (<i>Ziziphus mauritiana</i>) Tree Species Planting Initiatives in Promoting Holistic Rural Community Wellbeing in Mukumbura Ward 2, Mt Darwin District – Musekiwa Innocent Maruza, Edson Gandiwa, Never Muboko, Ishmael Sango, Tawanda Tarakini (CUT)
1425-1435	Partnering for Innovation in Namibia: Leveraging Traditional Ecological Knowledge for Sustainable Mushroom Cultivation and Rural Livelihood Development – Fimanekeni Shivute (IUM, Namibia)	1425-1435	Integrated Hydrometeorological Monitoring for Climate-Resilient Water Management in Manyame Catchment, Zimbabwe – Andrew Takunda Bangwayo, T. M. Manyuchi, Mr Vhiriri (CUT)
1435-1445	<i>Ivhu Inhaka Yedu: Community-Driven Agricultural Intelligence for Rural Industrialisation and Food Sovereignty in Africa</i> Cleopatra Mushonga, Zelda K. Molnes, Salome S.N. Nyangari (Athabasca University, Canada; Inland Norway University of Applied Science, Norway; Queensland University, Australia)	1435-1445	
1445-1510	DISCUSSION SESSION		
1510-1520	TEA BREAK		
	Evaluation of the Larvicidal Efficacy and		Turning Pollution into Pavement: A

1520-1530	Insecticidal Activity of Afzelia quanzensis Bark Extracts Against Spodoptera frugiperda – Charity Chausina, Nilton Mashavakure (CUT)	1520-1530	Community-Scale Plastic Waste-to-Paving Block System for Rural Zimbabwe – Aaliyah Phiri (NUST)
1530-1540	First survey of entomopathogenic nematodes (Heterorhabditidae and Steinernematidae) in Zimbabwe: A Foundation for Sustainable Biological Control in Climate Smart Agriculture – Mathema Ndabanye, Robert Musundire, Antoinette Malan, S. Patricia Stock (Gwanda State/CUT/Stellenbosch/Oregon)	1530-1540	Geospatial Modelling of Urban Green Space Dynamics in Harare Municipality – Murwadzi Takudzwa P, Mukedzimwe Francisca (CUT)
1540-1550	Laboratory Evaluation of Jacobaea maritima Extracts as a Biopesticide Against Cabbage Aphids – Vongai Chipfunde, Nilton Mashavakure (CUT)	1540-1550	
1550-1625	DISCUSSION SESSION & WRAP-UP		

Session 1.5: Health, Biotechnology and Human Well-being Venue: Lecture Theatre Session Chairs: Dr W. Mozirandi, Dr. T. Kaseke, Dr Chisango Rapporteurs: Mr Zaranyika, Ms Mberi, Mr Manjengwa		Session 1.6: Society, Governance and Inclusive Development Venue: STEM Lab Session Chair: Prof. J. Mapara, Ms V. Chinokwetu, Dr. M. Kamoyo, Mr. C. Mukayani Rapporteurs: Ms. S Shoko, J. Dzinonwa, Ms. L. Matumbure	
1355-1405	Ceramic-Based Composite Filter Cartridges for Fluoride Removal from Contaminated Water: A Case Study of Gwai and Siyakobvu, Zimbabwe – Audrey Kawondera, Stephen Nyoni, Tavengwa Bunhu (CUT)	1355-1405	Marking Territory with Affection: Understanding the Materiality of Love and Belonging at Established Tourism Destinations – Forbes Kabote (CUT)
1405-1415	Systematic Review: L-DOPA-Free Mucuna pruriens Seed Residue as Animal Feed – Thomas Marangwana, T. Chisango, T. Mduluza (CUT/UZ)	1405-1415	BrailleRead: A Low-Cost Refreshable Braille Display for Advancing Inclusive Education in Rural Zimbabwe – Kudzanai Chabara (HIT)
1415-1425	Green Synthesis of Silver Nanoparticles Using Plant Extracts (Aloe Vera and Neem) for Antimicrobial and Antidiabetic Activity – Tafara Mashaya, Stephen Nyoni (CUT)	1415-1425	A Hybrid Artificial Intelligence Integrated Credit System to Enhance Financial Inclusion for Underserved Populations in Zimbabwe – Leonard Shambira (GZU)
1425-1435	In-Silico Assessment of Determinants Influencing HIV Status Amongst Pregnant Zimbabwean Women Using Machine Learning on ZIMPHIA 2020 Data – Munashe Chakamanga, Tinashe Rudeve, Tom Muzenda, Mbire P (MSU)	1425-1435	Integrating Intellectual Property Rights in Engineering Education for Sustainable Development – Bigirimana S (Africa University)
1435-1445	Ethnomedical and health roles of Zimbabwean indigenous fruits and their derivatives. A Review - Dzoro, M.; Chisango, T.; Musundire, R.; Masheka,	1435-1445	Stakeholder' perceptions on the adoption of ESG in Small to Medium Tourism Enterprises in Chinhoyi (Zimbabwe) Chikarara Lawreen, Mwando Molline, Mazibeli

	A. (CUT)		Tiisetso
1445-1510	DISCUSSION SESSION		
1510-1520	TEA BREAK		
1520-1530	Insects's cultural and medicinal significance globally. A Review - Dzoro, M. Chisango, T. Musundire, R.; Masheka, A. (CUT)	1520-1530	
1530-1540	RNN-BASED predictive analytics for early detection of malaria outbreaks in rural Zimbabwe - Sophia Tembure; Harmony K. Nzou (HIT)	1530-1540	
1540-1600	DISCUSSION SESSION & WRAP-UP		

Session 1.7: Health, Biotechnology and Human Well-being Venue: ICT Room 1 Session Chair: Prof. K. Chitindingu, Mr Masaiti, Mr Gozho Rapporteurs: Audrey Kaondera, Tapiwa Mutetwa, Chido Mudawarima		Session 1.8: Smart Agriculture and Agro-Industrial Systems Venue: ICT Room 2 Session Chair: Mr. Jambwa, Dr. C. Chakanya Rapporteurs: Mr A. Muchandiona, Mr E. Gororo, Mr Mupepe	
1355-1405	Zimbabwean Traditional Medicinal Plants: Research Trends, Therapeutic Potential, Commercialization Status, and the Need for Establishment of a Centre of Excellence - Moreblessing Dube; Pardon Mugari; Zedias Chikwambi; Kimberly C Konono; Pamhidzai Dzomba; Stephen Nyoni Joshua Mqabuko Nkomo Polytechnic	1355-1405	Development of slicing machinery for root crops targeted for small to medium scale farmers. A Systematic Review - A. Muchandiona, O. Svubure, C. Murungweni, P. Rakatiwana (CUT)
1405-1415	Investigating therapeutic potential of a polyherbal gel containing azadirachta indica and ocimum gratissimum in burn wounds - Pesistence Maronga; Lorraine Y Bishi; Stephen Nyoni (CUT)	1405-1415	IoT-Based Precision Irrigation System for Small-Scale Farming – Oackentrevor Kaswa (NUST)
1415-1425	Biotechnology, food safety and human well-being: addressing contaminated grains, nuts and GMO misconceptions - Handsen Tibugari; Shamiso Muchayi; Abednico Bhebhe; Lucky Musarandega; Blessing Silwangani; Kudakwashe Machokoto; Loreen Ncube; Praise Wandile Hadebe; Halimah Roy Gomani Lupane State University (LSU)	1415-1425	Design of an Energy Efficient Flue-Cured Tobacco Tunnel Barn targeted for Smallholder Farmers. A systematic Review - N. Gashiten, P. Rwakatiwana, A. Muchandiona, D. Jambwa, M. Chivero, M. Chikafa (CUT)
1425-1435	Phytochemical Characteristics, In Vitro Antidiabetic and In Silico Studies of Cassia abbreviata – Chido VP Mudawarima	1425-1435	AI Adaptive Rain Water Harvesting System: A Framework for Restoring Zimbabwe's Indigenous System with Smart Solutions. Sureshkumar M.S., Monika Gonde. Nathan Jubilation Chifamba , Mildred Nyamunokora, Romeo Toga (HIT)

1435-1445	Formulation of Ultrasonography Gel Using Aloe vera and Cucumber Extracts – Cathrine Tariro Muchakata, Michelle S. Nyoni, Tavengwa Bunhu (CUT)	1435-1445	
1445-1510	DISCUSSION SESSION		
1510-1520	TEA BREAK		
1520-1530	Rational Design of a Multi-Epitope-Based Lassa Fever Vaccine – Elias Fambayi, Mpho Langalanga, Alfred Mutaramutswa, Mustapha Umar Imam, et al. (MSU)	1520-1530	
1530-1540	The Use of L-DOPA Extracted from Mucuna pruriens in the Management of Parkinson's Disease: A Comprehensive Systematic Review and Meta-Analysis – Thomas Marangwana, T. Chisango, T. Mduluza (CUT/UZ)	1530-1540	
1540-1550	Waste-to-Feed: Indigenous Fruit-Based Bio-Silage Additive – Jonathan Jojo, Eddington Gororo, Callisto Gwatarisa (CUT)	1540-1550	
1550-1600	<i>(Session slot kept open for overflow from other tracks)</i>	1550-1600	
1600-1625	DISCUSSION SESSION & WRAP-UP		

DAY 2: 8 JULY 2026

PLENARY SESSION – From Campus to Community: 4IR, Enterprise, and the Rural Development Imperative Venue: Great Hall, Chinhoyi University of Technology Session Chair/Moderator: Eng Chawagarira Rapporteurs: Dr. W. Ruziwa	
Time	Activity
0800-0825	Registration, Networking, Refreshments and Entertainment: ZPCS
0825-0830	Welcome Remarks: Prof Mwedzi (Chairperson- Conference Organising Committee)
0830-0900	Presentation: African universities as saviours of Africa in the digital era. - Prof Mwenda Ntarangwi (United States International University - Africa, Kenya)

0900-0930	Presentation: Innovation Leadership and the Fourth Industrial Revolution: Opportunities for African Universities - Prof. Kanhukamwe (Vice Chancellor, Harare Institute of Technology)
0930-1000	DISCUSSION SESSION
1000-1030	TEA BREAK AND ENTERTAINMENT

PARALLEL SESSIONS (BEGIN 1045 HRS)

Session 2.1: Green Technologies, Digital Innovations, AI, and Industry 4.0 for Rural Industrialisation Venue: Robert Mugabe Auditorium Session Chairs: Eng. Chawagarira, Eng Chimanyiwa, Eng Musasa, Dr Mugadza Rapporteurs: Ms Shalom Nhika, Mr Aaron Chifamba, Ms. V. Mupindu		Session 2.2: Innovation, Enterprise and Rural Industrialisation Venue: Great Hall Session Chairs: Eng. Mlambo, Dr Manyangara, Dr T Mutsunge, Dr Viriri Rapporteurs: Mr Lloyd Simango, Raymond Nyakudanga, Ms P. Matinenga	
1045-1055	Integrated AI-Driven Signal Processing and Hardware Architectures for Multi-Biomarker Point-of-Care Diagnostics: A Systematic Review - Humphrey Nkosiyo Dera (CUT)	1045-1055	Agro-Processing Enterprises as Drivers of Rural Industrialisation - Leonard Shambira, Edna Shambira (GZU)
1055-1105	Feasibility Study of Free Space Optical Communication as 5G Backhaul Link under Zimbabwean Conditions - Kudzanai Chabara (HIT)	1055-1105	Determinants of Enterprise Success and Rural Industrialisation in Zimbabwe: An Empirical Analysis of MSMEs - Kizito Danha, Tinashe Rvinga, Tatenda Katsande (CUT)
1105-1115	A GIS-Based Hybrid Modelling Approach Using CART Classification and Cellular Automata (MOLUSCE) for Predicting Future Land Use Dynamics in Mutare - Mitchell Tendesai Zimunya, Margaret Dadai Masinire, Francisca Kunedzimwe (CUT)	1105-1115	Mobile Platforms as a Tool for Social Innovation in Universities: A Case Study of the IUM Application - Theron I. N. Kasita (IUM, Namibia)
1115-1125	A Theoretical Framework for Smart Agriculture Systems Using AI and Data Science for Climate Resilience and Adaptation for Smallholder Farmers in Zimbabwe - Leonard Shambira (GZU)	1115-1125	Probabilistic Cash-Flow Model for Off-Grid Solar Systems in Rural Zimbabwe - Lloyd Chimusakasa, Henry Samambgwa, Joseph Kamusha, Thomas Musora (CUT)
1125-1135	A New Integrated IoT-Based Fall Armyworm Surveillance and Control	1125-1135	A Low-Cost AI-Driven Supply Chain Framework for Rural SMEs in Zimbabwe -

	System for Smallholder Farmers in Zimbabwe - Taremekedzwa Denhere, Nilton Mashavakure, Onward Svubure (CUT)		Blessed Ziyambe, Godfrey Murairidzi Gtora, Sibongile Natasha Malindi, Christmas Vutuzah, Tendai Mukande (BUSE/UZ/UKZN/DCU)
1135-1200	DISCUSSION SESSION		
1200-1210	AI-Driven Optimization of eSIM-Based Roaming Services in the Zimbabwe-South Africa Corridor - Gashirai Jakopo (HIT)	1200-1210	Leveraging VAL-U Educational Games Through ISEOP Initiatives to Foster Entrepreneurship and Innovation - Rungano T, Chipandambira C (Gweru Polytechnic)
1210-1220	Addressing the lack of a lightweight, locally validated convolutional neural network (CNN) for three class VIAC classification (Negative, Positive, Suspicious of Cancer [SOC]) deployable in low resource settings- Tinotenda P Murapa, Shakemore Chinofunga, Tavengwa Masamha, Jacqueline Fungai Kiwa (CUT)	1210-1220	Systematic Review on the Effective Interoperability of Global Digital Product Passport Standards and Indigenous Informal Repair Networks - Themban Gaswa, Hazel Mubango, Patson Chawuruka (Women University in Africa)
1220-1230	Leveraging Artificial Intelligence and Mobile Money Ecosystems to Accelerate Rural Industrialisation in Zimbabwe: A Conceptual Framework - Kudzanai Chabara (HIT)	1220-1230	Developing a Digital Marketing Framework for Enhancing Consumer Purchasing Behavior in the Zimbabwean Telecom Sector - Joyce Zata, Michael Kamoyo, Shylet Chigwende (CUT)
1230-1240	Developing a Machine-Learning Forecasting Model for Daily Outage-Related Call Volumes- Samukeliso Gamuchirai Makore, Shakemore Chinofunga, Tavengwa Masamha, Fungai Jacqueline Kiwa, Tinotenda Priscilla Murapa (CUT)	1230-1240	A Lightweight Social Media Analytics Framework for Micro and Small Enterprises in Infrastructure-Constrained Environments - Jena Ronald, Nigel Huni, Mercy Chinyuku (CUT)
1240-1250	An Exploration of Digital Skills Knowledge Gaps to Enhance Employee Productivity in Zimbabwe's Hotel Sector - Tendai Chikari, Clotilda Kazembe, Enes Madzikatire (CUT)	1240-1250	
1250-1315	DISCUSSION SESSION		
1315-1415	LUNCH		
1415-1425	E-Readiness Factors for Extended Enterprise Resource Planning Implementation in Zimbabwean State-Owned Enterprises - Chingwaro Phillip,	1415-1425	Commercialisation Pathways for University-Based Innovations in Zimbabwe - Joshua Simuka (HIT)

	Masengu Reason, Kiwa Fungai Jacqueline, Chinofunga Shakemore (CUT)		
1425-1435	AURORA-nexus: AI-Powered Digital Twin Platform for Sustainable Urban Infrastructure Management - Sizolwenkosi Ndlovu, Huldah Nkomo, Takudzwa Nyengerai, Prosper Ncube (NUST)	1425-1435	Transforming Agricultural Production into Competitive Rural Industries: A Case of Gokwe and Lupane - Handsen Tibugari, Sheckmore Kwangwari, Noel Shirto, Tamirirashe Shumba, Owen Tshuma, Graciano Mlilo, Halimah Roy Gomani (Lupane State University)
1435-1445	An Artificial Intelligent Prescriptive Hybrid-Platform for Enhancing Extended Enterprise Resource Planning Implementations in Zimbabwe State Owned Enterprises - Chingwaro Phillip, Masengu Reason, Kiwa Fungai Jacqueline, Chinofunga Shakemore (CUT)	1435-1445	Financing and Scaling Rural Enterprises: Entrepreneurial Pathways for Inclusive Agro-Industrial Development - Everjoy Mukunga, Heniuck Mutisi, Pardon J Muzondo (CUT/MUAST)
1445-1455	User Perceptions of an Extended ERP Implementation Model in Zimbabwean State-Owned Enterprises: A PLS-SEM Analysis - Chingwaro Phillip, Masengu Reason, Kiwa Fungai Jacqueline, Chinofunga Shakemore (CUT)	1445-1455	Leveraging Artificial Intelligence to Strengthen Health Insurance Systems in Zimbabwe - Harison Ziyambe, Tsitsi Mufudza (CUT)
1455-1505		1455-1505	Combating Financial Misconduct in Rural Industrialisation Projects: A Forensic Accounting and Auditing Approach - Jimu Tafadzwa, Chirisa Innocent (MSU/ZEGU)
1505-1515		1505-1515	
1515-1545	DISCUSSION SESSION & WRAP-UP		
1545-1600	TEA		

Session 2.3: Smart Agriculture and Agro-Industrial Systems Venue: University Board Room Session Chair: Prof S. M. Makuza, Dr. Nantapo, Dr. C. Chakanya, Ms. T Murefu Rapporteurs: Ms. W. Nyoni, Ms. B. Maoneke, P. Moyo		Session 2.4: Sustainability, Climate and Environmental Systems Venue: GIS Lab Session Chair: Dr J. Ndlovu, Dr. Banda, Dr. N.T. Mukomberanwa, Dr Kawondera Rapporteurs: Mr Tasunungurwanashe Mafuruse, Mr Tavhiringwa Chabvutagondo, Mr Knowledge Darikai	
1045-1055	Development of an Integrated Fixed Time Artificial Insemination Model Incorporating Vaccination Schedule against major	1045-1055	Postharvest Losses in the Magumba (Hisa Kelee) Value Chain in Mozambique -

	Venereal Diseases – Arthur Zoraunye, Stanley Makuza, Showman Gwatibaya, Fungai Chatiza (CUT)		Helena Salencia (CUT)
1055-1105	Data-Driven Prediction of Semen Extender Composition Using Computational Approaches - Eddington Gororo, Stanley M. Makuza, Fungayi P. Chatiza (CUT)	1055-1105	Socio-Economic Impacts of Illegal, Unreported and Unregulated Fishing in Lake Kariba: Case of Sanyati Basin – Chipo Pedzisai, Tongai Mwedzi, Innocent Mabika, Takafara Gozo (University)
1105-1115	Climate-Smart Livestock Innovations and Partnerships for Enhancing Smallholder Resilience and Rural Industrialization in Zimbabwe - Lawrence Gweme, Showman Gwatibaya, Stanley M. Makuza, Maria Tsvere (CUT)	1105-1115	Assessment of groundwater quality for drinking purposes. A case study of Chinhoyi urban - Kundidzora Muriel Kunedzimwe Francisca (CUT)
1115-1200	DISCUSSION SESSION		
1200-1210	Pesticidal Effect of Chilli, Garlic and Marigold Extracts Against Fruit Fly in Guava - Delight Munashe Jambaya, Nilton Mashavakure (CUT)	1200-1210	An assessment of the Abundance and Distribution of Southern Ground Hornbills (SGH, <i>Bucorvus leadbeater</i>) on Sango Ranch, in the Save Valley conservancy, Zimbabwe – Edison Marime, Henry Varandeni, Alexander Cooper, Tawanda Tarakini (CUT)
1210-1220	Isolation and Efficacy Evaluation of Indigenous <i>Bacillus</i> spp. from Chinhoyi Soils Against Cabbage Aphid – Rutendo Sigauke, Nilton Mashavakure (CUT)	1210-1220	Twelve Years of Monitoring Terrestrial Birds at Chinhoyi University of Technology Campus in Zimbabwe - Matengo Tafadzwa, Chirwa Nancy, Tarakini Tawanda (CUT)
1220-1230	Evaluating living and organic mulches in No-till maize: Medium-term effects on soil properties and crop growth components - F. Manana, N. Mashakure and K Musiyiwa (CUT)	1220-1230	Spatio-temporal dynamics and baseline status of waterbird assemblages at Lake Sabakwe, Midlands, Zimbabwe - Tanyaradzwa Munengwa, Takunda Kwenda, Innocent Mabika, Tawanda Tarakini (CUT/ZPWMA)
1230-1240	Evaluation of Humic + Fulvic Acid-Based Bio-Nematicide Against Root-Knot Nematode in Tomato - Nyamupinga Benson, Nilton Mashavakure (CUT)	1230-1240	A Decade-Long Analysis of Waterbird Diversity and Population Dynamics at Biri Dam, Zimbabwe - Mwedzi Tongayi, Matengo Tafadzwa, Tarakini Tawanda (CUT)
1240-1250		1240-1250	Assessing Habitat Suitability and Spatial Overlap Between African Elephant and Baobab in Mid-Zambezi Biosphere Reserve - Francis Chitsa (CUT)
1250-1315	DISCUSSION SESSION		

1315-1415	LUNCH		
1415-1425	Parasitological Safety of Feed and Food Insects in Russia - M.V. Ladokhina (Perm State Agro-Technological University, Russia)	1425-1435	Vision Transformer-Based Architectures Trained on Multi-Year Sentinel Time Series to Detect Ecological Regime Shifts – Nobert Tafadzwa Mukomberanwa (CUT/MBRC)
1425-1435	Assessment of the Biological Qualities of Horses for Hippotherapy - Polkovnikova V, Bachurina E (Perm State Agro-Technological University, Russia)	1435-1445	An assessment of land use land cover (LULC) change, projected climate trajectories, and the mainstreaming of wildlife corridors into Zimbabwe's climate change policy frameworks: The case of Hwange-Shangani elephant corridor - Tapiwa Jeche, Tongayi Mwedzi, Blessing Onias Munetsi (PAUWES/CUT)
1435-1445	The Effect of Stimulant Drugs on the Biochemical Status of Calves in the Early Postnatal Period - Rolnik Alexey (Perm State Agro-Technological University, Russia)	1445-1455	Review of an IoT-Based Solar PV Energy Monitoring and Management System for Enhanced Grid Resilience in Zimbabwe - Raymond R Nyakudanga, Powell Mlambo (CUT)
1445-1455		1455-1505	A Geospatial Modelling Approach for analysing, stimulating and optimising Urban Green space dynamics for Harare Municipality- Murwadzi Takudzwa P, Mukedzimwe Francisca (CUT)
1455-1505		1455-1505	Web-GIS Solid Waste Management System for Chinhoyi Municipality – Nichole Mudzimiri, T Manyuchi, W Munjoma (CUT)
1505-1515		1505-15-15	Digitizing Zimbabwe's Entomological Heritage: The ZIBIS Project – Dorothy Chipso Madamba (CUT)
1515-1545	DISCUSSION SESSION & WRAP-UP		
1545-1600	TEA		

Session 2.5: Health, Biotechnology and Human Well-being Venue: ICT Room 2 Session Chairs: Prof K. Chitindingu, Dr W. Mozirandi, Dr. T. Kaseke, Dr Chisango Rapporteurs: Mr Zaranyika, Ms Mberi, Mr Manjengwa		Session 2.6: Society, Governance and Inclusive Development Venue: ICT ROOM 2 Session Chair: Prof M. Tsvere, Sr Dr. Chinyani, Ms V. Chinokwetu, Rapporteurs: Ms. S Shoko, J. Dzinonwa,	
1045-1055	Phytochemical Composition, Antioxidant and Antimicrobial Activity	1045-1055	Revitalizing Grass Root Development Structures for Responsive Governance -

	of Cucumis anguria L. Fruit - Princess Shumba, Bridgett Parirenyatwa, Ntobeko Ncube (MSU/Bulawayo Polytechnic)		Onesimo Mverecha (GZU/UKZN)
1055-1105	Harnessing Bioinformatics and Data Science for Genomic Insights and Improved Healthcare Outcomes in Africa - Munashe Chakamanga, Tanya Dzinemarira, Tom Muzenda, Allen Mazadza (MSU)	1055-1105	Exclusion by Inclusion: The Paradox of Women Electoral Representation in Zimbabwe - Onesimo Mverecha (GZU/UKZN)
1105-1115	Indigenous Medicinal Plant Use and Community Perspectives: A Case Study from Mapfungautsi Forest Reserve, Zimbabwe - Bridgett Parirenyatwa, Blessing Nda, Kudakwashe Muringaniza, Charles Paradzayi (MSU)	1105-1115	Waste Management Strategies for Ruralpreneurs in the Food Industry: The Case of Female Food Vendors in Lower Gweru, Zimbabwe - Chipandambira C, Rungano T, Maruzani N (Gweru Polytechnic/MSU)
1115-1125	The Impact of Age and Ejaculate of Afrikaner Bulls on Semen Quality - Tom Muzenda, Doroth Assan (MSU)	1115-1125	
1125-1135	Defluoridation Technologies: A Critical Review - Audrey Kaondera, Stephen Nyoni, Tavengwa Bunhu (CUT)	1125-1135	
1135-1200	DISCUSSION SESSION		
1200-1210	Cognitive Operational Learning Intelligence (COLI) - A Next-Generation Intelligent Assistant Platform for Biomedical Research - Colleen Vimbai Kangara, Songwe Fanuel (MSU)	1200-1210	Pandemics, Propaganda and Platforms: Social Media's Role in Public Health Governance and Misinformation - Mandiringa T, Muromo B (MSU)
1210-1220	Machine Learning-Driven Vaccine Antigen Discovery Against Schistosoma mansoni - Ashley Garith Mawazana, Stanley Panashe Alifa (MSU)	1210-1220	GIS-Based Shop License Management System for Chinhoyi Municipality - Triumph Mukume, T Manyuchi, W Munjoma (CUT)
1220-1230	A Systematic Review: Synthesising Evidence on the Acceptability, Feasibility, and Impact of AI-driven tools for Rural Maternal Health Education- Fadzai Dorcas Chigaro, Professor M. Tsvere, Dr A. Dikito, Dr C.J. Mawire (CUT)	1220-1230	
1230-1240	Machine Learning Based Digital Health Platform for Albinism Care in Sub Sahara Africa, Agatha Kunzekwenyika, Respect Vudzijena (HIT)	1230-1240	

1240-1250	GC-MS and In Silico Profiling of Antidiabetic Phytocompounds from Selected Plant Species Used for Diabetes Management in Bulawayo - Moreblessing Dube (CUT)	1240-1250	
1250-1315	DISCUSSION SESSION		
1315-1415	LUNCH		
1415-1425	Development, Implementation and Evaluation of a Community-Based Cognitive and Mental Health Intervention for Older Adults in Urban Zimbabwe - Maureen Tshuma (BSMS/BRTI/THRU ZIM)	1425-1435	Corporate Governance Framework for Service Delivery in Selected Zimbabwean Urban Areas - Agnes Kawiri, Obert Sifile (CUT)
1425-1435	Paraquat-Induced Parkinson's Disease in Rat Models: Neurodegeneration, Behavioral Impairments, and Hepatotoxicity - Thomas Marangwana, Dr T. Chisango, Professor T. Mduluza (CUT/UZ)	1435-1445	Integrating Traditional Cultural Expressions and Indigenous Traditional Knowledge Systems in Social and Economic Policy for Sustainable Development - Dr Stanislas Bigirimana (Africa University)
1435-1445		1445-1455	Policy Frameworks for Grassroots Innovation: Analyzing How National Policies Can Better Support 'Jua Kali' Engineering and Social Innovation - Rutendo Whitney Muchero (CB Muchero Innovation Hub)
1445-1545	DISCUSSION SESSION, NETWORKING AND WRSP UP		
1545-1600	TEA		

Session 2.7: Creativity, Design and Cultural Innovation Venue: STEM Lab Session Chair: Dr. E. Mutungwe, Mr. J. Nyamubaya, Mr. V Dewa, Rapporteurs: Mr. O Munetsia, Mr Madziwanzira		Session 2.8: Sustainability, Climate and Environmental Systems Venue: Lecture theatre Session Chair: Dr Kunedzimwe, Mrs Mangove, Dr. S. Nyoni Rapporteurs: Mr O. Munetsi, Mr. T. Gudoshava, Ms P. Mataranyika	
1045-1055	When Heritage Meets Innovation: Leveraging Motion Picture as a Powerful Conduit to Preserve Cultural Expressions of Minority Ethnic Groups in Lupane State University Film Productions - Isaac	1045-1055	Production of Ferric Chloride from Iron Swarf for Petroleum Wastewater Treatment - E. Million; P. Gurure; J. Govha (HIT)

	Chidaura (Lupane State University)		
1055-1105	Living Museums: A Framework for Revitalising the Shangani/Tsonga Language in the 21st Century - Theresah J Mutasa, Fortune T Muringa, Lister Matsilele (MSU)	1055-1105	Environmental Sustainability of Platinum Slag Reuse under Acid Rain Exposure: Risks, Mechanisms and Implications - Joana Dzinomwa, Wilbert Mtangi (CUT)
1105-1115	Augmenting SME Resilience in Emerging Digital Economies: A Framework for Human-AI Symbiosis in Multimedia Production - Sungai E, Chivhanga B (CUT)	1105-1115	Adaptive Ensemble AI Forecasting of E-Waste Generation in Harare, Zimbabwe: Towards a Circular Digital Economy - M.S. Sureshkumar; Nathan Jubilation Chifamba; Mildred Nyamunokora (HIT)
1115-1125	Ethno-Phenomenological Cultural Transformation Workshop Model: Pottery Design and Sustainable Cultural Continuity - Andrew Madziwanzira (CUT)	1115-1125	Application of Mining Waste in Construction Industry as a Resource for a Circular Economy - Magavhe Miriam, Sumanya Clemence, Mtangi Wilbert (CUT)
1125-1135		1125-1135	Synthesis and Optimisation of Polyaluminium Silicate Sulphate Coagulant from Zimbabwe's Silica Sand for Potable Water Treatment - N.T. Mbanje, J. Govha (HIT)
1135-1200	DISCUSSION SESSION		
1200-1210	Digital Transformation of Buhera's Creative Industries: A Framework for Rural Industrialization and Cultural Tourism - Tawanda Mbiriri, Godfrey Makandwa (MSUAS)	1200-1210	Spatial and Seasonal Patterns of Human--Elephant Conflict Around Hwange National Park, Zimbabwe - Rutendo Trish Madziwa, Nobesuthu Ngwenya, James Madzimure Africa University (AU)
1210-1220	Designing Sustainability: Bridging Cultural Heritage and Contemporary Creativity in Fashion Innovation - Verity Muzenda, Felisia Chimbindi (CUT)	1210-1220	Advancements in Biomass-Derived Carbon Nanostructures for Fuel Cell Applications: Synthesis Strategies, Structural Engineering, and Performance Optimization - Vimbai Mupindu; Kudzai Mugadza (CUT)
1220-1230	Development of an Augmented Reality Cultural Heritage Experience Platform for Zimbabwean Historical Sites - Tadiwanashe Dzitiro, Godfrey Makandwa (MSUAS)	1220-1230	Conservation Technologies and Circular Economy Pathways for Sustainable Rural Industrialisation in Mining Communities - Miriam Patience Magavhe, Joana Shamiso Dzinomwa, Edmore Takunda Mushonga (CUT)
1230-1240		1230-1240	First-flush behaviour and source-specific leachate signatures in unsegregated municipal solid waste at Pomona Dumpsite - Kudakwashe Mpofo (CUT)
1240-1250		1240-1250	Participation of Women Refugees in Water and Sanitation Governance: A Case of Tongogara Refugee Settlement - Wisdom Sibanda (GZU)

1250-1315	DISCUSSION SESSION		
1315-1415	LUNCH		
1415-1425	An Audience Reception Study in Zimbabwe: Decoding Health Promotion Materials that Focus on Children's Diseases - Nduna Hubert (CUT)	1415-1425	Smart Rock-Based Thermal Energy Storage System for Industrial Heating and Waste Heat Utilization - Phakamile Mlala (NUST)
1425-1435	Art and Design Curricula in SADC Universities: A Desktop Review and Futures Foresight in the Age of Artificial Intelligence - Verity Muzenda, Charles Paradzayi (CUT/MSU)	1425-1435	Assessing Hydro-period Pulsing and Buffer Vulnerability in the Monavale Wetland - Blessing Onias Munetsi (CUT)
1435-1445	Governance of Innovation Ecosystems: Institutional Frameworks for Creative Industries and Cultural Technology Development - Heniuck Mutisi, Everjoy Mukunga, Pardon J Muzondo (CUT/MUAST)	1435-1445	Beyond Bees: How Habitat Loss and Climate Change Threaten Southern Africa's Overlooked Beetle Pollinators: The Miombo Woodlands, a Blind Spot - Rejoice Chazireni; Tawanda Tarakini (CUT)
1445 - 1545	DISCUSSION SESSION AND NETWORKING & WRAP-UP		
1545-1600	TEA		

CONFERENCE DINNER - CELEBRATING SILVER JUBILEE

Venue: CUT Hotel Time: 1900 - 2200 HRS

DAY 3: 9 JULY 2026

POSTER SESSIONS, EXHIBITIONS /EXPOS, SPONSORED SIDE EVENTS AND TOURS

Venue: Great Hall

Session Chairs: Organizing Committee

Time	Activity
0800-0830	

	Registration, Networking and Refreshments
0830-0930	PANEL DISCUSSIONS Bridging Research and Industry: The Role of Innovation Hubs in Rural Development Sustainable Technologies for Rural Industrialisation: Opportunities and Challenges Partnering for Impact: University-Industry Collaborations for Community Development
0930-1000	TEA BREAK
1000-1300	POSTER SESSIONS, EXHIBITIONS, TOURS SPONSORED SIDE EVENTS- CONTINUATION
1315-1400	LUNCH

CLOSING CEREMONY Venue: Great Hall, Chinhoyi University of Technology Master of Ceremonies: Dr S. Nembaware, Director of Marketing and Public Relations, Chinhoyi University of Technology Chair/Moderator: Prof R. Musundire, Director- Graduate Studies and Research, Rapporteurs: Ms C Fundikwa, J. Dzinomwa	
Time	Activity
1400-1405	National Anthem
1405-1410	Devotion and Prayer: Chaplain, Chinhoyi University of Technology
1410 - 1420	Welcome Remarks: University Research and Innovation Committee Chairperson, Dr M. Mwando
1420 - 1440	Highlights of the Conference: Prof R. Musundire, Director- Graduate Studies and Research, Chinhoyi University of Technology
1440 - 1450	ENTERTAINMENT
1450- 1520	Conference Awards and Tokens of Appreciation: Engineer Dr. M Manuhwa, Council Chairperson- Chinhoyi University of Technology; Prof. T. Bere, Pro-Vice Chancellor for Innovation, Enterprise Development and Industrialisation - Chinhoyi University of Technology and Dr M. Mwando, URIC-Chairperson, Chinhoyi University of Technology
1520- 1530	Closing Remarks: Prof IDT Mpofu- Pro- Vice Chancellor, Academic Affairs and Administration, Chinhoyi University of Technology

Addendum

1. POSTERS

THEME	POSTER TITLE AND AUTHORS
Health, Biotechnology and Human Well-being	1. The Detection of <i>Eustrongylides Excisus</i> (Dorylaimea: Dioctophymatidae) in Fish from the Kama Reservoir - Olga Lazareva, (Perm Krai, Russia) 2. Traditional medicinal plants; Ethnomedicine; Herbal medicine commercialization; Pharmacological activities; Centre of Excellence Didymus T Makusha, Kizito Mupiwa (HIT)
Sustainability, Climate and Environmental Systems	3. Habitat suitability for elephants and baobabs across the Mid-Zambezi Biosphere Reserve, Zimbabwe, Francis Chitsa- CUT 4. Characteristics of the coal fines at Hwange Colliery Company Lesley Mutyavaviri, CUT 5. Use of Fairy Shrimp as Feed for Fish Fingerlings, Annah Mabidi- CUT 6. Remote sensing-based assessment of land cover dynamics and fire regimes from 2001 to 2025 in Gwayi Forest, Zimbabwe, Prince Gudoshava, Brendon Mharakurwa, Munyaradzi Chirova- CUT 7. Development of a Natural Biodegradable Superabsorbent Polymer for use in Potato Cultivation, Thembelihle Mguni, Ropafadzo Mabehlya – HIT 8. The optimization of injection moulding parameters for manufacturing mop sockets from fully recycled HDPE. A structured Design of Experiments (DOE) approach, Thembelihle Mguni, CharntalleT Machokoto, Dr K.H. Ruzvidzo – HIT 9. Investigating the Formulation and Performance of a Waterborne Epoxy Coating Enhanced with Sodium Benzoate as a Corrosion Inhibitor for Structural Steel Protection, Matsweru Natasha, Machokoto C.T, Chifamba N.J – HIT 10. Paper Production from Agave Sisalana Pulp and Musa Sapientum Pseudo-Stalks, Change MC, Mungwari C, Usai S – MSU 11. GIS Based Multicriteria suitability analysis for a solar powered water infrastructure in Chinhoyi. Casper Tatenda Makumbi, Prosper Gudoshava (CUT)-
Smart Agriculture and Agro-Industrial Systems	12. Synthesising existing literature on how behavioural drivers shape livestock productivity and value chain performance in Zimbabwe, Nyasha Nyakuchena - Womens University in Africa 13. Dual-Compartment Dehuller: Advancing Smart Agro-Industrial Processing of Traditional Grains in Zimbabwe, Ashley Chaleka, Emmanuel Nhedzi, Frank Chipfunde, Faith Matiza Ruzengwe – GZU

