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Editorial Team

Acknowledgement

It is a great pleasure to thank many people whose bountiful generosity and insights have helped us to publish this book. We acknowledge our debts especially to the Editorial board and Editors, Dr. Banamali Roy and Dr. Suparna Banerjee, Associate Professors, Bangabasi Evening College, Kolkata, for all their patience, support, invaluable suggestions and sharing their deep insights in preparing this volume.

We are grateful to all our colleagues for their kind cooperation in publishing this book. We hope all the students and teachers would be deeply enlightened from this variety of pleasant, interesting and thoughtful topics in various fields – Science, Humanities and Commerce.

Special and sincere thanks are rendered to Dr. Suparna Banerjee, Associate Professor & HOD, Bangabasi Evening College, Kolkata, for her constant effort, patience, sacrifice, motivation, encouragement and continued guidance which have led this book to come to reality.

We would sincerely like to pay thanks to Dr. Sanjib Chattopadhyay, Principal, Bangabasi Evening College and Dr. Prosenjit Mukherjee, Bursar for providing financial support for this volume.

The papers published in this volume are entirely self and personal opinion of each author. We, of course, are solely responsible for any errors that have crept in inadvertently. The College Authority and Editors are not responsible for any contents of this volume.

Foreward

Bangabasi Evening College has bestowed 60 years of service to the nation. The Research Journal entitled "Synthesis 2" gathers writings of different employees of the college on natural sciences as well as social sciences. Now, we have intended to publish the Third volume of the Synthesis. A good teacher should be a good student also. In other words, whenever he ceases to be a learner, he no longer remains a good tutor. With its glorious tradition in teaching and learning, the college continues disseminating higher and progressive education, holding high ideals of the motto of superior study.

The Bengal Renaissance can be said to have started with Raja Ram Mohan Roy (1772-1833) and ended with Rabindranath Tagore (1861-1941). However, there have been many stalwarts after that embodying particular aspects of the unique intellectual and creative output. Nineteenth-century Bengal was a unique blend of religious and social reformers, scholars, literary giants, journalists, patriotic orators, and scientists, all merging to form the image of a renaissance, and marked the transition from the 'medieval' to the 'modern'. Bengali intelligentsias like Acharyya Girish Chandra Bose, Bhupal Chandra Bose, Aghornath Chatterjee, Upendralal De, Ishan Chandra Ghosh, Tejesh Chandra Bidyananda, etc were the brilliant descendants of middle phase of Bengal Renaissance originated from Vidyasagar during the British ruled period, who could realize the utility of higher education to be spread over the Bengali youths, about which the ruler community were much conservative. During the Renaissance of Bengal, several educational institutions (Schools and Colleges) were established by the intelligentsia of Bengal with the support of the Government. Bangabasi College was one of them. The other Colleges include Hindu College (Presidency College), Scottish Church College, St Xavier's College, Vidyasagar College, City College, SurendraNath College etc. Bangabasi Evening College did not have any separate existence at the initial state. The main Bangabasi College, housed on the same campus, was founded by Acharya Girish Chandra Bose, as mentioned above, in 1887. Bangabasi Evening College from its establishment, guided by Sri Prasanta Kumar Bose, the illustrious son of Acharyya Girish Chandra Bose, was affiliated to the University of Calcutta, which was the pioneer of higher studies since the British monarchy. In 1944 Sri Prasanta Kumar

Bose, the Founder Principal, introduced the Arts and Science faculties in the Evening section.

Bangabasi Evening College was originally an integral part of Bangabasi College, which came into being on 11th April 1965 as a full-fledged evening college, the largest of all evening colleges in Calcutta based on faculties of Arts, Science, and Commerce, with student numbers, 3000- 3500 every year, 70 teaching and 36 non-teaching staff. The College Starts at 4.30 pm and runs up to 9.00 pm. It is located at the heart of the megacity of Kolkata, in the vicinity of Sealdah Station, giving easy access to students coming from rural, semi-urban, and urban areas. It is also very near to Central Metro Railway station and half an hour's distance from Howrah Station by bus. It is surrounded by 4 major roads of Kolkata, namely, Acharyya Prafulla Chandra Road, Raja Rammohan Sarani, Mahatma Gandhi Road and Bipin Bihari Ganguly Street of east-west and north -south respectively. Prof. Prasanta Kumar Bose, the illustrious son of Acharya Girish Chandra Bose was the founder Principal of Bangabasi Evening College. Now it offers 4year Honours degree in Bengali, English, Hindi, Sanskrit, History, Political Science, Philosophy, Economics, Chemistry, Mathematics, Anthropology, Physiology, Botany and Accountancy.

Other subjects include Geography, Physics, and Zoology and MSc Department of Pure Mathematics regular course under the University of Calcutta. Two B. Voc courses sponsored by UGC, affiliated to CU, i.e., (1) Banking, financial services, and insurance and (2) Hospitality and tourism. The college provides scholarships like Kanyshree, Swami Vivekananda Merit-cum Means Scholarship, Oasis, Aikyashree, and National Scholarship for meritorious students are available. It also helps poor students with its funds. The Student Credit Card of West Bengal Government is also available to students for higher studies. The institution provides computer training programs and online competitive examination training programs. The college is now preparing for 3rd cycle NAAC. It participates every year in NIRF. It has a main building and an annex building shared by the two other colleges of the Bangabasi Group. There is a playground also entitled "Bangabasi Play Ground", shared by the other two colleges. There are many established Alumni from this college. Professor Amia Bhaumik is now the Vice Chancellor of Linkoln University, Malaysia. Three streams - Humanities, Science, and Commerce (Hons and General) are taught at the graduate level by highly qualified and experienced teachers. Postgraduate studies in Mathematics has brought higher education's spotlight to a recognizable height. Two BVoc courses sponsored by UGC opened in 2018 i.e., (1) Banking, financial services, and insurance (2) Hospitality and tourism There are many opportunities for students to work with our faculty to improve their quality of learning. Our permanent and guest faculty members are amply efficient and affectionate in solving the student's problems. Many teachers are engaged in active research funded by UGC and DST research projects in specialized areas. PhD works are also performed here in the Botany and Physics Department. Some UGC and DST seminars, National and International have recently been organized in Anthropology, Economics, Chemistry, Political Science, English, Sanskrit, History, Botany and Mathematics departments.

Bangabasi Evening College along with Bangabasi Morning College originated as two distinct stems from the main branch of Bangabasi College in 1965; hence all of them including Bangabasi College of Commerce, later coined as Acharyya Girish Chandra Bose College, belong to the Bangabasi Group of colleges has extended the educational canopy for the service of the nation in expanded fields. At the moment the study of interdisciplinary science and humanity has gained special interest among the scholars of different Universities. It would enrich every field of study like an interdependent network. This attempt is admirable for the betterment of knowledge that can direct society to a definite destination. The maxim inscribed in the logo of the Journal sustains the ideals of faculty improvement programs in every walk of natural and social sciences. It is through reverential questioning that who teaches should be taught by others, and that knowledge ultimately helps render service to the cause of humanity. We are glad to say that Bangabasi Evening College is being presented for Re-Accreditation (3rd Cycle) by the National Assessment and Accreditation Council (NAAC). For the past few years, the College has sincerely endeavored towards quality sustenance and quality enhancement in the light of NAAC Peer Team recommendations. Publication of the Third volume of Synthesis is an attempt to sustain the long-lasting credentials of this college in the field of research publication and to reignite the lamp of a multidisciplinary approach to knowledge.

Dr. Sanjib Chattopadhyay
Principal,
Bangabasi Evening College

Editorial

It has been five decades since Sri Prasanta Kumar Bose, eminent scholar and educator, son of Acharya Girish Chandra Bose, founded Bangabasi Evening College. Under his guidance, Bangabasi Evening College forged its own path, providing not only the general body of young students with a supportive educational institution but also providing mature and working students an opportunity to further their educational aspirations and career prospects. As an evening college then, Bangabasi Evening College fills a highly required demand/contribution to academics which is invaluable. It is only fitting that the Golden Jubilee of Professor Bose's vision and the college he founded should be marked by an academic endeavour. We are privileged therefore to bring out this collection of essays aimed at students and teachers/scholars which focus on contemporary critical issues in diverse disciplines of Science, Humanities and Commerce. Our society is passing through several critical phases. The issues are mixed with different dimensions and directions. This book focuses on contemporary critical issues linked with diversified disciplines such as science, humanities and commerce. In fifty years, the world - and Indian Map has changed dramatically. The Cold War has thawed and global warming has come in its stead. Extreme environmental events, social unrest and violence has increased, food and water shortages are predicted and nearly all countries are feeling the effects of a worldwide recession.

The interdisciplinary nature of the collection has led to a wide variety of essays embracing both subject specialization as well as accessibility, particularly, in diverse disciplines of Science, Humanities and Commerce.

We hope that the readers will find interest while going through the different aspects of this broad and up-to-date presentation of the present multifarious subject and the essays will open up the scope of further research work in concerned areas.

The papers published in this volume are entirely self and personal opinion of each author. We, of course, are solely responsible for any errors that have crept in inadvertently. The College Authority and Editors are not responsible for any contents of this volume.

We would like to pay thanks to all our colleagues for their substantial help they rendered in producing this volume and also for their kind cooperation.

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We would like to express our sincere gratitude to Dr. Sanjib Chattopadhyay, Principal, Bangabasi Evening College and Dr. Prosenjit Mukherjee, Bursar for providing financial support for this volume.

Patron

Principal, Dr. Sanjib Chattopadhyaya,
Bangabasi Evening College

Biodata

Dr. Sanjib Chattopadhyay was born at Burdwan, West Bengal, India on 30 October 1967. He studied Zoology Honours in Ramkrishna Mission Vivekananda Centenary College, Rahara, and obtained B.Sc. degree from University of Calcutta in 1988. He completed his M.Sc degree in 1991 and his Ph.D degree in 1997 in Zoology from Visva-Bharati University, Santiniketan under the guidance of Professor A.K. Aditya. At that time, he was taught by Professor Nirmal Chandra Sukul, who is a legendary figure in the field of Homeopathic Reesearch. Chattopadhyay He joined as a Lecturer in Zoology at BKC College, Kolkata. He was promoted to the post of Associate Professor in 2009 and worked there up to 2nd July, 2015. During that time he expressed his keen interest in the field of Altemate Medicine and achieved MD degree in Biochemic system of Medicine. Chattopadhyay has got some well known publications in homeopathic research. In 3 July, 2015 he joined as a Principal of Bangabasi Evening College, Kolkata, India.

Publications : Total number of papers in peer reviewed research journals: 16

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Investigation into the Impact of Temperature on a Fractional-order Dengue Model

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Abstract

This study looked at the temperature-dependent entomological factors of Aedes aegypti that contribute to the transmission dynamics of dengue disease in subtropical Taiwan. The temperature change of pre-adult mosquito development, oviposition rate, adult mosquito mortality rate, and virus incubation rate in the mosquito was investigated using a vector–host transmission model. This study demonstrated the limited pre-adult mosquito maturation rate by demonstrating a positive correlation between the entomological parameter estimations and a progressive temperature increase, but not with the rate of mosquito mortality or maturation. The temperature climatic component had

a significant impact on the dynamic modeling of the vector-host interaction, as indicated by the results. Our simulation's results also indicate that temperatures around 32°C are the most conducive to dengue transmission. These findings may be applied to cost-effectiveness analyses and control measure modeling in the future.

Keywords

Fractional calculus, Dengue fever, Temperature, Numerical simul

1. Introduction

Around 100 countries in the WHO areas of Africa, the Americas, the Eastern Mediterranean, South-East Asia, and the Western Pacific have an endemic case of dengue, which puts 40% of the world's population at risk [1, 2]. This study will examine a mathematical model of dengue fever with an arbitrary order. The related parameter values in this epidemic model are determined using data on the characteristics of the people in the FongShan area of Kaohsiung, Taiwan. From 1998 to 2010, Kaohshiung, the nation's second-biggest urban area, was at high risk of contracting dengue fever. With 4790 cases of dengue fever documented between 2001 and 2003, one Taiwan district saw the worst dengue outbreak in the previous 60 years. The WHO has recorded over 238333 dengue cases in the recent past. Updates on the dengue situation by October 2020 are limited to the nations in the Western Pacific Region, which include Taiwan [1-3]. According to WHO [1, 2], the dengue pandemic has arisen as a result of the disease's spread to new areas and continents and an increase in cases reported worldwide. Investigating the temperature effect in the transmission dynamics of all dengue virus-caused diseases becomes one of the major research areas of epidemiology, computational biology, public health sciences, and environmental sciences since global warming is one of the major environmental problems of our day (see [3–13] and references therein). A meta-analysis is used in the most current review publication [12] to investigate how precipitation and ambient temperature affect dengue disease. For the sake of the general public's health, it is necessary to provide practical approaches for the prediction, management, and treatment of the epidemic. As a result, during the past several decades, a large number of scholars have been interested in the associated issues and have begun to make contributions in both biology and mathematics. The mathematical models for dengue transmission that are deterministic (integer-order) are thoroughly discussed in [14],

with further work being done in references [6, 10]. The populations of susceptible-exposed-infectious (SEI) mosquitoes and susceptible-infectious-recovery (SIR) humans made up the fundamental vector-host dynamic models.

Fractional derivatives provide the remarkable ability to capture memory effects, which are observed in several significant complex systems found in physics, mechanical systems, biology, and other fields. One of the key challenges facing today's real-world fractional modeling applications is figuring out which fractional operator—among the newly defined fractional operators with non-singular& non-local kernels and the traditional fractional operators with singular kernels—is the most efficient. There are other ways to implement new fractional operators in actual systems, but the Atangana-Baleanu operator in the Caputo sense (ABC) with the Mittag-Leffer (ML) kernel—which is non-singular—performs better than the others when it comes to comparison (see to [15 - 18] and its references). For a thorough grasp of the system's components and dynamics, the mathematical analysis based on compartmental fractional-order epidemic models inside singular and non-singular fractional differential operators offers a significant benefit. Fractional dengue models have been started to be developed in this regard in order to predict the dynamics and occurrence of outbreaks as well as to put the appropriate control measures in place.

2. Preliminaries

We provide the reader with some useful definitions and characteristics of fractional derivatives.

Definition 1 "The Caputo fractional derivative of order $0 < \phi \leq 1$ for the function u: $C^n\,[0,\infty] \to \mathbb{R}$ is defined as

$$^{c}D_t^{\phi}(u(t)) = \frac{1}{\Gamma(n-\phi)}\int_0^t \frac{1}{(t-z)^{\phi+1-n}}\frac{d^n}{dz^n}\,u(z)dz$$

where $C^n\,[0,\infty]$ is a n tines continuously differentiable function and the Gamma function is defined by $\Gamma(\quad)$such that $n-1 < \phi < n$".

3. Model formulation

The weekly-based meteorological data that has been collected by the Taiwan Environmental Protection Agency [19] in Kaohsiung district is considered for this study. The results corresponding to the period 2001 to 2010 show that Kaohsiung as a tropical city has a mean annual temperature of 25° C, the maximum as 32° C, and the minimum as 18°

C [7]. The entomological parameters of the model are investigated in details by ref. [7] according to these temperature levels in Kaohsiung, and it is reported that the dengue transmission dynamics at 32° C is significant in comparison to other values.

This work is based upon the vector-host (vertical) transmission model presented by the authors of [20] for describing the trans- mission patterns of the dengue fever in the mentioned tropical city of Taiwan. This study adopts the vector–host transmission model from Adams and Boots (2010) for modeling transmission dynamics of dengue fever in southern Taiwan. It is assumed that the population is divided into host (human), vector (pre-adult), and vector (adult female mosquito population). Two parameters of the *A. aegypti* pre-adult female mosquito population were defined, effectively eggs and larvae, in susceptible (S_e) and infected (I_e) populations. Three parameters of the vector (adult) were also defined: S_v, E_v, and I_v, which are the numbers at time t of susceptible, infected but not infectious, and infectious female mosquitoes, respectively. Similarly, three parameters of the host (human population) were defined: S_h, I_h, and R_h, which are the sizes at time t of susceptible, infected/ infectious, and recovered/immune human populations, respectively. Now we formulate the dengue model with fractional order derivatives with Caputo operator of order $0<\alpha\leq 1$.

$$ {}^{C}D_t^{\alpha} S_e(t) = b_v\left(1 - v\left(\frac{I_v}{S_v+E_v+I_v}\right)\right) - \omega S_e, \quad (1) $$

$$ {}^{C}D_t^{\alpha} I_e(t) = b_v v\left(\frac{I_v}{S_v+E_v+I_v}\right) - \omega I_e, \quad (2) $$

$$ {}^{C}D_t^{\alpha} S_v(t) = \omega S_e - \beta S_v \frac{I_h}{N_h} - \mu_v S_v, \quad (3) $$

$$ {}^{C}D_t^{\alpha} E_v(t) = \beta S_v \frac{I_h}{N_h} - \epsilon E_v - \mu_v E_v, \quad (4) $$

$$ {}^{C}D_t^{\alpha} I_v(t) = \epsilon E_v + \omega I_e - \mu_v I_v, \quad (5) $$

$$ {}^{C}D_t^{\alpha} S_h(t) = \mu_{hb} N_h - \beta S_h \frac{I_v}{N_h} - \mu_{hd} S_h, \quad (6) $$

$$ {}^{C}D_t^{\alpha} I_h(t) = \beta S_h \frac{I_v}{N_h} - \gamma I_h - \mu_{hd} I_h, \quad (7) $$

$$ {}^{C}D_t^{\alpha} R_h(t) = \gamma I_h - \mu_{hd} R_h. \quad (8) $$

The parameters of b_v, v, and ω represent the oviposition rate of the egg (per day), the vertical infection rate (proportion), and the pre- adult mosquito maturation rate (per day) in Eq. (1) and Eq. (2), respectively. Note that $S_v + E_v + I_v$ is the total size of vector population (N_v) in that $\frac{I_v}{S_v + E_v + I_v}$ is the infected probability. The $\frac{1}{b_v}$ represents the average oviposition periods, and $\frac{1}{\omega}$ represents the pre-adult mosquito average transition time from hatched eggs into adult forms. The parameter β is the transmission biting rate (per day). The female adult

mosquito is infected by the dengue virus during a blood meal as defined by $\beta S_v \frac{I_h}{N_h}$. Similarly, infected mosquitoes transmit the virus to susceptible people as defined by $\beta S_h \frac{I_v}{N_h}$. This model assumes that the underlying transmission probability between humans and mosquitoes is the same in both directions (Adams and Boots, 2010). The parameter γ expresses the human recovery rate (per day). Hence, S_h increases according to the human birth numbers $\mu_{hb} N_h$ and decreases by the term $\beta S_h \frac{I_v}{N_h}$. Finally, R_h increases according to the human recovery number γI_h and decreases by the human death numbers $\mu_{hd} R_h$.

To incorporate the temperature-dependent feature into the entomological parameters, we collected weekly mean temperature readings in Kaohsiung from 2001 to 2010 and defined the temperature, T, as a function of time. Four entomological parameters including the oviposition rate b_v, pre-adult mosquito maturation rate ω, adult mosquito death rate μ_v, and the virus incubation rate in mosquitoes ϵ were treated as temperature-dependent in the modeling process. We chose these parameters due to the availability of observed or experimental values from literature review.

4. Analysis of the system

The equilibrium points of the system

The system's equilibrium may be found by solving the model i.e.,

$ {}^{C}D_t^{\alpha} S_e(t) = {}^{C}D_t^{\alpha} I_e(t) = {}^{C}D_t^{\alpha} S_v(t) = {}^{C}D_t^{\alpha} E_v(t) = {}^{C}D_t^{\alpha} I_v(t) = {}^{C}D_t^{\alpha} S_h(t) = {}^{C}D_t^{\alpha} I_h(t) = {}^{C}D_t^{\alpha} R_h(t) = 0.$

The system has two types of disease free equilibrium points namely trivial disease-free equilibrium $E_0 = (0, 0, 0, 0, 0, {S_h}^0, 0, 0)$ and biologically realistic disease-free equilibrium $E_1 = ({S_e}^*, 0, {S_v}^*, 0, 0, {S_h}^*, 0, 0)$ where ${S_h}^0 = \frac{\mu_{hb} N_h}{\mu_{hd}}$, ${S_e}^* = \frac{b_v}{\omega}$, ${S_v}^* = \frac{b_v}{\mu_v}$, ${S_h}^* = \frac{\mu_{hb} N_h}{\mu_{hd}}$.

The basic reproduction number of the system

The next-generation matrix technique is used to calculate the model's basic reproduction number R_0, which may be obtained from the maximum eigen value of the matrix FV^{-1}[52, 53] where,

$$ \mathcal{F}V^{-1} = \begin{bmatrix} 0 & \frac{\beta}{\mu_v} & \frac{\beta\epsilon}{\mu_v(\epsilon+\mu_v)} & \frac{\beta}{\mu_v} \\ 0 & v & \frac{v\epsilon}{(\epsilon+\mu_v)} & v \\ \frac{\beta N_v}{N_h(\gamma+\mu_{hd})} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}. $$

Therefore, $R_0 = \frac{v}{2} + \frac{1}{2}\sqrt{v^2 + \frac{4\beta^2\epsilon N_m}{N_h(\gamma+\mu_{hd})\mu_v(\epsilon+\mu_v)}}$.

5. Numerical study

The generalized fractional-order dengue model is solved approximately using the second-order accurate Trapezoidal numerical scheme. The

numerical simulations presented in below are performed both for the discredited version of Caputo derivative based generalized fractional model based generalized fractional model (15). The impact of temperature fluctuations on dengue transmission dynamics is presented in Figure 2 where temperature is considered 18°C, 25°C and 32°C for a fixed fractional order .

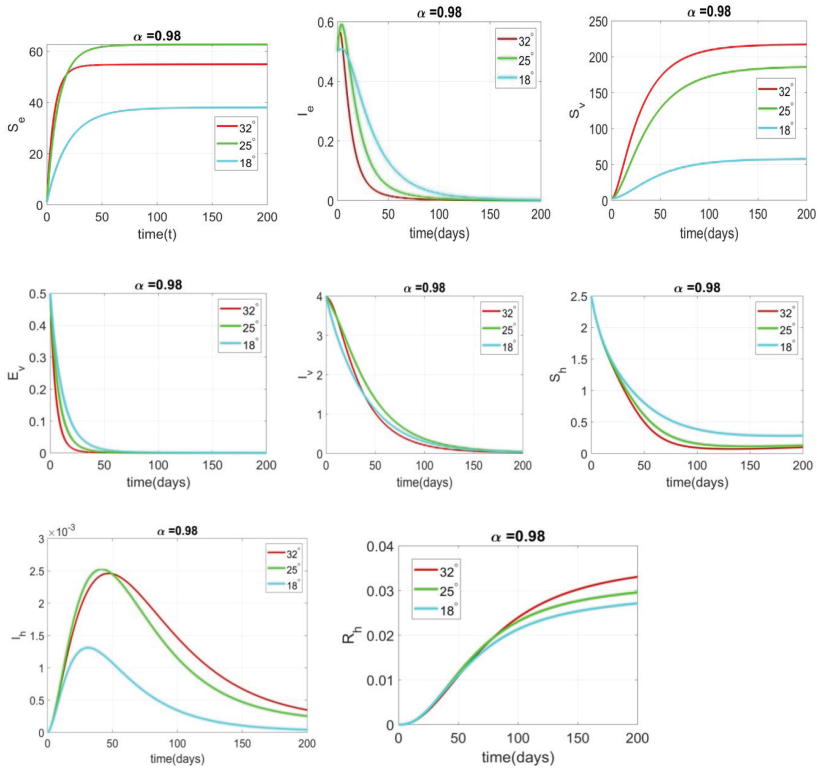

Figure 1: Comparison results of the Caputo operator governed by the fractional order dengue model at temperature 32°C, 25°C and 18°C.

6. Conclusion

For this purpose, the development of modern mathematical operators and tools reflecting properly the memory effect that naturally appears in most biological systems has a great importance. The generalized fractional order dengue model investigated in here reflected the temperature-dependent transmission dynamics of dengue epidemic in a way to obey the results stated in the epidemiological research studies which states the influence of temperature and precipitation on the life

cycle of adult female mosquitos, incubation, biting rate, mosquito density and distribution. In this research, the effect of the temperature 32°C is validated by the generalized fractional model as in the epidemiological facts of the considered subtropical region in Taiwan. Our numerical simulations governed by the discredited fractional model result the highest danger of dengue transmission exists at temperature 32°C. The results for fractional order at the mean temperature 25°C goes to steady state level for each population in the case of both fractional operators. In this way, we become eligible to include the memory effect into the process and monitor the different behaviors of the real observations, if provided, in a single model.

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Statistical Analysis of Choice Of Metals of Sensing Towards Hazardous Gas

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Abstract

Nanocrystalline (8–10 nm size range) calcium and Gadolinium doped ceria compositions of the formulae $Ce_{0.80}X_{0.20}O_{2-\delta}$ (X= Mn, Sm) were prepared by citrate - glycine–nitrate combustion process. Systematic (%) response studies towards sulphur dioxide gas of the nano powders also found to be very high indeed. Owing to the very high response towards sulfur dioxide gas, (%) response studies of both the compositions were also further statistically analysed for highlighting the importance of the best choice of the metal for an effective application. Infact, sulfur dioxide is a very toxic gas and is hazardous and directly harmful to both human health, aquatic life and ecosystems. So, its detection is very necessary and emergency for a healthy environment.

Keywords

Combustion synthesis; citrate-glycine- nitrate fuel approach; Nanocrystalline $Ce_{0.8}X_{0.2}O_{2-\delta}$ (X= Mn, Sm); % response; statistical approach

1. Introduction

Ceria (CeO_2) and its substituted derivatives in general had immense technological applications such as solid electrolytes in low temperature solid oxide fuel cell (SOFC) , O_2 sensors and also as catalytic supporters for automobile exhaust systems [1–20] due to their higher oxide ion conductivity at low temperatures (500°–700 °C). The catalytic activity of pure ceria is mainly due to oxide ion defects for oxygen mobility and its oxygen storage capacity (OSC) and can be largely enhanced by the use of a suitable metal catalyst as dopant. In fact, the role of the metal catalysts is to form an electronic interaction between metal and CeO_2 which plays a vital role in enhancing the catalytic activity of ceria in

presence of the metal. It is noteworthy to mention that, recently, doped ceria compositions are extensively being used as various % response purposes towards different gases, but not for sulfur dioxide gas yet. Among the various ceria investigated so far [21–24], we have chosen and considered Mn and Sm doped ceria as the most promising for % response towards most hazardous sulfur dioxide gas applications. However, from the viewpoint of material expenses, Sm nitrate is very costly but Mn nitrate is the cheapest one. Hence, there is an increasing interest to identify and develop new doped ceria based nanoparticles using cost-effective dopants for % response applications.

Since the incorporation of Mn^{2+} or Sm^{3+} ions in place of Ce^{4+} in fluorite lattice of ceria increases the concentration of extrinsic oxygen ion vacancy defects, so $Ce_{0.8}X_{0.2}O_{2-\delta}$ (X= Mn, Sm) solid solution possesses greater concentration of oxygen ion vacancy defects (both intrinsic as well as extrinsic as evident from both the following equations 3, 4 and 5) in addition to only intrinsic oxygen ion vacancy defects in pure ceria (equation 3) as evident from the following Kroger-Vink relation:

$$2CeO_2 \leftrightarrow 2Ce_{Ce}{}' (Ce_2O_3) + 3O_O{}^x + \tfrac{1}{2}O_2 + V_{\ddot{O}} \quad \text{..... (3)}$$

$$2CeO_2 \xrightarrow{2MnO_2} 2Ce_{Mn}{}'' + 2O_O{}^x + O_2 + 2\,V_{\ddot{O}} \quad \text{..... (4)}$$

$$2CeO_2 \xrightarrow{Sm_2O_3} 2Ce_{Sm}{}'' + 3O_O{}^x + O_2 + V_{\ddot{O}} \quad \text{..... (5)}$$

Also, the equation 4 indicates the formation of twice the concentration of extrinsic oxygen ion vacancy defects in $Ce_{0.8}Mn_{0.2}O_{2-\delta}$ solid solution compared to the concentration of intrinsic oxygen ion vacancy defects in pure ceria as in (equation 3).

In this paper, we have prepared nanocrystalline (8–10 nm size range) calcium and gadolinium doped ceria powders of the compositions $Ce_{0.8}X_{0.2}O_{2-\delta}$ (X= Mn, Sm) by citrate - glycine–nitrate combustion process. Systematic (%) response studies towards sulfur dioxide and other gases were also performed by these nano powders. Further Statistical analysis were also studied for highlighting the importance of the best choice of the metal for an effectively good application.

So, the main objective of this paper is to study the stability analysis of different metal doped ceria statistically, in order to trace out the best efficient metal in terms of % response towards the most toxic sulphur dioxide gas from cost benefit analysis for further future technological

advancement. Even at lower concentrations, sulphur dioxide gas can cause severe irritations such as coughing, shortness of breath, difficult breathing in the chest, accumulation of fluid in the lungs (pulmonary edema) and several nose and throat problems, all of which are life threatening. So, its detection is highly emergency for a fruitful healthy environment.

2. Materials and Methods

All the chemicals used were of analytical reagent grade. In this process, an aqueous 0.2(M) stock solutions of different metals such as Mn nitrate and Sm nitrate were prepared from their corresponding nitrates. For the preparation of both the compositions $Ce_{0.08}X_{0.2}O_{2-\delta}$ (X= Mn, Sm), calculated amount of citric acid monohydrate ($C_6H_8O_7.H_2O$, 99.5% Merck Ltd, Mumbai, India) and glycine nitrate as C/N = 0.3 and G/N = 0.1 were added to each of the metal nitrate salt solutions (0.2 M). The above mixed solution was allowed to evaporate on a hot plate with stirring (hot plate temperature 200±5 °C). The homogeneously mixed solution became viscous and turned into a gel during heating. The gel slowly foams, swells, and finally burns on its own, and once ignited at any point, the ignition slowly propagated forward until the whole sample fully burnt to produce the corresponding ash powders. The auto-ignition was completed within a few seconds, giving rise to a voluminous powder. The mode of decomposition and burning steps were monitored visually. The gels collected were air dried. The ash powders obtained after the combustion were ground in an agate mortar and calcined at 300°C temperature for 6 h.

3. Methodology

As methodology, simple statistical tools such as charts and diagrams, coefficient of variation, correlation coefficient have been used for the analysis. Here, line diagrams have been used in this paper to study the trend in the growth of the linear relationship between the variables so as to obtain the best fitted straight line. Besides, bar diagrams also have been used.

Bar diagram consists of a group of equispaced rectangular bars, one of each category of given statistical data. The bars, starting from a common base line, must be equal width and their length represents the values of statistical data. There are two types of bar diagrams - vertical

bar diagram and horizontal bar diagram. The former is used to depict the data classified for variables, while the latter is used the same for attributes only.

There are many types of bar diagrams like group bar diagram, component bar diagram, paired bar diagram etc. Group bar diagram is used to show the comparison of two or more sets of related statistical data. Component bar diagrams are useful for comparing the sizes of the different component parts among themselves, and also the relation between each part as a whole.

Coefficient of Variation (C.V.) is one of the most important and best relative measures of dispersion in statistics to analyse the variations of any variable for comparison purposes. It is defined as the percentage ratio of Standard Deviation (S.D.) to Mean (S.D./Mean x100).

Here, Coefficient of variation has been used to rank the stability analysis of these two different metal doped ceria at various temperature ranges.

Moreover, Correlation Coefficient (r), ranging between +1 and -1, is also used, in statistics, as a measure of the degree of association and also to determine the strength of association between the two variables. A positive value of correlation coefficient indicates a positive relationship, whereas a negative correlation coefficient indicating a negative one between the above mentioned two variables.

In this paper, correlation analysis [correlation coefficient (r)] analysis has been used as methodology, to study the nature of linear association between the two variables Further, the square of correlation coefficient (r) as (R^2) also has been used to analyse the degree of association between the two variables, in terms of the variation in the dependent variable (Y) as explained by the independent variable (X) (Gujrati & Sangeetha, 2008) [25].

4. Results and Discussion

Figure 1 displays the XRD patterns of the as-synthesized and the $Ce_{0.8}X_{0.2}O_{2-\delta}$ (X= Mn, Sm) nano powder samples. All the XRD patterns could be indexed as a cubic fluorite cell and the peaks are found to be quite broad indicating the nanocrystalline nature of the as-synthesized powders. The crystallite size was calculated from XRD and ranges between 8-10 nm as shown in Table 1. The surface area of these doped ceria powders are also found to be quite high around 45-55 m^2/gm.

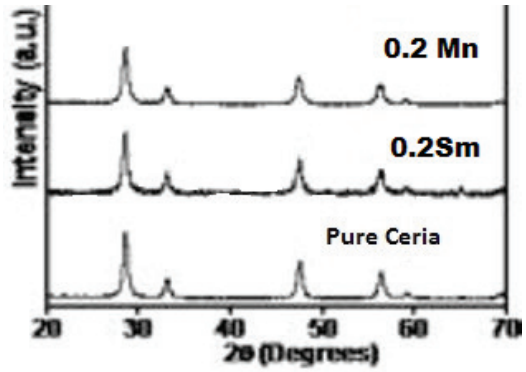

Figure 1:XRD

Table 1. The physico-chemical characteristics of nano ceria powders

Samples	D_{XRD} (nm)	S_{BET} (m^2/gm)
0.2Mn	8	55
0.2Sm	10	45

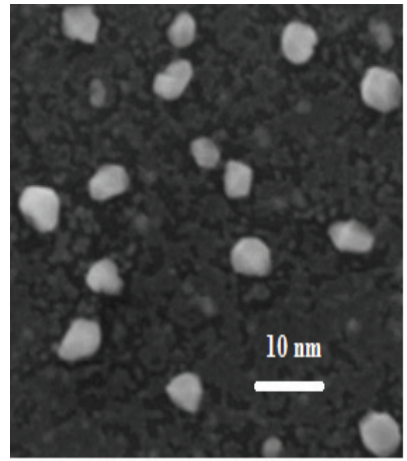

Figure 2: TEM

TEM picture of the powder sample $Ce_{0.80}Mn_{0.2}O_{2-\delta}$ is shown in Figure 2 which shows nanocrystalline fine powders of size around 8-10 nm.

5. Statistical Analysis

In this paper Mn and Sm have been chosen as two different metals with different characteristics in metal doped ceria.

