ESTD. 2010

Crossian Resonance

A Multidisciplinary Research Journal

(A refereed Biannual Published in June and December)

ISSN 0976-5417

Vol. 16 No. 1 June 2025

HOLY CROSS COLLEGE (Autonomous)
(Centre for Multidisciplinary Research)
Nagercoil

TAMIL NADU, INDIA

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Crossian Resonance strives to keep up the standard from the first issue and all the papers published in this issue sere assessed by competent referee editors and were recommended for publication. This journal is committed to the development and regeneration of the nation with the scope of providing an open and common platform to launch a united vision and empowerment of innovative knowledge.

May this endeavour grow and remain evergreen like an olive tree to create renewed awareness, dimensional consciousness and enlightenment.

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Review on Metal Oxide Nanostructures for Hydrogen Water Splitting

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ABSTRACT

Production of hydrogen through water splitting represents a promising leeway for generating clean and sustainable energy. The development of efficient catalysts is critical for the advancement of this technology. Metal oxide nanostructures have emerged as highly promising candidates owing to their unique physical and chemical properties, including tunable band gaps, high surface-to-volume ratios, and excellent chemical stability. This review reveals the recent progress in the synthesis and application of innumerable metal oxide nanostructures for water splitting, focusing on their roles as photocatalysts and electrocatalysts. Key challenges and future perspectives in the development of metal oxide-based catalysts for scalable hydrogen production are also highlighted.

Keywords: *Hydrogen water splitting, Mechanism, Metal oxide nanostructures*

1. Introduction

The increasing demand for clean and renewable energy sources has directed significant research efforts towards hydrogen fuel, considered an ideal energy carrier due to its zero carbon emissions and high energy density when used [1]. Water splitting, which entails the decomposition of water molecules into hydrogen and oxygen, offers a sustainable method to generate hydrogen fuel, particularly when powered by solar energy [2]. However, the water splitting reaction is kinetically sluggish and requires efficient catalysts to accelerate the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER) [3]. Metal oxides, especially in nanostructured forms, have attracted extensive attention as catalysts for water splitting since they are generally abundant, inexpensive, chemically stable, and exhibit tunable electronic properties [4]. The nanoscale dimension of these materials provides enhanced surface area and unique quantum effects that can considerably improve catalytic performance.

2. Metal Oxide Nanostructures: Types and Properties

Metal oxide nanostructures such as titanium dioxide (TiO_2), zinc oxide (ZnO), hematite (Fe_2O_3), tungsten trioxide (WO_3), cobalt oxide (Co_3O_4), and nickel oxide (NiO) are widely deliberated for their photocatalytic and electrocatalytic capabilities in water splitting [5,6]. These materials display significant differences from their bulk counterparts primarily owing to their nanometric size, which offers a higher density of active catalytic sites and altered electronic band structures that facilitate better light absorption and charge carrier dynamics [7].

For example, TiO_2 nanoparticles are well-known for their stability and photocatalytic properties under ultraviolet (UV) light. Though, their wide band gap (~3.2 eV) limits absorption to the UV spectrum, which constitutes only a small portion of solar radiation [8]. Similarly, hematite (Fe_2O_3) has a narrower band gap (~2.1 eV), allowing it to utilize visible light, but grieves from poor conductivity and fast charge recombination, which reduce overall efficiency [9]. Metal oxides like Co_3O_4 and NiO are considered effective OER catalysts due to their favorable electronic structures and robust stability under oxidative conditions [10]. The synthesis of these oxides in various morphologies such as nanorods, nanosheets, hollow spheres, and core-shell structures has been shown to increase catalytic activity by optimizing surface area, charge separation, and mass transport properties [11].

Table 1 : Comprehensive table summarizing key performance metrics for each major metal oxide and its modified/doped/heterostructure forms

Metal Oxide / Modified Form	Band Gap (eV)	HER Overpotential (mV)	OER Overpotential (mV)	Solar-to-Hydrogen Efficiency (%)	Stability (hours)
TiO_2 (anatase)	3.20	~550	~420	0.1–0.3	>100
N-doped TiO_2	2.45–2.65	~480	~400	0.5–1.2	~80
Fe_2O_3 (hematite)	2.10	>600	~350	0.2–0.8	50–100
WO_3	2.6–2.8	~500	~420	0.5–1.0	80–120
NiO	3.6–4.0	Poor HER	~350	—	>100
Co_3O_4	1.6–2.2	Poor HER	~300	—	>150
TiO_2/Graphene Composite	2.8–3.0	~400	~300	1.5–2.2	100–150
NiO–Co_3O_4 Nanorods	2.5–2.7	~350	~280	—	>200
Perovskite–TiO_2 Junction	1.55 + 3.2	~300	~250	10–12	~50

3. Synthesis Techniques

The catalytic properties of metal oxide nanostructures are highly dependent on their morphology, crystallinity, and defect structures, which in turn are governed by the synthesis methods employed [12]. Hydrothermal and solvothermal techniques are among the widely used techniques, enabling precise control over particle size and shape through temperature, solvent,

and precursor manipulation [13]. Sol-gel processing is another versatile method that produces highly uniform and pure nanostructures with tunable porosity [14]. Chemical vapor deposition (CVD) and electrochemical deposition methods allow the fabrication of thin films and nanostructured arrays with enhanced electrical conductivity, critical for electrocatalytic applications [15]. Template-assisted synthesis offers the ability to create hierarchical and hollow nanostructures with large surface areas, beneficial for efficient catalytic performance [16]. Each synthesis approach can be tailored to optimize the physico-chemical characteristics of the metal oxide nanostructures to increase their catalytic efficiency for HER and OER.

Table 2: Pros and Cons of Common Synthesis Methods for Metal Oxide Nanostructures

Synthesis Method	**Advantages**	**Limitations**	**Scalability & Cost**
Hydrothermal	Controlled morphology, low temperature	Long reaction time	Moderate scalability, low cost
Sol–gel	High purity, tunable porosity	Cracking during drying	High scalability, low cost
CVD	High-quality thin films, precise control	Expensive equipment	Low–moderate scalability, high cost
Electrochemical Deposition	Direct growth on conductive substrates	Limited to conductive bases	High scalability, moderate cost
Template-Assisted	Complex hierarchical structures	Template removal step	Moderate scalability, moderate cost

4. Scalability and Economic Considerations

Despite significant progress in enhancing the catalytic activity and stability of metal-oxide-based electrodes for water splitting, their large-scale deployment remains constrained by cost and scalability challenges. The economic feasibility of synthesis methods must be assessed not only by material cost but also by process scalability, energy consumption, and environmental impact.

(i) Comparative Cost Analysis of Synthesis Techniques

High-performance nanostructured oxides are often prepared using laboratory-scale techniques such as hydrothermal growth, atomic layer deposition (ALD), or pulsed laser deposition (PLD). While these yield superior structural control, their high capital costs, batch limitations, and significant energy inputs hinder large-scale translation. In contrast, solution-based methods—such as sol–gel processing, solution combustion synthesis, and

electrospinning—offer lower equipment costs, ambient-pressure operation, and tunable nanostructures, making them more favorable for industrial adoption.

(ii) Life-Cycle Cost Considerations

For real-world integration, a full life-cycle assessment (LCA) is critical, accounting for raw material sourcing, synthesis energy demand, electrode fabrication, operational lifetime, and recyclability. Nanostructures with high surface areas may enhance performance but often require multiple processing steps, solvents, or templates that add to manufacturing cost and environmental burden. Streamlining these steps can significantly reduce the overall cost per unit of hydrogen produced.

(iii) Promising Low-Cost Strategies for Scale-Up

Several synthesis routes show potential for bridging the gap between laboratory performance and industrial affordability:

- **Solution Combustion Synthesis (SCS):** Rapid, self-sustaining reaction capable of producing high-purity nanostructured oxides with minimal external heating.
- **Electrospinning:** Scalable fiber production method enabling large-area electrodes with controlled porosity and high active surface area.
- **Spray Pyrolysis & Dip Coating:** Continuous coating processes suitable for large substrates and roll-to-roll manufacturing.
- **Mechanochemical Synthesis:** Solvent-free, low-energy milling approach that reduces environmental and chemical costs.

Integrating these cost-effective fabrication routes with renewable energy-powered manufacturing and recycling strategies could accelerate the commercialization of oxide-based water-splitting technologies. Future research should emphasize **techno-economic analysis** alongside electrochemical performance metrics to ensure that performance gains translate into viable large-scale solutions.

5. Mechanism of Water Splitting

Water splitting involves two fundamental half-reactions: the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER). The HER entails the reduction of protons (H^+) to hydrogen gas (H_2), while the OER involves the oxidation of water molecules to oxygen gas (O_2) [17]. The water splitting reaction is thermodynamically uphill and kinetically challenging because of the multi-electron transfer steps involved, especially in OER. Metal oxides often function more effectively as OER catalysts owing to their resistance to oxidative degradation [18]. However, they exhibit poor HER activity. To overcome this, many strategies involve combining metal oxides with other catalytic materials or doping them

to improve their HER capabilities [19]. Efficient water splitting catalysts should facilitate rapid charge transfer, suppress recombination of photogenerated electron-hole pairs, and provide abundant active sites to lower the overpotential of the reactions.

This schematic illustrates the electrochemical steps in hydrogen and oxygen evolution under acidic and alkaline conditions, showing the role of catalysts and identifying rate-limiting steps.

5.1 Reaction Mechanism for HER & OER

5.1.1. Hydrogen Evolution Reaction (HER)

The Hydrogen Evolution Reaction (HER) involves the reduction of protons (in acidic media) or water molecules (in alkaline media) to produce hydrogen gas. The reaction mechanism varies depending on the electrolyte pH.

HER in Acidic Media:

Overall reaction: $2H^+ + 2e^- \rightarrow H_2$

Stepwise mechanism:

Volmer step (electrochemical adsorption): $H^+ + e^- \rightarrow H^*$

Heyrovsky step (electrochemical desorption): $H^* + H^+ + e^- \rightarrow H_2$

Tafel step (chemical recombination): $H^* + H^* \rightarrow H_2$

HER in Alkaline Media:

Overall reaction: $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

Stepwise mechanism:

Volmer step: $H_2O + e^- \rightarrow H^* + OH^-$

Heyrovsky step: $H^* + H_2O + e^- \rightarrow H_2 + OH^-$

Tafel step: $H^* + H^* \rightarrow H_2$

5.1.2. Oxygen Evolution Reaction (OER)

The Oxygen Evolution Reaction (OER) is the anodic process of water splitting where oxygen gas is produced. This reaction is kinetically more sluggish than HER due to the multi-electron transfer steps.

OER in Acidic Media:

Overall reaction: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

Stepwise mechanism:

$M + H_2O \rightarrow M–OH + H^+ + e^-$

$M–OH \rightarrow M–O + H^+ + e^-$

$M–O + H_2O \rightarrow M–OOH + H^+ + e^-$

$M–OOH \rightarrow M + O_2 + H^+ + e^-$

OER in Alkaline Media:

Overall reaction: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

Stepwise mechanism:

$M + OH^- \rightarrow M–OH + e^-$

$M–OH + OH^- \rightarrow M–O + H_2O + e^-$

$M–O + OH^- \rightarrow M–OOH + e^-$

$M–OOH + OH^- \rightarrow M + O_2 + H_2O + e^-$

6. Role of Metal Oxide Nanostructures in Water Splitting

Titanium dioxide remains one of the most widely analysed metal oxides for photocatalytic water splitting as a result of its chemical inertness and suitable band edge positions [20]. Though, its wide band gap limits its absorption to UV light, which contains only about 5% of the solar spectrum, restricting overall efficiency. Strategies such as doping with non-metal elements (e.g., nitrogen, sulfur), metal ion incorporation, or combining with narrow band gap semiconductors have been pursued to range its light absorption into the visible region [21]. Hematite, with a narrower band gap, shows promise for visible light-driven water splitting, but suffers from small charge carrier diffusion lengths and slow surface kinetics, which are addressed by nanostructuring and surface modification techniques [22]. Cobalt and nickel oxides are excellent OER catalysts in electrocatalytic water splitting systems due to their good conductivity and stability [23]. Tungsten oxide exhibits good visible light absorption and photocatalytic activity but suffers from photocorrosion; hence, it is often combined with protective layers or co-catalysts to improve stability [24]. Hybrid nanostructures, such as metal oxide coupled with conductive carbon materials (graphene, carbon nanotubes), are increasingly being developed to improve charge transfer and catalytic efficiency [25].

7. Challenges and Future Perspectives

In spite of significant progress, numerous challenges remain in the real-world application of metal oxide nanostructures for hydrogen production by means of water splitting. The overall solar-to-hydrogen conversion efficiency remains relatively low, primarily due to rapid recombination of charge carriers, inefficient light absorption, and high overpotentials for HER and OER [26]. Stability under prolonged operation, particularly for photocatalysts exposed to aqueous environments, is another critical issue [27]. Scalability and cost-effective production methods for high-performance nanostructures are yet to be realized for commercial applications [28]. Future research directions should concentrate on developing new materials with enhanced intrinsic catalytic properties, designing multifunctional nanostructures that simultaneously calibrate light absorption, charge separation, and surface reaction kinetics, and

enhancing the fundamental understanding of reaction mechanisms through advanced characterization and theoretical modeling [29]. Integration of these metal oxide nanostructures into complete photoelectrochemical systems and hybridizing with renewable energy sources could accelerate the transition towards a hydrogen-based economy.

8. Conclusion

Metal oxide nanostructures represent a highly promising class of materials for hydrogen production via water splitting due to their favorable properties such as chemical stability, abundance, and tunable electronic structures. Advances in synthesis techniques have allowed the fabrication of nanostructures with optimized morphology and electronic properties that significantly improve catalytic performance. Nonetheless, challenges related to efficiency, stability, and scalability persist and require innovative approaches in materials design and system integration. Continued interdisciplinary research combining materials science, chemistry, and engineering is crucial to realize the full potential of metal oxide nanostructures in sustainable hydrogen energy production.

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Photocatalytic Degradation of Congo Red Dye Using Green Synthesised NiO Nanoparticles from *Averrhoa carambola* Fruit Extract

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ABSTRACT

The present investigation deals with the photocatalytic degradation of the dye, Congo red using green synthesisedNiOnanoparticlesfromAverrhoa carambola (star fruit) fruit extract. The fruit extract acted as areducing and stabilizing agent for the preparation of nanoparticles. UV-Visible, FT-IR, XRD and SEM-EDX analytical techniques were used for the characterization ofNiO nanoparticles. The spectroscopic and microscopic analytical techniques confirmed the formation of NiOnanoparticles. Structural analysis revealed that NiOnanoparticles (37 nm) possess a rod-like morphology with a face centered cubic geometry. EDX confirmed the elemental composition of the respective metal oxide. The photocatalytic degradation of Congo red dye was performed usingNiO nanoparticles, the degradation efficiency and the rate constant were found to be 57.95 %and 1.19 x 10^{-2} min^{-1}. These findings demonstrate the effective use of Averrhoa carambola extract for the synthesis of nanoparticles for environmental remediation, particularly in wastewater treatment for dye removal.

Keywords: *Averrhoa carambola extract; green synthesis; NiO nanoparticles; photocatalytic degradation*

1. Introduction

Synthetic dyes, extensively employed in the textile, leather, paper, and plastic industries, are among the most persistent and hazardous pollutants present in the aquatic environments [1]. Congo red, a commonly used anionic azo dye, is notably resistant to biodegradation and has been identified as a potential carcinogen and mutagen, posing serious risks to both ecosystems and human health [2]. Traditional treatment methods such as coagulation, adsorption, and membrane filtration often prove inadequate or result in secondary pollution, highlighting the crucial need for the development of sustainable and environmentally friendly alternatives.

Photocatalysis employing semiconductor metal oxide nanoparticles (NPs) have emerged as a promising green approach for dye degradation, offering advantages such as cost-effectiveness, high efficiency, and low environmental impact [3,4]. Green synthetic approach utilizes plant extracts as natural reducing and stabilizing agents, provides an eco-friendly and

sustainable approach to NP fabrication [5]. Phytochemicals such as flavonoids, tannins, and alkaloids present in plant extracts play a vitalpart in reducing metal ions and stabilizing the resulting NPs [6]. *Averrhoa carambola* (star fruit), known for its abundance of antioxidants, polyphenols, and organic acids, serve as a promising candidate for green synthetic approach of metal oxide NPs.

In this context, the current research workemphasises on green synthetic approach of NiONPs using the extract of *Averrhoa carambola* and evaluates their effectiveness in the degradation of the dye Congo red. The synthesized NPsare characterized by a range of spectroscopic and microscopic analytical techniques, and their photocatalytic performance is assessed under UV irradiation. The findings highlightthe potential of this eco-friendly approach for effective environmental remediation, particularly in dye-contaminated wastewater treatment.

2. Experimental Section

2.1 Materials

Fresh, unripe *Averrhoa carambola* (star fruit) was purchased from the local market. The Congo red dye and nickel nitrate were procured from Merck. Double distilled deionized water was used for the synthesis of NPs and photodegradation studies.

2.2 Preparation of the Extract *Averrhoa carambola*

About 50 g of unripe *Averrhoa carambola* fruit was washed and cut into small pieces, ground it using a pestle and mortar, and filtered through Whatman filter paper. The collected filtrate was centrifuged for about 10 minutesat 8000 rpm. The supernatant extract was then collected, and utilized for the preparation of NiO NPs.

2.3 Synthesis of NiO NPs

A standard solution of nickel nitrate was prepared by accurately weighing 1.16 g of nickel nitrate crystals and dissolving it in distilled water. The solution was then diluted to 200 mL in a standard measuring flask. Subsequently, 160 mL of the nickel nitrate solution and 40 mL of the extractwere transferred to a conical flask. The mixture was incubated at room temperature, allowing for the synthesis of nanoparticles, which was specified by a colour change. The NiO NPs formed was preliminary confirmed from the colour change from green to grey within 10 minutes. The resulting solution was centrifugated at 15,000 rpm for 5 minutes and subsequently dispersed in sterile distilled water to get rid of any uncoordinated biological materials. The pellet of NiO NPs was collected, dried and stored at -4 ^{o}C.

2.4 Characterization Techniques

The NiO NPs were characterized using various spectroscopic and analytical techniques. UV-Visible absorption (Shimadzu UV-1800 spectrophotometer) and FT-IR analysis (Shimadzu IR Affinity-1 spectrometer) were performed. Additionally, the nanoparticles were analyzed by SEM-EDX and XRD to determine their surface morphology, elemental composition, and crystalline structure. SEM-EDX were recorded by Zeiss SmartEDX scanning electron microscope with EDX. Diffraction data for the nanoparticles on glass slides were recorded on an X-ray diffractometer (Ultima III, Rigaku, Tokyo, Japan) with Cu Kα radiation (λ = 1.5406 Å) source calculated from the width of the XRD peaks using the Debye-Scherrer formula.

2.5 Photocatalytic Degradation of Congo Red Dye using NiO NPs

A solution of Congo red was prepared by dissolving 2 mg in 500 mL of distilled water. From this, 15 mL was transferred to a 200 mL standard measuring flask and diluted to 200 mL. The degradation analysiswas conducted with and without NiO NPs. 50 mL of the Congo red dye solution was transferred into the first beaker (without catalyst) and another 50 mL dye solution inthe second beaker containing 0.01 g of NiO NPs. Thespectraof the sample solutions were noted before placing the beakers in the UV chamber. The beakers were then exposed to UV light, and readings were noted at 10 min intervals.The development of the photocatalytic reaction was observed by taking UV spectrum at regular time intervals. An aliquot of 3.0 mL is taken out from the reaction mixture at regular time intervals and UV spectrum is taken. The reduction in absorbance of the dye with increasing time intervals shows the degradation and the degradation efficiency (η) of the dye with and without catalyst was calculated by the equation:

$$\eta = (A_0 - A)/A_0 \times 100\ \%$$

where A_0 and A was the absorption intensities at the beginning and after photocatalytic reaction for certain time.

3. Results and Discussion

The current study reveals a cost-effective, eco-friendly approach for the mass production of NiO NPs using *Averrhoa carambola* fruit extract. The formation of NiO NPs is initially identified from the colour change and further confirmed by UV-Visible and FT-IR spectroscopy.

3.1 UV-Visible Spectral Analysis of NiO NPs

The formation of NiO NPs from *Averrhoa carambola* extract is preliminarily confirmed by UV-Visible spectroscopic analysis. The extract exhibits an absorption maximum at 276.45

nm. The synthesised NiO NPs shows surface plasmon resonance peaks at 280.71 nm respectively (**Fig. 1**)

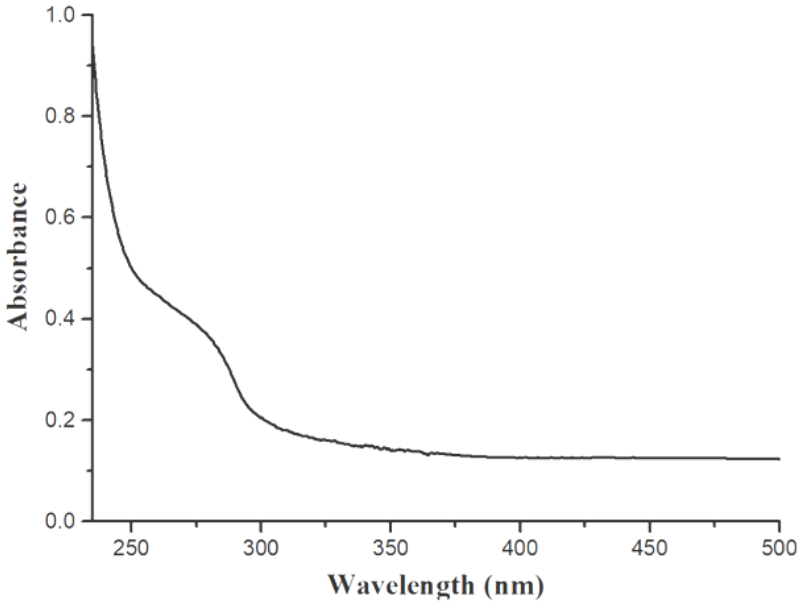

Fig. 1 Absorption spectrum of NiO NPs

3.2 FT-IR Spectral Analysis of NiO NPs

The FT-IR spectrum of NiO NPs synthesized from nickel nitrate crystal exhibits several absorption bands at 3388.26, 2886.58, 2821.59, 1613.73, 1441.30, 1366.78, 1309.59, 1071.31, 833.03, 750.72, 586.09 and 479.51 cm^{-1} respectively **(Fig. 2)**. The spectrum reveals the presence of amine group at 3388.26 cm^{-1}, alkyl groups at 2886.58 cm^{-1} and amine group at 2821.59 cm^{-1}. The peak at 1613.73 cm^{-1} is due to C=C stretching and the peak at 1441.30 cm^{-1} corresponds to ether group. Additionally, the spectrum shows peaks corresponding to amine groups at 1366.78 cm^{-1}, C-H bending of alkyl groups at 1309.59 cm^{-1}, C-O-C stretching of ether groups at 1071.31 cm^{-1}, and Ni-O stretching of NiO nanoparticles at 833.03 cm^{-1}. Further analysis of the spectrum reveals the presence of C-C stretching of alkyl groups at 750.72 cm^{-1}, C-Br or C-Cl stretching of halogenated compounds at 586.09 cm^{-1}, and metal-oxygen stretching at 479.51 cm^{-1}. These results confirm the formation of NiONPs using *Averrhoa carambola* fruit extract.

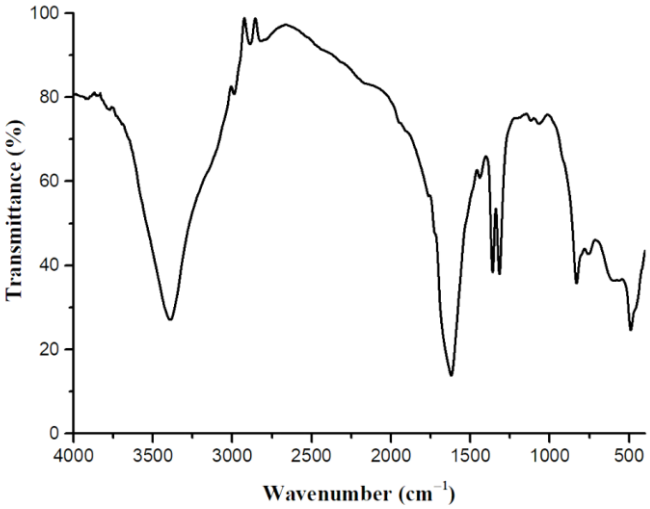

Fig. 2 FT-IR spectrum of NiO NPs

3.3 XRD Analysis of NiO NPs

The synthesised NPs shows fifteen peakvalues (2θ) at 18.878, 22.834, 30.359, 33.724, 35.665, 37.837, 41.105, 43.986, 46.570, 47.702, 49.007, 51.562, 58.598, 61.461 and 63.383 degree in the experimental diffractogram with a crystalline size of 37 nm (**Fig. 3**). The diffractogram of synthesised NiO NPs is in accordance with the diffraction pattern of JCPDS file No. 47-1049. The XRD study thus confirmed face centered cubic geometry for the NiONPsand this is in agreement with NiO NPs reported byEl-Kemary*et al*., [7].

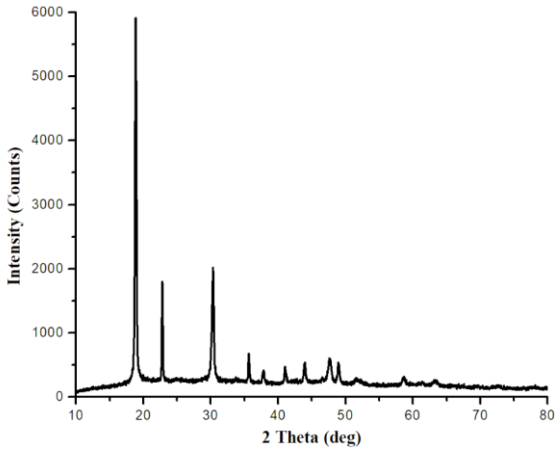

Fig. 3 XRD of NiO NPs

3.4 SEM-EDX Analysis of NiO NPs

The SEM image of NiO NPs reveals a rod-like shape with a smooth surface texture, indicating a low surface area (**Fig. 4**). This morphology, characterized by minimal edges, is expected to provide moderate photocatalytic efficiency due to moderate adsorption sites. The surface of the adsorbent exhibits a smooth texture.The EDX spectrum of NiO NPs confirms the occurrence of nickel (Ni) and oxygen (O) elements, with an atomic percentage of Ni at

5.82% and weight percentage at 19.53%and oxygen at 64.30% and 58.78%, respectively (**Fig. 5**)

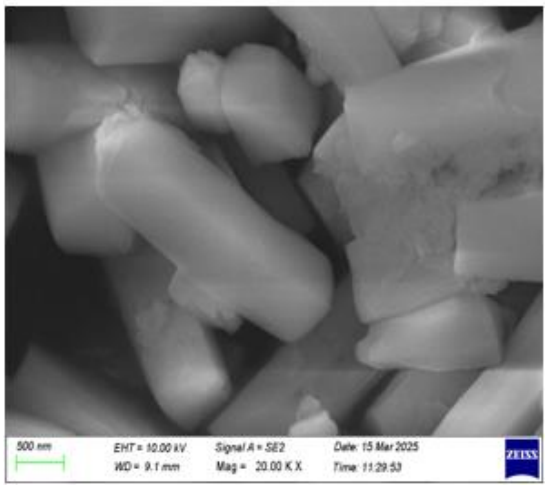

Fig. 4 SEM image of NiO NPs

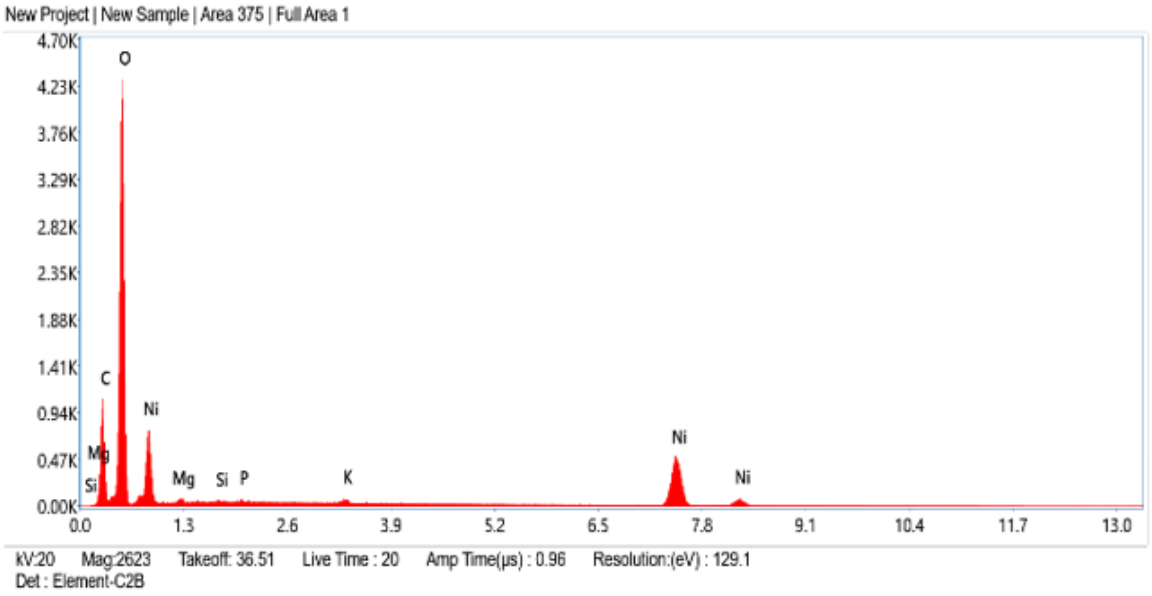

Fig. 5 EDX spectrum of NiO NPs

3.5 Degradation Studies of Congo Red using NiO NPs

The degradation studiesof Congo red dye under UV irradiation are investigated with and without NiO NPs (0.01 g) for about 100 minutes. (**Fig. 6**). Aliquots of 3 mL is taken from the reaction mixture at regular 10 minutes time intervals, and the absorbance is measured, the reduction in absorbance with increasing time at 498 nm indicates the dye degradation. A Plot of 1 + log A *versus* time is linear, where A is the absorbance of the medium at a particular time t. The rate constant (k) was calculated using the expression:

$$k = -2.303 \times \text{slope}$$

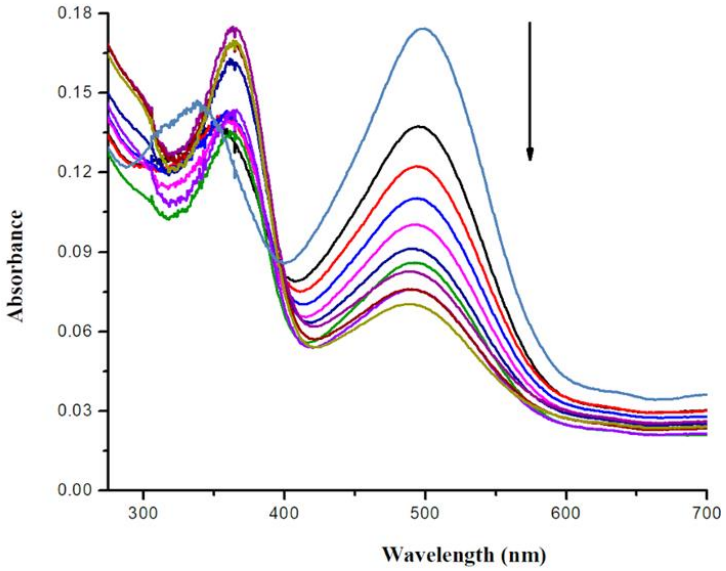

Fig. 6 Degradation spectra of Congo red dye with NiO NPs

The degradation rate and degradation efficiency of Congo red dye without NiO NPs are found to be 5.33 x 10^{-3} min^{-1} and 20.72 % respectively. The degradation rate and degradation efficiency of Congo red dye withNiO NPs are found to be 1.19 x 10^{-2} min^{-1} and 57.95 % respectively. The NiO NPs degrades the dyefaster and exhibits enhanced photocatalytic degradation.The findings propose that the synthesised NPs can be used as a photocatalysts for Congo red dye degradation, offering a promising solution for wastewater treatment.

