

The 3rd International Conference on Japan–Bangladesh Research and Practice (JBRP2024)

November 29-30, 2024
Online,

Coordinated from The University of the Ryukyus, Okinawa, Japan

JBRP2024 Proceedings

Also available online from [here!](#)

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Mohammad Abdul Malek (Miyazaki International University, Japan)

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**Network of Bangladeshi Researchers in Japan
(NBRJ)**

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Message from NBRJ Officers

November, 2024

Greetings!

We are pleased to inform you that the Network of Bangladeshi Researchers in Japan (NBRJ) was officially registered as a General Incorporated Association on June 25, 2024, with the mission of fostering intellectual exchange between Bangladesh and Japan. With a vision of promoting symbiosis and coexistence between Bangladeshi and Japanese researchers, NBRJ is dedicated to the joint development of both nations.

NBRJ's journey began on March 12, 2021, with a Zoom-based meeting of 20 members, coordinated by Mohammad Abdul Malek, then Associate Professor at the University of Tsukuba, following invitations sent to over 50 researchers via email. The network was formally inaugurated on August 12, 2022, at a general meeting at the Tokyo International Forum, where the first multidisciplinary workshop was held, inaugurated by H.E. Mr. Shahabuddin Ahmed, Ambassador of Bangladesh to Japan. In 2021, NBRJ also organized several online webinars during the COVID-19 pandemic to sustain its activities.

The International Conference on Japan-Bangladesh Research and Practice (JBRP) has become NBRJ's flagship event, providing a platform for researchers across diverse disciplines to share achievements, foster collaboration, and support NBRJ's vision of becoming a leading research and policy advocacy group. Through promoting scientific cooperation, intellectual engagement, and policy advocacy, JBRP bridges knowledge and development opportunities between the two nations.

The First JBRP Conference (2022) was held in Tokyo, chaired by Professor Sharifu Ura, Kitami Institute of Technology. The Second JBRP Conference (2023) took place at Nanzan University under the chairmanship of Professor Khondaker Mizanur Rahman. At the Third JBRP Conference (2024), we extend our congratulations to General Chair Professor Amzad Hossain and his team for organizing a successful event. Special thanks to Professor Yasuyuki Sawada (The University of Tokyo) for the keynote speech and plenary speakers: Professor Mirza Hasanuzzaman (Sher-e-Bangla Agricultural University), Professor Md Shoaib Bhuiyan (Suzuka University of Medical Science), and Professor Md Moshiur Rahman (Hiroshima University) for their contributions. We are also grateful to session committee advisers and authors for their rigorous efforts and valuable contributions.

We are excited to announce the Fourth JBRP Conference (2025), chaired by Professor Mohammad Abdul Malek. Details and invitations can be found at the end of the proceedings. In addition to the JBRP conference, NBRJ plans to organize year-round seminars and webinars to foster academic-industry collaborations, address Japan-Bangladesh educational and policy issues, and provide platforms for informed debate.

Please stay updated through our website: <https://nbrj.jp>.

On this occasion, we warmly invite all informal members of the NBRJ network to officially join NBRJ and continue supporting our vision and mission.

Sincerely,

Khondaker Mizanur Rahman – Representative Director (Chairman)

Chowdhury Mahbubul Alam – (Auditor)

Abdul Malek Mohammad – Representative Director (General Secretary)

Sharifu Ura – Representative Director

NBRJ 役員からのメッセージ

2024 年 11 月

ご挨拶申し上げます。

日本バングラデシュ研究者ネットワーク（NBRJ）が、2024 年 6 月 25 日に一般社団法人として正式に登録されたことをお知らせできることを、大変嬉しく思います。NBRJ は、バングラデシュと日本の間の知的交流を促進することを使命とし、両国の研究者間の共生と共存を目指して活動しています。

NBRJ の旅は、2021 年 3 月 12 日に 20 名のメンバーによる Zoom 会議から始まりました。この会議は、当時筑波大学の准教授であったモハマド・アブドル・マレク氏が 50 名以上の研究者に招待メールを送り、調整を行ったものです。その後、2022 年 8 月 12 日に東京国際フォーラムで開催された総会で正式に設立され、初の学際的ワークショップが開催されました。この会議は、当時駐日バングラデシュ大使であったシャハブディン・アーメド閣下によって開会されました。さらに 2021 年には、COVID-19 パンデミック中の活動を維持するため、NBRJ はオンラインセミナーを複数回開催しました。

「日本とバングラデシュの研究と実践に関する国際会議（JBRP）」は、NBRJ の旗艦イベントとして発展し、多様な分野の研究者が成果を共有し、協力を促進し、NBRJ の目指す研究および政策提言グループとしての地位を確立するための場となっています。JBRP を通じて、科学的協力、知的交流、政策提言を推進し、両国間の知識と発展の架け橋を築いています。

第 1 回 JBRP 会議（2022 年）は、北見工業大学の裡 しゃりふ教授を議長として東京で開催されました。第 2 回 JBRP 会議（2023 年）は、ナンザン大学でクホンダカーナ・ミザヌール・ラーマン教授が議長を務めました。そして第 3 回 JBRP 会議（2024 年）では、総会議長のアムザド・ホサイン教授とそのチームが成功裏にイベントを開催したことをお祝い申し上げます。東京大学の澤田 康幸教授による基調講演および、シェールバングラ農業大学のミルザ・ハサヌザマン教授、鈴鹿医療科学大学のショアイブ・ブイアン教授、広島大学のモシウル・ラーマン教授の全体講演に心から感謝申し上げます。また、分科会委員会のアドバイザーと著者の皆様の厳密な取り組みと貴重な貢献に深く感謝いたします。

第 4 回 JBRP 会議（2025 年）は、モハマド・アブドル・マレク教授が議長を務める予定であることをお知らせいたします。詳細と招待状については、議事録の最後に記載されます。JBRP 会議に加えて、NBRJ は年間を通じたセミナーやウェビナーを開催し、学術・産業の

連携、日バ教育・政策課題の解決、そして建設的議論の場を提供することを計画しています。

詳細は、NBRJ 公式ウェブサイト <https://nbrj.jp> をご確認ください。

この機会に、NBRJ ネットワークの非公式メンバーの皆様が正式に NBRJ に参加し、私たちのビジョンと使命を引き続き支援していただけることを心よりお待ちしております。

クホンダカーナ・ミザヌール・ラーマン 代表理事（会長）

チョウドリー・マフズール・アラム 監査役

アブドル・マレク・モハマド 代表理事（事務局長）

裡 しゃりふ 代表理事

Welcome Message from the General Chair



On behalf of the 3rd International Conference on Japan-Bangladesh Research and Practice 2024 (JBRP2024) Program Committee, I would like to welcome everyone to the online event for this year. It is a flagship event organized by the Network of Bangladesh Researchers in Japan (NBRJ, <https://nbrj.jp>). The JBRP2024 organizing committee members have worked extremely hard for the last several months and prepared an outstanding multidisciplinary program with 40 abstracts at 10 different presentation sessions under 4 tracks (1. Business, Humanities, and Social Sciences, 2. Agricultural Sciences, 3. Medical, Pharmaceutical, and Public Health, and 4. Natural Sciences, Engineering, and ICT). In addition, we have a world-renowned keynote speaker and three (3) professional plenary speakers at this conference. We are very fortunate to have Keynote speaker, Dr. Yasuyuki Sawada, Professor, Faculty of Economics, The University of Tokyo (Former Chief Economist and Director General, ERCD, Asian Development Bank). We are also honored to have outstanding scientists, Dr. Mirza Hasanuzzaman (Gold Medalist, Bangladesh Academy of Sciences), Professor, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Bangladesh; Dr. Md Shoaib Bhuiyan, Professor, Faculty of Medical Engineering, Suzuka University of Medical Science, Japan; and Dr. Md Moshiur Rahman, Associate Professor, Graduate School of Biomedical and Health Sciences, Hiroshima University, Japan, as plenary speakers. The quality of all abstracts is world-class, and the spectrum of topics is state-of-the-art. Thanks to all authors' invaluable submissions, we have great opportunities to discuss the truth and the beauty of science, technology and education. The best paper award will be presented to a few professionals and students for their outstanding accomplishment.

The presenters are mostly Bangladeshi researchers and students working in Japan, Bangladesh, and other countries. Everyone will be inspired to know how Bangladeshi professionals and students are contributing significantly to different countries. This event enlightens everyone about what we should do for our country and the world, through the enrichment of science, technology and education.

We would like to thank Dr. Khandakar Mizanur Rahman, NBRJ Chairman, for his tremendous support throughout the conference. We are very thankful to the track advisors, Dr. Khandakar Mizanur Rahman , Dr. Chowdhury Mahbubul Alam, and Dr. Mohammad Abdul Malek for the Business, Humanities, and Social Sciences; Dr. Tofael Ahmed and Dr. Md. Amzad Hossain for the Agricultural Sciences; Dr. S.M.A. Hakim Siddiki, Dr. Shofiqur Rahman, and Dr. Shafiqur Rahman for Medicine, Pharmaceuticals, and Public Health; and Dr. Shoaib Bhuiyan, Dr. Sharif Ura, Dr. Ashir Ahmed, and Dr. Kumkum Ahmed for Natural Sciences, Engineering and ICT, for their scholastic guidance and facilitation of the submissions. We would like to extend our gratitude to all reviewers and session chairs for their various support.

We are grateful to Dr. Tofael Ahmed (Technical Program co-chair), Dr. Mohammad Abdul Malek (NBRJ Secretary and Technical Program Co-Chair), Dr. Md. Shahajahan Kutubi (Organizing Committee Co-Chair), Dr. Shahida Pervin (Organizing Committee Co-Chair), and Dr. Angkush Kumar Ghosh (Organizing Committee Co-Chair) for their unwavering effort to put the conference programs together.

We would like to thank our media partner led by Mr. Mashiur Rahman, biggani.org, Bangladesh, for expanding the conference achievement throughout the world. We would like to appreciate Mr. Muhammed Bashir, Counsellor, The Embassy of Bangladesh in Tokyo for delivering a speech in the Award and Closing session. Your strong support and active participation are vital to the success of the JBRP2024 conference. Please enjoy the conference program today and tomorrow (November 29-30, 2024). Thank you all.

Md. Amzad Hossain

(The University of the Ryukyus, Japan)

General Chair, JBRP2024

Message from the Program Committee

On behalf of the program committee, it is our tremendous pleasure to welcome you to the 3rd International Conference on Japan-Bangladesh Research and Practice (JBRP2024), scheduled online on November 29-30, 2024, coordinated from The University of the Ryukyus in Japan, and organized and sponsored by the Network of Bangladeshi Researchers in Japan (NBRJ). Using an online platform (EasyChair), Call for Papers (CFP) employed the following procedure: each submission first registered its extended abstract, went through reviews by the track committee advisors, and subsequently submitted a revised version if necessary.

This year, we have received many abstract submissions coming from universities and research institutes in Bangladesh, Japan, India, Jordan, Malaysia, Sweden, UK, and USA. We were thrilled to receive such cutting-edge research from different fields and accepted a total of 40 presentations in a two-day program. The program contains an opening session, one keynote speech, three plenary sessions, ten presentation sessions, and a closing session. The multidisciplinary presentation sessions are divided into two parallel sessions (A and B) each day for the four tracks: (1) Business, Humanities, and Social Sciences, (2) Agricultural Sciences, (3) Medicine, Pharmaceuticals, and Public Health, and (4) Natural Sciences, Engineering, and ICT. The sessions are designed so that the audience will experience a ride of different knowledge beyond their disciplinary focus and thought processes throughout the two days.

The keynote will be the second session on the first day morning, and Dr. Yasuyuki Sawada will give a talk titled “The Bangladesh Miracle and Challenges.” The first plenary speaker is Dr. Mirza Hasanzaman with the title “Sustainable Crop Production in Bangladesh: Navigating Climate Change and Embracing Agriculture 4.0,” the second plenary speaker is Dr. Md Moshiur Rahman with the title “Enhancing Adolescent Reproductive Health in Rural Bangladesh: Anemia Prevalence, Associated Factors, and the Role of mHealth Interventions,” and the third plenary speaker is Dr. Md Shoaib Bhuiyan with the title “How artificial intelligence (AI) is changing healthcare and related fields.”

Among the presentations, the best presentation award will be nominated based on the evaluation by the program committee members and session chairs. All the accepted extended abstracts will be published in JBRP2024 online proceedings after necessary editing.

The exciting and stimulating conference program and the arrangement of JBRP2024 are the outcome of the hard work and efforts of the authors, reviewers, track committee advisors, and committee members. We would like to thank all of them sincerely. We hope you all enjoy the JBRP2024.

JBRP2024 Program Committee

JBRP2024 Program Committee

General Chair:

Md. Amzad Hossain (The University of the Ryukyus)

Technical Program Co-Chairs:

Tofael Ahmed (University of Tsukuba)

Mohammad Abdul Malek (Miyazaki International University)

Organizing Committee Co-Chairs:

Md. Shahajahan Kutubi (Nagoya University)

Shahida Pervin (Waseda University)

Angkush Kumar Ghosh (Kitami Institute of Technology)

JBRP2024 Track Committee Advisors

Track 1: Business, Humanities, and Social Sciences

Advisors:

Khandakar Mizanur Rahman (Nanzan University)

Chowdhury Mahbubul Alam (Fukuoka Women's University)

Mohammad Abdul Malek (Miyazaki International University)

Track 2: Agricultural Sciences

Advisors:

Md. Amzad Hossain (The University of the Ryukyus)

Tofael Ahmed (University of Tsukuba)

Track 3: Medicine, Pharmaceuticals, and Public Health

Advisors:

S. M. A. Hakim Siddiki (Tokyo Metropolitan University)

Shofiqur Rahman (EW Nutrition Japan)

Md. Shafiur Rahman (Hamamatsu University)

Track 4: Natural Sciences, Engineering, and ICT

Advisors:

Shoaib Bhuiyan (Suzuka University of Medical Science)

Sharifu Ura (Kitami Institute of Technology)

Ashir Ahmed (Kyushu University)

Kumkum Ahmed (Shibaura Institute of Technology)

The Bangladesh Miracle and Challenges

Yasuyuki Sawada

Faculty of Economics, The University of Tokyo, Japan

Abstract

In this talk, Professor Sawada will discuss Bangladesh's impressive economic and social progress, often regarded as a 'miracle,' achieved despite numerous challenges. The country has made remarkable advancements under difficult conditions, including weak governance, political instability, inequality, rapid urbanization, and severe disaster risks. As such, this talk will explore the factors driving this success and the challenges it brings, such as pandemic recovery, with the goal of identifying effective policy interventions that other developing countries might adopt.



About:

Professor Dr. Yasuyuki Sawada is a prominent scholar at the Faculty of Economics, The University of Tokyo, specializing in development economics, empirical microeconomics, disaster economics, and field-based surveys and experiments. His extensive academic contributions have advanced understanding in these critical areas of research. Professor Sawada previously served as the Chief Economist and Director General of the Economic Research and Regional Cooperation Department at the Asian Development Bank (ADB), where he led key research and policy initiatives across Asia. His expertise has also shaped collaborations with leading institutions, including JICA, RIETI, ERIA, IDE-JETRO, Pakistan Institute of Development Economics (PID), Bangladesh Institute of Development Studies (BIDS), International Rice Research Institute (IRRI), International Water Management Institute (IWMI), BRAC Bangladesh, and the World Bank. His work is widely recognized for its focus on addressing challenges in economic development, disaster resilience, and social progress, providing valuable insights into policy-making and sustainable development strategies.

Sustainable Crop Production in Bangladesh: Navigating Climate Change and Embracing Agriculture 4.0

Mirza Hasanuzzaman

Department of Agronomy, Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Bangladesh

Abstract

Bangladesh, an agrarian economy supporting over 170 million people, faces critical challenges in sustaining food security and agricultural productivity. The sector's vulnerability to climate change, compounded by rising sea levels, erratic weather, and soil salinity, significantly impacts crop production, especially in coastal regions. With over 85% of rural households relying on agriculture, adopting sustainable practices and advanced technologies is imperative for resilience and long-term growth. The country is implementing climate-smart agricultural strategies, including integrated pest management, organic farming, and developing climate-resilient crop varieties. These practices aim to enhance soil health, preserve biodiversity, and reduce dependence on synthetic inputs. Techniques such as crop rotation, agroforestry, and conservation tillage are gaining traction, contributing to sustainable intensification and environmental conservation. Innovative solutions like seaweed extracts, nano-fertilizers, and enhanced biofertilizers are being explored to improve nutrient use efficiency and minimize environmental impact. For example, nano-potash supplementation has shown the potential to boost crop yields while reducing fertilizer usage, which is crucial for sustainable agriculture. These practices are aligned with the broader adoption of Climate-Smart Agriculture (CSA) approaches. The Fourth Industrial Revolution (4IR) offers new opportunities through technologies like artificial intelligence (AI), Internet of Things (IoT), drones, and big data analytics. These tools enable precision farming, smart irrigation, and real-time crop monitoring, enhancing decision-making and resource use efficiency. Initiatives under the Smart Bangladesh Vision are promoting digital agriculture, though challenges remain due to limited infrastructure, financial constraints, and technical skill gaps. Government support, international collaboration, and targeted farmer education are essential to overcoming these barriers. By integrating climate-smart practices and leveraging Agriculture 4.0, Bangladesh aims to ensure sustainable crop production, enhance resilience, and secure long-term food security. Coordinated efforts will be key to achieving these goals and meeting the country's development targets.



About:

Professor Dr. Mirza Hasanuzzaman is a Professor of Agronomy at Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. He completed his Bachelor of Science in Agriculture (Hons.) and M.S. in Agronomy from Sher-e-Bangla Agricultural University with a Gold Medal and earned a Sher-e-Bangla Agricultural University Award. He received his Ph.D. in 'Plant Stress Physiology and Antioxidant Metabolism' from the United Graduate School of Agricultural Sciences, Ehime University, Japan. Later, he completed his postdoctoral research at The University of the Ryukyus, Okinawa, Japan. Subsequently, he became an Adjunct Senior Researcher at the University of Tasmania with an Australian Government's Endeavour Research Fellowship. Prof. Hasanuzzaman has over 300 Scopus-indexed publications and more

than 250 on the Web of Science. He has edited over 25 books and written over 50 book chapters on important aspects of plant physiology, plant stress responses, and environmental problems in relation to plant species. His publications are cited about 27000 times as per Scopus with an h-index of 84. He has established a Crop Science Laboratory at Sher-e-Bangla Agricultural University, where he has facilities to investigate plant stress responses and plant-soil interaction. During the last 18 years, he has been investigating the mechanisms of how plants can survive in adverse environments like floods, drought, salinity, and metal toxicity. One key mechanism Prof. Hasanuzzaman focuses on is antioxidant defense in plants. Prof. Hasanuzzaman is an Editor and a reviewer for more than 80 peer-reviewed international journals and the recipient of the 'Publons Peer Review Award 2017, 2018, and 2019'. He is an active member of 40 professional societies and is the acting Treasurer of the Bangladesh JSPS Alumni Association. He received the World Academy of Science (TWAS) Young Scientist Award 2014; the University Grants Commission (UGC) Gold Medal 2018; the Bangladesh Academy of Sciences (BAS) Gold Medal Award-2022 (Senior Group); Global Network of Bangladeshi Biotechnologists (GNOBB) Award 2021; Pothikrit Bigyan Sommanona 2022; Society for Plant Research Young Scientist Award (Agriculture)-2023; Eminent Scientist Award-2022 from the Society for Science of Climate Change and Sustainable Environment. He is a member of over 40 professional societies and a fellow of the Bangladesh Academy of Sciences (BAS), the World Academy of Sciences (TWAS), the Linnean Society of London, the Royal Society of Biology, the International Society of Environmental Botanists, and a foreign fellow of The Society for Science of Climate Change and Sustainable Environment. Prof. Hasanuzzaman attended over 40 international conferences as a Keynote speaker, invited speaker, and oral presenter and chaired/cochaired several workshops/sessions.

Enhancing Adolescent Reproductive Health in Rural Bangladesh: Anemia Prevalence, Associated Factors, and the Role of mHealth Interventions

Md Moshiur Rahman

Graduate School of Biomedical and Health Sciences, Hiroshima University, Japan

Abstract

Adolescent reproductive health in rural areas of developing countries faces several interconnected challenges, affecting both health and social outcomes. In many rural regions, educational programs are limited or absent about menstruation, contraception, and other health topics, resulting in misinformation or a complete lack of awareness. Anemia is a significant public health challenge, especially among adolescent girls in rural Bangladesh, largely due to limited nutritional knowledge and poor dietary intake. This study evaluated the effects of a mobile health (mHealth) education intervention aimed at increasing hemoglobin levels, improving knowledge, attitudes, and practices (KAP) related to anemia, and fostering healthier lifestyles among adolescent girls in rural Bangladesh. In this school-based randomized control trial, 138 adolescent girls with anemia were randomized into intervention ($n=69$) and control ($n=69$) groups. The intervention group received mHealth-based counseling and health education over eight months, while the control group received standard care. Primary outcomes included increased hemoglobin levels and anemia reduction, while secondary outcomes assessed improvements in KAP, BMI, mid-upper arm circumference, and hip and waist measurements. Results showed significant hemoglobin increases in the intervention group, with a 25.8% recovery rate compared to 13.6% in the control group. Additionally, the intervention group demonstrated significant improvements in BMI, body measurements, and KAP scores related to anemia. These findings highlight mHealth's potential as an effective tool in addressing anemia in rural Bangladeshi adolescents, supporting broader implementation of mobile health interventions for improving adolescent health in low- and middle-income settings. This study also investigated irregular menstruation among adolescent girls in rural Bangladesh, finding a 22% prevalence. Abdominal obesity was a significant risk factor, while a father's education was a protective factor. The study highlights the need for school-based health screenings, nutrition and lifestyle education, and reproductive health awareness for adolescents.



About:

Dr. Md. Moshiur Rahman is a distinguished public health physician with extensive expertise in global health, epidemiology, and healthcare management. His work focuses on public health research, population health science, and healthcare leadership, emphasizing multidisciplinary collaborations to advance the Sustainable Development Goals (SDGs). Dr. Rahman's contributions extend to molecular research in areas such as DNA extraction, cloning, and sequencing, showcasing his diverse skill set in both public health and biomedical sciences. He has also played a significant role in course curriculum development and public health trials, furthering education and research in the global health field.

How Artificial Intelligence (AI) Is Changing Healthcare and Related Fields

Md. Shoaib Bhuiyan

Faculty of Medical Engineering, Suzuka University of Medical Science, Japan

Abstract

Artificial intelligence (AI) is rapidly transforming healthcare by improving patient experience, advancing population health, lowering costs, and supporting care team well-being. This talk will introduce machine learning (ML) and deep learning (DL) as core components of AI, illustrating how these technologies shift from traditional programming to data-driven learning. Key ML concepts, including supervised and unsupervised learning and classification workflows, will be explored to demonstrate how data is imported, preprocessed, and applied in predictive models. These tools enable AI to support real-world healthcare applications, such as enhancing diagnostic accuracy, personalizing treatments, and improving resource management. Alongside these advancements, ethical and regulatory considerations are essential, as AI's integration into healthcare raises issues of data privacy, fairness in algorithms, and the need for robust regulatory frameworks. These measures are crucial for fostering trust and ensuring equitable access to AI-driven healthcare solutions. Consistent with healthcare's four primary aims—improved patient experience, population health, lower costs, and care team well-being—this shift to data-centric approaches holds meaningful implications across healthcare sub-disciplines, driving a new era of innovation and care delivery.

About:



Professor Dr. Md. Shoaib Bhuiyan is a tenured professor at the Health Data Science Department of Suzuka University of Medical Science, Japan, specializing in data science and health engineering. His research integrates image processing and machine learning for applications in Intelligent Transportation Systems and biomedical sciences. With over 80 peer-reviewed publications and a Japanese patent in intelligent vehicle technology, Professor Bhuiyan has made significant contributions to these fields. He is an active member of IEEE and other professional societies, having chaired sessions at major IEEE conferences and has served on various international technical committees.

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Organized by The Network of Bangladeshi Researchers in Japan (NBRJ)

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Conference Program

Friday, November 29 *All times listed in this program are in Japan Standard Time (JST)*	
10:00-10:20	Opening
10:20-11:20	Session 1A: JBRP Presentation
10:20-11:20	Session 1B: JBRP Presentation
11:20-11:30	Break
11:30-12:15	Session 2: Keynote
12:15-13:30	Break
13:30-14:30	Session 3A: JBRP Presentation
13:30-14:30	Session 3B: JBRP Presentation
14:30-14:45	Break
14:45-15:45	Session 4A: JBRP Presentation
14:45-15:45	Session 4B: JBRP Presentation
15:45-17:00	Break
17:00-17:40	Session 5: Plenary
17:40-18:00	Break
18:00-19:00	NBRJ General Meeting
Saturday, November 30 *All times listed in this program are in Japan Standard Time (JST)*	
10:00-11:00	Session 6A: JBRP Presentation
10:00-11:00	Session 6B: JBRP Presentation
11:00-11:15	Break
11:15-11:55	Session 7: Plenary
11:55-13:00	Break
13:00-14:00	Session 8A: JBRP Presentation
13:00-14:00	Session 8B: JBRP Presentation
14:00-14:30	Break
14:30-15:10	Session 9: Plenary
15:10-16:00	Break
16:00-17:00	Session : Award & Closing

Note:

Each presentation is allotted a 15-minute slot, as follows:

10 minutes for the presentation itself, followed by a 3-minute Q&A session, and a 2-minute transition to the next presentation.