	14. Effects of Feeding Practices on the Metabolic Status of Aberdeen Angus Cows in the Perm Region, Alena Klimova- Perm State Agro-Technological University, Russia 15. Genetic improvement of Pearl Millet for Bird Damage Resistance, Tarisiro Moyo- CUT 16. Investigating the Synthesis and Characterisation of Biodegradable Chitosan-Kaolinite Clay Composite Hydrogels as Sustainable Soil Amendments for improved Water Retention and Controlled Nitrogen Fertiliser Delivery in Smallholder Agricultural Systems, Charntalle T. Machokoto, Thembelihle Mguni, Dr Kudzai H Ruzvidzo, Nathan J Chifamba – HIT 17. Preliminary in vivo evaluation of a Cissus quadrangularis based block lick for gastrointestinal nematode control in beef cattle, Pelagia Khumalo, Chido Chakanya, Irvine DT Mpofu, CUT
Green Technologies, AI, Digital Innovations, and Industry 4.0 for Rural Industrialisation	18. Developing and validating a Light Gradient Boosting Machine (LightGBM) Model for Sustainable Waste Management at Jena Mine, Mabwe Linda M, Chinofunga Shakemore, Murapa Tinotenda P, Masamha Tavengwa, Kiwa Fungai Jacqueline - CUT

2. Exhibitions

THEME	EXHIBITS
Green Technologies, AI, Digital Innovations, and Industry 4.0 for Rural Industrialisation	OmegaOS: A Lightweight Operating System for Sustainable and Inclusive Digital Computing in Low-Resource Environments, Selby Mashiki (NUST) Funda Lami: An AI-powered Learning Platform for Student Access to Critical Learning Resources Aligned to the Official ZIMSEC curriculum, Lebohang Sebata, NUST
Innovation, Enterprise and Rural Industrialisation	A Digital Marketplace Software Designed to enhance Rural Inclusion by connecting Smallholder Farmers to Agricultural Markets, Huldah Nkomo, Takudzwa Nyengerai, Terrence Tavagwisa, Makomborero Gufe - NUST
Society, Governance and Inclusive Development	FixIt Zimbabwe: A Full-Stack AI-powered Public Infrastructure Complaint and Tracking Platform, Buhlebemvelo Tshabangu Terrence Ncube, Tanaka Mujaji - NUST
INDUSTRY EXHIBITIONS	INDUSTRIES

3. SPONSORED SIDE EVENTS

UNIVERSITY INDUSTRY LINKAGES AND RESEARCH COMMERCIALIZATION TRAINING PROGRAM

DATE: 09 JULY 2026

VENUE: UNIVERSITY BOARD ROOM / ROBERT MUGABE AUDITORIUM1

Time	Activity	Presenter	Facilitator	Rapporteur
08:00–08:30	Registration	Secretariat		
08:30–09:00	Welcome remarks	Prof. W. Goriwondo, Acting Vice Chancellor, Chinhoyi University of Technology	Prof. R. Musundire	
09:00–09:30	Keynote address: Effective approaches for strengthening University-Industry linkages	Prof. Maina Mwangi	Prof. R. Musundire	Dr. R. Makanda
09:30-10:00	Rural industrialization & community impact	Dr Cosmas Magorokosho- Agricultural Research Council of Zimbabwe	Dr. S. Munikwa	Dr. R. Makanda
10:00-10:30	TEA BREAK	Secretariat		
10:30-11:00	Agricultural Enterprise Development & Markets	Dr R. Mano (Livestock & Marketing Authority of Zimbabwe)	Prof. C. Chiome	Dr. S. Munikwa
11:00-11:30	Aligning Agricultural Education Curriculum to support Rural Industrialization	Pro. Chrispen Chiome (Zimbabwe Open University)	Mr. P. Neusu	Dr. R. Makanda
11:30-12:45	Plenary session (Panel Discussion)- Strategies for effectively translating Science into Policy and Practice	AgriFoSe 2030, Southern African Hub	Prof. R. Musundire and Prof C. Chiome	Dr N. Dr. C. Munikwa. Nembaware
12:45-13:00	Closing remarks	Prof Taurai Bere (Pro-Vice Chancellor - Chinhoyi University of Technology)		
13:00	LUNCH	Secretariat		
14:00-16:00	Tour of exhibition stands			
16:00	Departure			

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Health, Biotechnology and Human Well-being

Sub-Theme: Medical Technologies, Public Health Innovation, Bio Engineering and Health Systems Strengthening

Phytochemical Composition, Antioxidant and Antimicrobial Activity of Cucumis anguria L. Fruit

Princess Shumba, Bridget Parirenyatwa, Ntobeko Ncube — Department of Applied Biosciences and Biotechnology, Midlands State University; Bulawayo Polytechnic

Abstract

The qualitative and quantitative phytochemical composition, the antioxidant activity and the antimicrobial efficacy of Cucumis anguria fruit extracts were investigated using ethanol, methanol and distilled water as extraction solvents. Ethanol proved to be the optimal extraction solvent producing highest total phenolic content (81.83 mg GAE/g) and total flavonoid content (102.81 mg QE/g). Antioxidant activity was strongest in the methanol extract (90.10%). The Kirby-Bauer disk diffusion method demonstrated significant inhibition against Staphylococcus aureus and Escherichia coli, with ethanol extracts producing the largest zones (25 mm and 17 mm, respectively). The findings confirm the ethnobotanical uses of C. anguria fruit, highlighting its potential as a natural source of antioxidants and antimicrobials amid rising antimicrobial resistance.

Keywords: Phytochemical, Antioxidant, Cucumis Anguria L, Antimicrobial

Harnessing Bioinformatics and Data Science for Genomic Insights and Improved Healthcare Outcomes in Africa

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Abstract

This study demonstrates how bioinformatics-driven approaches can enhance disease surveillance, precision medicine, and healthcare analytics in Africa. A multi-layered data science framework incorporating bioinformatics pipelines for genomic sequence analysis, variant calling, and functional annotation was adopted. The study revealed that integrating bioinformatics with data science improves the accuracy of genetic risk profiling, enhances understanding of population-specific disease susceptibilities, and supports the development of regionally relevant diagnostic and therapeutic strategies. Genomic surveillance models were also shown to provide early warnings for outbreaks, strengthening preparedness for diseases with epidemic potential.

Keywords: Bioinformatics, Genomics, Data Science, Healthcare Analytics, Africa

Indigenous Medicinal Plant Use and Community Perspectives: A Case Study from Mapfungautsi Forest Reserve, Zimbabwe

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Abstract

Through semi-structured interviews and field guided walks with 87 community members, 58 medicinal plant species pivotal to local healthcare were documented, with strong consensus (ICF=0.93) on treatments for gastro-intestinal disorders. Key species like *Lippia javanica* and *Xeroderris stuhlmannii* were identified as particularly valuable. This indispensable knowledge is held predominantly by an aging generation, signalling a risk of intergenerational erosion. Community narratives reveal a sophisticated understanding of threats and a repository of indigenous conservation practices. The findings underscore an urgent need for a paradigm shift towards inclusive, biocultural governance, formally integrating traditional healers as co-managers.

Keywords: Mapfungautsi Forest Reserve, biocultural, biodiversity, ethnobotanical, medicinal plant

Insects's cultural and medicinal significance globally. A Review.

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Abstract

Entomophagy, the practice of consuming insects, sustains an estimated two billion people worldwide as a vital source of bio-active compounds, fatty acids, protein,minerals, and vitamins while also functioning as a repository of cultural meaning, social order, and indigenous medical knowledge. Insects and biochemicals extracted from them have been utilised as medical resources globally in various human cultures. This review examines the interconnected cultural, social, and ethnomedical dimensions that govern the harvesting, preparation, and consumption of edible insects worldwide. Harvesting and processing of insects requires monitored rearing or wild collecting followed by dehydration and thermal processing to ensure their microbiological safety and longer shelf. Culturally, insects such as winged termites and mopane worms are woven into seasonal celebrations, ancestral folklore, and totemic belief systems where their emergence is interpreted as a sign of fertility, impending rain, or a gift from the land rather than mere sustenance. Socially, entomophagy is structured by age and gender-based taboos exemplified by restrictions on the consumption of certain grasshopper species among East African communities alongside its

role in reinforcing tribal hierarchy and generating informal economic livelihoods, particularly for women involved in insects harvesting and trade. Ethnomedically, traditional healers across multiple continents incorporate insects and their derivatives into remedies for ailments ranging from rheumatism and anaemia to infant colic while certain species are believed to confer strength, immunity, exposure mitigating insect phobia, and spiritual protection. Underlying these practices is a deep ecological ethic in which sustainable harvesting limits and ritual cleansing ceremonies reflect indigenous efforts to preserve insect populations and ensure future abundance. This review highlights how traditional belief systems continue to shape contemporary attitudes toward insect-based foods, offering insight relevant to food security policy, biodiversity conservation, exposure therapy, and the broader global discourse on sustainable and culturally sensitive food systems. Versatile insects and their numerous by-products historically played valuable roles in entomophagy, folklore, traditional medicine, and entomotherapy.

Key words: Edible insects. Entomophagy, Entemophobia. Entomotherapy, Ethnomedical. Sensitive foods.

The Impact of Age and Ejaculate of Afrikaner Bulls (*Bos taurus africanus*) on Semen Quality

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Abstract

This study evaluated the influence of bull age and ejaculate number on key semen quality parameters in Afrikaner bulls used for AI. Semen samples were collected using an electro ejaculation system, processed, and assessed using a computer-assisted sperm analyser. Age influenced total motility and progressive motility ($p < 0.01$). Motility followed a non-linear trajectory, peaking at 6 years (Total Motility 79.53%) and beginning to decline at 8 years. Semen volume significantly increased with age, while sperm concentration and dose were not significantly influenced by age or ejaculate number. Bulls between 5 to 7 years showed maximal functional semen quality, indicating AI management should prioritize this age group.

Keywords: Semen quality, Sperm motility, Sperm concentration, Age, Ejaculate, Artificial Insemination

Ethnomedical and health roles of Zimbabwean indigenous fruits and their derivatives. A Review.

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Abstract

Non-communicable diseases (NCDs), particularly cardiovascular diseases (CVDs) and hypertension present a growing public health challenge across Sub-Saharan Africa. Ethnomedicine and dietary diversity offer complementary preventative strategies. This study evaluates the ethnopharmacological and cardioprotective mechanisms of indigenous and widely naturalised African wild fruits. The objective of this review is to synthesize the biochemical and physiological roles of selected indigenous and naturalised botanical remedies of Zimbabwean indigenous wild fruits in promoting cardiovascular health and public wellness. Published journal articles, indigenous knowledge, and folklore was used to collect and analyse the pharmacological profiles of Zimbabwean wild fruits (Baobab, Marula, Masawu, Mazhanje, Monkey Orange, Wild Medlar), naturalised tamarind (*Tamarindus indica*), Tsamvi/Shavi (*Ficus spp.*), and the African Sausage Tree (*Kigelia africana*). The study examined their individual flavonoids and phenolic acids against oxidative stress and hypertension. These fruit extracts exhibited overlapping cardioprotective pathways driven by specific polyphenolic profiles. The presence of **flavan-3-ols (catechins and epicatechins)**, **quercetin**, and **rutin** drives potent free-radical scavenging, reducing lipid peroxidation and preventing atherosclerosis. Furthermore, **phenolic acids**, including **gallic, syringic, and coumaric acids**, induce vascular smooth muscle relaxation and inhibit angiotensin-converting enzyme (ACE) activity. Extracts from *Tamarindus indica* show significant hypocholesterolemic effects via lipid profile modulation, while *Kigelia africana* iridoids and flavonoids exhibit established hypotensive and anti-inflammatory attributes. Indigenous wild fruits and their specific monomeric polyphenols represent a valuable, underutilized resource in public health preventive care. While they are not standalone cures for diagnosed hypertension, integrating these bio-active botanicals into community dietary patterns could mitigate cardiometabolic risks, provided they are used alongside conventional medical treatments.

Keywords: Cardiovascular diseases. Ethnopharmacological. Hypocholesterolemic effects. Hypotensive. Indigenous wild fruits. Polyphenols.

Defluoridation Technologies: A Critical Review

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Abstract

This review critically examines existing defluoridation technologies, with particular emphasis on adsorption-based approaches as sustainable and cost-effective solutions for resource-limited settings. Conventional chemical precipitation methods are reviewed in terms of their operational

principles, effectiveness, and limitations. The review places strong focus on adsorption processes, detailing mechanisms governing fluoride uptake and recent advancements in adsorbent development. Special attention is given to calcium-based materials, bone char, and ceramic-based composite adsorbents due to their strong affinity for fluoride, local availability, and suitability for point-of-use applications. The review identifies adsorption—particularly bone char and ceramic-based adsorbents—as a promising pathway toward scalable, affordable defluoridation technologies.

Keywords: defluoridation technologies, fluoride concentrations, fluorosis, neurological disorders, magnesium-based precipitation

The In-Silico Assessment of the Determinants Influencing HIV Status Amongst Pregnant Zimbabwean Women, Using Machine Learning on ZIMPHIA 2020 Data

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This study conducted an in-silico assessment of the factors affecting HIV status among pregnant women in Zimbabwe, utilising the 2020 ZIMPHIA dataset and employing machine learning techniques. The methodology encompassed multiple stages of data processing to discern critical determinants affecting HIV status. The research revealed that Viral Load Suppression (VLS) and CD4 counts are the most significant factors impacting HIV status. The machine learning algorithms demonstrated remarkable performance, achieving AUC values of 0.996 and 0.997 for Random Forest and Boosting Machine respectively, highlighting the necessity of integrating these models into clinical practice to enhance decision support and inform policy decisions.

Keywords: Bioinformatics, Genomics, Machine Learning, HIV, Healthcare Analytics, Zimbabwe

Cognitive Operational Learning Intelligence (COLI) – A Next-Generation Intelligent Assistant Platform for Biomedical Research

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Abstract

This study developed Cognitive Operational Learning Intelligence (COLI), a scalable assistant platform integrating conversational AI, voice interaction, automation, and scientific support. COLI was developed using a React Native Expo frontend, Node.js/Express and Python backend services, and PostgreSQL for data management. Integrated modules included conversational AI, speech processing, contextual memory, task automation, authentication, and cloud synchronisation. The platform successfully integrated conversational AI, voice communication, contextual memory, and intelligent task execution into a unified assistant system with potential applications in healthcare, laboratory informatics, and biomedical research.

Keywords: Artificial Intelligence, Biomedical Research, Bioinformatics, Conversational AI, Intelligent Assistant Systems, Voice Interaction

Machine Learning-Driven Vaccine Antigen Discovery Against *Schistosoma mansoni*: A Research and Innovation Approach for Sustainable Schistosomiasis Control in Endemic Communities

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Abstract

This study developed, evaluated, and applied a proteome-scale machine learning framework to systematically predict vaccine antigen candidates from the complete *S. mansoni* reference proteome (46,702 proteins). A biologically curated labelled dataset of 1,070 proteins was assembled. The Tuned Random Forest achieved superior performance (accuracy = 0.8271, F1-score = 0.6891, ROC-AUC = 0.8414), substantially outperforming the established VaxiJen v2.0 tool. SHAP analysis identified biologically coherent predictors including signal peptide score, antigenicity, net charge, and surface localisation. When applied to the full proteome, the model recovered nine of ten known WHO priority vaccine candidates alongside one novel prediction warranting experimental validation.

Keywords: *Schistosoma*, schistosomiasis, machine learning, random forest, vaccine antigen prediction, reverse vaccinology, immunoinformatics, proteome-wide screening

AI-Driven Maternal Health Education in Low-Resource Settings: A Systematic Review of AI Tools for Maternal Health Education

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Abstract

This systematic review synthesised evidence on the acceptability, feasibility, and impact of AI-driven tools for rural maternal health education. Of 372 records screened, 58 studies met inclusion criteria across Sub-Saharan Africa, South-Asia, and Zimbabwe. Interventions included voice-SMS (n=24), IVR with basic AI (n=19), and NLP chatbots (n=15). Acceptability was high (>75% satisfaction). Health literacy improved in 42 of 49 studies (knowledge gains 18–34%, $p<0.05$). Critical gaps remain: offline capability, local language support, and culturally sensitive support are under-addressed. The findings show the urgent need for an AI-driven educational tool that is culturally sensitive, offline-capable, and tailored to rural areas with limited connectivity.

Keywords: AI, IVR, maternal health, Zimbabwe, LMICs, Natural Language Processing

Rational Design of a Multi-Epitope-Based Lassa Fever Vaccine

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Abstract

This study aimed at designing, in silico, a multi-epitope vaccine against Lassa fever targeting the glycoprotein complex (GPC) and the nucleoprotein (NP) across seven different lineages. Four CTL epitopes, 6 HTL, and 3 B cell epitopes were predicted using multiple immunoinformatics tools, connected via suitable linkers and conjugated to carrier protein partial Tetanus toxin fragment C, forming a 770 amino acid long vaccine construct. The vaccine construct was modelled and validated for overall quality, allergenicity, antigenicity, solubility, and stability. The immune simulation at three doses predicted sustained memory B and T cell responses for 350 days. This in silico design suggests the vaccine construct could elicit an effective immune response against the Lassa virus.

Keywords: Multi-epitope vaccine, Lassa fever vaccine, Glycoprotein precursor, Nucleoprotein, immunoinformatics

Paraquat-Induced Parkinson's Disease in Rat Models: Neurodegeneration, Behavioral Impairments, and Hepatotoxicity

Thomas Marangwana, Dr T. Chisango, Professor T. Mduluza — Chinhoyi University of Technology; University of Zimbabwe (thomasamarangwana@gmail.com)

Abstract

This study was designed to develop a consistent animal model of Parkinson's Disease based on the destruction of dopaminergic neurons. Three groups of seven adult male albino rats were used: Group A with 10 mg/kg paraquat, Group B with 5 mg/kg paraquat, and Group C with 4% saline injection. Behavioural assessment used open field, cylinder, and pole tests. Notable body weight loss was observed in the paraquat-exposed rats in a dose-dependent manner. Histological observations showed dark pyknosis in neurons, perineuronal oedema and perivascular oedema in paraquat-exposed rats. High levels of liver enzymes (AST 184 U/L; ALT 231 U/L; ALP 480 U/L) were observed. Paraquat exposure led to PD pathology due to dopaminergic neurodegeneration and motor dysfunctions in a dose-dependent manner.

Keywords: Parkinson's disease, paraquat, dopaminergic neurons, oxidative stress, rat model, herbal neuroprotection

The Use of L-DOPA Extracted from *Mucuna pruriens* in the Management of Parkinson's Disease: A Comprehensive Systematic Review and Meta-Analysis

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Abstract

A systematic review of clinical, pre-clinical, extraction methods, and safety studies from 2016 to 2026 was done to assess the suitability of L-DOPA extracted from *Mucuna pruriens* in the treatment of Parkinson's Disease. The search of 486 articles resulted in the selection of 108 relevant articles for meta-analysis. Meta-analysis of five randomised clinical trials showed that *M. pruriens*

extract was effective in increasing ON time compared to the standard levodopa/carbidopa combination (mean difference = 37.2 minutes, $p < 0.001$) while showing faster onset of action. The aqueous extraction approach using *Phyllanthus emblica* water as green solvent showed better physicochemical stability with preservation of 73.55% L-DOPA content at 12 months.

Keywords: *Mucuna pruriens*, L-DOPA, Parkinson's disease, velvet bean, levodopa, systematic review, meta-analysis, green extraction

Waste-to-Feed: Indigenous Fruit-Based Bio-Silage Additive

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The Waste-to-Feed project is developing a low-cost silage additive formulated from nutrient-rich residues generated during indigenous fruit processing, converting an underutilised biological waste stream into a value-added livestock feed technology. The product functions as a bio-fermentation enhancer, utilising naturally occurring fermentable substrates and beneficial microbial activity to support improved silage preservation, palatability, and feed quality in ruminant production systems. The innovation simultaneously addresses the unavailability and rising costs of livestock feed additives and the disposal of organic waste from fruit processing. Waste-to-Feed represents a circular bio-economy innovation linking waste valorisation, climate-smart livestock production, and sustainable agricultural value creation.

Keywords: Silage additive, indigenous fruits, waste valorisation, bio fermentation, circular bio-economy

Machine Learning Based Digital Health Platform for Albinism Care in Sub Sahara Africa

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Abstract

This prototype demonstrates a machine learning-based digital health platform designed to address the severe yet neglected health crisis facing people with albinism in Sub-Saharan Africa. The system integrates a convolutional neural network trained on combined HAM10000 and ISIC dermoscopic datasets to classify nine lesion categories from smartphone-captured images. The platform delivers weather-responsive ultraviolet exposure alerts, supports community health worker referral workflows, and provides multilingual skin protection education. Edge inference and federated learning enable the system to function under intermittent connectivity while preserving patient data privacy. Evaluation employs macro F1-score and RMSE to ensure clinical reliability.

Keywords: Albinism care, convolutional neural network, digital health platform, skin lesion classification, mobile health, Sub Sahara Africa

Phytochemical Characteristics, In Vitro Antidiabetic and In Silico Studies of *Cassia abbreviata*

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Abstract

This study investigates the phytochemical characteristics, in vitro antidiabetic potential, and in silico molecular interactions of the crude *Cassia abbreviata* bark extracts. Sequential extraction was performed using methanol, methanol/water, ethyl acetate, and ethyl acetate/water. For α -amylase inhibition, the ethyl acetate extract exhibited the strongest activity ($IC_{50} = 43.18 \mu\text{g/mL}$). Molecular docking studies showed selected phytochemical compounds demonstrated strong binding affinities against the target enzyme, with binding energies ranging from -8.6 to -9.7 kcal/mol. In conclusion, *C. abbreviata* bark extracts possess significant antidiabetic potential through reversible, concentration-dependent inhibition of carbohydrate-hydrolyzing enzymes, supporting the ethnomedicinal use of this plant.

Keywords: *Cassia abbreviata*, Type 2 diabetes mellitus, Antidiabetic activity, α -amylase inhibition, α -glucosidase inhibition, Molecular docking, Phytochemicals, ADMET prediction

Formulation of Ultrasonography Gel Using *Aloe vera* and Cucumber Extracts

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This study aimed to develop a low-cost, botanically derived ultrasonography coupling gel in response to the shortage of affordable and reliable ultrasound gels in Zimbabwe's public health sector. Using xanthan gum and Carbopol 940 as base polymers, 6 different gel formulations were created. Formulation S6 showed the best results in terms of viscosity, electrical conductivity, and antimicrobial activity. Cost-effective production analysis indicated that Formulation S6 could be produced for \$15 for 5 litres, representing a 34.8% savings compared to the commercially available product. These data indicate that the botanical ultrasound coupling gel provides safe and functionally acceptable alternatives with significantly reduced costs.

Keywords: Ultrasonography gel, *Aloe vera*, cucumber, botanical formulation, physicochemical evaluation, antimicrobial efficacy, Carbopol 940, cost-effectiveness

GC-MS and In-silico profiling of Antidiabetic Phytocompounds from selected plant species used for Diabetes management in Bulawayo

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Stephen Nyoni, Chinhoyi University of Technology

Abstract:

Diabetes mellitus remains a global health challenge, with rising prevalence in sub-Saharan Africa. Type 2 Diabetes Mellitus (T2DM) accounts for over 90% of diabetes cases globally [1,2]. In Bulawayo, traditional healers use polyherbal combinations from indigenous plants to manage T2DM, yet scientific validation remains limited. To profile the antidiabetic potential of a polyherbal formulated from selected ethnobotanical plants used in Bulawayo for T2DM management using in vitro and in silico studies. Plant species identified as key from the conducted survey were collected, identified and prepared for qualitative GC-MS and In-silico phytochemical profiling. The polyherbal exhibits significant glucose-lowering effects relevant to T2DM, primarily via carbohydrate-digesting enzyme inhibition. These findings support its ethnomedicinal use in Bulawayo for T2DM management. Clinical studies are warranted for further study. GCMS analysis identified a total of 2 726 compounds from the six selected plants, 307 were phytochemicals and 261 were reported to be antidiabetic. *Z. capense* and *A. zebrina* recorded the highest number of phytoconstituents belonging to various compound classes. In silico studies revealed that 28 ligands have a higher binding affinity than the reference drug (metformin). Only 7 ligands passed all ADMET tests, outcompeted metformin in every test and stigmasterol was considered the best ligand. Docked against α - amylase and α -amylase, stigmasterol has more binding interactions than metformin. The study concluded that the selected plants possess anti-diabetic bioactive compounds that can be targets for developing antidiabetic drugs, however, in vivo studies are recommended to validate the efficacy of the herbal formulation developed from these plants.

Keywords: phytocompounds; binding interaction; pharmacokinetics; anti-diabetic compounds; ethnomedicinal; reference drug

Development, implementation and evaluation of a community-based cognitive and mental health intervention for older adults in urban Zimbabwe

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Abstract:

Zimbabwe's ageing population faces a rising burden of cognitive decline, dementia, depression, and anxiety, yet community-based services for older adults remain limited. This PhD developed, implemented, and evaluated a community-based cognitive and psychological health intervention for older adults in urban Harare, guided by the WHO ICOPE and MRC Complex Interventions frameworks. Conducted within the NIHR-funded KOSHESAI programme, urban evidence is now extended into rural Zimbabwe, aligning with the conference theme of innovation, rural

industrialisation, and community impact. A mixed-methods design was employed. Co-design engaged older adults, community organisations, the MoHCC, the Friendship Bench, ZARDA, and international Cognitive Stimulation Therapy (CST) experts. CST-UK was culturally adapted to create CST-Zimbabwe (CST-Z), the country's first such adaptation. Thirty non-specialist volunteers delivered the 16-week CHAPS programme integrating CST-Z, dementia awareness, and physical activity. Those at risk of depression/anxiety were referred to the Friendship Bench; complex cases to mhGAP nurses. Validated tools (PHQ-2/9, GAD-2/7, RUDAS) and a process evaluation measured impact and affordability. 292 older adults at risk of depression/anxiety were referred to the Friendship Bench; 131 at risk of cognitive impairment joined 15 CHAPS groups across two urban sites. Process evaluation showed high acceptability, with improvements in social engagement, mood, communication, and quality of life. A February 2026 national Training of Trainers for 42 participants from government, health, civil society, and academia established the CST-Zimbabwe National Network. This PhD established Zimbabwe's first culturally adapted cognitive and mental health intervention for older adults, showing non-specialist volunteers can deliver effective, affordable care. Urban evidence is now applied rurally through KOSHESAI, demonstrating how community-led innovation drives rural health industrialisation. The CST-Z National Network supports national scale-up and offers a replicable model for other LMICs.

Ceramic-Based Composite Filter Cartridges for Fluoride Removal from Contaminated Water: A Case Study of Gwai and Siyakobvu, Zimbabwe

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Abstract:

Fluoride contamination in groundwater poses a severe health risk to communities in Gwai and Siyakobvu, Zimbabwe, where naturally high fluoride levels are prevalent. This study focuses on developing and evaluating ceramic-based composite filter cartridges for effective fluoride removal, specifically tailored for the local water conditions in these regions. The cartridges are fabricated using locally sourced kaolin clay and river sand as the ceramic matrix, enhanced with local bone char, lanthanum-modified clay as fluoride adsorbents. The best fabrication process, out of several, will be optimized to ensure affordability and accessibility for the affected communities. On-site batch adsorption experiments, utilizing water samples from Gwai and Siyakobvu, are carried out to assess fluoride removal efficiency under varying conditions, including local pH and initial fluoride concentrations. The performance of the cartridges on fluoride reduction and in achieving levels below the WHO permissible limit is reported. Furthermore, the study evaluates the cartridges' durability and potential for local production, considering the socio-economic context of the region. This research highlights the potential of locally produced ceramic-based composite filter cartridges as a sustainable and effective solution for mitigating fluoride

contamination in Gwai and Siyakobvu, contributing to improved public health and water security in these vulnerable communities.

The Detection of *Eustrongylides Excisus* (Dorylaimea: Dioctophymatidae) in Fish from the Kama Reservoir

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Poster Presentation

Abstract:

Eustrongylidosis of fish is caused by the larvae of nematodes of the genus *Eustrongylides*. Nematode has extensive geographic distribution and in the field of pathogens of zoonotic importance. *E. excisus* is considered to be the most common zoonotic parasite of freshwater fish. The expansion of the range of this species is observed in the Volga Reservoirs. This study aimed to investigate the infection of commercial fish from water bodies in the Perm Krai with nematode larvae of the genus *Eustrongylides*. Ichthyological material was obtained from September 2024 to May 2026 from Kama and Votkinsk Reservoirs, the rivers Sylva, Kama, Chusovaya, Lysva, Vilva. A total of 888 fish specimens belonging to the families Cyprinidae, Percidae, Esocidae, and Gadidae were examined. Fish were considered using the incomplete parasitological autopsy. Species identification was based on morphological characteristics using identification keys and data from scientific articles, parasitological indices were determined. Among sampled fish species, only in ruff (*Gymnocephalus cernuus*) larval were morphologically referred of *E. excisus* were isolated. The prevalence of infection in ruff from the central district (58°88'78" N, 56°18'37" E) of the Kama Reservoir was 0,75 %, intensity of infection 1. Previously, there were no reports of the detection of representatives of the genus *Eustrongylides* in fish from bodies of the Perm Region. The expansion of the range of *E. excisus* is explained by the expansion of the range of their definitive hosts: the Great Cormorant and the Great Egret to the north. *E. excisus* larvae were found in ruff for the first time in the Kama Reservoir in the central region. Despite the low prevalence of infection, the presence of record of infection indicates a danger to fish and mammals.

Keywords: Eustrongylidosis, *Eustrongylides*, commercial fish, parasitological autopsy, *E. excisus*

Paraquat-Induced Parkinson's Disease in Rat Models: Neurodegeneration, Behavioral Impairments, and Hepatotoxicity

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Abstract:

Parkinson's disease (PD) is the second most frequent neurodegenerative disease, defined by the progressive loss of dopaminergic neurons from the substantia nigra pars compacta. Environmental exposure to toxic substances, such as herbicides like paraquat, has been shown to be associated with the etiology of PD through oxidative stress. The current study was designed to develop a consistent animal model of PD, based on the destruction of dopaminergic neurons. Three groups of seven adult male albino rats (7 weeks old, 240-300 g) were used for the experiment: Group A with 10 mg/kg paraquat, Group B with 5 mg/kg paraquat, and Group C with 4 % saline injection through oral gavage for 4 weeks. Behavioral assessment was done using the open field, cylinder and pole tests. Histological analysis of brain tissue was done to observe dopaminergic neuron damage. Liver function tests were performed as biomarkers of systemic toxicity. There were notable body weight loss in the paraquat-exposed rats in a dose-dependent manner (10-40 g) where Group A had lower body weight when compared to Group B ($p < 0.05$). There were lower locomotion, higher thigmotaxis and forelimb asymmetry as well as increased times in the movement of the animals. The histological observations showed dark pyknosis in neurons, perineuronal edema and perivascular edema in paraquat-exposed rats while Group A experienced more tissue damage. There were high levels of liver enzymes (AST 184 U/L; ALT 231 U/L; ALP 480 U/L) and bilirubin (1.4 mg/dL) while the levels of albumin reduced to 3.7 g/dL in Group A. Paraquat exposure led to PD pathology due to dopaminergic neurodegeneration and motor dysfunctions as well as hepatotoxicity in a dose-dependent manner.

Keywords: Parkinson's disease, paraquat, dopaminergic neurons, oxidative stress, rat model, herbal neuroprotection

An approach towards Energy Intelligence over Artificial Intelligence: Case Studies on Energy Consumption and Water Exploitation on Adapting AI Based Systems

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Eng. Nathan Jubilation Chifamba – Chairperson, Polymer Technology and Engineering (HIT)

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Abstract

The baseline energy concept of this study is succinctly captured in the following statement: “Energy can neither be created nor be destroyed but transformed from one form into other” Though mankind is busy transforming one form of energy into another, it is constantly striving to restore the losses during the transformation process. This safeguard of loss drives human intelligence and efforts towards a robust process. Water, the least possible manufacturing source, is directly connected with the energy harvesting process. The catastrophic demand for freshwater as compared to the available fresh water supply is becoming an additional stress for developing countries, apart from population explosion and exponential urbanization. The additional water stress is due to the implementation of AI (Artificial Intelligence) based systems. This paper highlights the case studies of energy consumption starting from using ChatGPT to water exploitation of data centers.

Keywords: Artificial Intelligence, Energy Intelligence, Water Stress, Data Centers, AI systems, gigawatt, terawatt

The use of L-DOPA extracted from *Mucuna pruriens* in the Management of Parkinson's Disease: A Comprehensive Systematic Review and Meta-Analysis of Extraction Technologies, Clinical Efficacy, and Safety Considerations

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Abstract:

Parkinson's disease (PD) is the most rapidly growing neurological disease, while levodopa (L-DOPA) is the best pharmacological treatment. Velvet beans (*Mucuna pruriens* seeds) are tropical legumes that have a natural content of L-DOPA estimated at around 4-6 %. A systematic review of clinical, pre-clinical, extraction methods, and safety studies from 2016 to 2026 was done to assess the suitability of L-DOPA extracted from *Mucuna pruriens* in the treatment of PD. The search of 486 articles through PubMed, Web of Science, DOAJ, Google Scholar, and Scopus databases resulted in the selection of 108 relevant articles for meta-analysis. Meta-analysis of five randomized clinical trials with 89 candidates showed that *M. pruriens* extract was effective in increasing ON time compared to the standard levodopa/carbidopa combination (mean difference = 37.2 minutes, 95 % CI 22.4–52.0, $p < 0.001$) while showing faster onset of action (mean difference = -33.8 minutes; $p = 0.021$). The aqueous extraction approach using *Phyllanthus emblica* water as green solvent was found to have better physicochemical stability with preservation of 73.55 % L-DOPA content at 12 months; while acidified ethanolic extraction had 12.5 % w. Evaluation of safety found that there was neither acute nor chronic oral toxicity caused by ethanolic seed extract of *M. pruriens* in the Sprague Dawley rats. These results prove the appropriateness of *M. pruriens* L-DOPA as an effective drug for treating PD but leave key issues that need further research.

Keywords: *Mucuna pruriens*, L-DOPA, Parkinson's disease, velvet bean, levodopa, systematic review, meta-analysis, green extraction, phytochemistry, neuroprotection

[Word Count: 251 words]

Systematic Review: L-DOPA-Free *Mucuna pruriens* Seed Residue as Animal Feed – Processing Methods, Nutritional Value and Safety

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Abstract:

There has been rising demand for more sustainable protein sources for animal feeding, which have led researchers to look at under-exploited legumes. Velvet beans (*Mucuna pruriens* seeds) show remarkable similarity to other legumes from a nutritional perspective. However, velvet beans contain a neuro-toxin called L-3,4-dihydroxyphenylalanine (L-Dopa). The current study aims at reviewing the potential of L-Dopa free *Mucuna pruriens* seeds as animal feed. A systematic review was carried out in the DOAJ, NCBI PubMed, Web of Science, Google Scholar, and Science Direct databases to identify articles on *Mucuna pruriens* and its processing between 2016 and 2026. Keywords included “*Mucuna pruriens*,” “L-Dopa,” “animal feed,” “detoxification,” and “processing.” Articles that provided information on L-Dopa reduction efficiency and animal performances were selected. From 247 articles initially identified, 85 studies qualified for inclusion in the qualitative analysis, while 47 studies had extractable data for the meta-analysis. The process involving fermentation (yeast-based, 37 °C, 72 hours) was found to result in the greatest reduction of L-Dopa content (55.8 %; 95 % CI: 48.3 - 63.2 %), followed by alkaline extraction (reduction of 71 %) and acid extraction (reduction of 53 %). Heat processing resulted in a reduction in trypsin inhibitor content by 85 - 95 % and a 12 - 18 % reduction in lysine. Animal studies involving 23 trials on 1,456 animals showed no significant differences between the use of processed *Mucuna* seeds meal and the conventional animal feed. *Mucuna pruriens* seeds can be used as an alternative source of proteins for livestock after appropriate processing. Processing *Mucuna* seeds reduce feeding deterrents to tolerable amounts and increase nutrient bioavailability. Fermentation is the safest and the best means to detoxify the seeds.

Keywords: *Mucuna pruriens*, Velvet Bean, L-Dopa, Animal Feed, Detoxification, Fermentation

Zimbabwean Traditional Medicinal Plants: Research Trends, Therapeutic Potential, Commercialization Status, and the Need for Establishment of a Centre of Excellence.