Conclusion

The present investigation reveals the synthesis, characterization and photocatalytic efficacy of NiO NPs from *Averrhoa carambola* extract. The synthesized NiO NPs show peak in the region 280.71 nm and act ascatalyst for Congo red dye degradation. This study highlights the potential of *Averrhoa carambola* extract as a green and sustainable reducing agent for the formation of metal oxide NPs. The synthesized nanoparticles have promising applications in environmental remediation, particularly in the degradation of textile dyes.

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Adsorption Behaviour of Nickel (II) on Silica Nanoparticles from Pistachio Shell Ash and Cashew Nut Shell Ash via Sol-Gel Process

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ABSTRACT

In the present study, silica nanoparticles were synthesized from pistachio shell ash and cashew nutshell ash through a sol-gel process and evaluated for their adsorption behaviour towards Ni(II) ions in aqueous solutions. The synthesized nanoparticles were characterized using UV-Visible spectroscopy, Fourier-transform infrared spectroscopy (FTIR), X-ray diffraction (XRD),EDAX, scanning electron microscopy (SEM) and Brunauer–Emmett–Teller (BET) surface area analysis to elucidate their structural and morphological properties. The effects of various parameters such as solution pH, contact time, initial metal ion concentration, and temperature on the adsorption capacity were investigated in batch experiments. The adsorption data were well described by the Langmuir isotherm model, indicating monolayer adsorption with maximum uptake capacities of 28.6 mg/g and 25.3 mg/g for pistachio shell ash-derived and cashew nutshell ash-derived silica nanoparticles respectively. These findings highlight the potential of agricultural waste-based silica nanoparticles as effective and eco-friendly adsorbents for the removal of Ni(II) ions from contaminated water systems.

Keywords: *Silica nanoparticles; Adsorption; Nickel; Pistachio shell ash; Cashew nutshell ash; Sol-gel process.*

1. Introduction

The contamination of aquatic environments with heavy metals, particularly nickel (Ni^{2+}) poses a significant ecological and human health threat due to their persistence, bioaccumulation, and non-biodegradable nature [1]. Nickel, a transition metal commonly used in electroplating, battery manufacturing, and alloy production, is known to cause dermatological disorders, respiratory complications, and carcinogenic effects upon prolonged exposure [2]. Conventional methods for nickel removal, such as chemical precipitation, ion exchange, and membrane filtration, are often economically unfeasible for large-scale application, particularly in low-resource settings, and may generate secondary pollutants [3]. Therefore, the development of cost-effective, eco-friendly, and high-efficiency adsorbents remain pressing area of research in environmental remediation [4]. Agro-waste-derived silica nanoparticles have emerged as promising candidates for metal ion adsorption due to their abundance, low cost, renewability, and high surface area [5]. Pistachio shell (*Pistacia vera* L.)

and cashew nutshell (*Anacardium occidentale* L.) are lignocellulosic biomass residues rich in carbon and silica precursors, commonly discarded as waste in agro-industrial sectors [6]. These materials can be thermochemically processed into ash and further refined *via* sol-gel methods to yield amorphous or partially crystalline silica nanoparticles with unable physicochemical properties [7].

In this study, we focus for the synthesis of nano silica from pistachio shell ash (PSA) and cashew nutshell ash (CNSA) and evaluate the adsorption efficiency towards (Ni^{2+})ions under varying physicochemical parameters including contact time, pH, adsorbent dosage, and initial ion concentration.

2. Materials and Methods

2.1 Preparation of Pistachio Shell and Cashew Nutshell Ash

Pistachio shells were sourced from the local market in Nagercoil, while cashew nut shells were obtained from a cashew processing factory in Marthandam. The shells were thoroughly washed and air-dried under ambient conditions. The dried shells were then subjected to thermal treatment in a muffle furnace. Combustion was carried out at 750^0C for 3 hours with a controlled heating rate of 10^0C per minute. After combustion, the resulting ash was allowed to cool gradually inside the furnace to ensure thermal stability [8].

2.2 Extraction of silica from Cashew Nut Shell Ash (CNSA) and Pistachio Shell Ash (PSA)

10g of the sample was mixed with 500 mL of 3M NaOH and heated for 2 hours on a hotplate with continuous stirring to dissolve the silica content, forming a silicate solution. The resulting mixture was filtered using ashless filter paper, and the residue was washed with 100 mL of boiled distilled water. After cooling, the clear filtrate was titrated with 3M HCl to adjust the pH to the range of 7.5-8.5 under constant stirring, following by aging for 24 hours to facilitate gel formation. The formed gel was gently broken, then centrifuged at 4000 rpm for 4 minutes. The supernatant was discarded, and the resulting aqua gels were dried in an oven at 80^0C for 24 hours to obtain silica xerogels [9].

2.3 Extraction of Nano Silica from CNSA and PSA

The silica xerogels obtained from both cashew nut shell ash (CNSA) and pistachio shell ash (PSA) were subjected to further processing to extract nano silica (Figure 1). Initially, the xerogels were refluxed with 3 M HCl at 70^0C for 4 hours to remove residual metal ions. The treated samples were repeatedly washed with deionized water until neutral pH was achived. Subsequently, the acide-treated gels where dissolved in 3M NaOH under continuous magnetic stirring for 10 hours, followed by pH adjustment to the range of 7.5-8.5 using concentrated H_2SO_4 to induce reprecipitation of silica. The precipitated nano silica was repeatedly washed

with warm deionized water until completely free of alkali impurities. The purified silica was then dried in a vacuum oven at 80^0C for 48 hours. The final nano silica products were collected and stored for further analysis [10].

Figure 1. (A) Pistachio shell ash; (B) Cashew nutshell ash; (C) Nanosilica synthesized from pistachio shell ash; (D) Nanosilica synthesized from cashew nutshell ash.

2.4 Adsorption Studies for the Removal of heavy metal from solution of Ni^{2+} ions

A stock solution of 1000 mg/L (Ni^{2+}) was prepared by dissolving a known quantity of nickel(II) sulfate hexahydrate $NiSO_4 \cdot 6H_2O$in deionized water. Adsorption experiments were conducted using synthesized silica microparticles as the adsorbent. For initial adsorption trials, 0.5 g of the silica microparticles were homogenized with 10 mL of 0.1 M nickel(II) sulfate solution and stirred at room temperature (23 ± 1 °C) for 10 minutes. The solution pH was adjusted and maintained at 6.0 using 1.0 M HCl and 1.0 M NaOH.To evaluate the effect of adsorbent dosage on Ni^{2+} ion removal, varying amounts of silica microparticles (0.5–2.5 g in 0.5 g increments) were added to five separate 10 mL aliquots of 50 mg/L nickel ion solutions. Additionally, the influence of initial Ni^{2+} concentration was assessed by preparing duplicate samples with concentrations of 10, 20, 30, 40, and 50 mg/L under the same adsorption conditions.The contact time required to achieve adsorption equilibrium was examined by allowing the adsorbent–adsorbate systems to interact for varying durations: 10, 20, 30, 40, and 50 minutes. It was observed that equilibrium was reached at approximately 40 minutes for both nickel and lead ionTo assess the influence of pH on adsorption efficiency, experiments were conducted across a pH range of 1–8 while maintaining other parameters constant (adsorbent dose: 0.5 g, initial Ni^{2+} concentration: 50 mg/L, volume: 10 mL, contact time: 40 min). The optimum pH for Ni^{2+} removal was found to be 6.0.Subsequent isotherm studies were performed to model the adsorption behavior using Langmuir and Freundlich equations. These experiments

were conducted under optimized conditions: pH 6.0, contact time 40 min, initial metal ion concentration 50 mg/L, and adsorbent dosage 2.5 g. Metal ion concentrations in the filtrates post-adsorption were analyzed using an atomic absorption spectrophotometer (AAS). All experiments were carried out in triplicate, and the results were reported as mean values ± standard deviation to ensure statistical reliability [11].

3. Result & Discussion

3.1 UV–Visible Spectroscopic Analysis of Bio-derived Silica Nanoparticles

UV–Vis analysis (Figure 2) revealed strong absorption peaks at 203.3 nm (PSA-derived SiNPs) and 203.9 nm (CNSA-derived SiNPs), characteristic of Si–O–Si electronic transitions in silica nanostructures. The minor shift in peak positions is attributed to variations in surface composition, degree of siloxane network formation, and presence of Si–OH groups. Defects such as silicon/oxygen vacancies and partially formed tetrahedral structures may also influence the observed absorption behavior [12].

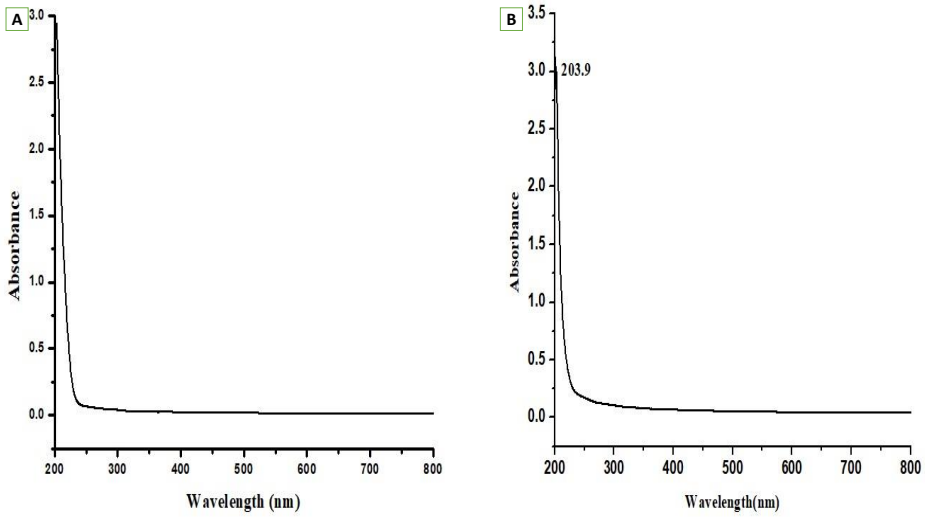

Figure2. UV-Vis absorption spectra of nanosilica synthesized from (A) Pistachio shell ash and (B) Cashew nutshell ash.

3.2 FTIR Spectroscopic Analysis of Silicananoparticles

FTIR spectroscopy (Figure 3) was employed to elucidate the functional groups involved in the capping and stabilization of silica nanoparticles (SiNPs) synthesized from pistachio shell ash (PSA) and cashew nutshell ash (CNSA). A broad O–H stretching band appeared at 3759.26 cm^{-1} (PSA-SiNPs) and 3766.77cm^{-1}(CNSA-SiNPs), confirming surface hydroxyl (silanol) groups. C–H stretching vibrations were observed at 2929.87 and 2862.36cm^{-1} (PSA) and 2930.25 and 2854.06cm^{-1} (CNSA), indicating aliphatic hydrocarbons. Both spectra showed an

O–H stretching band near 2379 cm^{-1}, likely from residual alcohols. Peaks at 1637.56cm^{-1} (PSA) and 1641.27cm^{-1} (CNSA) correspond to O–H bending of adsorbed water and surface Si–OH groups. In the fingerprint region, Si–O bending was noted at 557 cm^{-1} (PSA) and 580.85 cm^{-1} (CNSA). A broad absorption at ~1384cm^{-1} indicated asymmetric CH_3 bending, while a sharp band at 1117.28cm^{-1} (CNSA) was attributed to ester C–O stretching. The observed silanol (Si–OH) and siloxane (Si–O–Si) functionalities confirm successful hydrolysis and condensation reactions during nanoparticle formation [13].

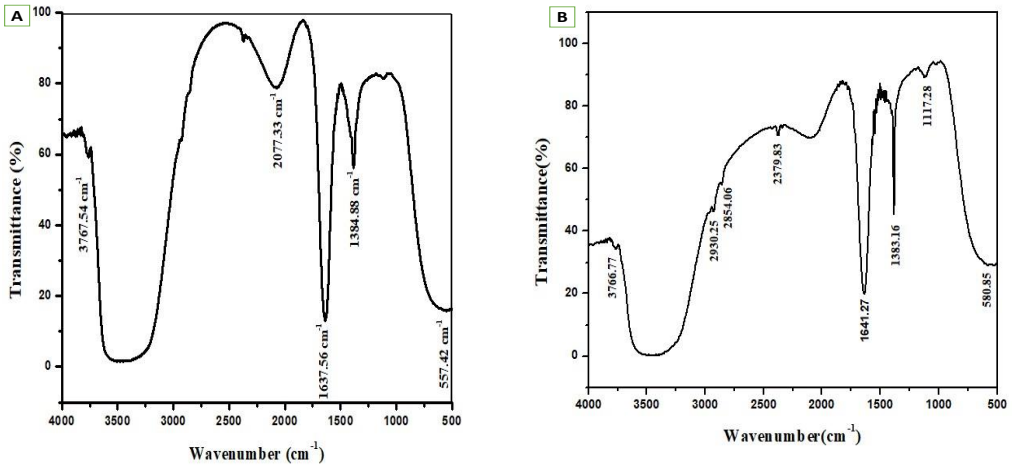

Figure 3. FTIR spectraof nanosilica synthesized from (A) Pistachio shell ash and (B) Cashew nutshell ash.

3.3 XRD Analysis of Silica Nanoparticles

X-ray diffraction (XRD) was utilized to assess the crystallinity and estimate the crystallite size of silica nanoparticles (SiNPs) synthesized from pistachio shell ash (PSA) and cashew nutshell ash (CNSA) (Figure 4). PSA-derived SiNPs exhibited sharp peaks at 2θ = 32.11°, 75.67°, and 84.25°, along with quartz-associated peaks at ~22° and 40°, indicating mixed crystalline and amorphous phases. A broad band at 2θ ≈ 22° confirmed the presence of amorphous silica, with an average crystallite size of 39.7 nm (Debye–Scherrer equation). CNSA-derived SiNPs showed a broader, less intense profile with peaks at 2θ = 22.07°, 24.05°, and 55.27°, and a diffuse halo near 20.9°, characteristic of amorphous silica [14]. The average crystallite size was 10.6 nm, suggesting finer particles. Variations in crystallinity and size are attributed to differences in biomass composition and thermal treatment parameters.

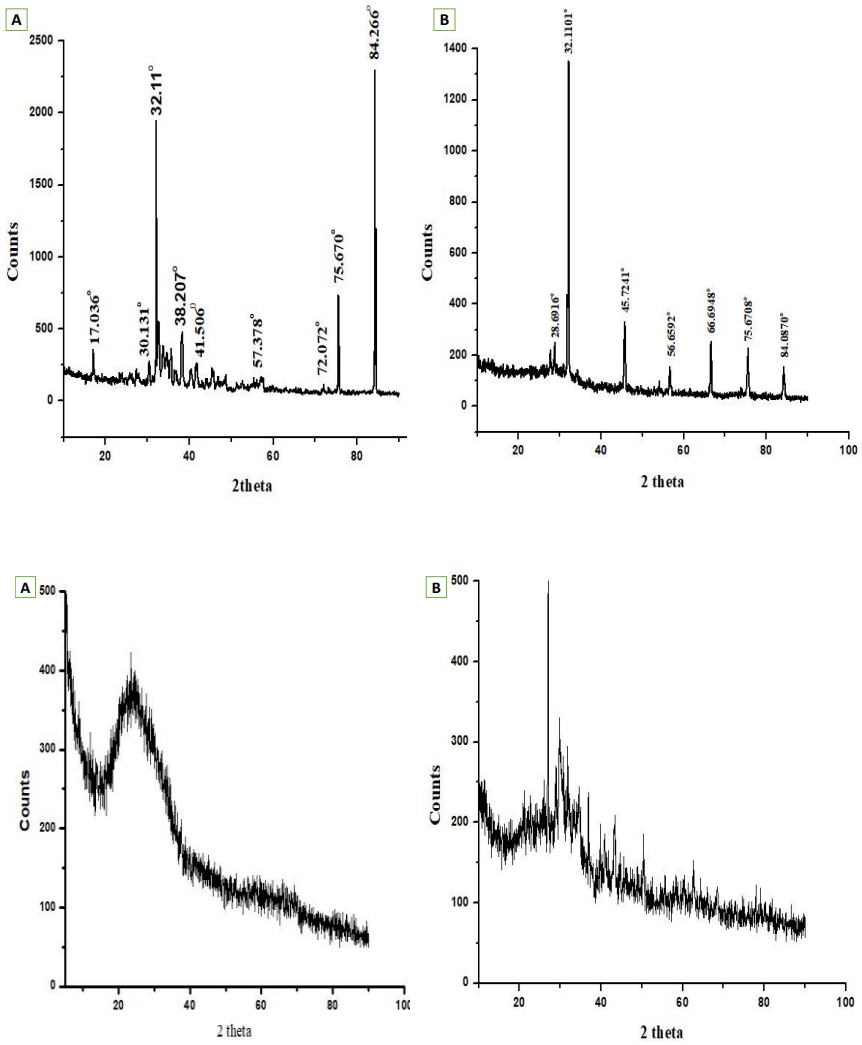

Figure 4. XRD spectrum of(Above) (A) Pistachio shell ash and (B) Cashew nutshell ash (Below)nano silica synthesized from (A) Pistachio shell ash and (B) Cashew nutshell ash.

3.4 SEM Analysis of Silica Nanoparticles

Scanning electron microscopy (SEM) was used to examine the morphology and particle size of silica nanoparticles (SiNPs) synthesized from pistachio shell ash (PSA) and cashew nutshell ash (CNSA) (Figure 5). PSA-derived SiNPs exhibited a rod-like morphology with irregular particle sizes and sharp edges, indicating partial crystallinity. In contrast, CNSA-derived SiNPs showed uniform spherical morphology with reduced agglomeration and enhanced dispersion, suggesting better stabilization [15]. The average particle size was approximately 6.34 nm.

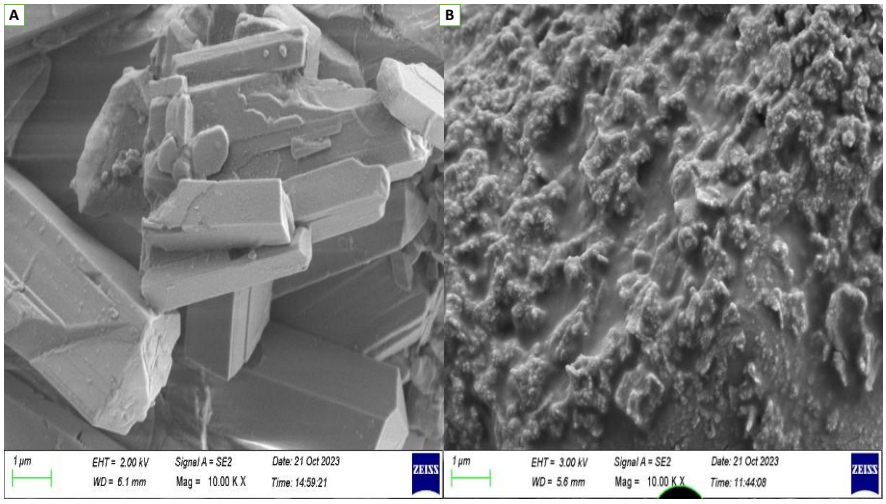

Figure 5. SEM image of nano silica synthesized from (A) Pistachio shell ash and (B) Cashew nutshell ash.

3.5 EDX Analysis of Silica Nanoparticles

Energy-dispersive X-ray (EDX) spectroscopy (Figure 6) confirmed the elemental composition of silica nanoparticles synthesized from pistachio shell ash (PSA) and cashew nutshell ash (CNSA). Both samples exhibited strong signals for Si and O, verifying the formation of high-purity SiO_2nanoparticles. The negligible presence of other elements highlights the efficiency and eco-friendliness of the green synthesis process [16].

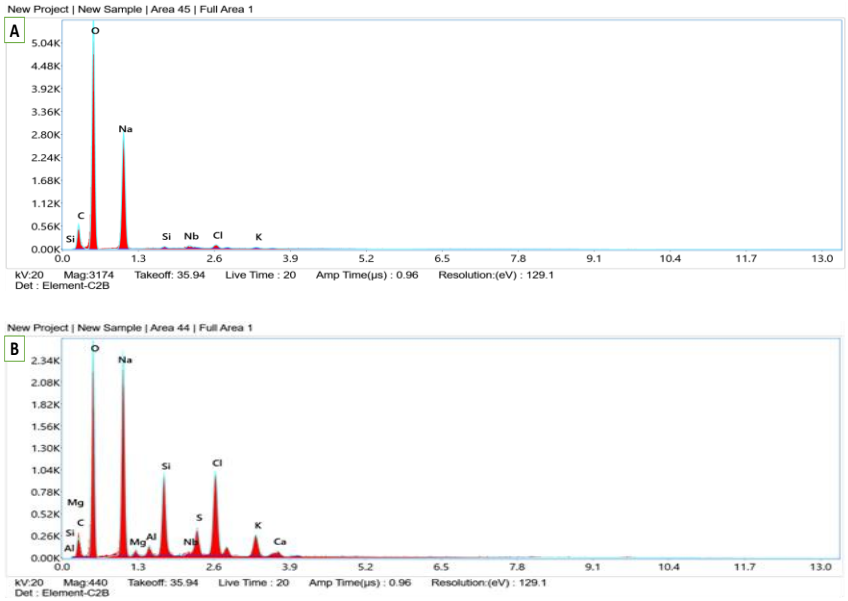

Figure 6. EDX spectra of nano silica synthesized from (A) Pistachio shell ash and (B) Cashew nutshell ash.

3.6 Effect of Adsorbent Dosage on Adsorption Efficiency of PSA CNSA and Silica Nanoparticles

The influence of adsorbent dosage on the adsorption efficiency of PSA, CNSA, and silica nanoparticles were evaluated and is illustrated in Figures 7 and 8. In all cases, the percentage of metal ion removal increased with increasing adsorbent dosage, reaching equilibrium within 1 hour. This enhancement in adsorption capacity at higher dosages is primarily attributed to the increased number of available active sites on the surface of the adsorbent. At the initial stage, a rapid adsorption rate was observed due to the abundance of unoccupied surface sites. However, as adsorption proceeded, the rate gradually decreased, likely due to saturation of the external active sites and the subsequent diffusion of ions into the inner pores of the adsorbent. For PSA, the adsorption efficiency increased from 45.80% at 0.05 g to 70.47% at 0.25 g. Similarly, CNSA demonstrated a significant increase in adsorption from 52.78% at 0.05 g to 88.72% at 0.25 g. In the case of silica nanoparticles, the adsorption efficiency rose from 50.5% to 77.51% for one study and from 33.36% to 90.31% in another, under the same dosage conditions. These results indicate that CNSA and silica nanoparticles exhibit superior adsorption performance compared to PSA, with silica nanoparticles showing the highest removal efficiency at maximum dosage. This trend highlights the critical role of adsorbent dosage in optimizing adsorption processes and suggests that adsorbent surface characteristics, including surface area, pore volume and functional group availability, significantly influence adsorption kinetics and equilibrium. Therefore, determining the optimal adsorbent dosage is essential for maximizing removal efficiency in practical applications such as wastewater treatment and heavy metal remediation [17].

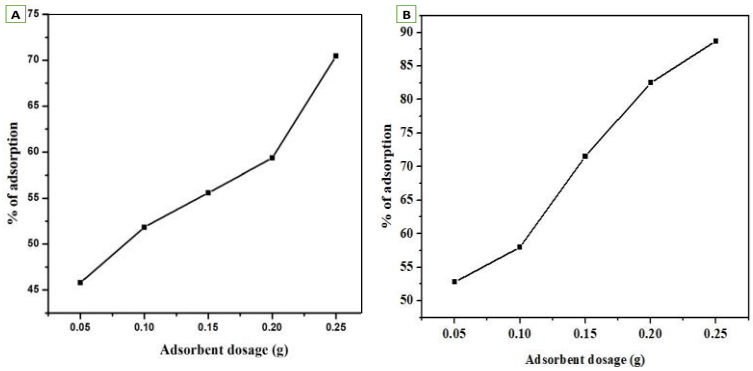

Figure 7. Effect of adsorbent dosage on adsorption of (A) PSA and (B) CNSA

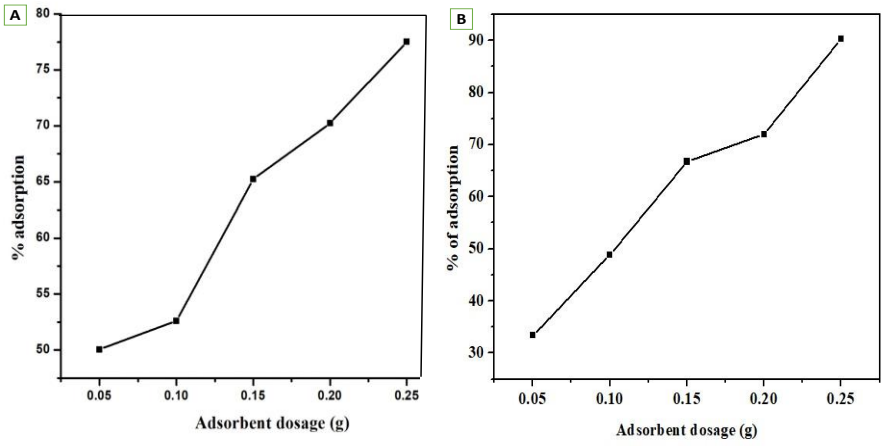

Figure 8. Effect of adsorbent dosage on adsorption of silica nano particle synthesized from (A) PSA and (B) CNSA

3.7 Effect of Contact Time on the Adsorption Efficiency of PSA, CNSA and Silica Nanoparticles

The influence of contact time on the adsorption efficiency of PSA, CNSA, and silica nanoparticles for the removal of Ni^{2+} ions from aqueous solutions was systematically investigated. The experiments were conducted at a controlled pH of 6, room temperature (23 °C), and an initial ion concentration of 50 mg/L. Adsorption performance was evaluated over a range of contact times: 10, 20, 30, 40, and 50 minutes. The corresponding adsorption percentages are presented in Tables 4.3 and 4.4 and Figures 4.8 to 4.11. The statistical analysis confirmed that contact time significantly influenced adsorption efficiency at $P < 0.05$. Across all adsorbents, a rapid increase in Ni^{2+} ion removal was observed at the initial stages of contact, which can be attributed to the abundance of unoccupied active sites on the surface of the adsorbents. As the contact time progressed, the rate of adsorption gradually plateaued, indicating that equilibrium was being approached due to the saturation of available active sites and reduced driving force for mass transfer. For silica nanoparticles, two sets of data were reported. In the first case, the adsorption efficiency increased from 21.86% at 10 minutes to 67.44% at 50 minutes. In a separate experiment, adsorption improved substantially from 44.42% to 97.98% over the same contact time, possibly due to variations in nanoparticle surface area or synthesis conditions. PSA demonstrated a moderate adsorption performance, with Ni^{2+} removal increasing from 55.86% at 10 minutes to 72.00% at 50 minutes. CNSA exhibited a more progressive adsorption trend, with efficiency improving from 21.87% at 10 minutes to 75.75% at 50 minutes. These results suggest that silica nanoparticles, particularly those with enhanced surface properties, show superior performance in Ni^{2+} ion adsorption

compared to PSA and CNSA. The contact time-dependent increase in removal efficiency reflects the kinetics of adsorption, highlighting the importance of allowing sufficient interaction time between adsorbate and adsorbent for optimal metal ion sequestration. Understanding this behavior is crucial for designing effective treatment protocols for heavy metal removal in environmental applications [18].