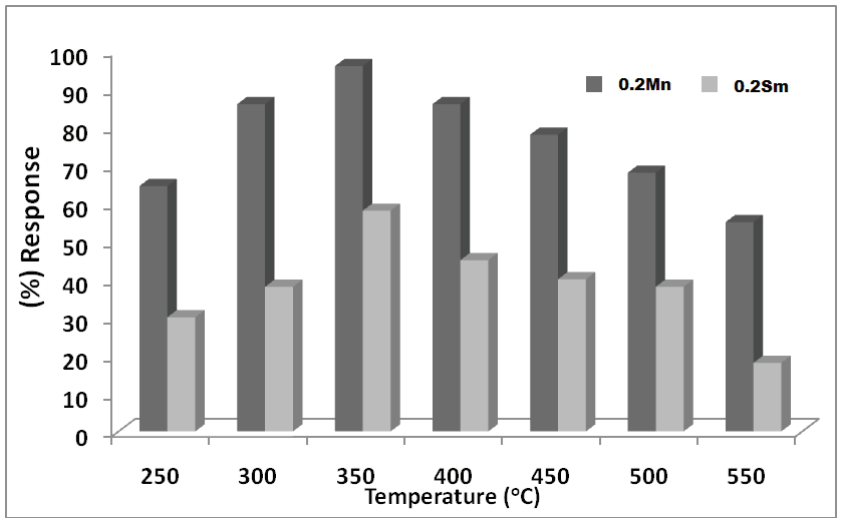

Figure 3

Figure 3 shows the % response verses temperature data for sulphur dioxide gas among two different metal doped ceria. % response studies verses temperature data towards other gases like butane shows very low data around 20-25% for both the samples. It shows that Mn doped ceria exhibits highest % response towards sulphur dioxide gas at all temperatures, almost >95% at 350°C, much better performance than Sm doped ceria with same composition. So, Coefficient of variation (C.V.) studies (Table 2) have been performed which ranks and in fact confirms the stability analysis of these two different metal doped ceria at various temperature ranges. Here, % response of these two different metal doped ceria have been used as the two variables (x) and (y). Now, from the statistical data analysis, C.V. of 0.2Mn (16.57) is found to be much lower than that of 0.2Sm (34.21). Since lower CV means more stability and greater efficiency in terms of % response, hence, Mn is proved to be more stable and efficient than Sm metal in terms of % response. Tables 2 shows a detailed descriptive statistical data analysis.

Table 2. The descriptive statistics

Samples	Mean (nm)	Standard Deviation	coefficient of variation (CV)
0.2 Mn	76.21	14.38	18.87
0.2Sm	38.14	12.36	32.41

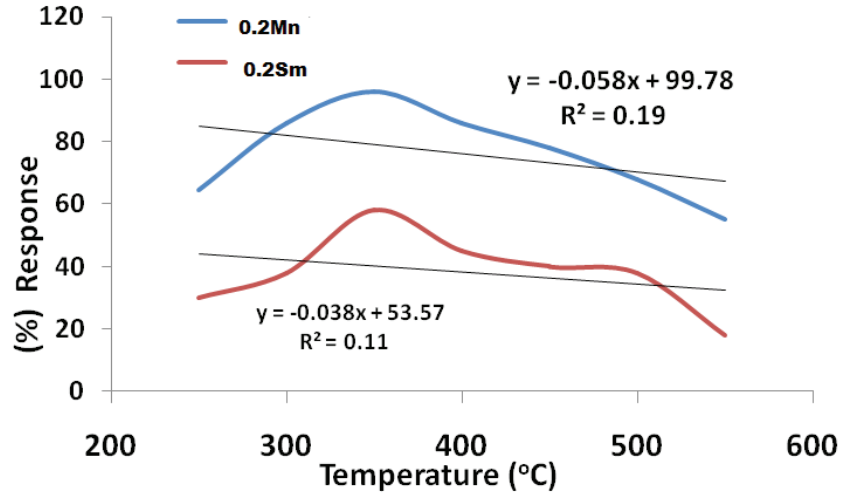

Figure 4

Table 3. The results of correlation analysis

Samples	Correlation Coefficient (r) between % response and temperature
0.2 Mn	-0.52
0.2 Sm	-0.25

Moreover, Correlation Coefficient studies have also been performed which studies the relationship between the metal and the variation of the % response of these two different metal doped ceria over same temperature range. In correlation analysis from Table 3, the value of correlation coefficient (r) is also more for Mn (0.52) than for Sm (0.25) which indicates a stronger linear correlation between temperature and % response towards sulphur dioxide gas for Mn than for Sm, which is also proved from diagrammatic analysis in Figure 4. Negative sign of r indicates that % response at first increases, reaches a maximum and then slopes down. Further, from the value of R^2 in Figure 4, the R^2 value of Mn (0.19) is also greater than that of Sm (0.11), so that the greater proportion of variation in % response over the same temperature range is better explained by Mn than by Sm. Moreover, from Figure 4, the slope coefficient (β value) of the line diagram is also more for Mn (0.058) than for Sm (0.038) which implies that per unit change in temperature leads to a greater change in % response of Mn (more β value) than in Sm. So, in terms of statistical ranking, Mn is the best choice as Mn>>Sm in all respects.

Also, as cost benefit analysis, as Sm is a very costly rare earth metal, Mn can be proposed for usage in further future advancement of research applications.

6. Conclusion

Combustion Process using both citric acid and glycine as fuel and nitrate as an oxidizer synthesizes highly nanocrystalline $Ce_{0.80}X_{0.20}O_{2-\delta}$ (X= Mn, Sm) powders with very fine crystallites of almost 8–10 nm size ranges and very high surface area of 45-55 m^2/gm. The Mn doped ceria powders showed higher % response towards hazardous gas sulfur dioxide almost at all temperatures compared to Sm doped ceria powders which show much lower response. % response towards other gas like butane gas is very poor almost 20-25% for both the samples. Our statistical coefficient of variation and correlation studies both shows higher r, R^2, β values and lower CV value for only Mn than Sm. Lower CV means more stability and more efficiency. Also from cost benefit analysis, Mn is the most cheapest metal than Sm. So, Mn proves to be more stable and best efficient metal in terms of % response, thereby to be recommended in further research/policy purposes.

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Utilizing Fractional order Calculus in the Context of Epidemic Models

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Abstract

We have studied the analysis of four different epidemic models under various conditions regarding possible applications to the COVID-19 pandemic. In spite of numerous more complicated models, we show how the qualitative features of the solution to the SIQR, SEIR, SEIRV and SEIQRD models continue to provide valuable public health insights in some scenarios. It is quite challenging to genuinely create an appropriate mathematical model using classical differentiation in the situation of COVID-19 because to the large number of uncertainties, unknowns, and disinformation. Generally, non-local operators are better suited for such circumstances because, depending on whether power law, fading memory, or overlap effects are taken into account, they can represent non-localities and certain memory effects.

Keywords

Epidemiological model; SIQR; SEIR; SEIRV; SEIQD; COVID-19

1. Introduction

Mathematical modeling in epidemiology is an important branch of basic science. Epidemiology is the branch of science where the patterns and determinants of health, illness, disease conditions and associated factors at population level are studied. The meaning of the Greek terms epi, demos, and logos are, respectively, 'upon', 'people' and 'study' [1]. So the word 'epidemiology' means 'the study of what is upon the people'. The Greek physician Hippocrates (460-377 B.C.E.) who described the connection between environment and disease, is considered the father of epidemiology [2].

Although the history of epidemiology is very lengthy, but the mathematical study and analysis of infectious diseases is only about three hundreds and fifty years old. John Graunt (1620-1674) was honored for first statistical study of infectious diseases. Daniel Bernoulli worked on smallpox by using mathematical methods in 1766 [3, 4]. In the early twentieth century, William Hamer did commanding work on measles. He was the first to use the mass action law in mathematical modeling of infectious diseases. Sir Ronald Ross is considered as the father of modern mathematical epidemiology for his commanding work on malaria. He discovered that malaria transmits from mosquitoes to humans and then humans to mosquitoes. He worked for the prevention of malaria and derived a threshold number, which is nothing but the basic reproduction number that provides whether the disease can persist or not. For his work on malaria, the Nobel prize was awarded to Sir Ronald Ross in 1902. But, the mathematical epidemic model proposed by Kermack and McKendrick in 1927 [5] has helped to reach the subject mathematical epidemiology to a new level. They proposed a deterministic epidemic model for the first time and provided biological interpretation by analyzing the model using mathematical tools. More developments and progresses have been particularly made during the past three decades. Numerous mathematical models have been formulated by the researchers to study the dynamical behavior of various infectious diseases which show rich non-linear phenomena [6 -7]. Mathematical modeling in epidemiology has become powerful and important tool to understand the infectious disease dynamics and to improve control of infection in the population. A good epidemic model is an intelligent model which is able to predict any possible outbreak of the disease and is effective in reducing the transmission of the disease. It is a simplest version of reality in Biology [8 -9].

The novel coronavirus disease (COVID-19) is a worldwide infectious disease in the current time. Including this year the world faces severe attack by coronavirus several times, some of those are: (i) SARSCoV occurred in China and then spread many neighboring countries in 2002-2003, (ii) MERS-CoV appeared in 2012 throughout the Middle East, (iii) SARS-CoV-2 was first identified in China in December 2019 and the whole world has been suffering from it [10]. Though the infection of COVID-19 was first reported in Wuhan, China in December 2019, due to human movement it spread throughout the world. The emergence of COVID-19 occurred in a crucial time because that time was the spring festival time in China, so a large number of people moved from one place to another places [11] and the disease started to spread to huge number of people who moved from their working place to their home land as a consequence the disease spreads to the whole world. COVID-19 have killed enormous people throughout the world.

The plague of Athens is the first serious epidemic mentioned by the historians that hurt the city of Athens in 430-426 B.C.E. The Black Death is the one of the most well documented epidemics that struck the Mediterranean and Europe and killed 50-100 million people in 1348-1350. The Bombay plague in the years 1905-1906, the influenza pandemic in the early twentieth century, the H1N1 swine flu pandemic in the year 2009 are some of other notable epidemic all over the world.

Mathematical models have become extremely important tools in understanding and analyzing the spread and control of infectious diseases. Though the SIR model is one of the simplest epidemiological models, it is still one of the most popular and mainly used to study infant viral and bacterial infections. There are few models, used for childhood disease is SEIR model, one which adds a class of exposed (E) individuals. Similar models like SAIR, introducing asymptomatic class (A) are fruitful for analyzing epidemic like COVID-19. There are many modifications of the SIR model, including those that include births and deaths, where upon recovery there is no immunity (SIS model), where immunity lasts only for a short period of time (SIRS), where there is a latent period of the disease where the person is not infectious (SEIS and SEIR), and where infants can be born with immunity (MSIR).

Motivation and Research Background

A mathematical modeling of infectious disease is critical for better understanding the transmission patterns of the disease and evaluating control strategies. It serves as motivation for mathematical and biological experts to investigate and evaluate the dynamical systems that regulate such diseases in order to anticipate their spread and control in the long term. Fractional order modeling is a useful tool that has been used to explore the nature of diseases since the fractional derivative is an extension of the integer-order derivative. In order to replicate real-world issues, several innovative fractional operators with various properties have been designed. In addition, the integer derivative has a local identity, whereas the fractional derivative has a global character. Numerous varieties of fractional derivatives, both with and without singular kernels, are available today. Leibniz's query from 1695 marks the beginning of the fractional derivative. The fractional derivative also improves in the improvement of the system's consistency domain. We have the derivatives of Caputo, Riemann-Liouville, and Katugampola for singular kernels. There are two varieties of fractional derivatives without singular kernels: the Caputo-Fabrizio fractional derivative, which has an exponential kernel, and the Atangana-Baleanu fractional derivative, which has a Mittag-Leffler kernel. While memory and genetic properties are involved, working with fractional-order derivatives is crucial because it provides a more accurate technique to describe COVID-19 outbreaks. Numerous academic articles, monographs, and novels have provided evidence to support this claim; for instance. Over these years, several types of fractional calculus [12 – 14], for example, Riemann–Liouville , Caputo, Caputo–Fabrizio, Katugampola, Atangana–Baleanu, Hadamard etc. have been introduced to study the dynamics of the epidemic models, each displaying certain advantages and disadvantages. We have used the Caputo–Fabrizio operator because of its possession of a nonlocal and nonsingular exponential kernel and is found to be best suited to analyze the dynamics of COVID-19. The dynamics of COVID-19 transmission are described using a fractional order SIQR model. We investigate the disease's impact using an appropriate mathematical model in context of the Caputo–Fabrizio fractional differential equation, motivated by early research. One of the several variations of the conventional SIR model is the SIQR model. It has been observed that quarantining the infected individuals is a better measure to control the spread of the disease.

Motivated by the current research, we present and analyze different models using fractional derivative. The Caputo derivative is particularly useful for discussing real-world situations since it permits traditional beginning and boundary conditions to be used in the derivation, and the derivative of a constant is zero, whereas the Riemann–Liouville fractional derivative does not.

2. Model formulation

Model 1:

Let us consider the case of a Susceptible –Infected – Quarantine – Removed (*SIQR*) epidemic. The population (*N*) is divided into four classes: the susceptible individuals (*S*), the infected individuals *(I)*, the quarantine individuals *(Q)* and the recovered individuals *(R)* at any time t ≥ 0. Now *N(t)=S(t)+I(t)+Q(t)+R(t)*.

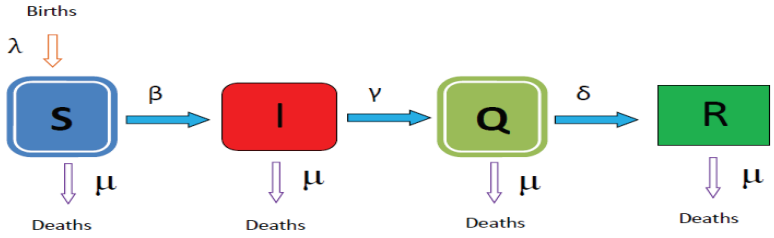


Figure 1: The Diagram of the *SIQR* model

Table 1. The parameters of the model and their descriptions

Notation	Interpretations
λ	Natural birth rate
β	Contact rate between S and I
γ	Infection rate of Q class
δ	Recovery rate
μ	Natural death rate

Now we formulate the SIQR model with fractional order derivatives with Caputo operator of order $0 < \alpha \leq 1$.

$$
\begin{aligned}
{}^{CF}D_t^{\alpha} S(t) &= \lambda - \beta SI - \mu S, \\
{}^{CF}D_t^{\alpha} I(t) &= \beta SI - (\gamma + \mu) I, \\
{}^{CF}D_t^{\alpha} Q(t) &= \gamma I - (\delta + \mu) Q, \\
{}^{CF}D_t^{\alpha} R(t) &= \delta Q - \mu R.
\end{aligned} \tag{1}
$$

Model 2:

At time $t \geq 0$, the whole population (N) is divided into four classes, namely, the susceptible (S), the exposed (E), the infected (I) and the recovered (R) class. Thus $N(t) = S(t) + E(t) + I(t) + R(t)$.

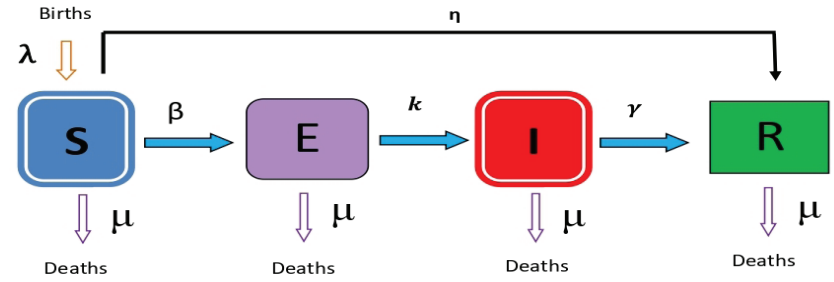


Figure 2: The model is depicted as a diagram

We analyze the *SEIR* model with vaccination in this presentation, utilizing the Caputo operator of order $0<\alpha \leq 1$.

$$
\begin{aligned}
{}^{C}D_t^{\alpha} S(t) &= \lambda - \beta SI - \mu S - \eta S \\
{}^{C}D_t^{\alpha} E(t) &= \beta SI - (\mu + k) E \\
{}^{C}D_t^{\alpha} I(t) &= kE - (\mu + \gamma) I \\
{}^{C}D_t^{\alpha} R(t) &= \gamma I - \mu R + \eta S
\end{aligned} \tag{2}
$$

where
λ : birth rate of susceptible individuals,
β : contact rate from S to E,
μ : death rate,
η : vaccination rate,
k : progression rate exposed to infected,
γ : recovery rate.

Model 3:

The entire population *(N)* is divided into five categories, namely, the susceptible individuals *(S)*, the exposed individuals *(E)*, the infected individuals *(I)*, the recovered individuals *(R)* and the vaccinated individuals (V)at any time t ≥ 0. Thus *N(t)=S(t)+E(t)+I(t)+R(t)+V(t)*.

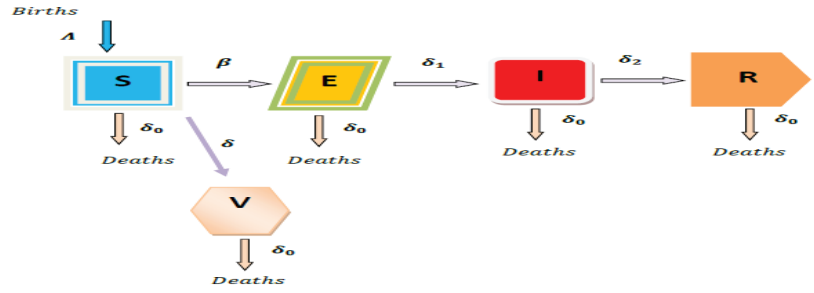


Figure 3: The SEIRV model is represented schematically.

In this communication, we consider the *SEIRV* model using fractional order derivatives with Caputo operator of order $0 < \nu < 1$.

$$
\begin{aligned}
{}^{C}D_t^{\gamma} S(t) &= \Lambda - \beta S(t)I(t) - \delta_0 S(t) - \delta S(t),\\
{}^{C}D_t^{\gamma} E(t) &= \beta S(t)I(t) - (\delta_0 + \delta_1) E(t),\\
{}^{C}D_t^{\gamma} I(t) &= \delta_1 E(t) - \delta_0 I(t) - \delta_2 I(t),\\
{}^{C}D_t^{\gamma} R(t) &= \delta_2 I(t) - \delta_0 R(t),\\
{}^{C}D_t^{\gamma} V(t) &= \delta S(t) - \delta_0 V(t),
\end{aligned}
\tag{3}
$$

Where

Λ : birth rate of susceptible individuals,
β : the rate of infection of susceptible individuals,
δ_0: the rate of mortality of all individuals,
δ: the rate of vaccination,
δ_1: the rate of progression from exposed to infected individuals,
δ_2: the recovery rate of infected individuals.

Model 4:

In the present study, the model will be divided into six compartments. The total human population to be considered is denoted as *N(t)*, and at any time, it comprises of the susceptible *(S)*, exposed *(E)*, infected *(I)*, quarantined *(Q)*, recovered *(R)*, and death *(D)* compartments, respectively.

Thus *N(t)=S(t)+E(t)+I(t)+Q(t)+R(t)+D(t)*.

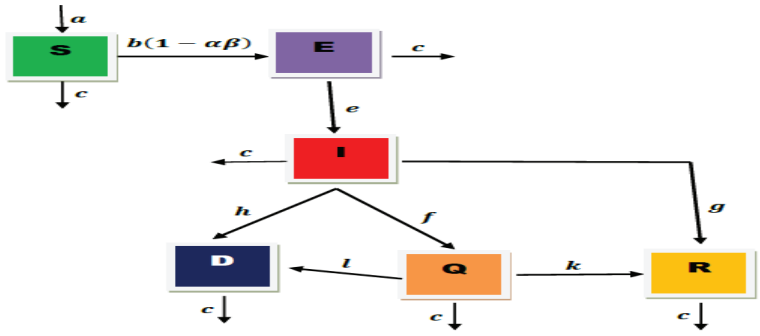


Figure 4: depicts a flow chart of the proposed model.

Table 2. Description of the relevant parameters.

Parameters	Significance
a	Recruitment rate into
b	Contact rate
α	Percentage of people who use a face mask
β	The efficacy of face masks

c	Mortality rate of all individuals
e	Progression rate from to
f	Isolation rate for
g	Recovery rate of
h	Death rate of due to COVID-19 disease
k	Recovery rate of
l	Death rate of due to COVID-19 disease

Now we formulate the *SEIQRD* model with fractional order derivatives with Caputo operator of order $0 < \phi \leq 1$.

$$
\begin{aligned}
{}^{C}D_t^{\phi} S(t) &= a - b(1-\alpha\beta)S(t)I(t) - cS(t),\\
{}^{C}D_t^{\phi} E(t) &= b(1-\alpha\beta)S(t)I(t) - (e + c) E(t),\\
{}^{C}D_t^{\phi} I(t) &= eE(t) - (f + g + h + c) I(t),\\
{}^{C}D_t^{\phi} Q(t) &= fI(t) - (k + l + c) Q(t),\\
{}^{C}D_t^{\phi} R(t) &= gI(t) + kQ(t) - cR(t),\\
{}^{C}D_t^{\phi} \mathrm{D(t)} &= hI(t) + lQ(t).
\end{aligned}
\tag{4}
$$

3. Result and discussion

The data fitting and model validation of the system (3) for Infected population in Brazil are described in this section. From the 10th of April to the 19th of July, 2021, we compared the model values with the real scenario for Brazil. The total initial population of Brazil is around. The parametric values are given in Table 3. We have taken day as time unit and as final time. Table 4 recommends day wise Infected population from 10th April, 2021 to 19th July, 2021. Figure 6 depict time series solution of Infected population of the system (3) for Table 2 taking

Table 3: The estimated parametric values are as follows in Brazil:

Parameter	Value
Λ	0.0187
β	0.32
δ_1	0.344
δ_2	0.041
δ_0	0.0063
δ	0.01

Table 4: Day wise Infected population of Brazil from 10th April, 2021 to 19th July, 2021.

Day	Infected population
10/04/2021	1269000
20/04/2021	1285000
30/04/2021	1270000
10/05/2021	1111000
20/05/2021	1068000
30/05/2021	1108000
09/06/2021	1128000
19/06/2021	1257000
29/06/2021	1227000
09/07/2021	813700
19/07/2021	825000

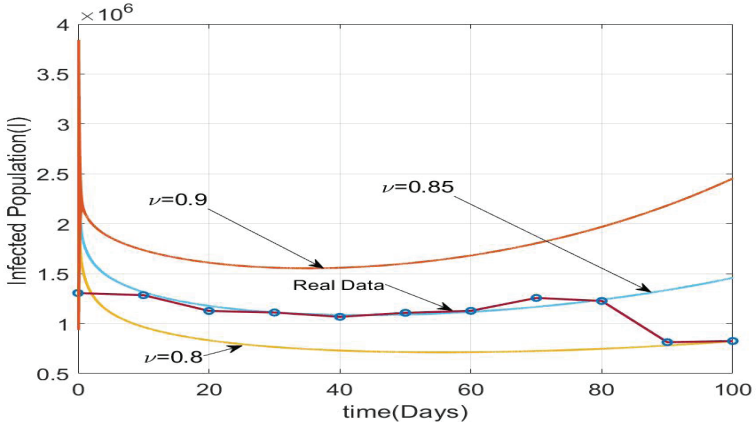


Figure 5: Time series solution of Infected population of the system (3) for Table 2 taking

Table 5 shows the parameter values utilized in the numerical simulations for Part 2. The acquired findings are shown in Table 6 after computing the fundamental reproduction numbers and utilizing the model parameters from Table 5. Table 6 shows that if a higher number of individuals in a community constantly utilize face masks, the COVID-19 epidemic can be decreased.

Table 5. Parameter values for numerical study.

Parameters	Value
a	1191
b	0.98159
α	0.1
β	0.7
c	0.0006
e	0.1
f	0.0007
g	0.05
h	0.015
k	0.053
l	0.012

Table 6. Numerical simulation of the varying effects of .

Parameter	Value	
α	0.1 (10%)	1.423 <1
α	0.5 (50%)	0.973 <1
α	0.8 (80%)	0.659 <1

Figure 6 depicts that the values of decrease when α increase. The various consequences of wearing face masks were also investigated in this study, and it was discovered that wearing face masks on a consistent and suitable basis can inhibit the spreading of the COVID-19 pandemic.

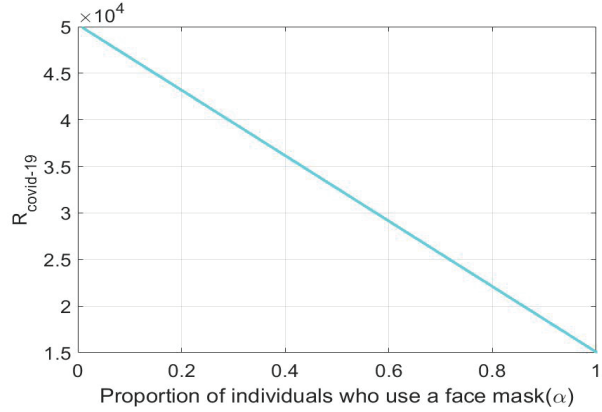
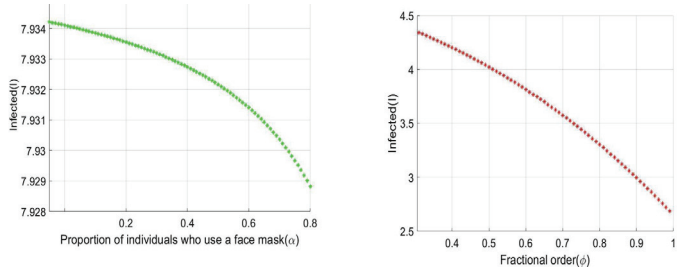


Figure 6. Variation of under .

The impact of α and ϕ on the Infected individuals is depicted in Figures 7(a) and 7(b). Based on the following figures, it can be noted that the implementation of maximum portion of population who use a face masks in order to effectively reduce COVID-19 transmission.



(a) (b)

Figure 7. Dynamics of under and ϕ.

4. Conclusion

In the beginning, the dynamics of COVID-19 transmission is described, using a fractional order model. To obtain semi-analytic solutions to the model, the Iterative Laplace Transform Method [ILTM] is implemented. Considering COVID-19 cases data in India and Brazil, collected upto 1st August, 2020, the basic reproduction number is estimated to be 1.7824 and 2.767 respectively. A fractional order *SEIR* model with vaccination has been studied. It has been found that introduction of the vaccination parameter reduces the reproduction number . Based on the COVID-19 cases data in India, collected upto 1st August, 2021, the basic reproduction number without vaccinationis estimated to be 3.67 and with vaccination to be 1.55. As is evident from this study that vaccination is an effective method in control and prevention of the COVID-19 disease. Chapter 4 presents a study of an SEIRV epidemic model with optimal control in the context of Caputo fractional derivative of order . A comparative study of the model values and real scenario of Brazil starting from 10th April 2021 through 100 days has been performed. It has been observed that the model fits with with realistic data. In the fractional order compartmental model of COVID-19 is explored with six different categories in the Caputo approach. From 1st of January 2022 to 31st of January 2022, we have compared model values with real data in Italy. This study looked at the many consequences of wearing face masks, and it was discovered that wearing face masks consistently can help reduce the propagation of COVID-19 disease.

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Graphene Supercapacitors: A Step towards Flexible Energy Storage Device

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Abstract

For real-time high-power application, it is critical to have high specific capacitance with fast charging time at high current density. With its very high specific surface and conductivity, graphene fits all the requirements for the high-performance supercapacitors. Using modified Hummer's method, graphene oxide (GO)has been synthesized, followed by the reduction in hydrogen atmosphere at 400°C. In the EDL architecture, the as synthesized graphene electrodes show excellent mechanical flexibility and supercapacitive behavior giving an optimum performance of specific capacitance value 419 F/g at current density 0.2 A/g.

1. Introduction

The demand for innovative, affordable, eco-friendly, and high-performing energy storage technologies has been steadily rising due to the needs of modern society and emerging ecological concerns [1,2]. The development of a safe, clean, and extremely efficient mode of transportation is required due to the ever-increasing cost of fuel and the strict regulations governing emissions [3]. With increasing electrical cars and the use of power plants encourage the development of rechargeable batteries with better electrochemical capabilities[3,4].A lot of research is going on to boost the energy density of batteries and supercapacitors, two energy storage devices, to keep up with the rapidly rising amount of renewable energy [5,6]. It is desirable to design novel electrode materials with larger specific capacities, especially beyond their theoretical capacities, in order to further improve the energy and power densities. Due to their enhanced surface area, enticing kinetics, controlled nanostructures, and unique electrical, mechanical, and optical properties at the nanoscale, nanomaterials hold great promise for application in next-generation energy-related technologies [7,8].

The variety of materials classified as two-dimensional materials has increased significantly since the exotic display of graphene properties. These include transition metal dichalcogenides (TMDCs), phosphorene, g–C_3N_4, MXenes, h–BN, and layered double hydroxides [3, 9].

Graphene, a two-dimensional single sheet of sp2 bonded carbon with a thickness of one atom, is widely regarded as the foundational material for all other dimensional carbon compounds [8, 10]. Due to its distinct structural characteristics, graphene exhibits several notable inherent chemical and physical properties, including extraordinarily high electrical and thermal conductivity, a large surface area (2675 m2/g) leading to theoretical specific capacitance 550 F/g, and strong mechanical strength (∼1 TPa)[10, 11]. However, graphene products, are always obtained and used for energy-related applications in the form of powder, which makes it challenging to fully retain and display the fundamental properties. In the quest for the theoretical limit with pristine graphene, in this report, a completely new facile approach has been adopted to fabricate scalable-sized supercapacitor and specific capacitance upto 419 F/g has been achieved at 0.2 A/g current density.

2. Battery vs Supercapacitor:

Because of their great capacity to store energy, batteries power our everyday appliances continuously throughout the day. However, when they run out of power, it takes hours to recharge. So, a demand for overcoming this discrepancy is always there, i.e, the quest for rapid power delivery and recharging (i.e., high power density) devices, which finds an optimistic edge with electrochemical

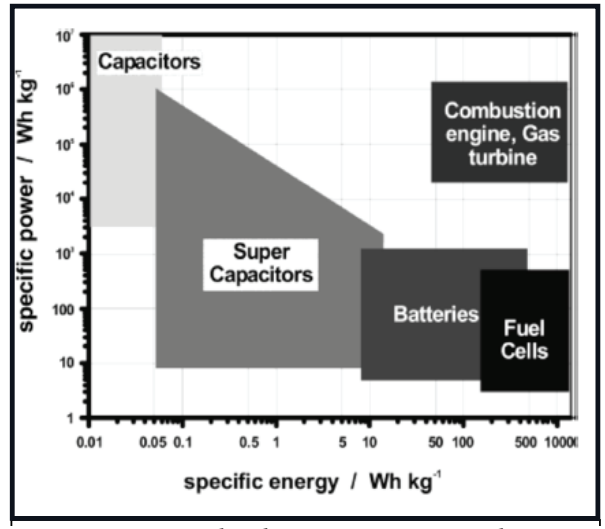

FIG. 1:Ragone plot showing a comparison between various energy storage devices [14].

capacitors known as supercapacitors (SC) [12]. In the realm of green energy, they have garnered significant attention lately. Their capacity to store energy rapidly renders them ideal for regenerative braking applications, an area in which batteries struggle because of their sluggish charging rates [12, 13]. While different electrochemical mechanisms govern the relative energy and power density of batteries and supercapacitors, both devices are dependent on electrochemical processes [13].

Supercapacitors have the ability to store and release energy quickly, producing high current in a little amount of time [13, 15]. As a result, they are used in memory backups in IT systems, electric vehicles, and uninterruptible power supplies (UPS). In extremely cold conditions, even their output outperforms batteries, providing superior low-temperature charge and discharge capabilities. Regarding power and energy density, the Ragone plot provides a qualitative comparison of different energy storage technologies (FIG.1). The performance of energy storage is clearly shown in this figure; however, important details like cycle life, cost, and safety are not included. However, the literature asserts that SCs' built-in charge storage mechanism accounts for their extraordinarily extended cycling life [13-16].

3. Mechanism of electrochemical SC performance:

To understand the dramatic paradigm shift in energy storage technology in the last decade, the fundamental mechanism of the SC performance demands a quick look back.

Charge carriers, usually electrons, are taken off of one metal plate and placed on another in a traditional capacitor to store energy. The dielectric breakdown limits the potential between the plates, but the size and material characteristics of the plates effectively determine how many charges may be stored [14]. Different voltages must be stored depending on the materials that are positioned between the plates to keep them apart. More material optimization results in higher energy densities for any given capacitor size.

As seen in FIG. 2, SCs in the electrical doublelayered (EDL) architecture lack a conventional dielectric, in contrast to conventional capacitors [17]. In these capacitors, the "plates" are actually two layers of the same substrate; the electrical properties of this "electrical double layer" allow for the effective separation of charge despite the vanishingly

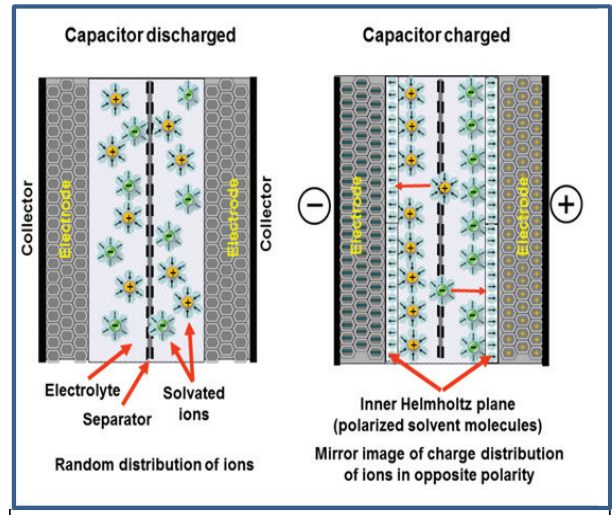

FIG. 2: Charging and discharging mechanism of EDL capacitors

thin (in the order of nm) physical separation of the layers. This is in contrast to two separate plates separated by an intervening substance. Because "plates" with significantly larger surface areas can be packed into a given size without the need for a thick layer of dielectric, resulting in their extraordinarily high capacitances in practical sized packages. However, the double layer can withstand only a low voltage, which means that EDLCs rated for higher voltages must be made of matched series-connected individual EDLCs, much like series-connected cells in higher-voltage batteries[17, 18].

4. Role of graphene:

Enhancing the capacitance performance of supercapacitors is largely dependent on the choice and construction of the electrode materials, which must provide a high specific surface area, good thermal and chemical stability, conductivity, and resistance to corrosion [7]. They should also be inexpensive and ecologically beneficial.

Graphene is an obvious choice for supercapacitors application, offering high intrinsic electrical conductivity with accessible and defined pore structure, good resistance to oxidative processes and high temperature stability[19].Since graphene is independent of the distribution of pores in solid states, it can be utilized as an electrode material. Graphene has the highest specific surface area (SSA) of any carbon material utilized as an electrode material for EDLC, at around 2675m2/g [10, 11]. It is possible for graphene to create capacitance up to 550F/g if the entire SSA is used [11]. The fact that the two main surfaces of the graphene sheet are

external and easily accessible by the electrolyte is an additional advantage of employing graphene as an electrode material.

5. Synthesis of the flexible electrodes:

For the preparation of the flexible electrodes, at first graphene oxide (GO) was synthesized from graphite powder using conventional modified Hummer's method as shown in the flow-chart (FIG. 3).