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Abstract:

Zimbabwe possesses a rich diversity of traditional medicinal plants supported by diverse ecosystems, indigenous knowledge systems, and centuries of ethnomedicinal practice. Of the more than 5,000 plant species found in the country, approximately 10% are reported to possess medicinal value, highlighting their potential in the discovery and development of plant-based therapeutics. Traditional medicinal plants remain important in primary healthcare, especially in rural communities where access to conventional medicines is limited. This review summarizes the current status of research on Zimbabwean medicinal plants, focusing on publication trends, medicinal activities investigated, and commercialization potential. Available literature indicates

that more than 300 scientific publications have documented the medicinal uses, phytochemistry, and pharmacological properties of Zimbabwean medicinal plants. Over 500 medicinal plant species have been reported across different ecological regions of the country. Documented biological activities include antidiabetic, antimicrobial, anti-inflammatory, antioxidant, anticancer, antimalarial, antiviral, antifungal, antihypertensive, and wound-healing properties. Antidiabetic and antimicrobial studies dominate recent research because of the increasing burden of noncommunicable diseases and antimicrobial resistance. Commonly studied plants include Aloe vera, Azadirachta indica, Moringa oleifera, Lippia javanica, and Warburgia salutaris. Despite increasing scientific validation, only a few medicinal plants have been commercialized into standardized herbal products and supplements. Challenges limiting commercialization include inadequate funding, weak research infrastructure, insufficient clinical validation, and limited policy support. The review highlights the urgent need to establish a Centre of Excellence in Zimbabwean Traditional Medicines dedicated to research, validation, standardization, conservation, and commercialization of medicinal plants to support the development of affordable and evidence-based traditional medicines.

Keywords: Traditional medicinal plants; Ethnomedicine; Herbal medicine commercialization; Pharmacological activities; Centre of Excellence

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Presentation Type: Poster

Abstract:

Severe limitations in daily functioning sometimes result from missing an upper limb, which can worsen social and psychological conditions. These factors led to the early advancements in body-driven and cosmetic prostheses, which began to take shape several centuries ago and have continued to do so ever since. The project's goal is to design and build a robotic arm that can be activated by speech. A robotic arm that recognizes and responds to speech commands - a voice-activated robotic arm. The robotic arm operates in accordance with voice orders and complies with them. The task was achieved by interfacing a voice module to a microcontroller, some servo motors were also interfaced with the microcontroller for actuating the prosthetic robotic arm. This work will help those with disabilities who are unable to use their hands. The detected voice is followed by the quantification, sampling, and discretization of the voice signal. Thus, the sampling procedure corrects the noise signals. After being processed, the voice commands are translated into written commands. Voice signals and text commands are used to operate the stepper motor and other devices to achieve the intended task.

Investigating therapeutic potential of a polyherbal gel containing azadirachta indica and ocimum gratissimum in burn wounds

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Abstract:

Burn injuries remain a significant global health challenge, particularly in low- and middle-income countries where access to advanced wound care is limited. Conventional topical agents such as Silver sulfadiazine are widely used but have notable limitations, including delayed dermal re-epithelialization, fibroblast cytotoxicity, and increasing microbial resistance. This study aimed to formulate and evaluate the physicochemical properties and in vitro therapeutic potential of a standardized polyherbal gel containing ethanolic extracts of *Azadirachta indica* (neem) and *Ocimum gratissimum* (wild basil) as an alternative treatment for burn wound management. A laboratory-based experimental design was employed, involving cold maceration extraction, qualitative phytochemical screening, UV–Vis spectroscopy, Fourier Transform Infrared (FTIR) spectroscopy, and formulation into a neutralized Carbopol-940 gel base. The resulting formulation was evaluated using agar well diffusion assays against *Staphylococcus aureus* and *Escherichia coli*, together with physicochemical assessments of pH, viscosity, and thermal stability. UV–Vis and FTIR analyses confirmed successful extraction and preservation of key phytochemical constituents, including highly conjugated systems, hydroxyl groups, and aromatic rings associated with phenolics and flavonoids. The formulated polyherbal gel demonstrated good physical stability, a skin-compatible pH of 6.1, and markedly enhanced antimicrobial activity against both bacterial strains compared with the individual mono-herbal extracts and a commercial standard, indicating a synergistic effect. The findings suggest that the neem–wild basil polyherbal gel is a promising, non-toxic, and cost-effective candidate for superficial burn treatment. Further in vivo and clinical studies are recommended to determine re-epithelialization rates, safety, and optimal dosing, particularly for resource-limited healthcare settings such as Zimbabwe.

Keywords: Burn wound management; Polyherbal gel; *Azadirachta indica*; *Ocimum gratissimum*; Antimicrobial activity.

Green Synthesis of Silver Nanoparticles Using Plant Extracts (Aloe Vera and Neem) for Antimicrobial and Antidiabetic Activity

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Abstract:

Type 2 diabetes mellitus (T2DM) and antimicrobial resistance (AMR) are major global health challenges that require safer, effective, and accessible therapeutic approaches. This study investigated the green synthesis of silver nanoparticles (AgNPs) using aqueous extracts of Aloe

vera, neem (*Azadirachta indica*), and their binary combination (1:1 v/v), and evaluated their antimicrobial and antidiabetic activities through in vitro assays. Nanoparticle synthesis was confirmed by a rapid colour change from pale yellow to brownish-yellow, with the combined extract showing the fastest reduction kinetics within 3 minutes. UV-Visible spectroscopy revealed characteristic Surface Plasmon Resonance peaks at 423 nm for neem-AgNPs, 400 nm for aloe-AgNPs, and 412 nm for combined-AgNPs, confirming successful nanoparticle formation. The combined-AgNPs exhibited the sharpest and most intense peak, indicating smaller, more uniform particles and improved yield. Fourier Transform Infrared spectroscopy confirmed the involvement of phytochemical functional groups in nanoparticle reduction, capping, and stabilization. Antimicrobial activity was evaluated against *Staphylococcus aureus* and *Escherichia coli* using the agar well diffusion method. All AgNP formulations demonstrated greater activity than their crude extracts, with activity increasing across concentration ratios from 9:1 to 7:3. Combined-AgNPs at the 7:3 ratio produced the highest inhibition zones against both bacterial strains, approaching the effectiveness of ciprofloxacin. Antidiabetic activity was assessed using the α -glucosidase inhibition assay with acarbose as the positive control. Combined-AgNPs (7:3) showed strong inhibitory activity with an IC_{50} value close to that of acarbose. Overall, the combined formulations consistently outperformed individual extracts, demonstrating synergistic enhancement. The bifunctional antimicrobial and antihyperglycaemic properties of combined-AgNPs highlight their therapeutic potential for managing T2DM complicated by bacterial infections, particularly in resource-limited settings.

Keywords: Green synthesis; Silver nanoparticles; Antimicrobial activity; Type 2 diabetes mellitus; α -Glucosidase inhibition.

Biotechnology, food safety and human well-being: addressing contaminated grains, nuts and GMO misconceptions

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Abstract:

Contamination of grains and nuts by mycotoxins, particularly aflatoxins produced by *Aspergillus* species, remains a major public health challenge in many developing countries. Exposure to aflatoxins has been linked to liver cancer, immune suppression, childhood stunting, and reduced productivity. Biotechnology offers promising solutions through improved diagnostics, resistant crop varieties, biological control agents, and enhanced post-harvest management systems that reduce contamination and improve food safety. At the same time, public debate surrounding genetically modified organisms (GMOs) continues to be influenced by misconceptions regarding their safety and health effects. Scientific assessments conducted by international regulatory and research bodies have consistently found approved GM foods to be as safe for human consumption as their conventional counterparts. This paper seeks to evaluate scientific evidence on the safety and health implications of genetically modified foods. It examines the contribution of biotechnology to safer food systems, distinguishes evidence-based findings from common GMO myths, and highlights opportunities for science-driven public engagement. Strengthening biotechnology adoption and public awareness can improve food safety, nutrition, and human well-being while supporting sustainable agricultural development.

Keywords: Contamination, Mycotoxins, aflatoxins, immune suppression, genetically modified organisms, sustainable agricultural development

Sustainability, Climate and Environmental Systems

Sub-Theme: Conservation Technologies, Renewable Energy, Sustainable Tourism, Water Systems, Circular Economy and Resilience

Vision Transformer–Based Architectures Trained on Multi-Year Sentinel Time Series to Detect Ecological Regime Shifts in the Midlands Black Rhino Conservancy, Zimbabwe

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Abstract

Earth's ecosystems are approaching critical thresholds under accelerating climate and anthropogenic pressures, yet current satellite analytics remain limited in detecting nonlinear regime shifts before irreversible transitions occur. This study introduces a Vision Transformer (ViT) framework trained on multi-year Sentinel-1, Sentinel-2 and Sentinel-3 time series to detect emergent ecological regime shifts in the Midlands Black Rhino Conservancy. Cross-modality attention modules integrate optical and radar signals, enabling robust representation learning under cloud contamination and seasonal variability. The architecture achieved a mean ROC-AUC of 0.94, an overall classification accuracy of 91.8%, and a Cohen's Kappa coefficient of 0.89. Early-warning indicators derived from variance inflation and temporal autocorrelation shifts were detected approximately 8–12 years before observable regime transitions, substantially increasing predictive lead time relative to traditional remote sensing approaches. These findings demonstrate that transformer-based models can move EO from descriptive monitoring toward predictive ecological intelligence.

Keywords: Ecological tipping points, Spatiotemporal representation learning, Multimodal data fusion, Self-supervised pretraining, Early-warning signal detection

Understanding African Indigenous Knowledge System in the Era of Climate Change

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Abstract

This study explored the extent to which rural communities of Ruwedza in Chimanimani District, Zimbabwe, make use of indigenous knowledge systems (AIKS) in the fight against climate change. It gave precedence to the abundance of indigenous knowledge prevalent in women whose sustainability faces new threats from climate change. The research found that indigenous people and their knowledge systems are sometimes excluded in climate governance and action for ecological sustainability, yet they possess vital cultural knowledge. The study used three Focus Group Discussions, twenty interviews, and five Key Informant Interviews. Evaluating the efficiency of community-based strategies in mitigating the impacts of climate change and analysing their capacity to adapt their cultural practices to the changing climate is key to the study.

Keywords: Ruwedza, Climate change, African Indigenous Knowledge System, Indigenous living heritage

Advancements in Biomass-Derived Carbon Nanostructures for Fuel Cell Applications: Synthesis Strategies, Structural Engineering, and Performance Optimization

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Abstract

This review critically evaluates current developments in the production of biomass-based carbon nanostructured nanomaterials and their utilization in fuel cells. Biomass, as a renewable and inexhaustible source of carbon, can solve the question of cleaner energy while addressing the loss of agricultural and industrial wastes. Carbon-nanostructured materials derived from biomass have tunable structures and large surface areas, making them suitable as efficient and cheap catalysts or catalyst supports in fuel cells. The review examines sustainable production patterns, circular economy guidance, and plans to increase electrocatalytic activity toward next-generation energy conversion technologies.

Keywords: fossil fuels, resource exhaustion, biomass, renewable, carbon-nanostructured, electrocatalytic

Environmental Sustainability of Platinum Slag Reuse under Acid Rain Exposure: Risks, Mechanisms, and Implications

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Abstract

This research synthesises existing mechanistic evidence on acid-induced leaching from steel, copper, and ferrochrome slags, focusing on four key processes: proton attack, mineral phase destabilisation, buffering depletion, and redox-controlled speciation. Platinum group metal (PGM) slags remain critically understudied in acidic exposure conditions, which is alarming given that Southern Africa's Bushveld Complex produces vast amounts of PGM slag annually. This research proposes a structured framework for assessing PGM slag behaviour under acid rain conditions. The paper will also critically evaluate current regulatory frameworks, revealing their limitations in addressing acid rain impacts. This work supports sustainable slag valorisation within circular economy strategies while protecting ecosystems and communities.

Keywords: Slag valorisation, metallurgical slags, acid rain, platinum group metals, environmental risk assessment, circular economy, Southern Africa

Integrated Hydrometeorological Monitoring for Climate-Resilient Water Management in Manyame Catchment, Zimbabwe

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Abstract

This study developed an integrated near-real-time hydrometeorological monitoring system for the Manyame Catchment to support evidence-based water resource management. An applied system-development approach used available ZINWA hydrological records, MSD Norton rainfall observations, NASA GPM IMERG satellite rainfall estimates, and OpenWeatherMap API feeds, harmonised and stored in a PostgreSQL/PostGIS geospatial database. Random Forest Regressor models were trained for eleven monitoring stations. Results showed strong model performance, with Lake Chivero producing a training fit of $R^2 = 0.9898$ and blind testing producing $R^2 = 0.969$. The methodology is transferable to other Zimbabwean catchments and supports climate adaptation and long-term water security.

Keywords: Hydrometeorological monitoring, climate resilience, water resource management, GIS, Web-GIS

Production of Ferric Chloride from Iron Swarf for Petroleum Wastewater Treatment

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Abstract

This study focuses on the production of ferric chloride coagulant from iron swarf using hydrogen peroxide as an oxidising agent, achieving a purity of 41.2% w/w FeCl_3 . The synthesised ferric chloride was applied to the treatment of petroleum wastewater under optimised coagulation conditions. Performance benchmarked against commercial ferric chloride achieved comparable removals: turbidity reduced from 80.0 NTU to 2.78 NTU, total suspended solids from 114 mg/L to less than 1 mg/L, oil and grease from 1810 mg/L to 0.1 mg/L, and dissolved oxygen saturation improved from 36.8% to 98.6%. This study demonstrates that ferric chloride coagulation from locally sourced raw materials is a technically and economically viable solution.

Keywords: Petroleum wastewater, ferric chloride, swarf iron, hydrogen peroxide, coagulation-flocculation

Synthesis and Optimisation of Polyaluminium Silicate Sulphate Coagulant from Zimbabwe's Silica Sand for Potable Water Treatment

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Abstract

This research aimed to synthesise PASS from locally available silica sand, optimise process conditions and assess technical and economic feasibility. PASS was synthesised via the sol-gel

route. Optimal synthesis conditions were established at pH 3, temperature of 40°C, Al/Si molar ratio of 0.67, aluminium sulphate concentration of 0.15 M and reaction time of 90 minutes. The synthesised product met specifications of commercially imported Al-Pro 60 PASS. A conceptual production plant designed for 10,000 litres per day yielded a net present value of USD 8.19 million over five years and an internal rate of return of 65.35%. Findings confirm that locally produced PASS from Zimbabwe's silica sand is technically sound and economically viable.

Keywords: Polyaluminium silicate sulphate, coagulation, water treatment, Zimbabwe, silica sand, sol-gel synthesis, economic feasibility

Sustainable Supply Chain Systems and Circular Economy Practices for Climate-Resilient Rural Industrialisation

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Abstract

This study investigates how sustainable supply chain systems and circular economy practices can enhance climate resilience and support inclusive rural industrialisation. The study adopts a mixed-methods approach, combining a systematic review of literature with case analyses of rural agro-industrial and manufacturing value chains. Expected findings suggest that the adoption of circular supply chain models can significantly reduce waste generation, lower carbon emissions, improve resource utilisation, and strengthen the adaptive capacity of rural enterprises. The study recommends the development of supportive policies, investment in green infrastructure, stakeholder collaboration, and capacity-building initiatives to accelerate climate-resilient industrial transformation.

Keywords: Sustainable Supply Chains, Circular Economy, Climate Resilience, Rural Industrialisation, Green Logistics

Spatial and Seasonal Patterns of Human–Elephant Conflict around Hwange National Park, Zimbabwe

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Abstract

This study assessed the spatial and seasonal patterns of elephant-related human-wildlife conflict around Hwange National Park using long-term conflict report data from 2015 to 2026. Results showed that elephants were among the leading contributors to human-wildlife conflict, with crop damage accounting for approximately 88% of elephant-related incidents. Conflict intensity peaked during the crop maturation period between February and April. Hwange district recorded significantly higher elephant conflict reports compared to Binga district, followed by Lupane district. Ward-level hotspot analysis further identified Ward 24 in Lupane district and Wards 17

and 18 in Hwange district as the highest-risk wards, each experiencing more than twice the average monthly conflict rate.

Keywords: Human-wildlife conflict, elephants, spatial hotspots, sustainable conservation

Paper Production from *Agave sisalana* Pulp and *Musa sapientum* Pseudo-Stalks

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Abstract

The purpose of this study was to make kraft paper from *Agave sisalana* (sisal) and *Musa sapientum* pseudo-stalks (banana fibre) as a renewable and non-wood option. The Taguchi method was used to find optimum cooking conditions. Spectral analysis indicated the presence of cellulose and hemicellulose in both fibres. *Agave sisalana* gave the best pulp yield and kappa number at 20% NaOH concentration, 100°C for 4 hours. Results for *Musa sapientum* showed best conditions were 15% NaOH at 150°C for 75 minutes, giving 47.02% pulp and a kappa number of 7.21. These experiments confirmed that both fibres can be processed using moderately alkaline solutions to produce good pulp, contributing to the paper industry's sustainability.

Keywords: Kraft paper, *Musa sapientum*, *Agave sisalana*, Characterization, sustainable materials

Application of Mining Waste in Construction Industry as a Resource for a Circular Economy

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Abstract

This paper reviews the existing information on potential uses of mining waste in various areas of application, focusing on the circular economy concept of increased reuse, recycling, reprocessing, and converting waste into value-added products. Mining waste has found use in the construction industry in roads and building structures. The utilisation of mining waste will not only reduce solid waste and environmental contamination, but also enhance the conservation of natural resources. In Africa, the present rate of utilisation of mining waste is below expectations compared to advanced international economies, highlighting a significant gap that needs to be addressed through effective utilisation of these waste materials.

Keywords: mining waste, circular economy, construction industry, environmentally friendly

Conservation Technologies and Circular Economy Pathways for Sustainable Rural Industrialisation in Mining Communities

Abstract

This study proposes a conservation technology-driven circular economy framework that repositions mining waste as a valuable resource for sustainable production. It investigates the transformation of gold ore tailings into high-value ceramic construction materials, offering a dual pathway for environmental remediation and rural economic development. Preliminary findings show that incorporating gold ore tailings into ceramic matrices improves mechanical strength and durability compared to conventional clay-based materials. The study outlines a scalable implementation pathway integrating environmental conservation with socio-economic development, presenting a practical and replicable model for waste valorisation in mining regions that contributes to sustainable rural industrialisation and climate change mitigation.

Keywords: Circular Economy, Conservation Technologies, Gold Ore Tailings, Waste Valorisation, Rural Industrialisation, Sustainable Materials

Participation of Women Refugees in Water and Sanitation Governance: A Case of Tongogara Refugee Settlement

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Abstract

This study explores the participation of refugee women in WASH (water, sanitation and hygiene) governance in Tongogara Refugee Settlement in Zimbabwe. The paper argues that gender discrimination, sexual harassment and socio-cultural stereotyping in WASH governance has led to challenges that threaten the success of the projects. Informed by a Feminist Political Ecology (FPE) theoretical framework, data were gathered from five Focus Group Discussions, 25 interviews, and five Key Informant Interviews. The study revealed that women possess vital knowledge regarding water provisioning, while men dominate decision-making processes. The paper concludes that the heterogeneity of the refugee community influenced women's response to gender inequality and inequity of WASH governance.

Keywords: gender inequality, participation, Tongogara Refugee Camp, Water governance, water sanitation and hygiene

Postharvest Losses in the Magumba (Hisa Kelee) Value Chain in Mozambique

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Abstract:

Magumba (Hisa Kelee) is a crucial protein source in Mozambique, yet significant postharvest losses constrain its potential. Small-scale fisheries rely mainly on cooler boxes with ice blocks (70%) and drying (30%) for preservation, but limited research exists on how these methods affect

product quality. This study examined the Magumba value chain from landing site to market, quantifying losses, identifying drivers, and evaluating mitigation strategies. Using FAO's load tracking method, IFLAM, and QLAM, changes in product weight and microbial quality were monitored. Weight differed significantly between treatments ($p < 0.001$): ice landing sites recorded the least weight, markets intermediate, and landing sites the highest. Mould counts showed no significant differences ($p > 0.05$). Yeast levels varied significantly ($p < 0.001$), with ice landing sites recording the lowest, while landing sites and markets had similarly high counts. Coliform bacteria also differed ($p < 0.04$), with ice landing sites and product landing sites showing lower levels than markets. *E. coli* differences were not significant ($p < 0.05$). Losses during fishing were relatively low but notable, with quality losses at 1% and physical losses at 5%, mainly due to lack of preservation, temporary storage in buckets, delays, and exposure to high ambient temperatures. Unloading added 2% quality loss and 0.1% physical loss, linked to handling and ambient exposure. Marketing losses reached 3%, largely from continued exposure. Women play a dominant role in processing and marketing, underscoring the need for gender-inclusive interventions. A multidisciplinary approach is recommended to reduce postharvest losses, strengthen food security, improve nutrition, and enhance economic returns along the Magumba supply chain.

Keywords: Magumba, postharvest losses, preservation strategies, high ambient temperatures, economic returns

First survey of entomopathogenic nematodes (Heterorhabditidae and Steinernematidae) in Zimbabwe: A Foundation for Sustainable Biological Control in Climate Smart Agriculture

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Abstract

Entomopathogenic nematodes (EPNs) of the families Steinernematidae and Heterorhabditidae are obligate, lethal parasites of the soil stages of insects. The infective juveniles moving through the soil, their natural habitat, enter the insects through natural openings, move to the haemocoel, where they release their symbiotic bacteria, causing death within 12-24 hours. Even though EPNs are important in sustainable pest management, information about the presence and distribution of naturally occurring species in Zimbabwe is missing. This study reports the first survey of EPNs in Zimbabwe, aimed at detecting indigenous EPNs from selected Agro-ecological regions. Soil samples were collected from agro-ecological regions I, III, and IV, and a total of 96 soil samples were collected and screened for the presence of *Tenebrio molitor* larvae as trap insects. We used larval mortality and nematode recovery using the white trap as indicators of EPN presence. Five of the samples were positive on this basis, suggesting the possible presence of EPNs in Zimbabwean soils. The first step was to take soil samples and determine naturally occurring EPN

species in undisturbed and agricultural systems through surveys where soil samples were collected at random. Further work on the EPN isolates will involve identification using morphological and molecular techniques at Kutsaga Research Station to verify their taxonomic identity, followed by evaluating their virulence in managing cutworm (*Agrotis Ipsilon*) under laboratory conditions. These findings present a baseline for the production of locally adaptable biopesticides, which contribute to climate-smart and sustainable insect-pest control strategies in Zimbabwean Agriculture.

Keywords: Entomopathogenic nematodes, Biological control, Zimbabwe, Insect pests, Indigenous isolates, *Agrotis ipsilon*

ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSES: A CASE STUDY OF CHINHOYI URBAN

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Affiliation(s): Chinhoyi University of technology

Abstract

The purpose of this study was to evaluate the quality of the groundwater used as potable water in the Chinhoyi Urban area in Zimbabwe. The main objective was to determine the quality and suitability of the groundwater in the area for human consumption. The parameters used in the study included pH, temperature, electrical conductivity, salinity, and total dissolved solids. The sampling points included nine boreholes located at Mzari, Orange Grove, Mapako, Central Business District, Coldstream, Industrial Area, Ruvimbo, White City, and Gadzema. The locations were identified using the stratified random sampling method. The data analysis was carried out using the QGIS and Microsoft Excel applications, which included the determination of the hotspots and the parameters compared with the guidelines set by the World Health Organization and the Statutory Instrument SI 6 of 2015 set by the Zimbabwean government on the quality of potable water. The results revealed that five of the nine locations sampled were identified as high-risk zones for groundwater contamination, with influences from industrial activities and environmental factors such as low elevation and ferric luvisol types of soils, which are conducive for groundwater contamination. However, areas with elevated positions and those with forest cover were identified as having low levels of groundwater contamination. High concentrations of heavy metals and nitrates were observed in the high-risk zones, thus rendering the groundwater unfit for human consumption as indicated in WHO and SI 6 of 2015 standards. The study recommends the need for monitoring groundwater, the design of effective groundwater treatment systems, the enforcement of environmental policies, the design of green infrastructure, and the need for stakeholders to work together in order to improve groundwater quality and provide safe and potable groundwater for the residents of Chinhoyi Urban.

Keywords: groundwater, portable water, electrical conductivity, salinity,

Digitizing Zimbabwe's Entomological Heritage: The ZIBIS Project as a Model for Biodiversity Conservation, Research Capacity Building, and Sustainable Heritage Preservation

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Abstract:

Zimbabwe's entomological collections represent an important yet underutilized scientific and cultural resource for biodiversity research, ecological monitoring, and sustainable development. However, many museum insect collections remain vulnerable to deterioration, limited accessibility, and insufficient digitization. The ZIBIS Project, implemented at the National Museum of Natural History of Zimbabwe, seeks to safeguard and revitalize Zimbabwe's entomological heritage through large-scale digitization, databasing, and innovative 3D imaging technologies. The project focuses on the preservation and documentation of ecologically and economically important insect groups, including Scarabaeidae, Cerambycidae, Saturniidae, and edible insects such as mopane caterpillars. Through specimen digitization, imaging, and targeted field collections from biodiversity hotspots, the initiative aims to improve accessibility to biodiversity data while strengthening long-term conservation of fragile museum collections. In addition to digital preservation, the project incorporates field schools and technical training workshops designed to build local expertise in insect collection, taxonomy, databasing, and biodiversity analysis among students and museum technicians. Public engagement activities, including exhibitions, documentaries, podcasts, and outreach publications, further promote awareness of Zimbabwe's insect biodiversity and its cultural and ecological significance. The ZIBIS Project demonstrates how museum-based digitization initiatives can contribute to biodiversity conservation, scientific collaboration, heritage protection, and capacity development in the Global South. The project provides a scalable model for integrating digital technologies, entomological research, and community engagement to strengthen both scientific infrastructure and environmental stewardship in Zimbabwe.

Keywords: entomology, biodiversity, 3D imaging technologies, databasing, ecological significance

SOCIO-ECONOMIC IMPACTS OF ILLEGAL, UNREPORTED AND UNREGULATED (IUU) FISHING IN LAKE KARIBA: CASE OF SANYATI BASIN.

Author(s): Chipu Pedzisai, Tongai Mwedzi, Innocent Mabika, Takafara Gozo

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Affiliation(s): University

Abstract:

Illegal, Unreported, and Unregulated (IUU) fishing accounts for up to 30% of global fish catches, posing a significant threat to the sustainability of inland fisheries and the livelihoods of dependent communities. The objectives of this study were to assess the perceived socio-economic impacts of IUU fishing in Sanyati basin of Lake Kariba; investigate the underlying factors contributing to

IUU prevalence, and evaluate the level of regulatory awareness and compliance among fishing communities in the Sanyati Basin of Lake Kariba. A mixed-methods research design was employed, combining a cross-sectional survey (n = 117 respondents) and focus group discussions across nine fishing camps along the Sanyati Basin shoreline. Data were analyzed using chi-square tests, logistic regression, and Pearson correlation. Illegal, unreported, and unregulated (IUU) fishing has severe socioeconomic impacts, 64% of legal fishers saw income loss, 62% faced more resource competition, and 48% had reduced food security, with women being more vulnerable. Key predictors of IUU involvement were lack of registration, age 26–33, and use of prohibited twine nets. Greater regulatory awareness was linked to lower IUU involvement, but awareness explained only a small portion of compliance variation (11.7%), and both legal and illegal fishers had similar basic knowledge ruling out lack of awareness as the primary cause of IUU fishing. The evidence from Lake Kariba demonstrates that IUU fishing is driven by a combination of demographic factors (particularly young age), behavioral factors (unregistered status and use of twine nets), and systemic gaps (low training rates and weak perceived government effectiveness). The author suggests that while improving awareness through community education, anonymous reporting systems, and cooperative partnerships can help reduce IUU fishing, awareness.

Keywords: IUU fishing, legal and illegal fishers, anonymous reporting systems, cooperative partnerships

First-flush behaviour and source-specific leachate signatures in unsegregated municipal solid waste at Pomona Dumpsite.

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Abstract

Municipal solid waste leachate is widely recognised as a major threat to groundwater quality, particularly in unlined dumpsites where rainfall-driven infiltration mobilises dissolved ions and toxic metals. This study identified major potential pollutants at the Pomona dumpsite by simulating short-term contaminant mobilisation and quantifying leachable fractions under controlled conditions, while contextualising results with a two-year field monitoring programme capturing natural wetting–drying and oxidation cycles. A 16-day PVC column leaching experiment, adapted from Van der Sloot’s protocol without pH control to preserve site-relevant pore-water chemistry, was conducted on four treatments (control, industrial ash, domestic residue, industrial plastic), followed by multivariate statistics (linear mixed-effects modelling, PCA, hierarchical clustering) and integration with groundwater quality assessment against EMA SI 6 of 2007 regulatory benchmarks and associated public health risk considerations. Distinct first-flush behaviour was observed, with domestic residue showing rapid early-phase release of key anions and nutrients, while industrial ash exhibited steadier solubility-driven leaching. Cumulative masses indicated substantial metal mobilisation from industrial plastic (Cr ~85 µg; Pb ~200 µg) relative to domestic residue and ash (~30–100 µg), and notable Hg release from domestic residue (~14 µg) and plastic (~10 µg). Major ion loading was pronounced, including very high K release from industrial plastic

(~40,000 mg), alongside Ca (~2,500 mg) and Mg (~500 mg), implying strong potential to alter aquifer alkalinity and scaling. Mixed-effects models showed significant temporal declines for most constituents, but fluoride and mercury displayed no significant trends, suggesting persistence. PCA (64.8% variance explained) differentiated source signatures, associating Hg, Pb and K with domestic residue and Cl^- , SO_4^{2-} , NO_3^- and F^- with industrial ash, while clustering identified fluoride and Hg as priority pollutants. Overall, unsegregated waste especially domestic residue, industrial ash, and industrial plastics can generate chemically distinct, regulatorily relevant leachate pulses, underscoring the need for targeted segregation, stabilisation, and engineered infiltration controls to reduce long-term groundwater risk.

Keywords: Solid Waste leachate, groundwater quality, pollutants, ion loading, engineered infiltration controls.

A preliminary assessment of the abundance and distribution of Southern Ground Hornbill (*Bucorvus leadbeater*) on Sango ranch, in Savé Valley conservancy, Zimbabwe

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Abstract:

The Southern Ground Hornbill (SGH) *Bucorvus leadbeateri* is threatened by a variety of natural and anthropogenic factors. The declining populations of threatened species requires constant monitoring to support adaptive management. Here, we assessed the abundance and distribution of Southern Ground Hornbills (SGH, *Bucorvus leadbeater*) on Sango ranch, in Savé Valley conservancy, Zimbabwe. Data were collected by conducting drive counts along established roads from September 2020 to April 2021. A total of 61 SGH individuals were recorded in Sango Ranch, comprising 17 groups, with family sizes ranging from 2 to 5 individuals (mean 3). Groups containing four individuals were the most common, accounting for 41.2% of all recorded groups. Adults dominated the population structure, contributing 59% of all individuals observed, suggesting low recruitment levels within the study area. Overall, it was clear that the age structure of the SGH population is not evenly distributed across age classes. Spatial analysis showed that SGH sightings were concentrated mainly within open woodland habitats. The findings indicate that SGHs preferentially utilize open savanna umbrella thorn habitats that provide suitable foraging conditions and nesting opportunities. However, the low proportion of juveniles may indicate potential future population challenges if recruitment remains low. The study highlights the importance of conserving suitable woodland habitats and protecting nesting trees, and maintaining habitat connectivity to support long-term SGH conservation within the study area.

Keywords: Anthropogenic factors, adaptive management, drive counts, spatial analysis, open woodland habitats, nesting

Twelve Years of Monitoring Terrestrial Birds at Chinhoyi University of Technology Campus in Zimbabwe.

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Abstract:

Although university campuses can be refuge sites for birds surrounded by highly disturbed habitats in cities, there is little documentation of trends on Zimbabwean university campuses. This research seeks to analyze the seasonal and annual trends in the diversity and abundance of terrestrial bird species at Chinhoyi University of Technology (hereinafter, CUT) campus from 2012 to 2024. Data was collected from 2012 to 2024 through systematic line sampling. The feeding guild of each observed bird species was established from the literature. The species abundance, and Shannon Wiener diversity of the birds were analyzed using generalized linear models across the seasons and years. Jung Box test was used to check if there was an autocorrelation between the mean number of birds and the year. Then the Autoregressive Integrated Moving Average (hereinafter, ARIMA) was used to predict future trends and outcomes of bird species for the years 2025 to 2030. Among the 765 individuals recorded, abundance was highest in 2017 and least in 2020. Omnivores were the most common (40.26%), while herbivores were the least (0.13%). The CUT campus appears to support a moderately diverse bird community and this calls for such areas to be included in conservation planning especially such islands that may be surrounded by fast development of urban infrastructure.

Keywords: Terrestrial birds, feeding guild, Jung Box test, autocorrelation, Omnivores, herbivores

Spatio-temporal dynamics and baseline status of waterbird assemblages at Lake Sabakwe, Midlands, Zimbabwe

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Abstract:

Wetlands support critical waterbird communities, which serve as bioindicators of ecosystem health. Baseline data on seasonal waterbird dynamics are lacking for many southern African wetlands, including inland man-made reservoirs such as Lake Sebakwe in the Midlands province of Zimbabwe. This study documents the waterbird abundance, richness, diversity, and feeding guild composition across wet and dry seasons (January 2025–July 2025) at 13 sites around Lake Sebakwe using point counts. A total of 11,793 individuals from 40 species and 14 families were recorded, with the communities being dominated by the Egyptian Goose (*Alopochen aegyptiaca*) and White-faced Duck (*Dendrocygna viduata*). Generalized linear models showed that waterbird

abundance was significantly higher in the dry season than in the wet season ($p < 0.0001$), with the Impala Bay, Sebakwe Confluence, and Fakaliche Creek supporting the highest numbers. However, there were no seasonal differences in species richness and diversity. The herbivorous species and insectivorous waterbird species (constituting 54% and 29% respectively) remained largely stable across seasons, PERMANOVA $p = 0.87$). Conservation-significant species included the vulnerable Grey Crowned Crane (*Balearica regulorum*) and near-threatened Yellow-billed Stork (*Mycteria ibis*). There is scope in increasing sampling as this site has potential to be designated a RAMSAR site, as some of the conditions have already been met.

Keywords: Waterbird communities, bioindicators, Egyptian Goose, species richness,

A decade-long analysis of waterbird diversity and population dynamics at Biri Dam, Zimbabwe (2014-2023)

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Abstract:

This study examined the dynamics of waterbird populations at Biri Dam, Middle Manyame Sub-catchment, Zimbabwe, from 2014 to 2023. The work focused on analyzing ecological guild trends, seasonal patterns, and responses to environmental disturbances. Two 900 m long transects were established, one close to the dam wall and the other one along a fishing camp. Each year, surveys were conducted during the wet season (January/February) and dry season (July). The findings indicated that Biri dam supports a diverse array of bird species, with egrets, storks, and ibises dominating community composition. The majority of birds were resident species (70%), with smaller proportions of Afrotropical (18%) and Palearctic migrants (12%). Seasonal decomposition analysis showed a clear cyclical pattern in bird abundance, with the wet seasons having more birds than the dry seasons. In contrast, the trend component exhibited fluctuations without a discernible linear trend. An autoregressive model predicted relative population stability in waterbird populations in the coming years, with some fluctuations. Significant differences were found in species richness and Shannon's Diversity Index across disturbance categories (dam wall and fishing camp site). Non-Metric Multidimensional Scaling (NMDS) analysis revealed distinct spatial patterns in bird species distribution, influenced by season, weather and disturbance categories. Analysis of Similarity (ANOSIM) confirmed significant differences in bird species composition across these factors. This study highlights the complex relationships between bird populations and environmental factors at Biri dam, providing insights into the dynamics of this ecosystem over a decade. The findings have implications for conservation and management strategies, there is a need to maintain anthropogenic pressure remains low, as the upstream dams have very high disturbance levels.

Keywords: Ecological guild trends, Shannon's Diversity Index, Non-Metric Multidimensional Scaling, Analysis of Similarity.

A Geospatial Modelling Approach for analysing, stimulating and optimising Urban Green space dynamics for Harare Municipality

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Abstract:

The fast urbanization processes occurring in Harare Municipality have been accompanied by dramatic changes in the structure of the area's land system through fast-built up area expansion, fragmentation of vegetation areas, and degradation of ecological integrity, thus compromising the potential of the area for effective regulation of climatic conditions. This study therefore sought to design a comprehensive geospatial modelling approach for analysing, simulating, and optimizing urban green space dynamics with regard to climate regulation within Harare municipality. The objectives of this research were to examine land use and vegetation change in Harare between 2015 and 2025, examine patterns of fragmentation, simulate LULC scenarios for 2035, and identify priority areas for conservation and restoration. An integrated methodological approach involving Remote Sensing (Landsat 8 and Sentinel-2), GIS, NDVI assessment, OBIA, landscape ecology metrics, and a cellular automata random forest (CA_RF) machine learning approach was employed. It can be clearly seen that there is an increase in the number of impervious surfaces along with a decrease in vegetation cover from 38.86% in 2015 to 33% in 2025, along with increased fragmentation and decreased connectivity of green spaces, with predictions of more vegetation depletion in high-density urban areas by 2035. It is suggested that urban development is greatly destroying the green infrastructure and its role in regulating the climate system.