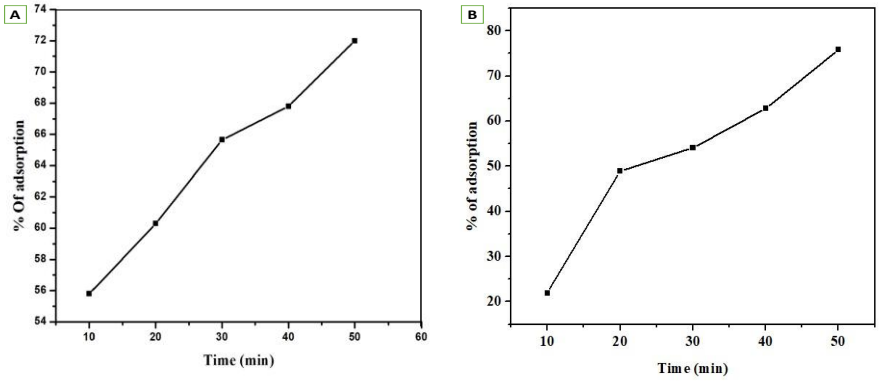

Figure 9. Effect of contact time on adsorption of (A) PSA and (B) CNSA

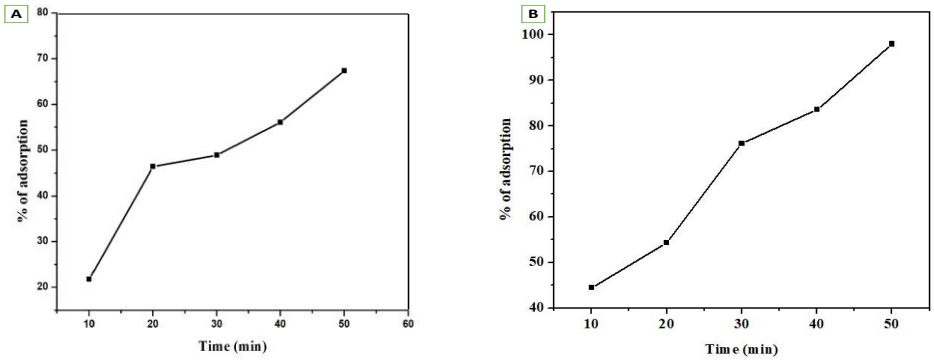

Figure 10. Effect of contact time on adsorption of silica nano particle synthesized from (A) PSA and (B) CNSA

Conclusion

This study presents a sustainable approach for the green synthesis of silica nanoparticles (SiNPs) from pistachio shell ash (PSA) and cashew nut shell ash (CNSA) via a surfactant-free sol–gel process. Elemental analysis (EDX) confirmed the high purity of SiNPs, while UV–Vis spectra exhibited sharp absorption bands at 203.3 nm (PSA) and 203.9 nm (CNSA), corresponding to Si–O–Si electronic transitions, indicative of well-formed silica networks. FTIR analysis revealed characteristic functional groups such as silanol (Si–OH), siloxane (Si–O–Si), and minor organic residues, enhancing surface reactivity for metal ion binding. XRD

patterns indicated partially crystalline phases in PSA-derived SiNPs (crystallite size ~39.7 nm) and predominantly amorphous structures in CNSA-derived SiNPs (~10.6 nm). SEM images showed morphological differences—rod-like particles in PSA and well-dispersed spherical nanoparticles in CNSA—with the latter displaying a smaller average size (~6.34 nm) and minimal agglomeration. Adsorption studies demonstrated that CNSA-derived SiNPs achieved up to 97.98% Ni^{2+} removal under optimized conditions (pH 6.0, 2.5 g adsorbent, 40 min, 50 mg/L), attributed to their enhanced surface area, uniformity, and functional group accessibility. These findings underscore the potential of CNSA-derived bio-silica as a high-performance, cost-effective, and environmentally benign adsorbent for heavy metal remediation, offering a scalable route for agro-waste valorization in wastewater treatment technologies.

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Integrating Internet of Things (IoT) in Smart Agriculture: Challenges and Opportunities for Precision Farming

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ABSTRACT

The integration of Internet of Things (IoT) technologies into agriculture has given rise to precision accuracy based smart farming. IoT enables real-time monitoring of crop, soil, livestock, and environmental conditions, allowing for data-driven decision-making. This paper explores the use of IoT in architecture, key applications, benefits, challenges, and future potential of IoT in agriculture. It includes a research analysis of global adoption trends and presents case studies from India, demonstrating successful implementations. This paper provides a comprehensive understanding of how Internet of Things (IoT) is shaping modern agriculture and driving sustainability.

Keywords: *IoT, Smart Farming, Precision Agriculture, Sensors, Cloud Computing, Agri Tech, Automation*

Introduction

Agriculture is undergoing a rapid digital transformation to meet the food requirements of a growing population while mitigating climate challenges and resource scarcity. IoT has emerged as a critical enabler of this transition by connecting sensors, actuators, and machines to cloud systems that assist in data-driven decision-making.

Related works

Over the past ten years, a large number of research papers have focused on the use of the Internet of Things (IoT) in agriculture. An overview of pertinent literature about the development, technologies, difficulties, and real-world applications of IoT in agricultural fields is provided in this section.

In order to address food security and environmental sustainability, smart agriculture incorporates IoT with other cutting-edge technologies like artificial intelligence and cloud computing, as highlighted in [1]. According to their research, medium- and large-scale farms are increasingly adopting data-driven decision-making procedures in place of manual ones. Using Arduino, DHT11 (temperature/humidity), and soil moisture sensors, Precision Crop

Management and Smart Irrigation [2] created a smart irrigation system that demonstrated a 40% reduction in water usage compared to conventional techniques.

In their evaluation of IoT architectures for precision farming, Core Technologies in IoT-Based Agriculture [3] identified three essential elements: sensor nodes, cloud servers, and user interfaces. They maintained that scalable solutions in low-resource environments are mostly made possible by open-source platforms and standardised protocols like MQTT and LoRaWAN.

Microsoft's Farm Beats platform (2020) [4] showed how IoT devices with edge computing and AI might make decisions offline in places with poor connectivity in a large-scale implementation. Using predictive models, the platform successfully identified microclimates and decreased the use of pesticides.

The FAO [5] reports that government-funded pilot projects are driving the fastest growth in IoT-based agriculture in Asia, especially in China and India.

African countries, on the other hand, use technologies backed by NGOs and exhibit delayed adoption. In order to facilitate AgriTech businesses and guarantee data stewardship, European countries have implemented a legal framework. Obstacles and Difficulties in Adoption [6] lists a number of obstacles to the broad use of IoT in agriculture, such as high deployment costs, a dearth of internet infrastructure in rural areas, worries about data privacy, and farmers' low technological proficiency. According to their research, cooperative models and community-led IoT hubs. Overall, the body of research demonstrates that IoT in agriculture greatly enhances production, prevents illness, conserves water, and improves agricultural productivity. However, because of socioeconomic and infrastructure constraints, adoption is still uneven worldwide. To improve technology, solve contextual issues, and fully utilise IoT's potential in attaining global agricultural sustainability, more multidisciplinary study is necessary.

IoT Architecture in Agriculture

An IoT-based farming system typically comprises of the following layers.

Perception Layer: Physical sensors collects raw datas like for soil moisture, temperature, pH, crop health, etc. Actuators employed, such as irrigation pumps, greenhouse controls acts as instructions to these layers.

Network Layer: This layer consists of communication protocols likethat of ZigBee, LoRa, Wi-Fi, or 5G network for data transmission. This layer enables that data is securely transmitted to edge devices or cloud servers.

Processing Layer: This layer comprises of cloud computing devices or the edge devices for real-time data storage and analysis. Also AI/ML models can be used for predictions of irrigation needs and also forecast plant diseases.

Application Layer: Dashboards and apps for farmers to helps receive alert messages and recommendations or suggestions which help them take actionable insights and control automatically from remote places.

This is diagrammatically shown in figure 1.

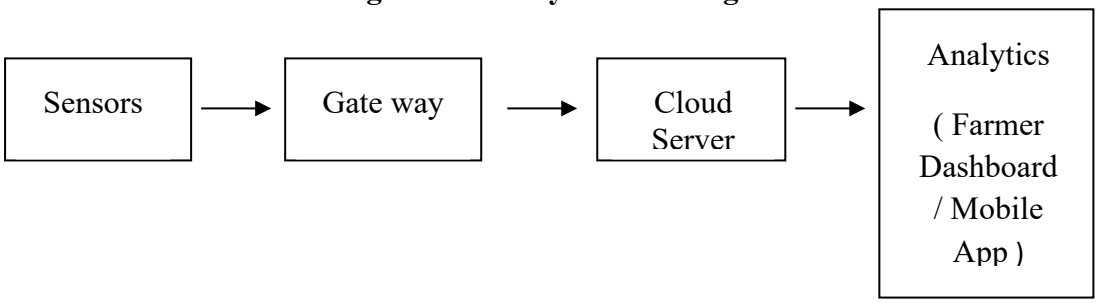

Figure 1. Architectural Diagram

Applications of IoT in Agriculture

Precision Crop Monitoring System that enables monitoring of soil conditions and environmental variables to optimize irrigation and nutrient delivery, Livestock Monitoring such as Wearable IoT devices that help monitor animal vitals, movements, and behaviour patterns, Smart Irrigation Systems that are based on real-time soil and weather data. These systems helps to automate water supply. Greenhouse Automation is yet another application where IoTdevices regulates lighting, ventilation, and temperature inside greenhouses, Drone Imaging in IoT smart application, in which the drones capture NDVI and thermal images to detect crop health and water stress conditions, Post-Harvest Monitoring application in which, sensors track grain storage conditions and transport logistics that helps to reduce spoilage.

Benefits of IoT in Agriculture

Water Efficiency is the main benefit of employing IoT in smart farming, where, 30–40% water savings is achieved through smart irrigation. Higher Yields are achieved through these systems with 20–30% increase in productivity with real-time interventions. The is a huge Operational Cost Reduction in which up to 25% savings through automation and reduced labour can be achieved. Sustainable Practices employed in smart farming enables precise use of fertilizers and pesticides that in turn helps in improving environmental health. Remote Monitoring allows for a 24/7 surveillance of large farms or remote areas without much difficulty.

Challenges, Limitations and Solutions

High capital investment in hardware and connectivity is a major challenge that can be solved by encouraging government subsidies schemes promotion. Poor internet infrastructure in rural regions is a challenge. This can be overcome by low power wide area networks that work well in rural areas where it operates with low power and long range communication. Also government and private infrastructure projects like tha of 5G, community Wi-Fi or public – private partnerships can help overcome this issue. Data privacy and ownership concerns. Lack of technical literacy among farmers is yet another challenge that can be addressed by conducting farmer training programs, local-language mobile apps and visual dashboards for easy access. Integration issues between IoT systems and legacy equipment can be done by developing standard IoT protocols that work with traditional farming equipments.

Research Analysis

A research analysis is made on reviewing few related works and reports from FAO, ICAR, survey survey datas from farmers across India, Europe and Africa, shows how IoT adoption is evolving in agriculture across regions and its measurable impact on farm productivity, efficiency, and sustainability.

Key Findings

The key findings from the study carried out summaries as follows. Adoption Growth has shown an increased level from 12% (2018) to 28% (2024) in medium to large farms globally. Top use cases shows increased 45% usage of IoT for smart irrigation, An increased 30% for soil health and crop monitoring has been achieved with a increase in 15% for livestock health and an improvement of 10% for post-harvest tracking. Yield Improvements shows farms using IoT showing an average yield increase of 23% and resource savings up to 35%. An increased return on Investment (ROI) in which most farmers recovered IoT costs within 2–3 seasons. Farmer Readiness also has an increased rate that has 67% farmers were open to adopting IoT tools if training and financing were available to them.

Regional Comparison

Government subsidies act as a catalyst for adoption in Europe, while high customization costs act as a deterrent and R&D-backed tools act as a safety net. In India, agritech start-ups act as a support system, connectivity in rural areas is a challenge, and state-led pilot programs are the region's main driver of adoption. In Africa, adoption is fuelled by donor-supported programs, obstacles are posed by infrastructure and power supplies, and support is provided by mobile-based platforms.

Opportunities Threats

Integration of AI and 5G, data insights, data theft, and vendor dependence present potential and risks.

Literature-based case studies below is a study and summary of the successful IoT-integrated smart farming implementations in Kenya, the United States, and India.

India's e-Krishi

In Kerala, an IoT-based soil and water monitoring system was put into place, which resulted in a 20% increase in tomato yield and a 30% water savings.

Smart Farming by John Deere (USA)

Optimized sowing patterns and fuel efficiency were the outcomes of the integration of cloud services with autonomous tractors and smart sensors.

Kenyan SmartFarmNet

Farmers were able to plant and protect crops on time thanks to a mobile platform that linked them to IoT weather stations.

Future Scope

AIoT (AI + IoT) systems allow for predictive analytics that can be used for disease and weather forecasting in the future. Edge Computing and its fast deployment can help reduce latency in remote farms. Block chain technology can ensure traceability and data integrity in the agri-supply chain. 5G Connectivity can enable faster real-time operations and wider network coverage in the future. Farmer Cooperative Societies and Tech Hubs help sharing of resources to promote the low-cost deployments in future.

Conclusion

IoT technologies are transforming agriculture from intuition-driven to insight-driven. Though barriers like that of cost and connectivity exists, the IoT systems have great potential to improve productivity, reduce the input waste, and ensure sustainability practices. With supportive government policies, affordable cost effective devices, and capacity-building among the farmers, IoT will for sure become central to the future of farming in a global scenario.

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Artificial Intelligence in Identification and Classification of Medicinal Plants

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ABSTRACT

Identifying medicinal plants is vital for the progress of healthcare particularly in fields such as pharmacology, ethnomedicine, and disease management. Traditional identification methods are time-consuming and error-prone due to human variability and environmental influences. This study explores a deep learning-based approach for rreliable and efficient recognition of medicinal plants through image classification techniques. Employing convolutional neural networks (CNNs) and transfer learning, the proposed model classifies medicinal plants based on their leaf images, offering a scalable and robust alternative to conventional taxonomy.

Keywords: *Deep Learning, Medicinal Plants, Plant Identification, Image Classification, CNN, Transfer Learning, ResNet50, Healthcare.*

Introduction

Medicinal plants have long played an essential role in traditional medicine systems across the globe, with the World Health Organization (WHO) reporting that up to 80% of people in underdeveloped nations depend on herbal remedies. Despite their widespread use, accurate identification remains a challenge due to morphological similarities, seasonal variations, and a lack of expert knowledge among users. This paper proposes a machine learning (ML) technique and deep learning (DL) technique solution to automate and enhance the medicinal plant classification accurately.

Problem Statement

Manual plant identification methods, though time-tested, are inefficient and often unreliable without expert intervention. Environmental conditions and morphological variability further complicate the process. The increasing reliance on herbal plants used for therapeutic purposes necessitates a dependable system of classification designed to support sustainable harvesting and prevent misidentification. Hence, a DL-based image classification framework is proposed that develops an efficient and accurate model capable of identifying and classifying medicinal plant species using their leaf images.

Related Works

Conventional techniques involving taxonomic keys and field observation are widely used, but recent advancements techniques of ML and DL have shown promise in automating botanical classification. Various studies highlight the success of CNNs in feature extraction and classification tasks in agricultural and biological domains and are briefed below.

A convolutional neural network (CNN) model used for plant classification in leaf images is proposed in [1]. The approach demonstrated the deep learning models outperform the traditional machine learning techniques by learning complex patterns directly from raw image data.

A deep learning framework [2] is used to identify plant species using deep features extracted from leaf and flower images. Their model utilized pre-trained deep networks and achieved high classification accuracy across multiple species.

A comparative analysis of applying machine learning algorithms for plant species identification is done in [3]. They highlighted that support vector machines and random forests could perform well on smaller datasets, but CNNs dominated in scalability and accuracy.

A mobile application integrating CNN-based identification of medicinal plants in real time is proposed in [4]. The app allowed users to photograph leaves and receive instant classification results.

A study [5] demonstrating AI-based techniques combining image preprocessing and feature selection to enhance the recognition of medicinal plants shows high precision with hybrid ML models.

Transfer Learning for Medicinal Plant Species Recognition [6] uses for transfer learning with ResNet-50 to classify segmented Leaves of medicinal plants. The work shows strong results even with a limited dataset, suggesting transfer learning is highly effective for domain-specific plant identification.

Proposed Methodology

Dataset Used: The "Segmented Medicinal Leaf Images" dataset from Kaggle. Below Figure 1 shows the sample input leaf images from the publicly available dataset.

Figure 1: Sample Input Images

The proposed system architecture with different modules is shown in figure 2.

Data Preprocessing: Images are resized, denoised, and normalized. Data is split into training, validation, and test sets.

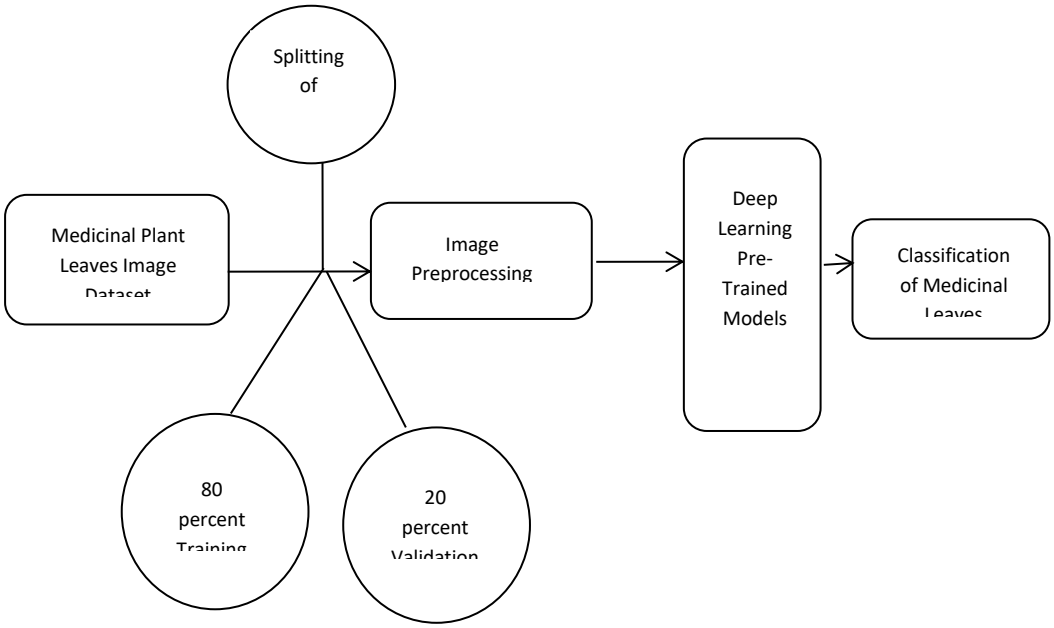


Figure 2: Architecture of Proposed System

Feature Extraction: Leveraging a pre-trained model (e.g., ResNet50), features of texture, color, and shape are extracted.

Model Fine-Tuning: The ResNet50 model layers are frozen while the later layers are retrained on the medicinal leaf dataset.

Model Evaluation: Performance may be assessed by accuracy, precision, recall, and F1-score on the validation set.

Deployment: A web-based interface is developed to allow real-time classification based on user-uploaded images.

Results and Discussion

Four pre-trained deep learning models are used to evaluate the performance.

$$\text{Accuracy} = \frac{\text{correct classifications}}{\text{total classifications}} = \frac{TP + TN}{TP + TN + FP + FN}$$

$$\text{Precision} = \frac{\text{correctly classified actual positives}}{\text{everything classified as positive}} = \frac{TP}{TP + FP}$$

$$\text{Recall (or TPR)} = \frac{\text{correctly classified actual positives}}{\text{all actual positives}} = \frac{TP}{TP + FN}$$

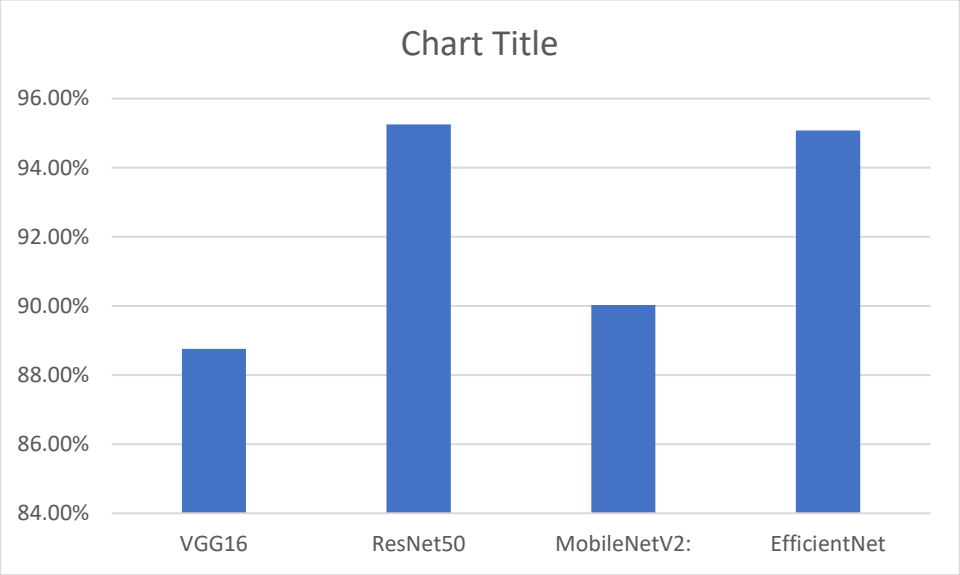
$$\text{F1 Score} = \frac{TP}{TP + \frac{1}{2}(FP + FN)}$$

The table 1 below ResNet50 produces the highest accuracy with precision. Table 2 gives the graphical representation of the same.

Table 1: Performance Evaluation

Model Name	Accuracy (%)	Precision (%)	Recall (%)	F1 Score (%)	Training Time	Observation
VGG16	88.76	High	High	High	High	High Accuracy but Computationally expensive
ResNet50	95.25	Very High	Very High	Very High	High	Good balance between accuracy and efficiency
MobileNetV2	90.03	Moderate	High	Moderate	Fast	Best for Mobile Applications
EfficientNet	95.08	Very High	Very High	Very High	Slow	Best Accuracy with fewer Parameters

Table 2: Graphical Representation



The proposed model attains high classification accuracy across diverse medicinal plant species, while the integration of transfer learning substantially reduces training time and enhances generalization. Visual samples and confusion matrices indicate strong performance in distinguishing visually similar species.

Conclusion

The deep learning-based framework for medicinal plant classification offers a robust, efficient, and scalable alternative to traditional identification methods. By using CNNs and transfer learning, the system can aid in sustainable harvesting, reduce misidentification, and contribute to the discovery of new medicinal compounds. Future work will focus on expanding the dataset, incorporating additional plant parts (e.g., flowers, stems), and enhancing model interpretability.

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Role of Entrepreneurship in Sustainable Development Goals (SDGs)

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ABSTRACT

Entrepreneurship has become a revolutionary force in advancing the United Nations Sustainable Development Goals (SDGs), offering innovative solutions to complex global challenges. The 2023–2024 GEM Report highlights the growing alignment between entrepreneurial initiatives and the SDGs, showcasing how businesses can simultaneously pursue profitability and social impact. This article examines how entrepreneurship contributes to each of the 17 SDGs, from poverty reduction and quality education to climate action and gender equality. By generating jobs, stimulating innovation, and building community resilience, entrepreneurs are essential to advancing social justice, environmental sustainability, and inclusive economic growth. Through real-world examples and recent studies, the article illustrates how entrepreneurial ventures across sectors are successfully incorporating sustainable practices into their core strategies. This integration underscores the importance of supportive policies and strong ecosystems that enable entrepreneurs to drive sustainable development. Overall, the study reinforces entrepreneurship as a critical catalyst for achieving the 2030 Agenda.

Keywords: *Entrepreneurship, Environmental sustainability, GEM report, Sustainable Development Goals.*

Introduction

The contribution of entrepreneurship to the advancement of the Sustainable Development Goals (SDGs) of the UN is highlighted in the GEM report for 2023–2024. The report claims that entrepreneurship is becoming more widely acknowledged as an essential tool for accomplishing these objectives, which include reducing poverty, promoting gender equality, fostering economic expansion, and maintaining a sustainable environment. It also indicates that many entrepreneurs are prioritizing sustainability in their ventures, which helps to solve environmental problems while also contributing economic growth and job creation. This intersection of entrepreneurship and the SDGs presents both challenges and opportunities, highlighting the need for policies that support sustainable practices and entrepreneurial ecosystems. Overall, the GEM 2023-2024 report not only showcases current trends in global entrepreneurship but also reinforces the notion that fostering entrepreneurial activity is crucial for achieving the SDGs by 2030.

Figure 1

THE UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS (UNSDGs)

Source: GEM Global Entrepreneurship Monitor

Figure 1 captures the UNSDGs. Through the development of sustainable business models, the creation of jobs, and the application of scalable solutions to social and environmental problems, entrepreneurship becomes an accelerator for accomplishing the SDGs. By integrating the SDGs into their core strategies, entrepreneurs not only contribute to global progress but also unlock new market opportunities and build long-term resilience. The contribution of entrepreneurship towards the UNSDGs are as follows,

Entrepreneurship and Sdgs

SDG-1: No Poverty

Entrepreneurship is an effective strategy for combating poverty (SDG 1). By creating businesses, entrepreneurs generate employment opportunities, especially in low-income and rural communities where formal job markets are limited. They offer direct employment and stimulate the local economies. In many economies, these businesses are the primary source of jobs. Additionally, social entrepreneurs often focus on addressing poverty-related challenges, such as providing affordable healthcare, education, or housing [1]. Access to microfinance and inclusive business models further empowers marginalized communities, enabling individuals to become self-sufficient and contributing to broader community upliftment.

SDG-2: Zero Hunger

SDG -2 aims to end hunger and improve food security for everyone. Entrepreneurs can help these mission by starting businesses that provide affordable, nutritious food and improve

food production methods, like sustainable farming and food distribution. By focusing on innovative solutions, such as urban farming or food waste reduction, businesses can address hunger and reduce food scarcity. Supporting food-related entrepreneurship also creates job opportunities and boosts local economies. Through these efforts, entrepreneurs can significantly contribute to the goal of achieving a hunger-free world.

SDG-3: Good Health and Well-Being

SDG-3 is all about making sure that everyone can get good health care and live a healthy life. Entrepreneurs can start businesses that provide affordable healthcare services and health products to improve the people's quality of life [1]. They can also create innovations like medical devices or apps to increase access to healthcare, particularly in underserved areas. Businesses that prioritize health, not only improve public well-being but also help to create a healthier society by addressing health challenges and fostering better living conditions for all.

SDG-4: Quality Education

SDG -4 aims to guarantee universal access to high-quality education. Entrepreneurship has a vital strategies and solutions to achieve this goal. Entrepreneurs can create businesses which can provide education, training and skill-building opportunities for people to learn new skills and make them qualified for dynamic organisational jobs [3]. By offering affordable and innovative education solutions, like online courses or vocational training, entrepreneurs help to bridge the gap in access to quality learning [5]. Supporting education-focused businesses also creates jobs and fosters a more skilled workforce which can benefits the economy.

SDG-5: Gender Equality

SDG-5 seeks to empower women and girls and achieve gender equality. In order to accomplish this, entrepreneurship is crucial because it helps women launch their own companies and get over barriers [2]. Businesses led by women often focus on creating fair and inclusive workplaces which offering opportunities for other women and underrepresented groups. By ensuring that, women have equal access to funding, education and guidance, entrepreneurship becomes a powerful way to break the cycle of inequality. Encouraging more women to become entrepreneurs not only transforms individual lives but also contributes to building a fairer and more equitable world for all.

SDG-6: Clean Water and Sanitation

SDG -6 focuses on ensuring access to clean water and sanitation for everyone, which is closely tied to sustainable business practices. Entrepreneurs who prioritize eco-friendly methods such as reducing waste and conserving water helps to protect this vital resource while growing their businesses. By incorporating these practices, companies not only help create a

healthier environment but also serve as role models for others. Supporting entrepreneurship that values social and environmental responsibility can lead to innovative solutions for water management and sanitation challenges. This approach is crucial in building a more sustainable future for everyone.

SDG-7: Affordable and Clean Energy

The goal of SDG-7 is to guarantee that everyone has access to affordable, reliable, and clean energy. Entrepreneurs are vita in developing and promoting renewable energy solutions, such as solar panels, wind turbines and energy-efficient technologies [7]. They contribute to lowering carbon emissions, decreasing dependency on fossil fuels, and lowering energy costs for communities by establishing clean energy-focused businesses. Supporting clean energy entrepreneurship boosts innovation and creates job opportunities in strengthening local economies. When businesses invest in sustainable energy solutions, they contribute to a greener planet and also meet the growing energy needs of people worldwide.

SDG-8: Decent Work and Economic Growth

Entrepreneurship significantly supports SDG 8 by promoting economic growth and creating decent job opportunities. Entrepreneurs drive innovation and open new markets, which boosts economic diversification and productivity. By establishing businesses, they generate employment and reduce joblessness, particularly among underrepresented groups like youth and women [6]. These ventures often introduce flexible work models and invest in skill development, contributing to more inclusive and fair labor practices. Moreover, entrepreneurship attracts investment and strengthens economic resilience by responding quickly to changing market demands. By doing this, it contributes significantly to inclusive and sustainable economic development.

SDG-9: Industry, Innovation and Infrastructure

Achieving SDG 9, which focuses on fostering inclusive and sustainable industrialization and creating resilient infrastructure, is largely dependent on entrepreneurship. Entrepreneurs often lead the way in in creating novel technologies, business plans, and solutions to problems in infrastructure and industry. Startups and small businesses often contribute towards modernization and innovation through digitalization, automation, and green technologies. By investing in innovative products and services, entrepreneurs enhance productivity and competitiveness across sectors. Through partnerships and private sector initiatives, entrepreneurs play a critical role in expanding access to sustainable transport, energy, and communication systems, making industrial growth more inclusive and environmentally responsible.

SDG-10: Reduced Inequalities

Promoting entrepreneurship provides opportunities for individuals from diverse backgrounds to enhance their financial situation and overcome barriers to success. It strongly connects with SDG-10 of reducing inequalities [2]. By encouraging entrepreneurship, marginalized groups can overcome systemic barriers and access resources such as funding, education, and networks to build their own businesses. It also empowers individuals to innovate and address local challenges, tailoring solutions to meet the unique needs of their communities. By encouraging everyone to take part in entrepreneurship, governments and organizations can ensure that economic opportunities are spread more evenly and helping to close the gaps between different communities and regions.