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Conference Program

Friday, November 29 *All times listed in this program are in Japan Standard Time (JST)*				
Opening				
10:00-10:20				
10:20-11:20				
		Session 1A: JBRP Presentation Chair: Sharif Ura (Kitami Institute of Technology)		
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author
10:20-10:35	4	Abdul Wasie and Md. Mustaqim Roshid. Attaining Industrial Integrity and Competitiveness in Bangladesh's RMG Sector via Lean Manufacturing Techniques	Natural Sciences, Engineering, and ICT	Abdul Waaje
10:35-10:50	19	Md Zahorul Islam, Jesmin Akter and Md. Amzad Hossain. Anti-Inflammatory, Wound Healing, and Anti-Diabetic Effects of Pure Active Compounds Isolated from the Ryudai Gold Variety of Curcuma longa	Agricultural Sciences	Md Zahorul Islam
10:50-11:05	37	Shahida Pervin and Lei Lei. Migration to Address Labor Shortage in Japan: Evidence from Immigration Policy	Business, Humanities, and Social Sciences	Shahida Pervin
11:05-11:20	28	Mahbub Hossain, Ryosuke Hase, Natsumi Yamaguchi, Sunao Wada, Reiji Shirovama and Tsuyoshi Tanabe. Role of Circulating Amino Acids and Gut Microbiota in Health and Healthy Aging	Medicine, Pharmaceuticals, and Public Health	Mahbub Hossain
10:20-11:20		Session 1B: JBRP Presentation Chair: Shofiqur Rahmann (EW Nutrition Japan)		
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author
10:20-10:35	14	Juel Sikder, Sharif Ura and Nippon Datta. Sentiment Analysis of Bangladeshi Roman Chakma Language Using Lightweight CNN	Natural Sciences, Engineering, and ICT	Juel Sikder
10:35-10:50	20	Maimuna Qazi, Tetsuo Takano, Daisuke Tsugami and Shaheen Kumar Gupta. Pearl Millet WRKY Transcription Factor PgWRKY60 Can Retard Growth under Both Unstressed and Abiotically Stressed Conditions in Genetically Modified Arabidopsis	Agricultural Sciences	Maimuna Qazi
10:50-11:05	29	Mst. Jeba Shazida, Md. Mahfuzur Rahman, Bayezid Bustami and Angkush Kumar Ghosh. Facial Emotion Recognition Using Custom CNN Model: A Comparative Analysis on FER-2013 Dataset	Natural Sciences, Engineering, and ICT	Mst. Jeba Shazida
11:05-11:20	42	Md Shamsuzzoha, Rajib Shaw, Ryozo Nozuchi and Tofael Ahmed. Remote Sensing and Machine Learning-Based Disaster Risk Assessment on Agricultural Land Use in Onshore Regions of Bangladesh Delta Affected by Recurrent Tropical Cyclones—Bulbul, Amphan, and Strigra	Agricultural Sciences	Md Shamsuzzoha
11:20-11:30		Break		
11:30-12:15		Session 2: Keynote Chair: Mohammad Abdul Malek (Miyazaki International University)		
		Keynote Speaker: Yasuyuki Sawada (Professor, Faculty of Economics, The University of Tokyo) Keynote Topic: The Bangladesh Miracle and Challenges		
12:15-13:30		Break		
13:30-14:30		Session 3A: JBRP Presentation Chair: Mahbubul Alam Chowdhury (Fukuoka Women's University)		
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author
13:30-13:45	9	Forhad Hossain, Prajat Paul and Ashir Ahmed. Challenges Faced by Physicians in Developing Countries in Following Necessary History-Taking Steps	Natural Sciences, Engineering, and ICT	Forhad Hossain
13:45-14:00	22	S M Sayeed Anowar, Md. Mahfuzur Rahman, Md Tahiduzzaman and Shoyeb Muhammad. Identifying Problem and Analyzing Business Scenario of Bangladeshi Light and Medium Industry: A Lean Kaizen-Based Approach	Natural Sciences, Engineering, and ICT	S M Sayeed Anowar
14:00-14:15	31	Asima Monjur and Md. Abu Bin Hasan Susan. Shuttling of Drugs in Ionic Liquid-Water Biphasic System	Medicine, Pharmaceuticals, and Public Health	Asima Monjur
14:15-14:30	38	Mizanur Rahman, Rummana Rahim and Tatsuo Shiota. Serotype and Genotype Changes of Dengue Virus in Bangladesh during 2018–2023 and Its Association with Disease Severity	Medicine, Pharmaceuticals, and Public Health	Mizanur Rahman
13:30-14:30		Session 3B: JBRP Presentation Chair: Kumkum Ahmed (Shibaura Institute of Technology)		
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author
13:30-13:45	24	Barnali Biswas, Katsushi Komai and Takeshi Sonoda. Numerical Modeling of a Coastal Lagoon in Japan: Prospects for Sustainable Development in Bangladesh	Natural Sciences, Engineering, and ICT	Barnali Biswas
13:45-14:00	12	Dewan Abdullah Al Rafi, Sanzida Taurin, Kentaka Aruga, Arifa Jannat and Md. Monirul Islam. Revealing the Pathway of Reluctancy Toward Agricultural Credit Repayment: A Case Study on Fish Farmers in Bangladesh	Agricultural Sciences	Dewan Abdullah Al Rafi
14:00-14:15	30	Shofiqur Rahmann. Egg Immunoglobulins (IgY): Novel Sustainable Nanotechnology Applications in One Health	Medicine, Pharmaceuticals, and Public Health	Shofiqur Rahmann
14:15-14:30	13	Md Mamunur Rashid and Sharif Ura. Unlocking Jute's Potential: A Strategic Roadmap for Enhancing Productivity and Overcoming the Middle-income Trap in Bangladesh	Business, Humanities, and Social Sciences	Md Mamunur Rashid
14:30-14:45		Break		
14:45-15:45		Session 4A: JBRP Presentation Chair: Tofael Ahmed (University of Tsukuba)		
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author
14:45-15:00	16	Mehedi Shahid, Shahinur Islam and Mohammad Malek. Revolutionizing Agriculture with the Smart Farming Mobile App	Agricultural Sciences	Mohammad Malek
15:00-15:15	32	Md. Hasibul Hasan and Md. Abu Bin Hasan Susan. Tuning Morphology and Electrocatalytic Activity of Cobalt Ferrite Magnetic Nanoparticles Using Ionic Liquids and Double Salt Ionic Liquids as Soft Templates	Natural Sciences, Engineering, and ICT	Md. Hasibul Hasan
15:15-15:30	35	Azizul Moqsid and Tomohiro Okamoto. Plant Microbial Fuel Cells: A Potential Solution to the Green Energy Problem in Bangladesh	Natural Sciences, Engineering, and ICT	Azizul Moqsid
15:30-15:45	33	Mehedi Hasan Jihad and Md. Abu Bin Hasan Susan. Composites of Poly(pyrrole), Reduced Graphene Oxide, and α-Manganese Dioxide with Ionic Liquid-Based Electrolyte for Dye-Sensitized Solar Cells	Natural Sciences, Engineering, and ICT	Mehedi Hasan Jihad
14:45-15:45		Session 4B: JBRP Presentation Chair: S. M. A. Hakim Siddiki (Tokyo Metropolitan University)		
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author
14:45-15:00	39	Nishat Tahsin, Md. Shahidur Rahman, Md. Aftab Ali Shaikh, Hasina Akhter Simol, Badhon Ali Khan and Md. Anamul Haque. Hydrogel Composites of Agro-Waste-Derived Graphene Oxide and Silica for Removing Methylene Blue Dye from Aqueous Solution	Natural Sciences, Engineering, and ICT	Nishat Tahsin
15:00-15:15	43	Md. Shahajahan Kutubi and Tsugio Kitamura. Fe-Catalyzed Cascade Reaction: C–H Activation and Cyclization in Efficient Coumarin Synthesis	Medicine, Pharmaceuticals, and Public Health	Md. Shahajahan Kutubi
15:15-15:30	15	Abir Nagata, Md. Mahfuzur Rahman and Md. Shafur Rahman. Inequalities in Dental Service Utilization Among Adults: Evidence from Bangladesh, Bhutan, and Nepal	Medicine, Pharmaceuticals, and Public Health	Abir Nagata
15:30-15:45	46	Angkush Kumar Ghosh, Liu Yan and Sharif Ura. Devising an Image Processing-Based Technique for Preserving Cultural Motifs	Natural Sciences, Engineering, and ICT	Angkush Kumar Ghosh
15:45-17:00		Break		
17:00-17:40		Session 5: Plenary Chair: Md Amzad Hossain (The University of the Ryukyus)		
		Plenary Speaker: Mirza Hasanuzzaman (Professor, Faculty of Agriculture, Sher-e-Bangla Agricultural University) Plenary Topic: Sustainable Crop Production in Bangladesh: Navigating Climate Change and Embracing Agriculture 4.0		
17:40-18:00		Break		
18:00-19:00		NBRJ General Meeting		

Note:

Each presentation is allotted a 15-minute slot, as follows:
10 minutes for the presentation itself, followed by a 3-minute Q&A session, and a 2-minute transition to the next presentation.

THE 3RD INTERNATIONAL CONFERENCE ON JAPAN-BANGLADESH RESEARCH AND PRACTICE (JBRP2024)

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Conference Program

Saturday, November 30 *All times listed in this program are in Japan Standard Time (JST)*					
Session 6A: JBRP Presentation Chair: Ashir Ahmed (Kyushu University)					
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author	
10:00-10:15	10	Tanmoy Kumar Ghose, Md Rezanul Islam, Kentaka Aruga, Arifa Jannat and Md. Monirul Islam. Disaggregated Impact of Non-Renewable Energy Consumption on the Environmental Sustainability of the United States: A Novel Dynamic ARDL Approach	Natural Sciences, Engineering, and ICT	Tanmoy Kumar Ghose	
10:15-10:30	44	Bibi Panjatul Kubra and Asif Reza Anik. Livelihood Diversification as an Enduring Form of Anticipatory Action of Flood for the Farmers of Bangladesh	Agricultural Sciences	Bibi Panjatul Kubra	
10:30-10:45	1	Mohd Basheer and Luma Abuorabi. Mitigating Climate Change Impacts on Agriculture: A Comparative Study between Bangladesh and Japan	Agricultural Sciences	Mohd Basheer	
10:45-11:00	5	Md. Sumon Rahman, Tatsuru Yazaki, Takanori Chihara and Jiro Sakamoto. Assessment of Joint Forces on the Lower Back During Bricklaying Tasks	Medicine, Pharmaceuticals, and Public Health	Md. Sumon Rahman	
Session 6B: JBRP Presentation Chair: Md. Shahajahan Kutubi (Nagoya University)					
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author	
10:00-10:15	2	Sharifu Ura. Role of Japan in Bangladesh-based Research	Business, Humanities, and Social Sciences	Sharifu Ura	
10:15-10:30	21	Md Mahfuzur Rahman, Md Shafiu Rahman and Stuart Gilmour. Child Marriage in Bangladesh (1960–2016): Historical Trends, Natural Calamities, Policy Interventions, and Socioeconomic Impact	Medicine, Pharmaceuticals, and Public Health	Md Mahfuzur Rahman	
10:30-10:45	34	Most. Israt Jahan, Muhammed Shah Miran and Md. Abu Bin Hasan Susan. Development of a β-Cyclodextrins/Cationic Surfactants Based Supramolecular System: Interactions with a Phenothiazinyl Drug	Natural Sciences, Engineering, and ICT	Most. Israt Jahan	
10:45-11:00	25	Md Tahiduzzaman, Angkush Kumar Ghosh and Sharifu Ura. Comparison of Conventional Methods for Manufacturing Process Optimization	Natural Sciences, Engineering, and ICT	Md Tahiduzzaman	
11:00-11:15	Break				
Session 7: Plenary Chair: Md Shafiu Rahman (Hamamatsu University)					
11:15-11:55	Plenary Speaker: Md Moshiur Rahman (Associate Professor, Graduate School of Biomedical and Health Sciences, Hiroshima University) Plenary Topic: Enhancing Adolescent Reproductive Health in Rural Bangladesh: Anemia Prevalence, Associated Factors, and the Role of mHealth Interventions				
11:55-13:00	Break				
Session 8A: JBRP Presentation Chair: Md. Shahajahan Kutubi (Nagoya University)					
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author	
13:00-13:15	3	Sufia Jahan. Recent Trends in the Development and Management of the Social Business Sector in Bangladesh	Business, Humanities, and Social Sciences	Sufia Jahan	
13:15-13:30	23	Md Rashedul Islam and Md Shafiu Rahman. Disparity in the Prevalence of Anemia Among Non-Pregnant Women in 49 Low- and Middle-Income Countries from 2011–2021	Medicine, Pharmaceuticals, and Public Health	Md Rashedul Islam	
13:30-13:45	17	Md. Enamul Kabir, Md. Momnul Islam, Md. Abu Bin Hasan Susan and Muhammed Shah Miran. Improving MnO₂/ Porous Carbon Nanocomposites Electrocatalytic Oxygen Reduction Performance by Surface Modification Using Protic Ionic Liquid for Fuel Cell	Natural Sciences, Engineering, and ICT	Md. Enamul Kabir	
13:45-14:00	45	Sahib Ur Rauf, Afia Zaman, Md Nahid Shahriare, Sadia Mostofa, Md Tanvir Shakil, Mohammad Mahdi Hasan, Jagobandhu Some and Muhammad Sharif. Design and Development of a Weather Balloon-Launched CubeSat Prototype for Atmospheric Data Collection	Natural Sciences, Engineering, and ICT	Muhammad Sharif	
Session 8B: JBRP Presentation Chair: Shahida Pervin (Waseda University)					
Time Slot	Submission Number	Author(s) and Title	Track	Presenting Author	
13:00-13:15	7	Samimuzzaman. Comparative Analysis of Infrastructure Diplomacy in South Asia: Assessing the Impact of China's Belt and Road Initiative and Japan's Free and Open Indo-Pacific Strategy	Business, Humanities, and Social Sciences	Samimuzzaman	
13:15-13:30	27	Habibur Rahman, Atia Afsana, Umma Aysha Mim, Rahidul Islam Roman and Effat Jahan. Hybrid Energy-Based Battery Storage Swapping Station for Electrical Vehicles and Net Metering in Bangladesh	Natural Sciences, Engineering, and ICT	Atia Afsana	
13:30-13:45	41	Afia Zaman, Munirul Alam, Anik Shabab Soudha and Md. Afsar Ali. Molecular Dynamics Investigation of Nanostructure and Characterization of Al_xCoCrFeNi High-Entropy Alloy	Natural Sciences, Engineering, and ICT	Munirul Alam	
13:45-14:00	11	Sweety Shahinur, Julfikar Haider and Sharifu Ura. Comparative Study of Jute, Coir, and Bamboo Fibers Based on Uncertain Data	Natural Sciences, Engineering, and ICT	Sweety Shahinur	
14:00-14:30	Break				
Session 9: Plenary Chair: Sharifu Ura (Kitami Institute of Technology)					
14:30-15:10	Plenary Speaker: Md. Shoail Bhuiyan (Professor, Faculty of Medical Engineering, Suzuki University of Medical Science) Plenary Topic: How Artificial Intelligence (AI) Is Changing Healthcare and Related Fields				
15:10-16:00	Break				
16:00-17:00	Session : Award & Closing				

Note:

Each presentation is allotted a 15-minute slot, as follows:

10 minutes for the presentation itself, followed by a 3-minute Q&A session, and a 2-minute transition to the next presentation.

JBRP2024 Extended Abstracts

Mitigating Climate Change Impacts on Agriculture: A Comparative Study between Bangladesh and Japan

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Track: Agricultural Sciences

Keywords: Climate Change, Precision Agriculture, Agricultural Adaptation.

Extended Abstract

Climate change presents hurdles for farming in both Bangladesh and Japan. In Bangladesh, farmers are at risk due to soaring temperatures, erratic monsoons, and escalating floods. Meanwhile in Japan despite its progress the country grapples with changing rainfall trends and the ramifications of typhoons [1-3]. This research examines the challenges confronting both countries and underscores areas for cooperation. A study analyzing climate patterns and agricultural output data from the Bangladesh Meteorological Department (BMD) [4] and Japan's Ministry of Agriculture (MAFF) [5] and insights gathered from interviews with 50 farmers in both nations from 2000 to 2020 revealed trends. (See Figs. 1-2 and Table 1.). It was observed that Bangladesh is facing challenges such as rising flood occurrences and soil salinity issues; in Japan, improved agricultural practices like automated irrigation systems and the cultivation of resilient crops have led to a 10% increase in productivity. The research highlights Bangladesh's potential to gain from Japan's affordable precision agriculture methods and for Japan to explore Bangladesh's community-centered approaches in regions. They can share knowledge by combining technology with farming practices and engaging in joint research to tackle the challenges posed by climate change in agriculture.

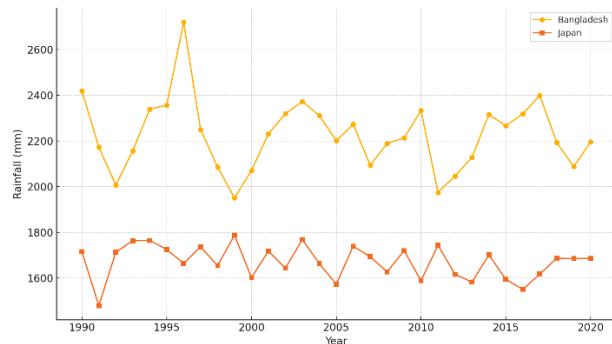


Figure 1: Annual Rainfall Trends in Bangladesh and Japan (1990-2020).

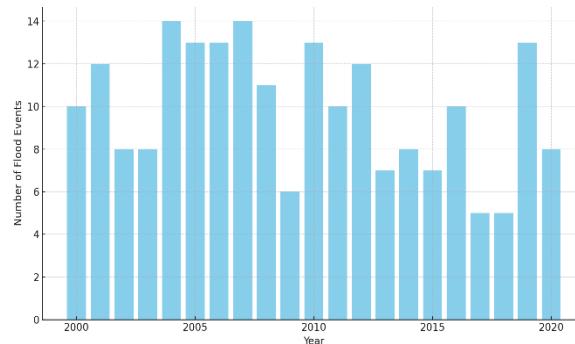


Figure 2: Frequency of Major Flooding Events in Bangladesh (2000-2020).

Table 1: Crop yield differences with and without precision agriculture in Japan.
(Data from Japan's MAFF [5]).

Crop	Yield Without Precision Agriculture (tons/ha)	Yield With Precision Agriculture (tons/ha)
Rice	5.2	5.7
Soybeans	2.8	3.1
Vegetables	6.5	7.2

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Role of Japan in Bangladesh-based Research

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Track: Business, Humanities, and Social Sciences

Keywords: Bangladesh, Research, Academic Discipline, Funding Agency, Institute.

Extended Abstract

Japan and Bangladesh have collaborated on high-quality academic research since Bangladesh's independence in 1971. This article explores the partnership using datasets from SCOPUS [1], focusing on records that include "Bangladesh" in the title. Key indicators are presented in Figure 1 through four plots, with the results summarized as follows.

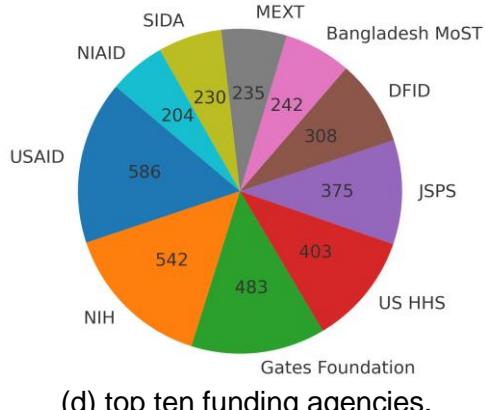
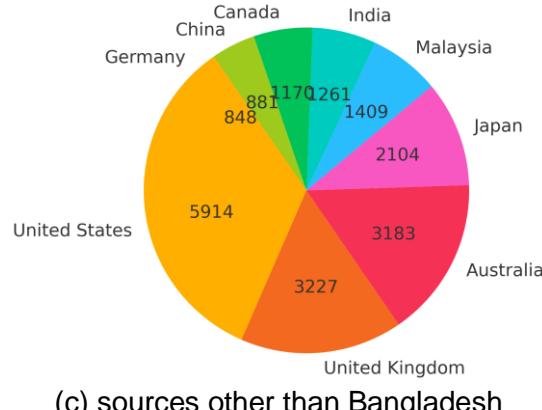
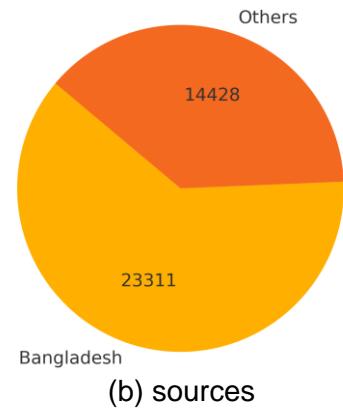
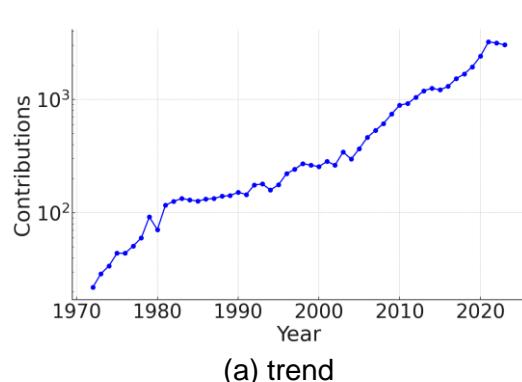


Figure 1: Depicting the Role of Japan in Bangladesh-based Research.

As seen in Fig. 1(a), during the 1970s and early 1980s, contributions were relatively low, with fewer than 100 contributions annually. From the mid-1980s to the late 1990s, there was a moderate rise in contributions, with annual counts ranging between 100 and 300. During the 2000s, the number of contributions steadily increased, reaching over 1000 contributions annually by 2010. The most significant growth occurred in the past decade, especially after 2010, with contributions rapidly increasing and crossing 3000 per year by 2021. The contributions more than doubled between 2010 and 2023, marking a significant rise in output.

In terms of research origins, Bangladesh stands out significantly, dominating the chart (see Fig. 1(b)). Contributions from the U.S. are less than a quarter of Bangladesh's total (see Fig. 1(c)). The U.K., slightly behind the U.S., is still a key contributor, followed by Australia. Japan, ranked fifth with just over 2,100 contributions, is a leading contributor from Asia, followed by Malaysia, India, Canada, China, and Germany.

The list of top funding agencies is led by U.S. organizations (see Fig. 1(d)), showcasing America's dominant role in global health, science, and development funding. Philanthropic organizations like the Bill and Melinda Gates Foundation are significant contributors, reflecting the growing role of private foundations in global development. Several governmental agencies from Japan, Bangladesh, and Sweden also feature prominently, reflecting their commitment to science, education, and global health. Several key Japanese funding agencies are notable for their contributions. Japan Society for the Promotion of Science (JSPS) is Japan's largest contributor, with 375 contributions. JSPS supports scientific research across various disciplines and fosters international collaboration. Ministry of Education, Culture, Sports, Science and Technology (MEXT) is another major Japanese organization, contributing 235 times. It plays a critical role in advancing education and scientific research in Japan. Japan International Cooperation Agency (JICA) contributed 35 times, focusing on international cooperation and development programs, particularly in areas such as education and healthcare. Japan Agency for Medical Research and Development (AMED) made 18 contributions, primarily funding medical research and innovation. Overall, Japan contributes significantly to Bangladesh-based research, with major support from its government-backed agencies, emphasizing scientific advancement and international collaboration.

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Recent Trends in the Development and Management of the Social Business Sector in Bangladesh

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Track: Business, Humanities, and Social Sciences

Keywords: Bangladesh, Social Business, Non-governmental organizations (NGOs), Building Resources Across Communities (BRAC), Grameen Bank.

Extended Abstract

Social business (SB) has become a buzzword currently in international business management development discourse. The study is examined recent trends in the development and management of the SB sector in Bangladesh. However, in the context of Bangladesh, the problem with recent trends in the development and management of social business enterprises (SBEs) are that very few research activities were done to articulate their styles, strengths, issues, and weaknesses. The various aspects of recent trends in the development and management of SBEs and their similarities and differences need to be studied to fill up the existing research gap in this rapidly expanding sector. Based on the survey of research literature, interviews of social business activists/leaders/scholars, review of social business enterprises' own published and unpublished documents, government laws and documents, and a firsthand investigation into the origin of social business enterprises (SBEs) in Bangladesh namely Grameen Bank, Grameen Family of Companies, and BRAC, the study contributes to a) explore on social business as a distinctive kind of business corporation, b) recent trends in the development and management of the social business sectors, c) find out current development and management strategy and structure of SBEs. This study has divided the SB concept into three perspectives namely, a) American perspective, b) European perspective, and c) Bangladesh perspective. The characteristics features of SBEs and how does it evolve in the society of Bangladesh are divided into three stages as follows: Firstly diversification, at the beginning stage BRAC and Grameen Bank focused on the concept of diversification to establish as nonprofit organization and welcomed American and European perspectives equally. Secondly convergence, later BRAC and Grameen Bank emphasized convergence of the nonprofit sectors and declared their non-profit business as a non-dividend business and profit will be used for business expansion instead of using donor money. Thirdly eventually in 2010 Yunus introduced this nonprofit business as SB through his "non loss, non-dividend" which has been adopted many world-

leading businesses, new entrepreneurs, NGOs, universities and research organizations including Japanese organizations namely Toyota, NTT, JICA, Kyushu university, OMRON to name a few. As the study aims to examine recent trends in the development and management of the social business sector in Bangladesh, the mixed method is used as its main research tool. In order to achieve this objective a questionnaire survey and an unstructured interview was conducted on 44 selected SBEs of BRAC and Grameen family of companies. In fact, this research is carried out on seventy-one aspects of five management practices namely corporate mission, corporate social responsibility, corporate governance, human resource management and project management and implementation in SBEs of Bangladesh. The study concludes that the four main areas help to understand the current context for social enterprise development including a) NGO and civil society activity, b) microfinance development and regulation c) private sector development and investment, in particular micro, small, or medium-sized enterprises (MSMEs) and d) corporate social responsibility (CSR). Moreover, there is no direct law to register and regulate SBEs in Bangladesh instead there are laws that allow doing SB. SBEs are registered under the Societies Registration Act 1860 and most of the Grameen SBs are registered under the Section 28 of The Companies Act 1994. However, corporate sectors are still in their initial stages in Bangladesh. The current system in Bangladesh does not provide sufficient legal, institutional, and economic motivation for stakeholders to encourage and enforce corporate governance practices. In addition, not only BRAC and Grameen Bank but there are also a huge number of NGOs in Bangladesh including Japanese NGOs (such as Shapla Neer, International Angel Association, Japan-Bangladesh Human Rights and among others) play numerous activities to develop territory and engage in the broad socio-economic uplift of the poor in rural and urban areas.

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Attaining Industrial Integrity and Competitiveness in Bangladesh's RMG Sector via Lean Manufacturing Techniques

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Track: Natural Sciences, Engineering, and ICT

Keywords: Lean Manufacturing, Toyota Production System, Ready-Made Garments (RMG), Operational Efficiency, Competitiveness.

Extended Abstract

Introduction: Ready-Made Garments (RMG) have evolved into Bangladesh's main industry, overtaking the other industries. World Bank: Bangladesh's RMG exports rose from US\$13 billion in 2006 to US\$34.1 billion in 2019, making it the world's second-biggest exporter after China [1]. Bangladesh just fell to third, behind China and Vietnam. According to the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), Bangladesh's clothing shipment to substantial nations fell 25%. As exports fall, the RMG industry appears operational standardization, inventory control ineffectiveness, production hold-ups, rising quality standards, and rising rivalry worldwide. These issues hamper the sector's recent expansion and worldwide competitiveness. Lean Manufacturing, which has its roots in the TPS, provides a practical approach to these problems. Improve production stability and competitiveness in the RMG industry with the help of TPS, which was developed by Toyota in the early 20th century [2]. TPS minimizes waste by optimizing processes, controlling inventories, minimizing non-value-added operations, and boosting efficiency. In the field of RMG, where simplified operations and low waste are essential to worldwide market dominance, this strategy is suitable for improving production consistency and profitability.

Problem Statement: Bangladesh faces challenges in adopting Lean Manufacturing principles effectively, a proven continuous improvement method. The Ready-Made Garment (RMG) business in Bangladesh, despite its economic importance, has operational inefficiencies such as prolonged lead times, substantial waste, quality deficiencies, and inadequate space utilization. The issues arise from inefficient workflows, overproduction, excessive inventory, and unstable supply chains, adversely affecting profitability and market share in a swiftly changing global market. Employing Lean Manufacturing methodologies, particularly Value Stream Mapping (VSM), Just-In-Time (JIT), Kaizen, and 5S, may resolve these ongoing challenges by strengthening production, eliminating waste, improving workstation functionality,

and cultivating a culture of continual enhancement amongst workforces. Lean principles reduce decreases in productivity caused by equipment bottlenecks while promoting sustainable development and compliance with global standards for quality, so enhancing the sector's resiliency and long-lasting economic sustainability. Lean Practices specifically, Value Stream Mapping (VSM) and Just-in-Time (JIT), have the potential to address these challenges by minimizing waste, enhancing production reliability, and creating a culture of ongoing improvement among workers.

Objectives: (1) Evaluate how Toyota Production System-based Lean Manufacturing might enhance Bangladesh's RMG sector's reliability in operation. (2) Find out how much of an impact Lean methods might have on profitability and consistency in output.

Methodology: This mixed-methods study will employ techniques that are both qualitative and quantitative. A rigorous Lean Manufacturing-related review of literature for the RMG industry is set to be done. Lean case studies from Bangladeshi RMG companies will be evaluated to discover what factors affect productivity, defect elimination, and profitability. Value Stream Mapping (VSM), Kaizen, 5S, Single-Minute Exchange of Dies (SMED) and JIT can be assessed for RMG production challenges. Conversations with manufacturing executives and employees, manufacturing process assessments, and operational indicators including cycle time, takt time, nonconforming units, and resource utilization (equipment and worker) will be collected [3-5]. A comparison of Lean and non-Lean factories will be made.

Findings: Introduction of Lean practices reduce lead time by 25-33% [6], improve control of inventory, and reduce failure rates by 20-40%. A particular RMG plant cut lead time by 61.20 percent after using Value Stream Mapping (VSM) [3] and two case studies found that using SMED cut changeover times by 42.1 percent and 70.76%, respectively [7]. Research studies show that Kanban and Kaizen strengthen turnover and encourage employees in manufacturing to optimize continuously. Lean Principles practicing plants claimed improved operational reliability and a better spot in the worldwide marketplace.

Contribution Anticipated: With an eye on bolstering economic performance and stabilizing production, this study will help build a complete framework for applying Lean Manufacturing in the RMG industry. Higher profitability and sustainability, as well as compliance with international quality and environmental responsibility requirements, are attainable goals for the RMG industry through waste reduction and process optimization [8]. Policymakers, business moguls, and plant managers will all be able to use the study's actionable suggestions for implementing Lean concepts [9]. Efforts to keep Bangladesh at the forefront of the global textile market would also benefit from this.

Conclusion: To strengthen economic ties between the two nations and increase operational excellence and ecological sustainability, this study reveals that the RMG sector in Bangladesh and Japan's Lean Manufacturing principles might work together in a complementary fashion.

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Assessment of Joint Forces on the Lower Back During Bricklaying Tasks

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Joint Reaction Force, Musculoskeletal Disorders (MSDs), Bricklaying Tasks.

Extended Abstract

Introduction: Bricklaying tasks are characterized by awkward postures and repetitive movements, which have a significant impact on the lower back. Despite the known prevalence of musculoskeletal disorders (MSDs), such as lower back pain, among construction workers[1], research on quantifying the biomechanical load in terms of joint forces on the lower back during bricklaying tasks remains unexplored. This study aimed to quantify the joint force in lower back during bricklaying tasks at foot and knee heights.

Methods: A total of seven male university students (22 ± 1.29 years) participated in this study. The participants performed four simulated bricklaying tasks at foot level height and knee level height. At foot level height, the participants were instructed to carry out the following tasks: scooping mortar from the right side (task-1), applying mortar to the left side (task-2), picking up the brick from the right side (task-3), and laying the brick on the left side (task-4). At knee level (47 cm, the average knee height of the participants) height, the participants were asked to perform same four tasks at a height of 47 cm. Inertial Measurement Unit (IMU) sensors were used to capture the three-dimensional (3D) movements data of the actual tasks. The joint forces of the lumbar region (i.e., L5Sacrum, L4L5, L3L4, L2L3, L1L2, L1T12) were assessed by inverse dynamic simulation using 3D Musculoskeletal(MSK) Modeling.

Results: The joint forces are considered as biomechanical risk factors for developing musculoskeletal disorders(MSDs) in lower back [2]. Therefore, in this study, we evaluated the risk of lower back load by assessing the joint forces for six lumbar joints. Fig. 1 indicates the six lumbar joints force during working at foot height (a) and knee height (b). At foot level (Fig. 1(a)), for tasks 1 to 4, the joint force on the L5Sacrum joint was consistently higher over time, with the highest value being 2.78 KN during task-3. These higher joint forces can strain the lower back muscles, which leads to MSDs, that is supported by Skovlind et al.[3]. In contrast, the joint force on the T12L1 joint was lower over the same period, with the lowest value being 0.33 KN during task-2. However, when performing the same tasks (1 to 4) at knee height, the joint forces (Fig.1(b)) of the selected joints changed significantly. In tasks 1 to 4, the highest and lowest joint forces were 1.92 KN, and 0.38 KN in task-2 for L1L2 and L4L5 joint respectively, which were comparatively lower than at foot level. The probable reason may be the minimal trunk forward bending, resulting in a shorter moment arm for the joints at knee height compared to foot height. Therefore, it can be said that working at knee height can help to avoid the risk of MSDs in lower back. The comparison of mean joint forces

in the lumbar joints for the same tasks at different working heights are shown in Fig. 2. Here, the mean joint force represents the average value of the joint force over the period. The maximum reduction of joint forces is exhibited in the L5Sacrum joint (i.e., 54.7%) in task-2, compared to other joints.