Keywords: Ecological integrity, geospatial modelling, green space dynamics, vegetation change

A GIS-Based Hybrid Modelling Approach Using CART Classification and Cellular Automata (MOLUSCE) for Predicting Future Land Use Dynamics in Mutare.

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Abstract

Urban expansion represents one of the most critical factors influencing land use and land cover (LULC) changes worldwide, leading to the degradation of agricultural land and invasion of sensitive natural ecosystems, as well as putting pressure on infrastructure and social services. The town of Mutare is currently characterized by unregulated urban expansion without any predictive models for future planning. Therefore, the current study attempts to predict future scenarios of the landscape of Mutare City employing machine learning algorithms, with specific objectives to investigate urban expansion between 2000-2024, model LULC patterns up to 2044 through cellular automata simulations, and determine critical socioeconomic and physical determinants for future urban development. The mixed research design including GIS technology, remote sensing, spatial analysis, and socio-economic surveying methods was used, where Landsat satellite images for 2000, 2014, and 2024 years were classified using Google Earth Engine software with CART classification algorithm, predictive modeling was carried out

with QGIS (MOLUSCE plugin), and socio-economic information – analyzed with Jamovi software. Results revealed a rise in proportion of built-up area (from 7.38% in 2000 to 9.34% in 2024) and decrease in proportion of forest cover (31.56% - 27.40%). The model suggests an increase in the proportion of built-up land up to 9.70 percent by 2044, reflecting continued urbanization. Some of the important factors that play a role in determining future land use patterns include road/transport infrastructure, availability/affordability of land, access to electricity, and increase in the number of students. The research findings suggest that significant spatial transformation is occurring in Mutare, and GIS modelling needs to be incorporated in the urban planning framework.

Keywords: Urban expansion, Land use and land cover, Remote Sensing, Geographic Information Systems, Machine Learning, Cellular Automata, Urban Growth Modelling

An assessment of land use land cover (LULC) change, projected climate trajectories, and the mainstreaming of wildlife corridors into Zimbabwe's climate change policy frameworks: The case of Hwange-Shangani elephant corridor.

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Abstract:

Ecological corridors are increasingly critical for sustaining wildlife movement under accelerating land use change and climate variability, yet their effectiveness depends on both biophysical integrity and enabling governance. This study assesses land use land cover (LULC) change, historical and projected climate trajectories, and the extent to which wildlife corridors are mainstreamed into Zimbabwe's climate change policy frameworks, using the Hwange-Shangani elephant corridor as a case study. The study hypothesizes that (i) continued LULC change and climate warming are progressively reducing corridor functionality, and (ii) existing climate policies insufficiently mainstream wildlife corridors as climate adaptation instruments. A mixed-methods approach was employed. LULC dynamics for 2003, 2013, and 2023 were mapped using Landsat imagery and Random Forest classification within Google Earth Engine, with future land cover simulated to 2033 using transition matrices and biophysical and anthropogenic predictors. Climate trajectories for rainfall and land surface temperature were analyzed using a multi-method ensemble forecasting framework combining historical trend analysis, statistical projection, and climate-informed adjustments for the period 2019-2050. Policy mainstreaming was evaluated through qualitative content analysis of four national climate instruments using a four-dimensional analytical framework focusing on explicit recognition, sectoral integration, implementation tools, and institutional arrangements. Results indicate a consistent decline and fragmentation of natural vegetation, expansion of settlements and farmland, and increasing bare land within the corridor, with projections suggesting further degradation by 2033. Climate analysis reveals statistically significant warming, particularly in minimum temperatures, alongside increasing rainfall variability without a clear long-term trend. Policy analysis shows that while biodiversity is acknowledged, wildlife corridors and ecological connectivity remain weakly and implicitly

addressed, lacking explicit objectives, spatial planning mechanisms, and governance structures. The study concludes that misalignment between ecological change and policy frameworks threatens the long-term functionality of the Hwange-Shangani corridor.

Keywords: Ecological corridors, land use change, wildlife corridors, anthropogenic predictors, Hwange-Shangani corridor

Habitat suitability for elephants and baobabs across the Mid-Zambezi Biosphere Reserve, Zimbabwe

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Presentation Type: Poster

Abstract:

Identifying where African elephant (*Loxodonta africana*) home ranges overlap with suitable *Adansonia digitata* L. (baobab) habitats is critical for identifying spatial hotspots of tree vulnerability in semi-arid savanna ecosystems. This study assessed current habitat suitability for elephants and baobabs across the Mid-Zambezi Biosphere Reserve, Zimbabwe, and quantified spatial overlap to identify areas where elephant browsing pressure is potentially concentrated on baobab populations. Elephant GPS-collar data and ranger-based observations from the Spatial Monitoring and Reporting Tool (SMART) were integrated with baobab occurrence records collected through a stratified systematic sampling design and analysed using species distribution models. Habitat suitability was modelled independently for each species using Random Forest and Extreme Gradient Boosting algorithms within the BIOMOD2 framework, incorporating bioclimatic, topographic, and anthropogenic predictors. Baobab suitability was primarily driven by precipitation seasonality, temperature variability, and proximity to alluvial river systems, with approximately 4,896 km² of climatically suitable habitat concentrated along the Zambezi River, alluvial terraces, and escarpment margins. Elephant dry-season suitability was more spatially restricted, with 2,554 km² forming a narrow corridor associated with the Zambezi floodplain and key artificial water points. Annual precipitation, distance to boreholes, and distance to roads were the strongest predictors of elephant habitat use, highlighting the combined influence of climate and human-mediated factors. Overlay analysis of binary suitability maps revealed that only 555 km² (4.8%) of the modelled landscape represented coincident high-suitability habitat for both species. These discrete overlap hotspots indicate spatially concentrated baobab vulnerability shaped by climatic suitability, water availability, and anthropogenic landscape modification, underscoring the need for targeted, spatially explicit conservation strategies in the Mid-Zambezi Biosphere Reserve.

Keywords: African Elephant, tree vulnerability, Mid-Zambezi Biosphere Reserve, Habitat suitability, anthropogenic landscape modification

The beneficiation and utilization of coal fines

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Presentation Type: Poster

Abstract:

Fine coal waste management has been a great challenge in the coal mining industry as little attention is given to its management and the fines are dumped as heaps on open sites. The characteristics of the coal fines at Hwange Colliery Company were analysed through particle size distribution and proximate and elemental analysis. Approximately 80% of the coal fines passed through the 2mm sieve. The coal fines had an average gross calorific value of 17.43 MJ/kg which has notable potential for energy extraction. Elemental analysis uncovered traces of heavy metals such as Fe, Co, Ni, and Cu, a potential environmental hazard. The potential environmental implications were assessed through water and soil quality analysis which revealed generally low turbidity levels in groundwater with readings ranging from 0.34 to 0.55 NTU. Soil analysis indicated the presence of heavy metals near coal fines dump sites with lead levels reaching up to 52.32 mg/l, nickel at 36.17mg/l, and copper at 53.70mg/l. A cleaner production assessment was done by feasibility analysis using literature review. Brickmaking, pelletization and briquetting were chosen to undergo cost-benefit analysis. Briquetting showed greater profitmaking potential with a payback period of 13 months, a net present value of \$1 771 493.18 and an internal rate of return of 90%. The briquettes were produced at varying coal fines and binder ratios using molasses and kaolin clay as binders. Physical strength analysis results show that the briquettes that were produced using 20% molasses were stronger therefore the optimum. The high heating value for the optimum was 21.59MJ/kg and thermogravimetric analysis showed that the addition of the binder had no significant effect on the combustion patterns of the briquettes. Therefore, briquetting was proposed to be the best beneficiation and value-addition technique for the coal fines that are being produced at Hwange Colliery Company.

Keywords: Fine coal waste, Hwange Colliery Company, elemental analysis, Physical strength analysis, thermogravimetric

GIS-based Multi-Criteria Suitability Analysis for Solar-Powered Backup Water Infrastructure in Chinhoyi Municipality

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Presentation Type: Poster

Abstract

Reliable water supply systems are essential for sustainable urban development; however, frequent electricity outages in Chinhoyi continue to disrupt municipal water pumping and distribution systems. The growing demand for sustainable and data-driven energy solutions has created the need to integrate renewable energy technologies into municipal infrastructure. This study conducted a GIS-based Multi-Criteria Decision Analysis (MCDA) to identify suitable locations for solar-powered backup water infrastructure in Chinhoyi. The objectives were to identify key

spatial factors influencing solar installation suitability, determine their relative importance using the Analytic Hierarchy Process (AHP), and generate a spatial suitability map for solar-powered installations. The study integrated Geographic Information Systems (GIS) and AHP techniques to evaluate spatial suitability. Ten criteria were considered: slope, aspect, hillshade, elevation, Global Horizontal Irradiance (GHI), Photovoltaic Power Output (PVOUT), Land Use/Land Cover (LULC), roads, powerlines, and rivers. Spatial datasets were obtained from recognized global sources, including NASA SRTM, USGS Earth Explorer, the World Bank Global Solar Atlas, European Space Agency World Cover, OpenStreetMap, and HydroSHEDS. Data pre-processing and spatial analysis were conducted in QGIS, while criteria weighting was performed in R using AHP. Results showed that solar-related factors had the greatest influence on suitability, with GHI and PVOUT each contributing 26.49% to the model. LULC and slope contributed 14.57% and 9.03%, respectively. The AHP consistency ratio was 0.036, indicating reliable weighting. The final suitability map identified highly suitable areas characterized by high solar radiation, gentle slopes, open land, and proximity to roads and powerlines. The study demonstrates the effectiveness of integrating GIS and AHP in renewable energy planning and provides a practical decision-support tool for sustainable water infrastructure development in Chinhoyi.

Review of an IoT-Based Solar PV Energy Monitoring and Management System for Enhanced Grid Resilience in Zimbabwe

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Abstract

The accelerated deployment of solar photovoltaic (PV) systems in Zimbabwe offers a viable pathway to alleviate persistent energy deficits and advance sustainable development. However, the long-term performance and viability of these renewable energy assets are often undermined by a lack of accurate and real-time operational data leading to inefficiencies in planning, maintenance and optimization. Predominant simulation tools including PVsyst and PVSOL along with satellite-based platforms such as PVGIS rely heavily on historical meteorological datasets and generalized modeling. These methods inadequately capture microclimatic variability and site-specific operating conditions, which are critical for the success of energy projects in rural industries and localized communities. Furthermore, traditional inverter-centric monitoring provides a limited representation of system performance, often obscuring critical module-level dynamics and degradation patterns. This review paper critically examines the development of Internet of Things (IoT)-enabled monitoring systems as a frontier innovation for enhancing the operational efficiency and reliability of PV installations. By evaluating existing solutions within the Zimbabwean context, the review synthesizes evidence on integrating real-time measurements of key performance parameters such as solar irradiance, module temperature, voltage and current to enable advanced fault detection and predictive maintenance. Such data-driven precision is essential for ensuring sustainability and environmental resilience in renewable systems. Ultimately, the paper presents the transformative potential of localized IoT-driven PV monitoring to support informed decision-making, improve system resilience and catalyze socio-economic

development thereby contributing to the realization of context-responsive energy solutions that deliver lasting community impact in Zimbabwe.

Hydrospatial Assessment of Depression Fill Dynamics and Borehole Siting Optimization in Semi-Arid Environments a case of Ward 21, Gokwe South District, Zimbabwe

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Abstract:

The escalating interconnectivity among water, food, and energy systems has contributed to rising water shortages in semi-arid areas, where groundwater is an essential source in ensuring rural sustainability, agricultural productivity, and socioeconomic development. This study evaluates access to groundwater in Ward 21 of Gokwe South District, Zimbabwe, using the combination of remote sensing and geophysical methods for more efficient borehole siting. A multidisciplinary research approach was adopted that involves analysis of satellite images, digital elevation models (DEM), and geophysical surveys to identify subsurface drainage networks and determine the depth of depression fill as an indirect measure of groundwater potential. Hydrogeological analyses of spatial and geophysical information were performed to determine favourable hydrogeological settings for groundwater presence and exploitation. Finally, the effectiveness of the method was confirmed using fieldwork involving borehole drilling and pumping tests on target locations. Field findings confirmed a high likelihood of groundwater presence in areas with high depression fill depth and productive boreholes, proving the usefulness of the method proposed. Furthermore, the results show that remote sensing data and geophysical techniques when combined form a sound scientific methodology that is both cost-efficient and scalable in terms of locating sources of groundwater within semi-arid regions where there is inadequate data on groundwater resources. This will help enhance the accuracy of borehole site selection and ultimately aid in better groundwater resource management practices.

Keywords: Groundwater Potential Zones; Remote sensing; Geophysical surveying; Borehole siting; Depression fill depth; Hydrospatial analysis

Use of fairy shrimp as feed for fish fingerlings

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Presentation Type: Poster

Abstract:

The increasing cost and limited availability of conventional fish feeds have stimulated interest in alternative and sustainable live feed organisms in aquaculture. Fairy shrimp (Branchiopoda: Anostraca) has emerged as a promising live feed source for fish fingerlings due to their high nutritional value, rapid reproduction, and adaptability to diverse aquatic environments. This study

reviews the potential use of fairy shrimp as a feed resource in fish fingerling production and evaluates their nutritional, economic, and ecological significance in aquaculture systems. Fairy shrimp are rich in essential proteins, lipids, amino acids, and fatty acids necessary for the rapid growth and survival of fish larvae and fingerlings. Their soft-bodied nature and active swimming behaviour make them highly palatable and easily digestible to young fish. In comparison to traditional live feeds such as *Artemia*, fairy shrimp can be cultured locally at relatively low cost, reducing dependence on imported feeds and enhancing the sustainability of small-scale aquaculture operations. Additionally, fairy shrimp exhibit high reproductive rates and can thrive in temporary water bodies, making them suitable for mass production under controlled conditions. The use of fairy shrimp as live feed has been associated with improved growth performance, higher survival rates, enhanced immunity, and better stress tolerance in fish fingerlings. However, challenges such as seasonal availability, optimal culture techniques, harvesting efficiency, and nutritional variability remain constraints to their widespread adoption. Further research is required to optimize production methods, assess species-specific feeding responses, and evaluate long-term economic feasibility. Overall, fairy shrimp represent a viable and environmentally friendly alternative live feed for fish fingerlings. Their utilization could contribute significantly to sustainable aquaculture development, and building resilience in resource-limited regions where access to commercial fish feeds is limited.

Recovery of Lead from Lead-Laden Cupels Generated in Precious Metal Extraction: An Enhanced Hybrid Approach Towards Long-Term Environmental Pollution Control

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Abstract:

Lead-laden cupels are produced in substantial quantities by mining companies and are routinely disposed of in the environment. Various methodologies have been employed to leach lead from cupels; however, none have achieved complete recovery. This study presents a circular economy-oriented approach to lead recovery from cupels. The recovered lead is recycled into litharge, which can serve as an input for precious metal mining companies. The lead-free cupel waste is subsequently remolded into new cupels. In the proposed lead recovery protocol, lead was leached at ambient temperature using urea in acetic acid, followed by precipitation, ion exchange chromatography, and reverse osmosis. Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) and X-ray Fluorescence (XRF) were utilized to quantify the lead content in the leachate and cupel residues. Ion exchange chromatography and reverse osmosis achieved a 99.9% lead-free effluent. The extracted lead was removed from the resins and the reverse osmosis membrane using an acidic solution to produce lead chloride as a second by-product while regenerating the used resins. In this protocol the lead-free effluent is taken back for further lead extraction resulting in a semi-solvo-metallurgical process that is environmentally friendly concerning disposal of cupel waste.

Keywords: environmental pollution; circular economy; lead waste; lead recovery process

Interrogating Stakeholders' Perspectives of the Integrated Catchment Management concept in Tokwe Sub-Catchment, Zimbabwe.

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Abstract:

There is a growing recognition of the interwoven nature of the social, land and water systems in a catchment, hence the birth of the Integrated Catchment Management (ICM) concept. It has also been noted that stakeholder perceptions can condition practice. However, there is often a discrepancy between policy and practice. This study, therefore, sought to interrogate stakeholders' perspectives of the ICM concept in Tokwe sub-catchment, Zimbabwe and applicable Government policy relating to the ICM concept. A mixed methods approach was applied which involved questionnaires, semi-structured interviews with key informants and focus group discussions. The study findings showed that there were several environmental challenges (e.g. deforestation) existing in the study area. This was despite the presence of environmentally friendly approaches to environmental management as well as institutions collaborating in the management of the environment in the study area. Study results also showed that the ICM concept has been adopted into Zimbabwe's environmental policies in line with global agreements and was generally understood in the study area. The study, however, showed that there was still a need for all stakeholders to embrace the ICM concept. The study, thus, recommended that there was need for the establishment of a stand-alone ICM policy for Zimbabwe in-order to improve adoption of the ICM concept.

Keywords: Integrated catchment management; deforestation; land degradation; environmental policies; stakeholder perspectives

Integrating the Arborloo Toilet Design and Indian Jujube (*Ziziphus mauritiana*) Tree Species Planting Initiatives in Promoting Holistic Rural Community Wellbeing in Mukumbura Ward 2, Mt Darwin District

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Abstract:

Circular Economy Sanitation Model was applied to analyse the socio-economic benefits of integrating Arborloo sanitation systems with the cultivation of *Ziziphus mauritiana*, with the goal of improving sanitation, promoting environmental health, strengthening food security, and

enhancing overall wellbeing in Ward 2, Mt Darwin District. The research analysed community perceptions and adoption dynamics, influencing the sustainable implementation of integrated ecological sanitation and fruit-tree-based landscape restoration initiatives in the study area. Using a mixed-methods approach, the study analysed attitudes, practices, and the potential socio-economic and environmental benefits of this integration. The Multinomial Logistic Regression (MLR) model with the dependent variable as Education level (Secondary) was ran against independent variables. The MLR results revealed households with no formal education, yearly household income is significant ($p = 0.010^{***}$) at 1%, while marital status ($p = 0.027^{**}$) significant at 5% and willingness to adopt the Arborloo toilet ($p = 0.000^{***}$) is significant at 1% respectively. These results reflect reliance on low-cost, practical sanitation solutions. Having reached tertiary education level increases the likelihood of the household having a higher mean annual income ($p = 0.025^{**}$), indicating positive correlation between education level and household income which in turn increases the likelihood of adopting the Arborloo toilet ($p = 0.000^{***}$) at 1% significance level. The binary logistic regression model with the dependent variable as willingness to adopt the Arborloo toilet was ran against independent variables. Age of the household head was found to be significant ($p = 0.014^{**}$) at 5% meaning that as the household head ages, their likelihood of adopting the Arborloo toilet facility significantly increases. These findings underscore the importance of integrating affordable ecological sanitation with agroforestry to enhance rural livelihoods and support sustainable development. Income remains a central factor influencing the adoption and quality of sanitation infrastructure in rural communities.

Keywords: Arborloo toilet, Circular Economy Sanitation Model, Indian Jujube (*Ziziphus mauritiana*), Sanitation, grass made bathroom

Remote sensing-based assessment of land cover dynamics and fire regimes from 2001 to 2025 in Gwayi Forest, Zimbabwe

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Presentation Type: Poster

Abstract:

Wildfires and land cover change are growing challenges to forest ecosystems in Zimbabwe, especially in the protected forest landscapes such as the Gwayi Forest. In this study, we examined land cover change and wildfire regimes in the Gwayi forest using satellite remote sensing and machine learning. The study objectives were (i) to assess temporal trends in vegetation condition, (ii) to analyse temporal trends in burnt area from 2001 to 2025, (iii) to analyse fire severity from 2001 to 2025, and (iv) to assess land use and land cover change from 2001 to 2025. We analysed multi-temporal Landsat images and MODIS burnt area products from 2001–2025 in Google Earth Engine to evaluate spatial and temporal variations in vegetation cover and wildfire occurrence. The vegetation condition and fire severity were evaluated using the Normalised Difference Vegetation Index and the Differenced Normalised Burn Ratio, respectively, for the same period. The major land cover types, like forest, shrubland, grassland, agricultural land, and bare land, were classified using a Random Forest classifier for the years 2001, 2005, 2010, 2015, 2020, and 2025.

Results showed a fluctuating fire frequency and forest fragmentation. Increasing forest loss points to ecosystem vulnerability and potential biodiversity loss. The study provides an efficient framework for forest monitoring and conservation, which supports United Nations Sustainable Development Goals 13 (Climate Action) and 15 (Life on Land) by promoting data-driven strategies for sustainable forest management in Zimbabwe. The findings also support the development of data-driven strategies by policy makers, the Forestry Commission, and conservation organisations for forest conservation in Zimbabwe.

Keywords: Forest Ecosystems, cover change, wildlife regimes, Random forest classifier, conservation

Turning Pollution into Pavement: A Community-Scale Plastic Waste-to-Paving Block System for Rural Zimbabwe

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Abstract:

Zimbabwe is currently facing a mounting plastic waste crisis that disproportionately burdens rural communities. With over 100,000 tonnes of plastic waste generated annually and less than 10% formally recycled, uncollected plastics accumulate in fields, waterways, and roadsides thereby degrading ecosystems, blocking drainage and contaminating soils. Rural Zimbabwe also suffers from severely inadequate road and pathway infrastructure which limits access to markets, schools and healthcare facilities. This paper proposes and develops an engineering solution that addresses both challenges simultaneously: a community operated plastic waste-to-paving block manufacturing system designed for rural deployment in Zimbabwe. The proposed system centers on a locally fabricable heat-compression press that is constructed from mild steel using skills available in rural artisan workshops capable of melting and moulding mixed plastic waste (PET, HDPE, LDPE) into dense, interlocking paving blocks without the use of cement or specialised industrial equipment. The system operates on a simple thermal cycle plastic waste is cleaned, shredded using a hand-operated granulator, melted in a controlled-temperature mould chamber, and compressed into standardised block dimensions. Blocks are produced at an estimated cost significantly below conventional concrete paving, while exhibiting comparable compressive strength for low-traffic pedestrian and light-vehicle applications. This paper presents the mechanical design of the press unit, strength and durability analysis of blocks produced from Zimbabwe's dominant plastic waste streams and a cost model demonstrating affordability at cooperative scale. The system is positioned as a replicable circular economy model for rural growth points across Zimbabwe, directly converting one of the country's most visible environmental failures into a community infrastructure asset.

Keywords: Plastic waste, ecosystems, waste-to-paving, interlocking paving blocks, circular economy model

Smart Rock-Based Thermal Energy Storage System for Industrial Heating and Waste Heat Utilization

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Abstract:

Zimbabwean industries and SMEs struggle with unreliable electricity and expensive heating methods like diesel and direct electric heating. At the same time, significant heat energy from industrial processes, generators and emerging data centres goes to waste. There is a real need for simple, affordable solutions that can store and reuse this energy. This project presents a working prototype of a rock-based thermal energy storage system built using locally available granite. The system charges by storing heat energy in a packed rock bed, then discharges it as controlled hot air for applications such as agricultural drying, food processing, space heating and small-scale industrial use. It also shows strong potential for capturing waste heat from factories, generators and data centres. The prototype includes a temperature control system that blends hot air from the rock bed with a regulated cold air bypass through an external mixing chamber. Strategically placed thermocouples continuously monitor charging and discharging cycles, measuring heat retention and output stability. Real-time temperature feedback enables consistent, controlled output and lays a clear foundation for future AI-based optimization. Unlike lithium-ion batteries, which are costly, have limited cycle life and require complex recycling, this system offers a safer, cheaper and more locally scalable alternative for thermal energy storage. The project demonstrates that low-cost local materials, combined with basic smart control, can deliver practical and impactful energy solutions. It supports industrial productivity, energy efficiency and sustainable development, aligning well with 4IR principles of integrating physical systems with data-driven technologies

Keywords: Energy, rock-based, data centres, thermocouples, lithium-ion batteries, 4IR principles

Assessing Hydro-period Pulsing and Buffer Vulnerability in the Monavale Wetland

Category: Remote Sensing and Wetland Ecology

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Abstract:

Seasonal valley-bottom wetlands (dambos) in Zimbabwe exhibit highly dynamic eco-hydrological processes that static land-cover classifications often fail to represent. To address this, the study employs a deep ecological approach, interpreting wetland pulse dynamics (seasonal expansion and contraction) as an indicator of ecosystem function, rather than land-cover status. Focusing on the Monavale wetland in the Upper Manyame Catchment, the study aims to (i) evaluate temporal hydro-period dynamics (2017-2025), (ii) assess the ecological integrity of the 100m riparian buffer zone, and (iii) formulate a spatial decision-support framework for wetland monitoring and conservation. A reproducible cloud-based workflow was established using Google Earth Engine

and Python, incorporating multi-sensor Sentinel-1 SAR and Sentinel-2 optical data. Monthly wetland maps generated from VV backscatter and NDWI thresholds facilitated a quantitative assessment of inundation frequency, seasonal variation in wetland area, and pulse dynamic magnitude. The ecological integrity of the 100m riparian buffer was analysed using the Mann-Kendall trend test and Sen's slope estimator on the NDWI time series to assess vegetation-moisture trajectories and buffer zone degradation. The study reveals a stable seasonal hydroperiod, characterised by wet season inundation followed by dry season recession, suggesting ecological functionality in Monavale wetland. However, a localised negative trend in the riparian buffer suggests increasing vegetation moisture stress and fragmented degradation related to urban development and climatic fluctuations. Together, the dynamic hydro-period and riparian trend analyses advance wetland assessment beyond static classification, fostering time-dynamic diagnostics and a spatially explicit decision-support framework for early-warning monitoring, adaptive watershed management, and long-term conservation of the Upper Manyame watershed.

Keywords: Eco-hydrological, hydro-period dynamics, wetland monitoring, pulse dynamic magnitude, riparian.

Development of a Natural Biodegradable Superabsorbent Polymer for use in Potato Cultivation

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Presentation Type: Poster

Abstract:

This project focuses on the development of a natural biodegradable superabsorbent polymer using methylcellulose and acrylamide for use in potato cultivation. This design and innovation serve as a solution to the growing problems faced in the potato farming industry which include poor crop yields caused by reduced soil retention, soil infertility, water scarcity and inefficient irrigation. It also serves as a solution to the environmental concerns associated with the use of petroleum based superabsorbent polymers which are non-biodegradable. These persist in the soil causing soil pollution and gradual soil infertility. The problems caused by the use of petroleum based superabsorbent polymers have driven the demand for biodegradable superabsorbent polymers from renewable resources such as polysaccharides and proteins. This project serves a dual purpose of eradicating the problems associated with non-biodegradable superabsorbent polymers and also a source of acrylamide. As the superabsorbent polymer degrades, acrylamide monomers from the SAP are up taken by the plant which increases the acrylamide content in the potato peels and tubers. The same acrylamide content can then be used in the extraction of acrylamide to make more SAPS, leading to a cost-effective production. Different ratios of acrylamide to methylcellulose were used to determine the sample with the best water absorption capacity, water retention capacity and buffering capacity in different pH conditions. The best sample was sample 3 with a ratio of 2:1.

Key words: biodegradable, super-absorbent polymers, agricultural, methylcellulose, polyacrylamide

The optimization of injection moulding parameters for manufacturing mop sockets from fully recycled HDPE. A structured Design of Experiments (DOE) approach.

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Presentation Type: Poster

Abstract:

The transition from a linear plastics economy to a circular framework requires innovative approaches to maximize the value of recycled polymers. High-density polyethylene (HDPE), one of the most widely used thermoplastics, presents significant challenges when processed as 100% recycled feedstock due to chain degradation, contamination, and variability in mechanical properties. This study investigates the optimization of injection moulding parameters barrel temperature, injection pressure, cooling time, and screw speed for manufacturing mop sockets from fully recycled HDPE. A structured Design of Experiments (DOE) approach, guided by the Taguchi method and Analysis of Variance (ANOVA), was employed to systematically evaluate the influence of processing parameters on mechanical performance. Material characterization included melt flow index, density, and thermal stability assessments, while mechanical testing focused on hardness, compression strength, impact resistance, and wear properties. Preliminary findings indicate that cooling time and injection pressure are the most significant predictors of performance, with cooling time strongly influencing hardness and dimensional stability. Nozzle temperature showed a marginal effect, while screw speed contributed minimally within the studied range. The absence of multicollinearity among factors ($VIF = 1.00$) confirmed the reliability of the regression models. The expected outcome is the establishment of optimized processing windows that enable 100% recycled HDPE to achieve mechanical properties comparable to virgin material. This research demonstrates that with precise parameter control, recycled HDPE can be successfully applied in high-performance applications, supporting circular economy goals by reducing reliance on virgin polymers and promoting sustainable manufacturing practices.

Keywords: recycled HDPE, injection moulding, process optimization, Taguchi method, circular economy

Beyond Bees: How Habitat Loss and Climate Change Threaten Southern Africa's Overlooked Beetle Pollinators: The Miombo Woodlands, a Blind Spot.

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Abstract:

Pollinating beetles (Coleoptera) are among the most ancient and ecologically vital insect pollinators, yet they remain strikingly neglected in research and conservation—particularly in Southern Africa, a global hotspot for beetle–plant mutualisms. This paper presents a comprehensive systematic review of the diversity, anthropogenic threats, and conservation status

of pollinating beetles across Southern Africa. Following PRISMA guidelines, five electronic databases were searched, yielding 37 studies that met predefined inclusion criteria. A narrative synthesis framework was used to integrate heterogeneous evidence. There were two main findings. First, the family Scarabaeidae—especially the subtribe Hopliini (monkey beetles)—constitutes the primary pollinating beetle group, with Curculionidae (weevils) ranking second. These beetles are concentrated in the Cape Floristic Region and Succulent Karoo, where they support highly specialised plant–pollinator networks. Second, habitat alteration (agricultural intensification, urbanisation, deforestation) consistently reduces beetle diversity, abundance, and pollination function through floral resource loss, larval habitat destruction, and landscape homogenisation. Organic farming and retention of native vegetation offer partial mitigation. Climate change compounds these pressures: thermal physiological constraints, phenological mismatch, and projected range contractions under warming scenarios all point to significant vulnerability. Critically, the interaction between climate change and habitat fragmentation may trap beetle populations in degraded landscapes unable to support climate tracking. There is a profound knowledge gap: not a single study from the Miombo woodlands—Southern Africa's largest and most socio-economically important biome—met the inclusion criteria in this study. This blind spot undermines evidence-based conservation across much of the region. The review concludes with targeted recommendations for policymakers, conservation practitioners, and researchers, emphasising that pollinating beetles cannot be protected by bee-focused strategies alone.

Keywords: Pollinators, beetle-plant mutualism, anthropogenic threats, scarabaeidae, Curculionidae, Miombo Woodlands

Investigating the Formulation and Performance of a Waterborne Epoxy coating enhanced with Sodium Benzoate as a Corrosion Inhibitor for Structural Steel Protection

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Presentation Type: Poster

Abstract:

Corrosion of structural steel remains one of the most economically and structurally consequential challenges in civil engineering and industrial infrastructure. Traditional solvent-borne epoxy coatings, while effective in corrosion protection, pose significant environmental and health concerns owing to their high volatile organic compound (VOC) content. This study investigates the formulation and performance of a waterborne epoxy coating enhanced with sodium benzoate as a corrosion inhibitor for structural steel protection. Four samples of the coating were prepared using varying ratios of the waterborne epoxy to the sodium benzoate were varied at 0:1; 1:1; 1:2; 2:1 respectively. The prepared coatings were evaluated using drawdown, viscosity, and opacity tests, corrosion coupon tests (moisture and water immersion), salt spray testing (ASTM B117 ISO 9227), and hydrogen-induced cracking test. The coating tests, that is draw down test produced a uniform film to evaluate good coverage (hiding power) by the coatings, the opacity test proved the coverage ability by the coating and lastly the viscosity tests determined the rheological properties of the coating. Coated mild steel panels were evaluated for corrosion resistance of the

coatings using the salt spray test (ASTM B117 ISO9227), which is an accelerated corrosion test used to evaluate how effectively a coating protects a metal substrate from corrosion in a chloride-rich environment. The Corrosion coupon tests (ASTM G31) and the Hydrogen Induced test (NACE TM0284) showed the coating's resistance to hydrogen permeation and the formation of blisters caused by hydrogen accumulation at the coating–metal interface. The findings indicate that the synergistic combination of the barrier protection offered by the waterborne epoxy resin and the active corrosion inhibition provided by sodium benzoate can effectively enhance the durability and protective performance of steel coatings.

Keywords: Corrosion, industrial infrastructure, epoxy coatings, VOC content, viscosity, opacity, Hydrogen Induced test

Paper Production from Agave Sisalana Pulp and Musa Sapientum Pseudo-Stalks

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Presentation Type: Poster

Abstract:

The purpose of this study was to make kraft paper from two natural fibres Agave sisalana (sisal) and Musa sapientum pseudo-stalks (banana fibre) as a renewable and non-wood option. Experiments involved refluxing the two biomaterials together with changed amounts of sodium hydroxide (NaOH), heating levels and cooking times. To improve the process, the Taguchi method was used to find the optimum cooking conditions that influence both pulp yield and the amount of residual lignin in pulp. The properties of both the fibres and the resulting pulp were studied by means of Fourier Transform Infrared Spectroscopy and Thermogravimetric Analysis. Spectral analysis indicated that the presence of cellulose and hemicellulose. It was shown by the features in the spectra that both fibres contain sufficient cellulose for making paper. Two major stages of thermal degradation were seen in the TGA results. Most of the weight loss that took place at that temperature was due to moisture vanishing. Hemicellulose and cellulose decomposed mainly during the second significant weight loss at temperatures between 250 and 350 °C. Agave sisalana gave the best pulp yield and kappa number at 20 % NaOH concentration, along with a temperature of 100 °C for 4 hours. The results for Musa sapientum showed that the best conditions were 15 % NaOH at 150 °C for 75 minutes, giving 47.02 % pulp and a kappa number of 7.21. These experiments confirmed that both fibres can be processed using moderately alkaline solutions for making good pulp. Results from the study confirm that kraft paper can be produced from the mix of sisal and banana fibres, contributing to the paper industry's sustainability.

Keywords: Kraft paper, Agave sisalana, banana fibre, Taguchi method, cellulose, paper industry sustainability.

Smart Agriculture and Agro-Industrial Systems

Sub-Theme 3a: Technologies, Value Chains, Climate Smart Systems and Food Security Solutions

Data-Driven Prediction of Semen Extender Composition Using Computational Approaches

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Abstract

This study integrated systematic evidence synthesis, statistical effect modelling, and machine learning to recommend candidate bull semen extender formulations with improved cryoprotective capacity. A dataset of diluent compositions and corresponding post-thaw sperm quality was collated from published literature and experimental records. A Generative Adversarial Network (GAN) was trained to predict semen quality from compositions and propose data-driven candidate extenders. The best five formulations were validated against a commercial egg-yolk control using semen from three Tuli bulls. Predicted total motility of the top five computationally optimised extenders was significantly higher than experimental results. These results demonstrate the feasibility of combining systematic evidence, meta-regression, and predictive machine learning to accelerate semen extender development.

Keywords: machine learning, semen diluents, media design, cryopreservation

Assessment of the Biological Qualities of Horses for Hippotherapy

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Abstract

Hippotherapy is an innovative and effective method of rehabilitation and correction of various health conditions in people with disabilities, based on the use of horseback riding and conservation for therapeutic purposes. Research into biological agents for equine hippotherapy is a relevant area that improves the efficiency of medical centers. The study involved 10 Vyatka horses, aged seven to twelve years, from the Yunost Children's Sports School, a modern rehabilitation and treatment facility. The horses are kept in stalls during the winter and are moved to paddocks during the summer. Each horse receives one to two 45-minute sessions daily. Feeding and housing conditions at the Yunost Children's Sports School comply with regulations; the horses receive a balanced diet and proper care. They are watered from buckets four times a day. The horses' conformation meets the maximum score of -5. All horses have well-developed muscles without signs of hypertonicity or hypotonicity and are rated with the highest score of -5. Heart rate and respiratory rate were also measured, first at rest, then the horses were subjected to moderate exercise—walking, then trotting for 20 minutes, then galloping for 10 minutes. The horses' movement at the walk was also assessed.

All horses demonstrated good results: smooth, precise, four-beat movements at all gaits. The horses are in good physical condition. Excellent results were achieved for heart rate and respiratory rate at rest and after exercise. When assessing psychophysiological stability (calmness when petted, lack of aggression, and lack of reaction to stimuli), the animals were rated from 4 to 5 points (max 5). When assessing biological qualities, all horses used at the enterprise scored from 4.7 to 5 points and are considered suitable for hippotherapy.