SDG-11: Sustainable Cities and Communities

SDG -11 is about making cities and communities inclusive, safe, resilient and sustainable. By starting businesses that address urban challenges like waste management, affordable housing and eco-friendly transport, entrepreneurs can improve the standard of living in cities and surrounding areas. The GEM National Entrepreneurship Context Index (NECI) highlights how well different regions support entrepreneurship and also exploring that how strong ecosystems encourage economic, social and environmental growth. Supporting entrepreneurs in urban and rural areas helps to strengthen connections between communities making them more sustainable and adaptable for the future.

SDG-12: Responsible Consumption and Production

SDG -12 encourages businesses to use resources efficiently and reduce waste effectively. Entrepreneurship supports responsible consumption and production by promoting sustainable business practices and innovations. Many modern entrepreneurs are focused on building environmentally conscious enterprises that minimize waste, reduce resource consumption, and offer eco-friendly alternatives to traditional products. Through circular economy models such as recycling, reusing, and upcycling, entrepreneurs help shift production patterns toward sustainability [7]. These businesses are crucial in raising consumer awareness and encouraging more sustainable purchasing decisions. Green entrepreneurship and technological innovation are thus essential in achieving long-term ecological balance and reducing the environmental footprint of production and consumption.

SDG-13: Climate Action

SDG -13 emphasizes the need for immediate action to mitigate the effects of climate change. This mission heavily relies on entrepreneurship. To reduce carbon emissions, entrepreneurs can develop cutting-edge solutions like eco-friendly products, sustainable

farming methods, and renewable energy technologies [7]. Businesses that adopt climate-conscious strategies not only help the planet but also satisfy the rising demand for eco-friendly goods and services. By building businesses that address climate change, entrepreneurs help in the creation of healthier world for everyone.

SDG-14: Life Below Water

SDG -14 focuses on protecting the oceans, seas, and marine life, which are essential for the planet's health and people's livelihoods. Entrepreneurs can effectively contribute towards this by providing creative solutions on reducing plastic waste, developing eco-friendly fishing methods and finding ways to clean up polluted waters. Businesses that focus on sustainable practices in industries like fishing, tourism, and shipping can protect marine ecosystems. Supporting entrepreneurs who focus on protecting the oceans can encourage industries to work in ways that are safe for marine life. Combining business ideas with ocean conservation efforts can ensure a healthier sea and a sustainable marine future.

SDG-15: Life On Land

SDG -15 focuses on protecting ecosystems and biodiversity. By starting businesses that promote conservation, such as sustainable agriculture, reforestation and wildlife protection, entrepreneurs can help to safeguard the environment. These businesses can offer products and services that prevent land degradation, restore habitat, and protect endangered species, all of which improve the ecosystems' long-term health. Additionally, sustainable land management practices and green innovations create job opportunities and encourage environmentally responsible growth. By supporting entrepreneurship in these areas contributes to the advancement of a sustainable future for the earth and its inhabitants.

SDG- 16: Peace, Justice and Strong Institutions

SDG -16 aims to promote inclusive societies, strengthen institutions and ensure access to justice for all. Entrepreneurs contribute to peace and stability by creating businesses that foster social inclusion, equality and access to resources helping to reduce social and economic disparities [2]. By providing employment opportunities and fair wages, businesses can alleviate reducing poverty and promoting social justice within communities. Strong institutions with transparent legal frameworks and efficient governance, can foster an atmosphere where companies can prosper and follow moral standards. Supporting entrepreneurs who focus on responsible business practices, ethical governance and social impact helps to build stronger institutions and contributes to a peaceful society.

SDG-17: Partnerships for the Goals

SDG-17 highlights the value of partnerships and collaboration to drive sustainable development worldwide. By incorporating SDGs into their business practices, entrepreneurs contribute significantly to the achievement of this goal. By identifying and prioritizing SDGs, businesses can foster innovative solutions to address the societal and environmental challenges. Entrepreneurs who embrace SDG-related initiatives can effectively build credibility and trust which enabling them to attract partnerships This strategy not only aids in their commercial success but also boosts global efforts to build a better and sustainable future for everyone [4].

Conclusion

In conclusion, entrepreneurship serves as a powerful engine for sustainable development, aligning business innovation with social and environmental goals. The analysis of each SDG demonstrates that entrepreneurial activities can offer scalable, inclusive, and impactful solutions that address some of the world's most pressing issues from poverty and hunger to climate change and institutional reform. Entrepreneurs contribute not only by creating economic value but also by promoting equity, environmental stewardship, and community resilience. Encouraging entrepreneurship, particularly among women, youth, and marginalized communities, is essential for broadening the impact of sustainable development efforts. For this potential to be fully realized, governments, institutions, and the private sector must work collaboratively to build enabling ecosystems, invest in education and infrastructure, and promote ethical and responsible business practices. As we progress toward 2030, fostering entrepreneurial spirit across all regions and sectors will be instrumental in achieving the SDGs and creating a more sustainable and inclusive world.

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https://www.gemconsortium.org/reports/latest-global-report

The Social Security Schemes for Women in Kanyakumari District

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ABSTRACT

The "social security schemes" play a significant role in enhancing the welfare and empowerment of women, especially in rural and coastal regions like Kanyakumari district. This paper explores the range of social security schemes specifically designed for women in Kanyakumari district, Tamil Nadu. These schemes, introduced by both central and state Governments, focused on providing financial aid, health care, educational support, employment opportunities and legal protection to women from diverse socio-economic groups. The study also highlights the challenges in implementation and suggests ways to improve the effectiveness of these welfare measures. In Kanyakumari, women benefit from a wide range of initiatives such as widow pensions, maternity assistance, marriage support, self- help group financing, free transportation, and skill development initiatives. These efforts have contributed to notable progress in women's living standards, independence, and social inclusion. Despite these advancements, challenges remain in terms of awareness, accessibility and administrative efficiency. This paper aims to highlight the significance, outcomes and existing gap in the delivery of women-focused social security programs in Kanyakumari district, offering recommendations for more inclusive and effective policy execution.

Keywords: *Empowerment, Implementation, Inclusive, Maternity, Execution.*

Introduction

Women in Kanyakumari district, known for their educational advancement and socio political participation, still face challenges in economic independence, health care and safety. To address these concerns, both the Central and State Governments have implemented various social security schemes. These programs not only uplift women from poverty and vulnerability but also enable them to lead self- sufficient and dignified lives [1].

Objectives of the Schemes

- Alleviate poverty among vulnerable women.
- Promote education and skill development.
- Support women-headed households.
- Provide health and social protection.
- Empower women through self-reliance.

Mathodology of Study

The methodology adopted for the study on "social security schemes for women in Kanyakumari district" is descriptive in nature, aimed at understanding the level of awareness, accessibility, and impact of various government welfare programs among women. "The study was conducted in selected urban and rural areas of the district using stratified random sampling" to ensure representation from different socio-economic backgrounds. Both primary and secondary data were collected. A mixed-method approach, combining both qualitative and qualitative research method was adopted for a comprehensive understanding of the subject.

Major Social Security Schemes

In Kanyakumari district, multiple major social security initiatives have been implemented to empower and support women, especially those from disadvantaged communities. Key programs include the Tamil Nadu Marriage Assistance Schemes, which provides monetary aid to encourage girls to pursue higher education, marriage of poor women, and the Cradle Baby Scheme, aimed at preventing female infanticide. The Moovalur Ramamirtham Ammiyar Higher Education Assurance Scheme offers financial assistance to encourage higher education among girls. Additionally, women benefit from Self-Help Group programs, which promote financial independence through microcredit and skill development. These initiatives collectively aim to enhance the social, educational and economic well-being of women in the district [2].

Educational Support

In Kanyakumari district, women benefit from a range of educational support and social security schemes spearheaded by the Tamil Nadu Government. Under the Pudhumai penn (Moovalur Ramamirtham Ammaiyar Higher Education Assurance) scheme, girls who studied from classes 6 -12 in Government schools receive 1000/ month until completion of their under graduate, Diploma or ITI programs. Minority Community women can access Pre- and Post-MATRIC Scholarship, with facilities across the district. The Sathiyavanimuthu Ammiyar Sewing-Machine Scheme offers free tailoring machines to widows, deserted, differently-abled and economically challenged women to aid self-employment. Additionally, there are 28 working women hostels providing secure, affordable lodging and district level Service Homes offering training, education support and necessities to destitute women and adolescent girls. Collectively, these schemes empower women through financial aid, education, vocational training and essential social security [3].

Financial Assistance Schemes

In Kanyakumari district, various financial assistance schemes are implemented to support women's economic empowerment and upliftment. These include government programs like "The Tamil Nadu State Rural Livelihood Mission (TNSRLM), which promotes women's Self Help Groups" by providing credit, subsidies and training for income-generating activities. The Mahalir Thittam Scheme plays a vital role in enabling women to access microfinance and entrepreneurship opportunities. Additionally welfare schemes such as widow pension, marriage assistance for poor girls and maternity benefits offer crucial support to women from marginalized communities [4]. These initiatives aim to enhance financial independence, reduce poverty and promote inclusive development among women in the district.

Health and Maternity Schemes

In Kanyakumari district, women benefit from a strong mix of central and state health and maternity programs aiming to ensure safe pregnancies, institutional deliveries and newborn care. Under Janani Suraksha Yojana, pregnant women receive free delivery (included C-Sections), medicines, diagnostics, diet, blood and transport services, alongside cash incentives of 700/ in rural areas and 600/ in urban ones. At the state level, the "Dr Muthulakshmi Reddy Maternity Benefit Scheme" provides up to 18,000 per pregnancy. In scheduled installments and improved newborn care kits. Additionally, Siddha-Based Magaperusanjeevi kits promote maternal and infant health, while tribal-focused initiatives ensure antenatal screening for hemoglobinopathies. Moreover, district health centers including the Kanyakumari medical college hospital are empaneled under the Chief Minister's Health Insurance Scheme, ensuring comprehensive obstetric and neonatal care at no cost. Together, these schemes significantly improve maternal and infant health access and outcomes [5].

Skill Development and Employment

In Kanyakumari district, several schemes support women's skill development, employment and social security. Programs like "The Tamil Nadu State Rural Livelihood Mission" help form and support Self Help Groups, offering training, financial aid and bank linkages for small businesses. Government ITIs and skill centers provide vocational training in areas like tailoring, computer skills and handicrafts. The women's employment and protection schemes promotes job opportunities in various sectors with added support like childcare facilities, social security schemes such as widow pensions, free sewing machines and housing support help women in need lead stable and independent lives. These initiatives aim to make women self-reliant [6].

Protection and Legal Aid

In Kanyakumari district, women have access to robust protection and legal aid services alongside essential social security schemes. The SAKHI One-Stop Crisis Centre provide immediate support medical, legal, psychological counseling, shelter and police assistance for survivors "of domestic violence, sexual assault, trafficking and other abuses." Under "the protection Women from Domestic Violence Act", district level protection officers help file FIRs, issue protection, residence and monetary orders and facilitate temporary custody and compensation [8]. These integrated efforts equip women with protection, justice access and a path to self-reliance.

Shelter and Vocational Support

In Kanyakumari district, women in vulnerable circumstances are supported through shelter, vocational training and social security initiatives. The Government Service Homes offer safe housing, meals, medical care, education and vocational skills such as computer training, spoken English and trades such as appliance repair and plumbing these homes also provide financial aid for ex-residents pursuing higher studies. NGOs and community centers, such as MSPC, offer free vocational courses in tailoring, computing, spoken English and arts & crafts, helping women gain self-employment opportunities [9]. Together these combined efforts offer women in Kanyakumari crucial shelter, practical skills training and tools to achieve financial security and independence.

Women Helpline Services

In Kanyakumari district, women helpline services like 181 and the police emergency number 112, which provide immediate support for those facing violence or distress. The district also implements various social security schemes to empower and protect women, including the "Pradhan Mantri Matru Vandana Yojana" (maternity benefit), Chief Minister's Girl Child Protection Scheme, Widow Pension Scheme and Self-Help Group support programs [10]. These initiatives aim to ensure safety, financial stability and improve living conditions for women across the region.

Challenges

In Kanyakumari district, social security schemes for women face multiple challenges. Limited awareness about available schemes, especially in rural and coastal areas, which prevents many women from accessing benefits. Bureaucratic delays, lack of proper documentation and inadequate outreach by government departments further hinder implementation [11]. Additionally, social stigma and traditional gender roles often discourage women from seeking assistance or joining empowerment programs. Ensuring regular monitoring, improving

awareness and strengthening grassroots networks are essential to overcome these challenges and make the schemes more effective.

Suggestions

To enhance "social security schemes for women in Kanyakumari district", several measures can be taken. Increasing awareness through local campaigns and community outreach can help more women access these schemes. Simplifying the application process and ensuring timely delivery of benefits will encourage participation [6]. Strengthening partnerships with self-help groups, NGOs, and local bodies can improve last mile delivery. Regular monitoring, feedback from beneficiaries and Training programs for Government staff will also improve the efficiency and reach of these schemes, resulting in greater empowerment and protection of women in the district.

Conclusion

The "social security schemes for women in Kanyakumari district" have created a foundational platform for empowerment and upliftment. However awareness and accessibility remain key challenges. Strengthening local level implementation, ensuring proper monitoring and encouraging women's participation in scheme design can enhance the overall impact. These welfare measures are not just economic interventions; they are steps toward gender justice and inclusive development.

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Progressive Strides and Patriarchal Realities: Status of Women in Early Buddhist Society

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ABSTRACT

This article explores the status of women in early Buddhist society, analyzing how Buddhist thought intersected with patriarchal tradition. While the doctrinal emphasis on individual spiritual potential fostered a new recognition of women's worth, persistent social structures limited its implementation. By examining canonical texts, historical narratives, and scholarly interpretations, this paper critically evaluates the role of Buddhism in advancing women's status and identifies the contradictions that impeded full gender equality.

Keywords: *Women, Buddhist society, social structures, family, salvation.*

Introduction

In the 6th century BCE, Indian society was deeply entrenched in hierarchical norms based on caste, gender, and ritual purity. The Vedic worldview placed women in a subordinate position, largely restricting them to domestic roles and denying them access to formal education or spiritual autonomy. The rise of Buddhism, under the guidance of Siddhartha Gautama marked a significant philosophical departure from these structures. This article seeks to examine how Buddhism addressed the status of women, both in principle and practice.

Methodology

This study employs a multidisciplinary and hermeneutic approach to examine the status of women in early Buddhist society, balancing textual analysis with socio-historical interpretation. The methodology is grounded in the following key components:

Textual Analysis: Primary Buddhist texts form the foundation of this inquiry Pali Canonical Literature: Special emphasis is placed on the *Vinaya Pitaka* (monastic code), *Sutta Pitaka* (discourses), and the *Therigatha* (verses of elder nuns). Sanskrit and Prakrit Sources: Where relevant, texts such as the *Mahāvastu* and *Lalitavistara* are consulted. Commentarial Literature: Later Theravada and Mahayana commentaries help trace evolving gender interpretations. **Analytical methods:** Close reading to identify representations of women. Discourse analysis to detect ideological patterns, patriarchal structures, and subversive voices. Comparative textual study to assess variances in gender norms across Buddhist schools and regions.

Historical and Sociological Contextualization. This study incorporates historical-critical analysis to understand how textual prescriptions aligned or conflicted with social realities: Use of epigraphic and archaeological records to map female patronage and visibility. Engagement with secondary historical works to interpret gender dynamics in early Indian society. Consideration of socio-religious norms from contemporary Brahmanical and Jain contexts to establish comparative baselines.

Historical Background: Women in Pre-Buddhist India

Prior to Buddhism, women's roles were primarily defined by patriarchal obligations: as daughters, wives, and mothers. The Dharmashastras emphasized obedience, purity, and the necessity of sons for family salvation. Education was rare, and widows faced severe restrictions, including practices like sati in later centuries. Marriage was considered a sacred duty, and a woman's identity was largely subsumed under that of her husband or son (Altekar, 1962). While there were some exceptionssuch as the Vedic composer Ghosha and philosopher Gargithese were rare, elite women who remained marginal to the mainstream narrative. It is against this backdrop that Buddhism's message of individual salvation offered a new perspective.[1]

The Buddha's Ethical Attitude towards Women

The Buddha's interaction with King Pasenadi of Kosala offers one of the earliest recorded statements advocating the value of female offspring. The king, upset that his queen Mallika bore a daughter, is gently corrected by the Buddha. Such a view was revolutionary at a time when daughters were often seen as burdens. It suggested that worth is not biologically determined but morally and spiritually cultivated. However, the uniqueness of this quote in the Tripiṭaka corpusand its absence elsewhere indicates that it may have been an authentic statement of the Buddha, later downplayed by more conservative monastic editors (Horner, 1930).[2]

Marriage, Polygamy, and Gender Roles

Buddhism neither explicitly abolished polygamy nor promoted monogamy. In practice, it coexisted with the institution of multiple marriages, often justifying them through the need for male heirs. Women like Mallika, wife of Bandhula, faced potential abandonment due to barrenness, echoing the patriarchal fixation on lineage. Interestingly, the Buddhist tradition discouraged compulsory adoption to ful fill funeral rites, which was a departure from Brahmanical customs. Instead, child adoption in Buddhismif it occurred was motivated more by compassion or familial continuation than by ritual necessity (Rhys Davids, 1909). This

marked a subtle but important shift in the valuation of women as individuals rather than merely as vessels of progeny.[3]

Co-Wives and Jealousy: Emotional Realities

The Buddhist texts do not shy away from depicting the emotional turmoil experienced by women in polygamous households. Co-wives often became rivals, and the absence of conjugal harmony led to distress and alienation. Though Buddhism encouraged detachment and inner peace, these teachings were aspirational and often difficult for laywomen embedded in societal expectations. The Pali Canon acknowledges that barren women sometimes brought second wives to ensure lineage continuity, yet this altruism often bred emotional suffering. The portrayal of such realities humanizes the struggles of women and challenges the romanticization of self-sacrificial virtue.[4]

Spiritual Liberation

The most transformative contribution of Buddhism was the creation of the Bhikkhuni Sanghathe order of ordained nuns. Though established reluctantly and only after repeated appeals by Mahapajapati Gotami (Buddha's foster mother), the order enabled women to pursue the path of Nibbana as equals to men. However, the Eight Garudhammas, or strict rules imposed on nuns, institutionalized a hierarchical structure. A nun must always defer to a monk, regardless of seniority. A nun must not scold a monk. A nun must confess offenses to monks bi-monthly, and so on. These rules reflected the patriarchal anxieties of the time, aiming to maintain monastic order rather than assert egalitarianism. Even so, the very possibility of female ordination marked a groundbreaking shift in religious access for women.[5]

Intellectual Women in Early Buddhism

Texts such as the (Therigatha Verses of the Elder Nuns) are some of the oldest female-authored literatures in the world. Women like Khema, Bhadda Kundalakesa, and Dhamma Dinna were revered not only for their meditative insight but for their ability to teach monks. Khema, originally a palace beauty, became a chief disciple of the Buddha and attained arahant ship. [6] Dhamma Dinna, a householder-turned-nun, was lauded for her deep understanding of Dhamma, and her conversations with Viakha are preserved in the Cuḷavedalla Sutta. These examples highlight that early Buddhist society, though structurally unequal, did provide spiritual and intellectual space for women.[7]

Societal Contradictions and Buddhist Limitations

While Buddhism sought to transcend societal categories, its institutional frameworks often accommodated the realities of its time. The continued justification for male heirs, the guarded stance on female ordination, and the monastic hierarchy all point to an incomplete

realization of gender equality. Moreover, later Mahayana literature occasionally portrays women as spiritually inferior or requiring rebirth as men to attain Buddhahood, although exceptions like Tara and Prajnaparamita show evolving views.[8]

Conclusion

Buddhism introduced a new moral and spiritual lexicon that challenged many gender-based discriminations of its time. Women were no longer passive dependents but active seekers of liberation. Nevertheless, Buddhism's revolutionary potential was tempered by the sociopolitical structures in which it operated. The voice of women while heard through the Therigatha and in rare canonical praiseremained constrained within a framework still largely defined by male authority. Understanding the nuanced contributions of Buddhism to women's emancipation requires both appreciation of its ethical vision and a critique of its institutional conservatism.

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Maramalai's Untapped Potential: Eco-Tourism, Conservation and Tribal Engagement in Tamil Nadu

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ABSTRACT

Eco-tourism has emerged as a vital approach for achieving both biodiversity conservation and sustainable local development. This study traces the trajectory of wildlife tourism in India, with a particular focus on its conservation-oriented impact. Emphasizing Tamil Nadu as a representative ecological landscape, the paper presents an in-depth case study of the Maramalai region within the Kanyakumari Wildlife Sanctuary. It critically assesses the ecological significance, socio-economic benefits, and policy frameworks shaping eco-tourism in this context. The involvement of indigenous communities, especially the Kani tribe, is explored, highlighting how their traditional ecological knowledge contributes to conservation efforts. Furthermore, the study outlines key challenges related to governance, infrastructural gaps, and policy enforcement. Supported by ten academic references, this paper offers a comprehensive analysis of the complex dynamics between tourism, indigenous stewardship, and environmental sustainability.

Keywords: *Eco-tourism, Wildlife Tourism, Biodiversity Conservation, Kani Tribe, Maramalai Estate.*

Introduction

India is one of the world's 17 megadiverse countries, with over 100 national parks, 500 wildlife sanctuaries, and several biosphere reserves that protect its rich biodiversity. These protected areas are vital for maintaining ecological balance, supporting endemic species, and providing essential ecosystem services.[3]

Wildlife tourism in India has grown from a recreational activity into a key conservation tool, generating revenue for park management, raising environmental awareness, and creating alternative livelihoods for local communities. Tamil Nadu, located at the southern tip of India, hosts important ecological zones such as the Western and Eastern Ghats, with protected areas including the Kalakkad-Mundanthurai Tiger Reserve and Mudumalai Wildlife Sanctuary. The Kanyakumari Wildlife Sanctuary, particularly the forested Maramalai region, remains less studied despite its ecological and cultural significance. [1]

This paper examines the role of wildlife tourism in conservation, focusing on Maramalai's ecological and socio-economic context. It explores indigenous community

participation specially that of the Kani tribeand analyzes challenges related to infrastructure, policy implementation, and habitat conservation. By integrating national trends with this local case study, the research highlights eco-tourism's potential as a sustainable development strategy in India's sensitive forest landscapes. [5]

Wildlife Tourism in India: Trends and Growth

Wildlife tourism in India has evolved significantly since the launch of Project Tiger in 1973, which laid the groundwork for conservation and public interest in biodiversity. This initiative marked the beginning of structured efforts to protect wildlife while encouraging nature-based tourism. Over the years, wildlife tourism has shifted from basic safaris to a more sustainable model aligned with ecological conservation and community development. Protected areas such as national parks, sanctuaries, and biosphere reserves now serve as major eco-tourism destinations. [1]

Key Trends

Eco-Tourism Circuits: States have developed linked routes connecting multiple reserves to balance tourist traffic and enhance visitor experience.

Community Involvement: Local and tribal communities participate in tourism through guiding, homestays, and handicrafts, supporting both livelihoods and conservation.

Public–Private Partnerships (PPP): Joint initiatives between governments, NGOs, and private operators promote responsible tourism infrastructure.

Digital & Policy Support: Online platforms and the draft National Eco-Tourism Policy have improved visibility and standardization in eco-tourism.[4]

The Role of Wildlife Tourism in Conservation

Wildlife tourism in India has emerged as a vital contributor to biodiversity conservation and sustainable development. It bridges ecological preservation with socio-economic growth, particularly in and around protected areas. [1]

A. Revenue and Park Management

Tourism generates critical funds through entry fees, safaris, and lodging, which support activities like anti-poaching efforts, habitat restoration, and wildlife monitoring. Many parks implement revenue-sharing models, channeling a portion of income to local communities and encouraging conservation-friendly livelihoods.[5]

B. Community Involvement

Local and indigenous communities increasingly play key roles in tourism serving as guides, hosts, and artisans. This participatory approach not only improves their economic well-being but also strengthens grassroots conservation ethics. Integration of traditional ecological

knowledge, especially in regions like the Western Ghats and Eastern Himalayas, enriches both tourism and biodiversity outcomes. [2]

C. Education and Awareness

Wildlife tourism fosters ecological literacy. Interpretation centers, eco-guides, nature walks, and school outreach programs raise awareness among tourists and local youth about biodiversity, ecological interdependence, and conservation challenges.

D. Research Support

Tourism often complements scientific inquiry. Activities like citizen science, camera trap monitoring, and volunteer tourism contribute valuable data for biodiversity research and park management.

E. Ethical Challenges

Despite its benefits, poorly managed tourism can lead to habitat degradation, wildlife stress, and cultural exploitation. Strict guidelines, visitor limits, and eco-certification standards are essential to ensure that tourism remains a tool for conservation not a threat.[6]

Tamil Nadu – A Conservation Landscape

Tamil Nadu, situated at the confluence of the Eastern and Western Ghats, is a key ecological zone within India's biodiversity map. Its varied landscapes ranging from tropical rainforests and grasslands to mangroves and dry deciduous forests support high levels of endemism and ecological richness. [2]

Areas and Biodiversity

The state hosts a robust network of protected areas, including:

KMTR (Kalakkad-Mundanthurai Tiger Reserve): Part of the Agasthyamalai Biosphere Reserve, known for its pristine tropical forests and endemic wildlife.

Indira Gandhi Wildlife Sanctuary: Located in the Anaimalai Hills, rich in large mammals and birdlife.

Mudumalai National Park: A critical corridor for elephant and tiger movement within the Nilgiri Biosphere.

Amirthi Forest Reserve: A smaller but vital Eastern Ghats habitat with ecological and local significance.

Kanyakumari Wildlife Sanctuary: Notable for the Maramalai region, combining biodiversity richness with tribal cultural landscapes.

Ecological Significance

Tamil Nadu's forests provide essential ecosystem services:

- Water Source Protection for rivers like Tamiraparani and Vaigai.

- Carbon sequestration and climate regulation.
- Habitat for over 3,000 plant species and hundreds of vertebrates.
- Support for pollination and soil stability, crucial for adjacent agricultural systems.[6]

Indigenous and Cultural Dimensions

Tribal groups such as the Kani, Irula, Toda, and Kurumba maintain traditional knowledge systems rooted in sustainable living. Their involvement in conservation enhances ecological stewardship and reinforces cultural continuity.[7]

Geographic and Ecological Significance

Maramalai Estate lies within the Kanyakumari Wildlife Sanctuary, itself part of the Agasthyamalai Biosphere Reservea biodiversity hotspot recognized internationally. The estate and surrounding forests are habitats for flagship species such as elephants (Elephas maximus), Bengal tigers (Panthera tigristigris), leopards (Panthera pardus), and the endemic lion-tailed macaque (Macaca silenus). Additionally, the area sustains numerous rare medicinal plants, integral to ecological balance and traditional healthcare.[3]

Indigenous Knowledge and the Kani Tribe

The Kani tribe inhabiting Maramalai are custodians of valuable traditional ecological knowledge. Their sustainable harvesting and use of Arogyapacha (Trichopuszeylanicus), a medicinal plant, have garnered scientific and commercial interest globally, exemplifying the potential for integrating indigenous wisdom into conservation and eco-tourism. [7]

Challenges in the Maramalai Region

Deforestation and Encroachments

Illegal encroachments, plantation expansions, and habitat fragmentation threaten the ecological integrity of the sanctuary, undermining conservation objectives.[8]

Tourism Pressure and Infrastructure Deficits

Despite its ecological value, tourism development in Maramalai remains nascent. The lack of eco-friendly infrastructure such as designated trails, interpretation centers, and effective waste management systems limits visitor experience and ecological sustainability.[6]

Policy Implementation Barriers

Policies like the Tamil Nadu Biodiversity Conservation and Greening Project (TNBCGP) aim to harmonize development with biodiversity protection. However, challenges such as administrative conflicts and inadequate local awareness hinder effective implementation. [9]

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Eco-Tourism Opportunities in Maramalai

Developing eco-tourism in Maramalai could:

- Provide sustainable livelihoods to the Kani tribe. [8]
- Promote conservation via guided biodiversity walks and forest trails.
- Engage tourists in participatory conservation activities including wildlife monitoring, seed collection, and habitat restoration.

Proposed initiatives include

- Establishment of tribal-run eco-lodges.
- Ethnomedicine awareness and knowledge-sharing programs.
- Nature interpretation centers to educate visitors on local ecology and culture.[10]

Recommendations for Sustainable Conservation

To ensure sustainable eco-tourism and effective conservation, it is essential to actively involve indigenous communities in both planning processes and benefit-sharing mechanisms. Local youth should be trained as eco-guides, naturalists, and conservation stewards to enhance their skills and create employment opportunities linked to environmental protection. Furthermore, eco-tourism initiatives must be aligned with existing biodiversity action plans and tribal welfare schemes to ensure policy coherence and inclusivity. Regular biodiversity assessments and visitor impact evaluations should be conducted to monitor ecological changes and manage tourist activities effectively. Additionally, widespread awareness campaigns promoting responsible and ethical tourism practices are necessary to reduce the ecological footprint and foster respect for natural and cultural heritage. [5]

Conclusion

Wildlife tourism, when sustainably planned and inclusive, plays a vital role in conserving biodiversity and uplifting rural economies. The Maramalai region, with its rich flora, fauna, and indigenous knowledge systems, presents a unique opportunity to develop eco-tourism that is both educational and conservation-oriented. Involving the Kani tribe in tourism and conservation efforts can foster cultural preservation alongside environmental protection. However, realizing this potential requires improved infrastructure, effective policy

implementation, and continuous monitoring to ensure ecological integrity. With the right balance of community participation, ecological sensitivity, and governance, Maramalai can emerge as a model for integrated conservation and sustainable tourism in Tamil Nadu.