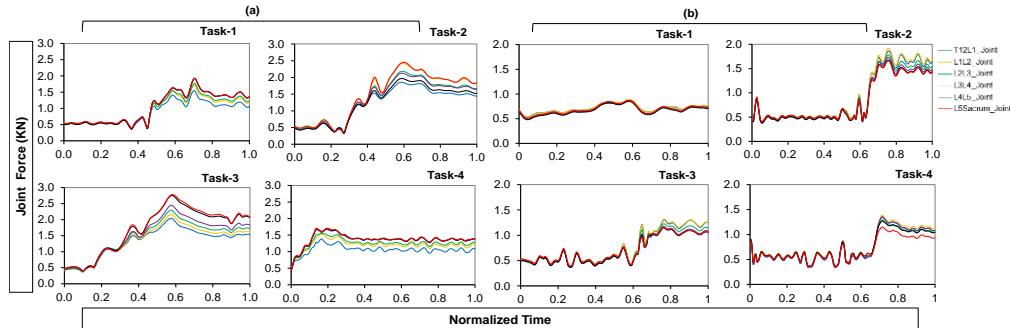


Figure 1: The lumbar joints force during work: (a) at foot level height, (b) at knee level height

Bending the trunk slightly and reaching the object more easily is likely the reason for the reduced joint forces when working at knee level height. Which indicates that working height is an important parameter for reducing the risk of MSDs. Therefore, it can be said that working at knee level height can reduce the risk of MSDs among bricklaying workers.

Conclusion: The joint forces, as a parameter of biomechanical load, were studied for bricklaying task focusing on the lumbar joints at foot and knee heights. The highest joint force was exhibited in the L5Sacrum at foot height which could contribute to the development of MSDs. Additionally, the L5Sacrum joint force was reduced by 54.7% during working at knee level height that was greater than in other joints. Therefore, knee level height is recommended as a comfortable working height to prevent the risk of MSDs in the lower back for bricklayers.

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Comparative Analysis of Infrastructure Diplomacy in South Asia: Assessing the Impact of China's Belt and Road Initiative and Japan's Free and Open Indo-Pacific Strategy

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Track: Business, Humanities, and Social Sciences

Keywords: Japan, China, South Asia, Economic Statecraft, BRI, AAGC.

Extended Abstract

China's Belt and Road Initiative (BRI) and Japan's Free and Open Indo-Pacific (FOIP) strategy are transformative infrastructure diplomacy frameworks reshaping regional stability, economic dependencies, and multilateral cohesion in South Asia. While BRI leverages economic integration to expand China's influence, FOIP emphasizes rules-based, inclusive development aligned with democratic partners. This paper focuses on the impacts of these initiatives in South Asia, analyzing their effects on regional stability, economic dependencies, and governance.

The research first explores the research gap in existing literature. The authors [1,2] argue that a cooperative "great power bargain" is essential for maintaining stability in East Asia, where issues like nationalism, territorial disputes, and complex security alliances continue to pose significant challenges. Yet, despite this, there is limited research on how large-scale infrastructure initiatives like China's BRI and Japan's FOIP shape power-sharing and the balance of power across the wider Indo-Pacific. The authors [3] provide a useful framework on economic statecraft, showing how economic inducements serve geopolitical objectives; their ideas are expanded by the works in [4,5], who examine how BRI often creates dependencies in recipient countries, though with mixed results. The FOIP approach is less frequent compared with BRI's more coercive economic methods, especially in Southeast Asia. Moreover, studies in [6,7] illustrate the competitive dynamics between China and Japan as they use economic levers to shape regional governance, yet there is little exploration of how BRI and FOIP interact in South Asia to either stabilize or escalate these tensions. Finally, the work reported in [8] highlights the importance of adaptive strategies in statecraft, though existing research does not deeply examine how the internal policy priorities of China and Japan affect BRI and FOIP's effectiveness, particularly in setting governance standards across the region. This prospective study seeks to fill these gaps, offering insights into the impact of these initiatives on stability, economic dependencies, and multilateral cohesion in South Asia.

This study uses a multi-theoretical approach to analyze the impacts of China's BRI and Japan's FOIP. Economic Statecraft, as reported in [3], examines how economic pressures from BRI and FOIP affect states' autonomy, capacity, and legitimacy, shaping their alignment. Knowledge for Statecraft, as reported in [8], guides a structured comparison across cases to highlight where China's and Japan's strategies converge or diverge. The Financial Statecraft of Emerging Powers [9] explores how BRI and FOIP's economic tactics foster either dependency or autonomy in recipient nations. Finally, Hegemonic Stability Theory, as reported in [10], assesses how BRI and FOIP support or challenge regional hegemony, examining if they encourage cooperation or intensify competition within the Indo-Pacific. Together, these theories provide a comprehensive view of BRI and FOIP's regional influence. Employing a mixed-methods approach, the study combines document analysis, comparative case studies, and expert interviews to examine the impacts of key infrastructure projects in countries like Bangladesh, Sri Lanka, and Nepal. Insights from policymakers and stakeholders provide a nuanced understanding of local perceptions, governance challenges, and the trade-offs involved in engaging with BRI and FOIP.

This research offers policy recommendations for South Asian countries to balance development with strategic autonomy, emphasizing the need for transparency, sustainability, and regional cooperation. By examining the strategic implications of infrastructure diplomacy, the study highlights pathways for fostering stability and empowering smaller states in South Asia to navigate competing external pressures.

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Challenges Faced by Physicians in Developing Countries in Following Necessary History-Taking Steps

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Track: Natural Sciences, Engineering, and ICT

Keywords: Electronic Health Records (EHR), Patient History Taking, Digital Health.

Extended Abstract

History-taking is a fundamental aspect of clinical practice, providing physicians with essential patient information that influences approximately 76% of diagnoses [1]. In developing countries like Bangladesh, physicians perform history-taking during consultations, following key procedural steps. While there is no fixed standard, common elements include: (1) Greetings, (2) Chief Complaint (CC), (3) History of Present Illness (HPI), (4) Past Medical History (PMH), (5) Medications, (6) Family History, (7) Social History, (8) Systematic Review, (9) Patient's Ideas, Concerns, and Expectations (ICE), and (10) Empathy [2-4]. However, limited resources and overburdened healthcare systems hinder the process. This study investigates the challenges physicians face in following these steps in Bangladesh and proposes a digital health solution to address them. The study utilizes a quantitative research design, targeting physicians from various backgrounds, working in both public and private healthcare settings in Bangladesh. The respondents were required to have at least two years of professional experience and represented different medical disciplines, including general practitioners and specialists. An online questionnaire, comprising 22 questions, was distributed, and responses were collected from 104 physicians.

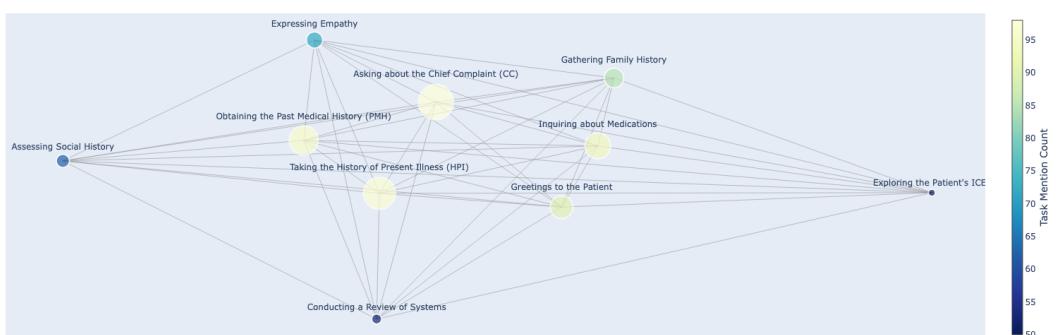


Figure 1: History taking tasks performed by a physician.

The study revealed that 70.19% of our sample of 104 physicians in Bangladesh were unable to consistently follow all necessary history-taking steps during consultations, emphasizing the challenges in delivering comprehensive care. The adherence rates for specific tasks varied significantly. The most frequently followed step was Inquiring about the Chief Complaint (CC) at 94.23%, while other critical steps such as Obtaining the Past Medical History (PMH) and Taking the History of Present Illness (HPI) were adhered to by 85.58% and 83.65% of physicians, respectively. Steps like Inquiring about Medications (79.81%) and Gathering Family History (76.92%) were also commonly followed.

However, tasks like Expressing Empathy (60.58%) and especially Exploring the Patient's Ideas, Concerns, and Expectations (ICE) (48.08%) were less frequently completed. Fig. 1 shows a network graph that visually illustrates these findings, where larger nodes, such as Chief Complaint (CC), represent higher adherence, while smaller nodes, like ICE, indicate lower adherence. The connections between tasks demonstrate that physicians tend to prioritize immediate medical concerns, often at the expense of more patient-centered steps, such as understanding the patient's ideas and expectations. This study introduces the Smart Health Gantt Chart (SHGC), a digital health solution designed to enhance the history-taking process, particularly in resource-limited settings like Bangladesh. The AI-powered SHGC collects, stores, and visualizes a patient's medical history, allowing physicians quick access to essential information during brief consultations. By automating record-keeping, it ensures that all critical history-taking steps are efficiently covered. Key features include comprehensive data collection, concise summaries for decision-making, shareable medical data, and predictive AI for assessing future health risks presenting a visual timeline of the patient's history, improving care quality, and reducing the risk of missed information [5]. Fig. 2 illustrates the lifelong medical history summary in a single chart, while Fig. 3 outlines the data processing steps. This study highlights the significant challenges physicians in Bangladesh face when conducting comprehensive history-taking, primarily due to limited time and an imbalanced physician-to-patient ratio. These constraints result in incomplete patient histories, potentially compromising care. Digital health solutions like the Smart Health Gantt Chart (SHGC) provide a promising way to address these issues by giving physicians quick access to complete medical histories. By reducing the cognitive load and ensuring critical information is not overlooked, these systems can substantially improve healthcare outcomes in resource-limited settings.

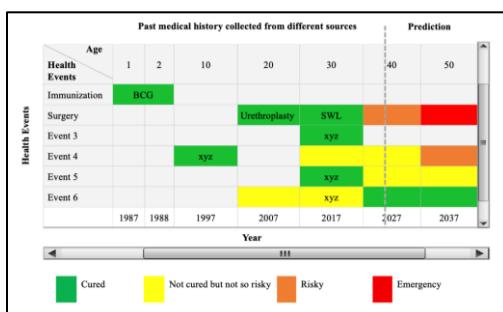


Figure 2: Dashboard concept of the SHGC for life-long history management.

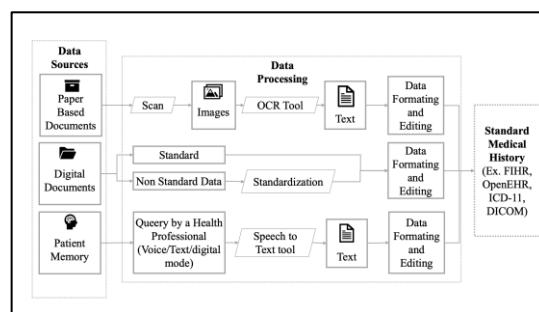


Figure 3: Various types of health data processing in SHGC.

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Disaggregated Impact of Non-Renewable Energy Consumption on the Environmental Sustainability of the United States: A Novel Dynamic ARDL Approach

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Track: Natural Sciences, Engineering, and ICT

Keywords: Non-renewable Energy, Environmental Sustainability, Dynamic ARDL, Coal, Petroleum.

Extended Abstract

The load capacity factor (LCF) represents the ratio of biocapacity to the ecological footprint and it is one of the most appropriate measures of environmental sustainability [1,2]. In the United States (U.S.), the LCF has consistently remained below 0.5 from 1970 to 2022, indicating that the country's resource supply is insufficient to meet current levels of consumption and production [3]. Despite extensive research on environmental sustainability, the disaggregated effects of major non-renewable energy (NRE) sources on U.S. environmental health are not well understood, particularly through the lens of the LCF. Given that approximately 90% of the U.S. energy consumption comes from four major NRE sources—coal, natural gas, petroleum, and nuclear energy [4]—this study seeks to fill that gap by examining the heterogeneous impacts of these energy sources on environmental sustainability from 1961 to 2022. Using a dynamic autoregressive distributed lag (DYNARDL) model, we examined the short- and long-term impacts of NRE consumption on the U.S. environment.

The findings reveal that every one-unit increase in coal, natural gas, and petroleum consumption reduces environmental sustainability by 0.007, 0.006, and 0.008 units in the short run and 0.006, 0.004, and 0.005 units in the long run, respectively (Table 1). In contrast, nuclear energy contributes positively to sustainability, with a 0.007-unit increase for each additional unit consumed in the long run. Furthermore, kernel-based regularized least squares (KRLS) analysis confirms that coal and petroleum have significantly negative causal links to environmental health, while nuclear energy shows a strong positive impact (Table 2). This research underscores the need to expand nuclear energy use in the U.S. while

gradually phasing out coal and petroleum, followed by natural gas, to achieve greater environmental sustainability. Policymakers must also consider the social and economic implications of transitioning away from fossil fuels, ensuring a balanced approach that promotes both environmental health and economic stability.

Table 1: Dynamic ARDL simulation result.

Variable(s)	Coefficient	Std. Err.
Δ COAL	-0.007***	0.0024
COAL	-0.006***	0.0013
Δ NG	-0.006***	0.0021
NG	-0.004***	0.0011
Δ PETRO	-0.008***	0.0016
PETRO	-0.005***	0.0014
Δ NUC	-0.011	0.0075
NUC	0.007***	0.0018
ECT(-1)	-0.521***	0.1101
Constant	0.546	0.1122
R-squared	0.7275	

Note: *** represents a 1% level of significance.

Table 2: KRLS Result.

Variable	Avg.	SE	t	P> t 	P25	P50	P75
COAL	-0.004	0.001	-3.992	0.000	-0.008	-0.004	-0.001
NATURAL GAS	-0.001	0.001	-1.334	0.187	-0.002	0.000	0.001
PETROLEUM	-0.008	0.001	-13.071	0.000	-0.012	-0.009	-0.006
NUCLEAR	0.004	0.001	2.588	0.012	0.002	0.004	0.005
Lamda	0.086	Sigma	4	R-sq.	0.977	Tolerance	0.062
Eff. df.	4	Looloss	0.17				

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Comparative Study of Jute, Coir and Bamboo Fibers Based on Uncertain Data

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Track: Natural Sciences, Engineering, and ICT

Keywords: Natural Fibers, Sustainability, Uncertainty, Decision-Making.

Extended Abstract

Managing uncertainty or variability in material properties poses significant challenges when determining design parameters for product development, a difficulty further amplified when working with natural materials. Addressing this issue has long been a focus of research. In this study, the uncertainties in tensile strength, Young's modulus, and strain characteristics of natural fibers—specifically jute (J), coir (C), and bamboo (B) fibers—are systematically quantified. The authors introduce a method for quantifying these uncertainties using both probabilistic approaches (e.g., normal and Weibull distributions) and possibilistic approaches (e.g., fuzzy numbers). The results from the possibility distributions are compared with those obtained from probability analyses. A material selection framework is developed as shown in Fig. 1. This framework consists of five components. The first is the introduction of alternative materials (in this case natural fibers). The next component is the performing material characterization testing. The third component quantifies the uncertainty using the abovementioned methods. The fourth component is the creation of database using the induced probability and possibility distribution. This final component is the making the right decision.

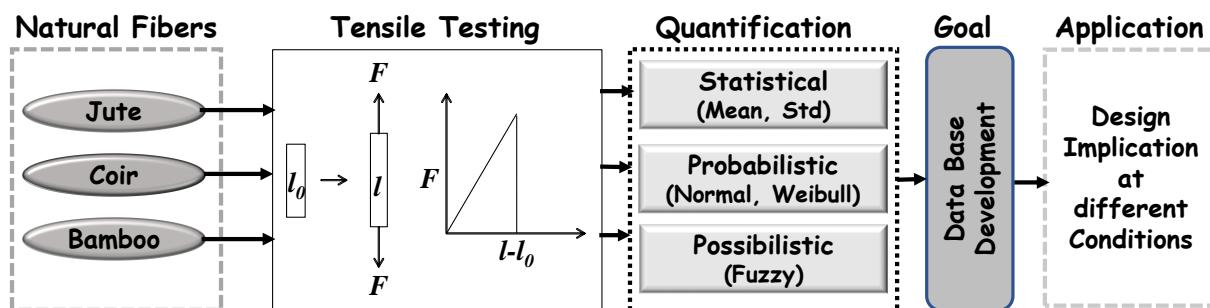


Figure 1: Schematic diagram of experimental procedure

It was found that the tensile strength (TS) of jute fiber varied significantly, ranging from 20 to 500 MPa, while its Young's modulus (E) varied from 2 to 100 GPa. Similarly, the tensile properties of coir fiber showed uncertainty, with TS ranging from 150 to 300 MPa and E from 2 to 6 GPa. Bamboo fibers exhibited even wider variability, with TS ranging from 400 to 1200 MPa and E from 21 to 50 GPa. This substantial variability has more effectively been quantified using possibility distributions rather than probability distributions. Four different scenarios were considered for material selection based on strength, modulus, and cost. Case 1 represents a strength-limited design, Case 2 indicates a stiffness-limited design, Case 3 focuses on a cost-limited design, and Case 4 considers all criteria as equally important, as shown in Table 1. The case studies reveal that when all criteria are equally important, or when the importance of modulus and strength is high, bamboo fibers are preferable to coir and jute fibers, with coir being a better option than jute. However, in the cost-limited scenario (Case 3), bamboo remains the top choice, but jute becomes a more favorable option than coir.

Table 1: Decision scores.

Alternatives	Case 1	Case 2	Case 3	Case 4
Jute	0.092833	0.088546	0.086025	0.506214
Coir	0.110041	0.089743	0.080334	0.539994
Bamboo	0.126432	0.134656	0.12674	0.549029
Ranking	B > C > J	B > C > J	B > J > C	B > C > J

This research presents a robust framework for selecting biobased materials in sustainable product development. Utilizing possibility distributions enhances the capacity to manage uncertainty in the properties of natural fibers, thereby facilitating more informed and reliable design decisions. Future research can delve into other natural materials, paving the way for the development of a comprehensive system for sustainable material selection.

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Revealing the Pathway of Reluctancy Toward Agricultural Credit Repayment: A Case Study on Fish Farmers in Bangladesh

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Track: Agricultural Sciences

Keywords: Agri. Credit Default, Fish Farmers, Pathway Analysis, Logistic Model, Loan Disbursement Policy.

Extended Abstract

In Bangladesh, the non-performing loan (NPL) ratio stands at almost 10%, positioning it as the second highest in Asia [1]. Among these NPLs, the Bangladesh Krishi Bank (BKB), a state-owned bank specializing in loans for farmers, has achieved a notable reduction of 22% in its NPLs [2]. This improvement is attributed to the BRPD-5 circular, which has been criticized as a “gift to bad borrowers” [1]. While agricultural credit disbursement is on the rise, recovery rates have not kept pace, creating an imbalance that negatively affects the overall economy. This study investigates both the direct and indirect impacts of various socioeconomic and demographic factors that contribute to fish farmers’ reluctance to repay agricultural loans in Bangladesh (Fig. 1). To achieve this, a field survey was conducted using a purposive sampling technique, gathering data from 250 fish farmers. The average age of the respondents was 45.42 years, and the average loan amount was USD 4,673.10.

Using a binomial logistic regression model, the study identified several factors that positively and significantly affect loan repayment. These factors include a secondary source of income, the number of earning members in the household, farm size, and training on sustainable fish farming and loan management. On the other hand, the ability to repay was found to have a negative relationship with loan repayment reluctance, indicating that as a borrower’s capacity to repay increases, the likelihood of repayment delays decreases. To further understand the indirect factors influencing loan repayment status, a second binomial logistic regression was conducted, this time considering the ability to repay as the dependent variable. The results suggest that farm size, the number of earning members, training, and farming experience all positively influence the ability to repay, while loans taken from alternative sources negatively affect repayment capacity (Fig. 2). Based on these findings, the study offers several policy recommendations, which are summarized in Table 1. These recommendations focus on enhancing farmers’ repayment capacity and mitigating the factors contributing to loan

defaults. They underscore the need for targeted financial literacy training and support in sustainable farming practices, as well as better monitoring of credit disbursement and repayment schedules to improve overall loan recovery in the agricultural sector.

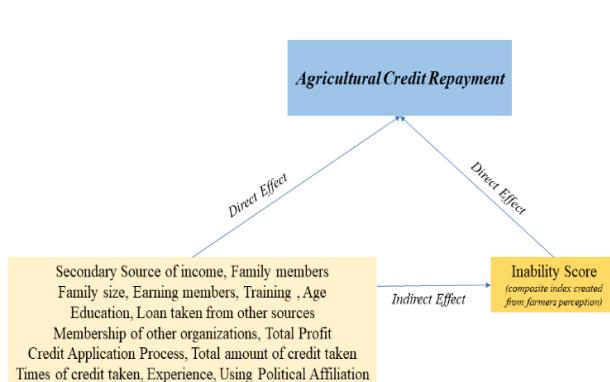


Figure 1: Conceptual Framework of this study.

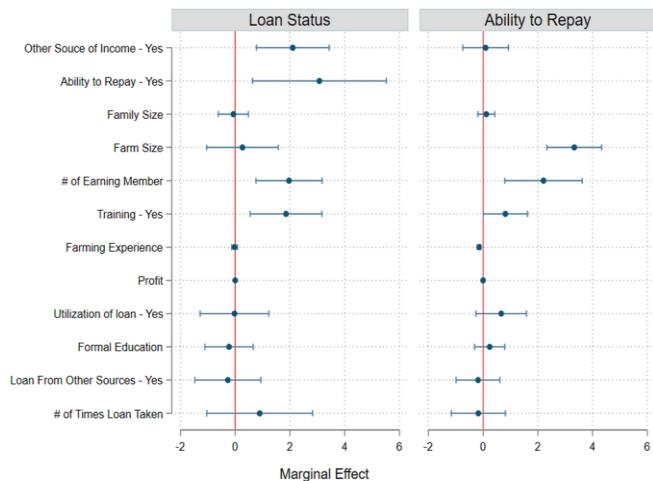


Figure 2: Coefficient plot of the estimation.

Table 1: Policy recommendation from the estimation.

Variables	Field situation	Our findings	Policy recommendation
Training	Serious lacking. 59% of farmers do not have any training	Training can be practical towards loan repayment.	Rigorous training on modern fish farming and loan management should be provided to the farmers.
Age	Most farmers were middle-aged.	Higher age can be effective.	Farmer's age and farming experience should be considered carefully before loan disbursement
Experience	16% have less than nine years of experience	Higher experience can be effective	
Education	The secondary level of education is the average level of our respondents	Education can be effective for timely loan repayment	Educated farmers should be encouraged to take a loan from banks
Secondary income source	44% of farmers do not have a secondary income source	The secondary source of income can be effective for loan repayment	Farmers having a secondary source of income should have priority in terms of loan receiving
The secondary source of loan	56% have taken a loan from the secondary source	A loan taken from a secondary source can be ineffective for timely loan repayment.	Those who have a loan from other sources should be excluded.
Times loan taken from banks	84% have taken a loan from the bank for the first time	A loan taken from banks more than one time have a higher probability of repaying the loan	Those farmers who have taken a loan from a bank more than one times should be encouraged
Loan use	35% of farmers used loans in an improper way	Proper use of a loan would help the farmer to repay the loan.	Proper investigation should be carried out from the end of the bank before and after disbursing the loan.

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Unlocking Jute's Potential: A Strategic Roadmap for Enhancing Productivity and Overcoming the Middle-Income Trap in Bangladesh

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Track: Business, Humanities, and Social Sciences

Keywords: Innovation-led Productivity, Jute Industry, Middle-Income Trap (MIT), TRIZ Methodology, DEMATEL Approach.

Extended Abstract

This research uses TRIZ to innovate jute products, aiming to enhance quality, productivity, and competitiveness. DEMATEL identified 14 critical success factors (CSFs) to avoid the Middle-Income Trap (MIT). The study provides TRIZ and DEMATEL frameworks to guide jute industry stakeholders in adopting sustainable practices and maximizing the industry's potential. This research investigates how innovation can bolster Bangladesh's jute industry and prevent it from falling into the middle-income trap. By employing TRIZ, a systematic problem-solving methodology, the study aims to identify innovative solutions for enhancing productivity, quality, and competitiveness within the jute sector. Additionally, the research analyzes the contribution of the seven global innovation pillars, such as creative outputs, knowledge and technology outputs, and human capital, to driving innovation-led growth. Furthermore, it identifies bottlenecks that hinder economic development in the jute industry, assessing their impact on productivity and sustainability. Finally, the study evaluates the effectiveness of existing innovation policies in promoting sustainable growth and avoiding the middle-income trap.

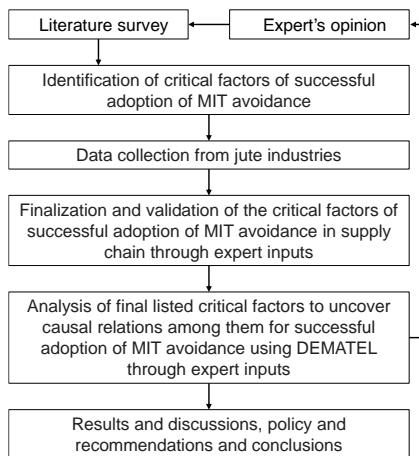


Figure 1: Research Framework.

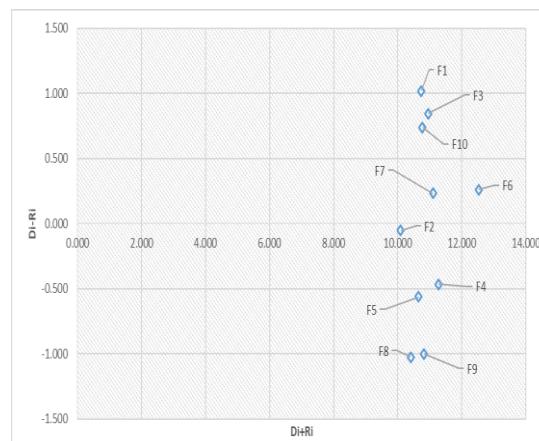
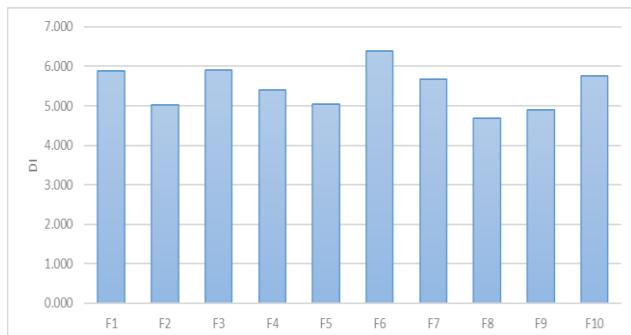


Figure 2: Causal Relationship Diagram.

Table 1: Experts' feedback on critical success factors.

Factor Codes	Factor Names	Number of Respondent	Cumulative	Cumulative %
F9	CSR	10	21	20.79%
F1	Green Design	9	30	29.70%
F6	Resident population	16	46	38.61%
F07	Reduction of fines for environmental disaster	8	54	46.53%
F13	Training and Education	8	62	54.46%
F10	Standards	7	69	68.32%
F03	Global Marketing	6	75	74.26%
F08	Organizational capabilities & efforts	5	80	79.21%
F4	Green Space Area	3	83	82.18%
F2	Environmental disaster	2	91	90.10%
F5	Technology granted by government	2	93	92.08%
F11	Green Manufacturing	2	95	94.06%
F12	Environmental Collaboration	2	97	96.04%
F14	Health and safety	2	99	98.02%

**Figure 3: Ranking of success factors.**

To avoid the middle-income trap, Bangladesh can apply DEMATEL to identify industry-specific CSFs; Explore other MCDM methods; Conduct more comprehensive research on CSFs; Analyze CSFs at the sector level; Foster a business-friendly environment; Attract FDI; Support knowledge acquisition and digital transformation; 8) Prioritize sustainability; and Monitor and evaluate innovation policies. By implementing these recommendations, Bangladesh can leverage innovation to boost productivity and escape the middle-income trap.

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Sentiment Analysis of Bangladeshi Roman Chakma Language Using Lightweight CNN

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Track: Natural Sciences, Engineering, and ICT

Keywords: CNN, Sentiment, NLP, Engineering, Roman Chakma Language.

Extended Abstract

Sentiment analysis has become an essential approach for evaluating public opinion and sentiment in various languages; nonetheless, there is still a shortage of study in this area for low-resource languages like Roman Chakma. Roman Chakma language is used by the Chakma population of the Chittagong Hill Tracts, Bangladesh, for communication, particularly on digital platforms. In this study, we have gathered the Roman Chakma language data from the Chittagong hill tracks area and developed a robust model using lightweight CNN. Because of its balanced design, the architecture is appropriate for resource-constrained applications. It balances computational efficiency with performance. The accuracy of our proposed model is 77%. Sentiment analysis is crucial to comprehending public opinion globally, particularly across linguistic and cultural divides. In this study, Lightweight CNN models provide an effective way to bridge language gaps in digital communication in Bangladesh by analyzing sentiments in regional languages such as Roman Chakma. In recent years, sentiment analysis has seen a considerable increase in interest [1]. Some of them are mentioned in Table 1.