Effects of Feeding Practices on the Metabolic Status of Aberdeen Angus Cows in the Perm Region

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Abstract

Ensuring the population's access to high-quality meat products remains one of the key priorities of the agro-industrial sector and is largely associated with the development and technological modernization of beef cattle production. However, the efficiency of the industry is determined not only by the implementation of innovative technologies, but also by the health status of animals. Currently, metabolic disorders represent a significant factor limiting the productive potential of beef cattle due to their negative impact on animal physiology and productivity. The study was conducted at an agricultural enterprise in the Perm Region using Aberdeen Angus cows ($n = 20$). During the winter period, the daily ration of cows weighing approximately 650 kg consisted of 16 kg of hay and ad libitum access to straw. Clinical examination of the animals was performed according to standard veterinary protocols. Blood samples were collected from the coccygeal vein using a vacuum blood collection system. Hematological parameters were assessed using a VetScan HM5 analyzer, while biochemical parameters were determined using a StatFax analyzer. Diet analysis revealed excessive levels of crude fiber, crude fat, phosphorus, and carotene, accompanied by deficiencies in crude protein, sugars, and calcium. Despite the absence of clinically evident abnormalities and hematological values remaining within reference ranges, biochemical analysis demonstrated pronounced metabolic alterations. In particular, serum total protein concentration decreased by an average of 13%, total calcium by 28%, and urea by 11% compared with physiological reference values. Simultaneously, albumin and inorganic phosphorus concentrations increased by approximately 21%, whereas triglyceride and total bilirubin levels increased 1.5-fold. These findings indicate that unbalanced feeding in Aberdeen Angus cows was associated with disturbances in protein, lipid, and mineral metabolism, as well as impaired liver and kidney function.

Keywords: metabolic disorders, animal physiology, Perm Region, Aberdeen Angus Cows, Hematological parameters, lipid, mineral metabolism

Design of an Energy-Efficient Flue-Cured Tobacco Tunnel Barn targeted for Smallholder Farmers. A systematic Review

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Abstract

Conventional wood fired tobacco barns in Zimbabwe consume up to 5.32 kg of wood per kilogram of cured leaf, driving extensive deforestation. Large continuous tunnel systems achieve a fuel efficiency of 0.9 kg coal kg⁻¹ cured leaf, but they are designed for estates of 120+ hectares and cost about USD 21,000, placing them beyond the reach of smallholders. The review approach was based on the use of electronic research databases to retrieve relevant journals and patents on flue-cured tobacco barns. This review paper presents a theoretical design for a scaled down continuous tunnel curing barn intended for a 4 ha sized farm. The barn features three compartmentalised curing zones, a meandering brick heat exchanger with a sand separated preheating duct, a V slot coal furnace, and a forced air counter current ventilation system. Construction relies on locally available materials clay bricks, galvanised iron sheets, thatch insulation, and sand and the total projected cost is USD 5,540. Based on scaling from validated tunnel data and local barn trials, the design processes 4,200 kg of fresh leaf per 7 day cycle, consumes 0.9 kg coal per kilogram of cured tobacco, and provides sufficient seasonal capacity for 4 ha. If validated through prototype testing, the barn could reduce wood fuel use by approximately 75% compared with conventional and rocket barns, offering a practical pathway to mitigate tobacco related deforestation.

Keywords: tobacco curing; tunnel barn; energy efficiency; flue-cured tobacco; smallholder farming

Development of slicing machinery for root crops targeted for small to medium scale farmers. A Systematic Review

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Abstract

Cereals are the most common source of carbohydrates worldwide; however, cassava, yam and sweet potatoes among other root crops are considered to be some of the major staple foods by millions of Africans. Cassava, sweet potatoes and *Neorautanenia brachypus* (Harms) C.A.Sm., among other root crops are drought tolerant and thrive well in poor fertility soils and thus they are one of the promising mitigation measures against seasonal variability and climate change. Root crops can also be used as grain substitute for animal feed formulation, consequently reducing the inevitable competition for grain between humans and livestock. Every root crop once harvested needs to be stored or processed quickly so as to reduce post-harvest losses. The aim of this systematic review is to analyse and evaluate the designs and technologies, capacities and efficiencies of machines employed in processing root crops and identify gaps for further

development and innovations. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) method was used to carry out this research. Electronic research databases; Science direct, Core Database ,Google Scholar search engine and Publish or Perish app was used to retrieve relevant journals and patents on root and tuber processing from 2000 to 2023. A total of 1780 studies were screened for relevance, date, and language, while only 50 studies were used in this review for further analysis. The findings of this review shows that most slicing machines use the principle of shearing forces to slice the tuber between the fixed plate and the extended cutting blades. Slicing machines reported very low capacities that are below 500kg/hr. The drawback of the reviewed chipping machines is that they are crop specific and cannot be used for other root crops such as *N. brachypus* (Zhombwe), among other root and tuber crops. It can be recommended that more research should focus on designing improved processing machinery so as to improve efficiency and capacity.

Keywords: root crops, slicing machinery, efficiency, capacity

AI Adaptive Rain Water Harvesting System: A Framework for Restoring Zimbabwe's Indigenous System with Smart Solutions

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Monika Gonde – M. Tech., Coordinator – School of Information Science and Technology

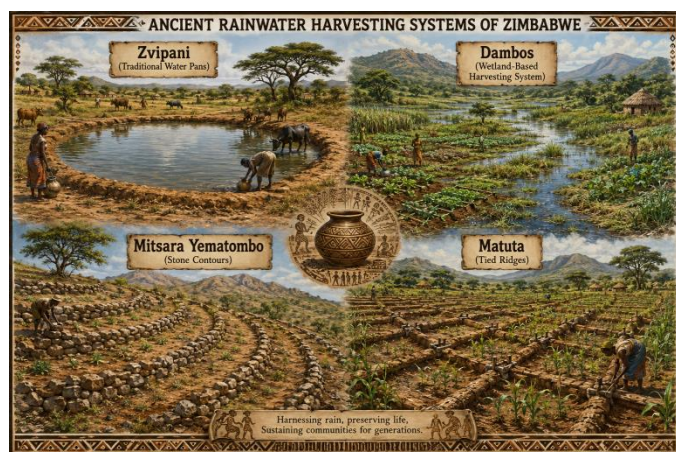
Eng. Nathan Jubilation Chifamba – Chairperson, Polymer Technology and Engineering

Eng. Mildred Nyamunokora – Lecturer, Polymer Technology and Engineering

Eng. Romeo Toga – Director, Infrastructure & Estate Management

Abstract

Zimbabwe traditionally relied on indigenous rainwater harvesting practices such as clay-lined reservoirs, contour ridges, infiltration pits, wetlands preservation, and community-managed water storage systems. However, urbanization, climate variability, and modernization have led to the decline of these practices. This paper proposes an AI-Adaptive Rainwater Harvesting System (AI-ARWHS) that integrates Zimbabwe's indigenous water harvesting knowledge with smart technologies including IoT sensors, machine learning rainfall prediction, automated water storage management, and decision-support systems. A framework is developed and evaluated using an ideal model site. The proposed system demonstrates improved water collection efficiency, storage optimization, and drought resilience while preserving indigenous water conservation practices. This paper presents the ease of adaptation of the methods into real-time implementations.



Keywords: Artificial Intelligence, Rainwater Harvesting, Indigenous Knowledge Systems, IoT, Zimbabwe, Climate Change Adaptation, Smart Water Management.

Ivhu Inhaka Yedu: Community-Driven Agricultural Intelligence for Rural Industrialisation and Food Sovereignty in Africa

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Abstract

Across much of Africa, farming decisions are still guided by handwritten notebooks, memory, and tacit knowledge passed from one generation to the next. While digital agriculture continues to advance globally, many existing solutions are designed for highly mechanized farming systems and do not adequately address the realities of African smallholder and medium-scale farmers, including intermittent connectivity, limited digital infrastructure, multilingual communities, and diverse farming enterprises. This presentation introduces the *NhakaYedu* Farm Intelligence System™, a community-driven agricultural intelligence platform being developed under the Udade AI Collective to support evidence-based decision-making while preserving African ownership of agricultural knowledge and data. The platform is being piloted in Zimbabwe through family-run farming operations and is designed to integrate livestock, crop, environmental, financial, and workforce intelligence within a single offline-first ecosystem. Rather than viewing AI as a replacement for farmers, *NhakaYedu* positions artificial intelligence as a tool that strengthens human judgment through trusted data, local knowledge, and responsible governance. Guided by the DROVE (Direction, Refinement, Ownership, Validation and Expression) framework, presented at the NORA conference in Norway, the platform ensures that farmers remain the decision-makers while AI provides context-aware recommendations to support more informed and resilient farming practices. The study explores how community-generated farm records can become a foundation for research, agricultural extension, environmental stewardship, rural entrepreneurship, and agro-industrial development. It highlights practical lessons from developing and introducing digital intelligence systems within Zimbabwean farming communities, demonstrating how technology can be designed around local realities rather than requiring communities to adapt to technology. By positioning agricultural intelligence as both a community asset and a research infrastructure, *NhakaYedu* demonstrates how responsible AI can strengthen sustainable livestock livelihoods, improve decision-making, support innovation, and contribute to resilient rural economies across Southern Africa.

Keywords: DROVE, *Nhaka Yedu*, Farm Intelligence, digital agriculture, smallholder farmers, digital intelligence systems, Udade AI Collective.

The effect of stimulant drugs on the biochemical status of calves in the early postnatal period.

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Abstract

Calves in the early postnatal period represent a group requiring special attention from veterinary specialists. Any stress factors or nutrient deficiencies can lead to growth retardation, reduced resistance and, consequently, to productivity losses at an older age. Therefore, the search for effective and safe stimulant drugs that can improve metabolic processes and immune status is an urgent task. Two groups of calves in the early postnatal period were formed for the experiment. At first 24 hour after birth the first group received a combination of stimulant drugs: Boostim at a dose of 0.5 ml and Sediminum plus at a dose of 5 ml intramuscularly. The second group (control) received no drugs. Blood samples were taken from all animals, and the following biochemical parameters by automatic analyzer VP100 (China) were determined: glucose, albumin, globulin, total protein, urea, creatinine, ALT, total bilirubin, phosphorus, calcium. Data are presented as mean $\pm$ standard error. In the group receiving stimulants, a significant increase in globulin levels (15.8 ± 0.1 g/L) was observed compared to the control (6.4 ± 0.1 g/L), as well as total protein (58.6 ± 0.2 g/L versus 47.9 ± 0.8 g/L). This indicates activation of the humoral immune system. Alanine aminotransferase activity in the experimental group was higher (21.7 ± 0.8 U/L versus 8.1 ± 0.9 U/L), which, combined with decreased urea (3.7 ± 0.1 versus 4.6 ± 0.3 mmol/L) and a tendency toward lower bilirubin, indicates metabolic remodeling of hepatocytes rather than their damage. Glucose level in the experimental group was higher (4.5 ± 0.3 versus 3.6 ± 0.3 mmol/L), indicating energy support. The use of Boostim and Sediminum plus has a positive effect on the biochemical status of calves, stimulating immunity and metabolic processes, which may contribute to increased productivity of calves in future.

Keywords: Boostim, Sediminum, Postnatal, growth retardation, stimulant drugs, metabolic remodelling

The Detection of *Eustrongylides Excisus* (Dorylaimea: Dioctophymatidae) in Fish from The Kama Reservoir

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Abstract

Eustroingilidosis of fish is caused by the larvae of nematodes of the genus *Eustrongylides*. Nematodesto extensive geographic distribution and in the field of pathogens of zoonotic importance. *E. excisus* is considered to be the most common zoonotic parasite of freshwater fish. The expansion of the range of this species is observed in the Volga Reservoirs. This study aimed

to investigate the infection of commercial fish from water bodies in the Perm Krai with nematode larvae of the genus *Eustrongylides*. Ichthyological material was obtained from September 2024 to May 2026 from Kama and Votkinsk Reservoirs, the rivers Sylva, Kama, Chusovaya, Lysva, Vilva. A total of 888 fish specimens were examined in the families Cyprinidae, Percidae, Esocidae, and Gadidae. Fish were considered using the incomplete parasitological autopsy. Species identification was based on morphological characteristics using identification keys and data from scientific articles, parasitological indices were determined. Among sampled fish species, only in ruff (*Gymnocephalus cernuus*) larval were morphologically referred of *E. excisus* were isolated. The prevalence of infection in ruff from the central district (58°88'78" N, 56°18'37" E) of the Kama Reservoir was 0,75 %, intensity of infection 1. Previously, there were no reports of the detection of representatives of the genus *Eustrongylides* in fish from bodies of the Perm Region. The expansion of the range of *E. excisus* is explained by the expansion of the range of their definitive hosts: the Great Cormorant and the Great Egret to the north. *E. excisus* larvae were found in ruff for the first time in the Kama Reservoir in the central region. Despite the low prevalence of infection, the presence of record of infection indicates a danger to fish and mammals.

Keywords: Eustroingilidosis, pathogens, zoonotic, commercial fish, parasitological autopsy, Kama Reservoir

Parasitological safety of feed and food insects in Russia

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Smart Agriculture and Agro-Industrial Systems: Technologies, value chains, climate-smart systems, and food security solutions.

Abstract

Insects in Russia are bred for the production of insect protein, vermicompost, and as feed for exotic animals. They have a high degree of metabolic plasticity and can effectively extract nutrients from agricultural waste. They are a potential source of food during long-term space missions. However, the use of insects for feed and food purposes carries parasitic risks. A total of 1,200 insects at different stages of development were collected from insectariums in Perm including Marbled cockroach *Nauphoeta cinerea* Olivier, 1789; Six-spotted cockroach *Eublaberus distantis* Kirby, W. F., 1903; Argentine cockroach *Blattella germanica* Serville, 1838; Madagascar cockroach *Gromphadorhina portentosa* Schaum, 1853; Turkestan cockroach *Periplaneta lateralis* Walker, 1868; Migratory locust *Locusta migratoria* Linnaeus, 1758; Two-spotted warbler *Gryllus bimaculatus* De Geer, 1773; Zophobas *morio* Fabricius, 1776; Mealworm *Tenebrio molitor* Linnaeus, 1758; Chinese beetle *Ulomoides dermestoides* Fairmaire, 1893. The study was conducted using the method of parasitological autopsy. After that, the insects' internal organs were examined on a dark background using a Meij microscope at 100x and 400x magnification. The images were captured using a Vision camera. The study revealed that nematodes and eggs of *Leidyneia portentosa* Van Waerebeke, 1978 and ciliates of *Nyctotherus* sp. Leidy, 1849 were found in cockroaches. Protozoa of the subclass Gregarinasina were detected in all insect species. However, all the detected parasites develop without intermediate hosts and do not pose a threat to human or exotic animal health. The protozoa Gregarine spp. and ciliates *Nyctotherus* spp. are pseudoparasites of humans and animals. However, the effects of insect-specific parasites on

humans are still not fully understood, but it is worth noting that Gregarine spp., a parasite specific to cockroaches, can cause asthma in humans.

Keywords: Vermicompost, metabolic plasticity, cockroach, nematodes, parasites

Partnering for Innovation in Namibia: Leveraging Traditional Ecological Knowledge for Sustainable Mushroom Cultivation and Rural Livelihood Development

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Abstract

This proposed community-based solution integrates Traditional Ecological Knowledge (TEK) with sustainable mushroom cultivation as a practical pathway for inclusive rural industrialisation and poverty reduction. The project aims to document indigenous knowledge related to natural resource use, construct low-cost community-managed mushroom houses using locally sourced materials, and provide structured hands-on training to community members. The initiative prioritises women, youth, and marginalised groups as primary beneficiaries. Expected outcomes include improved household incomes, enhanced food and nutrition security, skills development, and strengthened community-led enterprise systems through circular bioeconomy practices. The initiative calls for donor support and strategic partnerships to enable implementation and long-term sustainability.

Keywords: Community-based solutions, Traditional Ecological Knowledge, mushroom cultivation, rural livelihoods, inclusive development, social innovation

In Silico Comparative Analysis of Zeaxanthin Epoxidase Gene in Sorghum (*Sorghum bicolor*) and Millet (*Pennisetum glaucum*)

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Abstract

This study presents a comparative in silico analysis of the ZEP gene in *Sorghum bicolor* and *Pennisetum glaucum*, two staple cereals widely cultivated in semi-arid regions of Africa. Genomic sequences of the ZEP gene were retrieved from public databases and subjected to multiple sequence alignment. Phylogenetic reconstruction using the Neighbor-Joining method revealed a close evolutionary relationship between the two species, supported by a high bootstrap value of 92%. Functional annotation identified 12 genetic variants, including several missense mutations predicted to alter enzyme conformation and activity. These findings provide insights into the molecular evolution and functional dynamics of the ZEP gene and its application in marker-

assisted breeding programs aimed at developing climate-resilient, nutritionally enhanced crop varieties.

Keywords: Zeaxanthin epoxidase, *Sorghum bicolor*, *Pennisetum glaucum*, carotenoid biosynthesis, drought tolerance, comparative genomics, food security

Efficacy of Azithromycin Oral Powder and Toltrazuril in the Treatment of Dairy Calf Scours

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Abstract

This study evaluated the efficacy of Azithromycin Oral Powder administered alone and in combination with Toltrazuril in the treatment of calf scours in pre-weaned dairy calves. A total of 30 diarrhoeic calves were randomly allocated into three treatment groups. Calves treated with the combined Azithromycin and Toltrazuril therapy showed significantly improved recovery rates, shorter duration of diarrhoea, reduced severity of clinical signs, and better growth performance. The combination therapy proved particularly effective in cases involving both bacterial and protozoal infections, highlighting the importance of targeted treatment strategies and responsible antimicrobial use in dairy production systems.

Keywords: Antibiotics, dairy calves, productivity, recovery rates, scours

Influence of Farm Management Practices on the Occurrence of Diarrhoea in Piglets During Pre- and Post-Weaning Stages

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Abstract

This study examined the influence of farm management practices on the occurrence of diarrhoea in piglets during the pre-weaning and post-weaning stages within commercial pig production systems in Zimbabwe. A descriptive and analytical survey design was used. Results showed that poor sanitation, inadequate housing, contaminated feed, and abrupt weaning practices were associated with increased diarrhoea incidence in piglets. Farm records revealed a higher prevalence of diarrhoea in post-weaning piglets (57.1%) compared to pre-weaning piglets (30%). The study concludes that improved hygiene, proper feeding systems, better housing conditions, and effective weaning strategies remain important in reducing diarrhoea incidence.

Keywords: Diarrhea, health, piglets, management practices, weaning

Pesticidal Effect of Chilli, Garlic and Marigold Extracts against Fruit Fly (*Bactrocera dorsalis*) in Guava

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This study evaluated the pesticidal potential of aqueous botanical extracts from chilli (*Capsicum* spp.), garlic (*Allium sativum*), and marigold (*Tagetes* spp.) against fruit flies in guava under laboratory conditions. The experiment used eleven treatments with three replications. Results revealed significant treatment effects on fruit fly mortality. Most plant extracts performed comparably to the standard insecticide, Imidacloprid. Among the botanicals, the 20% marigold extract recorded the highest repellency. The findings demonstrate that chilli, garlic, and marigold extracts are potential biopesticides that should be considered in integrated pest management schemes for fruit fly in guava.

Keywords: Fruit fly, botanical extracts, mortality, repellency, biopesticide

Systematic Review: L-DOPA-Free *Mucuna pruriens* Seed Residue as Animal Feed – Processing Methods, Nutritional Value and Safety

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Abstract

This systematic review examined the potential of L-Dopa free *Mucuna pruriens* seeds as animal feed. From 247 articles initially identified, 85 studies qualified for inclusion in qualitative analysis. The process involving fermentation (yeast-based, 37°C, 72 hours) was found to result in the greatest reduction of L-Dopa content (55.8%). Animal studies involving 23 trials on 1,456 animals showed no significant differences between the use of processed *Mucuna* seeds meal and conventional animal feed. *Mucuna pruriens* seeds can be used as an alternative source of proteins for livestock after appropriate processing. Fermentation is the safest and the best means to detoxify the seeds.

Keywords: *Mucuna pruriens*, Velvet Bean, L-Dopa, Animal Feed, Detoxification, Fermentation

Evaluation of Humic + Fulvic Acid-Based Bio-Nematicide Against Root-Knot Nematode (*Meloidogyne* spp.) in Tomato (*Solanum lycopersicum* L.)

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Abstract

This study evaluated the efficacy of a humic and fulvic acid-based bio-nematicide at varying concentrations against *Meloidogyne incognita* in tomato under pot conditions at Chinhoyi University of Technology Farm during the 2025/26 summer season. Results demonstrated that humic + fulvic acid-based bio-nematicide significantly reduced root galling and nematode population densities compared to the untreated control. Bio-nematicide at 2 g/L and 3 g/L achieved nematode suppression and fruit yield (46 and 47 t/ha, respectively) comparable to Oxamyl 310 SL

(45 t/ha). These findings confirm humic and fulvic acid-based bio-nematicide as a promising, environmentally safe alternative to synthetic nematicides.

Keywords: Bio-nematicide, root-knot nematode, sustainable agriculture, integrated pest management, humic acid, tomato

Evaluation of the Larvicidal Efficacy and Insecticidal Activity of *Afzelia quanzensis* (Mukamba) Bark Extracts Against *Spodoptera frugiperda*

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This study assessed the insecticidal efficacy of mukamba (*Afzelia quanzensis*) bark extracts against fall armyworm larvae under laboratory conditions. Four concentrations of aqueous bark extract (5%, 15%, 25%, and 50% w/v) were applied to maize leaves infested with fall armyworm larvae. The results indicated that larval mortality increased significantly in extract-treated leaves compared to the untreated control. Feeding deterrence and larval abnormality were significantly higher in the extract treatments. These findings demonstrate that *A. quanzensis* bark extracts possess potent bioactive compounds with strong larvicidal and antifeedant properties with potential as a botanical pesticide for integrated fall armyworm management.

Keywords: *Afzelia quanzensis*, Mukamba, botanical extracts, fall armyworm control

Laboratory Evaluation of *Jacobaea maritima* Extracts as a Biopesticide Against Cabbage Aphids (*Brevicoryne brassicae*)

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This study evaluated the insecticidal efficacy of silver ragwort (*Jacobaea maritima* L.) against *Brevicoryne brassicae* using a 2 × 8 factorial experiment in a randomised complete block design with three replications. *J. maritima* extracts exhibit dose-dependent insecticidal effects on *B. brassicae* mortality. The greatest efficacy was recorded at the 25% extract concentration, yielding an 88.2% mortality. Topical application recorded a higher mortality of 57.0% compared to 49.4% for the contact method. These preliminary findings demonstrate that *J. maritima* extracts possess strong insecticidal properties, highlighting their promise for the development of eco-friendly biopesticides.

Keywords: Eco-friendly pesticides, biopesticide, sustainability, integrated pest management, silver ragwort

Isolation and Efficacy Evaluation of Indigenous *Bacillus* spp. from Chinhoyi Soils Against Cabbage Aphid (*Brevicoryne brassicae*)

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This study aimed to isolate, phenotypically identify, and evaluate the efficacy of naturally occurring soil bacteria as potential aphid biocontrol agents. Three soil samples were collected,

serially diluted, and characterised using Gram staining, colony morphology, catalase activity, starch hydrolysis, and citrate utilization tests. Eight distinct bacterial treatments along with an untreated control were evaluated against aphids in laboratory bioassays over a 72-hour period. After 72 hours, the OWRDR, LWRDR, and LWRDF treatment groups exhibited the highest mortality of approximately 75%. These outcomes confirm the biopesticidal potential of indigenous, rod-shaped, Gram-positive soil bacteria.

Keywords: Aphid biocontrol, *Bacillus* spp., biological pest control, entomopathogenic bacteria, soil isolates

A New Integrated IoT-Based Fall Armyworm (*Spodoptera frugiperda*) Surveillance and Control System for Smallholder Farmers in Zimbabwe

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This study developed and evaluated a low-cost, non-internet-based IoT-enabled device designed to send real-time alerts to farmers via SMS. Utilising an agile development methodology, the system integrated an Arduino Nano processor, an infrared break-beam sensor system, a GIM800L GSM module, and a solar power supply. A 12-week field evaluation was conducted comparing the IoT trap against conventional bucket traps and manual scouting. Results revealed significant differences in mean farmer reaction times, with the IoT-enabled device outperforming conventional methods. Validation testing yielded a high correlation ($r = 0.8443$), demonstrating excellent predictive capabilities for future infestations.

Keywords: Internet of Things, fall armyworm, pheromone, scouting, smallholder farmers, Zimbabwe

Development of Natural Biodegradable Superabsorbent Polymers Using Acrylamide and Methylcellulose for Potato Cultivation

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This project focuses on the development of a natural biodegradable superabsorbent polymer using methylcellulose and acrylamide for use in potato cultivation, addressing poor crop yields caused by reduced soil retention, water scarcity and inefficient irrigation. Different ratios of acrylamide to methylcellulose were used to determine the sample with the best water absorption capacity, water retention capacity and buffering capacity in different pH conditions. The best sample was Sample 3 with a ratio of 2:1. This innovation also serves as a solution to environmental concerns associated with petroleum-based non-biodegradable superabsorbent polymers, which persist in the soil causing soil pollution and gradual soil infertility.

Keywords: biodegradable, super-absorbent polymers, agricultural, methylcellulose, polyacrylamide

Modification of Waste Cooking Oil to Produce a Sustainable Biofuel for Tobacco Curing Process

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Zimbabwe's tobacco curing industry relies heavily on fossil fuels and firewood, contributing to deforestation, rising costs and greenhouse gas emissions. This research optimised transesterification conditions for waste cooking oil (WCO) biodiesel production. Optimal conditions: methanol as preferred alcohol over ethanol, 1:6 oil-to-methanol ratio, temperature of 60°C and residence time of 90 minutes achieving a biodiesel yield of 92.3%. The blend B80WCO10E10 (80% biodiesel, 10% WCO, 10% ethanol) emerged as optimal with an energy content of 39.11 MJ/kg. Economic analysis determined the project as promising, with an internal rate of return of 76.84% and net present value of \$1,420,887.97 after 5 years.

Keywords: Waste cooking oil, transesterification, break-even, net present value, rate of return, internal rate of return, biofuel

Antioxidant Potential and Cryoprotective Effects of Bovine Semen Diluents Enriched with Aloe barbadense Extracts

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This study aims to evaluate cryoprotective and antioxidant potential of bovine semen diluents enriched with extracts of Aloe barbadense. Split ejaculates from two Mashona and two Tuli bulls were diluted in extenders containing 0%, 10%, 15% and 20% inclusion levels of Aloe gel. Post-thaw sperm motility was significantly higher in the 10% Aloe vera treatment (53%) relative to other treatments. Free radical scavenging activity peaked at 72% and 62% for the DPPH and Hydroxyl RSA, respectively, at 15% inclusion. Thus, Aloe barbadense gel demonstrated efficacy in reducing oxidative stress and improving sperm cryosurvival of bovine semen, with an optimal balance between 10% and 15% gel inclusion.

Keywords: plant extracts, antioxidants, cryosurvival, longevity, bull semen

Resilient Agro-Industrial Supply Chains: Leveraging Smart Agriculture Technologies for Climate-Smart Food Systems

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This study examines how smart agriculture technologies can be leveraged to develop resilient agro-industrial supply chains that support climate-smart food systems. Anchored in Diffusion of Innovation (DOI) Theory and Supply Chain Resilience Theory, a mixed-methods approach was adopted. Expected findings indicate that the integration of IoT-enabled monitoring systems, digital traceability platforms, predictive analytics, and smart logistics networks can significantly improve supply chain visibility, reduce post-harvest losses, enhance resource efficiency, and strengthen adaptive capacity to climate shocks. The study recommends investment in digital infrastructure,

capacity building, public-private partnerships, and supportive policy frameworks to accelerate the adoption of smart agriculture technologies.

Keywords: Smart Agriculture, Agro-Industrial Supply Chains, Internet of Things, Climate-Smart Food Systems, Digital Agriculture

Herbal Perfume Production from a Blend of *Lippia javanica* (Zumbani) and *Eucalyptus grandis* (Flooded Gum) Oils Plant Extracts

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This project focuses on the synthesis of a herbal perfume from a blend of *lippia javanica* and *eucalyptus grandis* oils plant extracts, following a value addition agenda whereby underutilised natural resources are processed into a product. Zimbabwe relies heavily on imported synthetic perfumes which are also raising health and environmental concerns. Majority of experiments focused on extracting the absolute oils from the two plant species, with the optimum process parameters being solid to solvent ratio of 1:7, temperature of 55 degrees Celsius, n-hexane as the best solvent, and residence time of 45 minutes for *eucalyptus grandis* and 60 minutes for *lippia javanica*. The extraction method used was ultrasonic assisted solvent extraction.

Keywords: *lippia javanica*, *eucalyptus grandis*, steam inhalation, herbal perfume, absolute oils, UA-SE

Climate-Smart Livestock Innovations and Partnerships for Enhancing Smallholder Resilience and Rural Industrialization in Zimbabwe

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This presentation examines how climate-smart livestock innovations and multi-stakeholder partnerships can enhance smallholder resilience and contribute to sustainable rural industrialisation in Zimbabwe. Adopting a systematic review and synthesis approach, the study analyses climate-smart interventions such as improved feed and nutrition management, climate-resilient breeding systems, enhanced animal health services, water harvesting technologies, and sustainable pasture and rangeland management. Findings indicate that climate-smart livestock innovations have strong potential to improve adaptive capacity, productivity, and sustainability within smallholder livestock systems. The study recommends promoting resilient indigenous breeds, enhancing public-private partnerships, and developing supportive policies that facilitate climate adaptation and livestock value chain development.

Keywords: climate-sensitive, climate smart, livestock production, livelihoods, smallholder resilience

Synthesising existing literature on how behavioural drivers shape livestock productivity and value chain performance in Zimbabwe.

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Presentation Type: Poster

Abstract:

Livestock production is a cornerstone of rural livelihoods, food security, and agribusiness transformation in Zimbabwe, particularly within smallholder and emerging farming systems. Nevertheless, livestock productivity and participation in formal value chains remain limited despite the availability of improved technologies and management innovations. Increasing empirical evidence suggests that these persistent challenges are strongly influenced by behavioural factors linked to farmer decision-making and animal behavioural responses. This study synthesises existing literature to explore how behavioural drivers shape livestock productivity and value chain performance in Zimbabwe and comparable Southern African contexts. Drawing on Behavioural Economics, the Theory of Planned Behaviour, and Human–Animal Interaction Theory, the review examines how farmer attitudes, social norms, perceptions of risk, and animal responses interact to influence management practices, welfare outcomes, and economic performance. A systematic literature review was conducted in line with PRISMA guidelines, analysing peer-reviewed articles, policy documents, and development reports published between 2022 and 2026, with specific attention to livestock behaviour, farmer decision making, productivity outcomes, and value chain engagement. The findings indicate that farmer risk aversion, low institutional trust, labour constraints, and psychological stress significantly affect the uptake of improved livestock practices. Concurrently, suboptimal human–animal interactions and handling practices elevate animal stress, leading to reduced productivity and compromised product quality. These interconnected behavioural challenges contribute to inefficiencies and weakened livestock value chain performance. The study recommends the integration of behaviourally informed extension services, farmer wellbeing considerations, and animal-centred management approaches into livestock development programmes, alongside agribusiness policies that move beyond purely technical interventions to incorporate behavioural insights for sustainable and inclusive value chain development in Zimbabwe.

Keywords: Agribusiness, livelihoods, food security, livestock behaviour, sustainable

GZU Dual-Compartment Dehuller: Advancing Smart Agro-Industrial Processing of Traditional Grains in Zimbabwe

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Presentation Type: Poster

Abstract:

Traditional grains such as sorghum and millet play a critical role in enhancing food security and climate resilience in dry-land regions of Zimbabwe due to their drought-tolerant characteristics. Despite their importance, adoption and commercialization of these grains remain constrained by labor-intensive processing methods, high drudgery, and limited access to affordable agro-processing technologies among smallholder farmers. To address these challenges, a low-cost dual-

compartment dehulling machine was developed at Great Zimbabwe University to support smart agro-industrial processing of traditional grains. The developed technology is the first of its kind capable of simultaneously processing two different grain types, thereby improving operational efficiency and reducing processing time. The machine is powered by an 8 hp diesel engine, making it suitable for rural communities with limited electricity access. Each compartment consists of abrasive discs mounted on rotating shafts and fitted with 2 mm sieves for efficient hull separation. Power transmission is achieved through a pulley and V-belt system connected to the engine. Performance evaluation showed that the machine achieved effective capacities of 240 kg/h for finger millet and 270 kg/h for pearl millet and sorghum, with a fuel consumption rate of 3.2 h/L. Compared to conventional manual dehulling methods, the machine increased processing efficiency by approximately 22–24 times. The technology significantly reduces labor demands and processing drudgery, particularly among rural farming households, while strengthening traditional grain value chains and promoting value addition at community level. The adoption of this smart agro-processing technology has the potential to enhance climate-smart agricultural production, stimulate rural agro-industrialization, improve household livelihoods, and support sustainable food systems in Zimbabwe's dry-land areas.

Keywords: Traditional grains, dehulling machine, agro-industrial systems, climate-smart agriculture, rural industrialization, value addition, millet, sorghum.

The Design and Implementation of a Low cost, IoT-Based Precision Irrigation System Targeting Water Usage in Small-Scale Farming.

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Abstract:

The scarcity of water remains as one of the most impactful challenges facing agricultural productivity in semi-arid regions in Zimbabwe. Traditional irrigation practices are largely inefficient, relying on fixed schedules in significant water waste and reduced crop yields. This presentation outlines the design and implementation of a low cost, IoT-Based precision system of irrigation that targets water usage in small scale farming. The system integrates environmental sensors interfaced with a NodeMCU esp8266 Microcontroller to monitor field conditions in real time. The onboard automated control algorithm triggers irrigation only when the detected moisture and humidity levels are below optimum conditions. The data is transmitted wirelessly to a cloud platform for remote monitoring. Field tests indicated a reduction in water consumption of about 38% with no significant loss in crop yield thereby demonstrating the system's potential as an affordable, scalable solution for smallholder farmers in developing economies.

Keywords: Irrigation, design, implementation, environmental sensors, scalable solution, smallholder

Effects of Feeding Practices on the Metabolic Status of Aberdeen Angus Cows in the Perm Region

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Presentation Type: Poster

Abstract:

Ensuring the population's access to high-quality meat products remains one of the key priorities of the agro-industrial sector and is largely associated with the development and technological modernization of beef cattle production. However, the efficiency of the industry is determined not only by the implementation of innovative technologies, but also by the health status of animals. Currently, metabolic disorders represent a significant factor limiting the productive potential of beef cattle due to their negative impact on animal physiology and productivity. The study was conducted at an agricultural enterprise in the Perm Region using Aberdeen Angus cows ($n = 20$). During the winter period, the daily ration of cows weighing approximately 650 kg consisted of 16 kg of hay and ad libitum access to straw. Clinical examination of the animals was performed according to standard veterinary protocols. Blood samples were collected from the coccygeal vein using a vacuum blood collection system. Hematological parameters were assessed using a VetScan HM5 analyzer, while biochemical parameters were determined using a StatFax analyzer. Diet analysis revealed excessive levels of crude fiber, crude fat, phosphorus, and carotene, accompanied by deficiencies in crude protein, sugars, and calcium. Despite the absence of clinically evident abnormalities and hematological values remaining within reference ranges, biochemical analysis demonstrated pronounced metabolic alterations. In particular, serum total protein concentration decreased by an average of 13%, total calcium by 28%, and urea by 11% compared with physiological reference values. Simultaneously, albumin and inorganic phosphorus concentrations increased by approximately 21%, whereas triglyceride and total bilirubin levels increased 1.5-fold. These findings indicate that unbalanced feeding in Aberdeen Angus cows was associated with disturbances in protein, lipid, and mineral metabolism, as well as impaired liver and kidney function.

Keywords: Agro-industrial sector, beef cattle production, hermatological parameters, biochemical analysis, Aberdeen Angus.

Assessment of the Biological Qualities of Horses for Hippotherapy

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Presentation Type: Oral

Abstract:

Hippotherapy is an innovative and effective method of rehabilitation and correction of various health conditions in people with disabilities, based on the use of horseback riding and conservation for therapeutic purposes. Research into biological agents for equine hippotherapy is a relevant area that improves the efficiency of medical centers. The study involved 10 Vyatka horses, aged seven to twelve years, from the Yunost Children's Sports School, a modern rehabilitation and treatment

facility. The horses are kept in stalls during the winter and are moved to paddocks during the summer. Each horse receives one to two 45-minute sessions daily. Feeding and housing conditions at the Yunost Children's Sports School comply with regulations; the horses receive a balanced diet and proper care. They are watered from buckets four times a day. The horses' conformation meets the maximum score of -5. All horses have well-developed muscles without signs of hypertonicity or hypotonicity and are rated with the highest score of -5. Heart rate and respiratory rate were also measured, first at rest, then the horses were subjected to moderate exercise—walking, then trotting for 20 minutes, then galloping for 10 minutes. The horses' movement at the walk was also assessed. All horses demonstrated good results: smooth, precise, four-beat movements at all gaits. The horses are in good physical condition. Excellent results were achieved for heart rate and respiratory rate at rest and after exercise. When assessing psychophysiological stability (calmness when petted, lack of aggression, and lack of reaction to stimuli), the animals were rated from 4 to 5 points (max 5). When assessing biological qualities, all horses used at the enterprise scored from 4.7 to 5 points and are considered suitable for hippotherapy.