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Trade and Commerce in Medieval India: Role of Indian Ocean Trade Networks

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ABSTRACT

This study explores the pivotal role played by Indian Ocean trade networks in the development of trade and commerce in medieval India, from roughly the 8th to the 18th century CE. India's geographical position enabled it to act as a central node in the transoceanic exchange of goods, culture, and ideas. Key port cities, merchant communities, and state patronage facilitated commercial prosperity across different dynasties. The paper also explores the socio-cultural exchanges and the eventual transformation of trade due to European intervention in the Indian Ocean world.

Keywords: *Port cities, Indian Ocean trade, Cambay (Khambhat), Maritime infrastructure, Warehouses and docks, Foreign merchants, Cosmopolitan culture*

Introduction

Medieval India was a dynamic commercial center situated at the heart of Indian Ocean trade routes that connected East Africa, Arabia, Persia, Southeast Asia, and China. These maritime networks facilitated not just the exchange of goods, but also the movement of people, technologies, religious beliefs, and artistic practices. The Indian subcontinent emerged as both a consumer and producer within this trading system. Coastal cities prospered, regional powers patronized maritime commerce, and vibrant merchant communities mediated intercultural encounters.

Port Cities and Maritime Infrastructure

India’s extensive coastline nurtured the growth of numerous port cities that evolved into strategic nodes in the Indian Ocean trading system.

On the west coast, Calicut (Kozhikode) emerged as a major hub for the spice trade, drawing Arab, Persian, and Chinese merchants to its shores. The city's prominence stemmed from its accessibility, rich hinterland, and the hospitable policies of the Zamorin rulers. Further north, Surat flourished under the Mughal Empire in the 16th century, developing into a prosperous port that facilitated commerce with the Persian Gulf and the Red Sea. The port of Cambay (Khambhat) in Gujarat became renowned for its production and export of jewelry, cotton textiles, and high-value artisanal goods, linking it closely with West Asian trade circuits.

On the east coast, Masulipatnam on the Coromandel Coast emerged as a critical textile export center, contributing significantly to global cloth markets. Meanwhile, Nagapattinam and Kaveripattinam, thriving under the Chola dynasty, maintained commercial relations with Southeast Asian kingdoms such as Srivijaya. These port cities boasted advanced infrastructure, including warehouses, custom houses, docks, and residential quarters for foreign traders. Their cosmopolitan character made them not only centers of trade but also cradles of cultural, religious, and linguistic confluence [1].

Trade Commodities and Routes

Medieval India's commercial strength was reflected in the diversity and value of its trade goods, both exported and imported. Exports from India included luxury items and everyday goods such as spices—notably pepper, cardamom, and cloves—which were in high demand across Europe and Asia. Textiles constituted another major export, particularly cotton from Gujarat and Bengal and silk from the Deccan. Additionally, India exported gems, indigo, ivory, and intricately crafted metal ware, earning it the reputation of a land of wealth.

Imports included horses from Central Asia and Arabia, which were vital for military purposes, as well as dates, wines, and perfumes from the Gulf and Persia. From East Africa came gold, slaves, and ivory, while silks and porcelain arrived from China. These exchanges were governed by the rhythm of the monsoon winds, which enabled predictable two-way navigation across the Indian Ocean, facilitating an efficient system of transcontinental trade (Chaudhuri, 1985). The monsoon-based maritime calendar became central to Indian and foreign merchants alike, reinforcing the seasonal logic of global commerce [2].

Merchant Communities and Trade Guilds

The efficiency and resilience of India's maritime trade were underpinned by the activities of well-organized merchant communities. Among indigenous groups, the Chettis, Marakkayars, and Komatis of South India engaged in both coastal and long-distance maritime commerce. In western India, Baniyas and Bohras played a crucial role in managing inland supply chains and overseas trade, particularly from Gujarat. These groups were supported by robust trade guilds such as the Ayyavole and Manigramam, which regulated trade practices, standardized weights and measures, and provided dispute resolution mechanisms. These guilds also contributed to religious and educational institutions, reinforcing their social standing (Mukund, 1999). Alongside them, foreign merchant communities from Arabia, Persia, Armenia, and the Jewish diaspora settled in Indian port towns. These traders often integrated into local society through marriage and long-term residence, contributing to the religious and

ethnic diversity of port cities. Their presence not only expanded India's trading reach but also fostered intercultural exchange and tolerance (Goitein, 1967) [3].

State Patronage and Commercial Policies

Indian rulers played a vital role in sustaining and expanding maritime commerce through protective policies, infrastructural investment, and diplomatic engagement. The Chola dynasty (9th–13th century) actively promoted overseas trade, building a formidable navy and undertaking maritime expeditions to Southeast Asia to safeguard commercial interests. Epigraphic records mention trading missions to Srivijaya and even Tang China, highlighting the transregional scope of Chola trade (Kulke & Rothermund, 2004). During the Delhi Sultanate, though predominantly land-oriented, the state controlled strategic coastal regions like Gujarat and Bengal, collecting maritime taxes and maintaining customs stations. Under the Mughal Empire, rulers such as Akbar and Jahangir issued farmans (imperial decrees) granting trading rights and protection to both Indian and foreign merchants. The empire invested in roads, caravanserais, and port defenses, all of which fostered commercial confidence (Subrahmanyam, 1990). Thus, state intervention was critical in ensuring the security and stability needed for flourishing long-distance commerce [4].

Cultural and Religious Exchanges

The Indian Ocean trade networks were not only commercial corridors but also conduits for cultural and religious exchange. One of the most significant impacts was the spread of Islam into coastal India. Arab Muslim traders who settled in Gujarat, Kerala, and Tamil Nadu formed enduring communities, such as the Mappilas of Malabar, who played a major role in trade and religious life (Wink, 1990). Port cities became melting pots of languages, cuisines, and architectural styles, with Chinese ceramics, Persian-inspired buildings, and Arab loanwords becoming common features in Indian coastal towns. This multiculturalism fostered relative religious tolerance, essential for facilitating peaceful trade interactions (Pearson, 2003). Intellectual exchanges were also notable. Indian advancements in mathematics, astronomy, and medicine traveled westward, while Indian artisans adopted new techniques and designs from Chinese, Arab, and African influences. These interactions enriched Indian society and further cemented its central role in the maritime world [5].

European Intervention and Transformation

The arrival of European powers in the Indian Ocean brought both opportunity and disruption to India's established trade networks. The Portuguese, who landed at Calicut in 1498 under Vasco da Gama, aggressively sought to monopolize spice trade routes using naval superiority. Their enforcement of the cartaz system, which compelled Indian ships to purchase

passes, marked the beginning of militarized control over commerce (Boxer, 1969). In the following centuries, Dutch, English, and French East India Companies arrived and established fortified trading posts in key port cities like Surat, Madras, and Bombay. These European entities leveraged both diplomacy and coercion to displace Indian and Muslim merchants from dominant positions in maritime trade (Prakash, 1998). By the 18th century, European powers had not only commandeered Indian trade but also redirected its profits to their own economies. The once self-regulating, pluralistic, and prosperous trade system of medieval India thus underwent a profound transformation, paving the way for colonial dominance and economic dependency [6].

Conclusion

The Indian Ocean trade network was essential to the commercial and cultural life of medieval India. Its port cities, merchant communities, and ruling powers together shaped an intercontinental exchange system that contributed to India's prosperity and diversity. While the arrival of Europeans altered the structure of trade, the legacy of India’s vibrant maritime past is still evident in its coastal cultures, diaspora communities, and historical consciousness.

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Importance of Ethics in Leadership

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ABSTRACT

Leadership and ethics are two significant and intertwined concepts increasingly discussed in academic forums and professional platforms. Universities across the world recognize both as distinct yet complementary disciplines, and research in these fields is expanding rapidly. Leadership, often experienced in daily life, becomes meaningful and transformative when guided by ethics. Various theoretical frameworks have shaped how scholars and practitioners interpret leadership and ethical practice. This paper delves into questions such as: Is ethical leadership straightforward or complex? What historical benefits and drawbacks can be observed? And how do leadership and ethics mutually influence each other? The goal is to help emerging and established leaders gain deeper insight and develop their own ethical approaches suited to diverse situations.

Keywords: *leadership, ethics, social transformation, human behavior, ethical dilemmas.*

Introduction

This paper seeks to explore how ethics and leadership intersect, reflecting on major leadership theories to illustrate this connection. It examines why individuals may fall short of ethical standards, despite seemingly simple ethical guidelines, and why complicity in unethical acts sometimes arises. Furthermore, it offers a perspective on how a thoughtful approach to ethics and leadership can guide vocational choices and sustain social change efforts over time.

Understanding Ethics

Ethics, like metaphysics, epistemology, and aesthetics, is a branch of philosophy that critically examines human actions and choices. It addresses foundational questions: Why do we act, think, or feel a certain way? What is morally acceptable or unacceptable? Because ethics centers on human conduct, it becomes an essential compass for everyone, especially leaders. [1] Ethical values also resonate deeply with religious teachings, as they encourage individuals to recognize goodness in others and aspire to lead with integrity.

Understanding Leadership

Defining leadership in a single, all-encompassing sentence has been historically challenging. Scholars have offered varied theories and models, but leadership remains a

dynamic human activity aimed at guiding individuals or groups toward shared objectives. [2] Even those with extensive leadership experience may struggle to define it succinctly until they study its theoretical underpinnings. As Ciulla (2005) suggests, leadership fundamentally involves influencing people toward a goal, shaped by the leader's values, vision, and context.

Leadership Theories: An Overview

Scholarly work highlights how leadership styles emerge within specific cultural and social contexts. Leadership is influenced by language, religion, and intercultural interactions, making it both a personal and collective phenomenon. Three notable relational leadership theories are discussed here: charismatic, transformational, and servant leadership.

Charismatic Leadership

Coined by sociologist Max Weber, charismatic leadership hinges on the extraordinary qualities of an individual perceived by followers as exceptional. [3] While it has inspired many, it also risks sidelining cultural and contextual factors, often assuming that leaders are naturally born rather than shaped by environment and collective action.

Transformational Leadership

Introduced by Burns (1978) and expanded by Bass, transformational leadership combines charisma with inspiration, individual consideration, and intellectual stimulation. Such leaders cultivate team commitment, challenge members to think creatively, and aim for collective growth, though sometimes at the expense of follower focus.[4]

Servant Leadership

Robert Greenleaf's (1977) model views leadership primarily as service. Servant leaders prioritize the needs of their followers, emphasizing empathy, listening, and community-building. Though effective for long-term engagement, it may not align seamlessly with business goals focused on rapid market success.

Together, these theories reflect that effective leadership is context-sensitive and deeply rooted in ethical values.[5]

Ethics as a Philosophical Framework

Philosophy prompts critical reflection on human values, and ethics guides leaders to act responsibly. Ethical theories help explain what makes an action right or wrong:

- **Utilitarianism:** Maximizing benefits and minimizing harm for the greatest number.
- **Deontology (Kantianism):** Following moral rules irrespective of consequences.
- **Social Contract Theory:** Acting according to principles agreed upon in an ideal rational dialogue.
- **Virtue Ethics:** Focusing on moral character rather than specific acts.

- **Feminist Ethics:** Highlighting care, empathy, and relational dynamics.

For leaders, these frameworks shape decisions that affect not just organizational goals, but the wellbeing of individuals and society.

Ethical Challenges in Leadership

Leaders must balance self-interest and collective welfare. History often remembers leaders who effect change, sometimes overlooking their ethical considerations. While the goal of leadership is change, ethical leadership ensures that such change benefits the common good.[6]

The difference between ethics and morality is sometimes described as the distinction between social norms and personal values, but both guide decision-making toward the greater good.

Ethical Decision-Making: Complexities

Ethical decisions often appear simple in theory but become complex in practice. For instance, choosing actions that do the least harm (a utilitarian approach) can conflict with other ethical priorities when context changes. Leaders often face dilemmas where instinct and reason may clash. As Bazerman (2020) notes, rational analysis generally leads to more objective decisions, though emotions inevitably play a role.

Value-Based Leadership

Leaders in diverse sectors must consider multiple perspectives when making decisions. For instance, a leader's pay raise might seem unfair until contextual factors reveal broader organizational benefits. Ethical leadership involves not just following rules but creating value for everyone involved, balancing short-term and long-term goals.[7]

Leadership, Ethics, and Social Change

Leadership is not merely about authority; it is an effort to bring positive transformation. Ethical leadership ensures this change is sustainable, inclusive, and just. Despite the many leadership theories available, charismatic, transformational, and servant leadership remain especially significant for practitioners aiming to balance organizational success with societal impact.

Conclusion

Leadership and ethics are deeply interconnected disciplines that together drive meaningful social change. Leadership, as a human-centered practice, becomes truly transformative when grounded in ethical values. Charismatic, transformational, and servant leadership offer diverse approaches, each with strengths and limitations. Ethical frameworks from utilitarianism to virtue ethics guide leaders as they navigate complex decisions. Ultimately, every leader must develop their own ethical lens to address unique challenges,

highlighting why leadership remains an art rooted in human judgment rather than a mechanical process.

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Sardar Vallabhbhai Patel and the Foundation of Indian National Unity

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ABSTRACT

Sardar Vallabhbhai Patel popularly known as the "Iron Man of India," was instrumental in unifying post-colonial India a nation fragmented by over 560 princely states at the time of independence. This paper explores Patel's vision, political acumen and administrative strategies that laid the groundwork for India's territorial integrity and national unity. Through a comprehensive analysis of his role in key state integrations, constitutional approaches and administrative reforms, the study evaluates Patel's legacy in nation building. It also reflects on the continuing relevance of his efforts in preserving the unity and sovereignty of modern India.

Keywords: *National Integration, Princely States, Instrument of Accession, Political Unification, Indian Federalism.*

Introduction

India's independence in 1947 came with the dual challenge of political liberation and national consolidation. With more than 560 princely states granted the freedom to accede to either India or Pakistan or remain independent the potential for territorial disintegration loomed large. In this volatile landscape, Sardar Vallabhbhai Patel emerged as a decisive statesman. As Deputy Prime Minister and Minister of Home Affairs, Patel's leadership proved pivotal in creating a politically unified Indian state. This paper examines his diplomatic finesse, constitutional foresight and administrative strategies that forged the backbone of a united India.

India's Political Landscape Post - 1947

"At the time of independence, India consisted of a complex mosaic of British-governed provinces and semi-autonomous princely states." The lapse of British paramount left these states in political limbo. Some rulers aspired to independence, while others hesitated to join either dominion. This fragmentation posed a grave threat to the survival of a coherent Indian state. The situation demanded immediate political consolidation a task Patel undertook with remarkable resolve and pragmatism [1].

Patel's Vision for Unity

Patel envisioned a strong, centralized India that respected its cultural diversity but functioned under a unified constitutional framework. He firmly believed that political

fragmentation would leave India vulnerable to internal conflict and external aggression. For Patel, integration meant not only merging territories but also fostering a collective national identity rooted in secularism, federalism, and democratic values [2].

Patel's vision for unity was rooted in the belief that a **centralized administrative structure**, functioning under a **unified constitutional framework**, was essential for nation-building. However, this centralization did not ignore India's rich cultural, linguistic and regional diversity. Instead, Patel advocated for a model of **"unity in diversity"** one that respected local identities while prioritizing national interests. Integration in Patel's view was not merely a matter of geographic consolidation. It was about creating a **shared national identity** an India bound by the principles of **secularism**, **federalism** and **democracy** [3].

He emphasized the importance of law, order, and institutional stability in building a nation where all citizens, regardless of background had equal stake and opportunity. Through pragmatic diplomacy, legal tools like the **Instrument of Accession** and strategic firmness, Patel managed to bring almost all princely states into the Indian Union. His efforts ensured that India did not begin its journey as a fractured state, but rather as a **sovereign, united republic**. Today his vision remains a cornerstone of India's political structure and a guiding light in times of regional and communal tensions [4].

Diplomacy and the Instrument of Accession

Patel's principal tool for achieving integration was the **Instrument of Accession**, which allowed princely states to cede powers related to defense, foreign affairs, and communications. With the assistance of V.P. Menon, Secretary in the Ministry of States, Patel combined diplomatic persuasion with subtle pressure. Most rulers, recognizing the inevitability of integration, signed the Instrument peacefully. Patel's emphasis on negotiation over coercion distinguished his approach from purely authoritarian tactics.

Strategic Integration of Key States

While most accessions were peaceful certain states presented complex challenges:

- **Junagadh**: Despite having a Hindu majority the Muslim ruler of Junagadh chose to accede to Pakistan. Patel countered this by initiating a plebiscite, resulting in Junagadh's accession to India.
- **Hyderabad**: The Nizam's desire for independence led to growing unrest. Patel initiated **Operation Polo** a swift police action that ensured Hyderabad's peaceful integration without widespread violence.

- **Jammu & Kashmir**: Following an invasion by Pakistani tribal forces, Maharaja Hari Singh acceded to India. Patel strongly supported this accession, although he was later sidelined from further negotiations.

These cases underscored Patel's commitment to legal mechanisms, national sovereignty and constitutional integrity [5].

Administrative Reforms and State Reorganization

Post-accession Patel embarked on the challenging task of administrative integration. He merged hundreds of princely states into viable administrative units such as the Saurashtra Union and Madhya Bharat and laid the foundation for centralized governance. His groundwork facilitated the States Reorganisation Act of 1956, which later redrew state boundaries along linguistic lines while maintaining national cohesion [6].

Patel's Enduring Legacy

Patel's contributions remain foundational to India's political unity and administrative coherence. His legacy is evident in:

- A strong and centralized administrative system.
- India's internal security architecture.
- The enduring symbolism of unity amid diversity.

Sardar Patel is rightly honored as the "Bismarck of India," a unifier whose actions preserved India's democratic potential [7].

Contemporary Relevance and Challenges

Sardar Vallabhbhai Patel's monumental efforts in integrating the princely states laid the structural and political foundation of a united India. However, the task of national integration is not a one-time achievement it is an ongoing process that continues to face complex challenges in contemporary times. India today grapples with issues such as **regionalism, ethnic and linguistic tensions** and occasional **separatist movements** that test the strength of its unity. Demands for greater state autonomy, identity-based politics, and conflicts over cultural and religious differences highlight the fragility of national cohesion in a diverse democracy. Despite these challenges, Patel's principles retain strong relevance. His emphasis on **constitutional negotiation, decisive leadership** and the unwavering **prioritization of national interest over individual or sectional gains** provide a valuable framework for addressing modern governance issues. His approach combined **diplomatic tact with political firmness**, reinforcing that unity must be maintained through both democratic consensus and strong institutional authority [8]

Patel's legacy reminds us that unity is not about uniformity it is about embracing diversity within a shared national purpose. In times of discord, his model offers guidance: uphold the Constitution, act decisively in the national interest, and strengthen institutions that bind the country together. As India continues to evolve, the vision of its foremost unifier remains a cornerstone for sustaining peace, stability, and integrity.

Conclusion

Sardar Vallabhbhai Patel's role in the integration of India is unmatched in the annals of modern Indian history. Through steadfast leadership, legal ingenuity and administrative innovation, he transformed a divided subcontinent into a single sovereign republic. His legacy serves as a blueprint for national unity reminding future generations that India's strength lies in its ability to unify, accommodate and evolve. As India continues to face regional and ideological challenges, Patel's example remains a powerful testament to the enduring values of unity, discipline and nationalism.

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Role of Women in Preserving and Transmitting Indian Knowledge System: A Historical and Contemporary Study

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ABSTRACT

This article explores the multifaceted role of women in preserving and transmitting Indian Knowledge Systems (IKS) across historical and contemporary contexts. While traditional narratives often underrepresent women's contributions, evidence from Vedic texts, oral traditions, spiritual literature, and indigenous practices reveals their deep involvement in shaping India's intellectual and cultural heritage. From ancient sages like Gargi and Maitreyi to Bhakti poets and tribal healers, women have played a crucial role in sustaining knowledge in philosophy, medicine, literature, and the arts. In the modern era, women continue to contribute as scholars, artists, educators, and digital content creators, helping to revitalize and disseminate IKS globally. Despite ongoing challenges such as gender-based restrictions and lack of documentation, the paper argues for the urgent need to recognize, archive, and empower women's knowledge contributions to ensure a more inclusive and holistic understanding of India's civilizational legacy.

Keywords: *Indian Knowledge Systems (IKS), Women and Knowledge Transmission, Oral Traditions, Indigenous Knowledge, Cultural Preservation.*

Introduction

India's civilizational identity is deeply rooted in its diverse and evolving knowledge systems, which span disciplines such as philosophy, science, medicine, arts, architecture, linguistics, and spirituality. These systems collectively referred to as the Indian Knowledge Systems (IKS) have traditionally been viewed through a male-centric lens, often overlooking the critical roles played by women in their preservation, transmission, and evolution [1]. Contrary to this narrow portrayal, women have historically served as vital custodians of knowledge whether as Vedic scholars, philosophers, poets, healers, artists, or oral tradition bearers. Their contributions, though frequently undocumented or marginalized, have ensured the continuity and adaptation of indigenous knowledge across generations. In the contemporary era, women continue to play an essential role in reviving, teaching, and innovating within IKS, using both traditional means and modern platforms [2]. This article seeks to examine the historical and ongoing contributions of women to Indian Knowledge Systems, analyzing their roles across religious, cultural, educational, and social domains. By highlighting both the

legacy and the present-day significance of these contributions, the study aims to advocate for a more inclusive and comprehensive understanding of India's intellectual heritage.

Women in Vedic Period

During the Vedic period (approximately 1500–500 BCE), women occupied a prominent place in the intellectual and spiritual spheres of society. Far from being passive observers, they actively engaged in the composition and interpretation of sacred texts. Notable female sages, or rishikas, such as Lopamudra, Gargi Vachaknavi, Maitreyi, and Apala, contributed hymns to the Rigveda, reflecting their profound spiritual insight and philosophical acumen [3].

Among them, Gargi stands out for her participation in the metaphysical dialogues recorded in the Brihadaranyaka Upanishad, where she famously questioned the sage Yajnavalkya on the nature of reality and the cosmos. Maitreyi, similarly, was a philosopher deeply engaged in the discourse on the self (Atman) and liberation (moksha). Evidence also suggests that women were not excluded from formal education during this era [4]. Practices such as upanayana (the sacred thread ceremony) and the acceptance of women in ashramas indicate that they had access to Vedic learning and spiritual instruction. This period reflects a time when intellectual merit, rather than gender, often determined one's access to knowledge. Classical and Post-Vedic Period [5].

During the classical era (500 BCE–1200 CE), while formal participation diminished due to evolving patriarchal norms, women continued to contribute through literature, music, dance, and healing practices. Andal, a Tamil Bhakti poetess, composed devotional hymns that are part of the Divya Prabandham. Avvaiyar, a renowned Tamil poet, promoted moral education through her works. Women in Buddhist monastic traditions, such as Mahapajapati Gotami and the Therigatha poets, documented early Buddhist teachings. Women also practiced and preserved Ayurveda and folk medicine, often passed through matrilineal traditions [6].

Women in Oral Traditions and Folk Knowledge

India's oral traditions form a crucial part of IKS, particularly in rural and tribal societies. Women have been the primary custodians of Folklore and storytelling: Grandmothers and mothers transmitted myths, Itihasa, and moral stories orally [7].

Folk music and dance

Art forms like Lavani, Baul, and Bihu often express philosophical themes and community knowledge.

Traditional medicine

Women have preserved plant-based medicinal knowledge used in childbirth, menstruation, and common ailments. In regions like Kerala, tribal women have continued the practice of vanaspati shastra (plant science) and pranic healing techniques [8].

Women in Formal Education and Literature

In ancient India, educational centers like Nalanda and Vikramashila were predominantly male spaces, but some women found ways to contribute. Women like Meerabai, Lal Ded, and Rabia al-Basri preserved spiritual knowledge through vernacular poetry and oral narratives [9].

Literary production

The Gita Govinda, while authored by Jayadeva, owes much of its performance tradition to female dancers and singers in Odisha's temples. Their influence continues in devadasi traditions, where dance was a form of sacred knowledge transmission [10].

Contemporary Role of Women in Indian Knowledge Systems

Modern India has seen a resurgence in women participating in formal knowledge systems: Scholars like Kapila Vatsyayan (classical dance and aesthetics) and Romila Thapar (history) have redefined Indian cultural and historical studies. Women are leading research in Ayurveda, indigenous technologies, and Sanskrit linguistics [11].

Cultural and Artistic Preservation

Women continue to be torchbearers of classical arts such as Bharatanatyam, Odissi, Kuchipudi, and Carnatic music, preserving intangible heritage. Gurus like Alarmel Valli and Sonal Mansingh have transmitted art as a spiritual and educational tool. In crafts like Madhubani painting, women not only preserve but innovate within traditional frameworks [12].

Digital and Educational Initiatives

Women educators and influencers are using platforms like YouTube and Instagram to teach Sanskrit, Vedic maths, traditional cooking and yoga. Organizations like the IGNCA and Ministry of Ayush now include many female researchers and practitioners [13].

Challenges Faced by Women in IKS

Despite their contributions, women face structural and societal barriers. Patriarchal norms limit women's access to priesthood, Vedic chanting, and temple rituals in many traditions. Lack of documentation of women's roles in folk and tribal traditions risks the erasure of their legacy. Limited representation in institutional and academic positions within IKS-related fields [14].

Recognizing and Reinvigorating Women's Roles

To foster an inclusive and dynamic Indian Knowledge System, it is vital to promote gender-inclusive policies in education and research institutions. Support community-based initiatives that empower women to document and teach local knowledge. Digitally archive oral histories, songs, and rituals performed by women to preserve their contributions. Empowering women to lead in IKS will not only correct historical oversight but also enrich India's intellectual and cultural future [15].

Conclusion

From ancient seers and poets to contemporary scholars and healers, women have played a profound role in sustaining and transmitting the Indian Knowledge System. Recognizing their historical contributions and empowering them in the present is essential for a holistic understanding and revitalization of India's knowledge heritage.

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Structure and Dynamics of Social Economy

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ABSTRACT

Economic activities are fundamental to human existence, encompassing the production, consumption, and distribution of goods and services. These activities form the backbone of the social economy, aiming to satisfy the material, spiritual, and cultural needs of society. Intricate interdependence within this system is evident when considering the multitude of individuals involved in creating everyday essentials, like a loaf of bread or a cotton shirt. Within the framework of globalization, economic collaboration is now much more important, with supply chains extending across nations and digital advancements connecting consumers and producers instantaneously. The social economy is not solely focused on production and consumption of goods and services, it also encompasses social welfare programs, cooperative enterprises, and community-based initiatives aimed at enhancing the well-being of society. As the global economy evolves, understanding the intersection of social justice, subsidiarity, and equitable resource distribution becomes essential for promoting sustainable growth and social harmony.

Keywords*: Social economy, economic cooperation, globalization, supply chains, digital connectivity*

Introduction

India's social economy is a complex interplay of production, consumption, and distribution processes designed in order to fulfill the diverse needs of its population. These processes are directed by the tenets of social justice and subsidiarity, which ensure equitable resource allocation and uphold individual freedoms within the societal framework. The Indian economic system reflects both traditional structures and modern industrial frameworks, where labour relations, wage systems, and social welfare programs play a pivotal role. The historical context of India's social economy reveals a gradual transition from agrarian systems to a mixed economy characterized by industrialization and service-sector growth. Historical experiences, such as the Green Revolution and the post-liberalization era of the 1990s, illustrate the nation's ability to reconcile social duty with economic growth. Furthermore, ensuring a just and equitable society is emphasized by constitutional duties, especially the Directive Principles of State Policy. The post-independence period saw significant legislative efforts to protect workers' rights and promote equitable wealth distribution. Additionally, the 73rd and 74th Constitutional Amendments strengthened local governance by empowering urban local

councils and Panchayati Raj institutions, encouraging community involvement and grassroots decision-making.

Objectives

1. **Examine the Role of Social Justice**: To analyze how social justice influences the distribution of resources and opportunities in India's economy.
2. **Assess the Subsidiarity Concept**: To evaluate the effect of decentralized governance on local economic development and individual empowerment.
3. **Analyze Resource Distribution Mechanisms**: To investigate the effectiveness of current policies in ensuring equitable distribution of wages, profits, and wealth.
4. **Evaluate Inflationary Trends**: To understand the reason and effect of inflation on different socioeconomic groups in India.
5. **Investigate Labour Legislation Impact:** To assess the part of labor laws in shaping industrial relations and ensuring that workers have equitable working conditions.
6. **Explore Historical Labour Movements:** To trace the assessment of labour movements and their impact on present labour policies and social welfare.

Methodology

This study employs a combination of quantitative data analysis and a mixed methodologies approach with qualitative assessments:

- **Data Collection:** To provide a thorough overview of India's economic statistics, secondary data was gathered from credible financial news sources, government papers, and economic surveys. This includes information from the National Sample Survey Office (NSSO), the International Labor Organization (ILO), and the Ministry of Labor.
- **Data Analysis:** Statistical tools were used to analyze trends in GDP growth, income distribution, wage patterns, and inflation rates, providing a comprehensive picture of the socio-economic landscape.
- **Qualitative Assessment:** In order to comprehend the theoretical foundations of social justice and subsidiarity in the Indian context, policy papers and historical case studies were examined. Interviews with labour economists and policy analysts also provided insights into the real-world implications of these principles.

Historical case studies of significant labour movements and legislative milestones were also examined to understand their long-term implications on industrial relations and social equity.

Social Justice and Economic Equity

The social economy is based on social justice, which promotes fair access to opportunities and resources [5]. In India, this is enshrined in constitutional provisions like

Article 39, which directs the state to guarantee that the distribution of material resources promotes the common good [3]. Despite notable economic growth, income and wealth disparities have widened. For instance, the top 1% of income earners now receive a substantial portion of total pre-tax income, and they control a significant share of the nation's wealth, while the bottom 50% possess a minimal percentage. The post-1991 economic reforms led to liberalization, privatization, and globalization (LPG), fostering rapid economic growth but exacerbating income inequality [9] [12]. Examples of government programs include the Public Distribution System (PDS) and Direct Benefit Transfer (DBT) aim to mitigate such disparities by ensuring access to necessary goods and financial assistance for marginalized groups [5].