Table 1. Related Works of Sentiment Analysis System.

Article	Data source	Category	Algorithm
[2]	Movies and social sites	Positive & Negative	Naïve Bayes
[3]	Tweet Data	02 categories	Decision Tree

The detailed parameters of the proposed lightweight CNN model of the proposed model are illustrated in Table. 2 where it is seen that, the Proposed Model has 361,751 parameters and consumes only 1.38 Megabytes. Fig. 1(a) illustrates the classification report, whereas 1(b) illustrates the confusion matrix of the system. From the values of confusion matrix we have seen that the accuracy (derived using Eq. 1) of the proposed model is 77%. Using the random input to the system, the output is shown in Fig. 2.

This study fills a significant research gap by creating a lightweight CNN model for sentiment analysis in the underrepresented Roman Chakma language. It achieves 77% accuracy while maintaining computational efficiency, making contributions to digital communication in low-resource languages and linguistic technology.

Table 2. Detailed Parameters of the Proposed Lightweight CNN Model.

Layer Name	Output Shape	Param
Embedding	(None, 32, 64)	320,000
Conv1D	(None, 28, 128)	41,088
GlobalMaxpooling1D	(None, 128)	0
Dense	(None, 5)	645
Dense	(None, 3)	18
Total Params		361,751(1.38 MB)

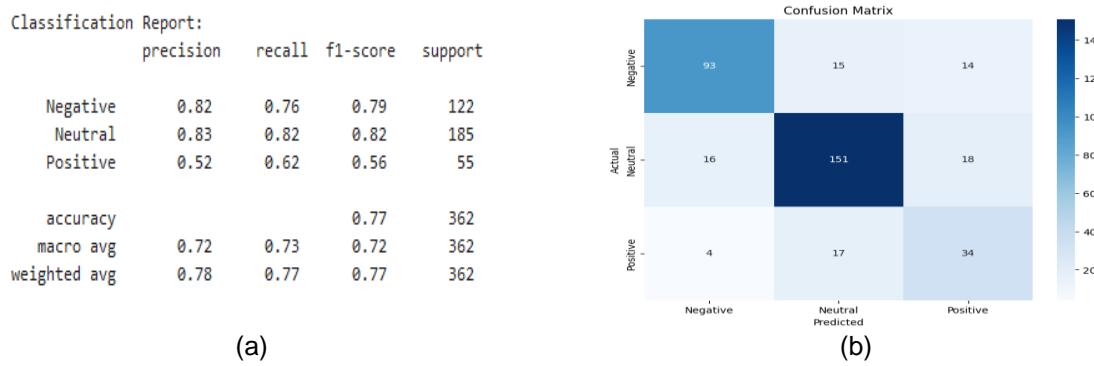


Figure 1: (a) Classification Report, (b) Confusion Matrix.

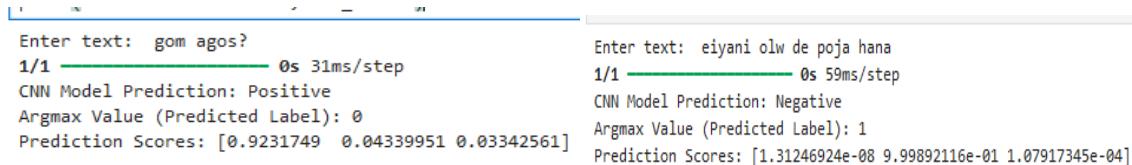


Figure 2: Result using Several random inputs.

$$\text{Accuracy} = \frac{\text{True Positive} + \text{True Negative} + \text{True Neutral}}{\text{Total Predictions}} = \frac{278}{362} = 0.77 \quad (\text{Equation 1})$$

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Inequalities in Dental Service Utilization Among Adults: Evidence from Bangladesh, Bhutan, and Nepal

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Dental Service Utilization, Inequalities, LMICs.

Extended Abstract

Background: Oral health is a vital aspect of overall well-being [1-3], yet there remain substantial disparities in Dental Service Utilization (DSU), particularly in low- and middle-income countries. This study investigates the socioeconomic and education-related inequalities in DSU among adults in Bangladesh, Bhutan, and Nepal, examining both relative and absolute disparities.

Objective: The objective is to assess socioeconomic and education-related disparities in dental service utilization (DSU) among adults in Bangladesh, Bhutan, and Nepal, with an emphasis on measuring both relative and absolute inequalities.

Methods: Data were obtained from the WHO STEPS-wise approach to surveillance surveys [4-6] conducted in Bangladesh, Bhutan, and Nepal. Descriptive statistics were used to describe the basic characteristics of the study population. Socioeconomic and education-related disparities in DSU were analyzed using the Slope Index of Inequality (SII), Relative Index of Inequality (RII), and Relative Concentration Index (RCI). A multilevel mixed-effects binary logistic regression model was also applied to identify key predictors of DSU, such as age, gender, residence, and socioeconomic status.

Results: The highest DSU rate was found in Bhutan (48.8%), followed by Bangladesh (29.1%) and Nepal (5.6%). In Bhutan, significant socioeconomic inequality was evident, with wealthier individuals being 2-3 times more likely to access dental services compared to poorer individuals (RII: 2.08 to 3.34). Absolute disparities were also notable in Bhutan, with significant gaps between advantaged and disadvantaged groups (SII: 34.3). In Bangladesh, moderate disparities were present (RII: 1.17, RCI: 6.3), while Nepal displayed minimal inequalities (RII near 1, SII: -2.6). Age, education, gender, and urban residency were key determinants of DSU.

Conclusions: Significant socioeconomic and educational inequalities in DSU are present in these South Asian nations, with the most pronounced disparities in Bhutan. Policy interventions targeting these inequalities, enhancing healthcare infrastructure, and providing support for disadvantaged populations are needed to address these gaps.

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Revolutionizing Agriculture with the Smart Farming Mobile App

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Track: Agricultural Sciences

Keywords: Smart Farming, Digital Agriculture, Farmer Empowerment, Agricultural Technology, Bangladesh Farming Innovation.

Extended Abstract

Introduction: The agricultural sector is critical to Bangladesh's economy, but productivity is still low due to low adoption of technology especially digital technology [1]. To address this, the Smart Farming Mobile App was developed with technical support from Japanese University and industry experts in Bangladesh. With over 130 million mobile users in Bangladesh [2], the app aims to bridge the gap between traditional farming and digital technology, enhancing productivity, profitability, and sustainability while contributing to food security and poverty reduction.

Research Achievements: The app is built upon research into digital agricultural solutions, focusing on practical, user-friendly tools that farmers can easily integrate into their daily practices [3]. These efforts have shaped a platform tailored to the specific challenges of local farmers in Bangladesh and connected them with best practices in Bangladesh and across similar contexts.

Features of the App: The app offers a comprehensive solution for farmers, including:

- Expert Consultation & Training:** Farmers can consult agricultural experts through the app to receive real-time advice on crop management, pest control, soil health, seed beading and modern farming techniques. It provides farmers with market price updates and disease outbreak alerts. The app offers online training modules, one-on-one video consultations, and opportunities for peer-to-peer learning through forums and discussion groups, allowing farmers to upgrade their skills. It also supports sharing crop photos to get expert diagnosis.
- Marketplace for Products and Equipment:** The app enables farmers to list their agricultural products and machinery for sale or rent. This digital marketplace removes intermediaries, allowing farmers to earn higher profits and have better control over their sales. It provides safe payment options, networking opportunities to connect with

other farmers, buyers, and industry professionals, and scope to expand product categories.

3. **Investment Opportunities & Contract Farming:** The app facilitates connections between farmers seeking funding and investors interested in agricultural projects, including contract farming agreements. This feature enables individuals who are passionate about agriculture but lack the means to participate physically to invest in farming initiatives. This creates a win-win scenario for both parties, as investors can benefit from guaranteed returns, risk mitigation, and the opportunity to support ethically compliant and sustainable farming practices.

Impact on Farmers and Consumers: The Smart Farming Mobile App aims to transform the agricultural value chain by offering significant benefits to both farmers and consumers:

- **Increased Income for Farmers:** By using the app to sell their products directly to consumers, farmers can eliminate middlemen and retain a larger share of the profit. For instance, a product typically sold for BDT 40 by the farmer can reach the market at BDT 200. Using the app, farmers can sell directly to consumers at a price range of BDT 80-100, benefiting both farmers and buyers.
- **Cost Savings for Consumers:** Consumers benefit from lower prices by purchasing products directly from farmers through the app. This direct connection also promotes transparency, fostering trust between buyers and producers.
- **Survey Funding:** After the pilot phase of the app, a survey conducted among the farmers revealed that 99% of them were highly enthusiastic about using the app.

Solutions to Challenges in Bangladesh: The app addresses critical challenges in the Bangladeshi agricultural sector, such as market access, lack of investment opportunities, and limited technical knowledge. By providing a digital marketplace and training modules, the app helps farmers overcome these barriers, enabling them to adopt modern practices and connect with a wider market. The collaboration with Japanese University has further strengthened efforts to introduce innovative farming methods and technology in rural Bangladesh.

Pilot Phase Success: The app has been piloted in three rural sub-districts of Bangladesh, with positive feedback from farmers. The “total solution” nature of the app has made it popular among early adopters, highlighting its potential to drive broader adoption.

Challenges and Opportunities: While the app presents numerous advantages, several challenges remain:

- **Cost of Technology and Smartphone Adoption:** Many farmers lack smartphones, often relying on family members for access. The initial investment required for smartphones, data plans, and other necessary tools may be a barrier for small-scale farmers with limited financial resources.
- **Device Compatibility:** Ensuring the app works seamlessly across different types of smartphones, including older and low-cost models, is crucial to avoid limiting its

accessibility. Expanding smartphone use and collaborating with government initiatives can help overcome these challenges.

- **Connectivity Issues:** In some remote areas, reliable internet access remains a challenge, which can limit the functionality of the app.
- **Digital Literacy:** Efforts are needed to improve familiarity with digital tools.

Future Prospects: The app aims to expand to all regions of Bangladesh by 2025, with plans to adapt it for other developing countries. Future updates will integrate AI and IoT, offering enhanced resource management and predictive analytics, turning the app into an intelligent farming assistant.

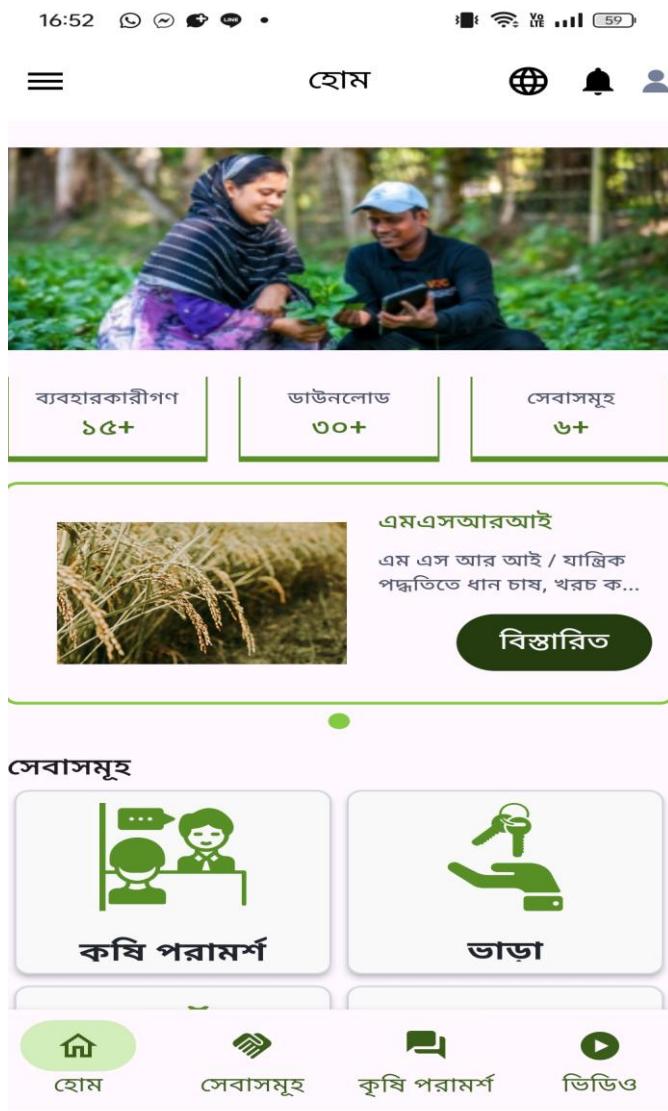


Figure 1: An instance of the smart farming mobile app.
[Available at <https://play.google.com/store/apps/details?id=com.nexkraft.oriscape>]

Conclusion: The Smart Farming Mobile App is a transformative tool for the agricultural sector in Bangladesh. It empowers farmers with access to expertise, direct sales channels, and investment opportunities, making agriculture more profitable and sustainable. This initiative modernizes farming and lays the foundation for a digitally connected agricultural future.

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Improving MnO₂/ Porous Carbon Nanocomposites Electrocatalytic Oxygen Reduction Performance by Surface Modification Using Protic Ionic Liquid for Fuel Cell

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Track: Natural Sciences, Engineering, and ICT

Keywords: Electrocatalysis, Triple Phase Boundary, Oxygen Reduction Reaction, Protic Ionic Liquid.

Extended Abstract

Background: Fuel cells have garnered increased interest as a portable power source in recent times due to their superior efficiency and environmentally friendly nature compared to alternative energy conversion technologies [1-3]. There is anticipation for the commercialization of fuel cells across diverse applications such as transportation, space technology, and portable electronic devices. This advancement is poised to contribute to addressing the global energy supply challenge [4]. The basic idea behind fuel cells is the sustainable conversion of chemical energy into electrical current. Being the most effective ORR catalyst to date, Pt nanoparticles supported on carbon materials (Pt/C) provide large current densities and low ORR overpotential. Furthermore, they show selectivity for a straight four-electron pathway. However, significant barriers have thwarted the widespread adoption of fuel cells implementing Pt-based electrocatalysts on an extensive basis, including high cost, scarcity, restricted long-lasting stability, and the possibility for degradation of Pt occurs because of methanol contact. Many studies have been devoted to developing equivalent Pt-free ORR catalyst equivalents to overcome such issues.

Methodology: This study introduces a simple method for synthesizing MnO₂/porous carbon (PC) composites with tunable morphology to improve oxygen reduction reaction (ORR) kinetics in intermediate-temperature fuel cells. Using banana pseudo stem and KMnO₄ as precursors, the resulting carbon is highly nitrogen-doped with an interconnected porous structure. The catalyst surface is modified with 2-isopropyl imidazolium trifluoroacetate ([2-IPIm]CF₃COO), a hydrophobic protic ionic liquid (PIL), creating a solid catalyst with a protective PIL layer. Characterization using FTIR, XRD, SEM, BET, Raman, and XPS confirmed the successful synthesis, with XRD revealing tunnel rod-shaped MnO₂ and SEM showing PIL surface modification. BET analysis indicated a mesoporous structure with a specific surface area of 45.61 m²/g. Raman spectroscopy showed a high I_D/I_G ratio for the carbon layer, while XPS identified nitrogen doping with pyridinic-N, pyrrolic-N, and N-oxide groups.

Electrochemical Measurements: ORR performance, evaluated using voltammetry in O₂-saturated 0.1 M KOH, showed an onset potential of 0.786 V and a half-wave potential of 0.713

V vs. RHE. Table 1 shows $E_{1/2}$ and Onset potential before and after surface modification of MnO_2/PC prepared at different temperatures with different PIL ratios.

Table 1: $E_{1/2}$ and Onset potential before and after surface modification of MnO_2/PC prepared at different temperatures with different PIL ratios.

Sample	$E_{1/2}$ of catalyst (V vs RHE)	Onset potential (V vs RHE)
$\text{MnO}_2/\text{PC}-400$	0.616	0.666
$\text{MnO}_2/\text{PC}-400+\text{PIL}(1:1)$	0.686	0.696
$\text{MnO}_2/\text{PC}-400+\text{PIL}(1:2)$	0.713	0.786
$\text{MnO}_2/\text{PC}-400+\text{PIL}(2:1)$	0.626	0.706
$\text{MnO}_2/\text{PC}-500$	0.606	0.676
$\text{MnO}_2/\text{PC}-500+\text{PIL}(1:1)$	0.616	0.696
$\text{MnO}_2/\text{PC}-500+\text{PIL}(1:2)$	0.706	0.766
$\text{MnO}_2/\text{PC}-500+\text{PIL}(2:1)$	0.556	0.666
$\text{MnO}_2/\text{PC}-600$	0.606	0.747
$\text{MnO}_2/\text{PC}-600+\text{PIL}(1:1)$	0.696	0.779
$\text{MnO}_2/\text{PC}-600+\text{PIL}(1:2)$	0.708	0.78
$\text{MnO}_2/\text{PC}-600+\text{PIL}(2:1)$	0.686	0.77

The superior ORR activity, with 85% current retention after 18,000 seconds, is attributed to the synergistic effects of nitrogen-doped carbon and MnO_2 , enhanced by the protective PIL layer, offering valuable insights for fuel cell electrocatalysts. Following PIL modification, the electrocatalysts exceeded commercial Pt/C in terms of catalytic efficiency and stability over the long term, while costing less than rare Pt. The PIL layer functioned as a reaction medium, discharging water and ORR byproducts, protecting the active sites from oxygenation or contamination, and considerably improving their long-term stability.

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Anti-Inflammatory, Wound Healing, and Anti-Diabetic Effects of Pure Active Compounds Isolated from the Ryudai Gold Variety of *Curcuma longa*

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Track: Agricultural Sciences

Keywords: Curcuminoids, Inflammation, Wound, Diabetes.

Extended Abstract

Background: The rhizome of *Curcuma longa* (turmeric) is commonly utilized in traditional medicine. It contains curcumin, demethoxycurcumin (DMC), and bisdemethoxycurcumin (BDMC). The Ryudai gold cultivar of *Curcuma longa* contains a higher concentration of these curcuminoids [1] and shows better antifungal and antioxidant activities than other species of turmeric [2]. We investigated the impact of these curcuminoids on wound healing, inflammation, and diabetes *in vivo*.

Methodology: Sub-planter injections of carrageenan induced acute paw inflammation in rats. The wound-healing ability of 1% curcuminoids was examined by making a 6 mm round wound on the shaved dorsum of the mice with a biopsy punch. A single intraperitoneal injection of streptozotocin (50 mg/kg) was used to induce diabetes in mice. Curcuminoids at a dose rate of 100 mg/kg body weight were used with feed and as a gastric gavage to treat diabetes and inflammation in experimental animals. Paw thickness was measured at 1, 3, and 6 h following carrageenan injection.

Results: After three hours, mean paw volume was 58% in carrageenan-injected mice, which was 35%, 37%, and 31% in the curcumin, DMC, and BDMC groups, respectively. BDMC showed the highest anti-inflammatory potency. Structural difference of BDMC make it more bioavailable and water-soluble than curcumin and showed more COX-1 and COX-2 inhibitory effects than curcumin and DMC [3]. Histopathology of the paw tissue demonstrated severe infiltration of inflammatory cells and thickening of the dermis, which were remarkably improved by the curcuminoids. The wound-healing abilities were significantly higher in the curcumin- (95.0%), DMC- (93.17%), and BDMC-treated (89.0%) groups, in comparison to that of the control (65.09%) group at day nine. Topical application of the curcuminoids makes them equally accessible at the wounded site which might be the cause of non-significant difference among the groups. Streptozotocin-induced diabetes was characterized by an increased blood glucose (552.2 mg/dL) and decreased body weight (31.2 g), compared to that of the control rats (145.6 mg/dL and 46.8 g blood glucose and body weight,

respectively). It also caused an increase in serum alanine aminotransferase (ALT; 44.2 U/L) and aspartate aminotransferase (AST; 55.8 U/L) compared to that of the control group (18.6 U/L and 20.1 U/L, respectively). Histopathological examination of the liver showed that diabetes caused hepatic cellular necrosis, congestion of the central vein, and parenchymatous degeneration. However, all three curcuminoids significantly decreased blood glucose levels, ALT, and AST and improved the histopathological score of the liver.

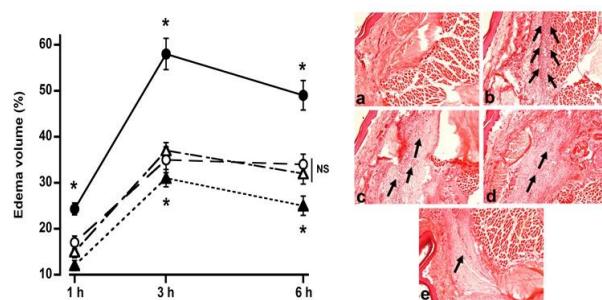


Figure 1: Effects of 100 mg/kg body weight of curcumin (□), DMC (△), and BDMC (○) on rat paw edema caused by carrageenan (●). n = 4.

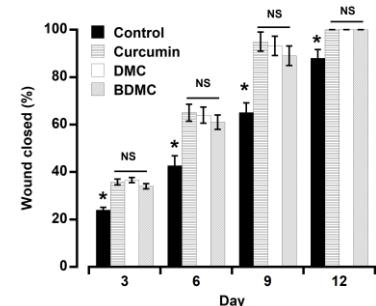


Figure 2: Effects of topical application of curcumin, DMC, and BDMC (1%) on the wound-healing time in mice. N = 3.

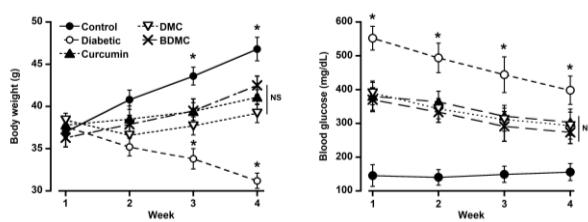


Figure 3: Effects of curcumin, DMC, and BDMC on body weight and blood glucose level of diabetic mice. N = 5.

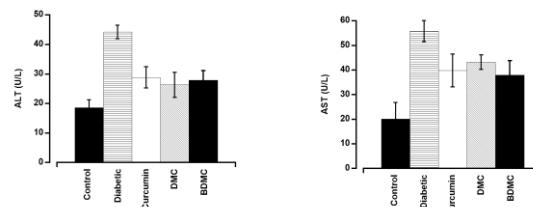


Figure 4: Effects of curcumin, DMC, and BDMC on serum ALT and AST levels in mice. N = 5.

Conclusion: These results evidenced that not only curcumin but also DMC and BDMC have potent anti-inflammatory, wound healing, and anti-diabetic efficacy, and the Ryudai gold variety of turmeric could be used as a functional food supplement.

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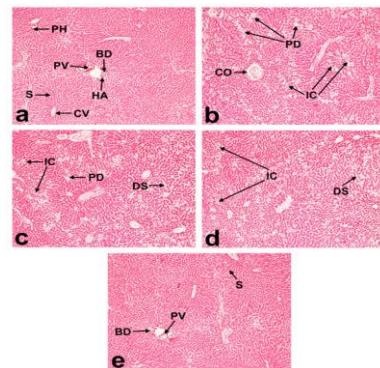


Figure 5: Effects of curcumin, DMC, BDMC and STZ on histoarchitecture of mice livers (a) control; (b) streptozotocin; (c) streptozotocin + curcumin; (d) streptozotocin + DMC; and (e) streptozotocin + BDMC. Dilated sinusoid (DS), congested central vein (CO), parenchymatous degeneration (PD), central vein (CV), (S), hepatic artery (HA), bile duct (BD), and inflammatory cells (IC).

Pearl Millet WRKY Transcription Factor PgWRKY60 Can Retard Growth under Both Unstressed and Abiotically Stressed Conditions in Genetically Modified *Arabidopsis*

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Track: Agricultural Sciences

Keywords: *Arabidopsis*, Dehydration, Pearl Millet, Salinity, Transcription Factor, WRKY.

Extended Abstract

Pearl millet (*Pennisetum glaucum*) is a cereal crop that can tolerate high temperatures, drought, and low-fertility conditions where other crops lose productivity. However, genes regulating this ability are largely unknown. Transcription factors (TFs) regulate transcription of their target genes, regulate downstream biological processes, and thus are candidates for regulators of pearl millet tolerance to the adverse conditions. PgWRKY60 is a pearl millet gene encoding a group III WRKY TF, and its expression is stronger in salinity-stressed ICMB081 shoots than salinity-stressed ICMB01222 shoots and unstressed ICMB081 and ICMB01222 shoots (Shinde et al., 2018). These findings tempted us to further characterize its functions as a TF potentially regulating plant responses to drought and salinity stress. Group III WRKYS in pearl millet have not been characterized thus far and their roles in abiotic stress mediation is unknown. This particular gene has nuclear localization potential (Fig. 1A). A construct with PgWRKY60 enabled yeast reporter cells to survive on test media in the yeast one-hybrid assays indicating the gene is capable of activation transcriptional function (Fig. 1B). Transgenic *Arabidopsis thaliana* plants overexpressing PgWRKY74-GFP fusion protein were generated and tested for growth and stress-responsive gene expression under mannitol and NaCl-stressed conditions (Fig. 2). Most PgWRKY60-ox lines exhibited smaller rosette areas and smaller root length than did the wild type under unstressed, mannitol-stressed and salinity-stressed condition. Only line #3 exhibited smaller rosette areas than did the wild type under mannitol stress. Lines #3, #4 and #5 had smaller root lengths than wild type under salt stress. This indicates that PgWRKY60 negatively regulates shoot and root growth even under an unstressed condition. These findings provide evidence for its possible roles in response to stress and provide ideas for future research to develop stress resistant cultivars.

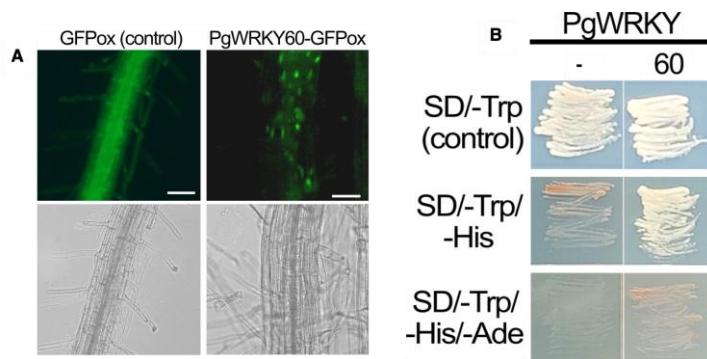


Figure 1: (A) PgWRKY60 is localized in the nucleus, (B) PgWRKY60 can activate reporter genes in a yeast one-hybrid.

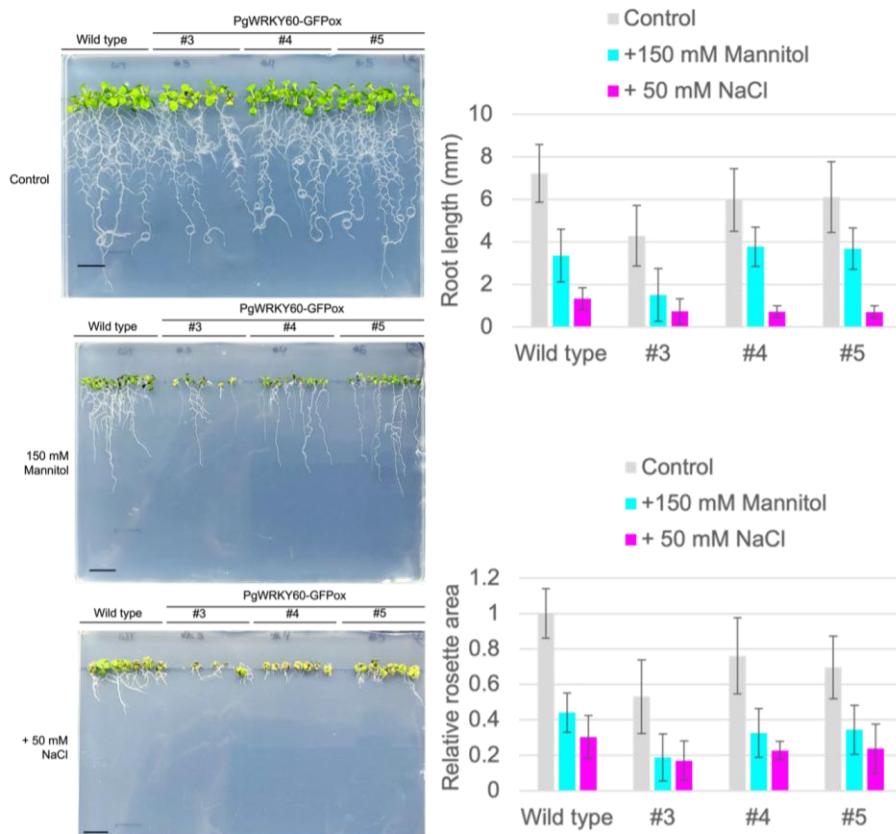


Figure 2: PgWRKY60-GFP-overexpressing (PgWRKY60-GFPox) plants exhibit rosette growth retardation under mannitol- and NaCl-stressed conditions.

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Child Marriage in Bangladesh (1960-2016): Historical Trends, Natural Calamities, Policy Interventions, and Socioeconomic Impact

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Bangladesh, Demographic and Health Survey, Child Marriage Incidence, Determinants, Historical Trend.

Extended Abstract

Background: Child marriage, defined as a formal or informal union before the age of 18 [1], is a global phenomenon that affects more than 650 million girls and women [2]. Child marriage is more common in low-income countries, but most cases (65%) occur in lower-middle-income countries [3]. Almost half (47%) of the world's child brides reside in South Asia, with Bangladesh having the highest prevalence of child marriage among South Asian countries [4]. Despite the legal minimum age for female marriage being 18, the prevalence of child marriage declined only a small amount, from 65% to 50% between 2011 to 2022, indicating a persistent and pervasive problem [5,6]. This study aims to analyze historical and current patterns of child marriage across regions, districts, and socioeconomic groups; identify the key drivers and barriers of child marriage; assess the impacts of different intervention and historical events like, natural disasters, and war on child marriage.