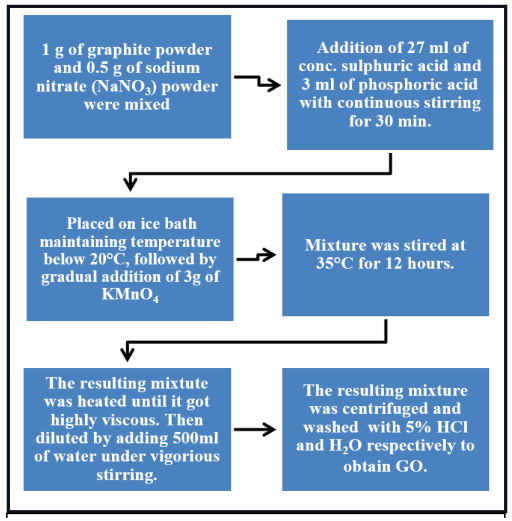

FIG. 3:Flow-chart of modified Hummer's method for GO synthesis.

The as synthesized brown GO solution is dried in petri-dish at 60°C overnight and obtained a paper the GO paper as shown in FIG. 4(a). In order to make the reduced graphene oxide (RGO) electrodes, at first GO paper was cut to desired size with ordinary scissor. Instead of following any complex chemical reduction procedure, a facile technique has been adopted where GO papers are treated in thehydrogen atmosphere at 400°C to get rid of the oxygenated groups present in GO. When the heating rate and flow of hydrogen gas were controlled precisely, it as remarkable to find that the resulted black RGO electrodes retained the shape and flexibility of its original [FIG. 4(b) & (c)].

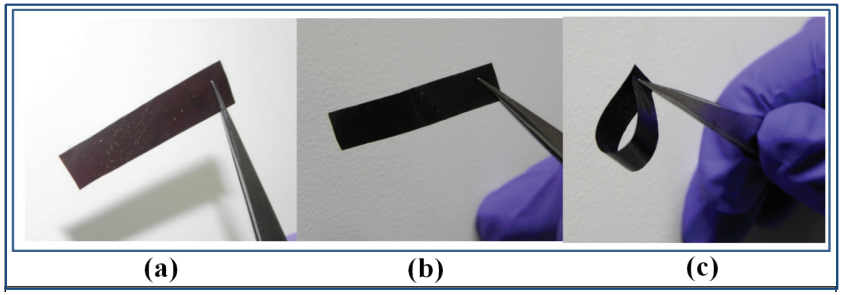

FIG. 4 (a) Graphene Oxide (GO) paper. (b) Reduced graphene oxide (RGO) paper after drying and (c) retaining the flexibility.

6. Characterizations:

Prior to the electrochemical performances, the sample has been studied for the morphology through Scanning Electron Microscope (SEM). The SEM micrograph ensues the obvious membrane-like texture of the RGO paper electrodes. To get an idea of the porosity of the materials, BET measurement has been carried out and a fairly high specific surface of 203 m2g-1 has been obtained. All the results are summarized in FIG. 5.

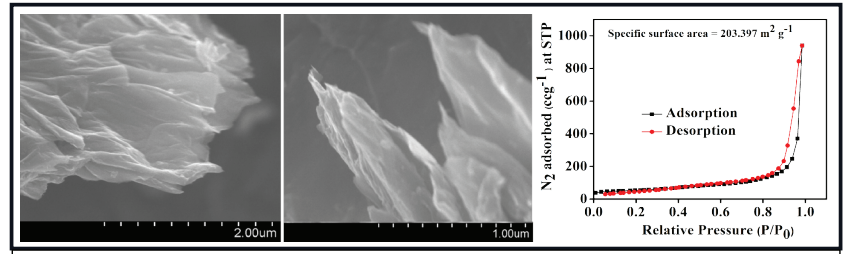

FIG. 5: (a) & (b) SEM image of RGO paper showing membrane-like microstructure. (c) Adsorption characteristics of BET measuring the specific surface area of the RGO sample.

7. Results and discussions

As mentioned earlier, the flexible graphene paper electrodes are assembled in the EDLC form to fabricate the prototype device as shown in the FIG. 6. Here the silver paste has been used as the current collectors on either side and a filter paper played the role of the separator between the electrodes. Different electrolyte (NaCl, H2SO4, KOH) of varying concentrations have been tried to optimized the cell performance, but with 1(N) NaCl electrolyte resulted the best.

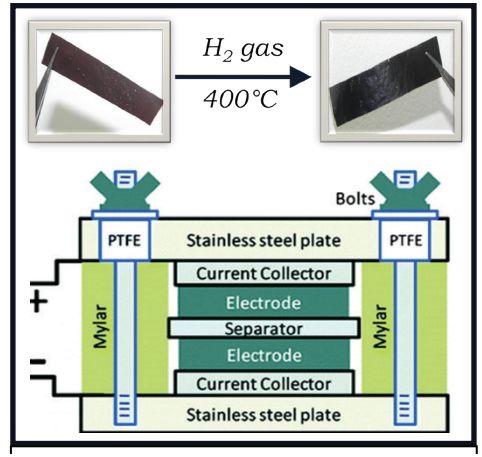

FIG. 6: Change of colour from Go (brown) to RGO (black) electrodes and the EDLC scheme of prototype cell.

Galvanostatic charge/ discharge and Cyclic Voltammetry methods

(Neaware Battery Tester Analyzer of model CT-3000) have been employed to analyse the specific capacitance and various parameters in the fabricated EDL supercapacitors.

Voltage across the supercapacitor at the time of charging and discharging, has been recorded through a number of cycles for a fixed current density. Curve has been drawn capacitor voltage vs charging/ discharging time for a fixed current density. From figure the specific capacitance is calculated from standard formula given below:

$$Ccp = I\Delta t/\Delta Vm \text{ in Fg-1}$$

where, 'I' is the discharging current (A), 'Δt' is the discharging time (S), 'ΔV' is the discharged voltage eliminating the IR (V) drop and 'm' is mass of active material (g).

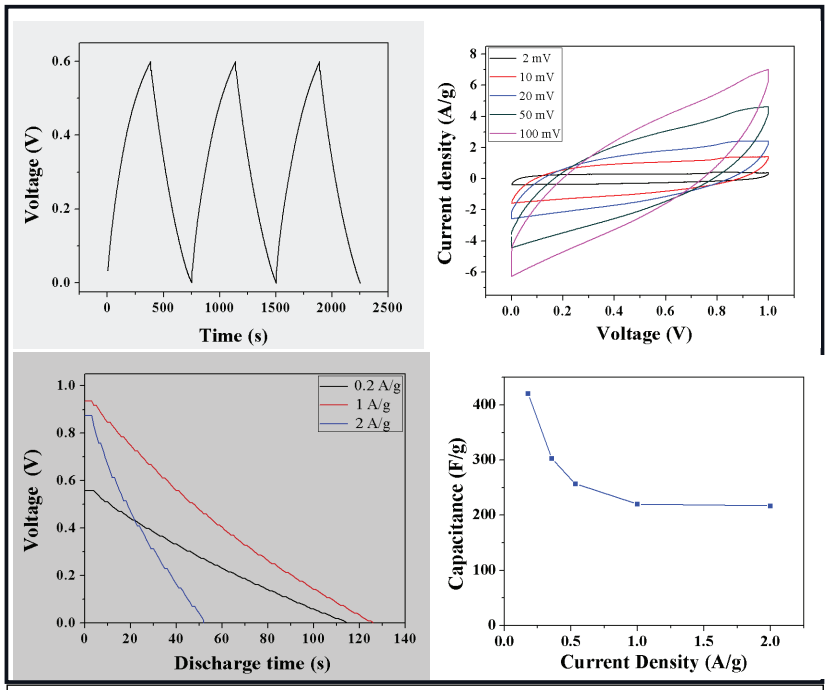

FIG. 7: (a) Regular saw-tooth nature of the charging-discharging profile. (b) rectangular CV curves confirming supercapacitive nature. (c) Discharging curve for the calculation of specific capacitance. (d)Specific capacitance vs. current density curve for the EDLC with graphene electrodes.

For a series of supercapacitors, these measurements have been repeatedat different current densities through a number of cycles. For all

the measurements, the saw-tooth nature of the galvanostatic charging/ discharging curves were obtained [FIG. 7(a)]. The supercapacitive nature of the cells are further confirmed by the almost rectangular nature in the cyclic-voltammetry study [FIG. 7(b)].The calculated maximum specific capacitance of 419 F/g has been obtained at 0.2 A/g current density [FIG.7(c)]. But, with increasing current density, the cell performance falls as the IR drop rises. Ultimately beyond 1 A/g current density, specific capacitance shows a consistent behavior [FIG. 7(d)].

8. Conclusion

This work projects the design of flexible supercapacitors with pristine graphene in a facile cost-effective method. It started with the synthesis of GO paper via modified hummers method form its precursors, followed by reduction procedure devoid of any rigorous chemical route. GO paper at 400°Ctemperature in a controlled hydrogen atmosphere and the obtained RGO paper remarkably retained its shape and flexibility. The samples have been characterized with SEM and BET analysis for the microstructure and porosity measurements respectively. Several EDL supercapacitors have been designed with different batch of RGOs and the prototype cells have been studied thoroughly with varying electrolytes to optimized the cell performance. For the best sample, it is found that the CV curves show almost rectangular nature ensuring the perfect supercapacitive behavior and specific capacity reaches 419F/g at Current0.2A/g,which eventually stabilized to a lower value at higher current densities.

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A Solution Technique of non Linear Programming Problem in Neutrosophic Environment

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Abstract

In this chapter, we establish the magnitude method in a generalized way. The study deals with the solving of the neutrosophic non linear programming problem (Neu-NLP-problem) with constraints in terms of generalized single valued trapezoidal neutrosophic number (SVTN-number) by using magnitude method. We also ddeveloped few important definitions, properties, and theorems related to the magnitude algorithm. Finally, to show the efficiency and applicability of the proposed method, we provided a numerical illustration.

Keywords

SVTN-numbers; Magnitude method; Ranking function; Neu-NLP-problem

1. Introduction

Non linear programming (NLP) indeed plays a crucial role in operations research. It helps optimize complex system with non-linear relationships

and constraints, making it a powerful tool for decision- making in various fields like economics, engineering, management science, control theory, and logistics. In many, practical sceneries, the data within the system being analyzed often lacks of precision. Hence, we aim to utilize concepts to capture the uncertainty present in the data. When faced such situations, employing linear programming (LP) with imprecise data is preferable.

Classical set (CS) theory is inadequate for managing that scenario since it merely determines if an element belongs to a set or not. In response to the growing complexity of our daily life aqctivities, Zadeh [1] introduced fuzzy sets (FS) to adress uncertainty and ambiguity, later followed by Atanassov's [2] development of intuitionistic fuzzy set (IFS). A FS classified based on membership value, while an IFS is classified by both membership and non membership simultaneouly. Both theories have been extensively implemented in contexts characterized by vagueness and uncertainty since their inception. Smarandache [3,4] introduced the neutrosophic set as way to handle uncertainty with more precision , extending beyond CS, FS, and IFS. NS is classified by a triplet (T,I,F), where T,I,F are represent truth, indeterminacy, and falsity components, respectively. To implement the NS theory, Wang [5] introduced the notion of single-valued neutrosophic set (SVN-set). Dele and Subas [6] generalized the introduction of SVN-numbers. Bera and Mahapatra [7] also introduced SVN-numbers in a new way. In this chapter, we follow the above type of SVN-numbers. Additional extensions of neutrosophic sets, including bipolar NS [8], multi-valued NS [9], neutrosophic logistics set [10], and interval NS [11], have been introduced and utilizrd to address diverse problems [12-16]. Lately, numerous researchers [17-18] have been employing NS to tackle LPP within neutrosophic environments.

In this chapter, the paper's structure is provided step by step. In the first section, we have outlined the introductory segment. In the second section, we revised some fundamental definitions to further develop the main concept of this paper. In the third section, we introduced the magnitude method and discuss its characteristics. In the next section, we introduced neu-NLP-problem by using magnitude method, and in next section, neu-NLP-problems can be addrtessed with a numerical examples. In the final section, we presented our conclusions.

2. Preliminaries

In this section, to develop the main concept of this article, we recall some fundamental and necessary definitions.

Definition 2.1 [13] A SVTN-number $\tilde{M}$ is defined on $\Re$ and is presented as: $\tilde{N} =< [s,t,\eta_1,\delta_1],[s,t,\eta_2,\delta_2],[s,t,\eta_3,\delta_3], >, w\square ere\ \eta_i > 0, \delta_i > 0$ are the extensions of left and right, respectively and $[s_i, t_i]$ are the modal intervals of T, I, and F components respectively, for i $= 1, 2, 3$. The membership function of truth, indeterminacy, and falsity are given respectively as follows :

$$T_{\tilde{N}}(\xi) = \begin{cases} \frac{1}{\eta_1}(\xi - s + \eta_1)s - \eta_1 \le \xi \le s \\ 1 \qquad\qquad s \le \xi \le t \\ \frac{1}{\delta_1}(t - \xi + \delta_1)t \le \xi \le t + \delta_1 \\ 0 \qquad\qquad ot\square erwise \end{cases}$$

$$I_{\tilde{N}}(\xi) = \begin{cases} \frac{1}{\eta_2}(s - \xi)s - \eta_2 \le \xi \le s \\ 0 \qquad\qquad s \le \xi \le t \\ \frac{1}{\delta_2}(\xi - t)t \le \xi \le t + \delta_2 \\ 1 \qquad\qquad ot\square erwise \end{cases}$$

$$F_{\tilde{N}}(\xi) = \begin{cases} \frac{1}{\eta_3}(s - \xi)s - \sigma_3 \le \xi \le s \\ 0 \qquad\qquad s \le \xi \le t \\ \frac{1}{\delta_3}(\xi - t)t \le \xi \le t + \delta_3 \\ 1 \qquad\qquad ot\square erwise. \end{cases}$$

Definition 2.2 [13] For two SVTN-numbers $\tilde{N} =< [s,t,\eta_1,\delta_1],[s,t,\eta_2,\delta_2],[s,t,\eta_3,\delta_3], >$and $\tilde{P} =< [g,\square,\mu_1,\omega_1],[g,\square,\mu_2,\omega_2],[g,\square,\mu_3,\omega_3] >$ and $k(\neq 0) \in \square$,

(i) $\tilde{N} \oplus \tilde{P} =< [s+g, t+\square, \eta_1+\mu_1, \delta_1+\omega_1],[s+g, t+\square, \eta_2+\mu_2, \delta_2+\omega_2],[s+g, t+\square, \eta_3+\mu_3, \delta_3+\omega_3] >,$

(ii) $\tilde{N} \ominus \tilde{P} =< [\mathrm{s-h, t-g}, \eta_1+\omega_1, \delta_1+\mu_1],[\mathrm{s-h, t-g}, \eta_2+\omega_2, \delta_2+\mu_2],[\mathrm{s-h, t-g}, \eta_3+\omega_3, \delta_3+\mu_3] >,$

(iii) $k\tilde{N} =< [ks, kt, k\eta_1, k\delta_1],[ks, kt, k\eta_2, k\delta_2],[ks, kt, k\eta_3, k\delta_3] > for\ k > 0,$

$k\tilde{N} =< ([kt, ks, -k\delta_1, -k\eta_1],[kt, ks, -k\delta_2, -k\eta_2],[kt, ks, -k\delta_3, -k\eta_3] > f\ or\ k < 0.$

The graphical representation of SVTN-number $\tilde{N} =$ [0.4,0.9,0.3,0.6], [0.5,1,0.4,0.8], [0.8,1.6,0.3,0.6] > is given below:

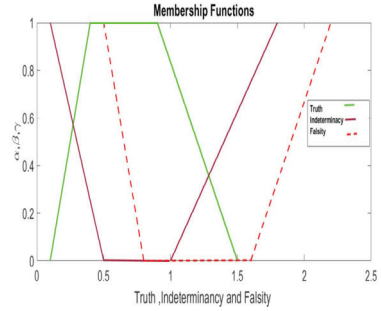

Figure 1: The graphical representation of Single valued trapezoidal neutrosophic number (SVTN) .

Definition 2.3 [18, 21]: Let be an SVTN number. Then cut of is designed by and described as

for

Thus, cut of for truth, indeterminacy, and falsity components is given by closed intervals as respectively, for .

Where are continuous and non-decreasing functions, and are continuous and non increasing functions in their respectively intervals.

.1 The magnitude of SVTN-numbers and its characteristics.

In this section, we developed the magnitude method and its characteristics in a generalized way, and using this notion, we established a ranking algorithm for the ordering of SVTrN-numbers.

Definition3.1:

components are defined as:

(), for α

(ii) (= (), for [,1]

(iii) (= (), for [,1]

Definition 3.2:

For any μ,the magnitude of is designed by and described by =[() (1-2μ)+()μ+ ()μ.

Where μ∈ [0, 1] is weight of magnitude which indicates the decision maker's choice of information. If μ∈ [0, 0.5), then the decision-makers behaviour indicatesoptimistic behaviour in the direction of positivity and certainty; if μ∈[0.5, 1], then the decision-makers behaviour indicates pessimistic behaviour in the

direction of negativity and uncertainty .

Without loss of generality, from now on we will take μ = in the remaining entire paper.

Then the magnitude of reduces to = (++)=[()+()+ ()].

Property 3.1:

For any and any two SVTN-numbers and , the following property are hold:

(i)

(ii))=

(iii) Mag( ) =k Mag( )

(iv) Proof. (i) By the definitions 2.2 and 3.1, = [{3()}+ {3()}+{3()}]= [()+()+ ()] +[(3)+ (3)+(3)] =

Similarly, we can prove the properties (ii) and (iii).

Definition 3.3

For any two SVTN- numbers and ,we determine the ordering of and by

(i) ,

(ii) ,

(iii) ,

(iv) The relation is determine as iff or.

Property 3.2 For any three SVTN numbers ,, , the order ≼ fulfils the following disciplines of partial order :

,(reflexive law) (i)
,(and (antisymmetric law (ii)
(iii) and (transitive law) .

Proof. (i),(ii), and (iii) are proved by the definitions 3.2 and 3.3.

Property 3.3: Let ,, and be any four SVTN numbers , Then

, (i)
, and (ii)
. (iii)

Neutrosophic non linear programming problem and its solution technique .2

In this section, we discuss the non-linear programming problem in a neutrosophic environment, which is called the Neu-LP-problem. Here, the constraints of the Neu-NLP-problem are taken in terms of generalized SVTN-numbetrs. The mathematical formulation of Neu-NLP-problem.

Max

Subject to,

for i= 1,2,3,…..,m.

Where, , , are generalished SVTN-numbers and ≥0 for j=1,2,3,……,n.

Methodology

Step-1: First of all, using the magnitude method , the constraints in terms of generalized SVTN-numbers of the neu-NLP-problem are converted to crisp numbers.

Step-2: After de-neutrosophication, we formulate the NLP-problem.

Step-3: Finally, applying the computational lingo method, we determine the optimal solution of neu-NLP-problem.

5. Numerical examples

In this section, we presented a neu-NLP-problem and solved it by magnitude algorithm to illustrate its efficiency and applicability.

Examples 5.1

Max ( )= +-

Subject to

+

+

Where =<[3,9,1,2],[3,9,2,1],[3,9,2,2]> , =<[4,8,1,3],[4,8,3,3],[4,8,2,1]> ,

=<[3,7,2,2],[3,7,2,3],[3,7,1,3]> , = <[2,3,1,3],[2,3,1,2],[2,3,2,1]> ,

= <[2,4,1,1],[2,4,1,2],[2,4,2,2]> , = <[2,3,1,2],[2,3,1,1],[2,3,2,2]>,

= <[3,4,2,2],[3,4,1,1],[3,4,2,3]> , = <[8,15,3,1],[8,15,4,1],[8,15,2,2]> ,

= <[7,16,3,2],[7,16,5,3],[7,16,3,3]>.

Solution:

Step-1: First of all, applying magnitude method to convert the constraints of neu-NLP-problem in terms of SVTN-numbers to crisp data.

By the definitriuons 3.2, Mag ()= 6.00, Mag ()= 6.05, Mag ()= 5.17, Mag()= 2.61, Mag()= 3.05, Mag()=2.55 , Mag()=3.55 , Mag()=11.22 , Mag()=11.33 .

Step-2: Therefore, the NLP-problem is

Max Z = 6.00 + 6.05 - 5.17

Subject to

$2.61 + 3.05 \leq 11.22$

$2.55 + 3.55 \leq 11.33.$

Step-3: Using Computational Lingo method, the optimum feasible solution is obtained and is given by =0.16, =3.08 and Max Z=19.44.

6. Conclusion

In this chapter, we propose a new method to solve Neu-NLP-problem in a new direction. In order to reach the aim, we established the magnitude method, in a generalized way that is easily understood and has applicability. It also helps with de-neutrosophication of SVTN-numbers. A numerical illustration is provided to show the stability and feasibility of this algorithm. In the future, the method may be used to solve different optimization and multi criteria decision-making problems such as transportation problems, inventory, game theory, assignment problems, and so on.

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Validation of the Theoretical Prediction of Capacitance of Circular Multi-Vented CMUT: A FEM Approach

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Abstract

The evaluation of the capacitance of a vented CapacitiveMicromachined Ultrasound Transducer (CMUT) is very cumbersome. As the size of the transducer is very small (in the order of micrometre), the effect of the fringing field may not be ignored in the capacitance calculation. In the case of vented CMUTs, the holes present in the membrane contribute further to the overall capacitance. In our last work,we proposed a new empirical formulation to calculate the overall capacitance of a vented circular CMUT. In the present work, we have modelled the Finite Element Method (FEM) based COMSOL simulation package to study the capacitance of a circular air gap CMUT having two and four vents in the silicon nitride membrane to verify the proposed theoretical formula. The simulation output results for capacitance considering various structural parameters of the CMUT corroborated well with the empirical formulation.

1. Introduction

Since the concept of CMUT was first introduced (Hunt 2014; Khuri-Yakub et al. 1988), it has surpassed the development of its predecessors,

such as PMUT (Piezoelectric Micromachine Ultrasound Transducer) (Pappalardo et al. 2008; Salim et al. 2012). CMUT exhibits enormous applications in the field of medical diagnosis (Jin et al. 1998; Wang et al. 2020), pressure sensors (Wang et al. 2016) and many more.

The two electrodes that face each other in the CMUT are flexible and positioned on a thin insulating membrane, whereas the stationary electrode is part of the setup. The two electrodes are separated by an insulating layer and an air-sealed gap. CMUTs can function in both transmitting and receiving modes, converting electrical energy into sound waves or the other way around through membrane vibration. As its name suggests, the CMUT operates via variations in the capacitance of parallel plate capacitors (Ergun et al. 2003).

The capacitance of a CMUT has been theoretically computed by Pirouz et al. to quantify the energy conversion during massive signal operation. In the process, they used the source impedance's inverse Fourier transform to calculate the capacitance (Pirouz & Degertekin 2019).Using a deflection shape function, Rahman and Chowdhury (2011) devised an approximative method to determine the capacitance of a parallel plate capacitor with a square diaphragm. They proved that when the diaphragm's dimension is tiny, the contribution of fringing field capacitance cannot be ignored. Chew and Kong (1980) created a rigorous analytical approach to calculatethe fringing field for circular microstrip disks.The Landau and Lifschitz approach provides an efficient expression of CMUT capacitance for circular diaphragm, as described by Pal et al. (2021).Apte et al. (2013) fabricated vented cavity CMUT and introduced the concept of using CMUT under high-pressure variation without mechanical failure. They created a vented cavity finite element model for CMUT (Apte et al. 2014). Ghosh Dastidar et al. (2023a) have optimized the bandwidth and sensitivity of the vented cavity CMUT.

Recently we have proposed a new empirical formula (Ghosh Dastidar et al. (2023b)) to estimate the capacitance of the CMUT with vented cavities. This formula includes the intricate fringing effects of both the edge of the capacitor plate and the edge of the hole and is justified with the FEM simulation for single-vented CMUT.In the present study, we have aimed to validate this newly proposed theoretical formula using multi-vented silicon nitride circular CMUTs with the help of FEM-based simulation using COMSOL.

2. The proposed analytical model

A basic and common CMUT structure consists of Al as the top and bottom electrode and Silicon Nitride (Si_3N_4) as membrane material mounted on a Silicon dioxide (SiO_2) wall (Ergun et al. 2003). Si_3N_4 has a good strength, shock resistance etc. which makes it a common choice as a vibrating diaphragm. In our previous work (Ghosh Dastidar et al., 2023b), thistype of single vented Si_3N_4circular CMUT structure was used to validate the proposed theory.

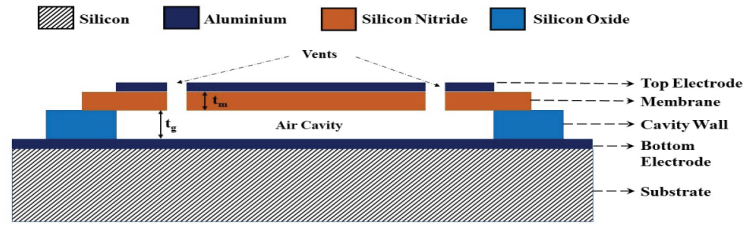

Fig 1: Structure of Si3N4-made CMUT

The vertical cross-section of a CMUT having a double vent is illustrated in Fig 1. The vent in the membrane plays an important role in maintaining the balance in the air pressure between the air cavity of the CMUT and the environment. With the Silicon Nitride membrane and air gap in between the two electrodes, the CMUT acts as a capacitor when DC bias is applied to the electrodes. The force between the oppositely charged electrode, causes the membrane to bend and deform toward the bottomelectrode which is fixed with the silicon substrate. With increasing bias voltage, the deflection of the membrane increases. When a small AC signal with ultrasonic frequency is coupled with the DC bias, the membrane starts to vibrate and produce ultrasound of the desired frequency. On the contrary, when the membrane receives an ultrasound, it also vibrates causing the generation of AC signal.

2.1. Capacitance due to the Fringing effect

In the described structure of CMUT there are two dielectric mediums, namely, air with permeability ε_0 and thickness t_g and Si_3N_4 with

permeability ε_m and thickness t_m. For such a capacitor having a cavity radius R_{in}, the total capacitance is given by

$$C_{Total} = \frac{C_m C_g}{C_m + C_g}, \qquad (1)$$

with

membrane capacitance $C_m = \varepsilon_m \pi \left(\frac{R_{in}{}^2}{t_m} \right)$ (2)

a\nd air gap capacitance $C_g = \varepsilon_0 \pi \left(\frac{R_{in}{}^2}{t_g} \right)$ (3)

For a small capacitor like CMUT having dimension in the order of micrometer, fringing plays an important and unavoidable role while calculating the capacitance. Fringing is the bending of electric lines of force at the edges of the capacitors. Total capacitance, is therefore, given by the equation $C_T = C_r + C_f$, where C_T, C_r, C_f stands for total capacitance, regular capacitance and capacitance due to fringe. This and our previous study used the Landau & Lifschitz technique (Lifshitz et al., 1984) to demonstrate the effect of fringing in a circular CMUT. The fringing corrected capacitance due to the presence of an air gap is given by,

$$C_{gf} = \left(\frac{\varepsilon_0 \pi R_{in}{}^2}{t_g} \right) + \varepsilon_0 R_{in} \ln \left(\frac{16\pi R_{in}}{t_g} - 1 \right) \qquad (4)$$

Capacitance due to membrane layer(fringing corrected) is given by

$$C_{mf} = \left(\frac{\varepsilon_m \pi R_{in}{}^2}{t_m} \right) + \varepsilon_m R_{in} \ln \left(\frac{16\pi R_{in}}{t_m} - 1 \right) \qquad (5)$$

The second term in the above equationsis associated with fringing and the first termisthe general expression of parallel circular plate

capacitance with radius R_{in}.The total capacitance will be given by the modified equation (1), replacing C_g by C_{gf} and C_m by C_{mf} respectively.

2.2. Capacitance in the presence of hole and fringing

The presence of vents in the electrode of parallel plate capacitance reduces the effective area and causes a reduction of capacitance. For an electrode with a radius R_{in} having n number of vents of radius R_h, the reduced capacitance should be $C_{reduced} = \left(\frac{\varepsilon \pi R_{in}{}^2}{t} \right) - n \left(\frac{\varepsilon \pi R_h^2}{t} \right)$. On the contrary, the introduction of holes in the electrode and membrane effectively increases the length of the edges which boosts the fringing effect causing a substantial increase in capacitance if the dimension of the capacitance is small. Therefore, the modified capacitance in the presence of a hole (Ghosh Dastidar et al., 2023b) will be

$$C_{m\_fh} = \left(\frac{\varepsilon_m \pi R_{in}{}^2}{t_m} \right) + \varepsilon_m R_{in} \ln \left(\frac{16\pi R_{in}}{t_m} - 1 \right) - n \left(\frac{\varepsilon_m \pi R_h^2}{t_m} \right) + n \left[\varepsilon_m R_h \ln \left(\frac{16\pi R_h}{t_m} - 1 \right) \right] \qquad (6)$$

$$C_{g\_fh} = \left(\frac{\varepsilon_0 \pi R_{in}{}^2}{t_g} \right) + \varepsilon_0 R_{in} \ln \left(\frac{16\pi R_{in}}{t_g} - 1 \right) - n \left(\frac{\varepsilon_0 \pi R_h^2}{t_g} \right) + n \left[\varepsilon_0 R_h \ln \left(\frac{16\pi R_h}{t_g} - 1 \right) \right] \qquad (7)$$

The series combination of eq (6) and (7), results inthe effective capacitance of the CMUT as follows.

$$C_{Total} = \frac{C_{m\_fh} C_{g\_fh}}{C_{m\_fh} + C_{g\_fh}} \qquad (8)$$

3. Result and Discussion

The performance of this theoretical model as described in eq (8), is studied using FEM simulation for a CMUT by varying the dimension of membrane thickness t_m, air-gap thickness t_g, and the radius of the vent R_h. This study aims to validate the model in the presence of multiple vents.

In COMSOL, at the top of the silicon substrate (breath and width 1.452×10^{-4} m) and Aluminum bottom electrode, a cylindrical air cavity

of 55 μm radius and 450 nm height, is created and trapped within a ring-shaped SiO_2 layer. The inner radius of the SiO_2 layer is the same as the radius of the cavity, whereas the outer radius of the wall is 10% greater than that of the cavity radius ($6.05x10^{-5}$ m). A one μm thick Si_3N_4 membrane is placed above the air cavity and above this, an Aluminum top electrode ofthickness 0.5 μm is deposited. A set of vents of radius 1μm is created through the membrane and top electrode and symmetrically placed around the centre of the device. The number of ventsis chosen as two and four for two case studies respectively. The device is operated for a DC bias of 40 volts. The membrane radius is chosen as 5% greater than the cavity radius for stable operation. The electrical and mechanical characteristics of different materials used in this simulation are described in Table 1.

Table 1: Material properties used for calculation and FEM simulation

Material	Property	Value
Aluminum	Density	2700 kg/m3
	Young's modulus	70 x 109 Pa
	Poisson's ratio	0.35
	Electrical conductivity	35.5 x 106 S/m
Silicon	Density	2329 kg/m3
	Young's modulus	170 x 109 Pa
	Poisson's ratio	0.28
	Relative permittivity	11.7
Silicon Nitride	Density	3100 kg/m3
	Young's modulus	250 x 109 Pa
	Poisson's ratio	0.23
	Relative permittivity	9.7
Silicon Oxide	Density	2200 kg/m3
	Young's modulus	70 x 109 Pa
	Poisson's ratio	0.17
	Relative permittivity	4.2
Air	Relative permittivity	1
Free space	Permittivity	8.854 x 10-12 F/m

A mesh size optimization is performed by varying the maximum mesh size (Fig. 2) keeping the minimum mesh size as one-twelfths of the maximum. It has been found that the value of capacitance reaches more or less a saturation value for a mesh size of less than 50 μm. For the rest of the simulation, the maximum mesh element is settled at36 μm and the minimum at 3 μm. The skewness of the mesh for a vented CMUT with four holes is shown in Fig.3.

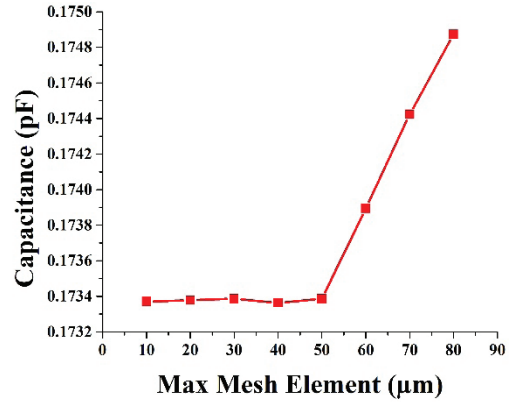

Fig. 2: Mesh element size optimization

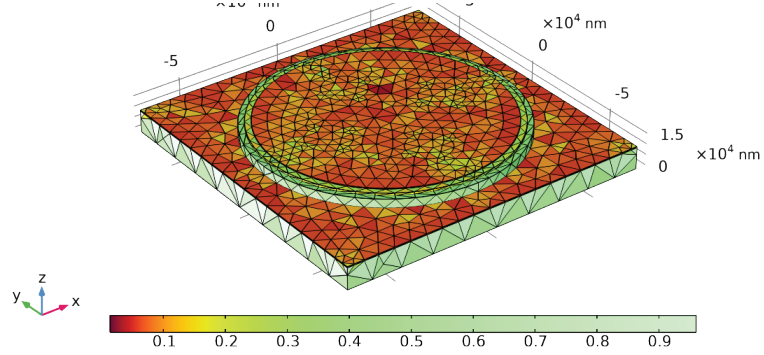

Fig.3: Skewness of the mesh

The simulation is calibrated with the experimental result of resonance frequency obtained as 106 KHz by Apte and his companions (Apte et al.,2013) for a similar geometry. The FEM model predicted the same as 94.28 KHz, which is very close to the experimental result and ensures the quality of the work.

To validate the proposed empirical formula (equation 8), we have modelled FEM simulation for the vented silicon nitride circular CMUTs having two vents and four vents on their membrane. In the following sections, the results obtained for capacitance in different configurations of the CMUT are discussed.

3.1. Vented CMUT with Two Holes

The results of variation of capacitance with R_{hole} for a doubly vented CMUT for three different membrane thicknesses viz t_m = 1 μm, t_m = 3.6 μm and t_m = 10 μm are presented in Fig. 4. The values of R_{hole} are taken from 1 μm to 10 μm. It shows that for a given membrane thickness, the capacitance does not vary much with the change in hole radius. As the membrane thickness decreases, the overall capacitance increases. For t_m = 3.6 μm, the simulation results exactly coincide with the theoretical predictions. With membrane thicknesses of 1 μm and 10 μm, the matching is not so good but overall satisfactory.