To deal with these disparities, the Union Budget 2024-25 reflects a commitment to inclusive development through social welfare programs targeting rural employment, food security, and affordable housing. Programs such as the Pradhan Mantri Jan Dhan Yojana (PMJDY) have facilitated financial inclusion for millions of unbanked citizens and the PM-KISAN scheme provide direct financial assistance to small farmers [1], while the Public Distribution System (PDS) offers subsidized necessary supplies to millions of low-income families. Additionally, the Equal Remuneration Act (1976) ensures that women receive fair wages comparable to their male counterparts, reinforcing social justice and equity.

The Indian labor movement began during British colonial control in the 19th century and has since developed throughout many decades. While the first formal trade unions emerged only in 1920, workers' struggles for better wages and working conditions began much earlier. The Bombay Mill Hands Association (1890) is acknowledged as one of the earliest labour organizations.The labour movements of the 1920s and 1930s were intertwined with the freedom struggle, as labor leaders like N.M. Joshi and B.P. Wadia advocated for workers' rights. When the All India Trade Union Congress (AITUC) was foundedin 1920 marked a significant milestone in organized labour advocacy.

By 1947, with independence, labour unions gained significant momentum. Today, in existence of four All India Trade Unions representing approximately 25 lakh industrial workers, but the most of the employees remains unorganized. Agricultural labour, constituting 14 crores, lacks formal representation, contributing to socio-economic vulnerabilities.Landmark legislation, like the Industrial Disputes Act (1947), was introduced to address employer-employee conflicts. However, the politicization of trade unions has sometimes hindered their effectiveness, making labor reforms an ongoing necessity.

Subsidiarity

The idea of subsidiarity highlights the need for decisions to be taken at the level closest to the resolution [5]. In India, this is reflected in decentralized administration using Panchayati Raj establishments, which empower local bodies making decisions on community welfare [1]. This framework facilitates grassroots development and addresses local socio-economic concerns more effectively than centralized governance [3].

Initiatives like "Make in India" have fostered local enterprise and manufacturing, leading to increased domestic production and exports [12]. Additionally, the Smart Cities Mission exemplifies subsidiarity by allowing local governments to design urban solutions tailored to their communities' unique challenges. Through these decentralized frameworks, communities can take greater ownership of their economic development, fostering both accountability and sustainable progress. Success of decentralized government is evident in Kerala's People's Plan Campaign (1996), which empowered local bodies to formulate and implement development plans [5]. However, disparities in resource allocation between rural and urban areas remain a challenge.

Distribution of Resources

Equitable distribution is integral to social justice. Economic theory traditionally categorizes production into four factors: land, capital, labor, and enterprise, corresponding to rent, interest, wages, and profits [11]. While rent and interest rates are typically regulated, wages and profits require careful management to ensure fair compensation. In India, schemes like the MGNREGA aim to provide wage security and reduce rural poverty by offering 100 days of employment annually [4]. However, wage disparities persist, highlighting the need for more robust enforcement and periodic revision of minimum wage laws. Regional imbalances in resource allocation further exacerbate inequality, necessitating targeted policy interventions and greater fiscal devolution to underdeveloped areas [1].

Wages

Wages are a critical aspect of the social economy as they directly impact workers' livelihoods. A fair pay should provide an acceptable standard of living for employees and their families [9]. The concept of a "living wage" extends beyond mere subsistence to encompass a standard of frugal comfort. The Code on Wages of 2019 was introduced in Lok Sabha by the Minister of Labour, Mr. Santosh Gang war on July 23, 2019. It tries to control wage and bonus payments in all jobs that involve any industry, trade, company, or manufacturing. The Code supersedes four laws: (i) the Payment of Wages Act of 1936; (ii) the Minimum Wages Act of 1948; (iii) the Payment of Bonus Act of 1965; and (iv) the Equal Remuneration Act of 1976.

Historical wage regulations, such as the Payment of Wages Act (1936) and the Minimum Wages Act (1948), laid the groundwork for modern labor protection. Yet, many workers remain underpaid despite legal frameworks. The Economic Survey 2024-25 emphasizes the government's commitment to inclusive growth, focusing on employment generation and skill development. India's new Code on Wages (2019) consolidates multiple labor laws to streamline wage regulations and ensure timely payment for all workers [1]. However, its implementation remains inconsistent, especially in the unorganized sector, which employs over 90% of the workforce [9].

Principles of Labour Legislation

1. **Social Justice:** Industrial social justice involves the equitable distribution of profits and benefits and the protection of workers' health and safety. For example, the Workmen's Compensation Act (1923) ensures injured workers receive adequate compensation, while the Factories Act (1948) mandates safe working conditions.
2. **Social Equity:** Labour laws must evolve to address contemporary challenges. The Payment of Wages Act of 1936 reflects both social justice and equity by ensuring timely and fair wage payments.
3. **International Uniformity:** India aligns its labour policies with global standards through the International Labour Organization, which promotes for fair labor practices across nations.
4. **National Economy:** Effective labour policies enhance national economic stability by promoting harmonious employer-employee relationships. This reduces industrial disputes and fosters productivity.

Profits and Wealth Redistribution

The principle of social justice extends to profit distribution. Profits are the reward for entrepreneurial risk and managerial skill, but ethical considerations demand that workers receive a fair share of the wealth they help create [11]. While India's Industrial Disputes Act (1947) provides for bonus payments linked to company profits, compliance remains inconsistent across industries. Cooperative models, such as the Amul dairy cooperative, demonstrate how collective ownership and profit-sharing can enhance social welfare and reduce wealth concentration [3] [10].

Inflation

Inflation, the sustained rise in the general price level, poses significant challenges to economic stability [2]. It erodes purchasing power, disproportionately affecting low-income households. In India, the Reserve Bank of India (RBI) monitors inflation using its monetary policy

framework, with the goal of keeping inflation within the 4% target range. Persistent inflation reduces fixed-income households' purchasing power, necessitating government interventions such as the Public Distribution System (PDS) to provide discounted food grains to disadvantaged communities [1]. Inflation rate in India decreased to 4.3 percent in January from 5.22 percent in December 2024. The monetary policy framework for 2024-25emphasizes on maintaining price stability while promoting economic growth [2]. To mitigate inflationary pressures, the Reserve Bank of India has implemented interest rate cuts, aiming to balance economic growth with price stability.

Conclusion

India's social economy stands at a pivotal juncture, with significant economic advancements juxtaposed against persistent inequalities. Upholding the principles of social justice and subsidiarity is important for promoting equitable development and sustainable growth. Policymakers must ensure fair wage practices, equitable resource distribution, and robust social welfare programs to bridge the socio-economic divide. By strengthening local governance and implementing targeted economic policies, India can achieve a balanced approach to economic growth while safeguarding social equity. Future policy recommendations should focus on bridging the space between organized and unorganized labor by ensuring strong legal systems to safeguard informal workers. Digital innovations like the e-Shram portal can enhance the visibility and welfare of unorganized labour. Furthermore, fostering public-private partnerships (PPPs) can enhance social welfare delivery systems and improve access to essential services. By promoting cooperative models and community-based initiatives, India can better address the socio-economic vulnerabilities of its diverse population.

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The Cartoon Connection: A Study on the Impact of Cartoons on Grammar and Vocabulary Development

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ABSTRACT

Education as a field has underwent changes over decades. New methods, inventions and techniques have elevated the process of learning to the next level. Cartoons as an edutainment provide the viewers with insights on knowledge and language. Acquisition is a subconscious process through which one acquires one's mother tongue. English as a language can also be acquired if the language is imbibed involuntarily. The paper entitled The Cartoon Connection: A Study on the Impact of Cartoons on Grammar and Vocabulary Development deals with the role of cartoons in enhancing grammar and vocabulary. The paper further explores the learner psychology in acquiring a language and its impact in improving language skills. Grammar and good vocabulary paves way for better communication. The aim of the study is to identify the impact of cartoons in education. A quantitative research was undertaken to analyzelearners from various disciplines of arts and science aged between 17 and 19. The study and the results are drafted based on their responses.

Keywords: *Acquisition, cartoons, grammar, language learner, vocabulary*

Introduction

Transforming ideas and thoughts from one person to other person through verbal and non-verbal cues is communication. It helps in maintaining a good relationship among people and aids in understanding and connecting people. Good communication bridges the gap between individuals. Language plays a vital role when it comes to effective communication. It helps in sharing one's thoughts and notions with others and it is important to encode and decode ideas between sender and receiver and to provide proper feedback. Language connects people from different countries, societies and identities. It supports in education, where acquiring and learning take place. The four basic skills Listening, Speaking, Reading and Writing are also acquired through language. English is the third most spoken language in the world. English is considered as the universal language, which makes the communication part easier. English is a link language which joins people from various parts of the world. Grammar and vocabulary plays a major role when it comes to effective communication.

Objective

The research studies

- the impact of cartoons in developing vocabulary and grammar skills.
- cartoon as a form of edutainment wherein language acquisition takes place subconsciously.

Methodology

A questionnaire was prepared using Google forms and circulated among the first year Under Graduate students of arts and science disciplines. Sixty learners' responses were collected and the results were analyzed.

Review of Literature

Muhammad Farriz Bin Aziz (2021) in "English Major Students' Perceptions of Using Animated Cartoons on English Vocabulary Knowledge of Rare Words in Malaysia" [5] illuminates the English major students' views on incorporating cartoons for vocabulary learning. An interview based on the students' interest towards using animated cartoons as material was conducted. The learners have showed significant improvement in learning rare vocabulary. This study further suggests that animated cartoons could be used effectively in the process of education for a better result.

Zülal Ayar (2020) in "The Effects of Cartoons on the Use of Vocabulary Learning Strategies: A Case in Turkish EFL Classes" [4] aims at identifying the effects of cartoons in vocabulary learning. Random people of varied age groups are chosen and were put into two groups - controlled and experimental groups respectively. Results varied with respect to the gender and age groups. Additionally, the survey also segregates the difference in learning strategies among the individuals using cartoons for vocabulary learning.

Abilasha R (2019) in "Enhancing Language Skills at the Primary Level through Cartoons" [1] explains how language skills can be enhanced at the primary stage using cartoons as an effective tool. The paper also widely explores the methods of enhancing language skills through cartoons in children at a young age. In "Enhancing Second Language Skills Using Multimedia" [2] the author further expands the idea of using multimedia platforms as a tool in improving language skills.

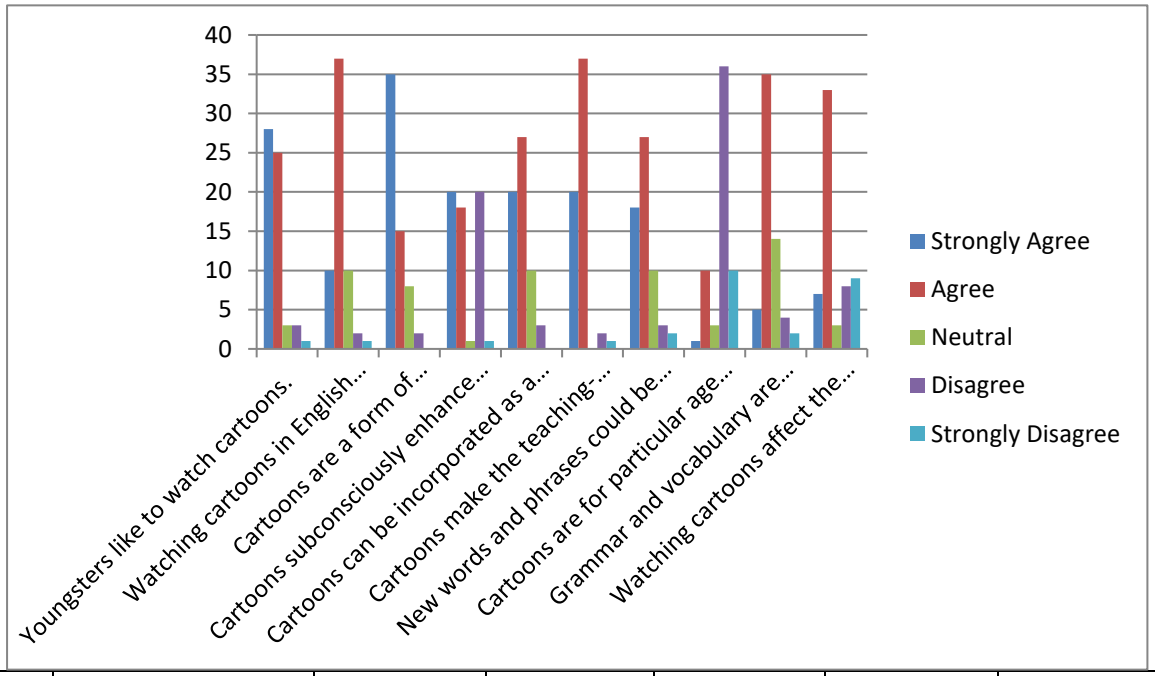
Arda Arikan (2010) in "Contextualizing young learners' English lessons with cartoons: Focus on grammar and vocabulary" [3] explains in detail about the efficiency of cartoons in teaching grammar and vocabulary to young learners. Thirty IV grade students were divided into two groups. One group was taught grammar using conventional classroom technique, while the others were exposed to a cartoon called "The Simpsons". The results proved that the experimental group outsmarted the controlled group of students. Thus the paper visibly states that cartoon as a teaching material enhances the learners' competency.

Grammar and Vocabulary

Grammar and vocabulary are two important areas an individual could concentrate, when it comes to language acquisition. It is also the section which any learner finds difficult to learn. The grammatical concepts and rules are to be taught and practiced frequently in order to have a bigger hand in the language. Cartoons could be used as a teaching material in grammar and vocabulary learning. In comparison to the conventional setting, where the learners are taught the rules through oral classes, cartoons make the difference by subconsciously enhancing the process.

Analysis

The need of the hour is to focuson the under graduate learners' language skills. The necessity to learn the skills are more for the first years, since they come from both Tamil and English medium schools. The questions and the responses are given below in the form of a table.



Sl. No.	Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	Youngsters like to watch cartoons.	28	25	3	3	1
2	Watching cartoons in English language	10	37	10	2	1

	is the favourite entertainment.					
3	Cartoons are a form of edutainment.	35	15	8	2	0
4	Cartoons subconsciously enhance language skills.	20	18	1	20	1
5	Cartoons can be incorporated as a part of the teaching-learning method.	20	27	10	3	0
6	Cartoons make the teaching-learning process stress-free.	20	37	0	2	1
7	New words and phrases could be learnt from cartoons than in conventional classroom.	18	27	10	3	2
8	Cartoons are for particular age groups.	1	10	3	36	10
9	Grammar and vocabulary are made easy with the incorporation of cartoons in teaching.	5	35	14	4	2

10	Watching cartoons affect the behavior of an individual.	7	33	3	8	9

Findings

- Cartoons are not for a particular age group but for varied age groups.
- Learners like to watch cartoons in English language.
- The impact of cartoons in the behaviour of an individual is an accepted fact.
- Cartoons could be incorporated in the teaching-learning process, as it makes the process easier.
- It is certainly a form of edutainment as it also enhances the grammar and vocabulary knowledge of the learner subconsciously.

Conclusion

Language acquisition takes place through various modes and medium. The crucial areas, grammar and vocabulary are majorly learnt in conventional classrooms. This study paves way for the educationists to incorporate cartoons as a material in the process of learning grammar and vocabulary. It also further discloses the minds of the learners with respect to watching cartoons. Through a questionnaire circulated among the first year under graduate students of varied disciplines, it is evident that cartoons not only entertains the audience but also educates them subconsciously. Education has evolved and therefore the process through which it is taught has also been evolving. The current trend is to adapt to the new technologies which can make the process easy and really quick.The benefits that pupils attain from cartoons are not only limited to better communication and writing, but also help the young learners in creative and innovative thinking. It opens doors for cognitive thinking.

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Discovering Self through Nature: An Ecological Reading of Easterine Kire's *When the River Sleeps*

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ABSTRACT

"Discovering Self through Nature: An Ecological Reading of Easterine Kire's When the River Sleeps" presents nature as a source of discovering oneself. This paper proclaims the faith of the author that a contemplation of nature can lead a man to the transcendental world. A person reconciles with nature not only to feel joy but also to derive meanings from various objects of nature. Nature has taught man to know the divinity in him, the source of his inspiration and vital knowledge. He drinks in the beauty and power of nature through all the senses of physical, emotional and intellectual. An understanding of nature and its spiritual dimension brings different perspectives on living in the world connecting earth to a larger cosmic realm. The world of nature always encourages explorations of consciousness.

Keywords: *nature, cosmic, mysterious, mystical, magical*

Nature is a living entity that plays a very significant role in shaping the physical, emotional and spiritual ideas of human beings. Humans are part of nature, indivisible from it. Human beings cannot survive in this world without the presence of nature. But in today's world, without any concern and awareness man destroys nature. The development of science and technology, has increased the destruction of nature. This is because the modern technology has invaded into the purities of nature. Writers like Kire want to create awareness to the people for which they produce works which expose the significance of human-nature relationship.

Kire, with keen ecological consciousness, shows deep concern on the endangered environment. The special value of Kire, in the novel, lies in the relationship between nature and human in the technological society. Kire uses nature as a source for human beings to discover themselves. The novel has a powerful element of nature in its framework comprising of the whole landscape in human terms with a narrative. Marilynne Robinson considers the role of landscape as fundamental because it plays an important role in shaping the development of self of any person. In her essay entitled "Wilderness" Marilynne Robinson writes:

> In fact, I started writing fiction at an eastern college, partly in hopes of making my friends there understand how rich and powerful a presence a place can be which, to their eyes, is forbidding and marginal, without population or history, without culture in

> any form recognizable to them. All love is in great affliction. My bond with my native landscape was an unnamable yearning, to be at home in it, to be chastened and acceptable, to be present in it as if I were not present at all. (246)

Engaging with nature can help individuals peel away societal masks and connect to a more authentic sense of being. Yet, some critics point out that this often involves a kind of escape from reality, ignoring social and political struggles in favor of solitary reflection. *When the River Sleeps*, narrates the story of Vilie, who expresses his belief in an untouched natural world and the human beings' lack of understanding of its sacredness. Simultaneously, he embarks on the journey of self-discovery, which he believes, can happen only in the wilderness. For the protagonist, Vilie, nature acts as an entrance into a new personal world while revealing its inseparability from him. Nature plays a significant role in the development of the character, Vilie. Vilie who goes into the woods to find heart-stone, senses his own identity which is hidden. He is determined to catch the river in its sleep, because he has been seeing it in his dreams for almost two years. The dream is about a heart-stone which lies in the sleeping river bed. If the stone is removed from the river bed and taken home, the heart-stone will grant all the wish of the person who takes the stone.

The journey is not an adventurous one, but it is a man's journey from ignorance to experience. Vilie aims to possess the heart-stone to attain the power of it. He begins the journey just to find the mysterious river because he is fascinated by the sleeping river and finally it becomes an obsession to him. "Vilie was fascinated by the tale of the sleeping river. It was more than a story to him. He wanted more than anything to find the mysterious river, and 'catch it' when it went to sleep. Nothing else matter to him. At least that was how he felt these days. It had become an obsession" (2).

In the first day of the journey he covers a good distance and when the sun is closed to setting he finds a shed which belongs to a Zeliang man. He finishes his dinner and goes to sleep. In the midnight when he is asleep a "weretiger" attacks him. Vilie shoots the weretiger and the tiger leaps away into the night. But the tiger again returns and starts attacking him. This time Vilie feels that it is not an ordinary tiger but a "weretiger". "The folk practice of certain men transforming their spirits into tigers was a closely guarded art" (25). When he knows that it is a "weretiger" he talks to the tiger and explains it that he is not there to harm it and finally the tiger leaves him.

The next day, he reaches the little forest, where he meets two young girls and an older woman collecting nettles in the forest. The old woman tries to teach him how to pluck the nettle but he gets stung by a thorn. Soon the old woman plucks one medicinal leaf and she takes the

juice out of it and places it near the wound. The old woman is just a stranger to him but once he gets stung she treats him first aid and cures him. This makes Vilie happy and he departs from them and again he starts his journey.

The next day he reaches a valley and he meets on the way four hunters and joins with them for shelter. In the night after their dinner, except the two brothers Hiesa and Pehu, the others have gone to bed. In the midnight the two brothers started arguing and finally the argument ends in a murder. Hiesa shoots Pehu in anger and he dies which is witnessed by Vilie. Hiesa tries to shoot Vile because he witnesses the murder but Vilie runs away from the place and escapes from Hiesa. Vilieis arrested by the villagers for the murder of Pehu. Hiesa blames Viliein order to escape from the villagers.

The villagers arrest Vilie and beat him up and then they come to know that Vilie is the guardian of Gwi. So, they let him go and ask him for apology. He feels shocked on this incident and he feels restless until he sleeps under the leafy roof. When people who falsely accused him of murder are hot on his trail he seeks refuge in the forest and thinks, "On his return, he felt safe enough to stretch out under his leafy roof. The forest was his wife indeed: providing him with sanctuary when he most needed it; and food when his rations where inadequate. The forest also protected him from the evil in the heart of man he felt truly wedded to her at this moment"(51).

Vilieis again back on his track and on the way he meets some villagers. Among them one woman whose name isSubale invites him to her house. Subale's husband is the headman of the village. Vilieacceptes her offer and follows her. There he meets Kani, Subale's husband who is a fisher man. Vilie shares his dream about the heart-stone to him. Kani offers him that he will lead Vilie to the sleeping river the next day. Vilie and Kani next day start the journey to the sleeping river. They travel a long distance and reach the sleeping river and they wait for the river to sleep in order to take the heart-stone. When the river is asleep Vilieplucks the heart-stone from the sleeping river and tries to escape from it. But the widow spirits chase Vilie and Kani and they run very fast. Suddenly Kani spells some names for which the widow spirits move back and Kani and Vilie escape from them and possess the heart-stone.

Zote is a 'Kirhupfumia', a woman who has the power of maiming, blinding or killing people simply by pointing at them with their fingers. She has been exiled from her ancestral village, and so, to take revenge she snatches away the heart-stone from Villie and uses it for the destruction of the village. But soon, she meets her tragic end when the ancestor spirits of the village appear to punish her. "The spirit-warriors seemed to have assembled from the charred remains, and formed a column, marching slowly but deliberately to the hall. Zote

turned at the sound of spears. As the warrior chant begun, Zote's face confronted and grew dark . . . The warriors kept marching toward her, ululating at intervals but never breaking their pace" (158).

Ate is Zote's younger sister. They live together in the village. Ate believes that she too has the power same like Zote. Because zote makes Ate believe that she too has the power which makes Ate live a lonely life to keep her self away from harming human beings. Vilie makes Ate feel that she is a human being and can't harm anyone with the help of the heart-stone. Vilie keeps the heart-stone in her hand:

> Vilie suddenly reached into his bag and pulled out the heart-stone. He held it up to the light in the room and said, "Here is the stone!" The heart-stone caught the light from the fire and reflected it back in its purple surface. He heard her gasp at the sight . . . he reached out to pull her hand and lay the stone in her palm. She slid the heart-stone up and down her palm and marveled it. "It's burning me a little. Just a little. It feels good. Like a cleansing" She still held the stone in her hand, her eyes closed and her whole face glowing with joy . . . I touched your hand and yet you did nothing to me. (138)

This incident makes her feel that she is a human. She discovers herself as a human being with the help of Vile and the heart-stone. Vilie decides to take Ate with him to the village where the women work in the nettle field and to make her stay with them. So he asks her to pack things needed for her fresh new life. The next morning Ate packs very few things and appears before Vilie. When they reach the nettle forest, Vilie gets to know that the woman whom he met in the nettle forest is passed away. So he decides to take Ate to his house. Vilie brings Ate to his village and makes her stay with his aunts. Knowing that the forest is unsafe for her she settles her in his ancestral village with his aunts and gives her the heart-stone. He hands over the heart-stones to her. She doesn't accept that but Vilie forces her to accept that by thrusting it on her palm, "Vilie held the stone up to the light again. It glinted in red, gold and purple lines. The red was a dark red, a rich deep shade of red" (222). Back in his home at the heart of the forest Vilie is brutally murdered by a man who coveted the stone to attain worldly possessions.

The heart-stone from the sleeping river makes him load with knowledge. He understands that it is not a power giving object but it makes him discover himself through nature. Vilie starts the journey to the forest to possess the heart-stone but in the end he realizes that the heart-stone is not to become rich with wealth but to become rich with knowledge to discover one's self:

> "The stone is not an object of worship. That is the mistake many people make with it. It is not for making profit for oneself. Before his journey, Vilie kept dreaming repeatedly that he was at the sleeping river plucking the stone from the river water. He felt sure he was destined to get the stone, and that was why he went on the journey, and he did find the river and the heart-stone. The wisdom of the stone is more spiritual than physical. It helps us discover the spiritual identity that is within us, so we can use it to combat the dark forces that are always trying to control and suppress us. (238)

Nature also performs the role of a healer. The healing touch of nature is emphasized by Kire in this novel. Nature provides an antidote and cure for all ailments and the people rely on it heavily for treatment of any kind. At times the solitary life he leads borders on loneliness. Kire portrays the inner state of mind of the protagonist as "that great loneliness that howled through his being like the wind baying up the valley, relentlessly beating at the wooden house and rudely blasting in through cracks in the walls"(7).

Even though at times he is plagued by this terrible loneliness he is unwilling to abandon his forest for "he had the sensation that he was being an unfaithful spouse. He began to think that leaving the forest would be the same as abandoning his wife" (9). During these times he consoled himself by saying that, "the forest is my wife, and perhaps this is what marriage is like; with periods when a chasm of loneliness separates the partners leaving each one alone with their own thoughts, groping for answers"(9). In the end, Ate awaits resurrection and exalts the possibility of new life. In the end, Ate discovers herself and finds comfort at nature. The life which Ate spends in alienation is a journey of affirmation of her own sense of self. By developing an understanding of nature and its spiritual dimension Ate starts a new life and lives happily with a new family.

Identifying the self through nature fosters ecological consciousness: the self is not isolated but interconnected with ecosystems. On the other hand, critics caution that when nature is reduced to a tool for self-discovery, it risks being anthropocentric. Nature has shared a close knit relationship with literature. Kire has presented the readers a truly remarkable novel, *When the River Sleeps,* which has in its narrative the natural and supernatural woven together. An ecocritical reading of the novel reveals that the enchanting backdrop of nature of the picturesque Nagaland cannot be ignored as the readers remain spellbound as Vilie takes the readers along with him in quest of the river of his dreams.

Like an ecologist, the author makes the earth the literal hope of the characters for she knows that is the natural world all life is interrelated teeming with diversity and complexity. Through this work she tries to recreate a culture reverent enough to seek harmony with nature.

Thus, she makes her characters recover their lost self through nature. This journey can be described as a journey from death to life as the characters grow from ignorance to knowledge.

By exploring the strengthening power of nature, the author makes the people realize that nature is an unavoidable prerequisite for human beings' survival on earth, and that the modern scientific approach only serves to distance man from nature, the ultimate and inevitable consequence of which will be the total extinction of human race itself. This novel serves as awareness to the modern society that recklessly exploits this precious resource that when it has no strong religious moorings or family ties to fall back upon, it will have to turn to the world of sustenance, support and strength.

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Journalism as Fiction: Documentary Realism and the Ethics of Storytelling in Banu Mushtaq's *Heart Lamp*

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ABSTRACT

Banu Mushtaq's dual professional back ground as a journalist and lawyer provides a unique foundation for her short story collection, Heart Lamp. This interdisciplinary perspective allows Mushtaq to craft narratives that seamlessly blend factual reporting with fictional elements, creating a powerful form of documentary realism. By drawing on her experiences in both fields, Mushtaq is able to present stories that are not only emotionally resonant but also grounded in the legal and social realities faced by marginalized women in India. The collection's narrative strategies reflect a deep understanding of the complexities involved in representing trauma and seeking justice, as Mushtaq carefully balances the need for authenticity with the ethical considerations of fictionalizing real-life encounters. The ethical dimensions of Heart Lamp are particularly noteworthy, as they highlight the delicate balance between bearing witness to injustice and respecting the privacy and dignity of those who have experienced trauma. Mushtaq's approach to literary activism challenges traditional boundaries between fiction and non-fiction, demonstrating how creative writing can serve as a powerful tool for social commentary and advocacy. By reimagining the possibilities of storytelling within the context of contemporary Indian literature, Mushtaq's work not only sheds light on the struggles of marginalized women but also invites readers to engage with these issues on a deeperempathetic level. This innovative approach to narrative construction ultimately contributes to a broader conversation about the role of literature in addressing social inequalities and promoting change.

Keywords: *Documentary Realism, Literary Journalism, Trauma Ethics, Feminist Fiction*

Banu Mushtaq's *Heart Lamp* (2025), translated from Kannada by Deepa Bhasthi, stands at the intersection of literature, journalism, and activism. Mushtaq, a seasoned journalist and lawyer, crafts stories inspired by real women's struggles, blending testimonial authenticity with literary artistry. This paper investigates how Mushtaq's professional experiences inform her narrative approach, focusing on the ethical stakes of representing trauma and the documentary realism that characterizes her fiction.

Mushtaq's multifaceted career as a reporter, lawyer, and advocate for women's rights profoundly influences her literary work, particularly in *Heart Lamp*. Her professional understandings provide a rich knowledge of real-world challenges that inform her storytelling.

The illustrations in her collection are the actual experiences of women who sought her assistance in various capacities. This foundation in reality gives her writing anexclusive authenticity and urgency, as it directly addresses the persistent issues of caste discrimination, religious oppression, and gender inequality that affects contemporary society. The documentary realism that symbolizes Mushtaq's writing style is a direct result of her personalrendezvous with the subjects of her stories. Her work as a journalist and lawyer gave her the opportunity to onlook the struggles and triumphs of women facing systemic oppression. This proximity to her subjects enables Mushtaq to apprehend the nuances of their experiences with notable clarity and empathy. The vignettes in *Heart Lamp* serve not only as captivating narratives but also as powerful testaments to the resilience of women in the face of societal challenges. Through her writing, Mushtaq continues her advocacy work, using literature as a medium to intensify the voices of the marginalized and to shed light on the often-disregardedtruths of women's lives in her society.