Methods: Data from the Bangladesh Demographic and Health Survey (BDHS) from 1994 to 2018 were used to assess the incidence of child marriage. The analysis included 173,377 women aged 8-49 years. The incidence of child marriage from 1960 to 2016 was calculated based on the life history for every woman, and a logistic regression model was applied to identify the factors influencing child marriage in Bangladesh.

Results: In 1964, 99% of marriages in Bangladesh involved child brides. By 1971, this percentage had decreased by 3%, and after 45 years, in 2016, the rate of child marriage had dropped by 45%, reaching 52%. The yearly incidence of child marriage fluctuated due to historical events such as war, famine, and various interventions. As shown in Fig. 1, the liberation war in 1971 significantly influenced the incidence of child marriage. The famine of 1974 led to an increase in child marriages, with the trend continuing upward until 1983. This rate started decreasing, along with the expansion of female employment in the Ready-Made Garment (RMG) sector following the 1982 industrial policy. Further reductions were seen at

the time of the introduction of the female school stipend program, aimed at subsidizing girls' secondary education in rural areas. This program helped reduce dropout rates and may have contributed to a decline in child marriage.

Women's education was a significant determinant of child marriage. Uneducated women had 2.71 times higher odds to marry as children compared to women with secondary or higher education. Similarly, socio-economic status played an important role; women from the poorest households had 2.15 times higher odds of child marriage than those from wealthier households. Rural girls had 1.18 times the odds of being married as children compared to their urban counterparts. Regionally, Rajshahi and Khulna divisions had the highest odds of child marriage (OR: 1.29), followed by Rangpur (OR: 1.18) and Mymensingh (OR: 1.07), while Sylhet had the lowest odds (OR: 0.42) compared to Dhaka.

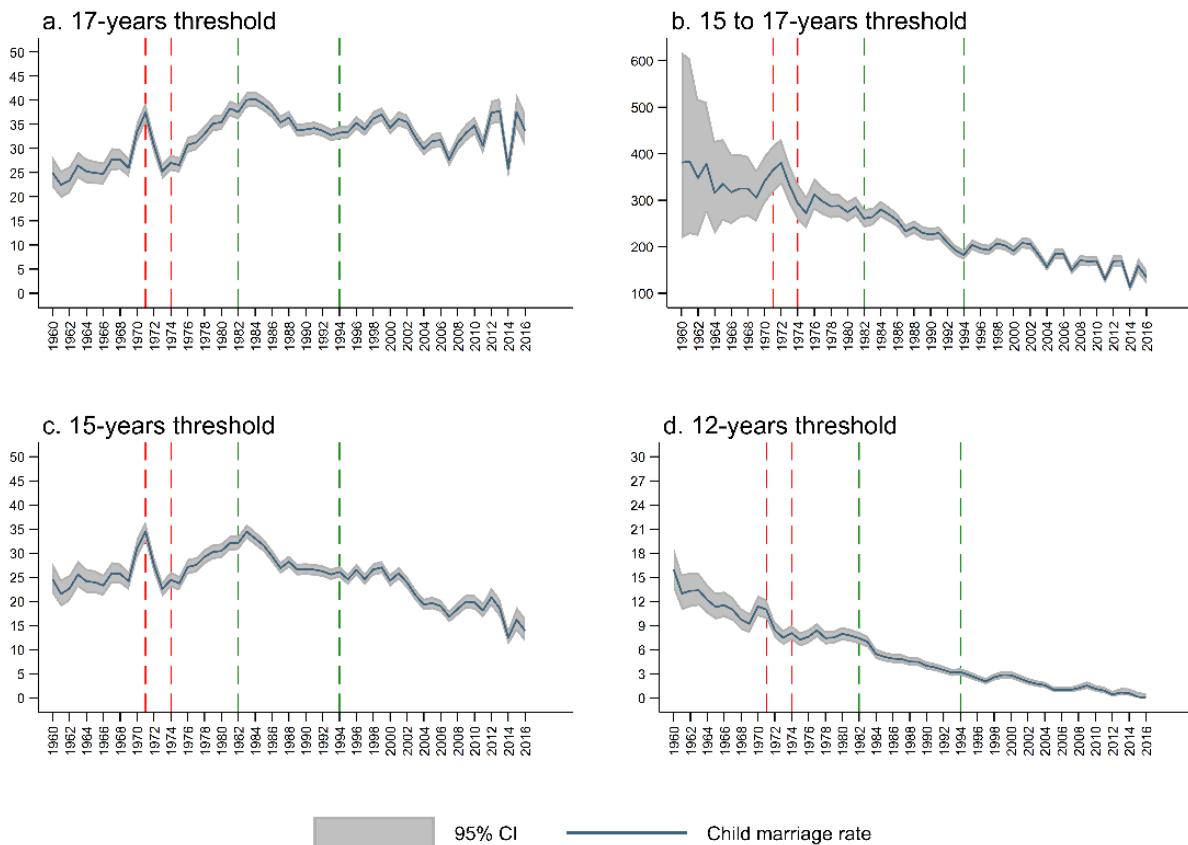


Figure 1: Yearly incidence of child marriage in Bangladesh.

Conclusions: In Bangladesh more than half of all girls have been affected by child marriage, which is a persistent problem, but this study shows that rates of child marriage have been declining rapidly in recent years and the risk of being married has dropped rapidly for very young girls. Key determinants include socio-economic status, education, and geographic location. Addressing these factors is crucial for developing policies to reduce child marriage incidence.

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Identifying Problem and Analyzing Business Scenario of Bangladeshi Light and Medium Industry: A Lean Kaizen-Based Approach

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Track: Natural Sciences, Engineering, and ICT

Keywords: Light Engineering, Value Chain Map, SWOT Analysis, Porter's Diamond model, Lean-Kaizen.

Extended Abstract

Light Engineering (LE) sector is one of the promising sectors in Bangladesh. Jashore LE sector consists of 256 workshops and serves as a key industrial hub in southwestern Bangladesh with an annual turnover of approx. 5500 million BDT. This sector manufactures a wide range of machinery and tools including stone crashers, chaff cutters, and agricultural equipment, which were previously imported. However, it currently faces several quality-related challenges. Although several studies have explored the challenges and growth potential of Bangladesh's LE sector, few have addressed its current challenges related to forward market linkages and high-quality product manufacturing concerning Industry 4.0 [1, 2]. This study aims to capture a big picture of Jashore LE sector employing comprehensive survey data from 256 workshops with a set of structured questionnaires. Based on the data, this sector was divided into three main subsectors-Foundry, Agricultural and Food Processing Machinery, and Special Purpose Machinery-for detailed analysis. This analysis included value chain assessment, SWOT analysis, and a competitiveness review using Porter's Diamond model to identify growth opportunities and lean-kaizen-based actionable insights for development. Research results revealed that the Jashore light engineering sector relies heavily on reverse engineering, while slow technology adoption and a lack of expertise in critical areas such as testing and productivity impede its growth which is a great concern considering I4.0. Thus, strategic actions, such as improving business functions and leveraging competitive advantages, are essential for fostering the sector's development, achieving its full potential and better competitive advantages.

As Bangladesh gradually moves from an agriculture-based economy to a manufacturing and services-based industry, understanding and improving the casting industry's role and challenges is a burgeoning concern. According to the survey data, Fig. 1 illustrates that only 6 industries utilize traditional cupola furnaces, 6 operate induction furnaces, and 3 use crucible furnaces, while none employ the advanced Electric Arc Furnace, which raises concerns regarding the production of high-quality products. Additionally, Fig. 2 indicates a shortage of skilled workers (only 30% are efficient) and educated personnel, which hampers the sector's

efficiency. It also demonstrates that the industry is not yet prepared to adopt the latest technologies, even if provided by the government or foreign companies. Fig. 3 shows the value chain of this sector, highlighting Chittagong's shipbreaking yard as a key raw material source, chemicals from Dhaka and India, and sand sourced from Sylhet. In the production phase, essential actors include pattern makers, production workers, and consultants, and quality testing is conducted by KUET, BUET, and JUST. Forward linkages involve transportation services, wholesalers, retailers, and end users, such as agricultural machinery manufacturers and farmers, who manage the distribution of foundry products.

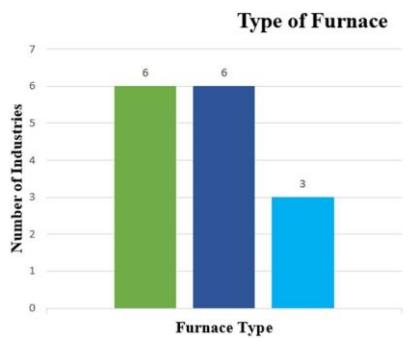


Figure 1: Current Scenario of Jashore LE industry.



Figure 2: Current Scenario of Jashore LE industry.

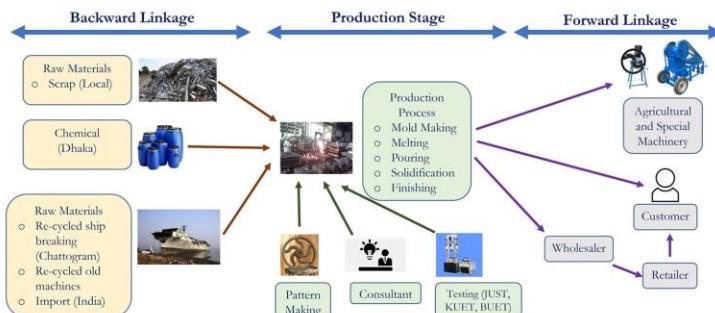


Figure 3: Current scenario analysis with value chain map.

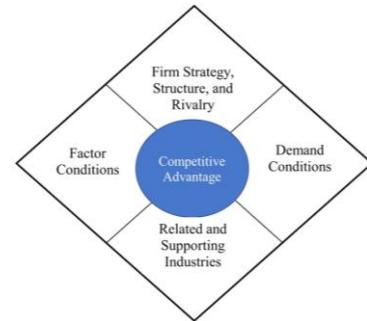


Figure 4: Current scenario analysis with Porter's Diamond Model.

From the SWOT analysis, Strengths include high demand and local availability of raw materials. Weaknesses involve a lack of skilled pattern makers, testing facilities, and marketing. Opportunities exist in developing skilled labor and improving quality for exports, while threats include scarcity of high-grade steel, high employee turnover, and lack of expertise. Though Jashore Light Engineering Cluster holds significant potential, the adoption of new technology is slow. The workforce primarily relies on outdated methods and lacks knowledge in testing, heat treatment, and productivity enhancement. Moreover, there has been little effort to explore new markets or products. This study aims to identify technology and skill gaps while offering recommendations with various lean-kaizen-based approaches to address them and unlock the cluster's potential.

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Disparity in the Prevalence of Anemia Among Non-Pregnant Women in 49 Low- and Middle-Income Countries from 2011-2021

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Anemia, Non-Pregnant Women, Socioeconomic Inequality, Education-Based Inequality, Low- and Middle-Income Country.

Extended Abstract

Background: Globally, one-third of all women of reproductive age are anemic [1]. While some studies have monitored socioeconomic inequalities in anemia prevalence in low- and middle-income countries (LMICs), they have often been limited to single countries or have only considered household wealth index at the national level [2,3]. This study aims to assess within-country socioeconomic and education-based inequalities in anemia prevalence among non-pregnant women.

Method: Data from 49 Demographic and Health Surveys conducted in LMICs from 2011 to 2022 were analyzed. The weighted prevalence of anemia in each country was estimated and then disaggregated by wealth quintiles and educational status. The slope index of inequality (SII) was used to assess socioeconomic and education-based inequality in anemia.

Results: Anemia prevalence varied significantly across countries, ranging from 11.3% in Rwanda to 70.0% in Yemen. Wealth-based absolute inequality in anemia prevalence was pro-poor (higher prevalence among the poor) in 32 countries (Fig. 1). The highest level of inequality was observed in Burundi, where anemia prevalence was 32 percentage points higher among disadvantaged women compared to wealthy women. Conversely, pro-rich inequality (higher prevalence among the rich) was most pronounced in Honduras, with a 22-percentage point difference. Education-based inequalities showed higher anemia prevalence among less-educated women in most countries.

Conclusion: This study highlights substantial socioeconomic and education-based inequalities in anemia prevalence among non-pregnant women in LMICs. Country-specific, effective interventions are needed to reduce the anemia burden and address these inequalities.

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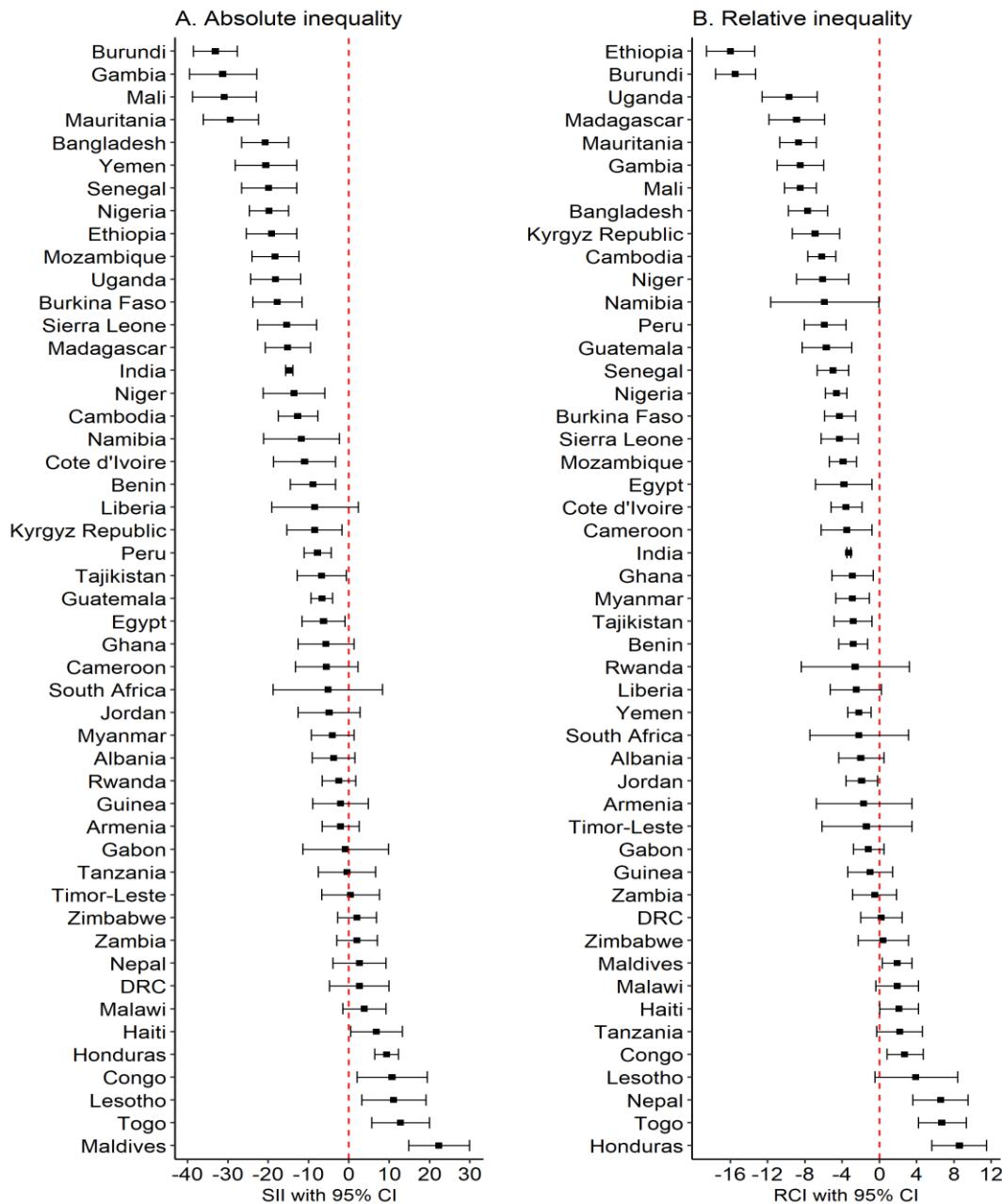


Figure 1: Wealth-based absolute and relative inequality in the anemia prevalence among women at the national level.

(DRC = Congo Democratic Republic, SII = Slope index of inequality, and RCI = Relative concentration index)

Numerical Modeling of a Coastal Lagoon in Japan: Prospects for Sustainable Development in Bangladesh

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Track: Natural Sciences, Engineering, and ICT

Keywords: Numerical Modeling, Coastal Lagoon, Climate Change, SDG, Aquaculture.

Extended Abstract

Coastal areas, vital for both biodiversity and fisheries, are increasingly threatened by climate change, sea level rise, and human activities. In response, Sustainable Development Goal 14 (SDG 14), "Life Below Water," focuses on conserving marine ecosystems and promoting the sustainable use of marine resources. Lake Tofutsu, a coastal lagoon on the Sea of Okhotsk in Japan, exemplifies the abovementioned balance. Recognized for its ecological value under the Ramsar Convention, the lake's brackish water supports biodiversity and serve as a key site for cultivating brackish water clams (*Corbicula japonica*), a crucial species in Japan's inland fisheries. With natural clam populations declining, sustainable artificial aquaculture in Lake Tofutsu has become increasingly important. To support this, a numerical hydrodynamic model, the Lagoon Environment Pollution Dynamics Model (LEPUM) [1], is being developed. The primary objective of developing this model is to understand the dynamic behavior of water quality parameters and their impact on the lake's ecosystem in the context of climate change and upstream influences, such as sediment deposition. This understanding enables practical solutions for aquaculture management within the lake and helps identify the need for upstream interventions to control excessive sedimentation. Ultimately, this supports the conservation of the lagoon ecosystem in alignment with the SDG.

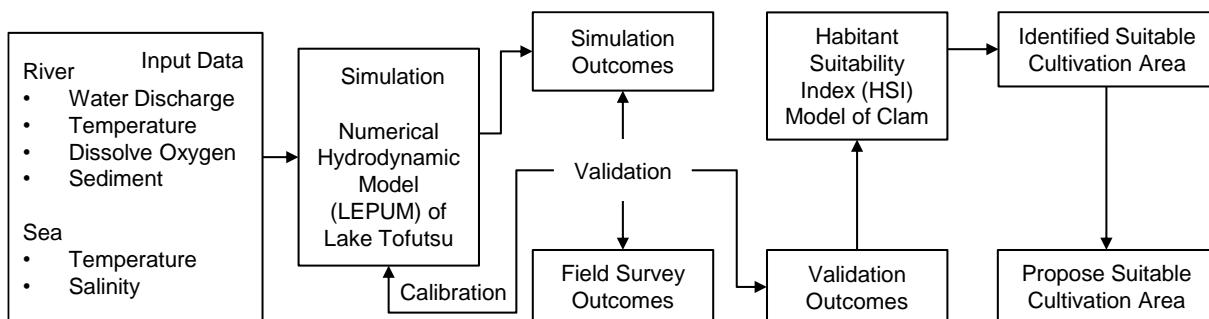
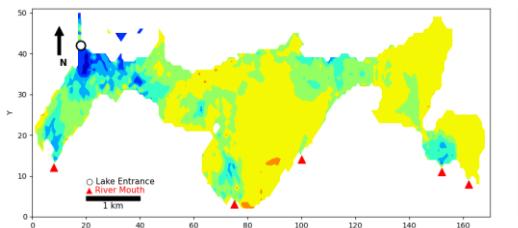
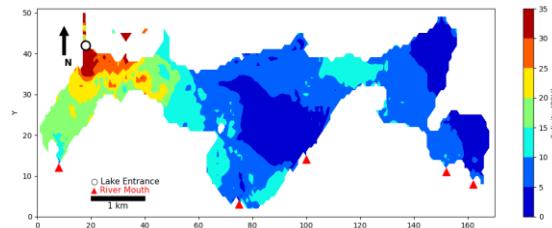


Figure 1: Research method for proposing suitable clam cultivation area.

As shown in Fig. 1, LEPUM simulates salinity, water temperature, and other environmental factors in the lake. The simulated outcomes are validated against real-life data and integrated

**Figure 2: Spatial Distribution of Temperature.****Figure 3: Spatial Distribution of Salinity.**

with the Habitat Suitability Index (HSI) model for clams, facilitating the identification of suitable aquaculture areas.

Since lake temperature and salinity are critical for understanding suitable clam habitats, the LEPUM model currently incorporates sea water temperature, river water temperature, and sea water salinity to simulate these conditions in the lake. Additionally, local weather data (wind speed, solar radiation, rainfall, heat flux, tidal action, seasonality, and alike) have been used to establish proper boundary conditions. The simulation results provide the spatial distribution of temperature and salinity within the lake, helping to assess how these inputs influence the lake's environmental conditions. For instance, Figs. 2 and 3 illustrate the water temperature (T , $^{\circ}\text{C}$) and salinity (S , PSU) distributions at surface layer of the lake in May 2017, respectively. T ranges from 5 to 24°C and S varies between 0 and 30 PSU. This variability means the suitability of clam habitats may change over time due to climate factors given that the optimal T and S for suitable habitation are $23.1\text{--}26.5^{\circ}\text{C}$ and 2–8 PSU [2], respectively. This way, the model provides valuable insight into the spatial variability of suitable habitats across the lake. Furthermore, such model outcomes will be incorporated into the HSI model to pinpoint the best areas.

The findings from this study offer insights into how climate change affects suitable habitats for aquaculture. Bangladesh faces similar challenges, with numerous canals and tidal ponds where saline water from the Bay of Bengal enters. Issues such as fluctuating salinity, water temperature, pH, heavy rainfall, and river siltation cause widespread damage to aquaculture (shrimp, crab, and carp habitats), including breeding ground destruction [3]. As such, this study offers an insightful approach for enhancing the resilience of aquaculture in Bangladesh in the face of climate-related impacts.

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Comparison of Conventional Methods for Manufacturing Process Optimization

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Track: Natural Sciences, Engineering, and ICT

Keywords: Machining Process, CV-EV-Centric Data, Analysis, ANOVA, Optimization.

Extended Abstract

Optimization of machining processes is essential to achieve high productivity and maintain product quality [1]. To accomplish this, certain variables are designated as Evaluation Variables (EVs) while others are selected as Control Variables (CVs). Experiments are conducted by varying the states of the CVs, and the corresponding values or states of the EVs are recorded. Subsequently, the relationships between CVs and EVs [2] are established using an appropriate data analysis method. These relationships help optimize the machining processes. In this regard, various methods, e.g., data visualization, denoted as M₁, calculation of mean and standard deviation, denoted as M₂, and analysis of variance (ANOVA), denoted by M₃, to name a few, have been used. In this study, these methods (M₁, M₂, and M₃) are used. The relevant datasets are collected from [3] for a manufacturing process called rotary ultrasonic machining for drilling precision holes in a workpiece made of Ti6Al4V. The sets of CVs, EVs, and datasets are presented in Tables 1, 2, and 3, respectively. The results of the data analysis for M₁, M₂, and M₃ are displayed in Tables 4, 5, and 6. Tables 4 and 5 provide the optimal states of the corresponding CVs for each EV, while Table 6 presents the p-values (ANOVA) for each CV-EV combination. In some cases, the results are consistent across different data analysis methods, whereas in others, the outcomes vary depending on the method used. For instance, as shown in Tables 4 and 5, ultrasonic power (P) = 40% should be used instead of 20% to minimize FC. However, for OE, the optimal P differs: P = 20% in Table 4 and 40% in Table 5. On the other hand, ANOVA results from Table 6 show that the levels of P (20 and 40%) are indifferent to minimize for FC, TW, OE, and CE while S (refers to spindle speed) plays a significant role to minimize the above EVs except TW. In addition, f has no effect on EVs except FC.

Table 1: Setting of CVs.

CVs	Levels		
	1	2	3
Ultrasonic power (P, %)	20	40	
Feed rate (f, mm/min)	0.1	0.6	
Spindle speed (S, rpm)	2000	4000	6000
Tool diameter (D, mm)	3.97	5.9	8.9

Table 2: Setting of EVs.

EVs	Objective
Cutting Force (FC, N)	Minimization
Tool Wear (TW, mg)	
Overcut Error (OE, mm)	
Cylindrical Error (CE, mm)	

Table 3: Experimental Datasets (CV-EV-Centric Datasets).

Exp. No.	P [%]	f [mm/min]	S [rpm]	D [mm]	FC [N]	TW [mg]	OE [mm]	CE [mm]
1	20	0.1	2000	3.97	97.32	2.8	0.28	0.0463
2	20	0.1	2000	5.9	67.58	0.9	0.25	0.0251
3	20	0.1	2000	8.9	30.2	4.5	0.18	0.0152
...								
36	40	0.6	6000	8.9	69.55	24.5	0.19	0.0078

Table 4: Results of M₁.

CVs	Level	EVs			
		Objective: Minimization			
		FC [N]	TW [mg]	OE [mm]	CE [mm]
Optimal State of CVs					
P [%]	20	40	20	20	20
	40				
f [mm/min]	0.1	0.1	0.1	0.6	0.1
	0.6				
S [rpm]	2000	6000			
	4000		2000	6000	6000
	6000				
D [mm]	3.97	5.9			
	5.9		3.97	8.9	8.9
	8.9				

Table 5: Results of M₂.

EVs			
Objective: Minimization			
FC [N]	TW [mg]	OE [mm]	CE [mm]
Optimal State of CVs			
40	20	40	20
0.1	0.1	0.6	0.1
6000	2000	6000	6000
5.9	3.97	8.9	8.9

Table 6: Results of M₃.

EVs			
Objective: Minimization			
FC [N]	TW [mg]	OE [mm]	CE [mm]
p-value if p < 0.05 then CV is significant			
0.913	0.618	0.229	0.644
0.001	0.127	0.239	0.178
0.014	0.268	0.006	0.001
0.169	0.195	0.459	0.016

In conclusion, the methods sometimes yield similar results, while at other times, they differ due to unique perspective, providing valuable insights into the CV-EV relationships. Therefore, integrating them into a holistic method might facilitate effective understanding and optimization of a process. Developing such a method will be a key focus of future research.

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Hybrid Energy-Based Battery Storage Swapping Station for Electrical Vehicles and Net Metering in Bangladesh

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Track: Natural Sciences, Engineering, and ICT

Keywords: Electric Vehicles (EV), Net Metering, Charging Swapping Station, Cost Effective, Homer Pro.

Extended Abstract

The Conventional EV charging techniques rely heavily on fossil fuels, which can hurt the environment and strain the grid, limiting access to charging. To facilitate widespread use of electric vehicles (EVs), a robust and dependable charging infrastructure is crucial. Local electrical systems are under pressure, prompting the use of cost-effective renewable energy sources such as solar power. This article intends to pioneer sustainable energy infrastructure and battery swapping stations for EVs using new methodologies. The proposal involves integrating photovoltaic (PV) panels, energy storage devices, and advanced net metering techniques to effectively gather and store solar energy on-site. This stored energy can subsequently be used not only to charge EVs batteries , but also to maintain grid stability via net metering, supporting a more sustainable and robust charging infrastructure. The effectiveness and functionality of hybrid energy-based EV swapping stations are evaluated using HOMER software. The solar PV system, grid, and bidirectional converter with battery storage contribute to the proposed configuration. HOMER software is used for evaluating the variance of various costs, including net present cost (NPC), initial cost, and cost of energy (COE) for solar PV systems.

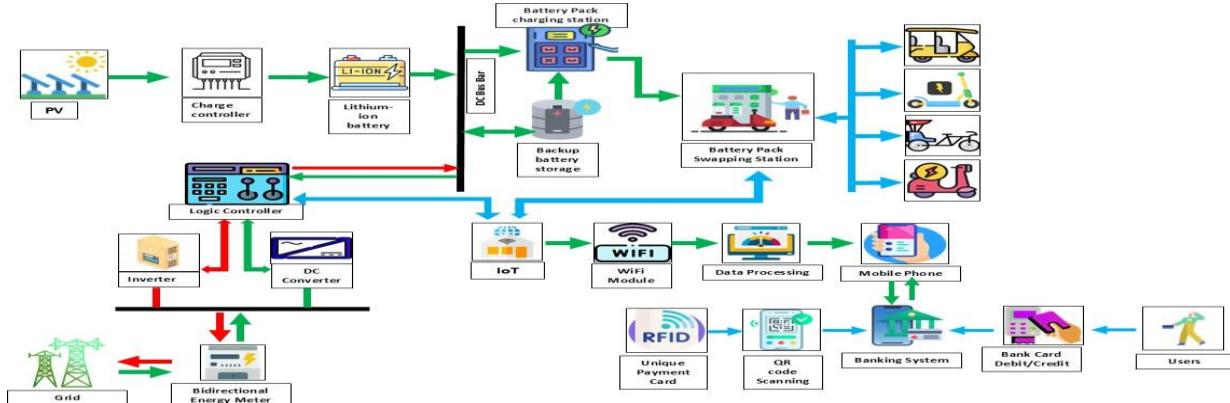


Figure 1: Block diagram of Battery Storage Swapping Station for Electrical Vehicles and Net Metering.



Figure 2: Hardware model of the device.

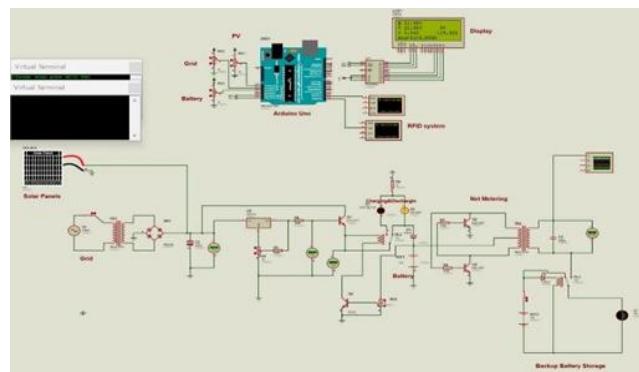


Figure 3: Simulation Schematic for proposed design.