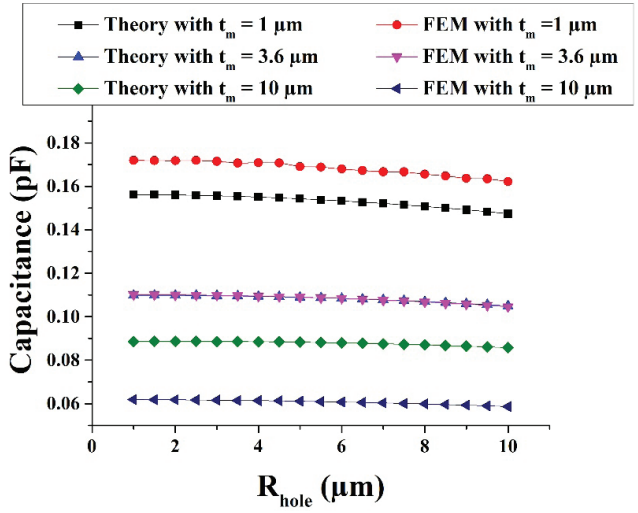

Fig.4: Variation of Capacitance with Hole radius for a vented CMUT (n=2) for various membrane thickness

Next, we have studied the similar variation of capacitance as above but with different air gap thicknesses with t_g = 0.4 μm, t_g = 1.6 μm and t_g = 4 μm. The results are depicted in Fig. 5. The natures of the curves are as before. Here, simulation outputs corroborated well the theoretical predictions. Therefore, we may conclude that the suggested theoretical model's performance is appropriate in the aforementioned scenarios.

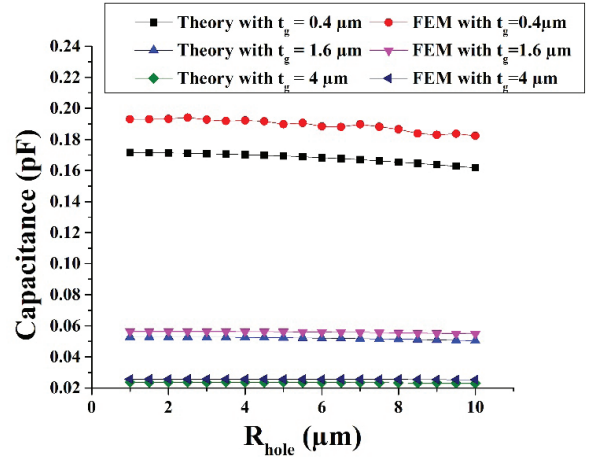

Fig.5: Variation of Capacitance with Hole radius for a vented CMUT (n=2) for various air-gap thickness

The results of the variations of capacitance with changing membrane thickness from 1μm to 6 μmare depicted in Fig. 6 considering R_h = 1μm. The nature of the curve is exponential decay in both theoretical and simulation outputs and they almost coincide with each other. A similar study considering R_h = 10 μm is depicted in Fig. 7. Here also a good agreement between theoretical results and simulation outputs is observed. So, we may conclude that the proposed theoretical model is quite acceptable.

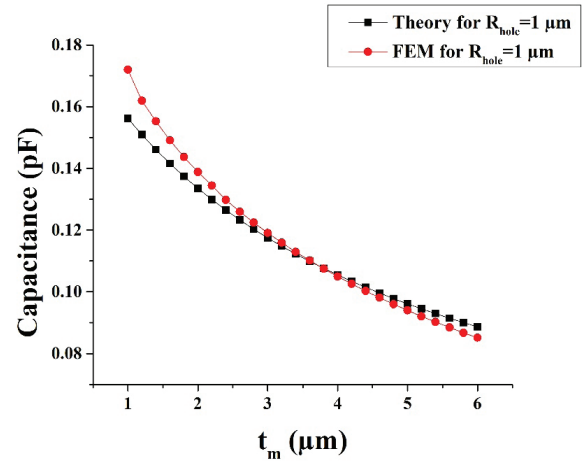

Fig.6: Variation of Capacitance with Membrane thickness for a vented CMUT (n=2) for R_{hole}=1 μm.

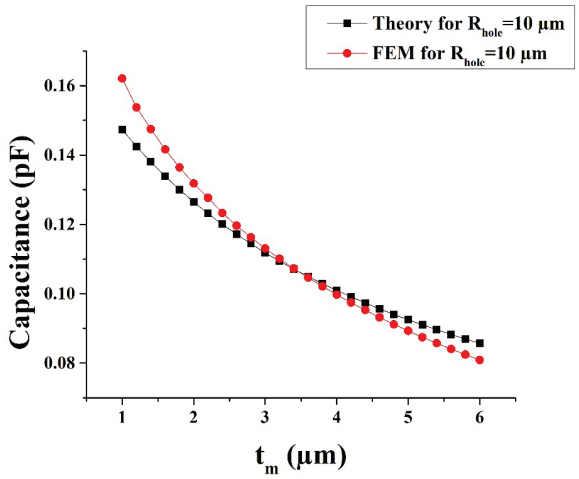

Fig.7: Variation of Capacitance with Membrane thickness for a vented CMUT (n=2) for R_{hole}=10μm.

Next, we have studied the performance of the proposed theory in predicting the capacitance with changing air-gap thickness. The considered values of t_g are here 0.5 μm to 4.0 μm. The obtained results are plotted in Fig.8 and Fig.9 respectively considering R_h = 1μm and R_h=10 μm. The capacitance values decreased exponentially as air-gap thickness values increased. Here very good agreement between theoretical results and simulation outputs has been obtained.

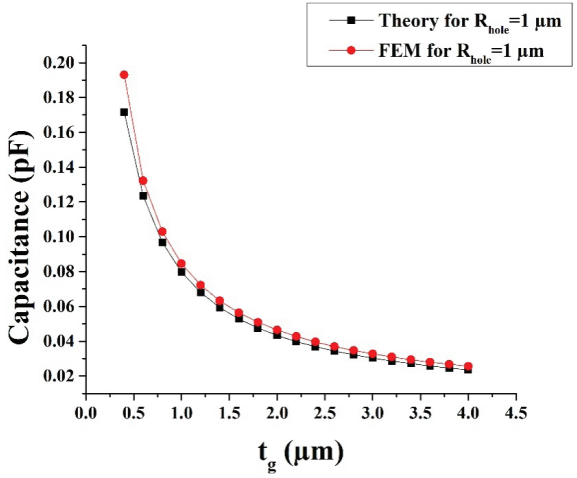

Fig.8: Variation of Capacitance with Air-gap thickness for a vented CMUT (n=2) for R_{hole}=1 μm.

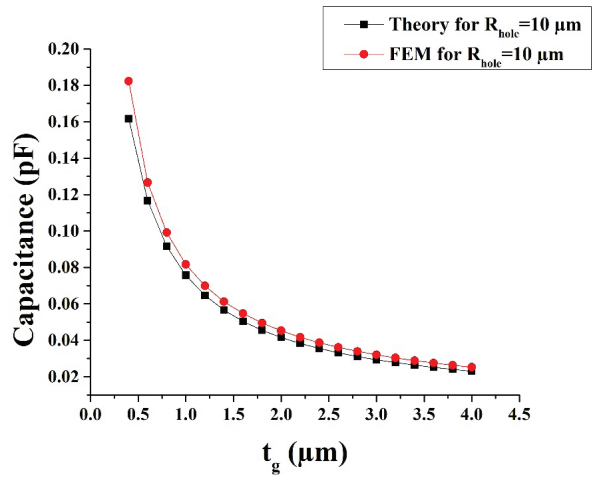

Fig.9: Variation of Capacitance with Air-gap thickness for a vented CMUT (n=2) for R_{hole}=10μm.

So, we may conclude that the proposed model has predicted the capacitance value of a doubly vented CMUT very well.

3.2. Vented CMUT with Four Holes

The capacitance variation of a vented CMUT (n=4) with hole radius is studied in Fig.10 using both simulation and theoretical results for various membrane thickness t_m and air-gap thickness t_g.

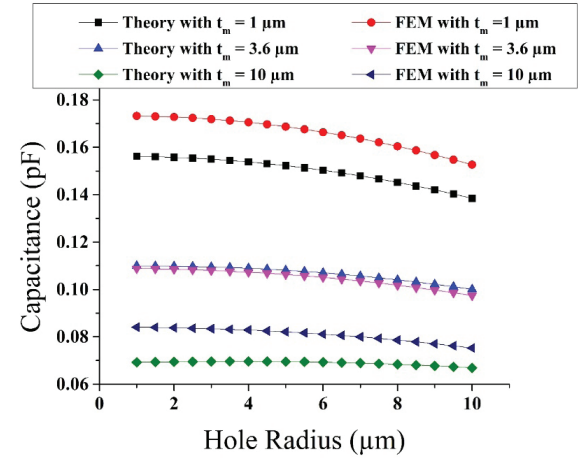

Fig.10: Variation of Capacitance with Hole radius for a vented CMUT (n=4) for various membrane thickness

To verify the capacitance values, we have considered three membrane thicknesses viz 1 μm, 3.6 μm and 10 μm while hole radii R_h have been varied from 1 μm to 10 μm. From Fig.10, we observe that as the membrane thickness t_m decreases, the overall capacitance increases in both theoretical and simulation results. For a given membrane thickness, the capacitance remains almost constant with a variation of the hole radius R_h. The simulation outputs corroborated well the theoretical predictions though in some cases it slightly overestimated the capacitance values. Overall, Fig.10 indicates that the performance of the proposed theoretical model is quite satisfactory in the cases considered here.

In Fig.11, the considered air-gap thicknesses are 0.4 μm, 1.6 μm and 4 μm while for each of these t_g, the hole radius R_h has been varied from 1 μm to 10 μm to study the capacitance variation using both simulation and theoretical results.

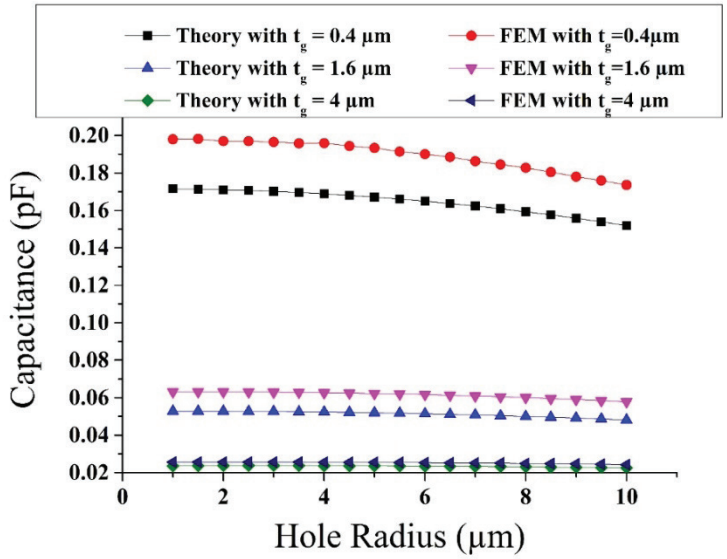

Fig.11: Variation of Capacitance with Hole radius for a vented CMUT (n=4) for various air-gap thickness

The figure exhibits that as the airgap thickness decreases, the overall capacitance of the CMUT increases as expected. For a given air gap thickness, the capacitance of the CMUT does not change much with the change in the hole radius. The change may be slightly significant as the

air gap thickness decreases. In all the above cases, the FEM simulation outputs slightly overestimated the theoretical predictions. Hence, we may say that the performance of the proposed theoretical model is acceptable in the above cases.

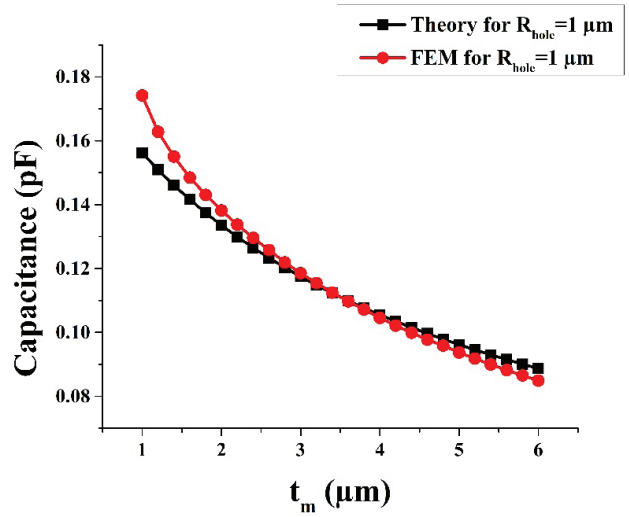

Fig.12: Variation of Capacitance with Membrane thickness for a vented CMUT (n=4) for R_{hole}=1 μm.

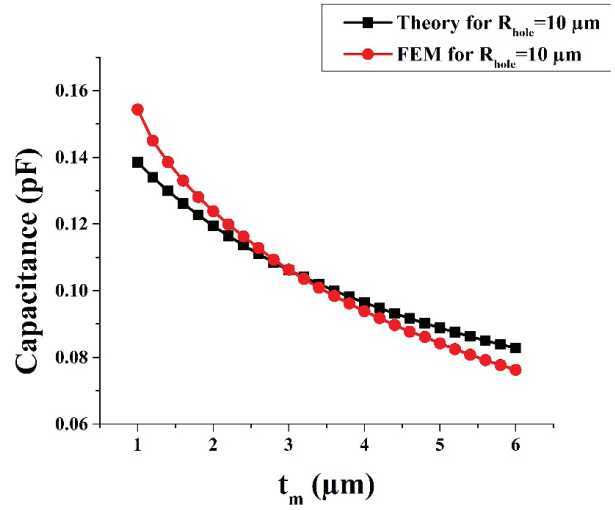

Fig.13: Variation of Capacitance with Membrane thickness for a vented CMUT (n=4) for R_{hole}=10 μm.

The variation of the capacitance of a vented CMUT (n=4) with membrane thickness for the fixed vent radii is also studied as depicted in Fig. 11 (with R_{hole} = 1 μm) and Fig. 13 (with R_{hole} = 10 μm). In both cases, the natures of the curves are exponentially decaying for theoretical as well as simulation outputs. Here also the FEM results substantiated very well with the theoretical predictions.

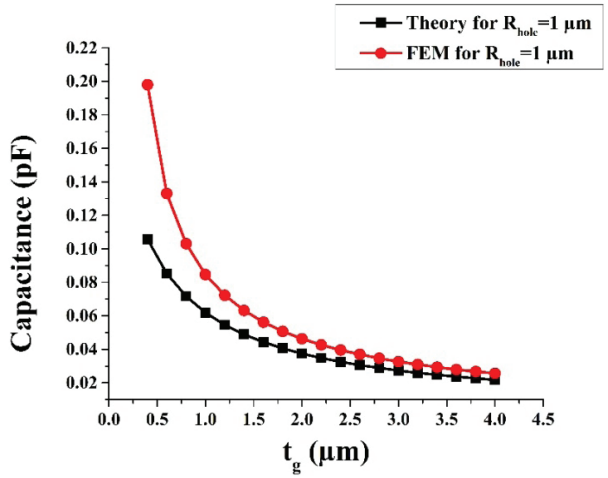

Fig.14: Variation of Capacitance with Air-gap thickness for a vented CMUT (n=4) for R_{hole}=1 μm.

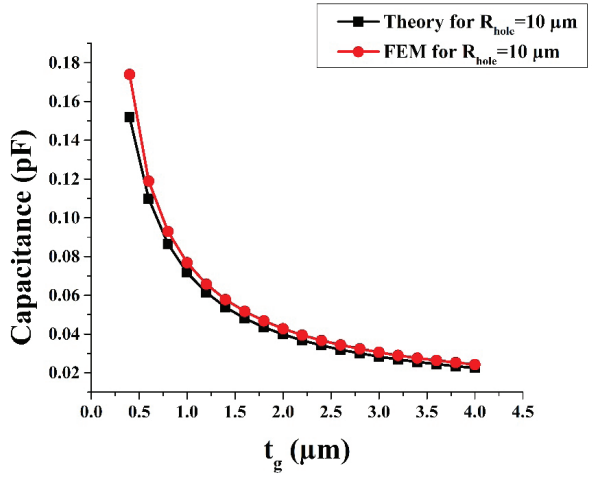

Fig.15: Variation of Capacitance with Air-gap thickness for a vented CMUT (n=4) for R_{hole}=10μm.

To understand how the capacitance of a vented CMUT (n=4) varies with the air-gap thickness for the fixed vent radii, we have calculated both the theoretical and simulation results for capacitances by changing the t_g from 0.5μm to 4.0 μm considering R_{hole} = 1 μm in case 1 (depicted in Fig. 14) and R_{hole} = 10 μm in case 2 (depicted in Fig. 15). In both cases, the natures of the curves are exponentially decaying. In the above two cases, the FEM results corroborated very well with the theoretical predictions.So, we may conclude that the proposed theoretical model has predicted very well the capacitance value of a vented CMUT with four holes.

Conclusion

The proposed theoretical model in our previous work (Ghosh Dastidar et al., 2023b) to accurately calculate the capacitance of a vented CMUT that includes the effect of fringing for the membrane, air-gap and holes vented in them along with the regular capacitance, demands verification. Experimental calculation of the capacitance of a CMUT is very difficult so in general not practiced. In the previous work, we verified the proposed theoretical model for singly vented CMUT. In the present study, we have obtained a very good performance of the said theory for the other vented CMUTs with n=2 and n=4. Hence, we may conclude that the proposed theory is verified from the simulation end. The acceptance of the proposed theory in calculating the capacitance of a vented CMUT will be more promising if experimental verification is done in the near future.

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Review of Recent Advances in Optical Music Recognition and PossibleApplication in Indic Notations

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1. Introduction:

The way music is processed, enjoyed, and appreciated has always been through the auditory part of our senses, for obvious reasons. The same cannot be said about 'music' as a field of study. Music practice, creation, retention, teaching, and learning have always been visual as well as auditory practices. Processing someone else's musical endeavor needs a record of that creation, to be processed by one or more people, possibly at a later time than it was created. Thus, music needs to be encoded in a form, to be accessed optically. For this, musical notations have been developed in different cultures worldwide, in varied ways – each with individual strengths and weaknesses – but ultimately speaking the same language.

It would be illogical, if not impossible, to deny that, as far as musical score writing goes, Common Western Music Notation (CWMN) wins hands down when popularity, development, and ease of digitization are concerned. Software used to encode music in staff notation has a long history. The euro-centrism of these endeavors, though just a historical quirk, has some problematic consequences for music from other cultures around the world. The rich,varied, and intricate Indian musical landscape is an example of that. The textual nature of the Indian notation systems and the multilingual culture of our country makemusic – written in one system – inaccessible to other systems even within the country. Even in thisera of increasing globalization,optically processing different Indian musical notations, the conversionof those among each other and to varied global notation systems (e.g., staff notation), and translatingworld music in these notations are largely unexplored fields. Whatever the notation, be it Staff orsome other textual one, encoding them in a machine-readable document and rendering them in achosen format is the first step towards successful digitization.

The field of computationally decoding the musical notation from an image using a computer isknown as Optical Music Recognition (OMR), similar to the widely known Optical Character Recognition(OCR). OMR for CWMN is already a hard problem to attack in itself and has only been partiallysolved. As we will see later, the state-of-the-art processes are all Deep learning (DL) methods withvaried neural network structures. The importance of knowing modern DL techniques and in-depthknowledge of music engraving, notwithstanding the need for some music theory knowledge, makes thisfield intrinsically interdisciplinary.

Despite recent breakthroughsin the form of curated datasets and sophisticated learning algorithms,all progress seems to happen in recognizing CWMN. In India, thousands of youngstudents are regularly introduced to some version of an Indian textual music notation (e.g., Bhatkhandeor Tagore Swaralipi). The ones who pursue music later in their lives, find that they need to relearneverything in CWMN just to make a career, or collaborate with other musicians—be it at an amateurlevel, or professional. A framework performing OMR of Indian music notation systems, translatingthose to CWMN and vice versa can largely ameliorate this problem.For training any network for OMR, we need a well-curated dataset. Many exist for CWMN, but wehave to create our own sets for Indian systems. ‘ -Karanto Swaralipi’ (Tagore Notation) can be easyin this case, as there have been long-running digitization projects regarding his music and notation.Similar efforts will be needed for other notation systems.

2. Review of the Status of Research and Development in the Subject

2.1 International Status

2.1.1 Notation Software:

Starting from the FORTRAN-based Score (1987) by Leland Smith (a version of it is still extensively used by renowned professionals) to the recent proprietary Sibelius (Finn & Finn, 2022), finale (Farrand, 2022), and Dorico (Andrew Dodman, 2022), computerized notation-writing software have quickly found popularity in the music industry. Open-source solutions (e.g. MuseScore (MuseScore BV. Musescore 3.6.2 stable, 2021)) are there as well, with no less rigor behind their development. What the open-source solutions lack in industrial backing, they make up for with a dedicated, enthusiastic, and extremely involved community.

There are two underlying threads through all of the software mentioned above: (a) all of them are about CWMN, (b) they are all of the ‘What You See Is What You Get’ (WYSIWYG) type (equivalent to ‘Microsoft Word’ in word processing), where the user interacts directly in a graphical interface with live rendering. Only when a file is saved, it is saved in a format dedicated to the framework in question.Most of them have some functionality to convert and render other types of music notation, but seldomboth ways.

There are software of the ‘What You See Is What You Mean’ (WYSIWYM) type as well (equivalentto ‘LATEX’ in word processing), e.g., Denemo, MusiXTeX, and Frescobaldi are there as well, most ofwhich depend on the software LilyPond as their backend. There are web-based solutions like EasyScore(depends on JavaScript tool VexFlow (Cheppudira, 2017)), Humdrum Toolkit (Huron, 2022) (command-line tool, programminglanguage agnostic), and Verovio (RISM Digital Center, Verovio 3.11.0. , 2015)(depends on MEI) as well. Though most software of this type isopen source, there are some proprietary versions, e.g., Musink Pro. A detailed list of available musicnotation software and their comparison can be found in these links: [(contributors, List of scorewriters — Wikipedia, the free encyclopedia., n.d.),(contributors, Comparison of scorewriters — Wikipedia, the free encyclopedia, n.d.)].

Of all these numerous software, only the Humdrum encoding contains a way of inputting andencoding one Indian Notation: the Bhatkhande notation (we will know more about it later) and thattoo is far from complete (Chordia, 2022).

2.1.2 OMR:

Works in the loosely defined and very young (first recognized works were by Pruslin (1966) (Pruslin, 1966) and Prerau (1970) (Prerau., 1970)) field of OMR, though rigorous and dedicated on the researcher’s part, have been largely fragmented – few and far between. Following a recent review (Calvo-Zaragoza, Jan Hajič Jr., & Pacha, Understanding Optical Music Recognition, 2020), OMR can be defined as “afield of research that investigates how to read music notation in documents computationally”. There aremultiple hurdles to face before effective research can be conducted on this extremely interdisciplinarysubject. Let us talk about them serially:

Software: There have been many attempts to create software to solve the OMR of CWMN overthe years, both proprietary and open-source (academic). None of these were complete in any way.The field went through an overhaul in around 2016, after the advent of DL. As a result, most of thissoftware became obsolete. Still, due to the unusual complexity of the problem, a quite satisfactorysolution is yet to come, even in this age of AI. A detailed list of such software can be found on theOMR Wikipedia page (contributors, Optical music recognition — Wikipedia, the free encyclopedia, n.d.).

Bibliography: Though there have been less than 500 papers in this field to date, individual workslargely ignored the contribution from others till recent times (Calvo-Zaragoza, Jan Hajič Jr., & Pacha, Understanding Optical Music Recognition, 2020). This is changing, as new researcherscan now make use of a live, updated bibliography of works published in this field(Calvo-Zaragoza, Jan Hajič Jr., & Pacha, Understanding Optical Music Recognition, 2020).

Datasets for Deep Learning: State-of-the-art DL networks and algorithms require well-curateddatasets, more so for OMR. We here list only some of the reasons for that:

A. Completely different approaches are needed for recognizing handwritten and typeset notation;
B. As was devised by Byrd *et al* in ref. (Byrd & Simonsen, 2015), a musical score can be of four types, depending oncomplexity: (i) Monophonic (one staff; one note at a time), (ii) Polyphonic (one staff; multiple voices),(iii) Homophonic (multiple staffs, each staff monophonic), (iv) Pianoform (multiple staffs; multiplevoices; significant interactions). All these need different treatments;
C. DL methods which approachthis problem as sequential image segmentation and classification problem, need correct bounding box-annotation as well as the notation vocabulary. End-to-end methods, which treat a score as just asequence, need only the encoding (more on these later). Thus, various types of datasets – large,well-curated, and accessible – are crucial for the field.This is also gradually being solved, as there has been a coordinated effort to accumulate all relevantdatasets (Pacha, 2018). International, non-profit organizations like Répertoire International des SourcesMusicales (RISM[1]), open source repositories of synthetic sheet music likeMuseScore, handwrittenmusic datasets curated by academic institutions – like Muscima++ (Hajic & Pecina, 2017), (Forn´es, Dutta, Gordo, & Llad´os, 2012)[2] and HOMUS (Calvo-Zaragoza & Oncina, Recognition of pen-based music notation: The homus dataset, 2014), andderived databases like PrIMuS (Calvo-Zaragoza & Rizo, End-to-end neural optical music recognition of monophonic scores, 2018) (collection of monophonic incipits with multiple encodings, especiallyfor end-to-end solutions), Camera-PrIMuS (Calvo-Zaragoza & Rizo, Camera-primus: Neural end-to-end optical music recognition on realistic monophonic scores, 2018)(attacks the problem of real-world distortions),and DoReMi (Shatri & Fazekas, 2021)(aspires towards universal OMR solutions by harmonization with existing datasetsand by supplying a plethora of meta-data for different stages of an OMR process) are examples ofthat.

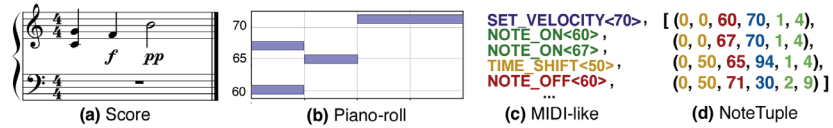

Figure 1: Different representations for symbolic music: (a) scores, (b) the piano-roll (the most widespread), (c) MIDI-like (Sageev Oore, 2018) (sequence of events), (d) NoteTuple (Curtis Hawthorne, 2019)(time offset, MIDI pitch number, velocity and two values for duration).

StandardizedMusicEncoding: Thenexthurdleisalackofstandardized computer encodingformat. Given a computer encoding of a piece of music, there are multiple ways to render that (as in Figure 1(Prang, 2021)), and given one rendering, there are multiple ways to encode that in a computer. Even if weconcentrate on the conventional staff notation, computer-readable encodings of these representationsare numerous. Global open-source solutions like MusicXML [(Good, MusicXML for Notation and Analysis. In The Virtual Score: Representation, Retrieval,

1 A joint effort by two organizations: International Musicological Society(IMS) and International Association of Music Libraries (IAML).
2 Created by Institute of Formal and Applied Linguistics (ÚFAL) at the Computer Science School, Faculty of Mathematics and Physics, Charles University, Czech Republic.

Restoration, 2001),(Good, Musicxml: An internet-friendly format for sheet music, 2001)] or Music Encoding Initiative (Andrew Hankinson, 2011)(MEI; an organization, a research community, and a markup language), Plaine and Easie (PAE;by IAML) code (B.S. Brook, 1964), JavaScript (VexFlow(Cheppudira, 2017), ɑlphɑTab (Kuschny, 2021)), textual (ABC) and MSCZ (internalencoding of MuseScore) are some examples of that. Any framework, working towards a universalOMR solution, needs to address this fragmented space of renderings and encoding by creating suitableinterfaces.

Machine Learning Models: Till around 2016, OMR was essentially a sequence of processes,e.g., image pre-processing, musical object detection, notation reconstruction, and encoding final representation,each sufficiently hard enough a problem in its own right (Ana Rebelo, 2012). A detailed process-wisebibliography can be found in ref.(Elona Shatri, 2020).The field went through a paradigm shift after DL processesbecame part of the academic zeitgeist. Figure 2 shows a typical OMR pipeline using DL. At present,we have two major ways of tackling the problem. The first one is to break the whole process up intothree parts: (a) image pre-Process/staff line removal and Object Detection (use of HMM can facilitatethis), (b) Music Notation Classification (older methods[3] have been almost completely replaced byDL techniques like regional Convolutional NNs (R-CNN) (Jifeng Dai, 2023), Faster R-CNNs (Shaoqing Ren, 2016), U-nets(Jan Hajic Jr., 2018), deepwatershed detectors (Lukas Tuggener, 2019), Single-Shot detectors (Wei Liu, 2016), etc.), and (c) Score reconstruction and encoding(previous paragraph).The second way is to approach OMR as an end-to-end sequence learning inessence, where a complicated and customized network is used to do all these things in one shot. Avery promising example of this is the work on the monophonic incipits from the PrIMuS dataset byZaragoza et al (Calvo-Zaragoza & Rizo, End-to-end neural optical music recognition of monophonic scores, 2018).Still, the problem of OMR is far from solved. The complexity of staff notation, real-world imagedistortions, lack of metadata and fully working converters are only some of the problems plaguing the field.

3 Support Vector Machines (SVM), Hidden Markov Models (HMM), k-Nearest Neighbor (kNN), Neural Networks (NN).

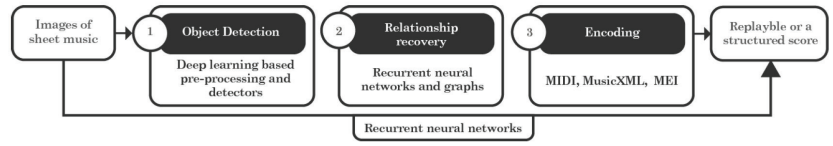

Figure 2: Two typical OMR pipelines using deep neural networks.

2.2 National Status:

2.2.1 Notation and Software:

The cultural melting pot of the Indian subcontinent has one of the richest, most diverse, and most complex musical traditions in the world. Much of this was disseminated orally, throughout history, from generation to generation. Though the musical system contains probably the oldest notated melodies (in Samaveda) (Courtney, 2022), the modern notation systems for Indian music (both classical and regional) have only been developed during the late nineteenth and twentieth century. Here are a few examples: (1) the Bhatkhande Swaralipi System (created by V. N. Bhatkhande) [(Bhatkhande, 1968), (V.N. Bhatkhande, 1990)] and another one by V. D. Paluskar (B. R. Deodhar, 1993)(mainly in Devanagari script), (2) the Carnatic Sargam notation system (mainly in Tamil script), (3) the Swaralipi created by the Pt. Ravi Shankar (mainly in Roman script), (4) the adaptation (with a few differences) of Bhatkhande's notation by Ustad Mahfooz Khokhar in Pakistan (Courtney, 2022)(in Urdu script), and (5) the '*Aa-kar Matrik Swaralipi*' created first by Dwijendranath Tagore (a modification of the '*Danda-matrik Swaralipi*' created by Kshetramohan Goswami) and thendeveloped by his brother Jyotirindranath Tagore (in Bangla script) [(Khan, 2015), (contributors, Aa-kar Matrik Swaralipi — Wikipedia, the free encyclopedia, 2020)].

All these, unlike the CWMN (which is symbolic), are textual. This is possible because of the intrinsic solfège-like (musical notes are identified relative to each other, rather than as a fixed frequency) interpretation of music. At the same time, India is a land of innumerable languages. The textual nature of notation enables (rather propels) one to use a notation in one's own linguistic script. This is why the '*Swaralipi*' are heavily influenced by their linguistic origins. Over the years, all of these systems are also written using the English alphabet, for ease of translation and collaboration, but most of the already existing notations are in those languages. A very recent attempt (*Ome*) has been made to create a symbolic notation following the Bhatkhande logic closely, by Dr. Ragini

Trivedi [(Trivedi, Lulu.com, 2010),(Trivedi, Ome swarlipi: Notation system for indian music, 2021),(Trivedi, Omenad fonts, 2021)].

The status of INS and software probably is rightly summed up by this quote from David Courtney: "The notation of Indian music is arguably one of the longest running 'work in progress' that the world has seen. Perhaps it is just in the nature of things that it will never truly be worked out". Among the few, fragmented but dedicated efforts, '*Sargam*' (open source) (Beaudoin, 2021) and 'Viswamohini'(Sawant, 2021) are good examples, but all of them are at different stages of development.

2.2.2 OMR:

Though there has been considerable involvement of Indian researchers in the larger field of Music Information Retrieval (MIR), e.g., music classification [(Vishnu S. Pendyala, 2022), (Akhilesh Kumar Sharma, 2021), (Sujeet Kini, 2011), (Moumita Sen Sarma, 2021)], music signal processing (Rajashekar Shastry, 2021), Raga identification [(Vijay Kumar, 2014), (Pranay Dighe, 2013), (K Priya, 2012), (Banerjee, 2017), (Gaurav Pandey, 2003), (Surendra Shetty, 2009)], musical sentiment analysis [(Sandipan Ganguly, 2021),(Rahaman, 2019)] and so on, works on the specific field of OMR have been rare – be it on CWMN or any Indian music script.If we neglect works in OMR before the advent of deep learning, for our purposes, then there hasbeen only one paper – specifically working in OMR, where the Indian authors have addressed thelimitations of the Connectionist Temporal Classification (CTC) Loss function used in the RCNN-typeof models – mainly utilized in the end-to-end approaches in OMR. They proposed a modification tothe CTC loss layer itself (Jimit K. Shah, 2019). If other works exist in this OMR space, they might either be obscureor so decoupled from the mainstream work, that we could not find them.

2.3 Importance of the work in the context of current status:

The proposed work can be broken into the following points:

a. ***INS to CWMN Converter*****:** Create a free and dependency-free translation system to convert INS to staff note and vice-versa.

b. ***Intra-CWMN Conversion*****:** Bring all the different CWMN encoding systems under that same roof, so that translating an Indian musical score to or from one encoding, automatically enables one to convert that score to others as well, simultaneously.

c. ***Creation of Curated Data-Sets*****:** Create a well-curated dataset of one INS both in image and textual notation form, first collected from an already available internet source[4], e.g., the online version of the Gitabitan by Rabindranath Tagore, which contains both the image files and the notation in text format. If possible, in the next part, we can create a unique dataset for a not-so-well digitized body of work in some other Indian language, or collaborate with university archivists.

d. ***Deep Learning for OMR*****:** Work directly to catch up to and improve (if possible) the present OMR technology on CWMN, using state-of-the-art DL models. This is essential because, (1) the field is still quite open and there is a huge chance to improve and innovate, (2) Any hope of automatic and direct translation of CWMN scores to INS hinges on the successful OMR of the CWMN score-image. Otherwise, we have to stick to only available scores in some encoding or other (though the sheer numbers of these are formidable too).

Choosing the strategy and the type of network (e.g., deep watershed detectors vs. RCNN or segmentation + classification vs. end-to-end approaches) will be extremely important in this work for this reason. All this needs to done in an operating system-independent and dependency-free frameworksto be directly used by researchers later on.

We can see from the review of the field in the previous section that there is almost no work in the international landscape on OMR of Indian music. On the other hand, the Indian participation in the present-era DL-dominated OMR research has been, effectively non-existent. Through this project, we intend to bridge those gaps. We also earnestly hope that our upcoming works, at the very least, will start a conversation about these topics in the Indian academia and build the stepping stones leading to further progress.