Keywords: Hippotherapy, hypotonicity, rehabilitation, biological agents, Vyatka horses, psychophysiological

Genetic improvement of Pearl Millet for Bird Damage Resistance

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Presentation Type: Poster

Abstract:

Pearl millet (*Pennisetum glaucum* L.) is a climate-resilient cereal that contributes significantly to food and nutrition security in the arid and semi-arid regions of Africa and Asia. However, its productivity is severely constrained by bird damage, particularly from quelea birds, which can cause grain yield losses of up to 80% during the milk and dough stages. Conventional bird control methods are labour-intensive, costly, and environmentally unsustainable. Bird deterrence traits such as bristles and panicle architecture offer a promising alternative, but their genetic basis remains poorly understood. This study aims to genetically improve pearl millet for bird damage resistance by identifying resistant germplasm, assessing combining ability, and determining the inheritance and heritability of resistance-related traits. Twenty-two diverse pearl millet genotypes will be evaluated under field conditions in Mwenezi during the 2026 rainy season using an 11 × 4 alpha-lattice design with two replications. Genotypes will be screened for bird damage resistance during the milk and dough stages. Selected parental lines will be crossed to evaluate general and specific combining ability for bird damage resistance and key agronomic traits. Genetic analyses will be conducted to determine gene action, mode of inheritance, heritability, and gene interactions associated with bristle and panicle architecture traits. Data will be analysed using Genstat 18th Edition and R version 4.6.0. Expected outputs include the identification of resistant germplasm, superior parental lines and hybrids, and genetic information on resistance-related traits. The study will also generate selection criteria and breeding materials for developing high-yielding, bird

damage-resistant pearl millet varieties. Ultimately, the research will contribute to improved pearl millet productivity and support Sustainable Development Goal 2 (Zero Hunger) by enhancing food security in semi-arid regions.

Keywords: Pearl millet, bird damage resistance, quelea birds, bristles, panicle architecture, heritability, combining ability.]

OPTIONS FOR SUPPORT TO AGRICULTURE AND FOOD SECURITY UNDER CLIMATE CHANGE

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ABSTRACT

Agriculture and food security are key sectors for intervention under climate change. Agriculture production is highly vulnerable to 2 degrees Celsius prediction for global mean temperature by 2100, with major implications for rural poverty and both rural and urban food security. Agriculture presents opportunities for mitigation given the large land area under crops and rangelands. This paper presents a summary of current knowledge on options to support smallholder farmers in achieving food security through agriculture under climate change. Areas of adaptation fall into two broad based overlapping areas, 1; Accelerated adaptation to progressive climate change over decade times scale, 2; Better management of agricultural risks associated with increasing climate variability and extreme events. Maximization of agricultural mitigation potential will require investments in technological innovations and agricultural intensification linked to increased efficiency of inputs, creation of incentives and monitoring systems that are inclusive for smallholder farmers. Food systems faced with climate change need urgent, broad based action in spite of uncertainties.

Keywords; Climate change, Food security, Livelihoods, Adaptation and Mitigation

Development of an Integrated Fixed Time Artificial Insemination Model Incorporating Vaccination Schedule against major Venereal Diseases

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Abstract:

Reproductive efficiency remains one of the major constraints in animal production especially beef cattle operating in cow-calf systems, whereby suboptimal pregnancy establishment is prevalent due to conception failure, embryonic loss and prolonged inter calving periods. Fixed-time artificial

insemination (FTAI) accelerates cattle reproductive management through synchronizing parallel follicular waves, enhancing luteolysis and same ovulatory response. Despite this, pregnancy rates to artificial insemination in beef cattle remains suboptimal, especially in cases where reproductive disease may compromise vaginal, uterine environment, development of conceptus and maintenance of pregnancy. The study is focusing on developing an integrated Fixed Time Artificial Insemination model incorporating vaccination schedule against major venereal diseases Brucella abortus, Leptospirosis, Bovine viral diarrhea and Bovine herpesvirus. A randomized complete block design (RCBD) will be conducted in multifarms in a period of two successive breeding seasons on 100 multiparous Bos taurus beef cows. Heterogeneity and management between herds will be accounted for using farms as treatment blocks. The trial will comprise of four treatment groups: (a) non-vaccinated control, (b) vaccination 90 days before AI, (c) vaccination at day 0 of synchronization, (d) vaccination 14 days after insemination. A standardized synchronization protocol involving CIDR, prostaglandin, PMSG, estradiol benzoate and estradiol cypionate. Samples will be stratified to determine base line serostatus as well as post-immunization response for serological profiling. The primary endpoints will include pregnancy per artificial insemination, pregnancy loss. The secondary endpoints will cover calf birth weight, 205 day-weaning weight, and pre-weaning mortality. The binary reproductive results will be analyzed using generalized linear mixed model. We hypothesize the integration of venereal disease vaccinations into Fixed Time Artificial Insemination programs to enhance ovulatory synchrony, foetal survival and maintenance of pregnancy.

Keywords: Fixed Time Artificial Insemination, Pregnant mare Serum Gonadotropin (PMSG), Controlled Internal Drug Release (CIDR), Bos Taurus, Brucella abortus, Leptospirosis, Bovine Viral diarrhea, Bovine herpesvirus.

Investigating the Synthesis and Characterisation of Biodegradable Chitosan-Kaolinite Clay Composite Hydrogels as Sustainable Soil Amendments for improved Water Retention and Controlled Nitrogen Fertiliser Delivery in Smallholder Agricultural Systems.

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Presentation Type: Poster

Abstract:

Water scarcity and fertiliser inefficiency remain critical challenges threatening agricultural productivity and food security in Zimbabwe and sub-Saharan Africa. Conventional irrigation and fertilisation practices result in significant nutrient leaching and rapid soil moisture loss, with crops absorbing only 20–30% of applied fertilisers. This study investigates the synthesis and characterisation of biodegradable chitosan-kaolinite clay composite hydrogels as sustainable soil amendments for improving water retention and enabling controlled nitrogen fertiliser delivery in smallholder agricultural systems. Six hydrogel formulations were synthesised by ionic crosslinking of chitosan (2% w/v) with sodium tripolyphosphate, incorporating locally sourced kaolinite clay at varying concentrations of 0, 0.5, 1, 2, 3, and 5% w/v. Ammonium nitrate was encapsulated in situ at loading levels of 50–200% w/v relative to polymer mass. Synthesised composites were characterised using Fourier Transform Infrared Spectroscopy (FTIR), X-Ray

Diffraction (XRD), and Thermogravimetric Analysis (TGA) to confirm functional group interactions, crystallinity, and thermal stability. Water retention capacity, swelling kinetics, encapsulation efficiency, and nitrogen release profiles were evaluated under simulated soil conditions. FTIR analysis confirmed successful ionic crosslinking between chitosan and TPP, and hydrogen bonding interactions between chitosan and kaolinite. XRD results are expected to reveal incorporation of kaolinite within the chitosan matrix. TGA to demonstrated improved thermal stability of composites relative to pure chitosan. Swelling ratios and water holding capacity increased with optimised kaolinite concentration, with the composite hydrogels retaining significantly more moisture than unmodified soil. Encapsulation efficiencies exceeding 80%, with nitrogen release following a sustained sigmoidal profile over 30 days consistent with Korsmeyer-Peppas diffusion kinetics. The biodegradable nature of chitosan ensures environmental safety upon soil incorporation. These findings demonstrate that low-cost, locally available chitosan-kaolinite composites offer a viable, ecofriendly alternative to synthetic polyacrylate hydrogels for sustainable agricultural applications in Zimbabwe.

Keywords: fertiliser inefficiency, food security, chitosan-kaolinite, water retention, swelling kinetics, synthetic polyacrylate hydrogels.

Preliminary in vivo evaluation of a *Cissus quadrangularis* based block lick for gastrointestinal nematode control in beef cattle

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Presentation Type: Poster

Abstract:

Gastrointestinal nematodes (GINs) cause substantial production losses in cattle, especially in resource constrained communities. The use of natural plant-based anthelmintics such as *Cissus quadrangularis* (veldt grape) has become of interest as a cost-effective alternative for GIN control, with the added advantage of reducing over-reliance on conventional anthelmintics which contribute to global anthelmintic resistance. A preliminary evaluation of a *Cissus quadrangularis* based block lick for GIN control in beef cattle is presented in this short communication. Nine non-descript yearling male cattle with a mean initial weight of 248 ± 12 kg were allocated to three treatments (n=3 per group) which are T1 – single oral dose of Systamex (positive control); T2 – *C. quadrangularis* block lick; and T3 – untreated control. Faecal egg counts (FEC, eggs per gram, EPG) and body weights were recorded weekly for 28 days. FEC and ADG differed significantly among treatments ($p < 0.001$). The Systamex group significantly reduced FEC by 66% by week 4 and exhibited the best weight maintenance (1.417 ± 1.07 kg overall). The *C. quadrangularis* group showed a moderate FEC reduction of 21.6% by week 4 but showed an overall weight loss of -0.233 ± 1.121 kg. The untreated group had increasing FEC and modest weight maintenance of 0.758 ± 0.40 kg. *Cissus quadrangularis* showed mild anthelmintic activity but negatively affected weight under these conditions. These results represent the first in vivo evaluation of *C. quadrangularis* as a potential alternative anthelmintic against GINs in cattle, providing preliminary

evidence for its efficacy and establishing a foundation for future dose optimization and validation studies.

Keywords: *Cissus quadrangularis*, veldt grape, anthelmintic, beef cattle, gastrointestinal nematodes ethnoveterinary medicine

An Evaluation of the Contribution of Climate-Smart Indigenous Knowledge Systems to Agricultural Adaptation, Food Security, and Sustainable Rural Livelihoods

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Abstract:

Climate change poses a significant threat to global food security, particularly in Africa where agriculture is predominantly rain-fed. The Intergovernmental Panel on Climate Change reports that African agricultural productivity could decline by up to 17% by 2050 under high-emission scenarios, with smallholder farmers being the most vulnerable. In response, Indigenous Knowledge Systems (IKS) have gained renewed attention as locally adapted and cost-effective approaches for enhancing climate resilience. This paper evaluates the contribution of climate-smart indigenous knowledge systems to agricultural adaptation, food security, and sustainable rural livelihoods. The objectives of the study were to: (i) assess documented evidence of successful climate-smart indigenous agricultural practices; (ii) identify challenges limiting their adoption and integration into formal agricultural systems; and (iii) examine future opportunities for combining indigenous and scientific knowledge to strengthen climate resilience and food security. Evidence from Zimbabwe, Kenya, Ethiopia, India, and Peru indicates that indigenous practices such as traditional weather forecasting, seed selection and preservation, intercropping, agroforestry, water harvesting, and botanical pest management have improved farmers' adaptive capacity to climate variability. In Zimbabwe, for example, small grains such as sorghum and millet, traditionally promoted through indigenous farming systems, consistently outperform maize under drought conditions. However, the erosion of traditional knowledge, inadequate documentation, weak policy support, and limited incorporation into agricultural extension services remain major constraints. The paper concludes that climate-smart indigenous knowledge systems represent a valuable but underutilized resource for sustainable agriculture. Strengthening research, validation, documentation, and policy integration can facilitate the co-creation of resilient agricultural systems capable of addressing climate change, enhancing food security, and supporting sustainable development.

Keywords: Climate change, food security,

Sustainable cropping through allelopathic weed management: Advancing climate resilient and environmentally safe agriculture

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Abstract

Climate change, herbicide resistance, environmental degradation, and concerns over agrochemical exposure have intensified the search for sustainable weed management strategies. Allelopathy, the release of biochemicals that influence neighbouring plants, has emerged as a promising alternative to synthetic herbicides. Research has shown that allelopathic crops such as sorghum, rice, rye, sunflower, and brassicas can suppress weeds through residues, cover crops, mulches, rotations, intercropping, and bioherbicides. Significant progress has been achieved in integrating allelopathy into crop production systems. In wheat, sorghum water extracts (sorgaab) reduced weed density by 35–49% and enabled reductions of up to 60% in isoproturon application while maintaining grain yield ($P < 0.05$). Integrated applications of allelopathic extracts with reduced herbicide rates in canola and cotton lowered herbicide use by 50–67% and significantly reduced weed biomass ($P < 0.05$) without yield penalties. In direct-seeded rice, allelopathic cultivars suppressed weed populations by 40–60% and reduced herbicide requirements by approximately 50% ($P < 0.01$). Rye-based cover cropping systems reduced weed biomass by 56–82% and, in some cases, achieved a fourfold decrease in weed emergence. Rye allelochemicals, particularly benzoxazinoids, inhibited weed germination and seedling growth by 70–90% ($P < 0.01$), while sunflower and brassica residues reduced weed emergence by 30–70% ($P < 0.05$). Environmental benefits include reduced soil and water contamination, lower selection pressure for herbicide-resistant weeds, and decreased occupational exposure to hazardous chemicals. Allelopathic cover crops have also increased soil organic carbon by 10–20%, enhanced microbial biomass by up to 25%, and improved nutrient cycling ($P < 0.05$), thereby supporting climate-smart agriculture. Current research focuses on novel allelochemicals, commercial bioherbicides, enhanced crop allelopathy, and plant–microbe interactions. By reducing reliance on synthetic herbicides and promoting ecological weed suppression, allelopathy offers a scientifically validated pathway towards sustainable, resilient, and environmentally responsible cropping systems.

Keywords: Allelochemicals; allelopathy; bioherbicides; climate-smart agriculture; weed

Green Technologies, AI, Digital Innovations, and Industry 4.0 for Rural Industrialisation

Sub-Theme: Smart Automation, Cleantech and Rural Digitalisation

Leveraging Digital Innovations for Decongesting Harare's Transport System

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Harare's rapid urbanisation has intensified traffic congestion, undermining economic productivity, environmental sustainability, and the quality of urban life. This research explores the contribution of digital innovations in decongesting Harare's mobility system, focusing on intelligent transport systems (ITS), real-time traffic management, mobile-based mobility services, and data-driven urban planning. Based on successful practices in other countries and the realities of the Zimbabwean conditions, the study analyses how modern technologies including GPS traffic monitoring, smart traffic lights, ride-hailing services, and public transport apps can increase traffic efficiency. The research adopts a mixed-methods approach to investigate potential benefits, feasibility, and obstacles to deploying digital solutions for urban traffic management in Harare. Literature review, case study, and stakeholder consultations are used as primary research methods to evaluate the implications of ITS technology, traffic management in real time, and mobile services to ease traffic congestion. The key research findings are expected to reveal that digital solutions can significantly reduce congestion by improving route optimisation, enhancing coordination among transport operators, and promoting modal shifts towards more efficient and sustainable transport systems. However, constraints such as limited infrastructure, high implementation costs, policy gaps, and digital inequality remain critical limitations. This study contributes to the discourse on smart mobility in developing cities and offers policy recommendations for leveraging digital technologies to build a more efficient and resilient urban transport system in Harare.

Keywords: intelligent transport systems, smart mobility, digital innovation, urban traffic management, Harare

Integrated AI-Driven Signal Processing and Hardware Architectures for Multi-Biomarker Point-of-Care Diagnostics: A Systematic Review

Humphrey Nkosiyo Dera, Tawanda Mushiri, Edwel Tafara Mharakurwa, David Jambgwa Simbi — Chinhoyi University of Technology; SIRDC; Dedan Kimathi University of Technology

Abstract

The translation of liquid biopsy diagnostics from laboratory environments to point-of-care (POC) settings is fundamentally limited by signal-to-noise challenges and the complexities of integrated system hardware. This systematic review provides a comprehensive analysis of microfluidic POC platforms designed for the concurrent detection of circulating tumour DNA (ctDNA) and protein biomarkers, such as HER2. The study critically evaluates the transition from raw biosensor outputs including electrochemical impedance spectroscopy (EIS) and amperometric data to actionable clinical insights. Machine Learning architectures—specifically lightweight neural networks and support vector machines—are examined for autonomous on-chip denoising and feature extraction.

The review explores the mechatronic integration of microfluidic components, biosensors, and control systems, assessing hardware-software co-design for autonomous, high-sensitivity diagnostic prototypes capable of operating in diverse, resource-constrained environments.

Keywords: Point-of-Care Diagnostics, Machine Learning, Microfluidics, Signal Deconvolution, ctDNA, Biosensor Integration, Mechatronics

Climate Economics and Sustainable Rural Industrialisation: Understanding the Role of Green Technologies in Building Resilient Rural Communities in Zimbabwe

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Abstract

Rural communities in Zimbabwe are increasingly affected by climate change, with recurrent droughts, irregular rainfall patterns and decreased agricultural production. These obstacles threaten livelihoods and undermine attempts to encourage rural industrialisation, which is an important route to poverty reduction, job creation and inclusive economic growth. While climate adaptation has received policy attention, little research has been conducted on the use of climate economics to promote sustainable rural industrialisation through the adoption of green technologies. The purpose of this study is to investigate the influence of climate economics in enhancing climate-resilient rural industrialisation in Zimbabwe. A mixed-methods approach will be used, combining a review of literature and policy documents with stakeholder engagements with actors from agricultural, energy and rural development sectors. The study is intended to provide insights on how renewable energy, climate-smart agriculture, sustainable water management and circular economy practices might assist rural development.

Keywords: climate economics, rural industrialisation, green technology, climate resilience, sustainable development, Zimbabwe

Digital Entrepreneurship Ecosystems and AI-Driven Innovation for Rural Industrialisation in Emerging Economies

Everjoy Mukunga, Heniuck Mutisi, Pardon J Muzondo — Chinhoyi University of Technology; Marondera University of Agricultural Science and Technology (everjoymukunga@gmail.com)

Abstract

This study examines the role of digital entrepreneurship ecosystems and artificial intelligence (AI)-driven innovation in promoting rural industrialisation in emerging economies. Despite increasing investments in digital technologies, many rural regions continue to experience limited industrial growth, inadequate entrepreneurial support systems, and restricted access to innovation resources. The study adopts a qualitative conceptual research design based on an extensive review and synthesis of contemporary literature on digital entrepreneurship, innovation ecosystems, AI adoption, rural development, and industrialisation. Findings suggest that robust digital entrepreneurship ecosystems—characterised by digital infrastructure, access to finance, entrepreneurial skills development, innovation networks, and supportive policy frameworks—significantly enhance rural enterprises' capacity to leverage AI technologies. The study contributes

to entrepreneurship, innovation, and rural development literature by proposing an integrated framework for AI-enabled rural industrialisation.

Keywords: Digital Entrepreneurship Ecosystems, Artificial Intelligence, Rural Industrialisation, Emerging Economies, Innovation Ecosystems

Digital Innovation for Safe and Sustainable Transport Systems: A Smart Passenger-Centred Speed Monitoring Model for Zimbabwe

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Road traffic accidents remain a significant public safety and development challenge in Zimbabwe, particularly within the public transport sector where speeding contributes substantially to fatalities and injuries. This study investigates the potential of passenger-centred smart speed monitoring systems to improve road safety and strengthen transport governance in Zimbabwe. The research adopts a qualitative empirical approach involving semi-structured interviews with 30 key stakeholders comprising passengers, public transport drivers, and transport regulatory officials from Harare and Bulawayo. Guided by the Technology Acceptance Model (TAM) and Social Accountability Theory (SAT), findings indicate that passengers strongly support digital speed monitoring technologies. A dual-channel framework combining real-time speed visibility with anonymous digital reporting emerged as the most viable approach for promoting accountability and compliance.

Keywords: Smart Mobility, Digital Innovation, Road Safety, Technology Acceptance, Citizen Participation

Design, Implementation, and Subsystem Validation of a dsPIC30F4011 Controlled Bidirectional Dual Active Bridge Converter for Localized Energy Systems

Peter Bukelani Musiiwa, Engelbert Takawira Kapuya, Downmore Musademba, Doubt Simango

Abstract

This paper details the design, hardware prototyping, and standalone bring-up of an isolated 1 kW bidirectional Dual Active Bridge (DAB) DC-DC converter optimised for smart energy networks, supporting both Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) power execution. The proposed power stage operates with primary and secondary H-bridge cells utilising discrete IRF740 power MOSFET devices, with system coordination managed natively by a 16-bit Microchip dsPIC30F4011 Digital Signal Controller. Standalone open-loop commissioning confirmed stable, alternating square wave generation at the primary bridge switching node. The prototype successfully demonstrates a technically feasible, low-parts-count, and locally maintainable embedded power conversion architecture capable of reinforcing energy resilience within sub-Saharan grid environments.

Keywords: Dual Active Bridge, Pulse Width Modulation, Electric Vehicle Charging, Soft-Switching, Bidirectional DC-DC Converter

Next-Generation Connectivity in the Zimbabwe and SADC Context: Integrating AI-Driven Analytics, SGP.32 Standards, and Gamified User Experiences in eSIM Ecosystems

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Abstract

This study investigated the application of Artificial Intelligence in optimising eSIM-based roaming services within the Zimbabwe–South Africa corridor. A Random Forest machine learning algorithm was implemented using simulated roaming usage patterns, tariff datasets, and network quality indicators to recommend the most cost-effective roaming data plans. The model accurately identified the lowest-cost roaming options while reducing the need for manual plan selection. The model also showed potential to support automated profile switching within emerging GSMA SGP.32 eSIM environments, improving user experience and reducing operational complexity. Findings indicate that integrating AI-driven analytics into eSIM ecosystems can enhance affordability, efficiency, and accessibility of mobile connectivity services across the SADC region.

Keywords: Artificial Intelligence, eSIM, Roaming Optimization, Random Forest, SGP.32, Digital Connectivity, SADC, Zimbabwe

Feasibility Study of Free Space Optical Communication as 5G Backhaul Link under Zimbabwean Conditions

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Abstract

Free space optical (FSO) communication offers advantages including huge unlicensed spectrum, improved security, and ease of installation. This work presents a feasibility study for FSO deployment tailored to Zimbabwean climate using Harare as a case study. Historical meteorological data characterising Harare's visibility, humidity, temperature, and seasonal rainfall patterns were analysed alongside the Kim, Kruse, and Chu-Hogg atmospheric attenuation models to evaluate their predictive accuracy under sub-tropical conditions. A performance analysis framework quantified key FSO feasibility indicators including atmospheric attenuation, link availability, bit error rate, outage probability, and signal-to-noise ratio. The findings are intended to equip telecommunications engineers and policymakers with evidence-based determination of whether FSO technology is technically viable for 5G backhaul deployment in Zimbabwe.

Keywords: Free Space Optics, 5G Backhaul, Performance Analysis, Atmospheric Attenuation, Feasibility, Zimbabwe

An Artificial Intelligent Prescriptive Hybrid Platform for Enhancing Extended Enterprise Resource Planning Implementations in Zimbabwe State Owned Enterprises

Phillip Chingwaro, Reason Masengu, Shakemore Chinofunga, Fungai Jacqueline Kiwa — Chinhoyi University of Technology / ZINARA (philpchingwaro@gmail.com)

Abstract

This study developed an AI-driven prescriptive hybrid-platform designed to enhance the success of Extended Enterprise Resource Planning (EERP) implementations in Zimbabwean State-Owned Enterprises. The machine learning model was developed using Python and integrated through an API built on the .NET Core framework. Following the CRISP-DM framework, the trained model was converted into the Open Neural Network Exchange format and deployed within the API. The platform utilised continuously updated datasets collected through quantitative research instruments administered to key stakeholders at ZINARA and ZIMRA. Findings demonstrate that the proposed AI-driven prescriptive hybrid-platform offers a practical, scalable and data-driven approach to strengthening EERP implementation processes within Zimbabwean SOEs.

Keywords: Artificial Intelligence, Machine Learning, Hybrid Platform, Prescriptive Analytics, EERP implementation

E-Readiness Factors for Extended Enterprise Resource Planning (EERP) Implementation in Zimbabwean State Owned Enterprises: A Mixed Methods Investigation

Phillip Chingwaro, Reason Masengu, Fungai Jacqueline Kiwa, Shakemore Chinofunga — Chinhoyi University of Technology (philpchingwaro@gmail.com)

Abstract

This study investigated e-readiness across five dimensions: technological infrastructure, organisational leadership, financial capacity, human capital and policy/regulatory frameworks. A mixed-methods design under a pragmatist paradigm was used. Quantitative data were collected from 711 EERP users at ZIMRA and ZINARA using structured questionnaires, while qualitative data were obtained from 30 in-depth interviews. Quantitative analysis employed PLS-SEM and descriptive statistics; qualitative data were analysed thematically using ATLAS.ti. All five e-readiness dimensions were statistically significant predictors of successful EERP implementation. Path analysis revealed direct positive effects of e-readiness on EERP implementation ($\beta = 0.319$, $p < 0.001$) and on SOE performance ($\beta = 0.152$, $p < 0.001$).

Keywords: E-readiness, Extended Enterprise Resource Planning, State-Owned Enterprises, TOE framework, digital transformation

User Perceptions of an Extended ERP Implementation Model in Zimbabwean State Owned Enterprises: A PLS-SEM Analysis

Reason Masengu, Phillip Chingwaro, Fungai Jacqueline Kiwa, Shakemore Chinofunga — Chinhoyi University of Technology (masengumasengu@yahoo.com)

Abstract

This study addresses the gap on how user perceptions influence EERP implementation success and overall SOE performance, focusing on five perceptual dimensions: perceived usefulness, ease of use, user satisfaction, awareness, training and support. A quantitative, cross-sectional survey was administered to 711 EERP users across ZIMRA and ZINARA. The structural model revealed that user perception had a strong, statistically significant direct effect on EERP implementation ($\beta =$

0.213, $t = 5.370$, $p < 0.001$) and an even stronger direct effect on SOE performance ($\beta = 0.376$, $t = 10.997$, $p < 0.001$). The model explained 58% of the variance in EERP implementation success. The study concludes that the EERP implementation model for Zimbabwean SOEs must prioritise user-centric design, transparent communication, and sustained training to achieve intended outcomes.

Keywords: User perceptions, EERP implementation, State-Owned Enterprises, perceived usefulness, digital transformation

OmegaOS: A Lightweight Operating System for Sustainable and Inclusive Digital Computing in Low-Resource Environment.

Selby Mashiki; National University of Science and Technology, Zimbabwe.

Corresponding Author Email: mashikiselby@gmail.com

Presentation Type: Expo Showcase

Abstract

This study presents OmegaOS, a lightweight operating system designed to promote digital inclusion, sustainability, and accessible computing in low-resource environments. The objective is to reduce the digital divide by enabling efficient use of outdated and low-specification hardware while supporting educational and productivity needs. OmegaOS is developed using open-source technologies optimized for performance efficiency, minimal resource consumption, and usability in offline or low-bandwidth environments. The system architecture focuses on lightweight system services, streamlined UI design, and integration of essential productivity tools. The implemented prototype demonstrates improved performance on low-end hardware, reduced system resource consumption, and extended usability of legacy devices. OmegaOS shows potential in supporting rural education, digital literacy, and sustainable computing practices by reducing electronic waste and hardware dependency.

A GIS-Based Hybrid Modelling Approach Using CART Classification and Cellular Automata (MOLUSCE) for Predicting Future Land Use Dynamics in Mutare.

Mitchelle Tendesai Zimunya, Margaret Dadai Masinire, Fransisca Kunedzimwe Chinhoyi University of Technology

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Abstract

Urban expansion represents one of the most critical factors influencing land use and land cover (LULC) changes worldwide, leading to the degradation of agricultural land and invasion of sensitive natural ecosystems, as well as putting pressure on infrastructure and social services. The

town of Mutare is currently characterized by unregulated urban expansion without any predictive models for future planning. Therefore, the current study attempts to predict future scenarios of the landscape of Mutare City employing machine learning algorithms, with specific objectives to investigate urban expansion between 2000-2024, model LULC patterns up to 2044 through cellular automata simulations, and determine critical socioeconomic and physical determinants for future urban development. The mixed research design including GIS technology, remote sensing, spatial analysis, and socio-economic surveying methods was used, where Landsat satellite images for 2000, 2014, and 2024 years were classified using Google Earth Engine software with CART classification algorithm, predictive modeling was carried out with QGIS (MOLUSCE plugin), and socio-economic information – analyzed with Jamovi software. Results revealed a rise in proportion of built-up area (from 7.38% in 2000 to 9.34% in 2024) and decrease in proportion of forest cover (31.56% - 27.40%). The model suggests an increase in the proportion of built-up land up to 9.70 percent by 2044, reflecting continued urbanization. The research findings suggest that significant spatial transformation is occurring in Mutare, and GIS modelling needs to be incorporated in the urban planning framework.

Keywords: Urban expansion, Land use and land cover, Remote Sensing, Geographic Information Systems, Machine Learning, Cellular Automata, Urban Growth Modelling

Synthesising Evidence on the Acceptability, Feasibility, and Impact of AI-driven tools for Rural Maternal Health Education: A Systematic Review.

Fadzai Dorcas Chigaro, Professor M Tsvere, Dr A Dikito, Dr C J Mawire Chinhoyi University of Technology

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Abstract

Globally, approximately 287,000 women die each year from preventable pregnancy-related issues such as hypertension, with a maternal mortality ratio of 223 per 100,000 live births. In Zimbabwe, the MMR is 443 per 100,000 live births nearly double the global average and among the highest in Southern Africa. This mortality burden is partly driven by poor health literacy, language barriers, and delayed care-seeking. This systematic review aimed to synthesise evidence on the acceptability, feasibility, and impact of AI-driven tools for rural maternal health education focusing on identifying gaps relevant to rural populations. We searched PubMed, MEDLINE, Scopus, and Web of Science from 2015-2026. Inclusion criteria comprised pregnant and postpartum women; AI tools delivering maternal education; outcomes reporting acceptability and health literacy; and study designs, while exclusion criteria were high-income country settings, and non-empirical papers. The researchers performed screening and quality assessment using the Mixed Methods Appraisal Tool. Of 372 records screened, 58 studies met inclusion criteria: 29 (Sub-Saharan Africa), 15 (South-Asia), 5 (other LMICs) and 6 (Zimbabwe). Interventions included voice-SMS (n=24), IVR with basic AI (n=19), and NLP chatbots (n=15). Acceptability was high (>75% satisfaction). Feasibility challenges included network instability (21 studies), low digital literacy (8), gendered phone access (10), and lack of mobile data (19). Health literacy improved in 42 of 49 studies (knowledge gains 18–34%, $p<0.05$). Zimbabwean studies showed improved antenatal attendance but revealed critical gaps: lack of awareness, lack of culturally sensitive information, and absence of local language content. AI tools are acceptable for maternal education in LMICs. However, critical gaps remain: offline capability, local language support, and

culturally sensitive support are under-addressed. These findings show the urgent need for an AI-driven educational tool that is culturally sensitive, offline-capable, and tailored to rural areas with limited connectivity.

Keywords: AI, IVR, maternal health, Zimbabwe, LMICs, Natural Language Processing

Integrated AI-Driven Signal Processing and Hardware Architectures for Multi-Biomarker Point-of-Care Diagnostics: A Systematic Review

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Abstract

The translation of liquid biopsy diagnostics from laboratory environments to point-of-care (POC) settings is fundamentally limited by signal-to-noise challenges and the complexities of integrated system hardware. This systematic review provides a comprehensive analysis of microfluidic POC platforms designed for the concurrent detection of circulating tumour DNA (ctDNA) and protein biomarkers, such as HER2. The study critically evaluates the transition from raw biosensor outputs including electrochemical impedance spectroscopy (EIS) and amperometric data to actionable clinical insights. We examine the efficacy of Machine Learning (ML) architectures, specifically focusing on the implementation of lightweight neural networks and support vector machines for autonomous on-chip denoising and feature extraction. The analysis addresses the critical need for AI to interpret non-linear signal curves and eliminate artifacts arising from complex biological matrices in minimally processed samples. Furthermore, the review explores the mechatronic integration of microfluidic components, biosensors, and control systems. We assess the compatibility of various hardware architectures with the constraints of field-deployable diagnostics, focusing on power efficiency, modularity, and robust data acquisition. By synthesizing the current state of hardware-software co-design, this work establishes a technical framework for the next generation of autonomous, high-sensitivity diagnostic prototypes capable of operating in diverse, resource-constrained environments.

A Theoretical Framework for Smart Agriculture Systems Using AI and Data Science for Climate Resilience and Adaptation for Smallholder Farmers in Zimbabwe

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Smallholder farming is the backbone of rural livelihoods and food security in Zimbabwe, yet climate change poses great challenges, where erratic rainfall, rising temperatures and land degradation undermine agricultural productivity. This framework is grounded in the systems-thinking approach which combine climate data analytics, machine learning models, Internet of Things (IoT) sensors and indigenous knowledge systems to support adaptive decision-making. The framework emphasizes the need for real-time data collection, predictive modelling for weather and crop performance as well as appropriate advisory services appropriate for local agro-ecological conditions. This study proposes a framework for Smart Agriculture Systems that are anchored in

Artificial Intelligence (AI) and Data Science to enhance climate resilience and adaptation among smallholder farmers. The framework integrates data-driven technologies to enhance informed and appropriate decision making. The framework is structured around components that include climate data acquisition, predictive analytics, decision support systems and adaptive farm management practices. The framework emphasizes the adoption of AI models to forecast weather patterns, optimize planting schedules, monitor crop health and improve resource usage. The framework also incorporates socio-economic, institutional and infrastructural dimensions that have an influence on the adoption and scalability of smart agriculture technologies in rural settings. The study aims to strengthen farmers' capacity to anticipate, respond to and recover from climate related shocks. The study has a major contribution to the advancement of climate-smart agriculture by developing a scalable and appropriate framework that has the potential to support sustainable food systems, enhances resilience and promoting adaptive agricultural systems in Zimbabwe.

Keywords: Smart Agriculture, Artificial Intelligence, Data Science, Small Holder Farmers

Lightweight Convolutional Neural Network (CNN) for three-class VIAC classification (Negative, Positive, Suspicious of Cancer [SOC]) deployable in Low-resource Settings.

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Abstract

Cervical cancer is a leading cause of death among women in Zimbabwe, where Visual Inspection with Acetic Acid and Cervicography (VIAC) is widely used but suffers from diagnostic variability. This study addresses the lack of a lightweight, locally validated convolutional neural network (CNN) for three class VIAC classification (Negative, Positive, Suspicious of Cancer [SOC]) deployable in low resource settings. Using a quantitative, positivist design and the CRISP DM framework, 304 retrospective VIAC images (110 Negative, 110 Positive, 84 SOC) were obtained from Zimbabwe Health Interventions facilities in Manicaland (2022–2024). An EfficientNetB0 based CNN was trained with two stage transfer learning, data augmentation, class weighting, and early stopping. Evaluation metrics included accuracy, recall, F1 score, macro ROC AUC, bootstrap confidence intervals, and five fold cross validation. The model achieved a test accuracy of 78.7% (95% CI: 67.2–88.5%), macro ROC AUC of 0.9315, and 100% recall for SOC (17/17 cases), with a compact size of 7.8 MB and 85 ms inference on low end Android devices. Although the CNN outperformed a Random Forest baseline (72.1% accuracy, AUC 0.853), the difference was not statistically significant ($p=0.48$), likely due to the modest sample size ($n=304$). Limitations include class imbalance, internal validation only, and lack of external generalisability; external validation on larger, prospective multi site cohorts is needed. Nevertheless, the model offers a deployable, offline decision support tool to improve diagnostic consistency and reduce missed precancerous cases in Zimbabwe and similar low and middle income countries.

Developing Light Gradient Boosting Machine (LightGBM) model for Sustainable Waste Management at Jena Mine, Zimbabwe

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Presentation Type: Poster

Abstract:

Gold mining generates vast solid waste (tailings, overburden) that degrades ecosystems and water sources, especially in Zimbabwe. Conventional waste management is reactive and lacks predictive capacity, creating an implementation gap. This study develops and validates a Light Gradient Boosting Machine (LightGBM) model for sustainable waste management at Jena Mine, Zimbabwe. The study identified waste drivers, developed a predictive model, and evaluated its effectiveness. A quantitative, positivist CRISP-DM methodology was used. Daily operational data from 2020–2025 (2,258 observations, 24 variables) was cleaned to 2,211 records. LightGBM was trained on 80% (temporal split) using 26 engineered features and tested on 20%. Performance metrics: $R^2 = 0.9247$, Mean Absolute Error (MAE) = 67.83 tons (4.80% of mean daily waste of 1,411.89 tons), Root Mean Squared Error (RMSE) = 87.45 tons (6.19%). Compared to manual estimation, the model reduced prediction error by 63% and improved explained variance by 105%. Feature importance identified ore tonnage, processing hours, equipment utilisation, gold grade, and energy consumption as key waste drivers. The model provides a deployable decision-support tool for proactive waste planning, scenario evaluation, and regulatory compliance (Zimbabwe's Environmental Management Act), aligning with SDGs 12, 13, and 15. Mining managers, environmental officers, and policymakers should adopt this framework to transition from reactive to predictive, sustainable mining practices.