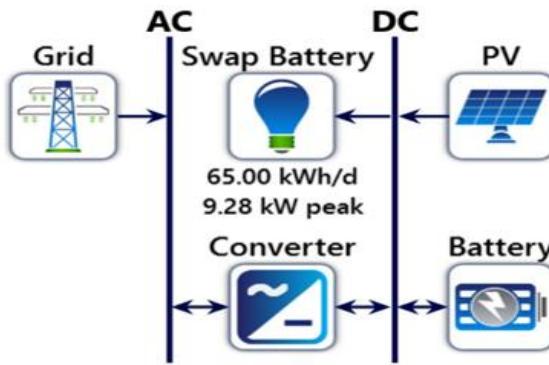


Figure 4: The proposed solar and grid-based hybrid swapping charging system.

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Role of Circulating Amino Acids and Gut Microbiota in Health and Healthy Ageing

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Circulating Amino Acids, Gut Microbiota, Health, Biomarkers.

Extended Abstract

Amino acids circulate abundantly in the blood, acting as essential mediators across all organ systems. Variations in these circulating amino acids significantly impact physiological processes, playing critical roles in the onset and progression of various diseases [1]. Studies suggest that amino acid profiles can serve as biomarkers for disease prediction, diagnosis, and response to therapies. However, findings on the roles of circulating amino acids in disease are often inconsistent, highlighting the need for further research.

Gut microbiota regulates vital health functions, including metabolism, digestion, and immune modulation. Dysbiosis—an imbalance in the gut microbiota—is associated with a wide range of health disorders, including metabolic, cardiovascular, and neurological diseases. Recent studies emphasize complex interactions between amino acids and gut microbiota, indicating a symbiotic relationship. We propose that interventions such as exercise and diet may beneficially modulate gut microbiota and amino acid profiles, supporting disease prevention and promoting healthy aging.

Our research, involving approximately 9,000 participants across various age groups, aimed to clarify associations between circulating amino acids and diseases such as diabetes, hypertension, and metabolic syndrome, which are becoming increasingly prevalent. In a recently completed cohort study, we attempted to explore potential links between gut microbiota, amino acids, and changes in physical, physiological and neurological functions among elderly individuals. To measure, plasma free amino acid (PFAA) levels, we used high-performance liquid chromatography coupled with electrospray ionization-mass spectrometry. Gut microbiota was analyzed through shotgun metagenome sequencing of collected stool samples.

Our findings (Fig. 1) indicate that specific profiles of plasma-free amino acids (PFAAs) are associated with lifestyle-related diseases (LSRDs) [2]. We identified distinct patterns of PFAA alterations linked to hyperuricemia within LSRDs, which we refer to as the ‘amino-uric interaction.’ Additionally, we observed positive associations between branched-chain amino acids (BCAAs) and hypertension [3], as well as significant correlations of isoleucine, leucine, and phenylalanine with reduced kidney function [4]. Data analysis from our cohort study is ongoing, and we anticipate sharing the results at JBRP 2024. This research could offer valuable insights into the interplay between gut microbiota, amino acids, and healthy aging, potentially informing the usefulness of new interventions to enhance health and promote longevity.

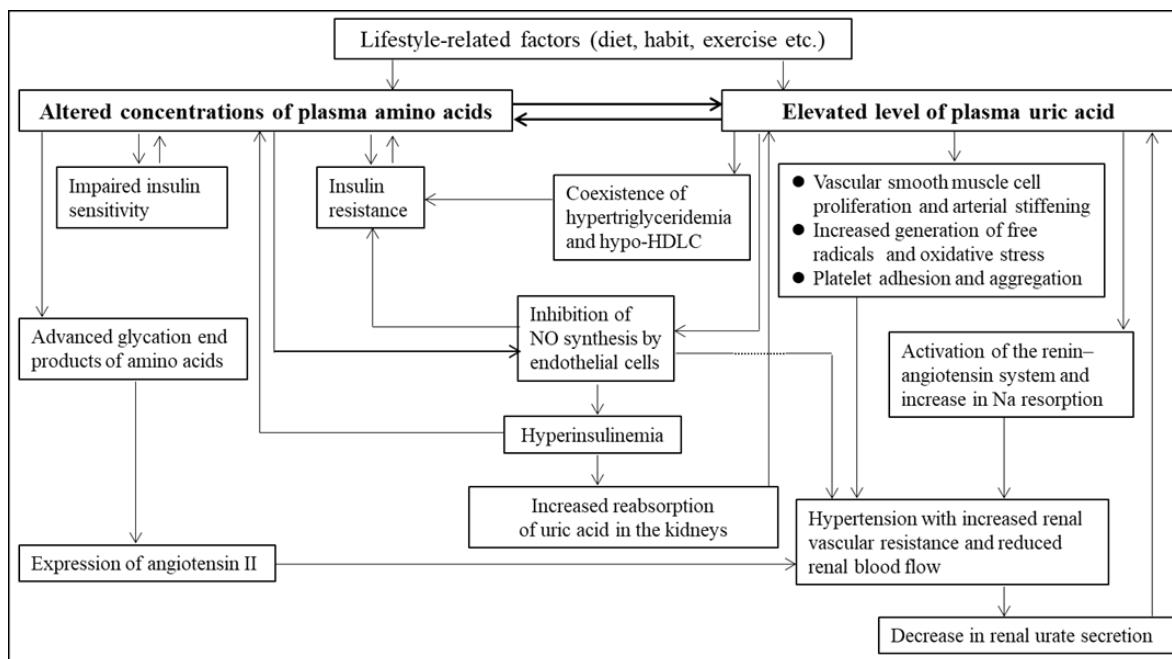


Figure 1: Schematic diagram of probable causes and consequences of altered plasma levels of amino acids and uric acids [2].

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Facial Emotion Recognition Using Custom CNN Model: A Comparative Analysis on FER-2013 Dataset

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Track: Natural Sciences, Engineering, and ICT

Keywords: Facial Emotion Recognition, Human-Machine Collaboration, Deep Learning, CNN, Comparison.

Extended Abstract

The successful implementation of Facial Emotion Recognition (FER) has become integral to enhancing Human-Machine or Human-Robot Collaboration (HMC/HRC), a significant feature in smart manufacturing environments. A FER system enhances other manufacturing systems by assessing human emotional states, and thereby improving worker safety, task efficiency, dynamic training and adaptation, as well as adaptive responses during manufacturing [1]. Among many, the FER-2013 dataset includes 35,883 grayscale images, each 48x48 pixels in size, representing seven (7) emotion categories: disgust, fear, anger, happiness, surprise, sadness, and neutral. In this dataset, class imbalance and expression variability, particularly in emotions like “disgust” and “surprise,” present challenges to achieving high accuracy compared to other datasets.

Several pre-trained deep learning models (MobileNetV2, ResNet50, DesneNet121, and alike) have been applied to the FER-2013 dataset, as shown in Table 1. MobileNetV2 has 53 layers that basically use ReLU6 activation [2], while ResNet-50 has 50 layers with residual connections [2]. DenseNet121 has 121 layers that connect each layer feed-forwardly [2]. In addition, other custom CNN models like CLCM, FERC, and DCNN (see Table 1), have demonstrated competitive results in recognizing facial emotions in FER-2013 [2, 3].

Table 1: Accuracy of various deep learning models on FER-2013.

Model	Accuracy	Model	Accuracy
MobileNetV2 [2]	68.62%	DCNN [3]	65.68%
FERC [2]	54%	CLCM [2]	63%
ResNet-50 [2]	60%	DeenseNet121 [2]	59%

This study aims to develop a custom CNN model with residual block optimization using hyperparameters (L2 regularization, dropout, and learning rate) for better accuracy in recognizing FER-2013 emotions.

For this, the dataset was extensively augmented after data preprocessing, which involved normalizing pixel values to [0,1]. The custom CNN model consists of 53 layers: one convolution block, three residual blocks, and four fully connected layers. All the layers deploy ReLU activation, except the output layer which uses Softmax. Training was performed with a 32-batch size and 0.0001 learning rate, optimized by cosine annealing with AdamW optimizer. Techniques such as LearningRateScheduler, ModelCheckpoint, ReduceLROnPlateau, and EarlyStopping ensured smooth training via Kaggle’s GPU. Additionally, an AdaBoost classifier was used to extract the features from the CNN.

Fig. 1 shows that the model achieved 84.6% training accuracy and 81% testing accuracy. The model-achieved precision is 81.22%, recall at 80.89%, and F1-score of 81.45%. Fig. 2 shows that the model performs well in recognizing emotions called disgust, happiness and surprise. Compared to the models listed in Table 1, the custom CNN with residual blocks shows superior performance in these areas.

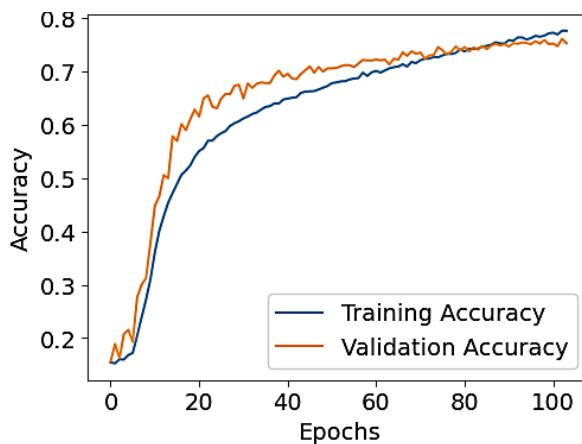


Figure 1: Model Accuracy.

		Predicted Label						
		Anger	Disgust	Fear	Happy	Sad	Surprise	Neutral
True Label	Anger	341	9	28	6	54	6	67
	Disgust	0	537	0	0	0	0	0
Happy	Fear	60	0	258	7	74	40	35
	Sad	10	1	8	474	13	10	30
Neutral	Surprise	49	8	34	11	292	6	122
	Neutral	9	1	20	11	5	433	8
		Anger	Disgust	Fear	Happy	Sad	Surprise	Neutral
		23	2	25	30	50	10	372

Figure 2: Confusion Matrix.

In conclusion, the custom CNN model developed in this study shows significant performance in FER compared to the traditional models. As such, the model holds promise for effective HMC/HRC in smart manufacturing environments. Future works will involve testing the model with real-time manufacturing shop floor data to evaluate its practical usability. The Monte Carlo Cross-validation (MCCV) will also be employed to verify its consistency and stability. Further enhancement might be considered to improve generalization ability, involving diverse datasets.

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Egg Immunoglobulins (IgY): Novel Sustainable Nanotechnology Applications in One Health

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: One Health, Immunoglobulin Y, Diagnostics, Prophylaxis, Immunotherapy.

Extended Abstract

Egg immunoglobulin (IgY) Abs is a non-invasive technology obtained from egg yolks of immunized hens. IgY-technology is an innovative sustainable method, that has been widely used during the last decades, in research and developing solutions for immunodiagnosis, immunoprophylaxis, and immunotherapeutics of human and animal diseases due to its many attractive advantages over mammalian serum immunoglobulins (IgG) regarding productivity, animal welfare, and specificity. Such advantages include: 1. being more powerful (4-5 times higher binding avidity) against pathogens; 2. not reacting with the human complement system and human Fc-receptors (due to structural differences and phylogenetic distance) thereby preventing non-specific inflammation (i.e. safer); 3. large-scale production possible; 4. easy to produce specific IgY against any antigens by immunizing layer chickens; Removes only pathogenic microbes not affecting normal microflora (unlike antibiotics); 5. is effective against virus infection (unlike antibiotics); 6. has no resistance problem; 7. is safe as natural dietary egg component; and 8. is user-friendly and eco-friendly [1].

Recent advances in the sustainable development and use of IgY and nanomedicine show good properties in One Health (diagnostic, prevention and treatment etc.) program applications. Many research groups have demonstrated that IgY is active against several pathogens or conditions, a fact that may support the design of novel, safe, and effective health products. Amazing advances in IgY technology align with several sustainable development goals, notably SDG 3 (Good Health and Well-Being), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 17 (Partnerships for the Goals), creating opportunities for developing countries to effectively tackle health challenges. Therefore, the policy recommendations adopted under United Nations (un.org) to provide an outline of empirical facts as well as a prospective work related to IgY-technology and the oral administration of egg yolk antibodies as prophylaxis and therapy in a wide range of infectious and non-communicable diseases [2].

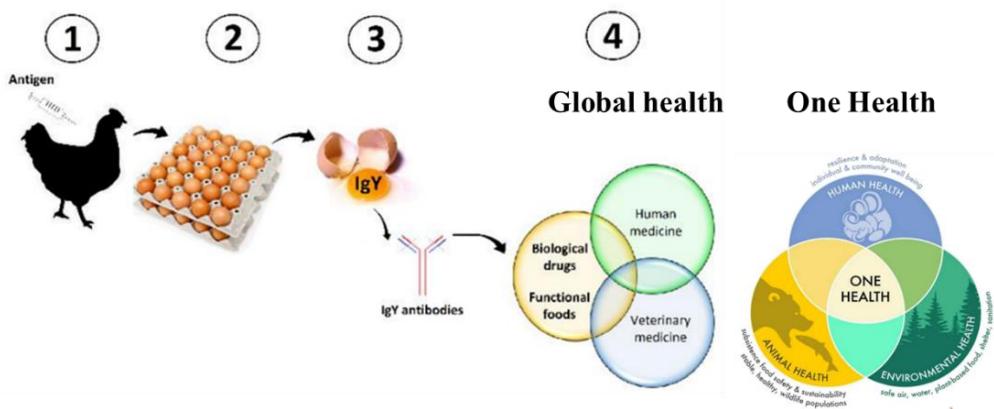


Figure 1: Overview of IgY production and its applications in health. (1) Chicken immunization, (2) Egg collection, (3) IgY purification, and (4) Formulation of IgY-based product [2, 3].

Moreover, nanotechnology has opened exciting avenues in drug delivery, particularly for biologics like IgY. The combination of IgY technology and nanotechnology offers innovative biosensors applicable in both human and veterinary medicine. Recent studies have demonstrated IgY's high sensitivity and specificity in immune diagnostics, showcasing its impressive pathogen-capturing capabilities. Additionally, the development of nanocomposites holds significant promise for the oral administration of IgY, enhancing stability, bioavailability, and targeted delivery. These advancements could lead to more effective therapeutic strategies against various pathogens. Continued research and development will be crucial in addressing existing challenges and unlocking the full potential of these innovative approaches [4].

In conclusion, the integration of sustainable development goals with nanotechnology applications of egg immunoglobulins (IgY) offers innovative solutions to pressing global health challenges. IgY, derived from the yolks of immunized hens, presents numerous advantages over traditional mammalian immunoglobulins, including higher binding avidity, non-reactivity with human complement systems, and a robust safety profile as a natural dietary component. Its ability to specifically target pathogens while preserving beneficial microflora underscores its potential as a safer alternative to antibiotics. By taking advantage of these leading-edge technologies, we can pave the way for safer, healthier communities and contribute to a more sustainable and harmonious world.

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Shuttling of Drugs in Ionic Liquid-Water Biphasic System

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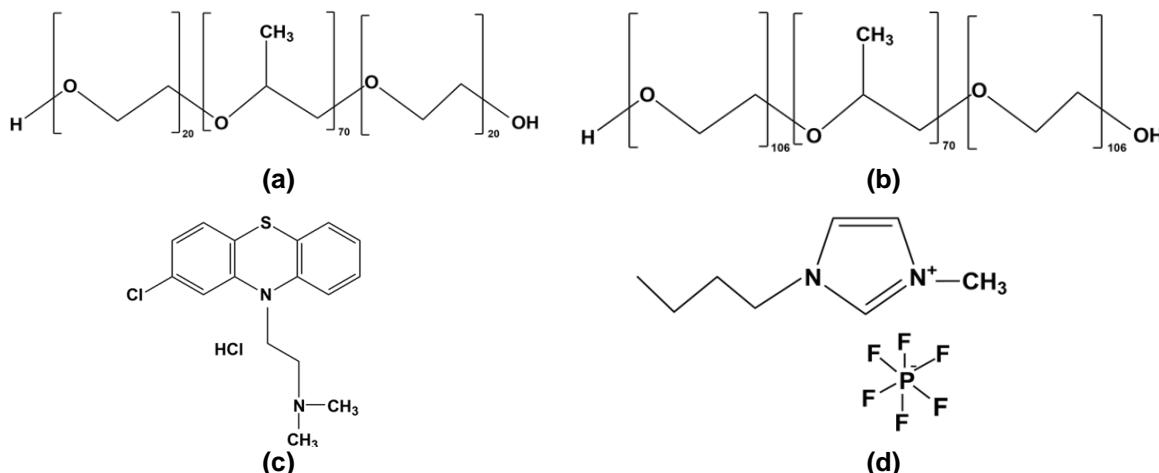
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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Pluronic, Micellar Shuttle, Thermal Switching, Supramolecular System, Chlorpromazine.

Extended Abstract

The selective aggregation behavior of amphiphilic molecules is of immense interest in developing smart material system based on supramolecular host-guest architecture. The systems are actively investigated mostly as extraction media for insoluble organic products [1], drug delivery system, nanoreactors, and so on. Apparently, block copolymers containing poly(ethylene) (PEO) and poly(propylene) (PPO) blocks have thermosensitive characteristics [2]. In this work, solution behavior of triblock copolymers (Pluronic P123 and F127) are studied in aqueous and an hydrophobic ionic liquid (IL), 1-butyl-3-methylimidazolium hexafluorophosphate [C_4mim]PF₆ (Scheme 1).



Scheme 1: Structure of materials used (a) Pluronic P123, (b) Pluronic F127, (c) Chlorpromazine, and (d) 1-butyl-3-methylimidazolium hexafluorophosphate.

The temperature-dependent aggregation behavior has been studied using dynamic light scattering up to 65 °C. The hydrodynamic diameters of Pluronic was found to increase linearly with temperature from (~10-30 nm) in IL with a sudden drop at ca. 45 °C in aqueous phase. The different LCST behavior of the poly(ethylene) block in water and ionic liquid gave a notion that the aggregates formed by the surfactants may act as a carrier of drug; that is to be switched in the biphasic system under thermal perturbation.

The interaction of another amphiphilic drug chlorpromazine is also manifested in the aggregation behavior. Chlorpromazine itself can act as a molecular probe. The redox reaction of the probe is a one electron process at neutral pH and follow simple heterogeneous kinetics at low scan rates. The concept of electrochemical switching was applied to transfer the drug from one phase to another based on the accumulation and depletion of charge from the micellar core of the Pluronic. The successful thermal switching was observed at temperature of 60 °C using P123 as the carrier of the drug (Fig. 1).

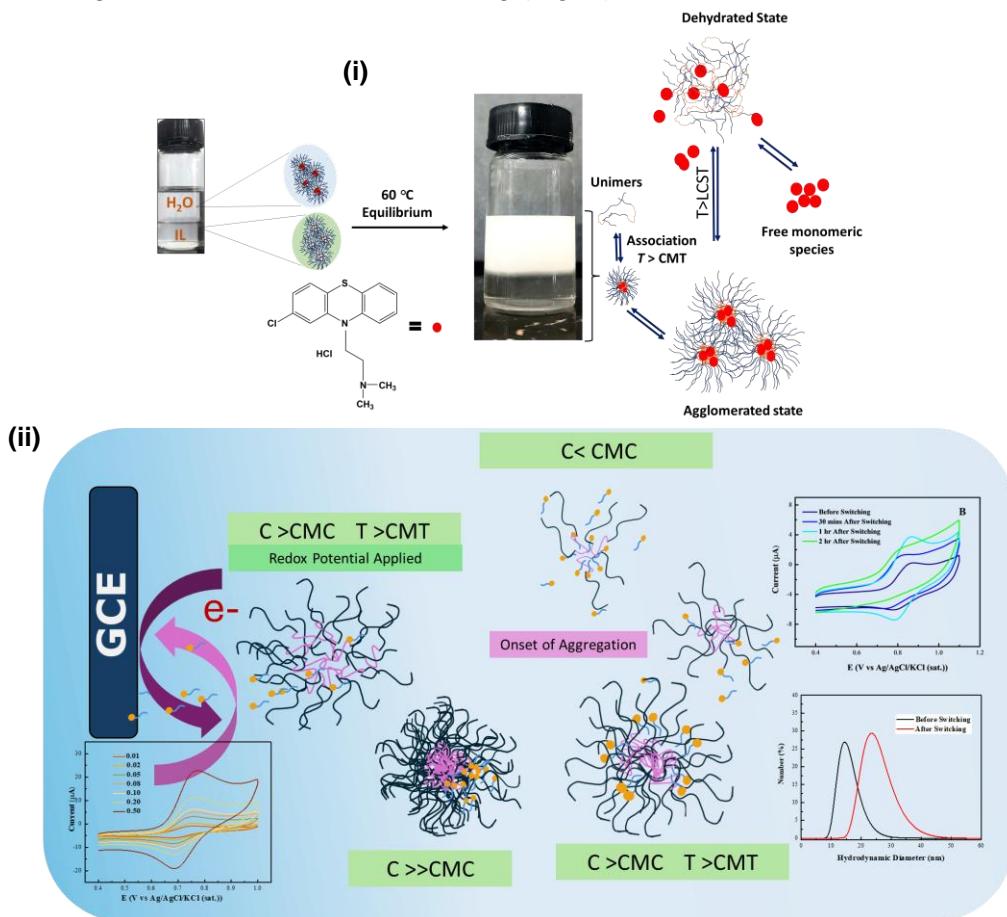


Figure 1: Tentative illustration of molecular events occurring during (i) thermal switching and (ii) electrochemical switching.

The successful switching is ascertained from the increment of hydrodynamic diameter, scattering light intensity and change of the reduction current in aqueous phase. The study can be regarded as an initiation to unlock the potential of micellar shuttle as a switching system used for delivering hydrophobic drugs from aqueous to hydrophobic environment.

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Tuning Morphology and Electrocatalytic Activity of Cobalt Ferrite Magnetic Nanoparticles Using Ionic Liquids and Double Salt Ionic Liquids as Soft Templates

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Track: Natural Sciences, Engineering, and ICT

Keywords: Cobalt Ferrite, Ionic Liquids, Double Salt Ionic Liquids, Oxygen Evolution Reaction.

Extended Abstract

A bottom-up strategy following a template-based approach to synthesize CoFe_2O_4 nanoparticles (NPs) has been a better way to obtain control over morphology and electrocatalytic activity [1]. Ionic liquids (ILs), can control morphologies and be utilized as a soft template to prepare CoFe_2O_4 NPs.

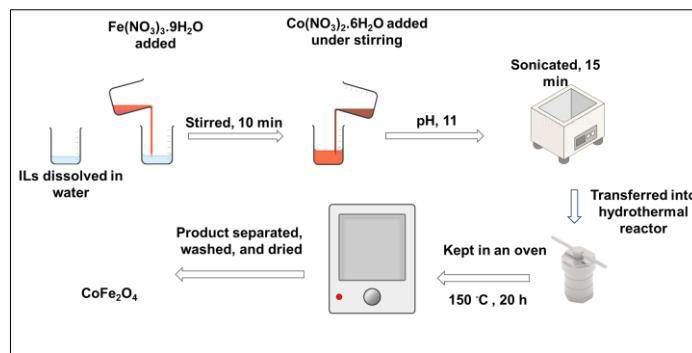


Figure 1: Hydrothermal synthesis of CoFe_2O_4 .

Ghaemi et al. used octyl-4-aza-1-azoniabicyclo [2.2.2]octane bromide ($[\text{C}_8\text{dabco}]\text{Br}$) as a template to synthesize different shapes of CoFe_2O_4 by varying IL:Fe:Co ratios. ILs affect the resulting morphology and magnetic behavior by controlling the distribution of Co^{2+} cation in octahedral and tetrahedral sites [2]. CoFe_2O_4 magnetic NPs are known as efficient oxygen evolution reaction (OER) catalysts due to their improved catalytic activity and durability during electrochemical water splitting under alkaline conditions.

In this study, using a hydrothermal method, as shown in Fig. 1, magnetic CoFe_2O_4 NPs were synthesized from cobalt(II) nitrate hexahydrate and iron(III) nitrate nonahydrate. Two imidazolium-based ILs such as 1-ethyl-3-methylimidazolium trifluoromethanesulfonate ($[\text{C}_2\text{mim}]\text{CF}_3\text{SO}_3$) and 1-ethyl-3-methylimidazolium methanesulfonate ($[\text{C}_2\text{mim}]\text{CH}_3\text{SO}_3$), having common cation but different anions, were utilized as soft templates. Efforts have been made to identify the mechanism by which the presence of either F or H atoms in the structure of two anions impacts the resulting morphology of CoFe_2O_4 . Further optimization of the morphology and therefore, the magnetic, optical, and electrocatalytic properties has also been achieved through the use of the double salt ionic liquids (DSILs) $[\text{C}_2\text{mim}](\text{CH}_3\text{SO}_3)_x(\text{CF}_3\text{SO}_3)_{1-x}$ with different mole ratios.

Using energy dispersive X-ray (EDX) and Fourier transform infrared (FTIR) spectroscopy methods, the successful synthesis of CoFe_2O_4 NPs was verified. Fig. 2 shows, the shape of CoFe_2O_4 synthesized using $[\text{C}_2\text{mim}]\text{CF}_3\text{SO}_3$ varies from nanospheres to truncated cubic as

the concentration of IL changes. $[C_2mim]CH_3SO_3$ exhibits nanospheres and nanocubes with smoother surfaces. DSILs show nanospheres with narrower size distribution throughout the mole ratios. $[C_2mim](CH_3SO_3)_{0.3}(CF_3SO_3)_{0.7}$ yields smaller NPs, with an average particle size of 13 nm. Whereas, when synthesized without ILs, $CoFe_2O_4$ had a particle size of 84 nm. In contrast, smaller NPs with sizes of 19 and 16 nm were obtained for 0.30 M $[C_2mim]CF_3SO_3$ and $[C_2mim]CH_3SO_3$, respectively. This difference was seen as a result of their varying degrees of interaction with NPs. It was accomplished by restricting the growth of particles through the attachment of ILs to the surface of $CoFe_2O_4$ as shown in Fig. 3. Furthermore, different levels of IL concentration exhibit differences in the size of crystallites, which in turn impacts the observed magnetic, optical, and electrocatalytic activities. ILs also play a crucial role in regulating the distribution of cations between tetrahedral and octahedral sites. $[C_2mim]CF_3SO_3$ has a stronger affinity for Fe^{3+} compared to Co^{2+} due to the interaction between the Fe^{3+} ion and the $CF_3SO_3^-$ anion, which contains F. For example, 0.17 M $[C_2mim]CF_3SO_3$ produced $CoFe_2O_4$ with the highest coercivity (H_c) value of 1021 Oe. It also demonstrated the highest remanence (M_r) value of 28 emu g⁻¹, indicating a substantial saturation magnetization (M_s) value of 72 emu g⁻¹. All materials synthesized using $[C_2mim]CH_3SO_3$ show lower magnetic properties. This occurs due to the octahedral site's lower particle size and fewer Fe^{3+} .

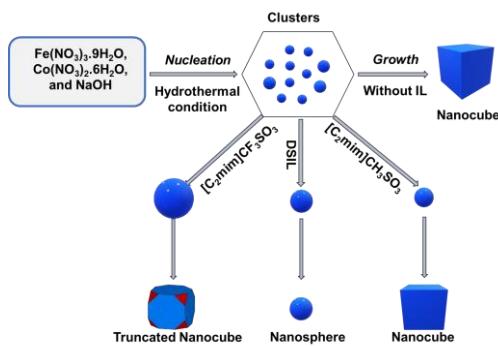


Figure 2: Schematic representation of various shapes of $CoFe_2O_4$ obtained with the variation of ILs.

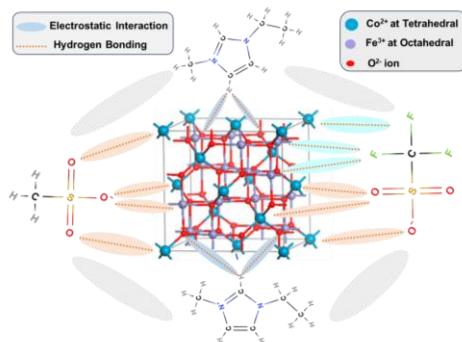


Figure 3: Schematic illustration of probable interaction of DSILs with $CoFe_2O_4$ in controlling morphology.

$CoFe_2O_4$ synthesized in DSILs displays a combination of high and low magnetic properties, showcasing its significant potential in optimizing magnetic properties for specific applications. The optical band gap energy exhibited a range of variation between 2.00 and 2.06 eV. $CoFe_2O_4$ synthesized using 0.45 M of $[C_2mim]CH_3SO_3$, owing to the improved magnetic properties, exhibits improved activity in the OER, which is demonstrated by a low onset overpotential of only 281 mV and a Tafel slope of 99 mV dec⁻¹. These show that ILs and DSILs can tune the structure of $CoFe_2O_4$ to produce optimized nanostructures and magnetic properties, which can enhance the OER activity.

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Composites of Polypyrrole, Reduced Graphene Oxide, and α-Manganese Dioxide with Ionic Liquid-Based Electrolyte for Dye-Sensitized Solar Cells

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Track: Natural Sciences, Engineering, and ICT

Keywords: Dye-sensitized Solar Cells (DSSCs), Platinum Counter Electrode, Ionic Liquids (ILs), Conducting Polymer Composites, Renewable Energy.