3. Conclusion

Possible applications of this work are virtually limitless. Straightforward use cases are:digitization and archiving of Indian musical texts – reducing manual labor and thus, cost; easy andimmediate conversion

4 Just like PriMuS(Calvo-Zaragoza & Rizo, End-to-end neural optical music recognition of monophonic scores, 2018) was created out of a PAEC encoding (B.S. Brook, 1964) of the RISM database(Klaus Keil, 2019).

of innumerable world music scores in Indian notation systems (INS), makingthem accessible to students here; opening up possibilities in the distance learning for our 'Guru-mukhi'classical music schools – students from remote parts can be reached through a mobile app and themaster's handwritten notes (generally created on the spot) can get to them as crisp images/text;reducing the need for a musician to learn to read staff notation and spend that time in learning/creatingactual music.

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Section
Humanities

A Review on Oil Politics

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Abstract

This paper presents a review on the oil politics in Central Asia. In spite of the emergent need of utilizing renewable resources, the fossil fuels, particularly oil and natural gas are likely to remain dominant sources of energy in the near future. Although the energy rich countries of Middle East remain major producers of oil and gas, but Central Asia, due to its close proximity to energy deficient states, play a vital role in the global energy politics. Russia and China, both being regional influential states and having a geographic connection with the Central Asia are also influencing this geopolitics. The geopolitics between the West and the East in the form of pipeline Politics and also the use of state owned energy entities and alliance suggest a volatile future as the powerful states support the autocratic regimes for their energy related interests.

Keywords

Oil ; Politics ; Central Asia

1. Introduction

Oil factor is a dominant issue in all spheres of modern politics and economy and its impact on the diplomacy of the state is enormous. During the last two decades, Central Asia comprising mainly the five republics of the former Soviet Union, has emerged as one of the important regions in global energy scenario. Energy has generated issues of geo-political dimension of great significance to the region. The discovery of oil under the surface lands of the Arab world changed it into the most developed rich global cities of the world. The West led by the USA have been supporting and aiding their proxy authoritarian regimes of the region to manipulate the state of affairs in their favour for the sake of oil. In 1973, oil power also led Arab to stay in the form of oil embargo. Although the western powers managed to control the situation by assurance of an unhampered

supply of oil at reasonable rates, still, they were concerned that the Arab countries could enjoy over them since the fuel running their economies was entirely dependent on external sources of energy. It was the use of oil that revitalized their dead economies.

In the present age, due to the awareness of environmental hazards and the exploitation of renewable energy resources, the world is finding ways to end dependence on oil and gas. But the developed, industrialized nations and owners of companies, could not utilize the alternative sources though there was greater attraction for the easy availability of comparatively low cost fossil fuels as a lucrative for industries for them. Two decades of favourable use of renewable energy also could not bring any significant reduction in the use of oil and gas. Their consumption and production are still on the rise. Fossil fuels provide 90 percent of total energy to the industrialized world and 75 percent of energy to the whole world and will continue to play a significant role in global political economy. That the oil and gas will remain the focus of energy politics in future decades arises a marked dissonance in the priorities related to energy policies among different developed and developing countries and also indicate the current incapability of renewable resources to meet the total global energy needs of the world. Hence, the current century will still compete for the access of fossil fuels. Until now the region of Middle East has been dominating at the stage of petro-politics with easy to access, cheap and sweet oil. But the constant volatility of the region together with the unprecedented public uprising against regional autocratic regimes pushes the energy consumer states to explore new avenues of oil and gas with stable supply.

The objective of this paper is to review on the study of oil politics in Central Asia. The aim of this research article is also to explore the future destinations of oil and gas consumptions discovering those regions where stable and lasting production could ensure their supply.

2. What is the Importance of the Energy Reserves and Politics in Central Asia

The importance of oil and gas still play a significant role in the present century as it has characterized the international political economy in

previous century as well. Since renewable resources lack the current capability of meeting the entire energy needs of the world, so, non-renewable resources become attractive to global economies. On the basis of available statistical information regarding the current state of petro-politics and after long explore of the hub of global production and consumption centres, it has been found out that the centre stage of oil and gas production is now being shifted from the global North to the global South. Middle East, Central Asia and North Africa will become significant in the future supply of these fossil fuels. The consumption trends also show a transformation from Europe and North America to the newly industrialized states of Asia.

Central Asia gains great significance since it has a huge potential unexplored energy reserves and also since it is situated in close proximity to the future big consumer markets of oil and gas. At the outset it is necessary to analyze both the energy resource potentialities and production and geo-political issues concerning the energy sector. Looking back into history, potentialities of the Central Asian States (CAS) were reasonably known since out of total Soviet oil reserves of 57 billion tons, the share of the CAS was about 16 pc. However, in 1991 in the total oil output of 10.3 million barrels per day, the share of CAS was not significant being less than 7 pc, because from the perspective of Soviet planners West and East Siberia, Volga, Ural and Azerbaijan were the dominant producers of oil and gas in the country. In terms of overall economy of the country in the Soviet centralized communist system, the CAS were relatively less developed and were totally dependent upon the support from Moscow. Among the Central Asian states, Kazakhstan, Turkmenistan and Uzbekistan are known to be well endowed with hydrocarbon resources, while Kyrgyz Republic and Tajikistan are not. It is important to note that estimates of hydrocarbon reserves of the CAS were huge. For example, reserves of oil in Kazakhstan were about 92 billion barrels. 80 billion barrels of oil of Turkmenistan were located primarily in the Caspian Sea region. In comparison to that Uzbekistan had estimated potential reserves of 2 billion barrels. According to Ariel Cohen of the Heritage Foundation of the USA, possible deposits of the CAS were 170.5 billion barrels of oil and 15.3 trillion cubic meters of natural gas. International energy analysts opinion was that Uzbekistan and Turkmenistan were rich primarily in natural gas. As per the US Congressional Research Service Reports in 1991, Turkmenistan and Uzbekistan had 2 giant oil fields and 14 natural gas fields among the

major oil-gas fields which develop energy sector of the CAS. In fact the last Soviet president Mikhail Gorbachev needs to be credited for his policy of Perestroika which opened the door of energy sector to the West, acquire modern western technology and equipments for exploration of and exploitation of Tengiz energy field of Kazakhstan in collaboration of Chevron Oil Company with an estimated investment of $ 20 billion.

Explorations during the last two decades by international energy companies have not only confirmed energy potentialities of the CAS but have also significantly increased potential estimates of hydrocarbon reserves that has also enhanced geo-economic and geopolitical importance of the region. For instance, as per the Statistical Review of World Energy in 2011, the resources of Kazakhstan oil were 39.8 billion barrels accounting for 2.89 pc of total world energy resources. It is true that this is relatively less than that of Russia which has 5.57pc, Saudi Arabia 19 pc and Venezuela 15.3 pc. of global reserves. According to the estimates of resource potentialities, Kazakhstan and Turkmenistan are even higher than that made in 2011. The three CAS with 5.726 trillion cubic meters of natural gas resources will account for 3.5 pc of total global gas reserves. This indicates clearly that Central Asia has huge potentialities due to its growing importance of energy and so aimed for major powers for their own needs and for control over the resources.

It is necessary to examine the impact of explorations on the production of oil and natural gas in Central Asia. According to BP Statistical Review of World Energy published in 2008, there was substantial increase in oil and gas production in the CAS. Between 1990 and 2007, in case of Kazakhstan oil production shot up by two and half times from 25.8 million tons to 68.7 million tons. While in case of Turkmenistan oil production increased from 5.7 million tons to 9.8 million tons and in the case of Uzbekistan production increased from 2.8 million tons to 4.9 million tons. There was similar significant increase in production of natural gas during the last two decades in all the CAS indicating significant growth of energy sector in the CAS.

It is also important not only due to its oil reserves but also because of its high energy statistics which clearly indicate that although the combined oil reserves of Central Asian countries are not sufficient enough as compared to other rich oil possessing regions of the world, still, natural gas reserves of this region are not only significant but also unexplored. The importance in the value of the energy reserves of

Central Asian countries is the variation found in different statistics. The US department of Energy Information Administration estimates that both Turkmenistan and Kazakhstan contain over 250 trillion cubic feet of natural gas and more than 100 billion barrels of oil in their reserve. The oil reserves of Kazakhstan has been estimated about 79 billion barrels. Turkmenistan has the world's fourth largest reserves of natural gas almost about 7.94 trillion cubic meters which is exceeded only by Russia, Iran and Qatar. The potential of Central Asian countries' energy reserves is also revealed from BP Statistical Review of June 2013 where even the value of Central Asian reserves mentioned is significant. According to this estimate, Kazakhstan has 12th largest oil reserves in the world with lasting capacity of 47 years. As far as natural gas reserves are concerned, Turkmenistan, and Kazakhstan contain 4th, 19th largest reserves in the world, with a lasting capacity of 100, and 65 years respectively. These statistics indicate that both Kazakhstan and Turkmenistan have huge energy potential of oil and natural gas. Also, Central Asia is situated at the junction of Europe, South Asia and East Asia and these regions are in search of fossil fuels. Geographical proximity gives these regions an attraction for searching energy reserves with an advantage of lesser distance of transport. In this connection, the states of China, India, and Pakistan are very significant. These countries not only would be in constant need of oil and natural gas in the coming two decades, but also these are at nearer distance to the oil and gas reserves of Kazakhstan and Turkmenistan. Russia is the current leading oil producer of the region which is predicted to lose its production capacity at the end of next two decades. Therefore, an open space in oil production would allow Kazakhstan to become the top most oil producer of the region. The oil deficient countries of Europe, along with China and India are located around Kazakhstan for its brighter prospects of production avenue. Although Turkmenistan would not be the only top most natural gas producer in the coming decades because of the presence of Russia and Iran, still, its role as a natural gas producer would increase because of the existing trend of switching natural gas as a fuel for oil. Moreover, Central Asian republics are landlocked which offer supply of energy via pipelines through land routes, which is considered safe and economical as compared to sea routes. Considering the potential value and advantages of these reserves, the Central Asia region is the most ideal production centre to meet the energy needs of the energy deficient economies of Asia and Europe. Therefore, the

major stakeholders already begun to exert political influence in this region inorder to secure stable supplies of oil and gas.

Considering the significance of Central Asian region, major powers have already involved themselves in the energy politics for safeguarding their energy interests. The major role was played by European states led by USA, Russia and China in this regard. Europe imports 26 percent of its oil and 29 percent of its natural gas from Russia. To avoid overdependence on Russia, reserves in Central Asia offer attractive source of energy for European countries. Direct access to Central Asian energy reserves and bypassing Russia is ending Russian use of energy as a political weapon. For this, the west led by USA has developed west directed Baku-Tbilisi-Ceyha (BTC) oil pipeline in 2006. For avoiding overdependence on oil, European countries are replacing it with natural gas gradually. Since European countries are deficient in natural gas, therefore, it is estimated that 80 percent of their natural gas needs to be imported. To meet the future gas needs from Central Asian reserves, two pipeline projects have been planned i.e. Nabucco Pipeline, which is supposed to bring Azeri natural gas to Europe and Trans-Caspian Pipeline (TCP), which would transport Turkmen and or Kazakh natural gas to Europe. But both these pipeline projects are facing opposition from the regional influential states like Russia and Iran and also from Caspian Sea sovereignty issues. To counter west favoured projects and to mitigate the US control of energy, Russia tries to exert its influence in these republics either by continuing the already existing northward pipeline routes or exploring those, which avoid Europe's direct access to resources of Central Asia. In this regard, Russia has planned three pipeline projects i.e. Nord Stream gas pipeline, South Stream gas pipeline and extension of already existent Blue Stream pipeline across Black Sea. These projects were implemented successfully which would offer cheap and affordable energy supply to southern countries of European Union. It would produce conflicts among EU countries as its western located countries prefer US favoured western directed routes. Moreover, the prospects of Turkey is becoming one of the hopeful for EU membership since it has become an energy transit country for Europe. Russia is pursuing two pronged political strategy. Not only it is planning to continue control over Central Asian energy transportation, but, it is also creating disunity among EU countries. Apart from the pipeline politics, the stakeholders in Central Asia are also involved in regional alliance making and using military means are also controlling Central Asian

States for their energy interests. USA has initiated partnership for peace and a military assistance program for securing energy infrastructure in Central Asia. It has also helped to establish GUUAM, a regional alliance of five countries including Georgia, Ukraine, Uzbekistan, Azerbaijan and Moldova. In reaction, Russia has also created the Collective Security Treaty Organization (CSTO), which consists of seven former republics of USSR. US military is also involved in Central Asian region for conductance of joint naval and military exercises with its allies for gaining trust of their regimes. Similarly, Russia is also planning to establish its military base in Kyrgyzstan. Further, Both Russia and USA have favoured their respective ideologically inspired styles of governments in different Central Asian states. Russia has been supporting autocratic rulers, while USA has supported democratic revolutions in few of the Central Asia republics. Both powers aim to secure their interests through favouring regimes in the region.

The successful exploration of Kashagan offshore oil field of Kazakhstan referred to as 'elephant' is considered to be the largest in Asia. Moreover, expansion of giant Tengiz oil field has further pushed the global significance of Kazakhstan as it produced 2.35 million barrels of oil per day in 2013. Moreover, Karachgansk gas field with its vast resources has become operational and attracted major energy giants in the country. As per Uzbek official sources, efforts of exploration made during the last decade indicated that out of 171 discovered fields, 73 possessed substantial gas reserves. Similar explorations also indicated positive results in Turkmenistan and Kazakhstan. Explorations have confirmed that with over 8.9 Trillion cubic meters of natural gas, Turkmenistan is the 5th largest depository of gas in the world.

Now, China due to its huge population and economy is concerned about to import energy as its own fossil fuels. China is likely to import 84 percent of its energy requirements by 2030. Currently, Chinese energy imports are sea based coming via Malacca strait where US has dominant presence. To avoid security threatened sea based imports, China has made inroads into Central Asian region, which has land link with it. Kazakhstan-China oil pipeline (KCP) is operational since 2005, which is meeting 15 percent of Chinese crude oil needs. Beijing is also receiving 30 to 40 bcm of natural gas from Turkmenistan through Chinese constructed natural gas pipeline. In this context, Chinese state owned companies have got considerable foothold in the region for future stable

supply of much needed energy for China. Chinese National Petroleum Company (CNPC) has acquired Petrokazakh Company in Kazakhstan and SINOPEC has got Kazakhstan's North Buzachi oil field. It has also got joint ownership of Kazakhstan Kumkol North field with Lukoil Company of Russia. Moreover, SINOPEC has also reached a deal with Uzbek authorities over oil exploration and development. China is also using Shangai Cooperation Organization (SCO) for gaining support of Central Asian regimes. Through this platform, China along with Russia have entered into the picture providing security against terrorism and insurgencies to the regional regimes.

3. Scenario of Oil and its Reserves

The analysis of existing oil reserves, their lasting capacity, production patterns and consumption trends of the leading countries of different global regions leads to a few important observations. For this, a study has been conducted for both oil and gas, locating their reserves strength, production and consumption trends in different global regions. This method is empirical as the use and production of oil and natural gas of different countries regarding future predictions have been made by observing their production and consumption trends of the last five years of the previous decade. On the basis of these trends, regarding the production of oil, according to the estimates of International Energy Agency (IEA), Saudi Arabia, Russia and USA with respective shares of 12.9 percent, 12.7 percent, and 8.6 percent of the total production are the leading global oil producers. The leading oil producing countries produce more than 60 percent of the global oil. Among top 10 oil producing countries, three are from the Middle East, three from North American region and China is the only exclusive Asian country in this group. Saudi Arabia has its advantage of huge reserves and hence can produce and make use of its oil for long time. According to the estimates, Saudi reserves would last for more than 60 years. Russia's economic growth and development was largely dependent upon the sale of oil after cold war and so it remained the greatest producer of global oil. But based on its reservation to production ratio, Russia's oil would end in 22 years. Greater production in absence of significant reserves will deplete Russian oil wealth quickly. In comparison to their reserves, the production ratio of USA and China is far greater as their lasting capacity is just 11 and 9 years respectively due to their greater production in the absence of sufficient oil reserves. But both are dependent on oil for running their huge industrial

and transport sector. So, especially for China, oil is the back bone of their unprecedented economic development. Even being the significant total global oil producers, both USA, 8.6 percent and China 5.1 percent are still not self sufficient in oil as both are largely dependent on its import to meet their domestic needs.

In production trends, also, Russia is one of the leading oil producing countries during the period (2005-9) as its oil production is constantly increasing mainly because of its strong dependence on oil exports. Saudi oil production is consistently declining whereas the production graph of USA and Iran has increased. The Russia, USA, China, Canada, Brazil, Angola, and Azerbaijan have also shown an increase in their level of oil production. Their reserves seem to end within almost 20 years. So, in order to compensate the loss of global oil production the world would then depend more on those countries which have greater reserves lasting capacity. According to the estimates, USA, China, Mexico and Norway would run out of oil by 2020. Almost in 2030, the production capacity of the greatest oil producer Russia along with that of Brazil, Angola, Algeria, and Azerbaijan would also end. From that time, , the period would be very critical as the present rich producers of oil will be empty of oil reserves. So after this period, the centers of oil production would be those countries that have oil lasting capacity of more than 50 years. In this respect five countries of the Middle East (Saudi Arabia, Iran, Iraq, Kuwait, and UAE,), one each from Africa (Libya), Central Asia (Kazakhstan), North America (Canada) and South America (Venezuela) will be then the attracting leading oil producers. Middle East will remain hub of production with countries having greater lasting reserves capacity. However, other countries belonging to global South like Libya, and Kazakhstan will also gain tremendous importance in the future politics of global oil. All this clearly indicate a shift in the center of gravity of world oil production. The analysis of future trend of oil politics is incomplete unless the consumption patterns are evaluated. Petro-politics is not only a matter of production but a business of consumption too. The centre of oil politics in future can only be located by analysing the oil consumption pattern.

Regarding the consumption of oil, according to BP Statistical Review of World Energy 2013, per day oil consumption was about 84077 thousand barrels in that year. The consumption trend reveals the fact that few countries of Asia are emerging as great oil consumers. The

striking feature is that the largest oil producing nations have a very thin consumption level. Only Saudi Arabia, Iran, and Russia are among the major oil consuming nations. From this observation, it is clear that the leading oil producers are not its great consumers. Economically, this trend can be explained by the fact that oil is consumed in those countries that have an extensive industrial sector like the countries of the West and Asia Pacific. The oil of Middle East has been fuelling the strong industrialized economies of the West. Similarly in Asia Pacific, the gradually developed newly industrialized economies are also using oil enormously. The region of Asia Pacific has become the largest user of oil with a share of 31.1 percent of the total global consumption. The values of consumption trends show that the trends of leading oil consumer countries during 2005 to 2009 are the five countries of Asia namely China, India, Indonesia, South Korea and Singapore. All these countries have registered significant increase in oil consumption in the transitional phase of development. The developing nations of Asia including China, India, South Korea, Taiwan, and the Southeast Asian countries combinedly consumed almost 14.8 mb/d or 30 percent starting in 2004 which is as much as is consumed by the mature industrialized nations. Since they are projected to experience a combined annual growth rate of 2.7 percent, their consumption is projected to jump to 29.8 mb/d by 2030 for a net gain of 15 mb/d. On the other hand, countries of North America and European Union have gradually curtailed oil consumption. Though they are technologically strong but lasting capacity of oil in their lands is low. To maximize the life of oil reserves these countries are diversifying their energy resources. According to an estimate, the mature industrialized nations forming as a group are expected to experience a relatively modest rate of increase in net petroleum usage, estimated 0.6 percent per year between 2004. However, because their consumption in 2004 was already quite substantial, even this moderate rate of increase will boast their combined consumption by 8 mb/d over this period, from 49.1 to a projected 57.1 mb/d. Still the margin of this declining trend will not make them complete independence from oil. Their industrial and transport sector will continue to use oil for many years since the prospects for full utilization of renewable energy resources are still far away.

The complete assessment about oil and its reserves shows that the leading oil producers are not its great consumers. For example, the

Middle East countries have huge reserves with great longevity period but apart from Saudi Arabia and Iran, others are not great consumers. Even these two cannot become the top ten global consumers. Whereas, the great oil consumers like USA, China, Japan, India, have lack of significant oil reserves. The great oil consumers will run out of their reserves during next two decades and would compete more vigorously to access more oil. In the year 2030, all the present great consumers would become total oil importers since they would have no oil to meet their domestic needs. Since all these countries are either developed or newly industrialized, their competition for oil would be transformed into new cold war involving those regions where oil would be produced. Another most significant observation is that Middle East countries, Central Asia, and North Africa would become the centers of oil production in the future decades. After 2030, Saudi Arabia, Iraq, Kuwait, UAE, Qatar, Iran, Kazakhstan, Libya, and Nigeria would have the capacity of meeting oil needs of the world. So far as consumption is concerned, USA, Russia and emerging countries of Asia like China, India, South Korea, Indonesia, and Singapore would be the recipients of oil. In this context, Central Asian countries, especially Kazakhstan and Azerbaijan will gain and enhance their importance owing to their ideal geographic location along with abundance of hydrocarbons.

4. Conclusion

The significance of Central Asian states for their oil and natural gas reserves reveals the nature of geopolitics of the region in near future. The tug of war for diverting energy resources through oil and natural gas pipelines via different waterways like the Caspian Sea, the Black sea, the Baltic Sea etc, predicts their militarization. Once the sea based pipelines are made effective, the concerned states would deploy their respective naval fleets for their safety. Secondly, the prospects of practical democracy in the states of Central Asia seem to be a remote possibility, at least in the near future. For the sake of their own energy related interests both USA and Russia would like to keep on favouring the autocratic regimes of the region, which are easily influenced as compared to democratically elected governments. The existing geopolitical developments indicate that both Russia and China face brighter prospects of manipulating geopolitics in their favour. Both these states are regional major powers, having geographical contiguity with the Central Asian states. Moreover, both would be highly dependent on easy to access fossil fuels, for which

Central Asian republics offer ideal source. On the other hand in the west, particularly European energy deficient countries are not geographically linked to the region of Central Asia. Further, due to the ongoing effect of world financial crises, these states can't afford highly expensive sea based pipelines. Moreover, as compared to the state controlled energy companies of Russia and China, the energy companies of European states are not influential in the countries of Central Asia. In the overall scenario, the energy related interests of both regional level states of Iran and India are also significant. Both Iran and India desire the southern flow of Central Asian energy for their own respective needs. Both are involved in energy related joint projects with Russian and Chinese state owned energy companies. Regarding the future geopolitics of Central Asian region is to form an energy cartel, the idea of which has already been proposed and is being strongly favoured by Russia. The projected scenario gain indicates the initiation of yet another cold war between the West led by USA and the East led by Russia.

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A Review On Agricultural Credit In India

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Abstract

The growth of agricultural credit in India which slowed down in the 1990s revived after 2000. Rural population in India suffers from a great deal of indebtedness and is subject to exploitation in the credit market due to high interest rates and the lack of convenient access to credit. Rural households need credit for investing in agriculture and smoothening out seasonal fluctuations in earnings. Bank creates new demand deposits in the process of granting loans and purchasing investment securities. This paper, therefore, examines that to what extent credit advanced by banks has helped economic growth in the states. It is found that although the scenario of rural credit activities of banking system spread all over India was highly satisfactory and very impressive. This is because the southern region is benefited both in direct and indirect financing whereas north east region still enjoys a backward position in this respect.

Key Words:

Agricultural credit; Banks; Regions

Introduction

Agriculture plays a very important role to improve the overall economic growth of a developing country like India as almost half of the population in India is still highly dependent and engaged in agricultural and rural sectors. But nowadays, the share of agricultural output in India has declined with the gradual growing importance of secondary and tertiary sectors within the Indian economy. For example, the share of agriculture and allied activities in the GDP had declined from 57.7% in 1950-51 to 22% in 2002-03 and further to 12.3% in 2009-10. It had increased to 17.32% in 2018-19 as compared to that in 2009-10, but had declined as compared to the level of GDP in the year of the first Five Year Plan (Economic Survey of India, The Department of Economic Affairs,

Ministry of Finance, Government of India). However, the upliftment of this vital sector, at par competition with other growing important sectors in the post globalisation period, is possible only through the improvement of the rural credit to this sector through the banking sector or other non banking financial facilities such as NGOs etc, in terms of the provision of better and sufficient both direct and indirect finance to the farmers (Basu and Maertens, 2013).

The banking sector offers an essential support to agriculture with the National Bank for Agriculture and Rural Development (NABARD) being the apex organization with respect to all matters relating to policy, planning and operational aspects in the field of credit for the promotion of agriculture and allied activities in rural areas (Misra and Puri, 2013). The major dominance of commercial banks is readily found in Indian banking system, with the co-operative and regional rural banks occupying a little business segment, with the flow of credit to agriculture has been increasing at a rapid rate, even surpassing the annual targets set for such growth from 2010 onwards. As a result of the expansion of institutional credit facilities to farmers, it will be possible to reduce both the importance of moneylenders, together with the exploitation of farmers at the hands of moneylenders (Datt et al, 2015).

Since agriculture is the back bone of Indian economy, proper cropping and adequate access of the farmers to the other inputs, storage, marketing and transportation facilities, land facilities, timely production, and healthy use of pesticides are equally most important especially for small and marginal farmers. It is of high credit facilities from financial institutions as it proves its great importance since credit is essential for establishing sustained and profitable farming system. But in case of the major agricultural states in India, such as Punjab, Haryana, Gujarat and Maharashtra, the area under marginal farms is quite low and that under large and medium-sized farms is considerably high. But, for the overall India, agrarian economy is based on small and marginal farmers (Economic Survey, Ministry of Finance, Govt. of India 2017; NABARD 2018).

Another important feature of agricultural credit after 1991 is its revival in the 2000s, following a slowdown in the 1990s. After 2010, the government also announced a scheme to double credit flow to agriculture over a period of three years. The growth rate of agricultural credit between 2007 to 2017 was 17.8% per annum, which was significantly higher than the corresponding growth rate between 1997

to 2007. Although the revival of growth of agricultural credit began after the 2000s but the doubling of agricultural credit "did not reach large numbers of small and marginal farmers according to the announcement made by The Task Force on Credit-Related Issues of Farmers in 2016 (Economic Survey, Ministry of Finance, Govt. of India, 2017). Various measures have been undertaken by the government of India to improve the commercial viability of the RRBs and their level of productivity, so that the contribution of the financial sector can play a major role to raise the current economic growth of Indian economy.

Literature Review

An important measure initiated was the expansion of institutional credit of farmers, especially through cooperatives and commercial banks. After nationalization of banks in 1969, nationalized banks have paid increasing attention to the needs of agriculture. Another policy measure of significant importance is the announcement of procurement and support prices to ensure fair returns to the farmers so that even in the years of surplus the prices do not tumble down and farmers do not suffer losses. The government has provided massive subsidies to farmers on agricultural inputs like irrigation, fertilizers and power (Mishra and Puri, 2013). In 2000, over 70% of Indian's population and roughly three-quarters of its poor lived in rural areas. India has witnessed some of the largest policy interventions aimed at providing banking for the poor. The formal credit sector accounted for the bulk of rural lending, with moneylenders contributing close to 70% of the total. The average annual interest rate on these loans exceeded 20%. In contrast, less than 1% of the borrowing was accounted for by commercial banks (Basu and Maertens, 2013). After 2000, indirect agricultural credit constituted a bigger share than previously to the growth of overall agricultural credit. There was a sharp increase in the share of large-size loans in agricultural credit. Agricultural credit was increasingly diverted away from rural areas, particularly from the marginal and small farmers, and towards large business interests based in urban areas. After the nationalization of commercial banks in 1969, "social and development banking" was declared to be an official policy objective of rural banking. Formal institutions of credit provision, mainly commercial banks, emerged as important sources of finance to agriculture, countervailing usurious moneylenders and landlords. The policy of social and development banking was supply-led; it aimed at augmenting the supply of

credit to rural areas and providing credit at affordable interest rates (Ramachandran and Chavan, 2015).

The financial requirements of the Indian farmers can be classified into three types depending upon the period. Firstly, farmers need fund for short periods of less than 15 months for the purpose of cultivation or for meeting domestic expense. For example, they want to buy seeds, fertilizer, and fodder for castle, etc., such period loans are normally repaid after the harvest. Secondly, the farmers require finances for medium period ranging between 15 months and 5 years for the purpose of making some improvement on land, buying cattle, agricultural implements etc., these loans short terms loan and can be repaid over longer periods of more than 5 years. Again credits available to the farmers are two sources – institutional and private. Institutional credit to loans provided to farmers by co-operative societies, co-operative banks and commercial banks including regional rural banks (RRB). Private sources are including money-lenders, traders and commission agents, relatives and landlords (Datt and Mahajan, 2015).

A commercial bank is a type of bank that provides services such as accepting deposits, making business loans, and offering basic investment products. Commercial bank can also refer to a bank or a division of a bank that mostly deals with deposits and loans from corporations or large businesses, as opposed to individual members of the public. The share of commercial banks in total institutional credit to agriculture is almost 48 percent followed by co-operative banks with a share of 46 percent and RRBs about 6 percent. But studies have shown that many of the ordinary people have no access to institutional credit. (Saini and Sindhu, 2014).

A large number of formal institutional agencies like Co-operatives, Regional Rural Banks (RRBs), Scheduled Commercial Banks (SCBs), Non-Banking Financial Institutions (NBFIs) and Self Help Groups (SHGs), etc., are involved in meeting the short and long term needs of the farmers. Several initiatives have been taken to strengthen the institutional mechanism of rural credit system (Kapila, 2015).

Objectives of the study

The main objective of this paper is to examine the changes in region wise growth and distribution of agricultural credit from commercial banks during the phase of revival (since 2009) all over India. Not only that, it also

highlights the major concern of the Government to bring all the farmer households within the banking fold and promote complete financial inclusion so as to show how easily the farmers can access to financial services at affordable cost which positively affects the productivities, assets formation, food and income security to their family.

Data Sources

This study is based on secondary data collected from the sources such as Reserve Bank of India Bulletin, www.rbi.org.in, NABARD www.nabard.org, Economic Survey, Statistical Abstracts of India (mospi.nic.in).

Methodology

Simple Graphical and mathematical tools have been used for the study in terms of various bar diagrams such as horizontal bar diagrams, grouped bar diagrams in order to show the state wise distribution of financing from banks to agricultural sector all over India. A Bar diagram consists of an equi-spaced rectangular bars, one for each category of given statistical data (Das, 2013).

Results and Discussion

Region wise distribution of advances of scheduled commercial banks in input facilities

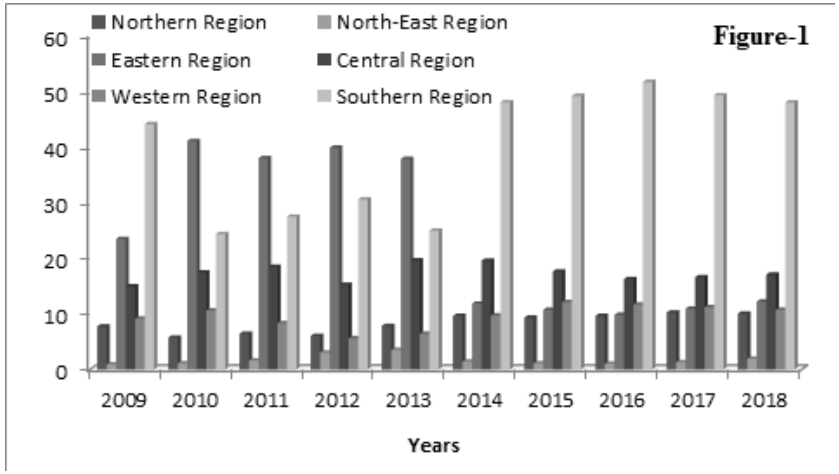

Figure-1: Region wise distribution of advances of scheduled commercial banks to agriculture during 2009-18 (Finance for Distribution of Fertilizers & Other Inputs)

Source: Reserve Bank of India (RBI)

From Figure 1, it is found that southern region plays a major role to increase their productivity in agriculture through advances of scheduled commercial banks in input facilities, as this region continuously had given its higher percentage from among all regions, followed by Central region during the period.

Region wise distribution of advances of scheduled commercial banks in loan facilities

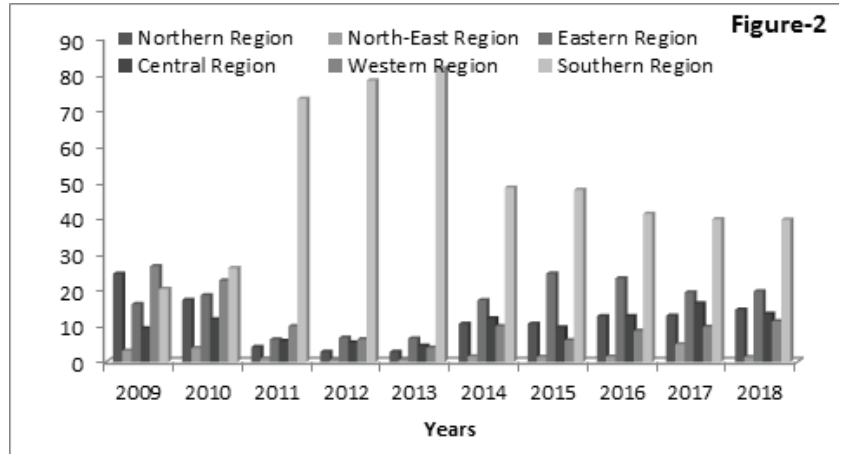

Figure-2: Region wise distribution of advances of scheduled commercial banks to agriculture during 2009-2018 (Finance for loan facilities)
Source: Reserve Bank of India (RBI)

From Figure 2, it is found that southern region in this case also plays a vital role to increase their productivity in agriculture through advances of scheduled commercial banks in loan facilities (other types of finances include loans to farmers through PACS/PSS/LAMPS, etc.), as this region continuously had given its higher percentage from among all regions, followed by Eastern region during the period.

Now, National Bank for Agriculture and Rural Development (NABARD) is responsible for refinance disbursement to commercial banks, rural development banks, Regional Rural Banks (RRBs) and other eligible financial institutions. It also sanctions money through its rural projects covering irrigation soil conservation. NABARD also offers a Kisan Credit Card Scheme and crop loans under the Rashtriya Krishi Bima Yojana. Over the years, there has been a significant increase in the

access of rural cultivators to institutional credit and simultaneously, the role of informal agencies, including money lenders, as source of credit no doubt has declined. But, the above performance of the region wise distribution of credit accessibility to the farmers implies that Southern region was only successful in achieving the benefits of institutional rural credit from scheduled commercial banks, thereby, raising the inter regional discrepancies. Not only that, the performance of other regions with only two regions such as Central region and Eastern region, other than southern region, enjoying limited accessibility to the provision of rural credit, therefore, has challenged the major government concern of bringing all the farmer households within the banking fold with a view to have complete financial inclusion.