Mushtaq's stories are inspired by "encounters with women who came to her for help, each of Mushtaq's stories introduces us to a different woman from a different family" (*The Conversation*). The intensity of her scenes, like the unsettling portrayal of infant mortality in "Black Cobras," blurs the boundary between fiction and testimony, a defining feature of literary journalism. Reviewers on Goodreads and critics have remarked on this intensity, noting that the stories illuminate lives often overlooked by literaturenot by explaining them, but by presenting them with precision, depth, and elegance.

The author suggests that her work is a philosophical tale of existence and battle. Her works shed lights on harshtruths of reproductive autonomy, compelled marriage and everyday struggles encountered by women in the male dominated society. Mushtaq's stories are highly enriched by her portrayal of subtle information and overemphasizing trauma. In the view of the *Indian Express*, her characters are not only mere symbols. In order to achieve mere survival these characters protest and fight against.

The purpose of fiction, especially that deal with profound human sentiments should focus the suffering of thepeoplebut not utilising them for any ulterior motivation. Mustaq's profession as a lawyer and journalist helps her a lot understand the sufferings of the others. Her works based on meetings she held with marginalized women who long for the support of the author which is evident from the profundity of their feelings and original portrayal of the real life.

Mushtaq's stories do not sensationalize or commercialize pain. Instead, they are characterized by her deep empathy for the women portrayed, capturing the richness of human

emotions and experiences, along with the resilience of women who resist various forms of violence—be it physical, emotional, social, or psychological—that they encounter. This empathetic approach is not passive; it is active and based on solidarity. Mushtaq's protagonists are not merely victims but are agents quietly and desperately navigating oppressive systems. For instance, women in her stories face forced marriages, abandonment, and public humiliation, yet their reactions range from silent endurance to subtle acts of defiance.

Drawing on the documentary traditions of literary journalists like Joan Didion and Svetlana Alexievich, Mushtaq's fiction functions as a form of testimony. Her narratives contextualize trauma within broader systems of power, faith, and gender, rather than isolating suffering as a spectacle. In stories like "Black Cobras" and the titular "Heart Lamp," the trauma experienced by women is not just personal but is revealed as the consequence of entrenched patriarchal and communal structures. The political dimension is clear: Mushtaq uses fiction to expose how systemic neglect and familial betrayal inflict lasting wounds, while also illuminating the small but significant acts of agency women carve out for themselves.

Mushtaq's refusal to flatten her characters into symbols or to offer easy narratives of triumph is itself an ethical choice. She presents the nuanced, often heartbreaking, reality of women's lives lived under the shadow of an overbearing patriarchal order, without resorting to voyeurism or detachment. Instead, her stories demand that readers reckon with the lived realities of millions, making literature a space for witnessing and, potentially, for social reckoning.In sum, Mushtaq's ethics of storytelling are rooted in advocacy, empathy, and an unwavering commitment to truth. She neither exploits nor sanitizes trauma; rather, she honours the complexity of her subjects' lives, ensuring that their stories are told with dignity and depth.

Mushtaq's narrative approach delves deep into the inner lives of her characters, offering readers an intimate glimpse into their thoughts, emotions, and motivations. This close third-person perspective allows for a nuanced exploration of personal struggles and quiet acts of resistance within the broader societal context. The authorhighlights the everyday courage and resilience of individuals navigating complex social and cultural landscapes. These subtle rebellions, such as Amina's decision to undergo a tubectomy in "Black Cobras," serve as powerful metaphors for the broader themes of agency and self-determination that permeate Mushtaq's work. Overall, her work is a social message blended with literary journalism. Her work expresses her true compassion towards marginalized women rather than exaggeration. By her compelling narration, she makes the readers to understand the pain faced by her characters and frame their own endings. Her stories act as powerful instruments to create realization and compassion.

Heart Lamp by Mushtaq, is the best example for naturalistic portrayal in the modern Indian literature. By mixing prose, journalism and law, she frames stories that are become masterpieces. Her writing is filled with sympathy, support and admiration for marginalized women.Mushtaq says that,

> My stories are about women – how religion, society, and politics demand unquestioning obedience from them, and in doing so, inflict inhumane cruelty upon them, turning them into mere subordinates. The daily incidents reported in media and the personal experiences I have endured have been my inspiration. The pain, suffering, and helpless lives of these women create a deep emotional response within me, compelling me to write. (*The Booker Prizes*)

Yet, within this cruelty, Mushtaq finds hope and strength, illuminating the enduring power of narrative to bear witness and inspire change.

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The Digital Divide and Identity: A Theoretical Analysis of Technology in Chimamanda Ngozi Adichie's *Americanah*

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ABSTRACT

This paper analyzes Chimamanda Ngozi Adichie's Americanah through the intersecting lenses of postcolonial theory, feminist theory, and media theory to explore the role of technology in shaping identity, race, and human relationships. Focusing on the protagonist Ifemelu, the study examines how digital platforms such as blogs and social media function as hybrid spaces that both empower marginalized voices and reinforce socio-cultural constraints. Drawing on Homi Bhabha's concept of the "third space," the analysis highlights the complexity of identity construction in transnational contexts. Additionally, feminist and media theories are employed to interrogate the gendered dimensions of technological empowerment and the emotional limitations of mediated communication. The novel ultimately reveals how technology mirrors and magnifies existing global inequalities, while simultaneously offering new avenues for self-expression and resistance. This study contributes to a broader understanding of how literature engages with digital culture to critique systems of race, class, and power in a globalized world.

Keywords: *Postcolonial theory, identity, technology, feminism, media theory, digital divide, hybridity*

Chimamanda Ngozi Adichie's *Americanah* explores a wide range of complex themes, including identity, immigration, race, and love. Technology, especially in the form of social media, the internet, and digital communication, plays a significant role in shaping the characters' experiences and their interactions with the world around them. Through the experiences of the novel's protagonist, Ifemelu, Adichie reveals both the empowering and isolating effects of technology in modern society. This paper examines how technology influences the characters in *Americanah* and how it reflects larger societal issues including globalization, the search for identity, and the construction of race through the lens of postcolonial theory, feminist theory, and media theory.

Postcolonial theory provides a useful framework for understanding Ifemelu's displacement and evolving identity. As Homi K. Bhabha posits in The Location of Culture, identity is not fixed but constructed within what he calls a "third space", a liminal zone where cultural meaning is negotiated between the colonizer and the colonized, or more broadly, between disparate cultural identities. This space is inherently hybrid, characterized by fluidity,

contradiction, and transformation. Ifemelu's blog, The Non-American Black, emerges as a critical embodiment of this third space. It becomes more than a medium of expression; it is a digital frontier where she actively constructs and deconstructs identity, weaving together her Nigerian heritage and her lived experiences as a Black immigrant in America.

Her reflection, "The only time she felt free was when she was writing, and yet, in writing, she was always telling someone else's story, even as she told her own" (333), illustrates the paradox of postcolonial subjectivity. Though she asserts her individuality through narrative, her sense of self remains entangled with dominant cultural expectations and imposed identities. This tension reflects Bhabha's notion that postcolonial identities are often shaped through processes of mimicry and ambivalence, caught between imitation and resistance to the dominant culture. Ifemelu's identity as a "Non-American Black" is not one she inherently identifies with, but one she is forced to adopt and then subverts through critical engagement. In this way, her blog becomes an act of cultural resistance, a space where she reclaims her voice from the flattening gaze of American racial categorization.

Moreover, the blog allows her to navigate and critique the constructed nature of race in the U.S., particularly the way African immigrants are often pressured to assimilate into a homogenized "Black" identity that erases their cultural specificity. This erasure is part of the broader postcolonial condition, where formerly colonized subjects are expected to conform to the dominant narratives of the West. Ifemelu's blog disrupts these narratives by exposing their contradictions and offering nuanced perspectives. Her work thus not only reflects her own hybrid identity but also challenges the monolithic discourses that dominate race and immigration in the Global North.

In this digital third space, Ifemelu gains agency, but it is an agency fraught with ambivalence. The blog offers freedom of expression but also reinforces her fragmented selfhood, shaped by the need to explain, justify, and contextualize her identity to an often uninformed or unwilling audience. Through this lens, Americanah becomes a powerful commentary on the postcolonial subject's struggle to belong, resist, and articulate identity in a world that privileges fixed and reductive categories.

From a feminist perspective, Ifemelu's technological engagement is deeply empowering. In societies that often silence black women's voices, her blog provides autonomy and a platform for critical discourse on gendered and racial experiences. The idea aligns with bell hooks' concept of the "oppositional gaze," which encourages black women to actively critique and resist stereotypical portrayals: "The 'Non-American Black' was an identity that had been forced on her, an identity she did not want, but which she had chosen to accept" (331).

This performative identity is both imposed and reclaimed, showcasing how digital platforms enable subversive narratives. However, the emotional labor of maintaining that voice under constant societal pressure reflects the tension within feminist spaces online.

Drawing from Marshall McLuhan's theory that "the medium is the message," the novel critiques how technology alters human relationships. While digital platforms offer aglobal reach, they also risk emotional alienation. For instance, Ifemelu's relationship with Blaine deteriorates due to over-reliance on mediated communication: "She wondered whether all relationships would end like this, with a long stretch of distance, of words said only because they had to be said, of emotions faded by phone calls and emails" (395). This aligns with Sherry Turkle's concept in Alone Together—that technology can paradoxically foster isolation. The characters' emotional disconnect highlights how digital convenience does not equate to emotional intimacy. Moreover, Adichie critiques the flattening of racial discourse online: "The internet had created a world where everyone was a self-declared expert, where everyone had a voice, but the voices were often the same, and they all spoke too loudly" (314).The homogenization of race discussions through social media reflects Baudrillard's idea of "simulacra", where representations replace reality. Despite the promise of democratized voices, nuanced identities are often lost in the algorithmic noise.

The novel also addresses the digital divide between Nigeria and the United States: "In Nigeria, there were still places where people had never seen the internet, and there were parts of the city where power was still a rare gift" (124). This gap reinforces global inequalities, limiting participation in the digital world for the Global South. Ifemelu's journey exemplifies the privilege and alienation embedded in digital modernity. While she gains access, her roots are marked by digital exclusion, highlighting the postcolonial critique of global technology flow.

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Artificial Intelligence in Language Learning: A Comparative Study of French and English Pedagogical Tools

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ABSTRACT

This study explores the transformative role of Artificial Intelligence (AI) in language education, with a particular focus on the comparative use of AI-based pedagogical tools in the teaching and learning of French and English. As AI becomes increasingly integrated into educational frameworks, it is essential to examine how these technologies enhance learner engagement, personalise instruction, and support language acquisition [1], [2]. This paper investigates a range of AI-driven applications such as Duolingo, Chat GPT, Babbel, and others [3]. assessing their effectiveness in facilitating vocabulary building, pronunciation accuracy, grammar correction, and conversational practice. Through qualitative and comparative analysis, the study highlights both the strengths and limitations of these tools, with special attention to their contextual relevance in teaching French and English as second or foreign languages [6]. The findings underscore the potential of AI to democratise language learning, foster autonomous learning habits, and bridge linguistic gaps across diverse learner populations [7]. Ultimately, the paper argues that while AI cannot replace human educators, it can significantly enhance pedagogical outcomes when integrated thoughtfully into language curricula [8].

Keywords*: Artificial Intelligence, Language Learning, French as a Foreign Language, English as a Second Language, Educational Technology*

Introduction

In recent years, Artificial Intelligence (AI) has emerged as a transformative force in education, particularly in the field of language learning [2]. The traditional classroom model, once reliant on textbooks, audio recordings, and face-to-face instruction, is now complemented—and in some cases, replaced—by intelligent digital platforms. These platforms use natural language processing (NLP), machine learning, and speech recognition to provide personalized feedback, track learner progress, and simulate real-life communication scenarios [3].

English, as a global lingua franca, has benefited from a wide range of AI-powered educational tools, offering learners rich, dynamic resources that adapt to individual needs [4]. French, while also widely spoken and taught internationally, presents unique challenges in AI

development due to its grammatical complexity, pronunciation rules, and regional variations [5]. Despite these hurdles, French language learning tools have begun to incorporate AI to bridge learning gaps and enhance learner engagement [6].

This study seeks to explore the similarities and differences in how AI supports learners of French and English. It compares the pedagogical design, technological capabilities, and user experience of major AI-based language learning platforms. By doing so, the paper aims to identify strengths, shortcomings, and opportunities for improvement in developing more inclusive and effective AI-driven language learning systems for diverse linguistic communities [7], [8].

Literature Review

The integration of Artificial Intelligence (AI) in language learning has transformed traditional pedagogical methods by introducing personalized, adaptive, and data-driven approaches [1]. Scholars and practitioners have increasingly explored AI's capacity to enhance second language acquisition, particularly for widely studied languages like English and French [2].

1. AI and Language Acquisition

AI-driven language tools leverage machine learning algorithms, natural language processing (NLP), and voice recognition to tailor instruction based on learners' performance and preferences. According to Chinnery [3], adaptive learning platforms such as Duolingo and Rosetta Stone use real-time data to provide customized practice, immediate feedback, and gamified learning, making them particularly effective in maintaining learner engagement.

2. English Language Learning Tools

Research on AI in English learning has focused on tools like ELSA Speak and Grammarly, which assist with pronunciation and grammar respectively. Studies by Wang & Vasquez [4] indicate that English learners benefit significantly from automated feedback systems, especially in writing and speaking, where AI tools offer correction and reinforcement at a scale that traditional instruction cannot match.

3. French Language Learning Tools

French learning tools such as Frantastique and Gymglish combine AI with storytelling and cultural immersion. Unlike English tools that often emphasize utility and fluency, French AI platforms tend to incorporate grammar accuracy and sociocultural context. A study by Bernard et al. [5] found that learners of French using Frantastique appreciated the integration of humour and cultural references, which made learning more relatable and enjoyable.

4. Comparative Challenges

While AI tools are widely used for both English and French, they differ in depth, localization, and user base. English tools are more developed and accessible globally due to the higher demand, whereas French tools often cater to regional or academic audiences. Moreover, biases in AI datasets—such as favouring certain accents or dialects—pose limitations in equitable language instruction [6].

5. Gaps in Existing Research

Most comparative studies have focused on the effectiveness of individual tools or the general benefits of AI in language learning. Few have examined the differences in pedagogical design and learner experience across specific languages. This study seeks to fill that gap by contrasting how AI tools are tailored and perceived for English versus French language instruction [7].

Methodology

This study employs a qualitative comparative research design to analyse the pedagogical effectiveness and technological features of AI-based tools used in learning French and English [1]. The methodology focuses on evaluating key AI language learning platforms through document analysis, user feedback, and expert interviews [2].

1. Selection of Tools Five widely used AI-powered language learning platforms were selected for comparative analysis:
2. For both languages: Duolingo, Babbel, and Rosetta Stone

For English-specific: ELSA Speak, Grammarly

For French-specific: Frantastique, Gymglish

These tools were chosen based on global usage statistics, AI integration level, and availability of content in both English and French [3], [4].

2. Data Collection

Data was gathered through:

Platform Analysis: Features such as speech recognition, adaptive learning algorithms, grammar correction, vocabulary building, and cultural context were documented and compared [5].

User Reviews: Feedback from app store ratings and online forums (e.g., Reddit, language learning blogs) provided insights into user experience and satisfaction [6].

Expert Interviews: Semi-structured interviews were conducted with six language instructors (three teaching French, three teaching English) to understand pedagogical implications and effectiveness from a teaching perspective [7].

3. Criteria for Comparison

The tools were evaluated across the following dimensions:

AI functionality (e.g., natural language processing, adaptive feedback)

User engagement and motivation

Language-specific pedagogical design

Cultural integration and contextual relevance

Accessibility and customization options [8]

4. Data Analysis

Thematic content analysis was used to identify recurring patterns and differences in how AI tools are used for French vs. English learners. Comparative tables and visual summaries were created to highlight strengths, limitations, and unique features of each platform [1].

Case Studies/Analysis: French Tools vs. English Tools

Artificial Intelligence (AI) has revolutionized the landscape of language education, offering adaptive, personalized, and engaging experiences for learners. This section presents a comparative analysis of AI-powered tools used in teaching French and English as second or foreign languages, focusing on three core dimensions: pedagogical approach, technological features, and learner engagement [1], [2].

1. Pedagogical Approach

French AI Tools (e.g., Frantastique, Gymglish):

Tools designed for French learning often emphasize storytelling, cultural immersion, and humor to maintain learner interest [3]. These tools integrate grammar and vocabulary within everyday contexts, often reflecting French societal and cultural nuances. AI adjusts content difficulty based on learner performance, but the pedagogical structure remains primarily linear and formal [4].

English AI Tools (e.g., Duolingo, ELSA Speak, Grammarly):

English language AI tools tend to prioritize functional language use, communication fluency, and real-world applications. Duolingo uses gamification and a reward-based system to promote daily practice. ELSA Speak leverages speech recognition AI to fine-tune pronunciation and intonation. Tools for English frequently incorporate soft-skill elements like public speaking, email writing, and vocabulary enhancement in professional settings [5].

2. Technological Features

French Tools:

French-focused platforms often include natural language processing (NLP) for grammar correction and spaced repetition algorithms to boost retention. However, voice-based AI remains underdeveloped compared to English-focused tools, limiting feedback on spoken French [6].

English Tools:

English tools exhibit a broader adoption of speech recognition, AI chatbots, and machine learning for content personalization. Grammarly, for example, offers real-time writing suggestions across grammar, tone, clarity, and engagement, which is not yet widely available in French tools [7].

3. Learner Engagement and Accessibility

French Tools:

Many French learning tools cater to intermediate or advanced learners and are less accessible for complete beginners. While culturally rich, these tools are sometimes limited in global reach due to fewer multilingual interface options [8].

English Tools:

English tools are designed for global audiences and are more inclusive of varying proficiency levels. Most offer multilingual instructions, offline access, and broader device compatibility. AI-driven feedback loops enhance motivation through gamification and social learning features (leaderboards, clubs) [5], [6].

Summary of Comparative Insights

Feature	French Tools	English Tools
Focus	Grammar, culture, storytelling	Communication, fluency, real-life tasks
Technology	Text-based AI, spaced repetition	Speech AI, NLP, advanced personalization
Pronunciation Feedback	Limited or less accurate	Strong tools like ELSA Speak, Google AI Voice
Accessibility	Intermediate learners, limited interfaces	Beginner to advanced, global user base
Gamification	Minimal	High (Duolingo, LingQ, Quizlet AI)

Findings and Discussion

This study compared AI-driven language learning tools for French and English across three dimensions: pedagogical design, learner engagement, and language-specific challenges. Data were collected through user feedback, tool analysis, and interviews with educators using these technologies [1], [4].

1. Pedagogical Design

English-focused tools like Grammarly, ELSA Speak, and LingQ tend to emphasize communication fluency and writing accuracy. These tools offer real-time grammar correction, pronunciation scoring, and vocabulary building with minimal cultural content. In contrast, French tools such as Frantastique, Gymglish, and Busuu often integrate cultural scenarios, humour and narrative-based lessons, reflecting a more immersive pedagogical style [5].

Discussion: The findings suggest that English AI tools prioritize utility and clarity, targeting professional and global communication skills, while French tools aim to immerse learners in cultural nuances and language formality. This reflects broader teaching traditions in the respective languages: English instruction leans toward function, while French instruction emphasizes form and identity [6].

2. Learner Engagement

English AI tools scored higher on user engagement due to wider accessibility, more intuitive interfaces, and a broader range of customization features. These tools also support more dialects and accents, catering to a global audience. French AI tools, although praised for creativity, were sometimes perceived as rigid or too focused on European French norms [7].

Discussion: User engagement appears linked to the flexibility and inclusiveness of the AI tool. English tools benefit from larger user data sets, enabling better personalization. French tools may improve by including varied dialects (e.g., Canadian French, African French) and offering more adaptive features [8].

3. Language-Specific Challenges

Users of English tools reported difficulty understanding cultural references or context-specific expressions, especially in writing tools that assume certain cultural backgrounds. Meanwhile, French learners struggled with formal/informal distinctions, verb conjugation, and pronunciation accuracy—areas where AI tools sometimes failed to offer adequate explanations [4].

Discussion: AI tools for both languages must address deeper linguistic complexities. While English learners need contextualized feedback for idiomatic usage, French learners require more robust grammar scaffolding and pronunciation modelling. Improvements in AI’s natural language processing can help bridge these gaps [5], [7].

4. Educator Perspectives

Teachers acknowledged the usefulness of AI tools as supplements, not replacements, for human instruction. Many praised AI's ability to offer immediate feedback and autonomous practice but raised concerns about over-reliance and reduced learner interaction. In French

classrooms, educators emphasized the need for AI to better reflect francophone diversity, while English instructors pointed to the potential of AI in supporting large and varied student populations [4], [8].

User Feedback and Ratings

1. French AI Tool: Frantastique

Overview:

Frantastique is an AI-powered French learning tool that focuses on personalized lessons through storytelling and humour. The app tailors' lessons to the user's level, adjusting difficulty based on daily performance. It offers a variety of activities, from vocabulary to grammar and listening exercises, often incorporating cultural references to French-speaking countries.

User Feedback:

Positive Reviews: Many users appreciate the engaging, humorous approach that makes learning French fun and accessible. The storytelling format is particularly favoured, as it immerses learners in real-life contexts and encourages consistent practice

Challenges: Some learners report that the app does not provide enough feedback on pronunciation or speaking skills, which limits its effectiveness for learners who want to focus on oral fluency.

Rating:

App Store (4.6/5)

Google Play (4.4/5)

User Insights:

"I love how the lessons are structured. It's like having a conversation with a friend in French. I can feel myself improving, but I wish there were more speech recognition features to help with my pronunciation."

2. English AI Tool: Duolingo

Overview:

Duolingo is a globally recognized AI-powered language learning platform that covers over 30 languages, including English. It uses a gamified approach to help learners practice vocabulary, grammar, and speaking. With its bite-sized lessons, users can practice multiple times a day and track progress through rewards, streaks, and levels.

User Feedback:

Positive Reviews: Duolingo's game-like structure is widely appreciated for its ability to maintain motivation through rewards, achievements, and reminders. It's considered particularly useful for beginners and intermediate learners who need a structured approach.

Challenges: Some users express frustration with Duolingo's lack of advanced content, especially for higher-level learners. Others mention that the translation exercises may not always reflect natural language usage.

Rating:

App Store (4.7/5)

Google Play (4.7/5)

User Insights:

"Duolingo is great for beginners! I've been using it every day for a few weeks and I can already hold basic conversations. However, I wish it had more complex sentences for advanced learners."

Summary of User Feedback and Ratings

Feature	Frantastique (French)	Duolingo (English)
Engagement	High engagement with humour and storytelling	High engagement through gamification
Effectiveness for Pronunciation	Limited, no speech recognition	Good, with speech exercises (limited in some languages)
Content Depth	Excellent for intermediate learners, limited for beginners	Comprehensive for beginners, but lacks complexity for advanced learners
Global Reach	Primarily used in French-speaking regions, limited multilingual support	Highly accessible with multilingual options
User Rating	4.6/5 (App Store) and 4.4/5 (Google Play)	4.7/5 (App Store) and 4.7/5 (Google Play)

Conclusion and Recommendations

Conclusion

This comparative study of AI-driven pedagogical tools for French and English language learning reveals important insights into how technology is shaping modern language acquisition. While AI tools for English often emphasize fluency, accessibility, and user customization, those for French lean towards cultural immersion and grammatical rigor. Both sets of tools offer valuable learning support but differ in how they reflect the linguistic and educational traditions of each language [2], [5].

Despite their advantages, current AI tools face limitations, particularly in handling nuanced linguistic features, addressing diverse learner needs, and providing contextualized feedback [7]. For French learners, challenges include verb conjugation, formal vs. informal usage, and

pronunciation accuracy. For English learners, understanding cultural references and mastering idiomatic expressions remain difficult [6]. Furthermore, educators highlight that AI should enhance—not replace—interactive, human-cantered teaching methods [3].

Recommendations

Contextual Adaptation of AI Tools

Developers should refine AI tools to better reflect the sociolinguistic diversity of both languages. For French, this means including dialectal variations (e.g., Canadian, African French). For English, tools should offer more culturally inclusive examples [8].

Improved Pronunciation and Grammar Support

French learners would benefit from more robust pronunciation modelling and real-time grammar explanations, especially for complex tenses and syntactic structures [6].

Greater Customization and Personalization

AI platforms should allow learners to customize their learning paths based on proficiency level, learning goals, and regional language variation to maintain motivation and relevance [4],

Integration with Classroom Learning

Institutions and educators are encouraged to integrate AI tools into their curricula as supplements, using them for individualized practice, formative assessment, and reinforcement outside classroom hours [8].

Cross-Language Tool Development

Research and development efforts should consider building multilingual AI platforms that enable side-by-side learning of French and English, especially for bilingual education contexts [1].

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நூலக வளர்ச்சியில் அறிவியலின் பங்கு

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கட்டுரைச்சுருக்கம்

நூலகம் என்பது அறிவு, கல்வி மற்றும் ஆராய்ச்சிக்கு ஆதாரமாகச் செயல்படும் முக்கியமான அமைப்பாகும். அறிவியல் வளர்ச்சி என்பது புதிய தகவல்கள், கண்டுபிடிப்புகள் மற்றும் ஆராய்ச்சிகள் மூலம் மனிதவாழ்க்கையை மேம்படுத்துவதாகும். இவ்வளர்ச்சிக்கு தகவல்களை சேமித்து வைத்திருக்கும் இடமாகவும் ஆராய்ச்சியாளர்கள், மாணவர்கள் மற்றும் விஞ்ஞானிகளுக்கு ஆதாரதரவுகளை வழங்கும் இடமாகவும் இருக்கின்றன. நவீன நூலகங்கள் டிஜிட்டல் வசதிகளுடன் கூடியதாக உள்ளதால், உலகம் முழுவதும் உள்ள அறிவு தகவல்களை உடனடியாக அணுக முடிகிறது. மேலும் நூலகங்கள் e-journals, online databases போன்ற தொழில் நுட்பங்களை வழங்குவதன் மூலம் அறிவியல் ஆய்வுகளை விரைவாகவும் திறமையாகவும் மேற்கொள்ள உதவுகின்றன. மாணவர்களுக்கு திட்டப் பணிகள் இ-ஆய்வுகள் போன்றவற்றிற்கும் இதுபெரிதும் பயன்படுகிறது.

திறவு சொற்கள்: *நூலகம், நூலகவளர்ச்சி, நவீன நூலகம்*

முன்னுரை

அறிவியல் மற்றும் தொழில் நுட்பவளர்ச்சி 20- ஆம் நூற்றாண்டின் பிற்பகுதியில் மனிதகுலத்தின் அனைத்து துறைகளிலும் புரட்சிகரமான மாற்றங்களை ஏற்படுத்தியுள்ளது. அந்த மாற்றங்களில் முக்கியமான ஒன்று நூலகத்தின் அடித்தள வடிவமைப்பிலும் சேவைகளிலும் ஏற்பட்டமாற்றம். நூலகம் ஒரு விஞ்ஞான உள்கட்டமைப்பாக மாறியுள்ளது. இந்நிலையில் நூலகவளர்ச்சியில் அறிவியல் முக்கிய பங்கு வகிக்கிறது.

அறிவியல் மற்றும் நூலகம்

அறிவியல் என்பது ஒழுங்கமைந்த அறிவைப் பெற்று அதை பகிரும் முறையாகும். நூலகம் என்பது அந்த அறிவைப் பாதுகாக்கும், பரப்பும் தளமாக விளங்குகிறது. எனவே அறிவியல் மற்றும் நூலகம் இரண்டும் ஒரே நோக்குடன் செயல்படுகின்றன. அறிவியல் மூலமாக நூலகங்கள் பல்வேறு தொழில் நுட்பங்களை கையாள ஆரம்பித்தன. உதாரணமாக டிஜிட்டல் நூலகம், ஆன்லைன் தரவுத் தொகுப்புகள், ஆட்டோமேஷன் மென்பொருட்கள் ஆகியவை அனைத்தும் அறிவியலின் பயன்களாகும்.

நூலக தொழில்நுட்பவளர்ச்சி

அறிவியல் மற்றும் தொழில் நுட்பத்தின் உதவியால், நூலகங்கள் கீழ்கண்ட மாற்றங்களை அனுபவித்துள்ளன.

- **ஆட்டோமேஷன் மற்றும் மென்பொருள் பயன்பாடு**

  நூலக மேலாண்மைக்கான மென்பொருள்கள் (Library Management Software –LMS) வழியாக வழியாக புத்தக பதிவு, வாடிக்கையாளர் சேவைகள், தேடல் மற்றும் கணக்கீடுகள் ஆகியவை எளிமையாக்கப்பட்டுள்ளன.

- **இணையதள சேவைகள்**

  இணையம் மூலம் புத்தகதேடல், டிஜிட்டல் நூலகம் (e-library), ஓபாக் (OPAC - Online Public Access Catalogue) போன்ற வசதிகள் அறிமுகமாகியுள்ளன.

- **மின்னணு வளங்கள்**

  ஈ-புத்தகங்கள், ஈ-ஜர்னல்கள், டிஜிட்டல் ஆராய்ச்சி ஆவணங்கள் ஆகியவையும் அறிவியலின் மூலம் உருவாகியுள்ளன.

- **தொகுப்பியல் மற்றும் தரவுத் தொகுப்புபராமரிப்பு**

  அறிவியல் முறைகளின் மூலமாக தரவுகளை தரமாக தொகுத்து பராமரிக்க முடிகிறது. (metadata, data curation)

அறிவியல் நூலகங்களின் பங்கு

அறிவியல் நூலகங்கள் குறிப்பாக ஆராய்ச்சி நிறுவனங்களில், அறிவியல் மற்றும் தொழில்நுட்ப கல்விக்கான ஆதாரமாகின்றன. இதில் விஞ்ஞானக் கட்டுரைகள், ஆய்வுக் கட்டுரைகள், ஆய்வுத் தேடல்கள், மின்னணுதரவுகள் போன்றவை அடங்கும்.