Extended Abstract

Conventional fossil fuels are limited, emphasizing the need for renewable energy. Dye-sensitized solar cells (DSSCs) offer a cost-effective, environmentally friendly solution. However, the high cost of platinum counter electrodes and volatile liquid electrolytes limits their efficiency [1-2]. This study explores alternatives like conducting polymer composites and ionic liquids to enhance performance and stability of DSSC.

Polypyrrole (PPy), reduced graphene oxide (rGO), α-Manganese Dioxide ($\alpha\text{-MnO}_2$), polyvinylidene fluoride (PVDF), and 1-butyl-3-methylimidazolium tetrafluoroborate ($[\text{C}4\text{mim}]\text{BF}_4^-$) were employed in the development of precursor materials and the polymer electrolyte, which incorporated an iodine-based redox mediator. The synthesis of PPy was accomplished through chemical polymerization, while rGO was generated using a modified Hummer's method, and $\alpha\text{-MnO}_2$ was produced via the hydrothermal approach.

Cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were applied to investigate the electrochemical properties of PPy and its binary and ternary composites with different composition of $\alpha\text{-MnO}_2$ and rGO. According to cyclic voltammetric studies, the charge transfer kinetics of the PPy electrode with 5% $\alpha\text{-MnO}_2$ and 10% rGO significantly increased. Also, the charge transfer kinetics of the ternary composite containing 15% rGO and 10% $\alpha\text{-MnO}_2$ was improved, indicating its better performance as a counter electrode (CE) material in DSSCs. Fig. 1 illustrates the cyclic voltammograms of the composites of PPy with varying $\alpha\text{-MnO}_2$ and rGO.

EIS measurements of the synthesized solid-state polymer electrolyte showed low bulk resistance of $25.17\ \Omega$ for the optimal composition, which enhanced the conductivity and stability of the electrolyte. Fig. 2 illustrates the EIS data showing the bulk resistance of the synthesized polymer electrolyte.

A cell was fabricated by using the standard techniques with the best performing materials, and the cell had been tested out under direct sunlight exposure which is illustrated in Fig. 3.

Huge variation in voltage indicates the successful preparation of the cell and the efficiency of the CE material with a solid-state polymer electrolyte. Further work is going on for performance testing of this fabricated solar cell.

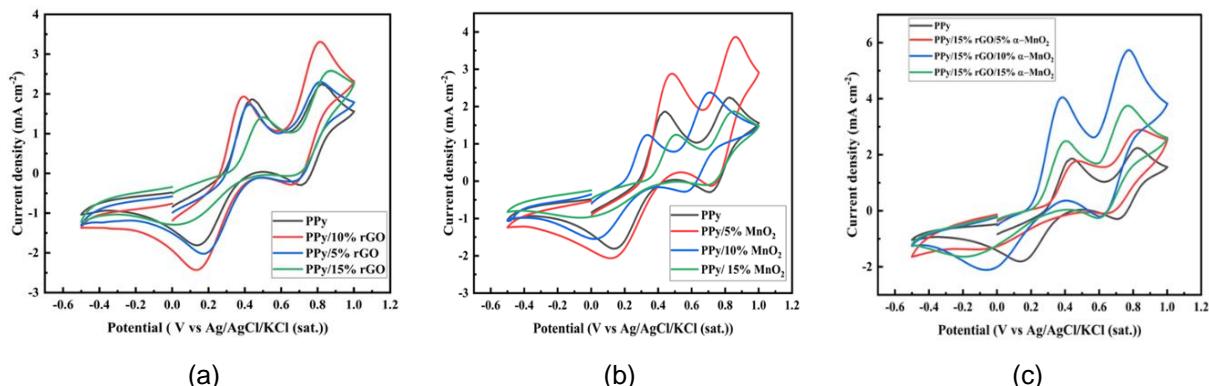


Figure 1: (a,b) Cyclic voltammogram of the binary and (c) ternary composites of polypyrrole with varying the composition of α -MnO₂ and rGO.

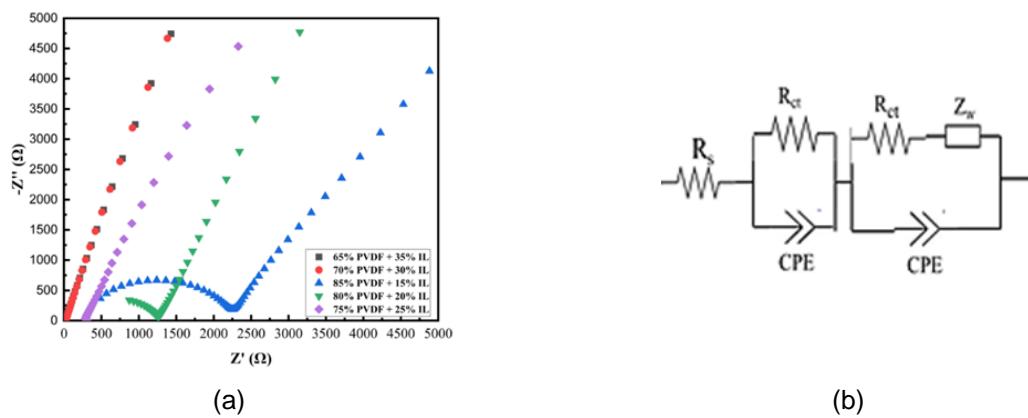


Figure 2: Nyquist plot and equivalent Randles circuit for the synthesized solid-state polymer electrolyte.

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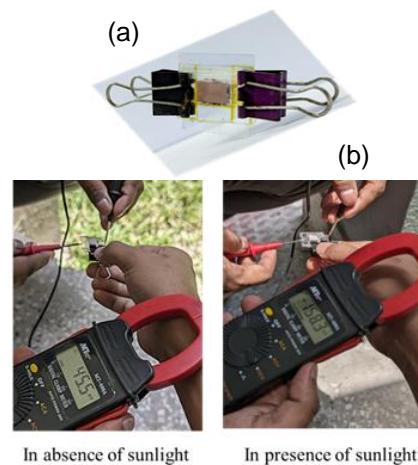


Figure 3: (a) Fabricated solar cells and (b) testing them in sunlight.

Development of a β -Cyclodextrins/Cationic Surfactants Based Supramolecular System: Interactions with a Phenothiazinyl Drug

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Track: Natural Sciences, Engineering, and ICT

Keywords: β -Cyclodextrin, Cationic Surfactants, Chlorpromazine, Binding Constant, Supramolecular Interactions.

Extended Abstract

The combination of β -cyclodextrins (β -CDs) and cationic surfactants has been studied for their formation of inclusion complex. This research examined interactions between β -CDs and four surfactants (C_nTAB ; $n=12, 14, 16, 18$) has been investigated using various experimental techniques, including surface tension measurements, UV-Vis spectroscopy, fluorescence spectroscopy, conductivity measurements, and cyclic voltammetry (CV). Longer alkyl chains strengthen hydrophobic interactions, with $C_{18}TAB$ having the highest binding constant (1840 M^{-1}) and $C_{12}TAB$ the lowest (100 M^{-1}). Phenothiazine (PTZ) and chlorpromazine (CPZ) also formed stable complexes, with CPZ displaying a higher binding constant due to its longer chain. The study also highlights the potential of β -CD-based systems for controlled drug delivery, especially for CPZ. The study demonstrates how β -CDs and cationic surfactants can form effective supramolecular systems for controlled drug delivery, with $C_{14}TAB$ showing enhanced drug release for CPZ in aqueous β -CD solutions. Finally, this work lays the foundation for the design of β -CD-based nanocarriers for drug delivery applications.

Supramolecular systems, known for their reversible and non-covalent interactions, provide a versatile platform for crafting functional materials with tailored properties [1]. Numerous interaction mechanisms, such as non-specific electrostatic contacts, π - π interactions, dispersion forces, hydrophobic forces, or more

particular binds like host-guest complex formation or “lock-and-key” binding, contribute to this process of supramolecular interactions [2]. CDs are cyclic oligosaccharides with hydrophobic interiors that can encapsulate various guest molecules, making them valuable in drug delivery systems. Common CDs like α -, β -, and γ -CDs consist of 6, 7, and 8 glucose units, with β -CDs being particularly useful due to their large cavity and low cost. CDs can form inclusion

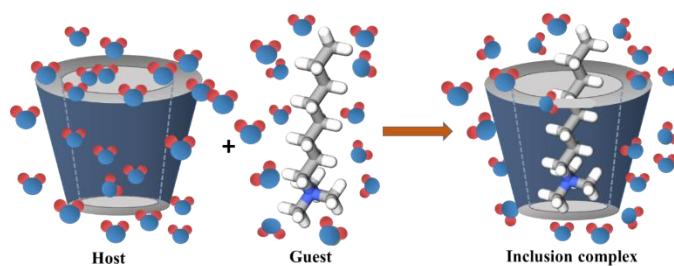


Figure 1: A schematic representation of host guest complex formed using hydrophobic interactions.

complexes with hydrophobic drugs, such as PTZ, improving solubility, stability, and bioavailability (Fig. 1). This research explores the interaction of β -CDs with cationic surfactants to enhance PTZ drug delivery [3]. By studying the thermodynamic parameters and binding constants, it was found that longer alkyl chains in surfactants exhibit stronger hydrophobic interactions.

It is observed that the surface tension of C_nTAB decreases in all cases, indicating their adsorption at air-water interface. However, β -CDs are surface inactive; the surface tension values of C_nTAB in the presence of β -CD are significantly different from the values obtained in absence of β -CD. This indicates the presence of inclusion complex between C_nTAB and β -CD in the aqueous solution according to the mechanism shown in Fig. 2. Based on all the observations obtained from different experiments, binding constants has been calculated and it has been found that longer alkyl chains in surfactants exhibit stronger hydrophobic interactions.

CV measurements show that adding cationic surfactants to an aqueous solution of PTZ and β -CDs increases the peak current intensity [Fig. 3]. This is due to the hydrophobic surfactants displacing PTZ from the β -CD cavity, enhancing its diffusion. Focusing on CPZ, electrochemical analysis identified $C_{14}TAB$ as the most effective surfactant for controlled release, with the release adjustable by varying surfactant concentrations. The study concludes that β -CD-cationic surfactant systems hold great potential for improving the delivery and efficacy of phenothiazine drugs, paving the way for optimized pharmaceutical formulations.

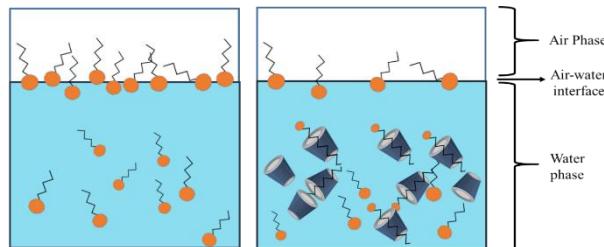


Figure 2: Behavior of surfactants (a) in absence of β -CDs and (b) in presence of β -CDs.

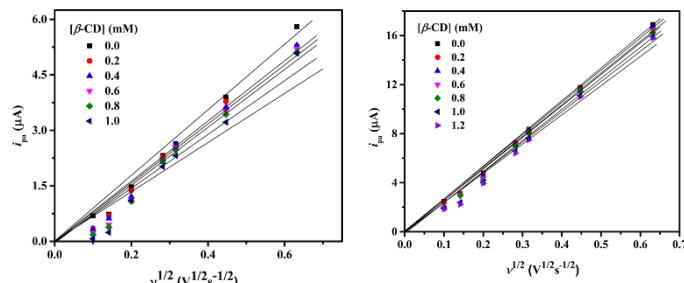


Figure 3: Anodic peak current vs. square root of scan rate of 0.5 mM PTZ and CPZ in 0.10 M KCl aqueous solution at different concentration of β -CDs.

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Plant Microbial Fuel Cells: A Potential Solution to the Green Energy Problem in Bangladesh

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Track: Natural Sciences, Engineering, and ICT

Keywords: Bioelectricity, Plant Microbial Fuel Cells, Green Energy, Tree.

Extended Abstract

Plant Microbial Fuel Cells (PMFCs) are a novel technology in which living plants can generate green electricity with the help of soil microbes. It can act as an ecological solar cell and hence it is a renewable energy source with zero carbon emissions. In short, the mechanism of the PMFCs is that, due to photosynthesis, the green leaves produce carbohydrates (sugar), and almost 70% of it is released in the root zones. The bacteria that live near the root zone break it and hence generate electrons. The electrodes and external circuit enable the electrons to flow and generates the bioelectricity. In our research, almost all different types of trees/plants show the potential for bioelectricity generation. The main benefits of these PMFCs are to get green energy and food from the plants simultaneously. So, we do not need to destroy food products such as corn or soybeans to get green energy.

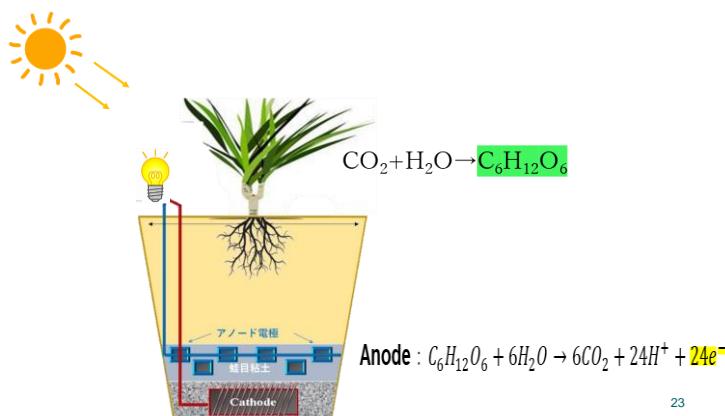
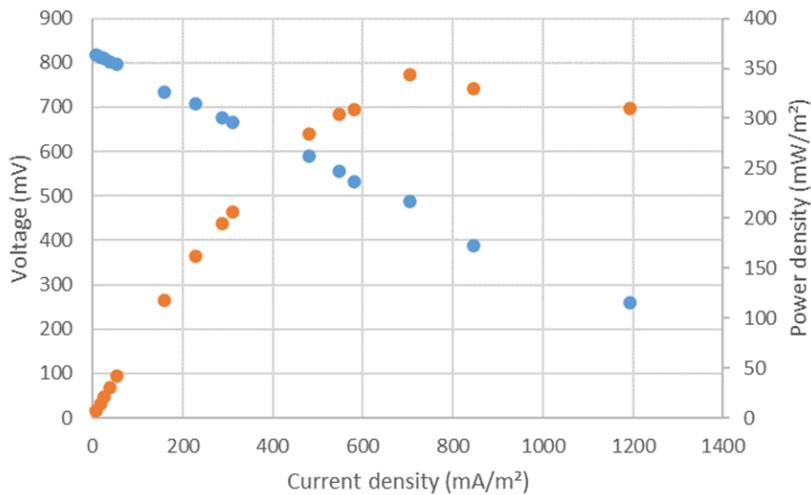


Figure 1: Mechanism of Plant Microbial Fuel Cells (PMFCs).

It has been observed that the PMFCs can generate electricity from rice fields, corn fields, and other vegetable plants without hampering the harvesting of the crops or vegetables. Fig. 1 shows the mechanism of PMFCs which have been used for the various types of plants in this research. Fig. 2 shows the polarization curve of a typical PMFC. It has been seen that the power density of a PMFC is around 350mW/m^2 .

**Figure 2: Relation among voltage, current, and power density in a PMFC.**

The voltage generation of PMFC can be increased with a series connection and according to the needs. Though the power density of PMFCs is not so high, it can be increased with further research by modifying the design and increasing the amount of effective microbes. Plant microbial fuel cell is a promising technology to generate green energy and to solve the problems of energy shortage in the future. It can also supply power to the sensors of the smart monitoring systems for the smart cities and AIEVs. As an environmentally friendly technology, PMFC can give the “Light of hope” to the people of the world who are still living in the dark at night.

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Migration to Address Labor Shortage in Japan: Evidence from Immigration Policy

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Track: Business, Humanities, and Social Sciences

Keywords: Migration, Labor Shortage, Japan, Immigration Policy, Labor Market.

Extended Abstract

To relocate human resources to match the demand and supply, this project studies the sources and prospects of migration to fill the labor shortage, particularly focusing on Japan as an island country. To conduct this study, we examine responses of migration to two policies: Point-Based System (PBS) and Specified Skilled Worker (SSW). By focusing on two policies, the specific research questions are: (a) How do changes in immigration policy in Japan impact migration? (b) How do factors in migrant-sending countries affect migration? The research approach combines qualitative and quantitative methods, including literature review, policy review, and data analysis. This research integrates the perspectives of both host-country policies and the characteristics of migrant-sending countries, which is scarce in migration literature. Findings of this study will contribute to policy making by providing evidence from rigorous research.

Some rich countries, for example, Japan has been struggling with a labor shortage due to an aging population and a low birth rate. Some countries are overwhelmed with displaced people who are in dire conditions and would prefer the opportunity for a better life through migration. In contrast, many emerging countries hardly have surplus labor to export since they are experiencing stable population growth. Nevertheless, ambitious people in different countries may seek opportunities with higher benefits in overseas countries. Thus, to fill the shortage, workers can be sourced from both labor abundant countries as well as from labor-balanced countries. However, many social, cultural, political, and economic challenges are embodied in such cross-border labor mobility. Migrant-receiving countries have specific demands including skills and expertise, while migrant-sending countries have their own characteristics. Migration has implications for both labor-receiving and labor-sending countries. For example, low-skilled and illegal immigrants are likely to increase discrimination and risk and discourage the use of robots and automation in the U.S. labor market [1,2]. Given the desperate need for workers, Japan may follow a similar path to that of other developed countries unless alternative measures are taken.

Broadly, sources of labor for a country can be domestic labor, migrant labor, and robots/technology. Japan has extended its support for population growth; however, the growth figures remain disappointing. On the other hand, it is not clear whether technology and robots

are complementary to or substitutes for human workers. The work in [3] suggests that while politicians and engineers may aim to solve Japan's care crisis by replacing human caregivers, the reality of robot use makes this unlikely in the foreseeable future. In the USA, there are negative effects of robots on employment and wages across commuting zones [4]. In this research, we focus on the remaining source—migration.

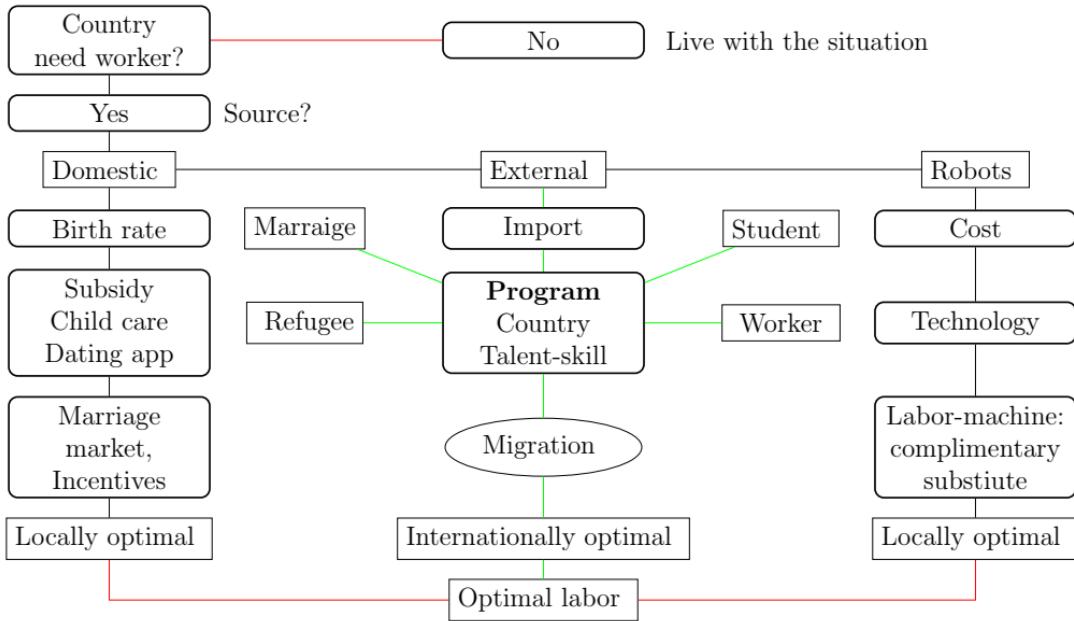


Figure 1: Potential sources of labor.

Japanese migration policies have been strict, that is, not welcoming foreign migrants, especially unskilled labor, to the country [5]. Despite the domestic labor shortage reality, there has been the sentiment and ambivalent attitude from Japanese citizens towards opening up, while it is also a political issue that no parties in different level would be reluctant to address [6,7]. However, it is also claimed that the traditional policy practices and notions of Japanese membership, based on the degree of cultural and ethnic purity, are being transformed [8]. In recent years, drastic policy initiatives have been taken to open up to foreign labor, both skilled and unskilled [9,10]. While Japanese government maintains that the country admits only skilled economic labor, a study finds that Japan has become more open to low skilled economic migrants [11]. Various factors in source countries, including education, impact the emigration decision [12].

Our analysis will focus on two policies: Point Based System (PBS) and Specified Skilled Worker (SSW). The former was initiated in May 2012 to attract high skilled professionals, and the latter one was initiated in 2019 to welcome capable specialists from overseas to work in certain Japanese industrial fields as ready workers, taking on jobs without prior training. We will also review other policies during the study time and take into account other external changes that might affect immigration, such as Covid-19, natural disasters, financial crisis. We

will account for individual and country level factors including mobility [13], language [14], distance, historical connections, culture, and so on. Data will be used from various published sources, and field investigations.

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Serotype and Genotype Changes of Dengue Virus in Bangladesh during 2018–2023 and Its Association with Disease Severity

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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: DENV, Bangladesh, Serotypes, Phylogenetic Tree, Clades.

Extended Abstract

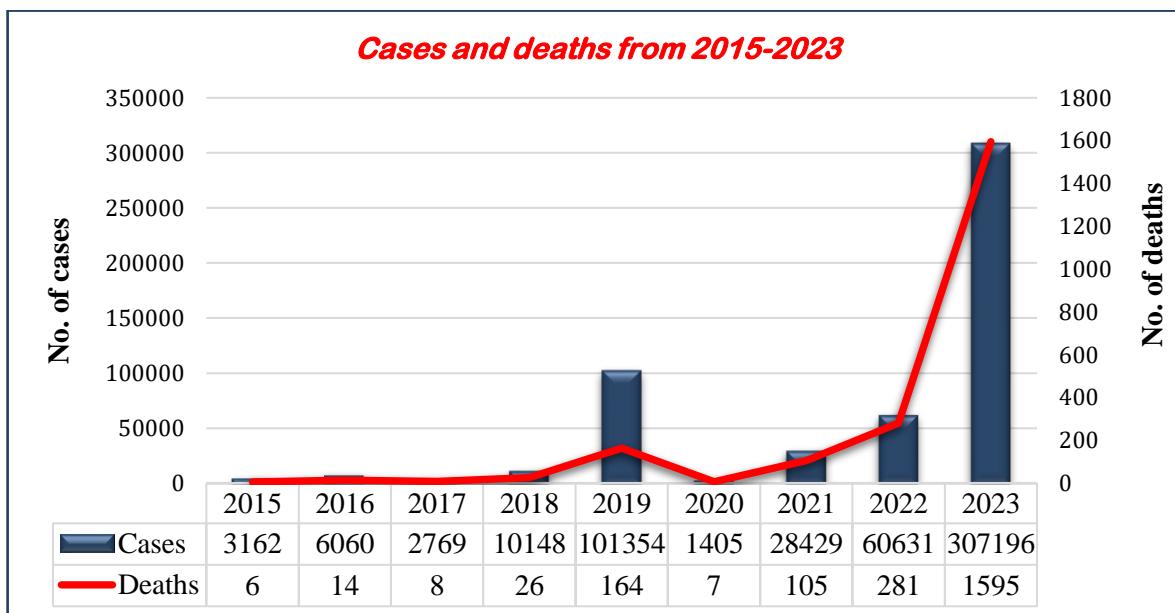


Figure 1: Number of dengue cases and death in Bangladesh from 2015 to 2023.

Dengue virus (DENV) infections have unpredictable clinical outcomes, ranging from asymptomatic or minor febrile illness to severe and fatal disease. The severity of dengue infection is at least partly related to the replacement of circulating DENV serotypes and/or genotypes [1-2]. To describe clinical profiles of patients and the viral sequence diversity corresponding to non-severe and severe cases, we collected patient samples from 2018 to 2022 at Evercare Hospital Dhaka, Bangladesh. Serotyping of 495 cases and sequencing of 179 cases showed that the dominant serotype of DENV shifted from DENV2 in 2017 [3] and 2018 to DENV3 in 2019. DENV3 persisted as the only representative serotype until 2022. Co-

circulation of clades B and C of the DENV2 cosmopolitan genotype in 2017 was replaced by circulation of clade C alone in 2018 with all clones disappearing thereafter. DENV3 genotype I was first detected in 2017 [4] and was the only genotype in circulation until 2022. We observed a high incidence of severe cases in 2019 when the DENV3 genotype I became the only virus in circulation. Phylogenetic analysis revealed clusters of severe cases in several different subclades of DENV3 genotype I. Again, huge case outbreak and fatality in 2023 (Fig. 1) was found associated with shift of serotype dominance from DENV3 to DENV2. Thus, these serotype and genotype changes in DENV may explain the large dengue outbreaks and increased severity of the disease in 2019 and 2023.

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Hydrogel Composites of Agro-Waste-Derived Graphene Oxide and Silica for Removing Methylene Blue Dye from Aqueous Solution

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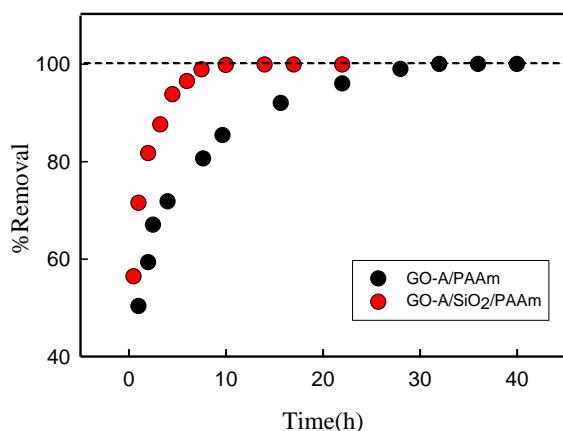
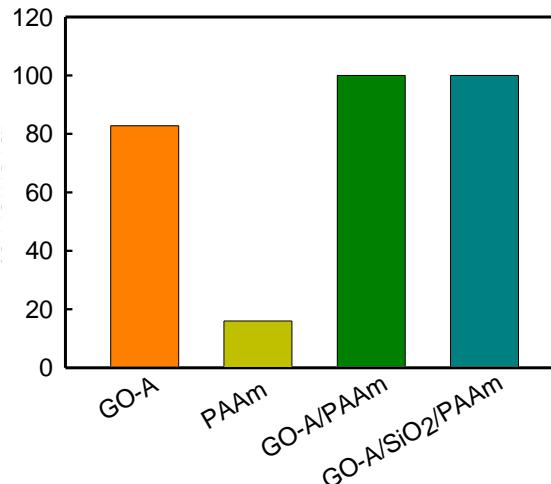
Track: Natural Sciences, Engineering, and ICT

Keywords: Agro-waste, Graphene Oxide, Hydrogel, Dye Removal, Adsorption.

Extended Abstract

The increasing environmental impact of industrial wastewater, particularly in developing nations like Bangladesh, has led to growing interest in sustainable solutions for water purification. This research introduces novel hydrogel composites synthesized by incorporating agricultural-waste-derived graphene oxide (GO-A) from sugarcane bagasse (SCB) and silica (SiO_2) from rice husk into a polyacrylamide (PAAm) polymer network for the removal of methylene blue (MB) dye from aqueous solutions. These materials were systematically characterized using X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Fourier Transform Infrared Spectroscopy (FT-IR), demonstrating the successful formation of GO-A and SiO_2 and their integration into the PAAm matrix.

The GO-A/PAAm and GO-A/ SiO_2 /PAAm composites exhibited remarkable dye adsorption efficiency, achieving over 99% removal of MB under optimized conditions. The hydrogel composites followed the Freundlich isotherm model, with the GO-A/PAAm composite showing an adsorption capacity of 344.83 mg/g. Notably, the inclusion of SiO_2 enhanced adsorption kinetics, providing faster dye removal (Fig. 1). The use of SCB-derived GO-A and rice husk-derived SiO_2 highlights a sustainable and cost-effective approach to wastewater treatment, addressing both environmental and economic concerns. Adsorption studies also revealed that while GO-A powder and PAAm hydrogel alone exhibited 83% and 16% dye removal efficiencies, respectively, the GO-A/PAAm and GO-A/ SiO_2 /PAAm hydrogel composites demonstrated nearly 99% removal efficiency (Fig. 2). The superior performance of the hydrogel composites is attributed to the well-dispersed GO-A and SiO_2 within the PAAm network, creating more accessible adsorbent sites, which enhances the binding of MB dye. This highlights the significant advantage of using hydrogels over powder adsorbents, as the three-dimensional polymeric network provides greater surface area and stability, facilitating more effective and rapid dye removal.

**Figure 1: Kinetic study for MB adsorption on the hydrogels.****Figure 2: Relative adsorption capacities for MB adsorption on the adsorbents.**

This study reflects the potential of agricultural-waste-derived materials in addressing key environmental challenges, particularly for Bangladesh, where industrial textile effluents contribute significantly to water pollution [1]. Moreover, this research aligns with the goals of Japan-Bangladesh research collaborations, emphasizing the importance of developing low-cost, high-efficiency solutions for wastewater management [2]. By leveraging Japan's advanced material science and Bangladesh's abundant agricultural resources, this partnership can help create scalable technologies to combat environmental degradation. The use of agro-waste materials not only reduces waste but also provides a viable solution for the industrial sectors in both nations, particularly in the textile industry.