However, the situation has become much more aggravated for the farmers with the following common negative impacts on both global and domestic agriculture related to crop production and availability of seeds, fertilizers, pesticides and other inputs shortage, travel bans thus leading to perishable or rottening of crops with respect to marketing and distribution of the agricultural produce- all of which had led to reduction in food quality and higher cost of production. But, all of the above had become major immediate problems and, in fact, issues surfaced farmers for Indian agriculture, which contributes about 17 per cent to Indian GDP, after COVID pandemic outbreak hit during the peak harvesting season. In addition to those, as mentioned above, the economic situation of the farmers, agricultural labourers and agricultural workers was worst because of rise in labour costs and lack of access due to adverse food demand owing to reduction in income and purchasing capacity, price uncertainty due to lack of market access including the stoppage of transportation and closure of borders, food inflation due to stock piling of the foods by panicked consumers and higher food insecurity due to slump in international trade, disturbance in food supply chain and food production, labour unavailability due to reverse migration, shortage of migrant labour due to absence of transport facilities clubbed together with vigilant blocking roads with a limiting effect on the movement of migratory harvest labour during the lock down situation (Arumugam, U. et al, 2000). As a result, the above low income agrarian class, occupying almost *70 percent of rural households, therefore,* either due to little saving or no saving, lack proper health services and social protection and often were obliged to work for their sustenance despite the self-isolation protocol.

Apart from the above mentioned self-imposed restrictions on the inter- and intra-State movements of farmers/labourers due to lockdown situation, the most important issue that farmers have to face is the problem of lockdown induced debt and cash flow constraints for which they need to repay their crop loans, gold loans and other informal debts between April and May, when a fresh loan is also granted at the onset of a new season. Otherwise they will be forced to borrow money from the informal sector at high rates of interest for the new season. In such situation, those of the so called informal agricultural class, with no options but somehow struggled to sell their produce from the rabi season and raised capital to prepare for the sowing season, had added huge losses to their existing debt crisis. Moreover, the rest among them who had failed to protect them during this critical juncture could worsen India's agrarian distress by committing suicide as the last chosen option (Sahoo et al, 2000).

The only way to give a ray of hope to this distressed Indian agrarian class is the Union Government's interest subvention scheme (ISS), which offers short-term loans to farmers at subsidised rates. The trend of farmers borrowing more for short-term production expenditure compared to long-term capital investment in productive agricultural technologies heightened partially due to ISS incentives, according to an internal working group of the Reserve Bank of India (www.rbi.org.in). This will be problematic as long-term investment is needed for the sector's sustainability which would rather act as added complication as tenant farmers in several states are unable to access institutional credit.

Conclusion

From the above analysis, it can be inferred that during the period 2009-2018, the growth of agricultural credit generating was high from banks but was beneficial to limited regions, as some regions, such as Northern region, North-Eastern region and Western Region are all facing backward position in this respect. This implies that all states of mainly southern region in India have a major support from bank in terms of the institutional credit facilities. But the other regions such as western, northern and, to some extent, eastern regions have to depend on the growth of indirect finance which was more pronounced in these regions of the country than in other regions, as, about one-fourth of the rise in agricultural credit in the 2000s was on account of

an increase in indirect finance (Kapila, 2015). North-Eastern Region, particularly, does not have an important support in matter of credit availability, in terms of both direct and indirect finance and, therefore, their agricultural production has also not so well improved as compared to other regions over the said period. This may be due to their adverse geographical locational disadvantage and also regional economic backwardness due to poor growth of infrastructure within the North Eastern Regional states. So, to conclude, the major beneficiaries of the revival in agricultural credit in the 2000s where corporate groups and other organisations are indirectly involved in agricultural production and not farmers who were direct producers in agriculture. Although the share of institutional credit in agriculture increased to 72 per cent in 2015 from 63 per cent in 1981, according to the National Bank for Agriculture and Rural Development's and *all India Financial Inclusion Survey* (agriculture.gov.in), the interregional disparities in case of credit availability from the formal financial sector within the economy had, no doubt, widened and could not be ruled out.

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Role of Teachers for Quality Improvement in Higher Education

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Abstract

Education is investigated as the most significant, essential and aristocratic activities. It guides person to reach a higher level of mental, spiritual, physical, and social potential. It is found that a small number of students can afford education in India due to various reason. According to report, most of Indian colleges and universities are running for degree not for quality education. Teachers/Students are also interested in degrees only not for knowledge or wisdom. Under these circumstances, the only solution for all problems is quality education and which can be provided only by quality. Here, in this paper,I focus on how a teacher can help society to provide quality education. A survey is performed to achieve the perfect conclusion.

Introduction

Present Situations of Higher Education in India: Higher Education in India has put a remarkable mark since independence. India has made its own path by producing scientists, technologists, engineers, teachers, doctors, and managers who are highly demanded all over the world. But, nowadays, the system has many concern and issues regarding financial, management, equity, etc. According to recent survey, only 10% young generation of India attend college whereas in developed country, this criterion is about 40-50%. Not only that, only 2/3 of Indian intuitions are providing second rate education while about 90 % of Indian colleges are providing poor quality of education. Most of the Indian institutions are running for degree only avoiding proper knowledge or wisdom. Classroom study is becoming a ritual only and as a result attendance is dropping drastically. The standard of Indian education is not meeting the standard of global education. As a result, Indian education system has no significant contribution to the national development. This system is also unsuitable to fulfil the expectations of employment sector.

Problem When Teaching in Higher Educational Institutions: Now a days, in India, number of higher educational institutions have been increasing day by day. Though there are many higher educational institutions, still institutions are running with a lesser number of teachers and infrastructures. This problem leads to such difficulties when students lose their interest towards study. Another problem is short time span and only exam focused education system. Teachers must complete a huge syllabus of a subject within a short time, thus quality of teaching got hampered, and teachers as well as students have to rush towards that timeline. After this pandemic situation, education system has changed a lot, now it is totally dependent on online mode. Teaching learning process through online has faced some different levels of difficulties, such as network issues sometimes, lack of knowledge of students about online processes, inactivity during online classes. There is another type of problem when students want to know about the practical implementation of any topic, that has been taught in any class. They just want to know what benefits they will get from any topic, instead of gaining a keen knowledge on that topic.

Impact and effect of disabilities in higher education: Present population of India is nearabout 1.21 billion and among them 2.21% (approximately) of the population has a special need (disabled) (Registrar General and General Census Commission, 2012b). Education for disabled students has a major concern in India. A student with disabilities faces many difficulties in school level as well as for higher studies in Indian institutions. Not only in India, but it is also a global issue that only limited attention has been for progression of students with disabilities in higher educational sector. Recently, after India became the signatory to United Nations Convention on Rights of Persons with Disabilities (UNCRPD), in September 2007, the educational sector got pressure from them for improving the accessibility of disabled people. Though there are many act and policies for disabled students, but they are only written on paper, no applicability of them in real life and as a result the students with special needs are always deprived of higher education.

Quality Education: Quality education gives a wholesome development of a person, transforms the person into a productive person for the society. Quality education involves quality teachers, quality tools for learning & productive development. And it should be for all irrespective of socio-

economic standard, cast, communities, and gender. Quality education faced challenges when it is being judged only based on numeracy and literacy. It should not be only the process of content delivery, rather it should be a process of development that brings out the best of a person and makes them a productive citizen. Quality education is a continuous process of adaptation, learners must adapt changing environments every day. Quality education should give the joy of learning to every person. Quality education is a fundamental right of each citizen.

Role and Quality of Teacher:

> "The primary task of a society is to find a real teacher, one who performs his duty with perfection and dedication and is a perfect moral example for the society"
>
> - Rabindranath Tagore

An education system succeeded with the help of quality teachers who are included in the system. Teachers' plays the significance role for developing the society as well as a nation. Teachers are the backbone for supplying the quality education without hampering the quality standard. So, the role of a teacher is:

- Prepare the student for vocational education so that they can get employment easily.
- Overall intellectual development of the students.
- Prepare quality student who can serve society and nation.
- Prepare good and smart students.

So, the characteristic of a teacher should have a combination of a liberationist, an executive and a therapist. That means, they should act as an executive, as a therapist or as a liberationist. The teacher must decide what will be the response according as situation. It's just liked a doctor who does not prescribe same medicine for all patients. Suppose a class is full of desperate, young, energetic students, so the situation demands a charismatic teacher whereas if the class is full of mature and older students may require a liberationist teacher.

An important skill for an effective teacher is classroom control. If they know the subject well but have no control in class is a characteristic of an ineffective teacher. An effective teacher will have appropriate knowledge on subject. The subject matter by that teacher should be

presented simply, systematically, and logically so that it becomes understandable for all the students. The personality of a good teacher be friendly, approachable, confident, warm, dedicated, charmful, motivated and cheerful.

An ineffective teacher has some common characteristic:

- Questions from students are not allowable in classroom.
- Not acceptance his/her own mistake.
- Punishment for students even for a small mistake.
- Bad classroom management.
- Teach from notes, gives problem for an hour and no input in class at all.

Teaching-learning is always a cooperative process, so it is mandatory to motivate students for clearing their doubts for a smooth communication.

Role of Teachers in Quality Enhancement: Quality enhancement in higher education means to upbring a student for the future society. And a quality teacher plays a crucial role to give quality enhancement in a whole to the students. Quality teacher not only prepare the students for a degree but prepares the students as an outstanding citizen of the nation. For that a quality teacher must become a constant learner, to update the knowledge of current technologies.

A dedicated and motivated teacher act as a role model for his/her students. Quality teacher should motivate students for rational thinking and decision making based on situations and difficulties.

Skill development is another major part of a quality teacher to play. Skill development is needed to prepare a student for the job market and current economic scenario in the society. Therefore, a quality teacher should be innovative, inspiring, and entrepreneurial in his/her skill development approach by having connections with industries, collaboration with neighbourhood companies.

Another tool of quality enhancement is the use of proper resources and tools in higher education, that motivate and create employable graduates.

Now a days, teachers are in crisis of professional freedom. Professional freedom has crucial impact in the role of a quality teacher.

Without getting professional freedom a teacher could not bring his/her best effort. As teachers are the one who nourish their students from their basic level, and they understand their students best. How a student can be taught and what are the intake capabilities of the students, a teacher can only judge it in the best way. Authorities can suggest newer technologies and methods of teaching through development programs, service training, and other methods, but authority should not command about which method to be used for teaching.

Teaching Learning Process: In higher educational institutions teaching learning process should come with a goal oriented, focused, interactive, enterprising form. Teaching is a process of accompanying to someone's experience, needs, and feelings. This is a constant process of sharing knowledge and experience in an organised and disciplined way that stimulates psychological and intellectual growth of a person. And learning is an action that is taken by both the students and teachers on different concepts. A teacher should always be ready to acquire new thinking, knowledge, and method and teacher training programs take important part in this aspect of teaching learning process. Good teaching practice includes setting a clear goal, getting teacher feedback, interactive sessions between teacher and students, that involve the learners. Learners got the best idea when they got involved in the process.

Frame of Teaching: A student is very familiar with this model without knowing the duties and responsibilities of a teacher. Some important points related with teaching are given below:

i. Planning and preparation: Teacher should demonstrate content knowledge, pedagogy, resources, outcomes, and assessments among with students.

ii. Classroom environment: Every teacher should create a classroom of harmony, empathy, respect, and culture of learning.

iii. Professional responsibilities: Every teacher should maintain accurate records, communicate with families and professionalism.

iv. Instruction and motivation: Teaching is a self-learning procedure, so, every teacher should communicate with students, discuss techniques and motivates them.

Conclusion

Education without vision is meaningless and fruitless. The faculties who are engaged with higher education must perform as a leader or as an executive with situation. A teacher should be presented as an ideal human being who can set example for the students. It is also a responsibility of a teacher to manage the classroom properly. As learning is a self-initiated method, so, it is a responsibility of every faculty to motivate every student. Every problem will be explained but the problem must be solved by the students. A society must be enriched with the active participation of the teachers and students. Then, we will get a better place to live in.

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What does the Russia-Ukraine war mean for Central Asia?

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Abstract

Central Asia is a landlocked, five-country region rich in mineral resources bordering Afghanistan, the People's Republic of China (PRC, or China), Iran, and Russia. Russia maintains strong political and military ties with the region, and China's significant economic presence is accompanied by an expanding security footprint. Since 2001, U.S. engagement with Central Asia has largely focused on security cooperation, particularly in relation to the conflict in Afghanistan. Russia's renewed invasion of Ukraine in February 2022 arguably has placed the Central Asian countries in a difficult position both economically and diplomatically, even as Central Asian governments face a range of domestic and regional challenges. Shifting geopolitics in the wake of Russia's invasion may present new opportunities for U.S. engagement with Central Asia, which some Members of U.S Congress have expressed interest in developing. Since the beginning of Russia's invasion of Ukraine, Central Asian countries have moved to diversify their diplomatic and economic relations, increasing engagement with the European Union and with countries such as Turkey, Iran, and Azerbaijan. Some analysts stated that the war is undermining Russia's position in the region and leading Central Asian countries to distance themselves from Moscow. Although Russia has long served as Central Asia's primary security guarantor, some observers see that role as diminishing as a result of the war. Central Asian countries appear to be increasingly engaging with other partners in the security sphere. In addition, some experts question the long-term viability of Russia-led multilateral organizations including the Eurasian Economic Union and the Collective Security Treaty Organization. While the economic impacts in Central Asia of the war have not been as dire as some experts initially predicted, regional countries are facing high inflation and disruptions to supply chains. In response, Central Asian countries are seeking to diversify their trade relationships and establish transit routes that bypass Russia.

Keywords

Russia, Central Asia, Ukraine, War, Geopolitics, Economic Union, Security, Organization

Introduction

In the aftermath of Russia's attack on Ukraine, a storm is brewing in another part of the former Soviet space – Central Asia. This region, rich in resources, is caught in a field of forces defined by Russian, Chinese, Iranian, Turkish, Indian and American (as related to the war in Afghanistan)'s interests. As a strong Russia defending and backing the five republics that comprise the region becomes weaker and the states are forced to look elsewhere for patronage and support, the resulting geopolitical void will create the conditions-of-possibility for extreme shifts in power that will have significant knock-on effects for the global balance of power. As a result, we may see a world where China and Iran border each other, allied against the Russians and Turks. We may see Indian-backed Central Asian republics. Depending on who does what, these changes may precipitate NATO involvement. Altogether, Russia and Ukraine's war is likely to have significant – maybe even ominous – geopolitical consequences outside of Europe that will reshape world politics, political alignments, and the security environment far beyond the region. Russia seems to wish to recreate the old Soviet Union – or perhaps even the old Czarist Empire. Putin has directly stated he thinks the republics should not exist, for countries so dependent on Russia, this is an existential threat. For each of these countries, they either have to look outside of Russia towards China and hope they will still exist or further afield. Turkey has major interests in the region in their talks of a unified Turan and Turkic solidarity. Iran wishes for a return of greater Iran and nearly every other group provides an existential threat to these states. Every Central Asian government can no longer trust Russia to help with their disputes, with their internal security, for economic support, for protection from other countries and beyond that cannot even trust them to not intervene themselves once they are finished with Ukraine. For the people within these republics, the opposition movements of any alignment have now noticed that Russia can no longer prevent movement, the economy is crashing for the average person and

the future is unclear. On top of this, Russia has the gall to request troops from Kazakhstan for Ukraine despite Russian actions. No wonder these states have called for mediation or refused to comment. The current set of responses are characterized by a shift in attention away from Russia and are 'hard fought and hard won' as seen in *Responses from Central Asian States to the Russian Invasion of Ukraine*. The current Russia is weak and unclear, and now Central Asia is looking towards a new path through realignment or regime change. Uzbekistan has directly made a statement declaring its support for an independent Ukraine in the face of Russian aggression, a clear sign of a pivot in support. What would be the role of NATO in this current situation in Central Asia? The paths are unclear. Despite the key strategic interest of the region in terms of economic interest and geopolitical balancing, trust in NATO is at an all-time low. NATO lost in Afghanistan has not curtailed Iran or Russia and the only main NATO power that seems to be interested in the situation seems to be Turkey which seeks assimilation or annexation. What path NATO can take is unclear. However whichever path NATO does take in Central Asia will affect the geopolitical balancing within the region, and influence could determine winners and losers overall. India however is a much more interesting player in Central Asia. India has increased its connections to many of the countries in the region and the Indian route for the governments of these republics seems to have an alternative to having to loosen religious restrictions. India could have powerful economic trade elements and is seeking to counterbalance other states in the region. India would have a vested interest in keeping China and Iran from expansion due to fears of increased support of Pakistan. However, India has close economic and trade partnerships with Iran and Russia, and the current hesitation of Modi to condemn Russia has made it clear that India does not want to align itself against Russia. However, if India wished to assert more power in the region to counter Chinese interests, now would be the time. It all depends on what Modi wishes to do, and that remains unclear. However, India would not be happy with an increase in Chinese influence and power unchecked. In totality, Central Asia is heading towards a radical reconfiguration in the geopolitical balance of power, possibly even towards war. In conclusion, the fate of the Central Asian Republics and the geopolitical implications remain unclear. However, it is important to watch what may happen in the coming weeks and months, as most of the regional and world powers have a grave stake in what is to come. China, Iran, India, Turkey,

Russia and NATO all have interests and possible avenues to stake claims and influence in the republics, which will have worldwide implications and consequences in the coming years. (1)

Revisiting Russia's "Turn to the East" amid the Ukraine War

A decade after Vladimir Putin declared that Russia would "Turn to the East," he invaded Ukraine in the largest land war in the West since World War II. What is the impact of his 2022 decision on Russia's agenda for Asia? How has Russia's approach to Central Asia, Japan, and the Korean Peninsula changed in light of the war in the West? This set of three essays puts the early signs of spillover from the war and the sanctions it evoked into the context of earlier Russian thinking in the aftermath of Putin's 2012 refocus on the East. Central Asia claims pride of place. After all, the five former republics of the Soviet Union bear striking resemblance to Ukraine as reminders to Putin of the "greatest tragedy of the twentieth century"—the loss of the Soviet Union. Kazakhstan resembles Ukraine in having a large Russian population concentrated close to the border of the Russian Federation, even as signs of de-Russification are growing. In Central Asia, the external factor is China, not the EU or the United States. While the year 2022 began with what was called a "color revolution" there, reminiscent of the "color revolution" Putin attributed to the West in Ukraine, China was also wary. Sino-Russian ties pose problems for coordination in Central Asia, less so than Russo-US ties in Europe but still significant. Russia is driven by much the same mindset seen in its invasion of Ukraine: jealous of its "unique" rights and hostile to perceived infringements, in this case by China; disrespectful of sovereign decisions there; prone to use the pretext of peacekeeping operations to interfere in a manner entirely different from actual peacekeeping forces; and ready to strain great power relations, even with its closest partner, China. Clearly, the image here of Sino-Russian relations in general and on Central Asia in particular is not alliance-like. The crux of the matter is Putin's growing hubris that Moscow is capable of reestablishing its dominance if not total control over states formerly in the Soviet Union. In January, he was emboldened by a quick "peacekeeping" foray into Kazakhstan, which drew praise in Russia for altering the balance between Russia and China in that critical country. A month later Putin went further uninvited in Ukraine. While China did not object in Central Asia and repeated Russia's justifications for anti-West action in the Ukraine war, these were not coordinated

actions. The upshot was that China was left in a greatly weakened position and could not be pleased at this situation. Japan and South Korea raise similar challenges for Moscow as allies of the United States, leading to the same hostile label in 2022 as "unfriendly." It was inevitable that China would be Russia's most important partner in the "Turn to the East," which began to receive more attention from the time of the APEC summit in Vladivostok in 2012. However, to avoid simply a "turn to China" it was essential for Russia to develop relations with other East Asian countries. Japan, as East Asia's second-largest economic power, was the obvious choice. When Putin spoke of settling the longstanding territorial dispute by means of a "*hikiwake,*" meaning a draw in Japanese, this was taken by many as a sign that Putin was willing to return two of the four Southern Kuril Islands. A new energy to Russia-Japan relations owed much to Abe Shinzo, who enthusiastically embraced the agenda of building closer relations with Russia. However, looking back over the decade that has now passed since Putin's call for a new start, it is clear that bilateral relations have not become markedly better. Indeed, economic ties continue to underwhelm, political frictions are recurrent, and security tensions are increasing. The territorial dispute also seems much further from resolution than it did in 2012. Yet, the Ukraine War brought home that the deepest cause was Putin's mindset centered on a "New Cold War," in which Japan stood on the opposite side. The decade from 2012 began with the Russian leadership expressing hope of Japan playing a central role in Russia's "Turn to the East," yet ended with Russia increasingly turning away from Japan. Analysts has demonstrated that the change in Moscow's attitude was driven by the deterioration of Russia-US relations and the knock-on effect this had on ties between Russia and Japan. Additional factors were Moscow's disappointment at the modest scale of Japan's economic cooperation, as well as Russia's increased closeness to China, which encouraged Moscow to echo Beijing's criticism of Japan over historical issues related to the Second World War. This negative trend was already discernible in 2019. It then became more apparent under Abe's successors, who were less eager to cultivate friendly relations with Putin. The Soviet legacy of going it alone, failing to capture on the dynamism of Asia, endures. Russia's quasi-alliance with China appears to belie such a negative verdict. After all, Moscow has joined with the rising power of Asia, unlike its past hostility to Japan, when it was the rising power and its dogged demonization of China in the 1970s to mid-80s when it could have

provided some balance of power. Has Putin not learned the lesson of isolation in Asia in line with trumpeting his "Turn to the East" breakthrough? In fact, Putin and Xi Jinping, while showcasing close personal ties, play a "cat and mouse" game with little trust. Central Asia is the prime battlefield of jockeying for power against the other. Behind a partnership with "no limits," there is a rivalry with scant trust. Putin is resistant to the BRI, Xi pays lip service to the Greater Eurasian Partnership, and they vie in Kazakhstan and elsewhere in Central Asia for a sphere of influence. Putin benefits from the fact that Xi prioritizes other arenas for expanding China's influence and welcomes Putin's alienation of the US, Japan, and South Korea. If the Ukraine war tests Chinese patience with Putin's rash decisions and counterproductive aggression, it is not sufficient cause to contribute to a humiliation of China's best bulwark against the US-led global order. To a degree, China benefits from Russia's alienation of all sides in Asia except China. Central Asian states need China more for balance, sensing vulnerability as Russia attacks Ukraine for reasons that could apply to them. Japan and South Korea are discouraged from efforts to drive a wedge between Moscow and Beijing, Moscow is more dependent. Yet, by isolating Russia Putin is casting a shadow on China too, rallying states behind the US. This is a net loss for China and Russia. Russia pressed for the EAEU, while China advanced the BRI. The two were officially linked during the May 2015 visit by Xi Jinping to Moscow, but there has not been a successful docking. The EAEU was meant to block Chinese economic penetration of Central Asia but was unsuccessful as Beijing treated it as a corridor for the BRI. Then Russia proposed the Greater Eurasian Partnership, a larger strategy to counterbalance China, meant to show Russia as taking the initiative in the post-Soviet space of Central Asia, treated as the center of a larger Eurasian regional architecture linked to the SCO and ASEAN. Some analysts focuses on the Collective Security Treaty Organization (CSTO), which was meant to function as a post-Soviet security mechanism for peacekeeping, and cooperation with China. She takes the Ukraine crisis as a case study of its viability as a peacekeeping organization. Putin expected the CSTO to help Moscow create a Russian sphere of influence among post-Soviet states. Additionally, Putin hoped to make the CSTO a basis for resistance to NATO and NATO's eastward expansion, a collective security arrangement to form a Eurasian regional order, an alternative to the Western liberal order. The rationale for peacekeeping in the post-Soviet

space is that Russia has a duty to protect ethnic Russians and Russian-speaking populations living there. It had this responsibility since the international community was not interested in participating in peacekeeping in this space. Chinese analysts have noted Moscow's stress on exerting influence over the post-Soviet space as a means to regain its status as a great power and Chinese recognize that the mechanisms used to consolidate its leadership in Central Asia are the CSTO and the EAEU. Yet, they perceive tension between ambitions to integrate and lead the post-Soviet states, and those states' determination to consolidate their sovereignty and territorial integrity. Over a decade, Putin's deeper embrace of China and intensified hostility to the United States reverberated in warming ties to Pyongyang and increasing wariness of Seoul. The timeline was affected by upbeat moods under new South Korean presidents and by setbacks in ties with North Korea when its new president held back from diplomacy and when, having outsourced to China Russia's approach to Security Council sanctions, it angered Kim Jong-un in 2017. Yet by the early 2020s Moscow had found the approach most in accord with the trend of its earlier thinking: a firm meeting of the minds with Beijing, maximum opposition to the US position on the Korean Peninsula, support for Pyongyang while waiting for an opening to bypass sanctions, and increasingly overt pressure on Seoul, from 2022 no longer even attempting to drive a wedge between it and Washington. The situation in 2022 aggravated the divide between Moscow and Seoul and held promise for Pyongyang. No matter how provocative North Korea's missile tests were seen in Seoul and Washington, Moscow along with Beijing refused to take action at the Security Council for violations of past resolutions. The North's votes in the General Assembly and elsewhere were among the few supportive of Russia, unlike China's abstentions. South Korea's sanctions were deemed "unfriendly." If to 2022 a semblance of optimism prevailed, Russian-ROK ties were in freefall. (2)

The implications of Russia-Ukraine conflict on Central Asia

Central Asia is geo-strategically significant for the Kremlin as the region border Afghanistan and Iran to the South, China to the East, and the Caspian Sea to the West. The Central Asian region is considered Russia's sphere of influence, and Moscow is also the region's security provider. Furthermore, Central Asian economies are heavily reliant on remittances from Russian Federation. Due to this complementarity, any geopolitical

development that affects Russia also impacts Central Asian Republics. In the same way, the Russia-Ukraine conflict has major consequences for Central Asian countries. On the issue of Russia's military operations in Ukraine, Central Asian countries have mostly stayed neutral. Kazakhstan, Kyrgyzstan, and Tajikistan abstained from voting in the United Nations General Assembly (UNGA) special emergency session on the Russia-Ukraine conflict on March 2, 2022, while Turkmenistan and Uzbekistan were absent. The UNGA voted on a Resolution suspending Russia's membership in the United Nations Human Rights Council on April 7. Ukraine proposed this resolution in response to disclosures of Russian military crimes against civilians in Ukraine, particularly in the city of Bucha. Except for Turkmenistan, which maintains a neutral position, four of the five Central Asian countries voted in favour of Russia in this voting. Since Russia began its military campaign in Ukraine, a Western narrative has disseminated that any response would put these nations in a situation comparable to Ukraine. This appears unreasonable because Russia-Central Asia relations are founded on long-term strategic ties and mutual respect for sovereignty and territorial integrity. Central Asian countries also have a balanced foreign policy approach. In addition, all Central Asian countries have Russian-speaking populations and significant economic and political ties with Russia. The Eurasian Economic Union, which Russia leads, includes several of these nations. A silent competition between Moscow and Beijing in Central Asia is evident with an increasing Chinese presence. Central Asian leaders have a strategic interest in balancing the two powers. These countries see their partnership with Russia as an imperative to resist Chinese dominance. Thus, they work conveniently with Russia. However, the Ukrainian crisis will have economic and geopolitical implications for the Central Asian region based on the strategic partnership that Central Asian nations have with Moscow. The sharp drop in the value of the Russian trouble due to Western sanctions has had a huge impact on Central Asia. Their economies are so intertwined with Russia's that when the rouble falls, so do their national currencies, and they suffer severe consequences. The Kazakh government also unveiled a new anti-crisis strategy that included more involvement in Forex markets and a new tenge deposit protection scheme. The deteriorating condition of Central Asia's migrant workers is the most serious challenge that the region is now facing. In both Kyrgyzstan and Kazakhstan, recent political upheaval has sprung from a mounting disparity between their life expectations and current

realities. Similarly, in Turkmenistan and Tajikistan, social unrest would be unpleasant news, as Ashgabat witnessed a dynastic power transition while Tajikistan is preparing for a similar dynastic succession. The vulnerabilities that have arisen as a result of the Ukrainian crisis may pose a threat to the security and stability of these countries. The remittances account for roughly one-third of Tajikistan's total GDP and more than a quarter of Kyrgyzstan's total GDP. Similarly, remittances contribute to around 12 percent of Uzbekistan's economic output. Following Russia's takeover of Crimea and the sanctions that followed, remittances to the region fell by 40 percent in 2014. The risks of dependency on Russian remittances were again visible during COVID-19, with Russian border closures leading to a 22 percent drop in aggregate remittances. Remittance flows are also expected to fall significantly in Tajikistan and Uzbekistan in 2022. Sanctions on Russia's financial system, including removal from the SWIFT network for cash transfers, are anticipated to impede remittances through official channels, causing a partial shift to be indirect and informal channels. Other Central Asian leaders have also expressed a desire to take concrete measures to strengthen the food production sphere. They cited the COVID-19 lockdown and the current Russia-Ukraine conflict as examples of the enormous vulnerabilities of the global food chain, which the privatisation of food production has exacerbated. Food prices in the Eurasian Economic Union (EAEU), which is led by Russia and includes Armenia, Belarus, Kazakhstan, and Kyrgyzstan, are growing faster than global food prices due to the Russia-Ukraine conflict. However, because the region is landlocked, these countries also faced logistical challenges in exporting their energy to profitable markets. Kazakhstan is dependent on Russian ports for its oil and gas exports. The majority of Kazakh oil, almost 90 percent, passes via Russian territory, and most of Kazakhstan's exports go to or transited through Russia. As a result, the current scenario provides several challenges to various industries in Kazakhstan. As a result, Kazakh authorities are attempting to diversify Kazakh export routes. Kazakhstan intends to divert export and transit goods to Latvian ports via the Trans-Caspian transport route, which it is establishing with Azerbaijan, Georgia, and Turkey to connect to the European Union (EU). Despite the heavy economic sanctions on Russia, Kazakhstan will maintain trade connections with Russia within the Eurasian Economic Union, said Timur Suleimenov, the deputy chairman of the Kazakh presidential office, in an interview with Euractiv news. This illustrates

that Central Asia maintains its multi-vector foreign policy while dealing with major powers. Previously, Russia was seen as a source of stability, security, and territorial integrity in the Central Asian region, however, after the Russian aggression in Ukraine, the CARs started to fear for their sovereignty. As a security patron, Russia sent military equipment to the Tajik–Afghan border under the CSTO and held military exercises with Tajikistan and Uzbekistan to deter any Taliban misadventure. However, Russia's invasion of Ukraine with its all military might has left the CARs in doubt about receiving similar assistance from Russia in the foreseeable future. Russian pre-occupation in Ukraine has also increased the anxiety amongst the CARs about the revival of the terror sleeping cells that are omnipresent in the region and even the new ones like ISIS. Given the uncertainty of Russian help, the rise of the Taliban and the presence of other militant groups will force the CARs to seek a new security arrangement. (3)

Ukraine war could push Central Asia to revisit Russia ties in future

Events following the start of Russia's invasion of Ukraine have raised questions about the future relationship of Russia with the five Central Asian states (Kazakhstan, the Kyrgyz Republic , Tajikistan, Turkmenistan and Uzbekistan), which have long been seen by Russia as an indivisible part of its sphere of influence. On April 24th Tigran Keosayan, a popular Russian public figure, used his YouTube channel, which has over 300,000 subscribers, to accuse Kazakhstan of "ingratitude" after the government announced that it would not hold a Victory Day parade on May 9th, when the former Soviet Union celebrates victory over Nazi Germany in 1945. He depicted this as ingratitude for Russia sending troops to Kazakhstan as a contingent from the Collective Security Treaty Organisation (CSTO), a joint security bloc of which both are members, to help quell violent civil unrest in January. The fact that Victory Day became a bone of contention was emblematic of the tussle over post-colonial narratives in Central Asia that has been increasing over recent years but has been brought to the fore by Russia's invasion of Ukraine. The cancellation of the parade rankled in Russia, where the government often uses outspoken pundits such as Mr Keosayan—who is married to Margarita Simonyan, the head of the government-run RT channel, the Kremlin's main English-language mouthpiece—to utter views that it wishes to put in the public domain without voicing them officially. In a similar case

involving the Kyrgyz Republic, a government prohibition on showing propaganda films about Ukraine announced in April sparked angry reactions from Russian commentators. Both the Kazakh and Kyrgyz governments have also angered Russia by discouraging, although not banning, the display of the letters Z and V, which symbolize support for Russia in the war. Mr Keosayan's statement was that "fraternal nations" like Kazakhstan should pick a side in what he depicted as a proxy war between the West and Russia probably reflects the view of the Kremlin elite, who are undoubtedly disappointed by the lack of overt support for the war from Kazakhstan in particular, as Russia's closest ally after Belarus, and the Central Asian states in general. None have recognised the independence of Ukraine's breakaway territories of Donetsk and Luhansk. Kazakhstan, the Kyrgyz Republic and Uzbekistan have publicly staked out a neutral stance, calling for a peaceful resolution to the conflict, on the basis of Ukraine's territorial integrity. There has been more public discussion in Kazakhstan and the Kyrgyz Republic about the war than in the other Central Asian countries, where there are greater constraints on freedom of speech. There is no reliable polling on opinions in Central Asia about the war. However, discussions on social media suggest that the war has caused existing fault-lines in society between supporters of Russia and those who favour distancing their countries from their former colonial master to widen. However, they are alarming for the government, since Russia has used such claims as a pretext for aggression in Ukraine. Kazakhstan is officially pursuing a transition to the Latin alphabet from Cyrillic for the Kazakh language, announced in 2017. The Russian government has viewed this warily, interpreting it as a sign that the country is distancing itself from Russia. However, although the transition has begun, it has been delayed until 2031 owing to logistical challenges. The results of the Demoscope poll demonstrate the difficulties for the Kazakh government of taking into account divided public opinion on Russia as it formulates its policies towards its neighbour, with which it shares a 7,600-km border. The president, Kassym-Jomart Tokayev, has expressed gratitude to Russia for sending troops to Kazakhstan in January, but given no indication that he considers his country beholden to Moscow as a result, or plans to give ground on the country's stance on Ukraine or make any other concessions. Kazakhstan, the Kyrgyz Republic and Tajikistan are closely bound to the Kremlin politically, economically and militarily, and will, in their view, remains so. They are members of the CSTO, and

the Kyrgyz Republic hosts a Russian airbase, while Tajikistan hosts a Russian military base. Kazakhstan and the Kyrgyz Republic are also members of the Eurasian Economic Union (EEU), a Russia-led free-trade bloc. Since Russia invaded Ukraine, there have been calls in both countries for them to leave the bloc. However, even if their leadership viewed that as a desirable outcome, given the economic disruption it would entail at a time when they are feeling the negative repercussions of sanctions against Russia, they are unlikely to be willing to provoke the Kremlin by abandoning the organisation. It is believed that Kazakhstan and Uzbekistan, as the most populous countries with the largest economies and carrying the most political weight, will seek to diversify their political and economic relationships, a priority they had embraced even before Russia invaded Ukraine, which now carries greater urgency. Experts believe the Central Asian states will quietly distance themselves from Russia where that is possible without provoking a reaction, as they contemplate the invasion of Ukraine and the altered geopolitical circumstances in which they find themselves. We nevertheless believe that Russia's influence will remain strong in Central Asia, where it will remain the dominant power politically in the early part of the 2022-26 forecast periods. (4)

Conclusion

Russia's political and economic isolation allows its economic and political rivals to establish important economic routes in Central Asia. China, Turkey, and NATO, among others, are keen on supplanting Russian authority in the region. For example, China is already emerging as a significant arms supplier and strategic partner, accounting for one-third of the total Central Asian trade. With China holding 40 percent of Kyrgyzstan and Tajikistan's national debt, Beijing's influence would keep up the region but not sufficiently to compensate for Russia's abrupt withdrawal from the regional market. However, the situation provides Beijing with a perfect opportunity to earn some brownie points. In Eurasian geopolitics, Turkey is another emerging regional force that might gain from the current circumstances. The conflict between Russia and Ukraine has caused economic and geopolitical concerns in Central Asia. The socio-economic and security settings of these countries have already been greatly impacted by the COVID 19 pandemic and the Taliban takeover of Afghanistan. The current conflict will disrupt Central Asian societies that are already in upheaval. Although it is too

early to calculate the future of Russia-Central Asia ties, one can assume that the Russian Federation will do all possible to ensure the security and economic well-being of its Central Asian neighbours. Similarly, as has been widely seen throughout the present crisis, Central Asian countries will continue to embrace Russia.