Developing a Machine-learning Forecasting Model for daily Outage-related call volumes

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Abstract:

Frequent transformer outages and load shedding overwhelm public utility contact centres in developing economies, causing excessive wait times greater than 14 minutes, high abandonment rates (32%), and annual losses of revenue approximately USD 1.8 million at Zimbabwe's ZETDC National Contact Centre. Traditional statistical methods cannot predict highly irregular, outage-driven call surges, leading to poor staffing and service quality. This study developed a machine-learning forecasting model for daily outage-related call volumes, tested whether Gradient Boosting improves accuracy over Random Forest, identified key predictors, and evaluated operational deployment in resource-constrained utilities. Using 1,766 daily observations (January 2019–September 2024) from contact-centre records, outage reports, weather, and calendar data, the CRISP-DM framework, time-series decomposition, and feature engineering were applied. The model performance was assessed using Mean Absolute Error (MAE), Root Mean Square Error (RMSE), R^2 , and the Diebold-Mariano test. The tuned Gradient Boosting Regression model achieved an MAE of 204.91 and R^2 of 0.598, outperforming Random Forest ($R^2 = 0.521$) with an 8.5% error reduction ($p = 0.005$). Feature importance identified previous-day call volume, outage severity, outage duration, rolling averages, and weather as strongest predictors. CatBoost yielded a slightly higher R^2 (0.614), but Gradient Boosting offered more consistent operational reliability. Limitations include reliance on secondary data with occasional missing

records and exclusion of unstructured inputs (e.g., sentiment, social media). The model provides a deployable forecasting tool for ZETDC and similar African utilities, enabling proactive staffing, reduced customer abandonment, and lower annual operational costs.

Empowering Rural Agriculture: An AI-Driven Livestock Monitoring Application for Enhanced Productivity and Industrialization in Zimbabwe.

Pride T Murwira, Rutendo Zindoga. National University of Science and Technology

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Abstract

Livestock farming is a cornerstone of rural livelihoods in Zimbabwe, yet traditional herding and monitoring practices are increasingly vulnerable to challenges such as disease outbreaks, theft, and environmental stressors. This paper presents the development and deployment of an Artificial Intelligence powered mobile application designed specifically for livestock monitoring in resource-constrained rural environments. The core problem addressed is the lack of accessible, real-time data for rural farmers to proactively manage herd health and security. The proposed digital innovation leverages computer vision and machine learning algorithms integrated into a user-friendly mobile interface. By analyzing behavioral patterns and physical anomalies through smartphone-captured imagery and low cost IoT sensor integration, the AI app provides early detection of diseases and tracks animal movement. The methodology prioritizes Smart Automation and Rural Digitalization, utilizing edge computing to function effectively in areas with low internet bandwidth. Ultimately, this technology transitions traditional livestock keeping into a modern, data-driven enterprise. By reducing preventable livestock mortality and optimizing farm management, the application directly contributes to Rural Industrialization and Community Impact. It empowers smallholder farmers to commercialize their operations, thereby fostering economic resilience, enhancing local value chains and driving sustainable agricultural development in rural Zimbabwe.

Funda Lami: An AI-powered learning platform built to give student access to a personal subject tutor and study notes aligned to the official ZIMSEC curriculum

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Presentation Type: Industry Showcase

Abstract:

Access to quality examination preparation in Zimbabwe is unequal. Students in well-resourced urban schools have tutors, structured revision materials and consistent guidance. The majority of ZIMSEC O-Level candidates do not. Funda Lami is a deployed AI-powered learning platform built to close that gap by giving every student access to a personal subject tutor, past papers, quizzes, flashcards and study notes aligned to the official ZIMSEC curriculum across 13 subjects. The platform uses large language model technology with a Retrieval-Augmented Generation layer trained on ZIMSEC syllabi and approved textbooks, ensuring that every AI response is curriculum-specific and examination-relevant. Students can access the platform via web browser, mobile application or WhatsApp chatbot, making it usable even where full data access is limited. A

freemium pricing model with EcoCash and Paynow integration keeps it affordable. An offline-capable build for rural students with limited connectivity is currently in development. Funda Lami is not a concept or a prototype waiting to be funded. It is live, it is in use and it is growing. This exhibition presents the working platform, the AI tutoring architecture, the curriculum alignment methodology and engagement data from beta testing. The broader argument being made is straightforward: the infrastructure for equitable secondary education in Zimbabwe already exists and it is accessible from a smartphone.

Empowering Rural Agriculture: An AI-Driven Livestock Monitoring Application for Enhanced Productivity and Industrialization in Zimbabwe.

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Abstract

Livestock farming is a cornerstone of rural livelihoods in Zimbabwe, yet traditional herding and monitoring practices are increasingly vulnerable to challenges such as disease outbreaks, theft, and environmental stressors. This paper presents the development and deployment of an Artificial Intelligence powered mobile application designed specifically for livestock monitoring in resource-constrained rural environments. The core problem addressed is the lack of accessible, real-time data for rural farmers to proactively manage herd health and security. The proposed digital innovation leverages computer vision and machine learning algorithms integrated into a user-friendly mobile interface. By analyzing behavioural patterns and physical anomalies through smartphone-captured imagery and low cost IoT sensor integration, the AI app provides early detection of diseases and tracks animal movement. The methodology prioritizes Smart Automation and Rural Digitalization, utilizing edge computing to function effectively in areas with low internet bandwidth. Ultimately, this technology transitions traditional livestock keeping into a modern, data-driven enterprise. By reducing preventable livestock mortality and optimizing farm management, the application directly contributes to Rural Industrialization and Community Impact. It empowers smallholder farmers to commercialize their operations, thereby fostering economic resilience, enhancing local value chains and driving sustainable agricultural development in rural Zimbabwe.

E Readiness Factors for Extended Enterprise Resource Planning (EERP) Implementation in Zimbabwean State Owned Enterprises: A Mixed Methods Investigation.

Chingwaro Phillip, Masengu Reason, Kiwa Jacqueline, Chinofunga Shakemore, Chinhoyi University of Technology

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Abstract

The success of Extended Enterprise Resource Planning (EERP) implementation in Zimbabwean State-Owned Enterprises (SOEs) depends critically on organisational e-readiness, yet this area remains under-researched. This study investigated e-readiness across five dimensions: technological infrastructure, organisational leadership, financial capacity, human capital, and policy/regulatory frameworks. A mixed-methods design under a pragmatist paradigm was used. Quantitative data were collected from 711 EERP users at Zimbabwe Revenue Authority (ZIMRA) and Zimbabwe National Road Administration (ZINARA) using structured questionnaires, while

qualitative data were obtained from 30 in-depth interviews with executives and implementation teams. Quantitative analysis employed PLS-SEM and descriptive statistics; qualitative data were analysed thematically using ATLAS.ti. All five e-readiness dimensions were statistically significant predictors of successful EERP implementation. The measurement model showed satisfactory reliability (Cronbach's $\alpha = 0.66\text{--}0.74$, composite reliability >0.80) and convergent validity (AVE = $0.57\text{--}0.65$). Discriminant validity was confirmed (HTMT <0.85). Path analysis revealed direct positive effects of e-readiness on EERP implementation ($\beta = 0.319$, $p < 0.001$) and on SOE performance ($\beta = 0.152$, $p < 0.001$), with the model explaining 58% of the variance in implementation success. Qualitative findings identified unreliable ICT infrastructure, inadequate change management, skills shortages, budget unpredictability, and weak policy coordination as the most critical e-readiness gaps. This study provides a validated empirical framework for SOE leadership, ICT managers, and policymakers to diagnose e-readiness deficits and prioritise targeted pre-implementation interventions.

Keywords: E readiness, Extended Enterprise Resource Planning (EERP), State Owned Enterprises (SOEs), Technology Organisation Environment (TOE) framework, PLS SEM, digital transformation

User Perceptions of an Extended ERP Implementation Model in Zimbabwean State-Owned Enterprises: A PLS SEM Analysis

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User perceptions are widely recognised as a critical determinant of Enterprise Resource Planning (ERP) success, yet their role in the implementation model of Extended ERP (EERP) systems within Zimbabwean State-Owned Enterprises (SOEs) has not been empirically established. This study addresses that gap by investigating how user perceptions influence both EERP implementation success and overall SOE performance, focusing on five perceptual dimensions: perceived usefulness, ease of use, user satisfaction, awareness, training and support. A quantitative, cross sectional survey was administered to 711 EERP users across two major Zimbabwean SOEs (ZIMRA and ZINARA). The data were analysed using Partial Least Squares Structural Equation Modelling (PLS SEM) within a positivist framework. The structural model revealed that user perception had a strong, statistically significant direct effect on EERP implementation ($\beta = 0.213$, $t = 5.370$, $p < 0.001$) and an even stronger direct effect on SOE performance ($\beta = 0.376$, $t = 10.997$, $p < 0.001$). Furthermore, user perception exerted a significant mediating effect on SOE performance through EERP implementation ($\beta = 0.029$, $t = 2.305$, $p = 0.021$). All outer loadings for perceptual indicators exceeded 0.79, indicating that perceived usefulness, ease of use, satisfaction, communication, and training are all robust measures. The model explained 58% of the variance in EERP implementation success. These findings demonstrate that positive user perceptions are not merely ancillary but are central drivers of successful EERP implementation and improved SOE performance. The study concludes that the EERP implementation model for Zimbabwean SOEs must prioritise user centric design, transparent communication, and sustained training to achieve intended outcomes.

Keywords: User perceptions, EERP implementation, State Owned Enterprises, Zimbabwe, perceived usefulness, user satisfaction, training and support, digital transformation

AURORA-nexus: AI-Powered Digital Twin Platform for Sustainable Urban Infrastructure Management

Sizolwenkosi Ndlovu, Huldah Nkomo, Takudzwa Nyengerai, Prosper Ncube

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Abstract

Zimbabwe's urban infrastructure—power grids, water networks, and buildings—is managed reactively, with problems addressed only after failures occur. This approach results in up to 40% power loss before reaching consumers, emergency maintenance costs 3-5 times higher than planned interventions, and days of unplanned downtime affecting businesses, hospitals, and schools. Infrastructure operators lack real-time visibility and predictive capabilities, operating blind while equipment deteriorates. To develop an affordable, AI-powered digital twin platform that enables real-time infrastructure monitoring, predicts equipment failures before they occur, and provides prescriptive maintenance recommendations, directly supporting SDG 12 (Responsible Consumption and Production) and Zimbabwe's NDS2 priorities in energy and smart cities. The system integrates three layers: (1) low-cost ESP32-based sensor nodes (\$50 each) measuring temperature, current, voltage, and load, with 12 LED indicators, relay module for surge protection, and buzzer for alerts; (2) an AI engine using ensemble machine learning (Random Forest + Gradient Boosting) to compare actual readings against digital twin expectations, achieving 92-95% fault prediction accuracy; and (3) a web dashboard with real-time visualization, 12-button independent mode control for each parameter, digital twin comparison tables, and live data feed. AURORA-nexus demonstrates that affordable, locally developed digital twin technology can transform infrastructure management from reactive chaos to predictive clarity. The platform offers a scalable, cost-effective pathway for Zimbabwe and the SADC region to achieve responsible consumption and production patterns while significantly reducing operational costs and improving service reliability.

Leveraging Artificial Intelligence and Mobile Money Ecosystems to Accelerate Rural Industrialisation in Zimbabwe: A Conceptual Framework

Kudzanai chabara, Harare Institute of Technology

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Abstract

Zimbabwe's mobile money ecosystem recorded significant growth in transaction volumes and values in 2025, yet rural enterprises remain excluded from the intelligence and financial services this data wealth could enable. This study addresses the lack of an integrated framework for co-deploying mobile money transaction data, telecommunications infrastructure, and artificial intelligence to drive rural industrialisation. Employing a socio-technical systems analysis of peer-reviewed literature, POTRAZ regulatory data, MNO annual reports, and national policy documents, including NDS1, the Smart Zimbabwe 2030 Master Plan, and Zimbabwe's National AI Strategy 2026–2030, the study maps mobile money transaction behaviours against five AI-enabled enterprise support functions: alternative credit scoring, predictive demand forecasting, digital market access, smart supply chain optimisation, and AI-driven business intelligence for

rural agro-processors and small-scale manufacturers. The analysis yields the Mobile Money, AI and Rural Industrialisation (MMARI) Framework a three-layer architecture comprising a data infrastructure layer, an AI analytics layer, and an enterprise services layer delivering actionable intelligence to rural producers via USSD and mobile platforms. Four policy prerequisites are identified: data privacy regulation, platform interoperability, digital literacy investment, and MNO incentive alignment. The MMARI Framework offers the first structured, policy-aligned blueprint for transforming Zimbabwe's mobile money infrastructure into an active engine of rural industrial transformation, aligned with Vision 2030 and Zimbabwe's National AI Strategy 2026–2030, with transferable applicability across Sub-Saharan Africa.

Keywords: Artificial Intelligence, Mobile Money, Rural Industrialisation, Industry 4.0, MMARI Framework, Zimbabwe

An exploration of digital skills knowledge gaps to enhance employee productivity in Zimbabwe's hotel sector.

Tendai Chikari, Dr Clotilda Kazembe, Dr Enes Madzikatire. Chinhoyi University of Technology

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Despite increasing global concern about the importance of digital skills, there remains a dearth of literature and research pertaining to the impacts of digital skills knowledge gap on employee productivity in Zimbabwe's hotel sector. This study therefore sought to explore digital skill knowledge gaps that can be bridged to enhance employee productivity in Zimbabwe's hotel sector. The main objective of the study was to explore digital skills knowledge gaps affecting employee productivity in Zimbabwe's hotel sector. The study specifically focused on the level of digital skills knowledge among employees, the causes and impacts of digital skills knowledge gaps and strategies for improving digital skills in Harare hotels. Using purposive sampling, the study collected semi-structured interviews and questionnaire responses from 27 hotel employees and supervisors who regularly work with digital technologies. Data were analyzed thematically and results were presented verbatim guided by themes augmented by table and quotes. The study established that digital skills knowledge gaps exist within Zimbabwe's hotel sector, with most employees possessing only basic digital competencies. Significant gaps were identified in critical areas such as social media management, online customer relationship management, specialized property management systems, digital marketing, digital content creation and management. Strategies suggested in the study include continuous training and development, investment in modern digital infrastructure, inclusive access to digital technologies, partnerships with industry experts and technology service providers, internet service providers, research and innovation. The study recommends development of national policies that promote digital skills knowledge development in Zimbabwe's hotel sector.

Keywords: digital skills, digital skills knowledge gap, employee productivity, hotel sector.

An exploration of digital skills knowledge gaps to enhance employee productivity in Zimbabwe's hotel sector.

Tendai Chikari, Dr Clotilda Kazembe, Dr Enes Madzikatire, Dr Nelson Zengeni, Dr Charity Mapingure. Chinhoyi University of Technology

Corresponding Author Email: chikaritendy@gmail.com

Abstract

Despite increasing global concern about the importance of digital skills, there remains a dearth of literature and research pertaining to the impacts of digital skills knowledge gap on employee productivity in Zimbabwe's hotel sector. This study therefore sought to explore digital skill knowledge gaps that can be bridged to enhance employee productivity in Zimbabwe's hotel sector. The main objective of the study was to explore digital skills knowledge gaps affecting employee productivity in Zimbabwe's hotel sector. The study specifically focused on the level of digital skills knowledge among employees, the causes and impacts of digital skills knowledge gaps and strategies for improving digital skills in Harare hotels. Using purposive sampling, the study collected semi-structured interviews and questionnaire responses from 27 hotel employees and supervisors who regularly work with digital technologies. Data were analyzed thematically and results were presented verbatim guided by themes augmented by table and quotes. The study established that digital skills knowledge gaps exist within Zimbabwe's hotel sector, with most employees possessing only basic digital competencies. Significant gaps were identified in critical areas such as social media management, online customer relationship management, specialized property management systems, digital marketing, digital content creation and management. Strategies suggested in the study include continuous training and development, investment in modern digital infrastructure, inclusive access to digital technologies, partnerships with industry experts and technology service providers, internet service providers, research and innovation. The study recommends development of national policies that promote digital skills knowledge development in Zimbabwe's hotel sector.

Keywords: digital skills, digital skills knowledge gap, employee productivity, hotel sector.

AI implementation to identify sector-specific lessons, opportunities, and challenges in Zimbabwe

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Abstract

Artificial Intelligence (AI) is increasingly recognized as a catalyst for innovation and competitiveness in Small and Medium-Sized Enterprises (SMEs). In Africa, SMEs form the backbone of economic activity, yet AI adoption is constrained by regulatory, infrastructural, and skills-related barriers. This study analyses successful case studies of AI implementation to identify sector-specific lessons, opportunities, and challenges across agriculture, health, logistics, manufacturing, and finance. A case-based approach is employed, integrating literature review, sectoral case studies, stakeholder consultations, and policy analysis. Evidence highlights diverse applications including precision farming, AI-enabled diagnostics, supply chain optimization, and digital financial inclusion. The study uncovers key barriers including inadequate infrastructure, limited digital skills, and fragmented policy frameworks. By situating AI adoption within African

SME ecosystems, this research contributes to academic discourse on innovation management. It advances knowledge by providing the first comparative, case-based analysis of AI adoption across five key sectors of African SMEs, linking implementation challenges to concrete, context-specific policy recommendations. Findings underscore AI's potential to strengthen SME resilience, foster inclusive growth, and advance socio-economic transformation across the continent.

Keywords: Artificial intelligence, SMEs, innovation, digital transformation, Africa, constraints, opportunities

Developing a low-cost non- internet based IoT pheromone trap device for real time alerts through SMS to farmers.

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Affiliation(s): Chinhoyi University of Technology

Abstract:

Fall armyworm infestation cause great losses for up to 264 000tonnes due to delayed management practices (Rwomushana, 2018). Agriculture 4.0 has led to precision agriculture that utilizes IoT (Internet of things) fostering precision agriculture (Polymeni, 2023). The current study developed and evaluated a low-cost non- internet based IoT pheromone trap device that sends real time alerts through SMS to farmers. An agile development method was used integration of Arduino nano, IR break beam sensory system, GIM 800L GSM module and a solar power (10w, 18W panel + 10000mAh battery lithium). A field evaluation of 12weeks was carried out comparing IoT trap against conventional bucket traps and manual scouting on 20 x 20 m maize plots. Data was collected on moth capture rates, infestation levels, farmer reaction time and labor requirements. There is a significant difference ($p < 0.05$) in the reaction time across all methods with an overall reduction in farmer's reaction time of 89.42% by the modified IoT pheromone trap device. Mean farmer reaction time was analyzed measuring the infestation differences over time IOT = 19.67%, conventional 22.33% and manual 23% thus showcasing high significance ($p < 0.005$). The developed IOT device was then tested and evaluated and it showed a high correlation ($r > 0.8443$) providing evidence that the system is excellent in predictive capabilities for future infestation. In conclusion the developed device is capable of offering early warning alerts of future infestation that can be used to direct spray decisions. Due to the small experimental pool leading to less variation would recommend testing on a larger experimental space with more traps being tested against the device.

Keywords: Pheromone trap buckets, IoT (Internet of things), FAW (fall army worm), Agriculture 4.0

An Artificial Intelligent Prescriptive Hybrid-Platform for Enhancing Extended Enterprise Resource Planning Implementations in Zimbabwe State Owned Enterprises

Author(s): Chingwaro Phillip, Masengu Reason, Kiwa Jacqueline, Chinofunga Shakemore

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Presentation Type: Oral

Abstract:

The adoption of Artificial Intelligence and Machine Learning technologies has become a key enabler of digital transformation within State-Owned Enterprises (SOEs). This study developed an AI-driven prescriptive hybrid-platform designed to enhance the success of Extended Enterprise Resource Planning (EERP) implementations in Zimbabwean SOEs. The machine learning model was developed using Python and integrated through an API built on the .NET Core framework using the Visual Studio IDE. The platform's frontend user interface was developed using HTML for structure, CSS for styling and design and JavaScript for functionality and user interaction. Following the CRISP-DM framework, to facilitate seamless integration between the machine learning model and the application layer, the trained model was converted into the Open Neural Network Exchange format and deployed within the API, enabling efficient model inference and interoperability across different platforms. The frontend interface and backend API were deployed on a hosted server and integrated with a live dataset maintained through Google Sheets, enabling continuous data updates and real-time analytics. The dataset was partitioned into training and testing subsets with 80% of the data used for model training and 20% reserved for testing and performance evaluation. The platform utilised continuously updated datasets collected through quantitative research instruments administered to key stakeholders at ZINARA and ZIMRA. The platform assists SOEs in assessing and improving organisational e-readiness, thereby increasing the likelihood of successful EERP implementation. The findings demonstrate that the proposed AI-driven prescriptive hybrid-platform offers a practical, scalable and data-driven approach to strengthening EERP implementation processes within Zimbabwean SOEs. The study recommends that the Procurement Regulatory Authority of Zimbabwe (PRAZ) consider incorporating the platform as part of the procurement evaluation and approval framework for SOEs planning to acquire and implement EERP systems.

Feasibility study of free space optical communication as 5G backhaul link under Zimbabwean conditions.

K.Chabara, S. Magidi Harare Institute of Technology

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Abstract:

The demand for data services has been exponentially increasing since the last few decades. This has been mainly due to a surge in devices connecting to the internet to access wireless data services. This has resulted in spectrum crisis in the radio-based data services. Free space optical communication is one of the prospective technology that can solve these challenges. This technology offers advantages such as huge unlicensed spectrum, huge bandwidth, improved security and ease of installation among others. One way it can be incorporated in cellular networks is by being part of the backhaul networks in 5G. Meanwhile deploying fibre optic-based backhaul network remains expensive. Although FSO technology is lucrative, it suffers from atmospheric turbulence and adverse weather conditions. In this work, we have carried out feasibility study for FSO deployment tailored to Zimbabwean climate using Harare as a case study. Historical meteorological data characterising Harare's visibility, humidity, temperature, and seasonal rainfall patterns have been analysed alongside the Kim, Kruse, and Chug atmospheric attenuation models to comparatively evaluate their predictive accuracy under subtropical conditions. The models have been used to do a performance analysis framework quantifying the key feasibility indicators of FSO deployment: atmospheric attenuation, link availability, bit error rate, outage probability, and

signal-to-noise ratio under Harare's prevailing atmospheric conditions, establishing the first data-driven FSO feasibility assessment in the Zimbabwean context. The findings will equip telecommunications engineers and policymakers with a clear, evidence-based determination of whether FSO technology is technically viable for 5G backhaul deployment in Zimbabwe, directly informing cost-effective infrastructure investment decisions that underpin downstream rural connectivity and digital industrialisation under Vision 2030.

Keywords: Free Space Optics, 5G Backhaul, Performance Analysis, Atmospheric Attenuation, Feasibility, Kim Model, Kruse Model, Chug Model, Zimbabwe

An AI-driven decision support model capable of automatically recommending the most cost-effective roaming data plans for cross-border mobile users

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Presentation Type: Oral

Abstract:

The study investigated the application of Artificial Intelligence (AI) in optimizing eSIM-based roaming services within the Zimbabwe–South Africa corridor. The aim was to develop and evaluate an AI-driven decision support model capable of automatically recommending the most cost-effective roaming data plans for cross-border mobile users. A Random Forest machine learning algorithm was implemented using simulated roaming usage patterns, tariff datasets, and network quality indicators collected from publicly available telecommunications data. The model was trained and tested to classify and recommend optimal roaming profiles based on user behaviour and prevailing network conditions. Results demonstrated that the AI-driven approach accurately identified the lowest-cost roaming options while reducing the need for manual plan selection, a common cause of excessive roaming charges among travellers. The model also showed the potential to support automated profile switching within emerging GSMA SGP.32 eSIM environments, thereby improving user experience and reducing operational complexity. The findings indicate that integrating AI-driven analytics into eSIM ecosystems can enhance affordability, efficiency, and accessibility of mobile connectivity services across the Southern African Development Community (SADC). This work contributes a practical approach for improving roaming cost management and demonstrates how intelligent decision-making systems can support regional digital integration and economic mobility in developing telecommunications markets.

Keywords: Artificial Intelligence, eSIM, Roaming Optimization, Random Forest, SGP.32, Digital Connectivity, SADC, Zimbabwe.

Innovation, Enterprise and Rural Industrialisation

Sub-Theme: Designing, Financing and Commercialising Technologies and Enterprises

Determinants of Enterprise Success and Rural Industrialisation in Zimbabwe: An Empirical Analysis of MSMEs

Kizito Danha, Tinashe Ruvinga, Tatenda Katsande — Chinhoyi University of Technology (kdanha@cut.ac.zw)

Abstract

This study investigates the determinants of enterprise success and their implications for rural industrialisation in Zimbabwe. Guided by the Critical Success Factors (CSF) framework, Entrepreneurial Ecosystem Theory, and Rural Embeddedness Theory, a quantitative cross-sectional design was employed with a sample of 377 MSMEs operating in rural districts in Zimbabwe. Binary logistic regression and Structural Equation Modelling (SEM) were the analysis tools. Access to finance, entrepreneurial skills, market access, infrastructure, and institutional support are all significant and positive determinants of enterprise success. Enterprise Success has a strong positive effect on rural industrialisation. These findings contribute to the literature by integrating rural firm-level and ecosystem-level determinants in the Zimbabwean context.

Keywords: Rural Industrialisation, MSMEs, Entrepreneurship, Zimbabwe, Structural Equation Modelling, Enterprise Performance

A Low-Cost AI-Driven Supply Chain Framework for Rural SMEs in Zimbabwe: Roads to Inclusive Digital Industrialisation

Blessed Ziyambe, Godfrey Murairidzi Gatora, Sibongile Natasha Malindi, Christmas Vutuzah, Tendai Mukande — Bindura University of Science Education; University of Zimbabwe; University of KwaZulu-Natal; Dublin City University (bziyambe@buse.ac.zw)

Abstract

This study addresses the underrepresentation of rural SMEs in AI-based supply chains by developing an economical AI-based supply chain framework. The approach for the structured framework development is Design Science Research (DSR). The study applies scenario-based walkthroughs for the evaluation and demonstration of the artefact. Scenarios examined include a shop suffering from repetitive out-of-stock commodities, an agro-retailer troubled with unpredictable demand, and cooperative transport resource management. The artifact has great potential for decreasing prediction errors, stock-outs, and transport inefficiencies by approximately 20–30% in rural SMEs, providing a scalable way for embracing AI in developing economies.

Keywords: AI supply chain, rural SMEs, Design Science Research, digital industrialisation, Zimbabwe

Leveraging VAL-U Educational Games Through ISEOP Initiatives by Zimbabwean Polytechnics to Foster Entrepreneurship and Innovation

Abstract

This study explores the adaptation and implementation of the VAL-U (VALues and yoU) educational game system through ISOP initiatives by Zimbabwean polytechnics to foster entrepreneurship and innovation. Adopting a mixed-methods approach, the study examines VAL-U's deployment within Zimbabwe's tertiary education landscape. A case study of VAL-U implementation via ISOP frameworks at a selected Zimbabwean polytechnic in the Midlands Province focused on multi-stakeholder engagement. Initial pilot phases indicated promising outcomes in cultivating entrepreneurial competencies across VAL-U's six progressive levels. The study recommended enhanced funding support by government and polytechnics for VAL-U/ISOP initiatives; contextual adaptation of VAL-U for Zimbabwean settings; and strengthened collaborations between polytechnics, industry, and communities.

Keywords: entrepreneurship, ISOP, VAL-U games, economic sustainability, skills development

Mobile Platforms as a Tool for Social Innovation in Universities: A Case Study of the IUM Application

Theron I. N. Kasita — The International University of Management

Abstract

The International University of Management (IUM) uses digital platforms to strengthen institutional engagement and drive social innovation. This study presents the IUM Mobile Application as a case study of how a rapidly growing university is using digital technologies to lead innovation in higher education through an integrated, people-centred approach. Available on both iOS and Android, the IUM App integrates student attendance tracking, lecture evaluations, graduation and ticket issuing, and student announcements. For staff, the platform enables leave management, IT Helpdesk, company policies, and asset registry. By integrating critical services into a single platform, the IUM App supports a connected university with over 30,000 students across five campuses. The platform reflects a proactive approach to digital transformation supporting operations through people-centred design.

Keywords: IUM Mobile Application, digital platforms, digital transformation, social innovation

Systematic Review on the Effective Interoperability of Global Digital Product Passport (DPP) Standards and Indigenous Informal Repair Networks in the Consumer Electronics Sector

Thembanani Gaswa, Hazel Mubango, Patson Chawuruka — Women University in Africa, Department of Commerce and Management

Abstract

This study focused on evaluating the structural barriers to interoperability amid global DPP standards and electronic informal repair ecosystems, using systematic literature review. Using the PRISMA-P protocol, 48 articles (2016–2026) focusing on digital traceability, indigenous informal repair networks and consumer electronics repairs were reviewed. Findings revealed 64%

traceability leakage when products enter informal markets. The use of Lite-DDP protocols enhanced by offline-first capabilities increases Right to Repair compliance by 30% and formalises secondary material without dislodging informal livelihoods. An indigenous-centric interoperability framework was proposed to bridge the gap between global rules and indigenous practices.

Keywords: Digital Product Passports, Interoperability, Right to Repair, Informal Repair Networks, Consumer Electronics

Combating Financial Misconduct in Rural Industrialisation Projects: A Forensic Accounting and Auditing Approach to Innovation and Enterprise Development in Masvingo District, Zimbabwe

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Abstract

This study examines financial misconduct in rural industrialisation and enterprise development projects, focusing on Masvingo District, Zimbabwe. The aim was to assess how forensic accounting and auditing approaches can be used to detect and reduce financial misconduct in rural industrialisation projects. Guided by Fraud Triangle Theory (Cressey, 1953) and Agency Theory (Jensen & Meckling, 1976), a mixed-methods approach was used. Results show that financial misconduct is mainly driven by weak internal controls, limited financial literacy, and inadequate monitoring systems. The study concludes that forensic auditing significantly improves transparency and accountability in rural projects and recommends strengthening digital financial systems and capacity building for rural administrators.

Keywords: forensic accounting, rural industrialisation, financial misconduct, auditing, Masvingo, enterprise innovation

Developing a Digital Marketing Framework for Enhancing Consumer Purchasing Behavior in the Zimbabwean Telecom Sector

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Abstract

The research examines how customer network switching behavior within the oligopolistic Zimbabwean telecommunication sector shapes the competition effect, influences mobile network market share, capacity utilization and profitability. It establishes the effect of digital promotions offered by Econet, Net One and Telecel on network selection choices. Using a two-staged proportional sampling procedure, a structured questionnaire was used to draw cross-sectional survey data from 385 network subscribers. A nested logit model was used to analyse the data. Results confirm that digital promotional packages without loyalty incentives have low switching cost features, with network-specific factors like connectivity and reliability shaping consumer network selection decisions.

Keywords: network switching behavior, oligopolistic, brand loyalty, nested logit model, digital marketing

A Lightweight Social Media Analytics Framework for Micro and Small Enterprises in Infrastructure-Constrained Environments

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Abstract

This paper addresses the challenge of democratising business intelligence for resource-constrained enterprises without cloud dependencies or subscription fees. Using a Design Science Research approach, a lightweight, locally deployable analytics framework is proposed. The architecture integrates an ETL pipeline, a local SQL Server data warehouse using a star schema, and a Power BI dashboard. The predictive component forecasts long-term post-performance using only two weeks of early engagement data, with the selected Random Forest model achieving an optimal F1-score of 0.94. The framework eliminates financial barriers by utilising free, open-source tools; removes the need for continuous cloud connectivity; and provides actionable insights that MSB owners can implement immediately.

Keywords: Social media analytics, micro-enterprises, rural industrialisation, predictive machine learning, lightweight framework

Chatbot-Facilitated Last-Mile Logistics for Rural Agribusiness E-Commerce: A Design Science Approach to Financing and Commercialisation

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Abstract

This study applies Design Science Research (DSR) methodology to design, validate, and commercialise a chatbot-facilitated last-mile logistics system for rural agribusiness e-commerce platforms. Through a systematic literature review (2020–2026) and stakeholder analysis (n=20 rural agribusiness actors), design patterns, financing mechanisms, and commercialisation pathways are synthesised. Three contributions are made: a hybrid financing framework combining grants, pay-per-transaction fees, and results-based micro-grants; three commercialisation pathways (standalone SaaS, platform-integrated feature, and franchise model); and a validated DSR artifact. Findings demonstrate that chatbots can transcend customer service to become active logistics facilitators when design respects rural constraints.

Keywords: Chatbot, last-mile logistics, rural agribusiness, e-commerce, Design Science Research, technology financing, commercialisation

Financing and Scaling Rural Enterprises: Entrepreneurial Pathways for Inclusive Agro-Industrial Development

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Abstract

This study explores entrepreneurial pathways that facilitate the financing and scaling of rural enterprises and examines how these pathways contribute to inclusive agro-industrial development. A qualitative conceptual research design based on a systematic review of scholarly literature is adopted. Drawing upon Entrepreneurial Ecosystem Theory and Resource-Based Theory, the study analyses the relationships between financial accessibility, entrepreneurial capabilities, institutional support mechanisms, and enterprise scalability within rural contexts. Findings reveal that access to diverse financing mechanisms—including microfinance, agricultural credit, impact investment, cooperative financing, and digital financial services—significantly enhances enterprise growth and sustainability. The study concludes that sustainable agro-industrial development requires coordinated financing mechanisms and entrepreneurial ecosystem support.

Keywords: Rural Enterprises, Enterprise Financing, Agro-Industrial Development, Entrepreneurial Ecosystems, Inclusive Growth

Commercialisation Pathways for University-Based Innovations in Zimbabwe

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Abstract

This systematic literature review examines the commercialisation pathways for university-based innovations in Zimbabwe. The study aimed to: analyse existing innovation commercialisation models and pathways; identify factors affecting commercialisation; examine the role of university–industry–government collaboration; and propose strategies for strengthening innovation ecosystems. Using the PRISMA framework, literature published between 2010 and 2026 was retrieved and analysed thematically. Findings indicate that commercialisation efforts in Zimbabwean universities are constrained by inadequate funding, weak industry partnerships, limited intellectual property management systems, insufficient entrepreneurial competencies, and fragmented innovation policies. Emerging opportunities are identified in innovation hubs, incubation centres, digital entrepreneurship, and public–private partnerships.

Keywords: University-based innovations, commercialisation pathways, technology transfer, industrialisation, university-industry collaboration

From Growth Points to Industrial Hubs: A Roadmap for Value Addition in Rural Zimbabwe

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Abstract

This paper examines rural industrialisation as a strategic imperative for Zimbabwe's economic transformation, framed within Vision 2030, NDS1/NDS2, and ZNIDP2. Drawing on findings from

doctoral research on reindustrialisation and export performance, the study employs an Enhanced Porter's Diamond Framework anchored by Perroux's Growth Poles Theory. The research identifies key barriers including technological obsolescence, infrastructure deficits, fragmented supply chains, macroeconomic volatility, restricted access to capital, and weak institutional quality. Empirical findings confirm that entrepreneurial orientation, local conditions, business networks, and STEM work-based education are statistically significant predictors of industrialisation outcomes. The paper proposes an operational roadmap comprising Rural Industrial Clusters, vocational decentralisation through Rural Manufacturing Hubs, and rural credit guarantee schemes.

Keywords: Rural Industrialisation, value addition, beneficiation, rural development, industrial clusters

Theories and Aspects of Best Practice Measures in Tax Revenue Mobilisation: A Case of the Bulawayo Micro-Small to Medium Enterprises (MSMEs)

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Abstract

This paper reviewed the social contract theory, enforcement theory and tax compliance theory as they are interrogated to analyse their relevance in mobilising tax revenue from MSMEs in the Bulawayo Metropolitan Province. Data were extracted from the World Bank Data 2009–2018 and ZIMSTATS Report 2021. The results show that the tax revenue-GDP percentage fell gradually from 2012 and further tumbled drastically from 2017. It was found that the majority of MSME operators who attained primary and secondary education had an aggregate of 83.5% non-compliance. Recommendations include making tax education compulsory from ECD level to university, engaging qualified tax accountants, and integrating revenue collection agencies with ZIMRA.

Keywords: tax revenue, social contract, enforcement, tax compliance, knowledge, tax education, revenue collection agencies

Leveraging Artificial Intelligence to Strengthen Health Insurance Systems in Zimbabwe: A Critical Review of Organizational Readiness

Harison Ziyambe, Tsitsi Mufudza

Abstract

Health financing systems are undergoing a tectonic paradigm shift, transitioning from historical, reactive risk management frameworks to predictive, value-based ecosystems enabled by Artificial Intelligence (AI). Technologies such as Machine Learning (ML), Natural Language Processing (NLP), and Predictive Analytics offer unprecedented capabilities to automate claim processing, optimize revenue pools, and detect complex Fraud, Waste, and Abuse (FWA). However, the real-world utility of these tools is strictly constrained by an institution's organizational readiness defined across technological infrastructure, data maturity, human capital, and regulatory governance. This paper provides a critical, multi-tiered review of organizational readiness for AI integration in health insurance. It traces an analytical path from mature, high-resource global landscapes down through emerging regional frameworks within Sub-Saharan Africa, before zeroing in comprehensively on the hyper-inflationary, multi-currency, and fragmented health

financing landscape of Zimbabwe. By contrasting global paradigms with local realities, this review illuminates the acute structural, infrastructural, and data gaps currently precluding Zimbabwean insurers from maximizing AI. Concurrently, it exposes how Zimbabwe can bypass legacy architectures and strategically deploy "frugal AI" mechanisms to build a resilient, inclusive, and democratized health financing ecosystem.