In conclusion, the development of GO-A/PAAm and GO-A/SiO₂/PAAm hydrogel composites represents a significant step forward in sustainable wastewater treatment, with promising applications for domestic and industrial sectors in Bangladesh and beyond.

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Molecular Dynamics Investigation of Nanostructure and Characterization of $\text{Al}_x\text{CoCrFeNi}$ High-Entropy Alloy

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Track: Natural Sciences, Engineering, and ICT

Keywords: High Entropy Alloy, Molecular Dynamics, Short Range Ordering, Mechanical Properties.

Extended Abstract

High entropy alloys (HEAs) have gained significant attention for their remarkable mechanical properties [1]. Among these, alloys based on the $\text{Al}_x\text{CoCrFeNi}$ system are particularly noteworthy. Their high-temperature strength makes them ideal for demanding applications such as aerospace components, engine parts, turbine blades, etc. Understanding the atomic-scale mechanical behavior of these alloys is essential for their widespread engineering utilization.

Previous research suggests that increasing the aluminum content (x) in $\text{Al}_x\text{CoCrFeNi}$ alloys improves their strength but reduces plasticity, which may compromise ductility in practical applications [2]. Additionally, the solidified microstructure of these alloys transitions from columnar cellular to equiaxed dendritic grains when the aluminum molar ratio varies in the range of $0.9 \leq x \leq 1.5$. Interestingly, Fig. 1 from our study depicts the peak values of yield strength and Young's modulus when (x) is between 0.13 and 0.15, indicating that this composition may offer an optimal balance of mechanical properties. Furthermore, Monte Carlo simulations have been used to explore short-range ordering (SRO) as shown in Fig. 2 by minimizing potential energy, which has been overlooked in previous studies [3] of microstructural behavior.

This study aims to investigate the relationship between aluminum content and mechanical performance under varying deformation conditions using molecular dynamics simulations. By correlating aluminum composition with performance, this research seeks to design $\text{Al}_x\text{CoCrFeNi}$ HEAs with enhanced mechanical properties for specific high-temperature applications. The findings of this study are expected to provide valuable insights into the compositional and operational factors affecting the mechanical behavior of HEAs and contributing to the development of advanced materials that achieve both high strength and ductility for critical engineering applications.

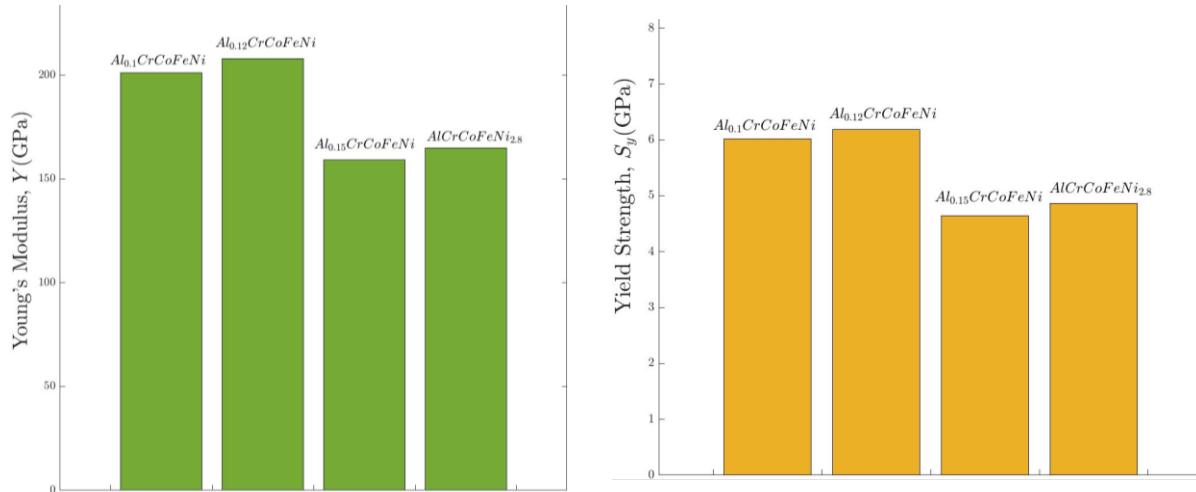


Figure 1: Variation of yield strength and young's modulus with Al concentration in Al_xCoCrFeNi HEA.

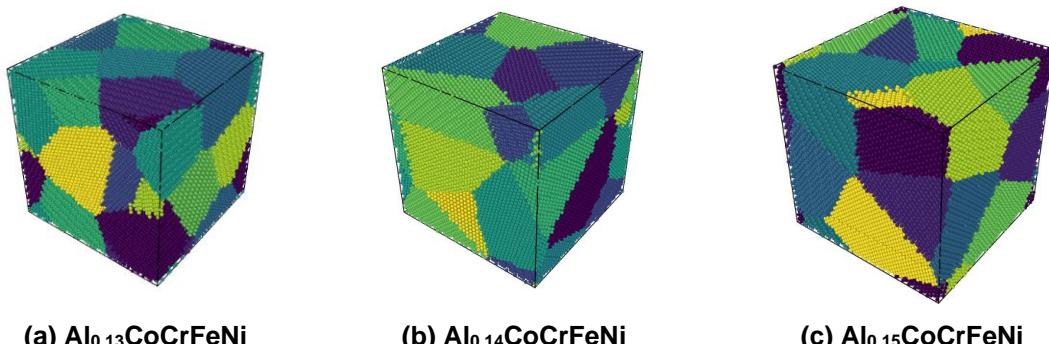


Figure 2: Different short range ordered compositions of the Al_xCoCrFeNi HEA.

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Remote Sensing and Machine Learning-Based Disaster Risk Assessment on Agricultural Land Use in Onshore Regions of Bangladesh Delta Affected by Recurrent Tropical Cyclones — Bulbul, Amphan, and Sitrang

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Track: Agricultural Sciences

Keywords: Agricultural Land Use, Disaster Risk Assessment, Machine Learning, Remote Sensing; Tropical Cyclones.

Extended Abstract

In Bangladesh delta's coastal regions, tropical cyclones cause harm to rice crops growing on agricultural lands almost every year. Therefore, utilizing remote sensing (RS) and machine learning (ML) technologies, this study addressed cyclones as climate-induced extreme events (42%) caused the most damage and were determined to occur most frequently in the last 46 years in the delta [1]. Among five compiled studies, the first research used tasseled cap transformation (TCT) from Landsat-derived RS datasets to measure shoreline changes throughout the delta's total onshore areas. It was discovered that in 1991, 2006, and 2021, respectively, 34.03%, 34.47%, and 33.52% of the area was used for farming agriculture. The study found that this delta's agricultural fields were extremely vulnerable to loss owing to coastal erosion processes and tropical cyclone (TC) landfalls respectively [2,3]. In the second study, changes were assessed based on TC Sitrang's landfall on 24th October 2022, and a machine learning system was used for rice crop change detection (CD) from TC Bulbul's landfall on 9th November 2019 in the Patuakhali district. Based on the CD classes moderately (26.07%), very (48.83%), and highly (17.73%) changed detected results showed damage to the transplanted Aman rice crop through machine learning techniques [4]. In the third study, a Bay of Bengal (BoB) adjacent Kalapara subdistrict under the Patuakhali district underwent a micro-scale damaged area assessment (DAA) for rice-farmed agricultural lands devastated by Bulbul [5]. Therefore, the fourth research was conducted in all administrative unions of the Kalapara subdistrict by developing the novel damaged area index (DAI) induced by the combined impacts of two recurrent cyclones Bulbul and Amphan. The TC Bulbul was selected from the 1st session of October–November (2019) and the TC Amphan was selected from the 2nd session of April–May (2020) duration of the said hazard-crop calendar respectively. The recurrent observations revealed that TC Bulbul caused greater damage than TC Amphan, which landed on 20th May 2020. The major DAI were reclassified among the DAI-6th to 9th ranked areas as 21.70%, 27.13%, 22.79%, and 2.92% due to the

joint recurrent impacts accordingly [6]. Therefore, in the fifth study, rice yield losses estimated from normalized difference vegetation index (NDVI) were classified in the sub-district as 1.5% marginal, 8.6% slightly, 38.2% moderately, 18.8% very, and 32.9% extremely loss areas using an overlay gamma-based fuzzy system [7]. The novel DAA, DAI, and fuzzy approaches for yield loss-based area calculations were introduced as disaster risk assessment results affected by cyclones. Furthermore, a new approach for estimating rice yield loss is provided with field validation for prompt action to assist emergency response needed-coastal farmers in the often-afflicted TC-prone regions.

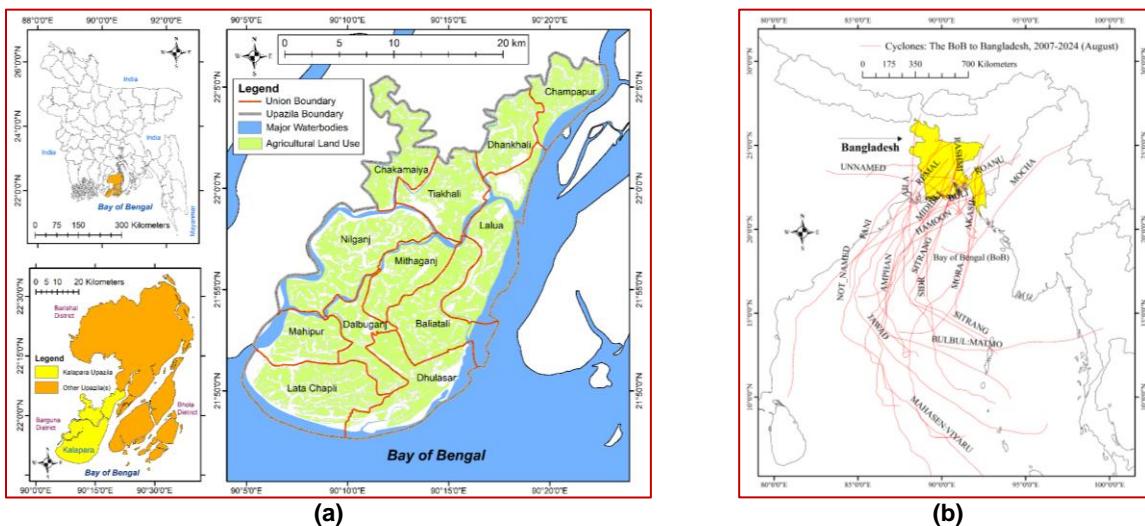


Figure 1: (a) Agricultural land use of the Kalapara subdistrict for the damaged area assessment, and (b) Recent cyclone outbreaks to Bangladesh 2007-2024.

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Fe-Catalyzed Cascade Reaction: C-H Activation and Cyclization in Efficiently Coumarin Synthesis

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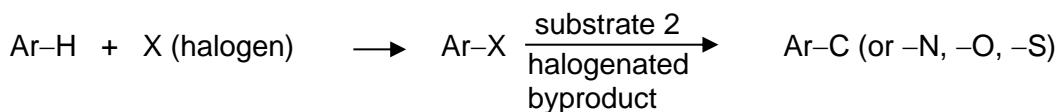
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Track: Medicine, Pharmaceuticals, and Public Health

Keywords: Fe-Catalyst, C-H Activation, Cascade Reaction, Coumarin, Catalysis.

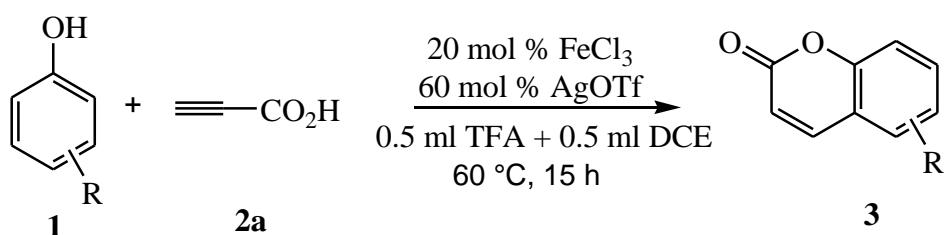
Extended Abstract

In general, the C–H bonds are omnipresent in organic/medicinal compounds in pharmaceutical fields, and the C–H bond is usually characterized as low reactive, because the bond dissociation energy of C–H bond is usually very large, e.g. 105 and 110 kcal/mol in CH₄ and C₆H₆. Therefore, direct functionalization of C–H bond is challenging and conventionally, it requires the pre-functionalization using halogenated compounds producing the halogenated byproducts as shown in Scheme 1.



Scheme 1. C–H bond functionalization in conventional method.

In the conventional strategy for direct C–H activation and cyclization in organic synthesis, the metallic systems of precious metals: Pd, Pt, Au, Ru, Ag etc. and La-series metals are usually used, and the main issues are high cost and toxicity for the contamination of these metals with products [1–3]. Still now, little attention has been paid to the nontoxic iron as a catalyst in such fields, although Fe-systems are very cheap in cost and environmentally benign compared to conventional transition metal catalysts. On the other hand, Coumarin and its derivatives occur widely in nature and most of them show biological activities: antioxidant, analgesic, anti-inflammatory and antimutagenic and so play a great role in medicine fields [4]. To date, many reactions for coumarin synthesis have been reported in [4], including various named reactions such as the Perkin, Knoevenagel and Pechmann reactions using transition-metal catalysts [2,3]. Therefore, Targeting for a greener, nontoxic and cheaper methodology for coumarin synthesis, we developed a Fe-catalytic system, in-situ Fe(OTf)₃ (OTf = triflate ion) formed instantly in order to avoid moisture contact which can destroy it and it showed C–H activation and cyclization between propynoic acid: R–C≡CO₂H (R = H, alkyl) and different phenols at a time, and these results afforded 33–95% coumarins (about 20 scopes for different coumarins) under the optimized conditions shown in Scheme 2.



Scheme 2. Fe-catalyzed C–H activation and cyclization between propynoic acid and phenols in mixture of trifluoroacetic acid (TFA) and dichloroethane (DCE).

To understand the efficiency of Fe(III)-catalyzed coumarin synthesis, these results was compared with those from the previous palladium- and platinum-catalyzed reaction of **2a** with **1** in trifluoroacetic acid, and the comparative results revealed that this Fe-catalyzed reaction explored better yields of coumarins than those found in palladium- and platinum-catalyzed reactions [3,5]. Different substitute screening revealed lower activity yielding low yield in case of terminal methyl substituent in propynoic acid, $\text{H}_3\text{C}-\text{C}\equiv\text{C}-\text{CO}_2\text{H}$ (**2b**) compared to that of **2a**, due to the absence of more acidic terminal H. In the case of different phenols, the role of electronic and inductive effects was observed in such catalytic cascade reactions.

Experimentally, the $\text{Fe}(\text{OTf})_3$ was formed in-situ by the reaction between $\text{Ag}(\text{OTf})$ and FeCl_3 in the mixed solvent of TFA and DCE and characterized by UV-Vis spectroscopy. The individual product was identified by NMR and quantified after purification by column chromatography.

In conclusion, this methodology of Fe(III)-catalyzed coumarin synthesis is expected to have a high degree of different medicinal coumarin derivatives, because it is a highly efficient and environmentally friendly economical nontoxic process and hopefully it would play a great role in the sectors of medicine/pharmaceuticals as well as chemistry/catalysis.

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Livelihood Diversification as an Enduring Form of Anticipatory Action of Flood for the Farmers of Bangladesh

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Track: Agricultural Sciences

Keywords: Flood, Livelihood Diversification, Anticipatory Action.

Extended Abstract

In Bangladesh, flooding has become a regular disastrous event as it causes serious social and economic losses. Most parts of the country are low lying and the 80% flood plain landmass is leaving the country highly vulnerable to the threat of repeated floods & about 34 percent of its land area is submerged every year for five to seven months [1]. To mitigate the impacts of flood, FAO & some other NGOs are aiming to establish an Anticipatory Action (AA) Protocol by government agencies to attain preparedness, response, and recovery. But it is not enough as there are some demerits such as: AA is highly time-sensitive; false forecasting calls for false preparation; roads and remote communities are inaccessible during rain; cash distributions are hindered because of insecurity. For an agriculture driven country like Bangladesh, an enduring AA is needed that will sustain for a long period of time as flood destroys not only farm products but also livelihood assets of the farmers. If livelihood diversification (LD) is considered as a form of AA, it probably meets the objectives of existing AA: to reduce or mitigate the impact of flood and enhance post-disaster response. The average arable land per capita declined from 0.13 ha in 1971 to only 0.05 ha in 2020 in the country [2]. So, the discussion of LD of all categorical farmers to mitigate flood's impact is a time demanding matter for Bangladesh as the main aim of LD is to reduce risk even if the primary activity (agricultural production) falls.

This study was carried out to explore the livelihood status and extent of LD of different categories of farmers; LD of farmers in different flood risk zones and the major determinants affecting the extent of LD to reduce the impact of flood. The study used IFPRI's BIHS-2018 database and analyzed 3849 farm household information. For a clear observation, farmers were classified into five categories namely landless, marginal, small, middle and large based on land holding status.

Table 1. Livelihood status and livelihood diversification status of different categories of farmers.

	Large	Middle	Small	Marginal	Landless
Livelihood Index	35.97	31.84	31.59	30.18	29.42
Livelihood Diversification Index (LDI)	0.56	0.52	0.42	0.32	0.21

Both the livelihood status and LD are following the same pattern which is it decreases with the decline of land holding status. The landless farmers occupied the lowest score in composite livelihood index with a low level of diversification. Except the landless farmer, there is no significant pattern found in case of diversifying livelihood at various risk zones of flood.

The values of LDI: < 0.01, 0.01 - 0.25, 0.26 -0.50, .51- 0.75 and >0.75 represent no diversification, low level of diversification, medium level of diversification, high level of diversification, and very high level of diversification, respectively.

Table 2. Livelihood diversification status of farmers at different flood risk areas of Bangladesh.

Farmers' Category	Livelihood Diversification Index at different flood risk areas					
	No risk	Very low risk	Low risk	Moderate risk	High risk	Very high risk
Large	0.57	0.56	0.51	0.61	0.60	0.52
Middle	0.49	0.45	0.56	0.51	0.53	0.54
Small	0.44	0.40	0.42	0.40	0.40	0.41
Marginal	0.36	0.32	0.32	0.31	0.31	0.31
Landless	0.25	0.23	0.22	0.20	0.19	0.17

It was found that age, education, family labor, social service, asset value (both agricultural and non-agricultural), savings, membership with different organizations, and land-to-man ratio had a positive and significant effect on the extent of livelihood diversification and the features of these determinants are connected to the existing AAs.

This study suggests that a livelihood diversification scheme, especially for landless farmers, should be approached as this particular community is living a miserable life and flood has a direct impact on them which hinders them from earning their livelihood.

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Design and Development of a Weather Balloon-Launched CubeSat Prototype for Atmospheric Data Collection

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Track: Natural Sciences, Engineering, and ICT

Keywords: CubeSat, Weather Balloon, Weather Analysis, Additive Manufacturing, Quick Release.

Extended Abstract

CubeSats, a category of picosatellites, have become increasingly popular due to their cost-effectiveness and their capacity to foster hands-on experience in satellite design, manufacturing, and testing. Despite these advantages, preparing CubeSat hardware and software for space missions presents a considerable challenge. Conventional space simulation methods, such as vacuum chambers and thermal testing, are often prohibitively costly, complex, and time-intensive, posing barriers to streamlined CubeSat development and deployment.

Advances in miniaturized electronics and power technology have enhanced their capabilities. Carolyn Mayer's 2011 research utilized weather balloons to test 3D-printed CubeSats equipped with sensors, providing an affordable means to simulate near-space conditions and identify potential issues before costly launches [1]. Similarly, in summer 2019, NASA's Jet Propulsion Laboratory interns tested a 6U CubeSat and Qualcomm Snapdragon flight computer using high-altitude balloons, effectively simulating orbital conditions and verifying CubeSat readiness at a low cost [2]. Previous research has overlooked the reusability of CubeSats, and these designs and prototypes are still not affordable and accessible for student research.

This paper presents the design and development of a CubeSat prototype optimized for atmospheric data collection, emphasizing both deployment via a weather balloon and subsequent multi-sensor data analysis. The CubeSat's payload includes five distinct sensors:

temperature, humidity, gas/ion detection, air pressure, and air quality. In addition to these sensing capabilities, two innovative features are incorporated: a quick-release mechanism and horizontal movement capability. The quick-release mechanism ensures a safe and controlled separation from the balloon, deploying a parachute for a secure descent, while the horizontal movement capability enables lateral maneuvers, enhancing the CubeSat's functional adaptability in the atmosphere.

The prototype is constructed entirely from weather-resistant 3D-printed plastic to ensure durability and cost efficiency. The system design was modeled using SolidWorks, as illustrated in Fig. 1, with the primary control architecture divided into two subsystems: the flight control subsystem and the data acquisition subsystem. The flight control subsystem manages the balloon launch, utilizing a quick-release mechanism along with a propeller-based horizontal movement system. Servo motors are employed for actuation, while BLDC motors provide propulsion. The data acquisition subsystem controls the sensor suite for real-time atmospheric monitoring, featuring the five sensors mentioned earlier. Power management for the CubeSat is maintained through a solar energy management board, and the printed circuit board (PCB) design is shown in Fig. 2. Initial testing of sensor functionality has been successfully conducted and quick release mechanism is in design phase currently. The CubeSat's design prioritizes reusability, affordability, and component accessibility, contributing to an economical and sustainable atmospheric research tool.

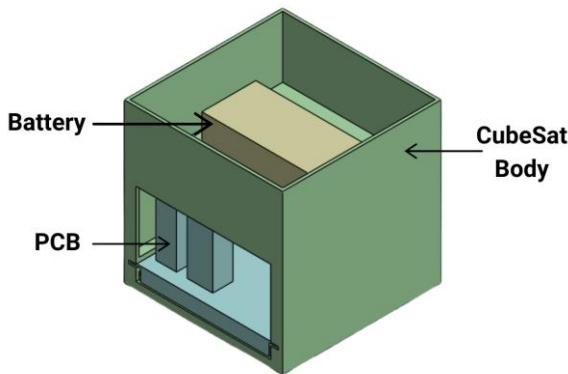


Figure 1: CubeSat system design in SolidWorks.

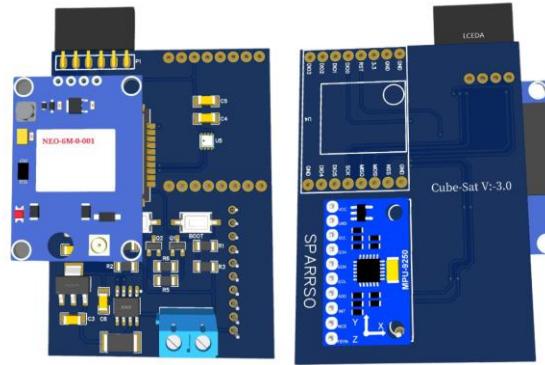


Figure 2: PCB design of the connection circuit.

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Devising an Image Processing-Based Technique for Preserving Cultural Motifs

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Track: Natural Sciences, Engineering, and ICT

Keywords: Cultural Heritage, Preservation, Motifs, Image Processing, DMC.

Extended Abstract

Preserving cultural motifs not only safeguards heritage but also fosters SME innovation, supports education, and enables the development of culturally significant products, all while enhancing global recognition and research [1,2]. As shown in Fig. 1, achieving this vision requires addressing two essential aspects: first, digitizing the physical motifs, and second, storing the digitized motifs in a digital marketplace, can be called the Digital Manufacturing Commons (DMC) [3], for seamless access and utilization by various stakeholders. To accomplish this, we must first understand the nature of cultural motifs themselves. Most motifs exhibit a degree of symmetry, often through repetition or the combination of simpler designs to create complex patterns (see Fig. 2a). Such symmetry and geometry can be effectively captured using parametric methods or point cloud algorithms [4]. However, this approach raises an important question: how do we capture the “beauty of imperfection”? For instance, a flower motif may seem symmetrical at first glance, but a closer look reveals slight inconsistencies in the petals, reflecting the human craftsmanship behind it (see Fig. 2b). These subtle imperfections are part of what gives the motif its cultural and historical value. While parametric and point cloud algorithms can model geometric precision, they can be cumbersome when it comes to encapsulating these subtle, human-made imperfections. Therefore, the digitization method must not only replicate precise geometry but also encapsulate these imperfections to ensure a complete and authentic digital representation. Equally important is the format in which these digital models are stored. A versatile data format is crucial—raster or vector graphics may suffice for educational purposes, but product development may require point clouds (Text or CSV), STL, or DXF files. Policymakers must also address system administration, access control, and trust to ensure the DMC is a credible platform. Although this study does not focus on policymaking, it remains an essential element for the successful preservation and broader application of cultural heritage in the digital realm. Nevertheless, this study devises an image processing-based technique to digitize cultural motifs, as shown in Fig. 3. The technique traces paths from images using a brightness cutoff detection method, processes the paths by cleaning or adjusting points, and converts the result into a vector format. The vector format can be exported into various other formats and decomposed into elementary point clouds if needed. This approach has been applied successfully to digitize several Nakshi Kantha motifs from Bangladesh (one

example is shown in Fig. 3), effectively capturing both their geometric structure and handcrafted imperfections. The digitized outcomes contribute to the DMC and thereby may facilitate culturally enriched product development as shown in Fig. 3. The findings of this study could play a pivotal role in preserving Bangladesh's traditional motifs, promoting global recognition, driving education, research, innovation, new product development, and supporting SMEs, given the support of policymakers and stakeholders.

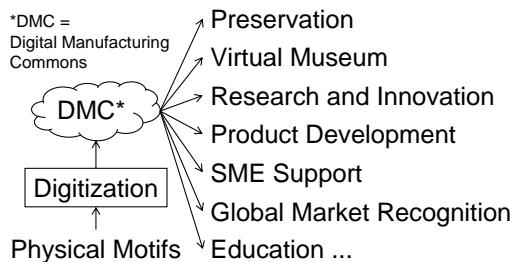


Figure 1: A motif preservation framework.

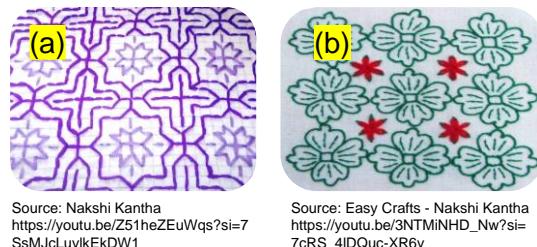


Figure 2: Examples of Naskhi kantha motifs.

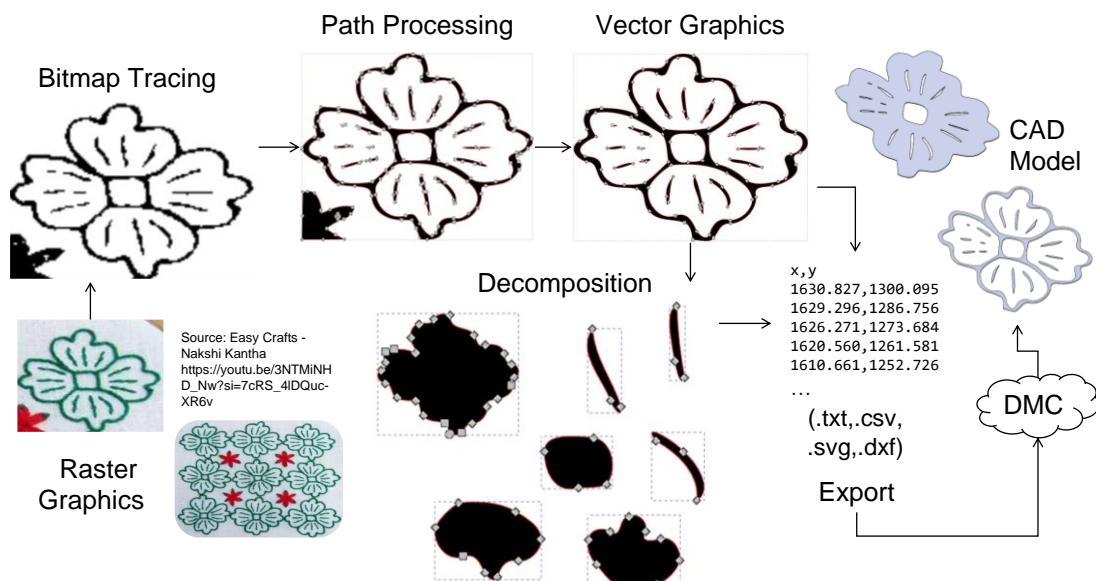


Figure 3: The image processing-based technique for digitizing a motif.

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Invitation to NBRJ-JBRP2025

It is our pleasure to announce that the International Conference on Japan-Bangladesh Research and Practice (JBRP) has become a flagship event proudly sponsored by the Network of Bangladeshi Researchers in Japan (NBRJ). This conference serves as a vibrant platform to bring together Bangladeshi-origin researchers working across universities, research institutions, industries, and corporate sectors in Japan.

On behalf of the 4th International Conference on Japan-Bangladesh Research and Practice (JBRP2025) Program Committee, I warmly invite you to actively participate in this prestigious event. The conference will be held in Tokyo, tentatively scheduled for the second weekend of August 2025 (August 9–10). Further details, including the exact venue, call for presentations, and registration information, will be announced in due course.

Please stay updated by visiting the official NBRJ website at <https://nbrj.jp>. We look forward to your participation and valuable contributions to this academic and professional gathering.

Sincerely,

Mohammad Abdul Malek, PhD

General Chair, NBRJ-JBRP2025 Program Committee

Professor of Economics

School of International Liberal Arts

Miyazaki International University

And

Invited Researcher

CREPE, The University of Tokyo