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Journey From Flags to Wires in India: Role of Sir William Brooke O'Shanassy's

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Introduction

The nineteenth century was a very crucial period in the history of India. Several religious, social, political, economic, and cultural intellectual currents emerged in the nation throughout this time. From the colonial power perspective, by the beginning of the nineteenth century, the empire had more or less been conquered. The task was to keep it and to use it for profit. British colonizers introduced steam vessels, stream railways, electric telegraphs, and printing technologies to establish their supremacy.India has a long history of telecommunication.The ancient Greek word 'tele' means 'far', so the word telecommunication means literally 'communication over long distances. Telecommunication can be defined assending information by electrical means over a distance that can be greater than the normal range of humans. In British India,AstheGovernor-Generalof Lord Dalhousie was engaged in continuous conflict with the Indian states, that time the electric telegraph was officially proposed.[1]He was conscious that the telegraph was crucial to the empire's continued existence. The primary goals of the telegraph line were military and political gains.

In this writing, I am goingto explore the beginning part—especially the history of the first fifty yearsof telecommunication in British India and the role of William Brooke O'Shaughnessy, the first Director General of the Indian Telegraph Department. Also, try to find out whether telegraph technology was an example of a diffusion model or a transfer of technology. I am going to start from the pre-electric telegraph era to better understand the communication situation of colonial India. Telegraphic communication is divided into two kinds: (1) those based on optical signals, and (2) those using electricity. The most practical pre-electric communication optical device was the semaphore telegraph. A French engineer and clergyman Claude Chappé (1635-1705) invented

this system, from the Greek 'tele' meaning 'far' and 'graph' meaning 'writing'. Thus, telegraphy enables written messages to be sent at similar distances by multiplied speed much faster than a letter can be carried.[2]

Visual Telegraph Eraor Semaphoric Telegraph

*Se*maphore telegraph was introduced in India in the first decade of the nineteenth century. In Bengal first *Se*maphore telegraph was set up between Calcutta and Barrachpuron 26th January 1828. It was the first semaphoric telegraph set up by the British IndianGovernmentsfor military and administration purposes. No public or private news was sent by this telegraph. Although European and Indian merchants in the Bengal provinces had made an offer: they were willing to pay a share for the semaphore setup as long as they could use the line for business purposes. For the government's good and to keep the Empire's secrets, they turned down theirplea.[3]

A second semaphore line was erected between Calcutta and Sagor in 1832, to collect news news from ships entering the Hooghly River. This saved time for merchants and saved time for seagoing vessels to reach Calcutta port. However, mercantile and trading firms, including news agencies and English aristocrats, combined to establish a similar type of semaphoric communication between Calcutta and Sagor Island. They approached the Government with representations and pressured for an appropriate offer from the business community. The community agreed to contribute the entire expenses for the establishment of the semaphore communication. According to an article published in the 'John Bull' on December 3, 1829, the government decided to create a telegraph line from Calcutta to Sagor, incollaboration with the business community with a monthly contribution of approximately Rs. 1000. Preparations were initiated for the construction of a building after an advance contract was signed. By May 1830, a branch of semaphore towers was set up from the Calcutta Exchange Building in Tank Square to the Light House station at Middleton's point at Sagor.

After December 1, 1851, the Electric Telegraph took the place of semaphore. The *Harkara,* December 6, 1851, reports 'fromthe 6th instant semaphore signal between Calcutta and Diamond Harbour has been turned off.[4]

William Brooke O'Shaughnessy: A Progressive Visionary

Samuel Morse an American who invented the electromagnet base telegraph machine, which allowed messages to be sent rapidly over the wire. The machine consists of a piece of iron with a coil of wire around it. When an electric current flows through the wire, the iron converts magnetized like all magnets attract iron. When the current is switched off, the effect of the magnet stops. In the context of India, we must note one name, Sir William Brooke O'Shaughnessy, an Irish physician, who made an important input to the telecommunication history of India in the mid-19th century. Apart from medicine, O'Shaughnessy was also interested in telegraphy and suggested a telegraph system in India in 1840, which finally became a reality in 1851. May we accept O'Shaughnessy as a 'colonial scientist'? Which we get from George Basalla's three-phase model. In the first part of Basalla's plan, the colony offers a source for European research mainly in the fields of botany, zoology, geophysics, astronomy, and anthropology. The studies are made mainly for mastering the environment and exploring its economic potential. According to Basalla,[5] real colonial science begins in the second phase when the range of scientific studies expands to meet the needs of the colony and the development of technological topics starts. Basalla's third phase is marked by the establishment of a separate scientific and technological practice in the colony. The transition from Phase II to Phase III, however, is pretty complicated. However, several social scientists/scholars rejected this idea.

O'Shaughnessy was one of those doctors from the 19th century who had a wide range of interests in science and technology. On August 8, 1833, he was assigned to the British Army's East India Company duty in Bengal as an assistant surgeon.[6] He was a scientific innovator and creative thinker. He installed a few miles of wire at his own expense in 1839 to dispel the widespread belief that India's topography and temperature would make electric communication systems workable. O'Shaughnessy's Telegraph experimental report was published by Bishop College Press, Calcutta, in 1839 under the title Memorandum relative to experiments on the communication of telegraphic signals by induced electricity, also reprinted in the Asiatic Society journal.[7]

Begging of a new world: Electric telegraph era and O'Shaughnessy

The year 1839 was very significant in terms of communication technology in modern India. Because in this year Dr.William Brooke O'Shaughnessy erected an experimental line of 26 miles between Calcutta and Diamond Harbour, half overhead and half underground(including the crossing of a broad river),the firstlong line of telegraph ever in any country. But, the year 1853 marked the end of the experimental stage and the beginning of the large-scale construction of telegraphs. Less than five months after construction began, 800 miles of telegraph line functioned on 24th March 1854.[8]Before the sepoy mutiny of 1857, about 4,200 miles of telegraph lines were laid in India and news was transmitted and received through 46 centres.[9] He was appointed 'Superintendent of Electric Telegraph in India' in 1851.[10]

Conclusion

Despite its limitations, large-scale construction and engineering efforts helped the colonial state dominate India's diverse topography, making the terrain more tractable. The rapid deployment of telegraphic communication, alongside the Railway network, emphasized the importance of military and political impetus in driving technological innovations during the 19th century in India.In the case of telegraph Communication Dr O'Shaughnessy may legitimately be considered as the father of the Electric Telegraph in India, however his contribution to the science of telegraphy as such may not be of abiding importance. He was fundamentally a man of action, and no higher honor can be offered to him than by inscribing on his grave the mapof the vast telegraphic network in India. In honor of the services given him, he was conferred a Knighthood in 1856; and was appointed a Fellow of the Royal Society in 1859; in January 1660 he was confirmed in the position of Surgeon Major. In June of the same year, he traveledto England on furlough and retired from duty the next year.

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Section
Commerce

Workforce Diversity: A New Approach To Human Resource Management

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Abstract

Nowadays, organizations are willing to invest resources in managing workplace diversity. Workforce diversity refers to their employees' differences in age, gender, family background, culture, social status, and language. As the economy becomes more global, the workforce becomes more diverse. The success and competitiveness of an organization are contingent upon the managers' ability to manage diversity. In today's multicultural society, managers must be extremely sensitive to managing such a diverse workforce and treat employees fairly.

Keywords

Diversity, Economy, Growth, Global, Advantage, Workforce, Success

Introduction

Diversity builds innovation and innovation builds success. True indeed as over the last few years engaging a diverse workforce has become a competitive necessity. It is counted as an added golden point for any business in the global economy. Diversity in the workplace comes with numerous potential benefits, as well as many potential conflicts for business owners to manage. Organizations that encourage workforce diversity are growing which makes them more competitive, but along with this workforce diversity also carries its own issues and challenges. As per the opinion of H. Brown, diverse management is a competitive advantage. Having employees from emerging markets and other growth regions will bring in new ideas, and it will help to increase our presence and attract new business. Many companies are proud of themselves for having a diverse workforce, one that is made up of individuals with a wide range of characteristics and experiences. The basic characteristics of workforce diversity include race, ethnicity, age, religion, ability, and

gender orientation. A company that embraces diversity can broaden its skill base and become more effective and innovative.

The changing demographics of employees, the growing number of positions in the economy, the ongoing rise of globalization, and the necessity for enhanced efficiency interaction have all emerged as essential aspects driving the significance of diversity in today's enterprises. As economy and entrepreneurship have expanded, the workforce in all industrialized countries has become more diverse. People from all over the world have been brought together in one area because of technological breakthroughs and the rise of a global economy.

Diversity in the workplace is characterized as recognizing, considering, appreciating, and tolerating variations across individuals about age, gender, physical and perceptual ability, sexual orientation, and race. Diversity has different connotations according to different people. Still, one thing is sure that creating a culture that rejoices the diverse perspectives from race, age, gender, language, educational background, and physical disabilities is one of the most vital objectives of the country's most progressive organizations. Hayles (1996) defines diversity as "all how we differ." He claims that the concept of variety isn't limited to what people think of when they think of gender, colour, or physical disability.

Now we have to understand the concept of workforce diversity, the next step will be to define the workforce diversity So as to respond to the examination question of how firms see and oversee labour force variety, a more extensive comprehension of this idea will moreover be required. Variety is a now-and-again utilized idea today, mostly because it is a varied idea that might mean numerous kinds of stuff. Variety is a challenging period and there are various meanings of the idea, some that are extremely wide (Nkomo and Taylor, 1999). Many individuals just refer to variety as race and identity however the idea incorporates significantly (Stevens and Ogunji, 2011). A few specialists even depict variety as expansive as all dissimilarities that individuals have as people (Nkomo and Taylor, 1999). Parvis is amongst of and he accentuates likewise that variety occurs in each public and each work environment (Parvis, 2003). He keeps on disclosing variety to remember culture and nationality just as contrasts for physical features, dialects, class, strict beliefs, sexuality, and personality. It is recognized that variety is an intricate idea (Nkomo and Taylor, 1999) which may be hard to get a

handle on due to its wide definitions. Nkomo and Taylor characterize variety as "a combination of individuals with various gathering personalities inside a similar social framework" (Nkomo and Taylor, 1999).

The following are some of the causes behind the rise in workforce diversity:

- In the previous two decades, third-world countries have seen significant demographic changes, with many people from traditionally agricultural populations now joining the middle class.
- Women are now part of the organization in this conventionally male-dominated society.
- Migration factor also leads to increasing diversity, as it can be due to pressure from the developing world or a draw from a developed nation, a large group of young unemployed population emigrates to find jobs apart from their own country.
- Due to improvements in the health care system, the aging population is active and is the member of the company for a longer time frame.
- Many companies are actively working to increase diversity in their workforce. Some of them have taken best practices from other organizations throughout the world and put them into practice.

Managing the Diverse Workforce

Managing a diverse workforce is not hard. It just takes a certain level of sensitivity and awareness to ensure employees work well together. As we know that for a manager to manage this workforce in a contemporary business, he or she must understand a few basic aspects to ensure success:

- They need to create a workplace where talent from different backgrounds can flourish and grow.
- Language and communication barriers must be high on the level of importance to ensure everyone can communicate.
- They must manage the varying viewpoints of each person within the workforce as they relate to gender, nationality, age, and culture.

Workforce Diversity, in most cases, refers to initiatives that incorporate employees in an organization's workforce who are perceived to be, in one way or another. There are seven primary aspects in this

framework that inspire businesses, large and small, to employ diverse workforces. The following are some of them:

- Social Accountability
- Monetary Remuneration
- Resource Necessity
- Legal Requirement
- Marketing Strategy
- Business Communications Strategy
- Capacity-building Strategy

Impact of Diverse Workforce

Many researchers favoured the positive results or outcomes of diversity. In light ofthe growing multiculturalism of the workforce and marketplaces, many organizations have started perusing and valuing the diverse workforce. They have engaged their human resource department to attract, retain and encourage more and more contribution of their diverse population of employees in the organisational workings. Any organization's success directly or indirectly depends on the ability of their managers or team leaders to manage a diverse workforce that can bring innovative ideas, perspectives, and views to their work.

Workforce Diversity positively impacts on:

- Productivity, creativity, quality, and teamwork
- Adaptability and innovation
- Improved marketing and customer service
- Better communication
- Improvements in recruitment and retention of the best talent due to goodwill
- Less chances of incurring costs of discrimination
- Fewer blind spots
- Expansion possibilities
- Many solutions to one problem
- Effective execution
- Enhanced problem solving due to broader and richer base of experience

- Improved corporate image, which generates public goodwill
- Greater customer loyalty
- Reduced turnover costs due to lower absenteeism
- Improved retention due to high employee morale
- Decreasing interpersonal conflicts
- Healthy and equitable work environment
- Generation of more effective conflict management techniques in the organisation

Advantages of Workforce Diversity

If a corporation can properly manage diversity, it enjoys a number of benefits. Some of these benefits include the capacity to spot new markets, cost savings, higher hiring quality, less inadvertent biases, good publicity, and creative advantages. Endorsing and managing diversity at work would go a long way toward supporting societal progress and minimizing disparities caused by language, caste, ethnicity, and religion. Diversity is beneficial to both employees and employers in any firm. Though associates are interdependent, acknowledging and appreciating the distinctions among them can lead to increased productivity. Diversity management in the workplace can reduce employee dissatisfaction while also increasing marketing opportunities, creativity, the company's image, and staff recruitment and retention. Diversity is crucial for an organization's success in a time when innovation, flexibility, and creativity are key to competition. Good diversity strategies are regarded to boost performance in the organization in the field of training and development. There is a significant correlation between strong diversity practices and revenues, according to recent studies. Diverse perspectives lead to improved problem definition, enhanced creativity, a wider range of possibilities, and better solutions. Any organization's capacity to handle diversity and reap its benefits is critical to its growth and development. When companies actively manage workplace diversity concerns, they contribute to the creation and execution of diversity programs, which has several benefits.

- Increased adaptability - Hiring a diverse workforce allows organizations to have a broader diversity of inventive and fresh solutions to challenges and resource allocation. Employees from all backgrounds contribute their abilities, ideas, and experiences to

develop concepts that are adaptable to changing market demands as well as client needs.

- Broader service – Due to the broad collection of personnel in terms of talents and skills, cultures, training, social and cultural background, the organization can now deliver service to their clients on a global basis.
- Diverse perspectives - As a result of the diversity of perspectives, ideas, and proposals represented by the company's workforce, more innovative solutions are generated. As a result, the firm can benefit from that pool of new ideas and thoughts in order to better satisfy business plans as well as customer needs, thereby enhancing productivity.
- Effective execution - Workplaces that respect diversity are more likely to have a more motivated staff. Following that, business strategies and policies are put into action, resulting in enhanced production, profit, and return on investment.
- Productivity is boosted– Increasing loyalty, retention, and productivity can be achieved through effective diversity management, which brings together a diverse group of people with a shared goal.
- Increased ingenuity and problem-solving skills - Many more explanations for arriving at a better response become available because of so many diverse minds coming together with distinct techniques of thinking, problem-solving elements, and unique decision-making processes.
- Retaining talent gives a company a competitive advantage -When employees feel involved and respected, their loyalty and sense of belonging to their company grows.
- Personal development is enhanced – Workplace variety allows individuals to discover new ideas and interact with coworkers, giving them a better feel of how to operate together as a team.
- Boosts team spirit and enhances communication –Diversity management boosts team spirit and improves communication skills. It also improves team cooperation and aids in the adoption of new attitudes and practices that benefit the entire team.
- Employees are given the ability to think independently.
- Market share grows - Connecting with people from various backgrounds improves one's chances of success in the global business arena.
- Hard work, dedication to business concepts, and the opportunity to understand how to manage change by adjusting to new conditions and learning from others who are unique from us are all part of diversity training. Because the only thing guaranteed is change, necessitating diversity to adjust keeps a company flexible and well-developed.

Implications of Workforce to Management

Given the value that diversity brings to the business, management should maintain and promote diversity practices and policies throughout the organization. Employees that exhibit behaviours that foster improved working relationships and diversity management should be recognized, according to management.

In terms of gender diversity, management should keep on promoting equal employment and professional progression opportunities for men and women. Managers should embrace flexible work arrangements that allow female employees to have a healthy work-life balance without conflicting with their professional obligations to increase gender diversity. Management could also attempt to monitor their performance by examining the ratio of men to women in the organization, the rate of advancement for male and females, as well as the average pay earned by both categories at each level. They will then be able to identify whether their policies promote gender equality in terms of recruitment, promotion, and retention.

Regarding generational differences, management should support the formation of teams comprised of individuals of all ages. Younger personnel are more adept in high-level business technology such as live broadcasting and social networking. These are abilities that, when shared, have the potential to improve the quality of both sets of workers and the company, as the institution will be better able to serve its clients through the usage of such technology. Senior personnel are seen to possess more critical interpersonal skills in addition to more standard business expertise. When these capabilities are shared, a business can improve client and customer connections, as well as increase consumer loyalty. This information sharing can benefit both groups of employees by enhancing their performance. Additionally, management should

begin valuing the expertise, skills, and years of service above the age of 40 to capitalize on the rewards of age diversity, as each generation offers unique talents and abilities to the organization. If management continues to foster age diversity, the organization will be able to prevent becoming obsolete. Offering internships is another approach to attract younger staff and capitalize on the advantages of age diversity. Personal prejudice should not be used by managers or recruiters during the hiring process. Management should provide all staff with diversity training, which should also address implicit bias. This training will increase employees' awareness of their unconscious behaviours and attitudes in the company, as well as provide practical techniques for modifying such behaviours.

According to the research, cultural diversity has no association with employee performance. But from the other hand, ethnic diversity has several benefits that can help boost performance in the organization. Hence Employee social contacts should be encouraged by management. Employees can learn about their coworkers' cultures in this way. Such information can help build worker tolerance, and comprehending a variety of cultures can aid in executing a task that requires such information when the opportunity presents itself. Additionally, ethnic diversity can help organizations expand their service offerings. An ethnically diverse workforce can boost performance. So,the management should promote employee cultural understanding. Managers should aim to build a culturally diversified holiday calendar since this can be a way to raise cultural awareness. It can contribute to making the workplace more welcoming for employees, as well as reducing misunderstandings and enhancing performance.

In regardless of academic diversity, management should offer opportunities for training to employees who lack the requisite abilities for the job. Employees who want to improve their education should be able to take advantage of study leave, which should be provided by management. Management might provide financial assistance to high-performing employees by sponsoring them to obtain a certification that would increase their performance. For other employees, this can be an extrinsic motivator. Workforce diversity encompasses both employee variances and similarities. Organizational performance refers to the degree to which a firm's aims and objectives are met.

Workforce Management in India

As elsewhere in the world, the composition of workforce diversity is changing in India too. The issue of worker diversity is becoming more widely recognized as a strategic concern for all businesses. Rapid industrialization and globalization have imposed the need to understand the importance of utilizing the diverse pool of talent in India. There have been comprehensive studies in Western nations on workforce diversity, but there has been less research on understanding the factors that impact workforce diversity in India.

Due to its diversity, India is known for its own type of country in the world. Indian organizations are filled with the multi-religion, representing the people from different areas of India. All these different regions have their unique importance and influence on also its working styles. When it comes to dealing with diversity Indian society is the oldest and richest in their opinions, views, faiths, and profoundness of values (Singh 2000). Individuals from the West had recently imagined the nation as a place where there are profound masters and snake charmers – an idea that has set aside a long effort to disintegrate even with globalization and financial advancement (Rai 2012). Indian people conceived and raised in the nation figure out how to understand and honour this Religion Caste Language Age Gender Education decent variety in the beginning times of their lives as a feature of their social upbringing, adapting methods for relating and figuring out how to survive in a place that is known for blossoming masses, diverse beliefs, tongues, castes, and customs (Rai, 2012).

Conclusion

Workforce diversity, firm performance, and employee morale are the most read topics in the field of management research, but there is no end to the addition of dimensions that can help in attaining employee satisfaction from the work. In the modern business era, organizations need to develop a culture that helps employees connect to the vision and goals of the organization to yield better productivity for the firm. The practice of workforce diversity hasgained much importance in recent times because it helps organizational individuals to understand the meaning of their work and relate the goals of the organization with their personal goals.

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Forensic Accounting - An Emerging Accounting Field in India

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Abstract

Forensic Accounting is one of the emerging trends in the field of accounting. Financial forensics have emerged mainly to investigate fraud and to get potential evidence of crimes to produce in front of the law. We know, in India, fraudulent practices have been increasing day by day,especially in the corporate sector which has led to various scams and scandals. In such asituation, traditional accounting is not able to completely penetrate the mighty wallofcorruption. Forensic accounting has been introduced to detect such fraud. The prime objective of this paper is to acquire adequate knowledge about the meaning, periphery, application and utility of forensic accounting. The study examines the importance and scope of forensic accounting in fraud detection. The data was collected to understand the overall impact of forensic accounting in India.

Key Words

Forensic Accounting, Fraud, Investigation, Litigation, White-collar Crime.

Introduction

Forensic Accounting is a special and modern field in the arena of accounting. It is a stringent process of detection or investigation of fraud and any misappropriation or misrepresentation of data, which can be found out and conductedthrough the in-depth analysis of financial information by way of interrogation and reports must be produced in the court of law, wherever necessary. Forensic accounting and fraud investigation methodologies are different than internal auditing. Thus, forensic accounting services and practice should be handled by forensic accounting experts, not by internal auditing experts.

Forensic accountants may appear on the crime scene a little later than fraud auditors, but their major contribution is in translating complex financial transactions and numerical data into lucid terms that ordinary laypersons can understand. However, forensic accounting refers to the specific procedure carried out in order to produce evidence andalso includes investigation of financial matters as an expert witness, if the frauds come to trial.

Meaning of Forensic Accounting

Forensic accounting is a particular field of accounting that explores fraud and examines historical data which can be used in legal proceedings. Forensic accounting is a sensible blend of accounting, auditing, and investigative abilities to conduct financial fraud inquiries. It is useful for court action and analytical accounting.

According to the ACFE Forensic accounting is the use of professional accounting skills in matters involving potential or actual civil or criminal litigation including, but not limited to generally acceptable accounting &audit principles, the determination of lost profits, income, assets, or damages, evaluation of internal controls, fraud &any other matter involving accounting expertise in the legal system.

The AICPA defines forensic accounting as, "Forensic accounting is the application of accounting principles, theories, and discipline to facts or hypotheses at issues in a legal dispute and encompasses every branch of accounting knowledge."

Forensic accounting is defined by Zia(2010)as, 'The science that deals with the relation and application of finance, accounting, tax and auditing knowledge to analyze, investigate, inquire, test and examine matters in civil law, criminal law and jurisprudence in an attempt to obtain the truth from which to render an expert opinion.'

One conclusion that could be drawn from the above definitions&information isthat forensic accounting is primarily focused on 'legal' situations, but it has the potential to reach beyond the legal focus into operating areas that could be of benefit to any organization.

History of Forensic Accounting

The history of forensic accounting is long. But the field came into its' own just in the last century. The forensic accounting can be traced back as far as1817 to Meyer V. Sefton, a Canadian case that allowed an expert witness to testify in court. The term 'forensic accounting 'was first published byMaurice E. Peloubet in 1946 in his essay "Forensic Accounting: Its Place in Today's world." Archaeological studies reveal that, during 3300-3500 BC, Egyptian accountants were involved in the prevention and detection of fraud. During the 18th century, a strong relationship developed between accountancy and legacies. Many changes to the disclosure of financial statements can be attributed to corporate fraud. In the 1930s, an American Eliot Ness was credited to bring down gangster Al Capone, but his case was based on Elmer Irey's investigative work, an accountant with the Internal Revenue Service who ensured Capone's conviction of tax evasion. He was obviously the first forensic accountant of high profile in America.

Evolution of Forensic Accounting in India

In India Kautilya was the first person to mention in his famous book Kautilya Arthashastra the famous forty ways of misappropriation. Chartered Accountants in India are called upon to undertake such investigative tasks. After Enron case, Rajat Gupta case and Satyam case, wide use of Forensic Accounting developed in India. Very few chartered accountant firms have as a separate practice the examination of fraud. Chartered accounting firms such as Sharad Joshi, S.K. Jain (Xerox Fraud case) provide services of this type. However, the big four consultancy firms like Deloitte, KPMG, Price water House Coopers and Ernst and Young dominate this area by and large. For Forensic Accountants, the formation of Serious Fraud Investigation Office in India is a landmark creation.The Companies Act 2013 paved the way for a special approach to preventing economic fraud and preserving American law and British Bribery Act national wealth. The reputational risk was to be managed for proper risk management. It required proper investigation as well as a strong preventive environment for fraud and irregularities and lapses in compliance culture. Forensic accounting was therefore required to detect fraud planning, fraud execution, and money laundering risks and book the culprits without much time delay.

Forensic Accountant

A forensic accountant is often retained to analyze, interpret, summariseand present complex financial and business-related issues in a manner which is both understandable and properly supported**.** The credibility of the

outcomes found by Forensic Accountants relies upon the information, abilities, and experience of the forensic bookkeeper. A forensic bookkeeper should be fit for incorporating information and abilities in the assessment, investigation, translation, revealing, and tribute backing of evidence. In court, the forensic bookkeeper can be a specialist witness, an advisor, or assume different parts like Trier of truth, exceptional expert, court-designated master, ref, authority, or middle person.

Techniques of Forensic Accounting

Besides the various conventional techniques of auditing, some special techniques are used by forensic accountants to examine fraud. These techniques are separately discussed below: *(source: International Journal of Engineering Research)*

Interview Technique:

This is the most common technique which is used in any inquiry. Forensic accounting investigators generally use this technique which is designed to obtain an admission of guilt by the person involved in the fraud scheme. These results form an integral part to be used in court and the adjudication process.

Benford's Law:

It is a statistical tool to determine whether the variable under study is a case of unintentional errors or any pattern signifying suspicious movement. Benford suggested the probabilities for the occurrence of each digit at various places in the number whereby if the data is manipulated; the said digit would not appear at the same place. Benford's Law does not detect fraud but only indicates the probable area of fraud.

Theory of Relative Size Factor (RSF):

RSF technique is used to identify the number in the data but in some relation with the second highest data in the number. In this method, the records that fall outside the prescribed range are taken into the books of account and it calls for further investigation. It highlights all unusual fluctuations, which may be routed from fraud to genuine errors.

Computer Assisted Auditing Tools (CAATs):

CAATs are computer programs developed for auditors. Forensic accounting software comes into two varieties: data extraction software and financial analysis software. Data extraction software is designed to

conduct spreadsheet analysis on all the company's database records, such as billing, accounts receivable, payroll, purchasing, etc. which helps in detecting anomalies. Financial analysis software analyses the financial statements and benchmarks the ratios between different accounts such as billing by revenues or supply costs as a percentage of revenue.

Data Mining Techniques:

It is a set of computer-assisted techniques designed to automatically mine large volumes of data for new, hidden or unexpected information or patterns. Data mining techniques are categorized in three ways: Discovery, Predictive modelling and Deviation and Link analysis. It discovers the usual knowledge or patterns in data, without a predefined idea or hypothesis about what the pattern may be, i.e. without any prior knowledge of fraud. In predictive modelling, patterns discovered from the database are used to predict the outcome and to guess data for new value items. In Deviation analysis, the norm is found first, and then those items are detected that deviate from the usual within a given threshold (to find anomalies by extracted patterns). Link discovery has emerged recently for detecting a suspicious pattern. It mostly uses deterministic graphical techniques and Bayesian probabilistic casual networks. This method involves "pattern matching" algorithm to extract any rare or suspicious cases.

Ratio Analysis:

Data analysis ratios are used for detecting fraud. Numerous ratios are used by various analysts including financial ratios, data analysis ratios, and utility ratios. However, the use of data analysis ratios is prominently used by forensic accountants is identifying possible symptoms of fraud. The ratio helps in predicting the relationships, with any abnormal ratio calls for examination towards detecting potential fraud.

Objectives of Forensic Accounting

- A forensic accountant can help improve and ensure the integrity of the financial reporting system.
- Forensic accounting helps in detecting financial frauds and thefts.
- To use the forensic accountant's conclusions to facilitate a settlement, claim, or jury award by reducing the financial component is an area of continuing debate.
- To restore the downgraded public confidence.

- To formulate and establish a comprehensive corporate governance policy and the statutory audit function.
- To create a positive work environment and help strengthen auditors' independence

Scope of Forensic Accounting in India

There is a great scope for forensic accounting in India due to an increase in white collar crimes and frauds, and scandals in public as well as private sectors. Forensic accounting covers two broad areas of practice. These are litigation support and investigative accounting.

- Forensic accountant detects fraud by analyzing financial matters, financial statements, financial reporting systems, management information systems, the company's method of operations, business structure, and accounting principles and by following internal and external auditing procedures.
- Forensic accounting helps to collect evidences and investigates the strategies, and litigation procedures to interpret the results
- Forensic accounting designs and performs statutory audit procedures for risk reduction of the business
- Forensic accountant or auditor acts as an advisor to the audit committee
- Forensic accountant helps in the research activities of the investment analyst, economic Offences Wings alsoeconomic crime investigation, and all kinds of civil litigation support including terrorist investigations. More social consciousness is required to control rampant white-collar crimes. Forensic accountants are now in great demand with the public need for honesty, fairness, and transparency in reporting increasing rapidly.

Key Challenges in Forensic Accounting in India

- Forensic accounting is developing the field of identification, tracking and detection of financial fraud. There is an intense shortage of skilled &qualified accountants in India with adequate forensic accounting technical knowledge.
- In India, politicians have been involved in most cases of financial fraud, so finding evidence against them is crucial.
- The Indian judiciary still follows the old British judiciary. Bringing the matter to court and hiring expert advocates is expensive.

- As a result of liberalization and a rapidly moving economy, more and more foreign investors are investing in India, making it difficult to sue other countries for financial fraudsters.
- Due to the continuous adoption by fraudsters of new information and technology techniques, it is challenging and difficult for Forensic accountants to handle them.
- Compared to other investigative fields, forensic accounting is a costly field.
- The appointment of forensic accountants in companies is not compulsory for companies.
- There are no specific forensic accounting guidelines or acts in India.

Literacy for Forensic Accounting in India

Forensic Accountants recently came into focus due to a rapid growth in fraud and white-collar crimes. In Indian Corporate Reporting, there is a vast prerequisite for honesty, fairness and accountability. The establishment of the India Chapter of the Association of Certified Fraud Examiners of USA in 1994 was the first major milestone in establishing Forensic Audit as a profession in India. The Association of Certified Fraud Examiners based in Austin Texas is world largest body of anti-fraud professionals in the world. The Institute of Chartered Accountants of India (ICAI) followed it up by starting a seminar on forensic accounting for its members. It is an "Authentication Course on Forensic Accounting and Fraud Detection utilizing IT and CAATs". As of now, Certified Fraud Examiners Qualification is taken up in large numbers by Chartered Accountants, Lawyers, investigators, and Govt. Auditors. In addition, we now have CFEs in our CAG Office as well as in Govt investigating agencies. There are other initiatives, which include India Forensic (Pune, Maharashtra) which started Courses in Bank Forensic Accounting (CBFA), and Certified Forensic Accounting Professional (CFAP). The Foundation of Chartered Financial Analyst of India (ICFAI) University also started a Postgraduate Diploma in Forensic Accounting. All these are at the incipient stage in a large portion of Indian colleges, numerous schools and colleges are giving seminars on "Forensic Science". Behind the scenes of expanding levels of fakes and financial inconsistencies, it is normal that the possibilities of forensic bookkeepers will undoubtedly increment generously soon. There is a need for setting an institutionalized mechanism by giving Statutory Recognition to the profession of Certified Fraud Examiners in India

and entrusting them to set standards and guidelines for Forensic Audits. It is imperative for lawmakers to amend the statutes,*i.e.* Companies Act as well as IPC and Contract Law to incorporate provisions for recommendation of a Forensic Audit by a Statutory Auditor or an investigating officer where primary scrutiny of Financial Statements and records is evident there is likely chance of financial manipulation and which require an investigation by an expert professional.

Conclusion

Forensic Accounting in India is still vastly untrodden, rather ironically, given the persisting corruption in the country and the alarming need for honesty, accountability, and transparency in the economy. More social consciousness is required to control rampant white-collar crimes. However, Forensic Accountants are now in great demand by the public for honesty, fairness & transparency in reporting increasing rapidly. Forensic accounting will develop as a specialized profession of accountancy and law for enforcing agencies and regulators day by day. A lot of research is also needed and accountants will play a very significant role in this mission.There is also a great scope for forensic accounting investigation during the merger, amalgamation, acquisition, economic crime investigation & all kinds of civil litigation support including terrorist investigation. Today is the right time to adopt and adhere strictly the forensic accounting at all levels of government, public, and corporation accounting as an accounting tool to cure and prevent entities from the financial and other ills.

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Unveiling Financial Literacy: An Investigate into Personal Finance Among Youth in Kolkata

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Abstract

This paper explores the financial mindsetof young individuals across various age groups, focusing on factors like financial goals and planning, investment habits, behavioral finance, investment behaviour, decision-making processes, attitude toward risk and personal financial management. By using data analysis techniques, I exam in if there are consistent trends in financial conduct and attitudes across various age groups of young people, I discovered notable associations between age groups and various aspects of financial mindset, light clarity of financial planning, the tendency for impulsive investment decisions, rest tolerance and commitment to budgeting practices. These results emphasize the importance of customized financial education and intervention programs that cater to the distinct needs of young people in various age groups. By understanding the intricacies of financial behaviour among youth, policymakers and educators can develop strategies to promote financial literacy and equip young individuals to achieve improved financial well-beingand stability.

Keywords

Youth financial attitudes, Financial habits, Customizing financial education programs, Financial knowledge empowerment.

Introduction

Comprehending the financial attitudes and behaviors of young people.It is really important to design financial education initiatives and policies that help them to manage their money better and give them financial security. This paper aims to explore how young people across different age groups approach money matters. I'll analyze their financial goals, investment habits, risk tolerance and day-to-day money management

practices across various age groups. Knowing how to handle money and make smart financial choices is really essential for people to reach their financial goals, especially in today's complex financial world. That's why it's vital to learn more about how youth approach money, their actions with it and the challenges they face. By doing this, we can make programs and support that meet their requirements and help them succeed financially. This paper undertakes an extensive investigation into the financial behaviour and attitudes of young people from various groups. Bhai carefully analyzing data collected from a diverse sample of youth, the study seeks to answer several key questions. By addressing thesequestions, this paper aims to contribute to the body of knowledge on youth financial behaviour and provide valuable insights for educators, policymakers and financial practitioners in developing effective strategies to increase financial literacy and empower young people to make informed financial decisions. Through a comprehensive analysis of youth financial attitudes, this study seeks to inform evidence-based interventions that promote financial resilience and well-being among young individuals facing today's complex financial landscape.