Keywords: Artificial Intelligence, Health Insurance, Zimbabwe, Claims Fraud, Digital Health, Organisational Readiness.

Design of a Plant for the Production of Essential Oil from Waste Lemon Peels with Potential Application in Antimicrobial Liquid Soap

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Abstract

This project addresses two pressing problems in Zimbabwe: the lack of citrus peel waste disposal and dependency on imported synthetic personal care products. Lemon peel essential oil is predominantly D-limonene (45–76%) which has antimicrobial, antioxidant and degreasing properties suitable for natural liquid soap formulation. Ultrasonic-assisted ethanol extraction (UAE) with 95% food-grade ethanol was selected for high efficiency. Optimal conditions for the distillation column were a temperature of 80°C with a residence time of 75 minutes, recovering 3.32% pure oil. The neutralisation reactor achieved a 98.6% oil recovery rate. The purified product conforms to international quality standards. The process is designed for agro-industrial scale-up within a closed-loop solvent recovery system.

Keywords: Lemon essential oil, waste valorisation, ultrasonic-assisted ethanol extraction, D-limonene, distillation, antimicrobial liquid soap, circular economy, Zimbabwe

Modelling Portfolio Credit Risk of Microfinance Institutions Operating Under Economic Stress in Zimbabwe

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Abstract:

Hyperinflationary environments engender nonstationary credit risk dynamics that extant modelling paradigms inadequately capture a lacuna prior literature has alluded to but not systematically addressed. To buttress risk management in such contexts, this study developed an integrated credit risk framework tailored to extreme macroeconomic instability, using Zimbabwe as an empirical laboratory. The proposed architecture synthesized borrower-level default modelling, macroeconomic shock transmission analysis, and portfolio risk aggregation within a unified quantitative structure. Methodologically, we employed a threestage design: (i) logistic regression to estimate probability of default (PD) on 200 loans disbursed between January 2020 and December 2025; (ii) a Bayesian vector auto-regression (VAR) with structural break detection

applied to 72 months of macroeconomic data; (iii) Monte Carlo simulation (10,000 iterations) to derive portfolio loss distributions across baseline, moderate and severe stress scenarios. Results delineated a fundamental reordering of credit risk drivers under hyperinflation. The debt to income ratio (odds ratio = 40.1) and prior default history (odds ratio = 3.88) emerged as salient predictors, whereas collateral value and conventional credit scores forfeited statistical significance corroborating the erosion of traditional underwriting criteria. Macroeconomic analysis revealed rapid shock transmission, exchange rate depreciation concomitantly exacerbated inflation and eroded real wages within short horizons. Notably, the April 2024 introduction of the Zimbabwe Gold (ZiG) currency constituted a statistically significant structural break. Portfolio simulations evinced elevated vulnerability, with expected losses spanning 28.9%–42.0% of total exposure. Hypothesis testing confirmed that macroeconomic stress significantly altered loss distributions ($p < 0.001$). This framework furnished a robust operational tool for capital adequacy planning, stress testing, and early warning systems in volatile economies.

Keywords: Credit Risk Modelling; Microfinance Institutions; Hyperinflation; Stress Testing; Monte Carlo Simulation.

Agro-Processing Enterprises as Drivers of Rural Industrialisation Leonard Shambira, Edna Shambira Great Zimbabwe University

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Abstract

Agro-processing enterprises are critical instruments for promoting rural industrialisation, economic diversification, employment creation, and sustainable development in developing countries. This study examines the role of agro-processing enterprises in transforming rural economies through value addition, market expansion, and increased agricultural productivity. The research explores how agro-processing activities such as food preservation, packaging, milling, and agricultural value chain development contribute to industrial growth within rural communities. Attention is given to the ways in which these enterprises stimulate entrepreneurship, improve household incomes, reduce post-harvest losses, and create employment opportunities for women and youths. The study investigates the challenges affecting agro-processing enterprises such as inadequate infrastructure, limited access to finance, poor technological adoption, unreliable energy supply, and weak market linkages. Using a mixed-methods approach involving surveys, interviews, and case studies from selected rural communities, the research analyses the effectiveness of policy frameworks and institutional support mechanisms in enhancing agro-industrial development. The findings revealed that agro-processing enterprises significantly contribute to rural industrialisation by strengthening local economies, enhancing food security, and promoting sustainable livelihoods. The study recommends increased investment in rural infrastructure, technological innovation, skills development, and supportive government policies to strengthen agro-processing industries. Furthermore, the integration of indigenous knowledge systems with modern agro-processing technologies is proposed as a sustainable pathway for accelerating rural industrialisation and improving socio-economic resilience in rural areas.

Keywords: Rural Industrialisation, Agro-Processing, Innovation, Entrepreneurship

A Probabilistic Cash-Flow Model for Off-Grid Solar Investment: Balancing Affordability and Financial Sustainability

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Abstract:

Off-grid solar systems are vital for rural electrification in Zimbabwe, yet investors face a fundamental conflict: keeping payments affordable for low-income households while ensuring financial sustainability. Traditional deterministic cash-flow models ignore random variations in default rates, repair costs, and seasonal income, leading to over-optimistic investment decisions or excessively high tariffs. This study develops a probabilistic cash-flow model that treats key inputs as random variables. We model monthly installment default probability using a Beta distribution, repair cost frequency as a Poisson process, and household agricultural income as Lognormal with seasonal peaks. A Monte Carlo simulation generates the probability distribution of net present value (NPV) for a typical solar home system over five years. Preliminary results from rural district data reveal that the probability of negative NPV exceeds 30% when monthly installments fall below USD 8. At USD 8, the expected NPV is positive but 40% of households cannot afford the payment (exceeding 10% of monthly income). Sensitivity analysis shows default probability is the most influential variable, followed by system lifespan. A break-even contour plot identifies that reducing default risk from 20% to 10% allows installments as low as USD \$6 without increasing insolvency risk beyond 5%. The model provides a practical decision tool for rural energy enterprises, cooperatives, and Non-Governmental Organisations. It quantifies the unavoidable trade-off between social impact and investor protection. Future work will integrate household willingness-to-pay surveys to refine affordability thresholds.

Keywords: Probabilistic cash-flow, Monte Carlo simulation, off-grid solar, rural electrification, affordability, financial sustainability.

A Digital Marketplace Software Designed to enhance Rural Inclusion by Connecting Smallholder Farmers to Agricultural Markets

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Affiliation(s): NUST

Presentation Type: Expo

Abstract:

This abstract presents the concept of a digital marketplace software designed to enhance rural inclusion by connecting smallholder farmers directly to agricultural markets. The platform addresses critical barriers such as information asymmetry, limited bargaining power, and poor market access. By integrating features like multilingual interfaces, offline functionality, voice-based inputs, and last-mile logistics support, the software ensures accessibility for low-literacy and remote farming communities. Farmers can list produce, access real-time price data, and link with buyers—including wholesalers, retailers, and processors—while benefiting from digital payment systems and traceability tools. The model promotes transparent price discovery, reduces post-harvest losses, and increases income resilience. Preliminary evidence suggests such platforms can

significantly improve rural participation in formal value chains, provided they are supported by capacity-building initiatives and interoperable with existing agricultural cooperatives and extension services. The software thus acts as a catalyst for inclusive agricultural commercialization.

Keywords: Digital marketplace software, rural inclusion, smallholder farmers, multilingual interfaces

Realising the untapped potential of agro-industrialisation in Gokwe and Lupane

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Presentation Type: Oral

Abstract:

Gokwe and Lupane are strategically positioned to become major agro-industrial growth poles in Zimbabwe owing to their agricultural potential, natural resource endowments, and emerging infrastructure investments. Gokwe has evolved into one of the country's most productive farming districts, producing substantial quantities of maize, cotton, sunflower, groundnuts, and sweet potatoes, while the Bomba irrigation area supports year-round horticultural production. Lupane, located in the semi-arid Matabeleland North Province, possesses significant potential in tobacco, small grains, fisheries, goats, sheep, and indigenous poultry. This potential is expected to increase substantially after the completion of the Gwayi-Shangani Dam project, which is anticipated to expand irrigation development, improve water availability, stimulate agricultural diversification, and create opportunities for agro-based industries throughout the district. Despite these opportunities, farmers in both districts continue to sell most agricultural products in raw form, allowing intermediaries and external processors to capture a significant share of value and profits. This paper explores technological and enterprise-based interventions that can transform agricultural production into competitive rural industries. Priority opportunities include sunflower oil extraction, peanut butter manufacturing, sweet potato flour and starch production, vegetable drying and processing, fish processing and cold-chain facilities, stock-feed manufacturing, small-grain milling and packaging, and improved tobacco-curing technologies to enhance leaf quality and market grades. Lessons from sweet potato and mango value chains in Murewa and tomato-processing opportunities in Lower Gweru demonstrate the economic benefits of localized value addition. The paper argues that investments in farmer-owned processing enterprises, rural industrial parks, renewable energy technologies, innovation hubs, irrigation infrastructure, and value-chain financing can drive rural industrialisation, create employment, strengthen food security, and promote inclusive economic growth in Zimbabwe's rural economy.

Creativity, Design and Cultural Innovation

Sub-Theme: Industrial Design, Creative Technologies, Digital Arts, Cultural Heritage and Innovation Ecosystems

Governance of Innovation Ecosystems: Institutional Frameworks for Creative Industries and Cultural Technology Development

Heniuck Mutisi, Everjoy Mukunga, Pardon J Muzondo — Chinhoyi University of Technology; Marondera University of Agricultural Science and Technology (hmutisi@cut.ac.zw)

Abstract

This study examines the governance of innovation ecosystems and explores how institutional frameworks can enhance the development of creative industries and cultural technologies. Grounded in Innovation Ecosystem Theory, Institutional Theory, and the Triple Helix Model, a thematic analysis identifies key governance mechanisms, institutional enablers, and barriers affecting ecosystem performance. Findings reveal that effective governance of innovation ecosystems requires collaborative institutional arrangements, supportive regulatory frameworks, intellectual property protection, innovation financing, digital infrastructure, and strong stakeholder networks. Well-designed institutional frameworks enhance ecosystem resilience, innovation capacity, and competitiveness in rapidly evolving digital environments.

Keywords: Innovation Ecosystems, Institutional Frameworks, Creative Industries, Cultural Technology, Innovation Governance

Digital Transformation of Buhera's Creative Industries: A Framework for Rural Industrialization and Cultural Tourism

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Abstract

This study explores how digital platforms can transform Buhera's creative industries to connect cultural heritage with global markets, driving rural industrialisation by empowering local artisans with sustainable, technology-driven business models. Using a mixed-methods approach combining interviews and discussions with community leaders, artisans, elderly women, and youth, the study found that Buhera is rich in cultural heritage and talent that has not fully reached its potential. Many locals have the skills but lack support, funding, and exposure. Technology-driven business models such as digital platforms, online marketing, and mobile money systems can help connect local communities to wider markets and increase visibility.

Keywords: cultural heritage, rural development, community-based tourism, creative industries, Buhera district

Integrating Traditional Cultural Expressions (TCE) and Indigenous Traditional Knowledge (TK) Systems in Social and Economic Policy for Sustainable Development

Abstract

This paper explores how intellectual property coupled with an increased awareness of intangible assets creates a paradigm shift for developing economies. WIPO has extended intellectual property protection to include indigenous knowledge, cultural expressions, and folklore. Cultural expressions such as Kente cloth patterns from Ghana, Burundian drums, traditional ways of rearing animals, knowledge of medicinal plants, and natural processes such as thermal waters can be protected as intellectual property of communities. The exploitation of intellectual property creates employment and generates revenue through selling and licensing, franchising, merchandising, joint ventures and strategic alliances, contributing to SDGs 8 and 9 on decent work, economic growth, industry, innovation and infrastructure.

Keywords: Intellectual Property, Sustainable Development Goals, intangible assets, related rights, WIPO, IP exploitation

Development of an Augmented Reality (AR) Cultural Heritage Experience Platform for Zimbabwean Historical Sites

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Abstract

This study sought to develop an augmented reality (AR) platform that enhances the interpretation and visitor experience of Zimbabwe's cultural heritage sites. A mixed-methods design captured both user requirements and technical development needs through interviews with tourism officials, museum curators, and heritage experts, as well as focus group discussions with students, tourists, and local users. Observations were conducted at the Great Zimbabwe Monuments, Khami Ruins, and Domboshava Caves. The AR application will be developed using Unity and AR tools, including 3D modelling and multimedia features. Research findings indicated that current interpretation methods relying on static signage and guided tours limit engagement, and that AR technology will improve visitor engagement and attract younger, tech-oriented audiences.

Keywords: Augmented Reality, Cultural Heritage, Digital Tourism, Heritage Interpretation, Historical Sites, Zimbabwe

Ethno-Phenomenological Cultural Transformation Workshop Model: Pottery Design and Sustainable Cultural Continuity in a Globalised World in Zimbabwe

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Abstract

This study examines how the integration of women potter experiences and involvement with the youth resonates with historical, symbolic and material culture dynamics within the broader context of cultural continuity. The adopted Ethno-Phenomenological Cultural Transformation Workshop Model for this project systematically demonstrates that knowledge sharing and collaboration

resulted in contemporary pottery design that satisfies modern lifestyles. This model promulgates pottery design as an intersection between history, symbolism and visual culture, strengthening the sustenance of cultural continuity in communities in Mhangura District where the influence of western material culture has led to distortion or denigration of indigenous cultural heritage.

Keywords: Product design, Cultural Continuity, Cultural Transformation, Ethno-Phenomenological, Visual Design

Art and Design Curricula in SADC Universities: A Desktop Review and Futures Foresight in the Age of Artificial Intelligence

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Abstract

This policy-oriented analysis examines the current state of Art and Design curricula at selected SADC universities and projects the educational demands likely to emerge as AI continues to transform design practice. The first phase employs a systematic desktop review of publicly available curriculum documents benchmarked against leading international Art and Design programmes. The second phase applies a futures foresight framework using scenario planning and horizon scanning. Preliminary findings indicate that most SADC Art and Design programmes have not yet systematically incorporated AI-related competencies, generative design tools, human-AI collaboration skills, or critical AI literacy. The paper recommends phased integration of AI literacy and generative design competencies into existing programmes.

Keywords: Art and Design Education, Curriculum Foresight, Artificial Intelligence, SADC Region, Creative Industries, Digital Pedagogy, Scenario Planning

Designing Sustainability: Bridging Cultural Heritage and Contemporary Creativity in Fashion Innovation

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Abstract

This paper examines how cultural heritage and modern design thinking can work together to push sustainable fashion practices forward. A qualitative multiple case study research design was situated within an interpretivist paradigm to look at actual fashion projects that blend indigenous knowledge, traditional craft skills, and locally sourced materials into contemporary design practices. Findings revealed that when designers tap into cultural knowledge, it genuinely helps sustainability by making clothes that last longer and getting communities more invested in what's being made. The study concludes that the integration of indigenous knowledge, traditional craftsmanship, and locally sourced materials into contemporary design enables the development of fashion systems that are environmentally responsible, socially inclusive, and culturally relevant.

Keywords: Sustainable fashion design, cultural heritage, cultural innovation, contemporary creativity, circular fashion, indigenous knowledge systems, ethical production

Living Museums: A Framework for Revitalising the Shangani/Tsonga Language in the 21st Century

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Abstract

This paper explores the 'Living Museum' concept through the development of the Shangani/Tsonga Language and Cultural Heritage Park in Chiredzi. The philosophy of the Language and Cultural Heritage Park utilises architecture as a pedagogical tool and AI as a bridge for intergenerational knowledge transfer. The design prioritises people-centred design by utilising locally sourced materials and traditional building techniques. The framework makes provision for active heritage preservation through active heritage zones such as a culinary hub and artisanal workshops. To bridge the digital gap, the park integrates AI-guided interactions such as QR code linked AI narrations and Augmented Reality overlays, offering a scalable model for the active preservation of marginalised languages.

Keywords: Living museums, Shangani/Tsonga, vernacular architecture, people-centred design, AI-guided heritage, Rural Industrialisation

An Audience Reception Study in Zimbabwe: Decoding Health Promotion Materials (Posters) that Focus on Children's Diseases

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Chivhanga, B, Muromo, B.

Abstract

This study evaluated the impact of health information on the targeted audience in Zimbabwe through evaluating how rural and urban residents decode and interpret health promotion posters focusing on children's diseases. Data was collected through questionnaires, interviews, observations, and focus groups in two different sites: Kuwadzana Poly Clinic and Makumbe District Hospital. The study revealed that visual elements are essential tools in capturing attention and influencing decision-making in public health. Audiences are not passive recipients but active interpreters, engaging with materials through dominant, negotiated and oppositional readings. Cultural resonance, educational attainment, generational preferences, and the urban-rural divide are critical determinants of communication success. It is recommended that digital distribution platforms be harnessed to improve access to health promotion content.

Keywords: Decoding, visual messages, audience reception, graphic messages, visual literacy, health promotion materials, health communication

When Heritage Meets Innovation: Leveraging Motion Picture as a Powerful Conduit to Preserve Cultural Expressions of Minority Ethnic Groups in Lupane State University Film Productions.

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Abstract

Heritage and innovation is a perfect blend for mainstreaming the elderly through the youth in creative arts. The study sought to interrogate how motion pictures can be used as a powerful conduit in the preservation of minority ethnic groups' cultural heritage in Lupane State University film productions, through the lens of a short film *The Land that Dreams* (2024). This paper asks how motion picture production at Lupane State University can be utilized to preserve isiNdebele cultural expressions. The theoretical framework of this study is underpinned by participatory film-making theory and indigenous knowledge systems as a way of life. The study used a participatory case study approach within the qualitative action research paradigm. Data was gathered through focus group discussion and participant observation. Research instruments included in-depth open-ended interviews, and data was also digitally recorded. The literature survey included books and journals. The research reveals that, motion picture is a powerful conduit for preserving isiNdebele cultural expressions. Findings demonstrated that blending heritage and innovation enriched the quality of Lupane State University film productions. The study underscores the role of motion pictures in the preservation of minority ethnic groups' cultural heritage, and promotion of understanding between the elderly and young people, fostering inter-generational connections and mutual respect. This paper concludes with a plea for blending heritage and innovation to amplify cultural expressions of minority ethnic groups in Zimbabwe.

Keywords: Heritage, Innovation, Motion Picture, Preserve, Minority, Ethnic Groups

Augmenting SME Resilience in Emerging Digital Economies: A Framework for Human-AI Symbiosis in Multimedia Production for Zimbabwean Urban Markets

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Abstract:

Small and Medium Enterprises (SMEs) in Zimbabwe's urban informal markets play a vital role in economic development, employment creation, and household sustainability. However, despite increasing use of smartphones and social media platforms such as WhatsApp Business, Facebook, Instagram, and TikTok for marketing, many SMEs face challenges including limited digital skills, weak branding capabilities, and restricted access to professional multimedia production tools. This study explores how human-AI symbiosis can enhance SME resilience in Zimbabwe's emerging digital economy through multimedia production. Grounded in the concept of AI as a collaborative partner rather than a replacement for human creativity, the research aims to develop a practical framework integrating traditional multimedia tools with generative AI to strengthen digital marketing capabilities among informal entrepreneurs. Guided by Human-Computer Symbiosis, Affordance Theory, Frugal Innovation, and Bourdieu's Theory of Capital, the study adopts a

pragmatic mixed-methods design focusing on SMEs in Harare's informal markets, particularly Mbare and Magaba. Data collection will include semi-structured interviews, digital analytics, co-creation workshops, and A/B testing comparing AI-assisted and non-AI-assisted marketing campaigns. Quantitative analysis will assess engagement, conversion, and revenue outcomes, while qualitative analysis will explore perceptions, barriers, and experiences of AI adoption. Expected outputs include a Human-AI symbiotic multimedia framework tailored for low-bandwidth, resource-constrained environments, a multilingual prompt library, an educational toolkit, and policy recommendations. The study contributes to knowledge on AI adoption in informal economies and offers an inclusive pathway for digitally empowering Zimbabwean SMEs in the Fourth Industrial Revolution.

Keywords: Human-AI Symbiosis; SMEs; Digital Transformation; Multimedia Production; Generative AI; Zimbabwe.

Living Museums: A Framework for Revitalising the Shangani/Tsonga Language in the 21st Century

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Abstract

The traditional museum model has inadvertently facilitated the erosion of intangible heritage by isolating cultural artifacts and indigenous languages from the living communities they are intended to sustain. The Shangani/Tsonga people is one unique community whose language's survival is intricately tied to daily domestic, economic and spatial practices, thus from vernacular architectural construction to indigenous food processing. This paper explores the "Living Museum" concept through the development of the Shangani/Tsonga Language and Cultural Heritage Park in Chiredzi. The philosophy of the Language and Cultural Heritage Park utilizes architecture as a pedagogical tool and Artificial Intelligence (AI) as a bridge for intergenerational knowledge transfer. Procedurally, the design prioritises people-centred design by utilizing locally sourced materials and traditional building techniques derived from indigenous knowledge systems. The framework model makes provision for active heritage preservation through active heritage zones such as the culinary hub where dishes like Xiendlahivomu and Xigugu are prepared, and artisanal workshop where Muhlava extraction is done. These zones ensure that the Shangani/Tsonga language is experienced within its functional and natural setting. To bridge the digital gap, the park integrates AI-guided interactions such as QR code linked AI narrations and Augmented Reality overlays. These digital layers allow both the indigenous community and global visitors to engage with the indigenous architecture and folklore in real-time. By merging indigenous design with industry 4.0 technologies, this framework offers a scalable model for the active preservation of marginalised languages, transforming the heritage site from a static repository into a dynamic engine for rural industrialisation.

Keywords: Living museums, Shangani/Tsonga, vernacular architecture, people-centred design, AI-guided heritage, Vernacular Architecture, Rural Industrialisation.

Society, Governance and Inclusive Development

Sub-Theme: Policy, Ethics, Social Innovation, Community Participation and People-Centred Design

Waste Management Strategies for Ruralpreneurs in the Food Industry: The Case of Female Food Vendors in Lower Gweru, Zimbabwe

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Abstract

This study investigated waste management initiatives and practices implemented by female-owned food vendor businesses in Lower Gweru, examining their effectiveness in reducing waste and environmental impact. Using a mixed-methods approach with interviews and observations of 20 female-owned food vendor businesses, the study found that informal waste disposal methods such as dumping and burning were prevalent. Limited access to waste management infrastructure and lack of environmental awareness hindered sustainable practices. However, some businesses had adopted innovative strategies like recycling, reuse, composting, and proper disposal. The study recommends improved waste management infrastructure, environmental awareness programs, and incentives for adopting sustainable practices.

Keywords: Environmental sustainability, Gender, Waste management, Rural Zimbabwe, Lower Gweru

Integrating Intellectual Property Rights in Engineering Education for Sustainable Development

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Abstract

This paper explores how universities and graduates can benefit from their knowledge through proper intellectual property rights protection and exploitation. Several IP protection regimes are discussed including copyright, patents, industrial designs, trademarks, and the protection of traditional cultural expressions and indigenous traditional knowledge systems. Intellectual property can be exploited through direct use, selling and licensing, franchising, merchandising, joint ventures and strategic alliances, and as collateral in financial institutions. IP offers significant opportunities for developing nations, especially with the extension of IPRs protection to unwritten and unrecorded cultural expressions, generally known as folklore, works of culture and intangible heritage.

Keywords: Copyright, intellectual property, intangible heritage, IP Rights, Trademarks, Patents

Revitalizing Grass Root Development Structures for Responsive Governance

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This qualitative research examined the effectiveness of grass root development structures in Zimbabwe, including village assemblies, village development committees, ward assemblies, ward development committees, and rural district development committees. It was revealed that these structures in Zimbabwe are not as active as they should be, do not discharge their responsibilities in line with their mandate, and have been conflated with ruling party structures. Village and ward-based structures do not meet regularly and have serious capacity challenges. There is mistrust and conflict between councillors and appointed officials as well as between councillors and traditional leaders. It was recommended that central government should resuscitate and capacitate grass root structures to enhance responsive and participatory governance.

Keywords: development, grass root, village, governance, participatory

Stakeholders' perceptions on the adoption of ESG in Small to Medium Tourism Enterprises in Chinhoyi (Zimbabwe)

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Abstract

Environmental, Social, and Governance (ESG) practices have emerged as important drivers of sustainable business performance at a global level. However, their adoption among Small to Medium Tourism Enterprises (SMTEs) in Zimbabwe remains limited and poorly understood. This study investigated stakeholders' perceptions on the adoption of ESG for Small to Medium Tourism Enterprises in Zimbabwe using Chinhoyi as a case. A qualitative approach was employed, using a structured interview guide to collect data from 25 participants who comprised of managers and employees within selected tourism SMTEs in Chinhoyi, and convenience sampling was used to select participants for the study. Qualitative data was analyzed using the thematic analysis technique. The findings revealed that stakeholders possessed varying levels of understanding of ESG, with environmental aspects being more widely recognized than social and governance dimensions. Overall perceptions towards ESG were predominantly negative, largely due to concerns regarding implementation costs, limited financial resources, inadequate knowledge, as well as lack of technical expertise and the absence of clear regulatory guidance. Despite these challenges, respondents acknowledged several benefits associated with ESG adoption, including enhanced organizational reputation, increased operational efficiency, environmental conservation and long-term business sustainability. Resultantly, the study recommends increased stakeholder education and training on ESG principles, financial incentives and support mechanisms for SMTEs and stronger government policy frameworks. The study concludes that while tourism SMEs in Zimbabwe recognize the potential value of ESG practices, significant institutional, financial, and knowledge-related barriers continue to impede widespread adoption. Addressing these barriers is essential for enhancing sustainability, competitiveness, and long-term resilience within the tourism SMEs.

Keywords: Environment, Social Governance (ESG), Small and Medium Tourism Enterprises, (SMTes) sustainability, adoption, Zimbabwe, stakeholders' perception.

Exclusion by Inclusion: The Paradox of Women Electoral Representation in Zimbabwe

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Abstract

This qualitative, descriptive, inductive research assessed the usefulness of the current electoral system in delivering gender parity in electoral offices. Main findings were that women representation is actually declining with regards to elections to local governments and parliament. Women find it difficult to compete against men in the ward and constituency elections, and lack resources to seriously compete in the political arena. The constituency and ward systems used to elect councillors and parliamentarians are highly skewed in favour of men in a patriarchal society. The main finding was that the electoral system in place does not speak to the 50/50 agenda and therefore migration to a purely proportional representation electoral system is needed.

Keywords: gender parity, electoral systems, first past the post, proportional, protocol

Corporate Governance, Ethical Leadership and Policy Frameworks for Inclusive Rural Industrial Development

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Abstract

This study examines the role of corporate governance, ethical leadership, and policy frameworks in fostering inclusive rural industrial development and develops an integrated framework that promotes sustainable and equitable industrial transformation in rural communities. Grounded in Stakeholder Theory, Stewardship Theory, and Institutional Theory, the findings reveal that effective corporate governance characterised by transparency, accountability, stakeholder participation, and responsible decision-making enhances the sustainability and competitiveness of rural enterprises. Ethical leadership promotes trust, social responsibility, inclusivity, and long-term value creation, while coherent policy frameworks facilitate investment, innovation, and equitable access to economic opportunities.

Keywords: Corporate Governance, Ethical Leadership, Policy Frameworks, Rural Industrial Development, Inclusive Growth

Corporate Governance Framework for Service Delivery in Selected Zimbabwean Urban Areas

Agnes Kawiri and Obert Sifile

Abstract

This study examines the relationship between corporate governance frameworks and service delivery outcomes in selected Zimbabwean urban municipalities, namely Harare, Mutare, Chinhoyi, and Marondera. The study assesses how accountability, transparency, stakeholder participation, and regulatory compliance influence the quality, efficiency, and responsiveness of municipal service delivery. A mixed-methods approach anchored in a pragmatic research philosophy is adopted. Quantitative data are analysed using regression analysis to establish relationships between governance variables and service delivery outcomes, while qualitative data are analysed thematically. The study proposes a strengthened corporate governance framework tailored to the local government context.

Keywords: Agency, corporate governance, Municipality, Service Delivery, Stakeholders

Marking Territory with Affection: Understanding the Materiality of Love and Belonging at Established Tourism Destinations: The Case of Victoria Falls

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Abstract

This paper investigates the growing phenomenon of travellers using material markers to express affection and permanence at established destinations. Using Victoria Falls as a critical case study and building on theories of place attachment and emotional geography, qualitative visual documentation of marked sites and netnographic analysis of related media posts were employed. Findings reveal that tourists perceive their acts as harmless romantic rituals while management organisations view them as threats to biodiversity, indigenous flora, architecture and sites' aesthetic preservation. The study proposes a sustainable management framework that accommodates visitor expressions without compromising heritage resources, including designated alternative canvases and digital love registries.

Keywords: Sustainable Tourism, Heritage based Tourism, Love and Affection, Victoria Falls

Pandemics, Propaganda and Platforms: Social Media's Role in Public Health Governance and Misinformation

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Abstract

This study examines how digital ecosystems influence public trust, policy compliance and the effectiveness of health communication strategies during pandemics. Adopting a qualitative research design, the study integrates discourse analysis of pandemic-related social media content with a review of public health communication policies. Grounded in theories of hegemony, digital governance and information disorder, the research explores how state and non-state actors interact to construct and amplify competing health narratives. The findings reveal that although social media enhances participatory communication and real-time updates, it simultaneously destabilises public health responses by amplifying conspiracy theories, politicised messaging and anti-science

sentiments. A multi-stakeholder governance framework emphasising platform accountability is proposed.

Keywords: Social media, public health governance, misinformation, propaganda, pandemics, digital platforms, Global South

Policy Frameworks for Grassroots Innovation: Analyzing How National Policies Can Better Support 'Jua Kali' (Informal) Engineering and Social Innovation Within Rural Zimbabwean Hubs

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Abstract

This study investigates the policy-practice gap affecting 'jua kali' (informal) engineering hubs—artisanal clusters that provide essential technical services but operate on the fringes of the formal economy. Findings reveal that while NDS2 provides a theoretical foundation for leaving no one behind, actual implementation remains centralised and exclusionary for informal clusters. Key results indicate that 85% of artisans in Magaba, Epworth and Glenview lack a pathway to SAZ quality certification and current tax regimes act as a deterrent to scaling. The study proposes Innovation Sanctuaries within these industries—zones where 'jua kali' artisans receive fiscal protection and technical retooling to bridge the gap between indigenous knowledge and formal engineering standards.

Keywords: National Development Strategy 2, policy-practice gap, industrialisation, innovation sanctuaries, jua kali

A Hybrid Artificial Intelligence Integrated Credit System to Enhance Financial Inclusion for Underserved Populations in Zimbabwe

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Abstract

The aim of the study is to address financial exclusion in Zimbabwe by developing an Artificial Intelligence (AI) driven hybrid credit scoring model to enhance credit access for individuals and small enterprises in the informal sector with no formal credit histories. Traditional credit assessment schemes rely on collateral, formal income records and historical banking data which exclude the majority who operate in the informal economy. The inadequacy of these traditional schemes leads to high rejection rates which in turn perpetuate financial exclusion. The study adopted a conceptual and systems design approach which examined the architecture, data sources and machine learning algorithms to operationalize the credit platform. The hybrid approach aggregates predictions from multiple algorithms to generate a more reliable credit score. The model reduces information asymmetry by incorporating multiple financial and behavioral data sources into the credit risk assessment for predicting legible and illegible clients for loans as well as improving borrower risk evaluation, allowing financial institutions to extend credit to previously excluded individuals. This model will increase financial inclusion and economic empowerment of

underserved communities. This model will promote business efficiency in the financial sector as well as limiting loan frauds.

Keywords: Hybrid AI model, Credit Score, Financial Inclusion, Machine Learning,

FixIt Zimbabwe, a full-stack AI-powered Public Infrastructure Complaint and Tracking Platform

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Abstract:

Zimbabwe's urban and peri-urban local authorities face a deepening infrastructure maintenance crisis. Potholes, burst water pipes, broken streetlights, and blocked drainage systems are routinely reported by citizens yet remain unresolved for months or years due to fragmented complaint channels, poor accountability structures, and the absence of data-driven prioritisation tools. Harare, Bulawayo, Mutare and other municipalities currently rely on manual, telephone-based or walk-in complaint systems that offer no transparency, no tracking, and no intelligent resource allocation — eroding public trust and accelerating infrastructure deterioration. This paper presents FixIt Zimbabwe, a full-stack AI-powered public infrastructure complaint and tracking platform that digitises, routes, and prioritises citizen-reported infrastructure faults across Zimbabwe's local authority areas. The platform provides three core functionalities: a citizen-facing mobile Progressive Web App (PWA) enabling geo-tagged fault reporting with photo evidence submission; an AI prioritisation engine that ranks complaints by severity, frequency, location clustering, and public health risk; and a council dashboard giving local authority engineers real-time visibility of outstanding faults, resource allocation recommendations, and resolution performance analytics. The platform is designed for direct adoption by Zimbabwe's Urban Councils Act-mandated local authorities, with potential licensing to the Ministry of Local Government as a national infrastructure intelligence tool. FixIt Zimbabwe advances Zimbabwe's Vision 2030 and NDS1 smart governance agenda by transforming reactive, opaque infrastructure management into a transparent, data-driven public service — rebuilding citizen trust while maximising the impact of councils' limited maintenance budgets.

Development of a Web GIS Based Shop licence Management System: A case study of Chinhoyi CBD

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Abstract:

Small and medium enterprises (SMEs) contribute significantly to economic development in Zimbabwe; however, many operate without licences due to inefficient manual and paper-based

municipal licensing systems. In Chinhoyi Municipality, these traditional systems result in data duplication, poor record management, weak compliance monitoring and revenue leakage, thereby limiting effective urban governance and service delivery. This study examined the role of digital innovation in strengthening urban governance through the development of a GIS-based shop license management system for Chinhoyi Municipality. The study aimed to improve efficiency, transparency, accountability and accessibility in municipal licensing processes while enhancing inclusive SME formalisation and sustainable urban governance. Spatial and administrative business data was collected and integrated into a centralised digital repository. Manual geocoding was used to capture the locations of business premises, while the developed web-GIS platform enabled online license applications, automated workflows and spatial visualization of compliance patterns. User Acceptance Testing (UAT) was conducted to evaluate system usability and functionality. The developed system introduced real-time visualisation of business locations and compliance status. This enhanced transparency, reducing processing time. It also demonstrated potential to improve revenue collection, reduce corruption and strengthen regulatory oversight despite challenges related to ICT infrastructure readiness and data quality. This study demonstrated how GIS and web technologies can enhance smart governance, inclusive service delivery and sustainable urban management. The system aligns with SDGs 8, 9 and 11, Zimbabwe Vision 2030 and NDS2 through promoting digital governance and efficient municipal administration.

BrailleRead: A Low-Cost Refreshable Braille Display for Advancing Inclusive Education in Rural Zimbabwe

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Abstract:

Objectives: Despite Zimbabwe's Amended Education Act of 2020 mandating inclusive education for all, only 10% of children with disabilities currently access schooling, and visually impaired learners in rural communities face near-total exclusion from Braille literacy due to the prohibitive cost and scarcity of assistive technologies. This study proposes BrailleRead, a locally designed, low-cost refreshable Braille display intended to render tactile Braille characters in real time, enabling visually impaired learners to access printed and digital textbooks independently. **Methods:** BrailleRead is designed around a Raspberry Pi microprocessor, camera module, and miniature push-pull solenoid actuators. Printed text is captured via a Tesseract OCR pipeline and digital documents imported through external storage, both translated into Unified English Braille and rendered through a six-pin solenoid tactile interface per Braille cell. The prototype is evaluated through design simulation and bench testing for OCR accuracy, tactile readability, solenoid response time, power consumption, and component cost against commercially available alternatives. Preliminary design analysis indicates the proposed architecture is expected to achieve reliable OCR-to-Braille translation, meet ISO 17351 tactile dot-height standards, and sustain operation under low-power conditions suitable for off-grid rural schools. Component costs are projected to be significantly lower than imported commercial refreshable Braille displays, supporting feasibility of local manufacture and scalable deployment across under-resourced schools. BrailleRead demonstrates the potential of people-centred, locally developed assistive technology to dismantle systemic literacy barriers for visually impaired learners in rural

Zimbabwe, advancing inclusive development aligned with Zimbabwe's Education 5.0 framework, Vision 2030, and SDG 4.

Keywords: Inclusive Education, Assistive Technology, Refreshable Braille Display, Solenoid Actuator, Social Innovation, Zimbabwe

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