Literature Review

- Johnson, M. (2019). Youth financial literacy: Understanding and addressing the needs of today's young people. Journal of Financial Education, 45(2), 78-92: From this paper, I can expect to gain insights into the recent state of financial literacy among youthand the challenges they face in managing their finances. The paper likely discusses strategies for enhancing financial literacy programs to better meet the requirements of today's youth. It may also give recommendations for policymakers, educators and other stakeholders on how to address the gaps in youth financial literacy and promote greater financial health among young individuals.
- Wang, Y., & Johnson, L. (2024). "The Role of Behavioral Finance in Shaping Youth Investment Decisions: Evidence from Experimental Studies." Journal of Economic Psychology, 50(2), 189-204: From this paper, I should expect to know about the influence of behavioral finance principles on the investment decisions of young people across various age groups. The paper likely presents findings from experimental studies that explore how cognitive emotions, cognitive biases and other behavioral factors impact youth investment behavior. It may discuss implications for financial literacy and decision-making support initiatives aimed at helping youth make more wise and rational investment decisions.
- Brown, L., & Jones, R. (2018). Investment behavior and risk tolerance among young adults: A comparative analysis. Journal of Investment Management, 36(4), 45-58: From this paper, we should expect to know insights into how young people handle investment decision and their risk attitude. It likely compares various strategies, attitudes and levels of risk tolerance across young investors of various age groups. Moreover, it may investigate the aspects influencing the investment behaviour of various age groups, like financial literacy, socio-economic background and market circumstances. Additionally, it may offer different ways to improve investment results and risk management strategies for young people across various age groups.

Objectives

Objectives of the paper are:

- To understand the financial mindset of the youth across different age groups based on financial goals and planning.
- To analyze the financial mindset of the youth across different age groups based on investment behaviour and planning.
- Financial behaviour and emotion-driven decision-making.
- Personal financial management.

Limitations of the study

This paper possesses the following limitations:

- *Sample bias:* The study's outcomes may be limited by the specific traits of the sample population, such as educational background, and socio-economic status. This could affect the applicability of the results to a broader youth population.
- *Respondent bias:* Data collected through Google form could be skewed by respondents' tendencies to provide socially desirable answers or inaccurately recall data about their financial behaviors.
- *Inferring causality:* Although the study may identify connections between variables, but causality cannot always be possible to infer especially in observational studies.

- *Poor response rates:* A low response rate in Subway using Google form could introduce selection bias and impact the representativeness of the sample.
- *Limited range of variables:* The study might overlook some relevant variables that could influence youth financial education, like family dynamics, cultural factors, or access to financial resources.

Methodology

The information used in this study is collected using Google Forms. There were 83 respondents, who made up the study's sample. Chi-square tests, with a focus on analyzing the financial mindset of the youth across different age groups in the city of Kolkata, were used to examine their opinions.

The formula of chi-square for a contingency table is:

$X^2 = \Sigma[(O - E)^2 / E]$

Here,

χ^2 = chi-square statistic.

Σ = The sum of all cells.

O = The observed frequency in every single cell.

E = The expected frequency in each cell under the null hypothesis.

Analysis and Findings

1. To examine if the financial mindset of young individuals across various age groups regarding goals and planning is consistent, I collected and analyzed the subsequent data set.

Table 1: The financial mindset of youth concerning financial goals and planning classified by age groups

		Age groups			
		Less than 20	**20-30**	**Above 30**	**Total**
Do you have a clearly defined financial plan and whether you analyze and upgrade financial goals and plans regularly?	Yes	49	18	4	71
	No	2	6	4	12
	Total	51	24	8	83

Null Hypothesis (Ho) : There is no relationship between age groups and financial goals and planning.

Alternative Hypothesis (H_1) : There is a relationship between age groups and financial goals and planning.

Now we can calculate the chi-square statistic.

Value of calculated square ($\chi 2$) ≈ 14.97(approx.)

Now, with two degrees of freedom with 5% significance level, the critical value is 5.99

Since the calculated value of chi-square (14.96) is greater than the critical value (5.99), we reject the null hypothesis and accept the alternative hypothesis.

Therefore, there is a significant relationship between age groups and financial goals and planning.

2. To examine if the financial mindset of young individuals across various age groups regarding behavioral finance and emotion-driven decision-making is consistent, I collected and analyzed the subsequent data set.

Table 2: The financial mindset of youth concerning behavioral finance and emotion drive in decision-making categorized by age groups

		Age groups			
		Less than 20	**20-30**	**Above 30**	**Total**
Have you made impulsive investment decisions regarding emotion rather than rational analysis? Also are you able to manage emotions such as greed and fear while making investment decisions?	Yes	10	16	5	31
	No	41	8	3	52
	Total	51	24	8	83

To examine if the financial mindset of young individuals across various age groups regarding goals and planning is consistent, I collected and analyzed the subsequent data.

Null Hypothesis (Ho) : There is no relationship between the age group and making impulsive investment decisions on emotion rather than rational analysis.

Alternative Hypothesis (H_1) : There is a relationship between age group and making impulsive investment decisions on emotion rather than rational analysis.

Now we can calculate chi-square statistics

Value of calculated chi-square ($\chi 2$) ≈ 17.82(approx.)

Now, with two degrees of freedom with 5% significance level, the critical value is 5.99

Sincethe calculated value of chi-square (17.82)is greater than the critical value (5.99), we reject the null hypothesis and accept the alternative hypothesis.

Therefore, there is relationship between age groups and making impulsive investment decision on emotion rather than rational analysis.

3. To examine if the financial mindset of young individuals across various age groups regarding investment behaviour and risk tolerance is consistent, we collected and analyzed the provided dataset.

Table 3: The financial mindset of youth concerning investment behaviour and risk tolerance categorized by age group

		Age groups			
		Less than 20	20-30	Above 30	Total
Are you comfortable taking risks with your investment if it means potentially high return? Also, do you have the ability to actively analyze and control risk?	Yes	13	16	7	36
	No	38	8	1	47
	Total	51	24	8	83

Null Hypothesis (Ho) : There is no relationship between age groups and investment behavior & risk tolerance.

Alternative Hypothesis (H_1) : there is a relationship between a group and investment behavior & risk tolerance.

Now we can calculate chi-square statistics .

Value of calculated chi-square ($\chi 2$) ≈ 18.3(approx.)

Now, with two degrees of freedom with 5% significance level, the critical value is 5.99

Since the calculated value of chi-square(18.3) is greater than the critical value (5.99), we reject the null hypothesis and accept the alternative hypothesis.

Therefore, there is a significant relationship between age group and investment behaviour and risk tolerance.

4. To examine the financial mindset of young individuals across various age groups regarding personal financial management is consistent, I collected and analyzed the subsequent data set.

Table 4: The financial mindset of youth concerning personal financial management classified by age group

		Age groups			
		Less than 20	20-30	Above 30	Total
Do you follow our budget to control your expenses and savings? Also, do you actively monitor your expenses and savings to stay within your budget?	Yes	12	13	5	30
	No	39	11	3	53
	Total	51	24	8	83

Null Hypothesis (Ho) : Thereis no relationship between age groups and personal financial management.

Alternative Hypothesis (H_1) : There is a relationship between age groups and personal financial management.

Now, we can calculate chi-square statistics.

Value of calculated chi-square ($\chi 2$) ≈ 9.27(approx.)

Now, with two degrees of freedom with 5% significance level, the critical value is 5.99

Since the calculated value of chi-square(9.27) is greater than the critical value (5.99), we reject the null hypothesis and accept the alternative hypothesis.

Conclusion

In conclusion, my research sheds light on the multifaceted financial mindset of youth across different age groups. After thorough data analysis, I identified meaningful associations between age groups

and fundamental financial behaviour, emphasizing the requirement to understand the nuanced needs of young people in different age groups. Myfindings underscore the necessity of customized financial education initiatives and intervention programs in tackling the unique obstacles and opportunities in counter by youth as they guidetheir financial journeys. By fostering financial literacy and empowerment, policymakers and educators can equip young individuals with the tools and knowledge required to navigate the complex financial environment and attain greater financial well-being and security. Looking forward, ongoing research and collaborative efforts are vital for continuingto refine and enact successful strategies that bolster the financial growth and resilience of the upcoming generation.

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Optimizing Human Resource: Harnessing AI for Talent Management

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Abstract

In the ever-changing field of HRM (Human Resource Management), businesses or organizations are increasingly leveraging AI (Artificial Intelligence) to streamline talent management and elevate employee engagement. In this paper, we explore the margin of AI and HRM, discussing how AI is currently being used andhow it might be used in the future of health with talent finding, developing and retention. We explore the advantages and disadvantages of using AI in Human Resource Management by thoroughly conducting a detailed review of existing literature and analyzingreal-world case studies. AI has the potential to revolutionize different aspects of HRM, from improving aerodynamics to streamlining recruitment processes and tailoring learning and development. But harnessing AI organizations can make more smarter decisions, boost operational efficiency and foster a more inclusive workplace. Moreover, the integration of AI in HRM raises important ethical and privacy issues to consider, along with the need to ensure fairness for all. This paper deals with how AI can be used by HR professionals and organization leaders to enhance HR strategies and elevate employee engagement in the modern digital landscape. It examines both the prose and cones integrated with AI implementation in HR practices, providing insights for those looking to leverage AI effectively.

Keywords*:*

Artificial Intelligence, Human Resource Management, employee engagement, ethical consideration, talent management.

Introduction

AI is revolutionizing the field of HRM, providing organizations with innovative approaches to improve talent management and boost

employee engagement. AI technologies, from sophisticated algorithms to machine learning systems, are revolutionizing traditional HRM. New and innovative solutions for talent acquisition, development and retention are offered by these technologies. This paper also investigates how AI is changing HR management, looking at its present applications and future potential in reshaping the HR landscape. We review existing literature and case studies to examine the prose and cone of using AI in HRM. I aim to show how AI can improve recruitment, learning program personalization and promote an inclusive cultural workplace. However, the incorporation of AI in HRM raises significant ethical, privacy and fairness concerns that must be carefully considered. By critically evaluating both the opportunities and challenges of leveraging AI this paper aims to offer valuable insights for HR professionals and organization leaders. Its goal is to assist in optimizing HR strategies and enhancing employee engagement in the digital era.

Benefits of AI in HR

AI has several advantages in the field of human resources. It includes:

1. **Offering efficiency:** AI helpsby taking over repetitive tasks such as resume screening, scheduling interviews and answering common employee queries. This frees up HR professionals to focus on more strategic work.
2. **Recruitment processes:** It helps by analyzing large volumes of job applications to identify candidates based on predefined criteria. This makes recruitment more successful and faster.
3. **Increase employee experience:** AI-powered chatbots can make an actual difference in how employees experience the workplace. They can quickly answer queries, offer personalized learning recommendations and facilitate smoother onboarding processes. This leads to happier employees overall.
4. **Data-driven insights:** AI can help organizations by analyzing HR data to identify trends, predict future requirements and provide insights for strategic decision-making. This optimizes workforce planning and management ultimately aiding in organizations' success.
5. **Bias reduction:**AI can be a game-changer. It can reduce unconscious bias in recruitment and performance evaluations. By emphasizing objective criteria, AI creates fair and more inclusive HR practices.
6. **Cost saving:** cost savings are a major benefit of AI in HRM. AI helps organizations to reduce costs related to recruitment, training, and HR administration by automating work and improving efficiency.

Challenges of use of AI in HR

Though AI offers various benefits in HR, its implementation also causes several changes. It includes the following

1. **Data privacy and security:** One major issue with AI in HRM is the accessing of sensitive employee data,which can raise concerns about privacy and security breaches.
2. **Lack of human touch:** AI usage in HR could be very useful by streamlining a process, but also poses a threat to the individual interaction of employees, even in the effect of morale and engagement.
3. **Buyers and fairness:** Bias in AI algorithms is another one of the salient issues that AI faces. It mayleadto the delivery of unjust or nondiscriminatoryresults instead.
4. **Integration with existing systems:** Combining AI systems into the existing HR systems and processes might be a complicated matter that will take a lot of effort and resources.
5. **Skill gaps and training:** AI may mean that HR professionals have to understand how to use the toolsfrom AI properly, which would require time and resources to master.
6. **Ethical concerns:** The use of AI in a chart raises ethical concerns, including the potential of AI making decisions that affect employees' liveswithout adequate oversight or transparency.

Methodology

First, I shall be dividing into a wide variety of articles, papers and other sources in order to grasp the knowledge of the expert about AI in HRM. Our attention will go to analyzing AI in order to handle talent management, employee engagement and ethics. This deep dive will provide and elaborate picture of the present status and the prevailing views about AI in HR.

- Davenport and Ronanki (2018) titled "Artificial Intelligence for the Real World" in the Hard WordBusiness Review – From this paper we present how AI is applied in practice in the area of business. The authors, by illustrating the instances where AI is used to resolve Real-world issues, increase efficiency and create competitive advantages, have talked about this. Along with them, they can also highlight issues and possible solutions tothe adoption of AI in organizations, such as data privacy, ethics and workforce implications.
- Jain and Bansal (2018) titled "Artificial Intelligence: The New Revolution in HR Practices" in the International Journal of Engineering and Technology– From this paper we learn how AI is changing HR practices. These writers probably go over a bunch of HR-related AI uses, including hiring, employee engagement, performance reviews and education. Future trends in this field may also be discussed, along with the pros and cons of incorporating AI into HR procedures.

My next topic will be real-life case studies. I shall be able to test how AI can be used in recruiting the right talent and ensure that employees are happy and engaged. For the present issue, I shall examine the AI existing in the HR departments of companies.

This is followed by interviews with HR personnel and organization heads. By means of this, we strive to get the first-hand option from them. This could shed some more light and thus allow us to see the human side of AI in HR.

Afterwards, we will have the necessary information and will assemble it, to see what stands out in terms of patterns and themes. In addition, we intend to use this to develop a few practical ideas and tips that would be useful for HR professionals and leaders who are on the lookoutfor house they can apply AI to develop a human-centered HR strategy.

Findings

Overall, the researchfindings demonstrate a positive effect of incorporating AI into HRM. Through a broad literature review, a case study of a real-lifeorganization and expert advice from each of our professionals, over time a variety of outcomes have been revealed :

1. **Improved talent acquisition:**Through automatic tasks such as resume screening, identifying the best candidate and making

the overall applicant experience better, the productivity of the process will be improved and AI will be able to streamline recruitment.

2. **Enhanced employee engagement:** AI helps with designing adaptive training courses, individualized learning and training, which leads to employee engagement and motivation.
3. **Operational efficiency:** AI automation of multiple manual HR activities,*e.g.* Interviews scheduled in data processing, lets HR staff concentrate on strategic issues and in this way boost operational efficiency and reduce costs.
4. **Inclusive workplace culture:** AI can base decisions on solid data and eliminate bias, creating a fairer, more diverse and equitable cultural workplace.
5. **Ethical considerations:** The integration of AI in HRM raises the ethical issues of privacy concerning employee data as well as algorithmic prejudice, which means that the responsible use of AI has to be done.

According to the research results, AI can bring great value to human resources strategies and also give way to improving employee engagement. Nevertheless, the companies should get the sort of ethical issues and come up with preventive steps to manage them. Thoughtful consideration of the pros and cons of AI implementation in HRM will enable companies to skillfully harness AI to augment, rather than replace human rose in the workplace.

Limitations of this study

The paper has some limitations that should be considered

- **Scope:** Moreover, there are some other essential issues related to AI in HRM, including performance management and HR analytics. This research frames out these areas. It mainly looks at certain areas, for example, talent management and employee engagement, where it can possibly neglect other areas.
- **Generalizability:**The results might not apply to all, as the AI impact in HRM is not the same in every organization, due to factors like organizational size, industry and technological maturity.

- **Data limitations:** Literature review, case study, or survey data maybe limited in scope and depth, hence the reliability of the findings.
- **Ethical considerations:** However, the ethical concerns are explored, and the ethical framework might not be sufficiently encompassing to reflect all the ethical dimensions.
- **Technological advancement:** AI advances at a quick pace which makes information and suggestions irrelevant as more novel technologies arise.
- **Favoritism:** Even with attempts to decrease bias, the data might still be biased, potentially impacting the objectivity of the results.

Conclusion

This paper explores into how AI is transforming HRM, especially in employee engagement, and talent management, fundamentally changing the landscape of HR practices.

AI has the potential to improve decision-making, boosting productivity and fostering a more inclusive workplace. It can simplify recruitment, personalized learning and automate routine human resource work. However, the adoption of AI in HRM raises important ethical, privacy and equity issues that need careful attention.

To ensure the responsible use of AI, organizationsare required to establish clear guidelines. This paper advocates for AI as a tool for HR managers and leaders to refine their strategies and engage employees in the digital era. By balancing the pros and cons of AI in HRM, companies can harness its potential to improve the workplace.

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The Dairy Sector of India: Foreign Trade Trends and Innovation

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Abstract

India has become one of the largest dairy exporters over the past decade. The government of India has set up several programs and schemes to strengthen the Indian dairy sector. The Indian dairy sector has played an essential role in heightening economic development in rural areas and enhancing dairy farmers' income. India is one of the biggest dairy producers in the world and also provides vast exports of dairy products globally. The present study aims to evaluate the current trend of foreign trade in the Indian dairy sector, highlights the top countries and regions involved in India's dairy foreign trade, and also shows the significant innovation for enhancing the development of the Indian dairy sector and also discuss major government schemes for improving the performance of Indian dairy sector. Additionally, it can be illuminated that with the effective implementation of modern innovative strategy and comprehensive government schemes in the Indian dairy sector, the value of dairy production and export may be enhanced in the future to capture the largest market share in the international market.

Keywords

Dairy Products, Export, Import, India, Innovations, Government Schemes

Introduction

India has become a significant exporter of dairy goods, and over the past decades, the dairy industry has seen considerable growth and development. The dairy industry in India is expected to grow from its current market size of USD 115.57 billion in 2022 to USD 227.53 billion by 2030, representing a compound annual growth rate (CAGR) of 8.94% over the envisioned period. Over 80 million farmers in rural India benefit

from this sector, which directly contributes 5% of the nation's GDP. With private dairies making up 23% of the world's milk production, India's dairy industry has witnessed remarkable growth. The country produces much milk, which allows for the creation of many processed dairy goods like butter, paneer, ghee, and curd. Over the past ten years, the rapid growth of India's dairy industry has been primarily attributed to government initiatives, which have made infrastructure facilities for processing and logistics investments necessary.Similarly, government initiatives like the Rashtriya Gokul mission, the National Programme for Dairy Development (NPDD), and the Dairy Entrepreneurship Development Scheme (DEDS) paved the way for several innovations in the dairy sector in India. The present study aims to evaluate the trends of foreign trade (export and import) in India's dairy sector from FY 2013-2014 to FY 2022-23. It highlights the top countries and regions involved in India's foreign trade. Finally, the study shows the innovations in the Indian dairy sector. The study has collected secondary data from several published sources, including government reports, journals and newspapers.

Review of Existing Literature

Ingavale (2010) described the export trend of dairy-related products in India. The study revealed that the value of the export of Indian dairy products is rapidly growing. India has recognized several emerging markets, including China, Korea, Myanmar and Iran. Due to the rapidly changing food patterns in Asian countries, India must follow a diversified product line to access the newly emerging markets.

Kumar et al. (2011) delineated the issues regarding various trade potentials in the Indian dairy sector in response to continuously fostering domestic consumption, enhancing supply and heightening monetary transactions related to Indian dairy products in the international market. India has been assessing several geographical benefits to meet the demand of milk-deficient countries by improving the quality and standard of dairy products. India must formulate suitable export policies to serve their dairy products to SAARC countries.

Ohlan (2014), in this study titled "Competitiveness and Trade Performance of India's Dairy Industry", elucidated the pattern, trend and computing of the value of export of dairy-related products in India. The study explored how the value of exports in India has significantly

heightened over the years, aligned with effective price competitiveness regarding dairy production. The study also showed enough chance to get the largest market share of Indian dairy products in the international market compared to other countries.

Khan and Parashari (2014) elucidated the comprehensive development of the dairy sector in India in their study. They elaborated on the significant barriers and challenges to strengthen further growth in this sector. The Government of India and other regulatory bodies have introduced several programs to augment the performance of the Indian dairy industry. These several development programs have been essential in strengthening the production and export of dairy products in India. However, the industry faces several challenges, including insufficient investment, lack of proper infrastructure to implement these programs, etc.

Kumar (2016) examined the significant issues related to the potential enhancement in the value of export of Indian dairy products. The study also exhibited some relevant export trends and several challenges that can directly impact the performance of the Indian dairy industry. It also provided some recommendations to improve the activities of this industry in the form of export and production of the Indian dairy sector.

Khongsai (2020) described the growth and progress of the Indian dairy sector. It also highlighted the current scenario of the level of consumption and the production of milk-related products in India. The study revealed enough scope to improve milk-related products' production, promotion and distribution. Hence, entrepreneurs and policymakers need to take immediate action to get a chance to enhance their activities.

Research Gap

Based on the aforementioned comprehensive review of literature, it was observed by the researcher that conceptual study is scarce in the specified area for getting more knowledge regarding the current trend of foreign trade of the Indian dairy sector and also related to modern innovation and recent government policies have been implemented to improve the performance of Indian dairy sector. To explore this area of concern, the researcher has selected to conduct the study to meet the relevant research gap by defining research objectives and doing analytical and explorative research work.

Research Question

1. What is the current foreign trade trend, including export and import, in the Indian dairy sector?
2. Which countries and regions are involved in India's foreign dairy trade?
3. What innovation has India adopted to enhance the development of the Indian dairy sector?
4. What schemes have the Government of India proposed or implemented to improve the performance of the Indian dairy sector?

Research Objectives

1. To evaluate the current foreign trade trend, including Export and Import, in the Indian dairy sector.
2. To highlight top countries and regions involved in India's dairy foreign trade.
3. To describe the significant innovation enhancing the development of the Indian dairy sector.
4. To discuss significant government schemes for improving the performance of the Indian dairy sector.

Research Methodology

The study is purely descriptive, and the required data has been gathered only from secondary sources. Several secondary sources have been included in the study, such as the Directorate General of Commercial Intelligence and Statistics (DGCIS) report, RBI published report, the Ministry of Commerce and Industry, other online websites, relevant reports and published research work, etc. The collected data have been scrutinized to meet the research objectives. All the data collected from various reports has been thoroughly scrutinized and elucidated in the form of several tables, and their interpretation has been provided to assess this sector's significant performance. The period of the study for the relevant data, which is extracted from the Directorate General of Commercial Intelligence and Statistics (DGCIS) websites to meet objectives 1 and objective 2, spans from 2013-2014 to 2022-2023 and 2018-2019 to 2022-2023 respectively. Based on the above-collected data, an appropriate analysis has been formulated for the study to meet

its objectives effectively. Based on the outcome of the current study, theconclusion has been generated to improve the strength of the relevant literature review that may be important for future work.

Analysis of the Study

On the basis of theabove objectives and the significance of the study, the researcher has done a relevant analysis.

Objective 1

Table 1 presents data on the export and import of Indian dairy products from 2013-14 to 2022-23. The table provides information on the exports (X) and imports (M), as well as the net exports (X-M) in terms of dollars (in millions).

Table 1: Export and Import Trends of Indian Dairy Products

Year	Export (X)		Import (M)		Net Export (X-M)
	Amount ($, Mil)	Growth (%)	Amount ($, Mil)	Growth (%)	Amount ($, Mil)
2013-14	727.54		38.47		689.07
2014-15	354.65	-0.72	61.49	0.47	293.16
2015-16	257.58	-0.32	56.64	-0.08	200.94
2016-17	255.28	-0.008	38.01	-0.40	217.27
2017-18	303.00	0.17	48.51	0.24	254.49
2018-19	481.52	0.46	36.43	-0.29	445.09
2019-20	280.22	-0.54	52.17	0.36	228.05
2020-21	321.96	0.14	48.91	-0.06	273.05
2021-22	634.70	0.68	43.64	-0.11	591.06
2022-23	588.93	-0.075	55.17	0.23	533.76

Source: DGCIS (2023)

It also includes the growth rates of exports and imports for each year. The export of Indian dairy products varied over the years, ranging from$257.58 million in 2015-16 to $727.54 million in 2013-14. There was an overall increasing trend, with a notable peak of $634.70 million in 2021-22. The import of dairy products also fluctuated, ranging from $36.43 million in 2018-19 to $55.17 million in 2022-23.While the imports experienced some ups and downs, there needed to be a

consistent trend. The net export (the difference between export and import) demonstrated varying levels of surplus or deficit in India's dairy trade. India had a significant net export of $689.07 million in 2013-14 and reached its highest net export of $591.06 million in 2021-22. However, there were years with negative net export values, indicating a trade deficit in the dairy sector. Some years showed positive growth, and others experienced negative growth, suggesting a certain level of volatility in the dairy trade.

Objective 2

Top Countries and Regions in the foreign trade of Indian Dairy products

Table 2: Top Exporting and Importing Countries ($ Mill)

Exporting Countries	2018-2019	2019-2020	2020-21	2021-22	2022-23
France	10.12	12.81	13.71	11.28	18.75
Italy	3.65	3.24	0.95	1.34	3.09
Germany	2.31	2.84	2.68	2.28	3.05
Poland	0.29	0.9	1	1.33	2.45
UK	2.09	1.85	1.05	1.21	2.07
Top 5 Total	18.46	21.64	19.39	17.44	29.41
Other Countries	10.12	12.66	11.99	9.71	11.44
% Share of Top 5 Countries	62.07	64.71	61.29	62.96	70.73
Importing Countries	2018-19	2019-20	2020-21	2021-22	2022-23
Bangladesh	38.19	1.12	24.13	91.45	53.86
UAE	43.6	36.94	39.34	58.66	52.23
Saudi Arabia	13.55	11.81	11.47	24.88	33.69
USA	14.98	14.29	22.8	18.99	22.96
Bhutan	20.72	22.46	22.52	20.37	21.13
Top 5 Total	131.04	86.62	120.26	214.35	183.87
Other Countries	214.69	100.11	81.11	177.24	100.78
% Share of Top 5 Countries	37.86	46.52	59.7	54.59	64.56

Source: DGCIS (2023)

Table 2 presents data on the top exporting and importing countries for Indian dairy products from 2018-2019 to 2022-2023. In exports,

France, Italy, Germany, Poland, and the UK were the top five exporting countries for Indian dairy products. The total export value of the top five countries increased from $18.46 million in 2018-2019 to $29.41 million in 2022-2023, indicating overall growth.

The percentage share of the top five countries in total exports consistently remained above 60%, reaching 70.73% in 2022-2023. On the other hand, Bangladesh, UAE, Saudi Arabia, the USA, and Bhutan were the top five countries that imported Indian dairy products. The total import value of the top five countries increased from $131.04 million in 2018-2019 to $183.87 million in 2022-2023, showing overall growth. The percentage share of the top five countries in total imports varied, but it consistently accounted for more than half of the total imports, reaching a high of 64.56% in 2022-2023. Data shows that a few countries dominate Indian dairy exports and imports. Maintaining strong trade relationships with these top countries is essential because they consistently account for a large share of total trade volume. The data also shows that the Indian dairy industry's export and import sectors can grow.

Objectives 3

Table 3: Region-wise India's Export and Import

Region Name	AVERAGE EXPORT ($Mil)	EXPORT (%)	AVERAGE IMPORT ($ Mil)	IMPORT (%)
West Asia- GCC	84.63	34.22	0.27	0.79
South Asia	74.3	30.05	0.98	2.87
ASEAN	28.59	11.56	0.43	1.26
Other European Countries	10.26	4.15	3.37	9.88
East Asia (Oceania)	6.77	2.74	2.21	6.21
TOTAL	247.27		34.12	

Source: DGCIS (2023)

Table 3 shows that West Asia-GCC and South Asia were the top regions for Indian dairy exports, accounting for 34.22% and 30.05% respectively. Other European Countries were the largest importing region, with 9.88% of India's total imports. The total average export value was $247.27 million, with an export percentage of 34.12%. The statistics here highlight the significant export opportunities in West Asia-GCC and South Asia while emphasizing the importance of other European countries as importing regions for Indian dairy products.

Objective 4

Innovations in the Indian Dairy Sector

In Table 4, crossbreeding is one breeding innovation that has significantly contributed to the dairy farming sector's profitability. Dairy farms have built a solid base for future growth by choosing resilient and disease-resistant breeds and applying scientific breeding techniques. When selecting animals, topographical factors such as soil type, availability of feed, and topography are also considered. Through the direct implantation of stored semen from a proven sire into a cow's uterus, artificial insemination (AI) has wholly changed breeding and made genetic advancement possible. Bull performance is assessed through progeny testing, which offers valuable and efficient genetic improvement. ETT (embryo transfer technology) and sexed semen offer quicker ways to unlock the genetic potential of superior animals. Calving can be managed effectively and is incontrollable thanks to hormonal synchronization and protocols. Bypass protein, bypass fat, total mixed ration, buffers, and probiotics are a few feeding innovations that have increased animal productivity and feed utilization. Design innovations for management include hygienic cow sheds, health monitoring tools, heat detection systems, robotic milking machines, waste disposal and management, and digital farm management tools—the dairy farming industry benefits from these innovations regarding productivity, animal health, and general profitability.

Table 4: Innovation in Indian Dairy Sector

Innovations	Descriptions
Breeding Innovations	**1. Artificial Insemination (AI) Technique** • Help to utilise of superior quality semen • Enhance desired characteristics with the help of intensive genetic selection. 2. **Progeny Testing** • The Most appropriate innovative technique to increase genetic enhancement in the breed **3. Embryo Transfer Technology (ETT)** • Faster enhancement of livestock **4. Sexed Semen** • Minimize economic burden and produce a more significant number of female cattle to ensure further productivity.

Feeding Innovation	**1. Baled Silage** • Protecting extra green fodder • Maintained fermentation of green fodder **2. Rumen Inert Protein** • Provides more critical amino acids at the intestinal level that lead to production **3. Bypass Fat** • Improvement in post-partum recovery and reproduction performance of dairy animals **4. Total Mixed Ration** • Facilities appropriate nourishment to fulfill the requirement of dairy cows **5. Probiotics** • Help to maintain the balance of the intestinal microflora • Enhance milk production • Help to control diarrhoea in calves.
Management Innovation	**1. Health Tracking Devices** • Help with early diagnosis of medical conditions in animal body • Formulate an appropriate policy for the welfare of animal **2. Heat Detection Systems** • Facilities the farmers for best fertility management • Help to control cow's activity **3. Robotic Milking Machine** • Reduce the pressure on physical labour and conducting a hygienic milking process. **4. Digital Farm Management** • Atomizing and digitalizing end-to-end production and operation activities • Record entire whole farm activities and disclose report
Health care Innovation	**1. Vaccination** • Help to control many diseases if timely vaccination is conducted • Reduce economic losses due to drastic reduction • Increase profitability and sustainability than AI **2. Teat Dip** • Help to prevent new mammary infections • Prevent several teat lesions and injuries **3. Mastitis Diagnosis Kit** • Preventing various incidence diseases that lead to increased productivity. **4. Lameness Management and Oral Magnet Feeding** • Facilities to reduce Traumatic Reticule- Peritonitis
Marketing Innovations	• Play vital role in input availability and product sales in dairy sector • Eliminate barrier between producers and consumers

Source: Compiled by the Author

Objective 5

Schemes for Dairy Development in India

The Government of India has launched various policies and programs to elevate this industry and ensure sustainable upliftment. For this purpose, the study mainly delineates a critical government framework for the dairy industry to improve the performance of the Indian dairy sector.

Schemes for the Dairy Sector	Description
1. Rashtiya Gokul Mission	• The foremost motive of this policy is to strengthen the value of the production capacity of dairy products in India. • This program emphasizes the upliftment of the quality and efficiency of cattle and widely enhances farmers' monetary performance in the Indian dairy industry. • Another reason behind this scheme is to establish research and development programs to promote the performance level of cattle.
2. National Programme for Dairy Development (NDPP)	• This policy intends to support rural farmers by giving monetary benefits to elevate production, maintain modern technology-based processing, and create an effective marketing strategy for Indian dairy products. • Establishment of Dairy Cooperative Societies (DCS). • Introducing extensive and adequate infrastructure to amplify required activities in procuring and processing dairy products. • Generating clean dairy products and improving the assessment relating to the quality control technique.
3. Dairy Infrastructure Development Fund (DIDF)	• The primary purpose of this scheme is to provide financial benefits and sufficient loans to the milk processing units. • This policy mainly endeavours to adopt an innovative and modern technology-based infrastructure to improve product quality and production processes. • Commencement of innovative techniques to reduce milk spoilage aligns with improving product quality and stimulating the revenue level of rural dairy farmers. • Motivating dairy farmers to purchase various equipment and other transportation cars to distribute milk products from one place to another.

4. Dairy Entrepreneurship Development Scheme (DEDS)	• The primary purpose of this policy is to provide financial benefits by introducing small-scale dairy processing units. • Giving sufficient financial support to buy machinery and equipment. • Enhancing the production capacity of dairy-related products.
5. Kisan Credit Card Scheme for Animal Husbandry	• The primary purpose of this scheme is to provide various credit facilities to rural dairy farmers by establishing a Kisan Credit Card. • This program provides affordable and flexible credit opportunities to fulfil financial demands concerning continuing animal husbandry. • Interest subvention schemes have been introduced to motivate dairy farmers to repay interest loan amounts on the due date.
6. Support to State Dairy Cooperative Societies, Farmers' Producers Organizations	• This policy helps rural farmers by providing various training and skill development programs to improve activities. • Encouraging rural dairy farmers to incorporate a dynamic marketing and milk processing approach. • Motivating State Dairy Cooperative Federations by giving monetary benefits.

Conclusion

The export and import trends analysis for dairy products from India reveals an upward trend with varying values. There are ups and downs in imports, with varying amounts of surplus or deficit, which shows that the dairy market is unstable. France, Italy, Germany, Poland, and the UK are the top exporters of Indian dairy products. At the same time, Bangladesh, the United Arab Emirates, Saudi Arabia, the United States, and Bhutan are the top importers. Commercial solid ties are essential for development. Indian dairy products are primarily exported to the West Asia-GCC and South Asia, while other European countries mainly import them. Innovations in the Indian dairy industry's breeding, feeding, management, healthcare, and marketing practices have increased productivity, animal health, and profitability. Breeding technologies improve genetics, feeding technologies improve nutrition, management technologies streamline operations, healthcare technologies stop diseases, and marketing technologies connect producers and consumers. The Indian dairy industry has the potential for growth and development. However, investing in research,

adopting cutting-edge technologies, and fostering trade relations for sustainability and profitability is essential. On the other hand, the Government of India has introduced several programs and schemes to elevate the performance of the Indian dairy sector. These schemes help rural farmers by providing financial support to continue their dairy-related production and export.

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