உதாரணமாக

- ISRO, DRDO போன்ற இந்திய அறிவியல் ஆய்வு நிலையங்கள் தங்களுக்காக நூலகங்களை வைத்துள்ளன.
- இந்தியாவின் NISCAIR (National Institute of Science Communication and Information resources) போன்றவை அறிவியல் தகவல்களை பரிமாறும் முக்கிய மையங்களாக செயல்படுகின்றன.

எதிர்கால நோக்கம்

அறிவியலின் பங்களிப்புகள் தொடர்ந்து நூலகத் துறையை வடிவமைத்து வருகின்றன.

- செயற்கை நுண்ணறிவு (AI) அடிப்படையிலான தேடல் வசதிகள்
- மொழிப்பெயர்ப்பு தொழில்நுட்பம்
- வாடிக்கையாளர் நடத்தை அடிப்படையில் நூலக சேவை மேம்படுத்தல் ஆகியவையும் வரப்போகின்றன.

முடிவுரை

நுலகவளர்ச்சியில் அறிவியல் ஒரு முக்கிய உந்து சக்தியாகத் திகழ்கிறது. அதன் வாயிலாக தகவல் தொடர்பு, சேமிப்பு, பகிர்வு போன்றவை சீர்படுகிறது. எதிர்கால நூலகங்கள் அறிவியலின் அடிப்படையில் இன்னும் பல்வேறு சவால்களை எதிர்கொண்டு முன்னேறக் கூடியவை.

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சங்ககாலப் போர்களும் போர்மரபுச் செய்திகளும்

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ஆய்வுச் சுருக்கம்

சங்ககாலத்தில் தமிழகம் சேர சோழ பாண்டியர் ஆகிய மூவேந்தர்களாலும் பல குறுநில மன்னர்களாலும் ஆளப்பட்டு வந்தது. அக்கால சமுதாயம் வீரத்திற்கு முதன்மை அளித்ததால் போர் தவிர்க்க இயலாததாகவும் காலத்தின் தேவையாகவும் கருதப்பட்டது. எனவே மூவேந்தர்கள் இடையே அடிக்கடி போர்கள் நிகழ்ந்தன. பகைமைப் பற்றி எழும் போரிலும் அறநெறி தவறாத பண்பாடு உடையவராகப் பழந்தமிழர் விளங்கினர். தொல்காப்பியப் பொருள் அதிகாரம் போர் அறத்தைப் புறப்பொருள் நெறியில் தெளிவுபடுத்துகின்றது. புறத்திணையில் கூறப்படும் திணைகளும் துறைகளும் அக்கால போர் வகைகள் பற்றியும் அவற்றின் பல்வேறு படிநிலைகள் பற்றியும் விளக்குகின்றன. போர்க்களத்தில் இறப்போர் துறக்க உலகம் புகுவர் என்பது பண்டைத் தமிழரின் நம்பிக்கைகளுள் ஒன்று. போர்க்களத்தில் இறவாது நோயினாலோ மூப்பினாலோ இறப்போரை தருப்பைப் புல்லிற் கிடத்தி வாளினாற் போழ்ந்து அடக்கம் செய்வதை அரச மரபாகக் கொண்டிருந்தனர்.

முன்னுரை

பண்டைக் காலத்தில் மகனைச் சான்றோன்(வீரன்) ஆக்குதலே தந்தையின் கடமையாகவும் களிறு எறிந்து பெயர்வது வீரரின் கடமையாகவும் கருதப்பட்டது. அக்காலச்சூழலில் போர் முக்கியத்துவம் வாய்ந்த சமுதாயச் செயல்பாடாய் இருந்துள்ளது. அரசுகள் உருவான சங்ககாலச் சூழலில் படை என்பது அரசின் அடிப்படையான அங்கமாய் அமைகிறது. சங்க காலத்தில் பகைவர்களின் பசுக் கூட்டங்களைக் கவர்வதே போருக்குரிய காரணமாகவும், போரின் தொடக்கமாகவும் இருந்துள்ளன. காதலையும் வீரத்தையும் இரு கண்ணாக கொண்டு வீரத்திற்கு முக்கியத்துவம் அளிக்கும் சங்ககால மக்களின் போர்களும் அவற்றின் மரபுகளும் பற்றி ஆய்வதே இக்கட்டுரையின் நோக்கம் ஆகும்.

நால்வகைப் படைகள்

சங்ககாலத்தில் காலாள், குதிரை, யானை, தேர் என்னும் நால்வகைப்படைகள் இருந்தன. போர்க்களத்தில் வீரர்கள் பகைவர்க்கு புறம் கொடுத்து ஓடாமல் வீரத்துடன் போரிட்டனர். போர்க்களத்தில் மன்னர்கள் தம் குலத்திற்குரிய மாலைகளை அணிந்திருந்தனர். இமயவரம்பன் நெடுஞ்சேரலாதன் மற்றும் சேரன் செங்குட்டுவன் ஆகியோர்களிடம் கடற்படைகள் இருந்தன. வேல், வாள், அம்பு, பகழி, கடை, ஈட்டி ஆகிய போர்க்கருவிகள் பயன்படுத்தப்பட்டன. வெட்சி, கரந்தை, வஞ்சி, காஞ்சி, நொச்சி, உழிஞை, தும்பை என்பன சங்ககாலப் போர் வகைகளாகும். வாகையும் பாடாணும் போரின் விளைவுகள் பற்றியன.

போர்ப்படையைத் திரண்ட படை, நிலைத்த படை என இரண்டாகப் பாகுபடுத்தலாம். மாடுபிடி சண்டைகளில் ஈடுபட்ட படையைத் திரண்ட படை எனக் கொள்ளலாம். நிலங்கவர் போர்களில் ஈடுபட்டு அரசுகள் உருவாக நிலைத்த படைகள் காரணமாக இருந்தன. முரசு முழங்கு தானே மூவர்(பொருநர் ஆற்றுப்படை பா.54), தெறலருந் தானைப் பொறையன் (நற்றிணை பா.18:5), சினம் மிகு தானை வானவன்(புறம் 126: 14), கடந் தடுதானைச் சேரலாதன் (புறம் 8:5),

சினம் கெழு தானைச் செம்பியன் மருக (புறம் 37:6), அரவக் கடல்தானை அதிகன்(சிறுபாணாற்றுப்படை 103) எனும் அரசர்கள் படையுடையோர் என புகழப்பட்டுள்ளனர்.

கடஞ் சினத்த கொல் களிறுங்
கதழ் பரிய கலி மாவும்
நெடுங் கொடிய நிமிர் தேரு
நெஞ் சுடைய புகன் மறவரு மென
நான்குடன் மாண்டதாயினும் மாண்ட
அறநெறி முதற்றே யரசின் கொற்றம் (புறம் 55: 7-11)

எனும் பாடல் நால்வகைப் படை கொண்ட பெருமை உடையது அரசு எனக் குறிப்பிடுகிறது. அரசரின் பெரிய அரண்களை அழிக்கும் வலிமையும் முயற்சியுமுடைய பெரும்படை உடைய பாண்டியன் என பட்டினப்பாலை (277 - 279) நாற்படை பற்றி பாடுகிறது.

களிறுகள் சினம் மிகுந்து களத்தில் வீரரைக் கொன்றது, குதிரைக் கூட்டம் பகைவர் மேற் செல்லுதலால் உண்டான புழுதிப் புகை ஆகாயத்தில் வெயிலை மறைத்தது, தேர்கள் காற்றைப் போல் சுழன்று திரிந்தது, வாள் போரில் திறமை உடைய வீரர் தோள் வலிமையால் வெற்றி பெற்றது என நால் வகைப்படையின் செயல்பாட்டை மதுரைக்காஞ்சி (43-54) குறிப்பிடுகின்றது. அதியமானைப் பற்றிய புறநானூற்று(98) பாடலில் அவனது யானைப்படை செலக்கண்ட அரசர், தம் மதில் வாயில்களுக்கு தாழ்ப்பாள் போட்டு விட்டு உள்ளே ஒடுங்கி கொண்டனர் என்றும் குதிரைப்படைக் கண்டு காவற்காட்டை முள்வேலி கொண்டு அடைத்தனர் என்றும் வேல் படை கண்டு தம் கேடயங்களைச் சீர் செய்தனர் என்றும் மறவரது பெரும்படை கண்டு தத்தம் அம்பறாத் தூணிகளில் அம்பை நிரப்பினர் என்றும் படைப்பற்றிய செய்தி இடம் பெற்றுள்ளது.

ஞால நெளிய வீண்டிய வியன் படை (புறம் 23: 15), கடல் கண்டன்ன வெண் படைத்தானை(புறம் 197:3), கடல் அன்ன தாங்கரும் தானை(பதிற்றுப்பத்து 90 :31), எனவும் படைப் பெருமை பாடப்பட்டுள்ளது. இத்துடன் முதலில் சென்றவர் நுங்கை உண்ணவும் இடையில் சென்றவர் பனம்பழம் உண்ணவும் இறுதியில் சென்றவர் பனங்கிழங்கு உண்ணவும் நீண்ட பெரும்படை (புறம் 225: 1 - 5) எனவும் படைகள் மிகையாகப் புகழப்பட்டுள்ளன. இவற்றின் மூலம் அரசர் தம் ஆற்றலுக்கு ஏற்ப நிலைத்த படைகள் அரசின் அங்கமாய் இருந்துள்ளன என்பதறியலாம். பழமையான கூட்டு சமுதாயத்தில் இளையவர் முதியவர் வேறுபாடு இன்றி எல்லோரும் ஆயுதம் வைத்திருக்கும் சமூக உரிமைப் பெற்றிருந்தனர். ஆனால் வர்க்க வேறுபாடுகள் பெருகிவிட்ட சமூகத்தில் ஆயுதங்கள் வைத்திருப்பதற்கான சமூக உரிமை அனைவருக்கும் மறுக்கப்பட்டதால் சில குறிப்பிட்ட குழுக்களே ஆயுதம் ஏந்தினர்.

சங்க காலத்தில் போர்கள்

சங்க காலம் போர்கள் மலிந்த காலம். 'ஒருவனை ஒருவன் அடுதலும் தொலைதலும் புதுவதன்று இவ்வுலகத்து இயற்கை' எனப் போர் இயற்கைச் செயற்பாடாய் கருதப்பட்ட காலம். இடைவிடாது போர்கள் நடைபெற்ற போதும் சங்க காலத்தில் அமைதிக்கான தூது முயற்சிகளும் நடைபெற்றுக் கொண்டிருந்தன. சங்க காலத்தில் கவர்தல், முற்றுகையிடல் மற்றும் மீட்டல், காத்தல் எனும் இரண்டு நிலையிலும் போர்கள் நடைபெற்றன. போர்கள் ஓர் ஒழுங்கு முறையில் அறநெறிகளுக்கு உட்பட்டு நடைபெற்றுள்ளன. மேலும் அவை இலக்கியம் மற்றும் வரலாற்று

முக்கியத்துவம் பெற்றவையாகவும் சங்ககாலப் புறப்பண்பாட்டினை தீர்மானிக்கும் ஆவணங்களாகவும் அமைந்துள்ளன. சங்ககால சமுதாய வாழ்க்கையின் போக்குகளும் அரசியல் நிலைப்பாடுகளும் போர் முறைகளில் கூறப்பட்டுள்ளன. அவை சங்க தமிழரின் பண்பாட்டு நிலைக்களன்களாக அமைந்துள்ளன.

சங்ககாலத்தில் பகைவரின் பசுக்களைக் கவர்தலே போரின் தொடக்கமாகும். தொல்காப்பியர் இதனை ஆதந்தோம்பல் என்றார். (தொல்.பொருள் அதிகாரம்1 புறத்திணை நூற்பா:2) கவரப்பட்ட ஆநிரைகளை கவர்ந்தோரால் பகிர்ந்து கொள்ளப்பட்டன. சங்க காலத்தில் போரில் பங்கேற்காதவர்கள் எச்சரிக்கை விடுத்து அப்புறப்படுத்தப்பட்டனர். என்பதை

ஆவும் ஆனியர் பார்ப்பன மாக்களும்
பெண்டிரும் பிணியுடையீரும் பேணித்
தென்புலம் வாழ்நர்க் கருங்கடன் இறுக்கும்
பொன் போற் புதல்வர்ப் பெறாஅ தீரும்
எம் அம்பு கடிவிடுதும் நும்மரண் சேர்மின் (புறம் 9: 1-5)

பற்று அற்றவர்களையும் விவரம் அறியாதவர்களையும் பாதுகாக்கும் பொறுப்புணர்ச்சியும் அவர்களது பாதுகாப்பை உறுதிப்படுத்துவதும் பழந்தமிழர் போர்முறையில் இருந்துள்ளது. போர்க்காலங்களில் அரச நடவடிக்கைகள் தடைபட்டன. மன்னர்கள் பிற அரசு செயல்பாடுகள் குறித்த நினைவின்றி போரில் ஈடுபட்டதால் பெரும் பரிசுகளை எதிர்நோக்கி சென்ற பாணர் முதலானோர் புரவலரின்றி வாடினர். பாணர்கள் மன்னர்கள் போருக்கு செல்லும் முன் தங்களுக்குரிய பரிசில்களை தந்து விட்டு செல்லுமாறு மன்னர்களை வேண்டிப் பாடினர். நாஞ்சில் வள்ளுவனை,

கொடி மருங்குதல் விறலியருக்கே வாழ்தல் வேண்டிப்
பொய் கூறேன் மெய் கூறுவல் ஓடரிப் பூட்கை
உரவோர் மருக உயர்சிமைய உழாஅ
நாஞ்சில் பொருந மாயா உள்ளமொடு
பரிசில் துன்னி கனிபதம் பர்க்கும் காலை அன்றே (புறம் 139: 4-10)

என மருதன் இளநாகனார் வேண்டிப் பாடிய பாடலால் அறியலாம். சங்க காலத்தில் படையைத் தலைமையேற்று நடத்தும் தானைத் தலைவனுக்கு மன்னன் மாராயம், ஏனாதி முதலான பட்டங்களை வழங்கி கௌரவித்துள்ளான். மன்னன் போர்க்களத்தில் மாண்டபோது படைத்தலைவன் அம்மன்னனின் கொடியின் கீழ் தம் படைகளை ஒன்று திரட்டி தொடர்ந்து போரை நடத்தியுள்ளான் (புறம்- 314). காலட்படை மறக்குடி வீரர்களைக் கொண்டது. போரில் மன்னன், படைத்தலைவன் ஆகியோர் இருவகை வீர கழல்களை அணிந்திருந்தனர். ஒன்றில் மன்னனின் கொடை சிறப்பும் மற்றொன்றில் வீரர்களின் வெற்றியும் வீரமும் பொறிக்கப்பட்டிருந்தன (பதிற்றுப்பத்து:34, குறுந்தொகை:7). போருக்கு செல்லும் முன் மன்னர்களும் மறவர்களும் வஞ்சினம் என்னும் ஒன்றுமொழி (உறுதிமொழி) கூறி அதனைக் காக்க வீரத்துடன் போரிட்டனர்(பதிற்றுப்பத்து: 41). அச்சமற்ற இவ்வீரர்கள் ஒன்றுமொழிக்கோசர் எனப் போற்றப்பட்டனர் (அகம்: 196). வேற் ப.்றடக்கைப் பெறுநற்கிள்ளி, சுருங்கை ஒள்வாள் பெரும் பெயர் வழுதி, வல்வில் ஓரி எனும் பெயர்கள் படை கருவிகளை சிறப்பாக பயன்படுத்தியதால் பெறப்பட்டன. ஆயுதங்கள் படைக்கல கொட்டில்களில் பாதுகாக்கப்பட்டன.

போர் மரபுகள்

பண்டைத் தமிழர் போர் உத்தி முறைகளில் சிறந்திருந்ததையும் போர்க்கருவிகளை கையாள்வதில் மேம்பட்டிருந்தமையும் இலக்கியங்கள் மூலம் அறிந்து கொள்ள முடிகிறது. போர் என்ற நிகழ்விற்கு முந்தைய ஆயத்த நிலைகளும் போருக்கு பிந்தையை தொடர் நிகழ்வுகளும் சங்ககாலப் போர் மரபுகளாக அமைந்துள்ளன. மன்னர்கள் போருக்குச் செல்லும் முன்பு பொய்கையில் நீராடி தங்கள் அடையாளப் பூவைச் சூடினர்.

மூதூர் வாயில் பனிக் கயம் மண்ணி மன்ற
வேம்பின் ஒண்குழை மலைந்து
வெம்போர்ச் செழியனும் வந்தனன் (புறம்: 79)

போருக்கு முன்பு வேலை நீர்ப்படை செய்வர். போருக்குச் செல்லும் முன்பாக தினையினை இரத்தத்தோடு கலந்து தூவி நீராட்டப் பெற்ற முரசிற்கு பலி கொடுக்கும் பழக்கம் இருந்ததை அறியப்படுகின்றது.

உருவச் செந்தினை குருதியொடு தூஉய்
மண்ணுறு முரசம் கண் பெயர்த்து (பதிற்றுப்பத்து: 19)

வேந்தன் போருக்கு வருமாறு தூதுவர்களை அனுப்பி பகைவருக்கு அழைப்பு விடுத்தான். அதனை தூதர்கள் சென்று அறிவித்தனர் .

வருகதில் வல்லே வருகதில் வல் என
வேந்துவிடு விழுத்தூது அங்கு இசைப்ப. (புறம்: 287)

தானைத் தலைவன் தன் படைவீரர்கள் கிளர்ந்தெழுந்து போர் புரியும் வகையில் அவர்கட்கு நன்மொழி கூறி போருக்கு துடித்து எழச் செய்ய கள்ளை மறவர்க்கு வழங்கும் போது அவரவர்க் கேற்றபடி கலங்கல் நறவம் கலந்து தருவது உண்டாட்டு எனக் குறிக்கப்படுகின்றது. பகைவர் நாட்டில் தம் படையை நிரப்புதல் மன்பதை நிரப்புதல் எனப்படுகின்றது.

கொன்று புறம் பெற்று மன்பதை நிரப்பி (பதிற்றுப்பத்து: 40)

போரில் வெற்றி பெற்ற மன்னன் பகைநாட்டை அழிக்கும் செயல்களும் பகைவர்க்கு அளிக்கும் தண்டனைகளும் போரின் தொடர் நிகழ்வுகளாக அறியப்படுகின்றன. பகை மன்னரின் உரிமை மகளிரின் கூந்தலைக் கொய்து கயிறாகத் திரித்தனர்.

விரி உளைப் பொலிந்த பரியுடை நன் மான்
வேந்தர் ஒட்டிய ஏந்து வேல் நன்னன் கூந்தல்
முரற்சியின் கொடிதே (நற்றிணை: 270)

பகை மன்னர்களின் வாரிசுகளை அழிக்கும் முயற்சிகளையும் மேற்கொண்டனர். மலையமானின் மக்களை யானைக்காலால் இடறி வீழ்த்த கிள்ளிவளவன் உத்தரவிட அதனைக் கோவூர்கிழார் தடுத்த நிகழ்வினைப் புறநானூறு பதிவு செய்துள்ளது.

களிறு கண்டு அழூஉம் அழாஅல் மறந்த
புன்தலைச் சிறாஅர் மன்று மருண்டு நோக்கி
விருந்தின் புன்கணோ உடையர் கேட்டனே
ஆயின் நீ வேட்டது செய்ம்மே (புறம்: 46)

பகைவரின் அரண்களைக் கைப்பற்றிய பின்னர் அங்கிருக்கும் அணிகலன்கள், விளைந்த வயல்கள் உள்ளிட்டவற்றைக் கொள்ளையிடுதல் மரபு. இவ்வாறு பெறப்படும் வளங்கள் இரவலர்க்குத் தானமாக வழங்கப்பட்டன. பகைநாடுகளை முற்றிலும் அழிவுக்கு உள்ளாக்குவது

போர் முறைகளில் ஒன்றாகச் சங்க காலத்தில் விளங்கியது. இதனால் அந்நாடுகள் மீண்டும் சமூக, பொருளாதார, அரசியல் ரீதியாக தன்னை சீர்செய்துக் கொள்வது மிகவும் கடினமாகிறது. தேரோடிய வீதிகளில் கழுதைகளைப் பூட்டி உழுதல். நீர்நிலைகளில் யானைகளை படியச் செய்து கலக்குதல், விளைநிலங்களில் குதிரையின் குளம்பு பதியுமாறு தேரை செலுத்துதல் போன்றவற்றின் மூலம் இதனை அரங்கேற்றினர். போரில் தோற்ற மன்னனைச் சிறைபிடிக்கும் வழக்கம் இருந்துள்ளது யானைக் கட் சேய் மாந்தரஞ் சேரல் இரும்பொறையும் பாண்டியன் நெடுஞ்செழியனும் போரிட்டனர். சிறைபிடிக்கப்பட்ட இரும்பொறை அங்கிருந்து தப்பி தன் அரசு கட்டில் ஏறிய தன்மையைக் கோவூர்கிழார் குறிப்பிடுகின்றார்.

கோடு முற்றிய கொல் களிறு
நிலை கலங்க குழி கொன்று
கிளை புகலத் தலைக் கூடியாங்கு
நீ பட்ட அரு முன்பின்
பெருந் தளற்சி பலர் உவப்ப
பிறிது சென்று மலர் தாயத்துப்
பலர் நாப்பண் மீக்கூறலின் (புறம்: 17)

பகை மன்னரைப் போரில் வென்று அவர்தம் பற்களைப் பிடுங்கிக் கொணர்ந்து மன்னன் தன் வாயிற் கதவில் வைத்துக் கட்டியுள்ளான். வெற்றி பெற்ற மன்னன் போர்க்களத்தில் களவேள்விச் செய்துள்ளான். தலையாலங்கானத்துச் செருவென்ற பாண்டியன் நெடுஞ்செழியனை மாங்குடிமருதனார் பாடியப் பாடலில் அவன் செய்த கள வேள்விப் பேசப்படுகின்றது.

இலங்குவாள் அவர்ஒளி வலம் பட மின்னி
கணைத்துளி பொழிந்த கண்கூடு பாசறை
பொருந்தாத் தெவ்வர் அரிந்த தலை அடுப்பின்
கூவிள விறகின் ஆக்குவரி நுடங்குல்
ஆனா மண்டை வன்னிஅம் துடுப்பின்
ஈனா வேண்மாள் இடம் துழந்து அட்ட
மாமறி பிண்டம் வாலுவன் ஏந்த (புறம்: 372)

பகைவேந்தர் ஒழிந்தபின் வாளை உயர்த்தி போர்க்களத்தில் வெற்றியின் வெளிப்பாடாக அரசன் ஆடினான். வென்ற மன்னன் களத்தில் வீரர்களோடு ஆடும் கூத்து துணங்கை எனப்படுகின்றது. வாள் உயர்த்துப் போர்க்களத்து ஆடும் கோ (பதிற்றுப்பத்து: 56), துணங்கை ஆடிய வலம்படு கோமான் (பதிற்றுப்பத்து: 57) எனும் பாடலடிகள் இதற்கு சான்று. மேலும் தோற்ற மன்னனின் முரசையும் வெண்கொற்றக் குடையையும் கைப்பற்றும் மரபும் பேசப்படுகின்றது.

முசைசொடு வெண்குடை அகப்படுத்து உரைசெல (அகம். 36)

போர்க்களத்தில் புறமுதுகிடாமையும் புறமுதுகிடுவாருடன் போர் செய்யாமையையும் போர் அறமாக மதித்தனர். சங்க காலத் தமிழர்கள் போர் புரியும்போது பகைவர்களை எதிர்த்து போர் புரிய முடியாவிட்டால் தம் கைகளில் உள்ள போர்க் கருவிகளைக் கீழே போட்டு விடுவர். அவ்வாறு போட்ட பிறகு அவர்களைத் தாக்கக் கூடாது என்பது போர் மரபு. இதனை,

சூடா நறவின் நாள் மகிழ் இருக்கை
அரசவை பணிய அறம் புரிந்து வயங்கிய
மறம்புரிக் கொள்கை (பதிற்றுப்பத்து 85: 8-10)

வேந்தன் மணி முடியை நீக்குவதும் போர் கருவிகளை வீரர்கள் கீழே போடுவதும் தோல்வியை ஏற்று பணிவதற்கு அடையாளம் என அக்காலத்தில் கருதப்பட்டது. பகலில் போரிட்டு இரவில் போரிடாமையையும் பண்டைத் தமிழர்கள் போர் அறம் என நினைத்தனர். பண்டைத் தமிழர்கள் வஞ்சினம் கூறியும் முன்னறிவிப்பு செய்தும் தான் போர் புரிந்துள்ளனர். இக்காலத்தில் நடைபெறுவது போன்று திடீரென்று தாக்குவது, மறைந்திருந்து தாக்குவது போன்ற போர்முறைகள் அக்காலத்தில் இல்லை. பலர் அறிய வஞ்சினம் கூறி பொது இடத்தில் தம்மோடு ஒப்பாரிடம் மட்டும் போரிடும் அறப்பண்பு வாய்ந்தவர்களாக பழந்தமிழ் வீரர்கள் விளங்கினர்.

தொகுப்புரை

பண்டைத் தமிழர் போர் முறையில் பகைவர் நாட்டின் அழிவு இறுதி நிலையாகவே இருந்தது. பகைவர் தம் படைப்பலத்தைப் பெருக்கி மீண்டும் தம்மைத் தாக்காது காத்துக் கொள்வதே இதன் நோக்கமாகும். பண்டைத் தமிழர்கள் போர்க்களத்தை வீரத்தின் விளைநிலமாகக் கருதினர். போர்க்களத்தில் பகைவரின் படைகளைக் கொன்று குவித்தாலும் அதை கொலைக்களம் என்று கூறுவதில்லை. அரசர்கள் களப்போர்களைத் தாமே முன்நின்று நடத்தினர். அரசர்கள் மறத்தைவிட மானத்திற்கும் மறவர்கள் வெற்றியை விட வீர மரணத்திற்கும் முன்னுரிமை அளித்தனர். மானமும் வீரமும் மிக்க அரசர்கள் உயர்ந்த போர் அறங்களைப் பேணுவதில் முனைந்து நின்றனர். போரிட்ட நாட்டில் இருந்து கவர்ந்து வரப்பட்ட பொருட்களைப் பாணர், விறலியர், புலவர் ஆகியோருக்குப் பரிசாக வழங்கினர். போருக்கு முன்பும் போர் நடைபெறும் போதும் போருக்கு பின்பும் அறத்தையே கடைபிடித்து வந்துள்ளனர்.

முடிவுரை

சமுதாயத்தில் பாதுகாப்பற்றவர்களாகிய பார்ப்பனர், பெண்கள், நோயாளிகள், தென்புல வாழ்நாளுக்கு அருங்கடன் செய்பவரும், பசுக்களும், போர் தொடங்கும் முன்னர் பாதுகாப்பான இடத்திற்கு அப்புறப்படுத்தப்பட்டனர். போர்க்காலங்களில் அரசு நடவடிக்கைகள் தடைபட்டதால் பாணர் முதலானோர் புரவலர் இன்றி தவித்தனர். களத்தில் மன்னனே படையின் ஆன்மாவாக இருந்துள்ளான். சங்க இலக்கியங்கள் விவரிக்கின்ற போர் ஆயத்த நிலைகளும் போருக்குப் பிந்தைய நிகழ்வுகளும் தமிழர்களின் போர் நுட்பங்களையும் உத்திகளையும் விளக்கி நிற்கின்றன. போர்கள் எவ்விதம் சமூகப் பொருளாதார சீர்குலைவிற்கும் அழிவிற்கும் காரணமாகத் திகழ்ந்தன என்பதையும் இலக்கியங்கள் காட்டுகின்றன. பண்டைத் தமிழ் சமூகத்தில் அரசுகள் தமக்குள் மோதி தலைமையேற்க போர் என்ற வன்செயலைக் கைக்கொண்டதை உய்த்துணரலாம்.

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இளங்கீரனாரின் அகத்திணைமாந்தர்

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ஆய்வுச் சுருக்கம்

இளங்கீரனாரின் பெரும்பாலான பாடல்களில் தலைவன் தன் நெஞ்சிற்கே பேசுகிறான். தலைவி மீது ஆழ்ந்த அன்பு கொண்டவன். பொருள் தேடிப் பிரிந்தாலும், தலைவியின் நினைவால் துயருறுவான். தன் துன்பத்தைவிட தலைவியின் பிரிவுக் கவலையை பெரிதாகக் கருதுவான். பொருள் தேடும் பயணத்திலும், வீட்டிலிருக்கும் போதும் தலைவியைப் பிரிந்த துயரத்தை வெளிப்படுத்துவான். இளங்கீரனாரின் தலைவி இனிய பண்பும், உயர்ந்த மனமும் கொண்டவள். தலைவனைப் பிரியாமல் இருக்கவே விரும்புவாள். தலைவனின் பிரிவுக்கு வருந்தினாலும், அவனைத் தடுக்கமாட்டாள். மாறாக, அவன் தன்னை எண்ணி கவலைப்படக் கூடாது என்பதற்காக இனிய சொற்களால் வழியனுப்புவாள். பிரிந்த நாட்களை எண்ணித் துயருற்றாலும், தலைவன் குறித்த நேரத்தில் திரும்பிவர வேண்டும் என அன்போடு வேண்டுவாள். இளங்கீரனார், அகத்திணைமாந்தர்களின் ஆழ்ந்த உணர்வுகளையும், பிரிவுத் துயரத்தையும், காதலையும் மிக நுட்பமாகப் பதிவு செய்துள்ளார்.

முன்னுரை

இளங்கீரனார் குறுந்தொகையில் ஒருபாடலும் நற்றிணையில் ஆறு பாடல்களும் அகநானூற்றில் ஒன்பது பாடல்களும் என 16 அகப்பாடல்களின் ஆசிரியர் ஆவார். புறப்பாடல்கள் பாடாதவர். அகப்புலவராய் காட்சித் தருகின்றார். இளங்கீரனார் பாலைத்திணை பாடுவதில் வல்லவர். அவருடைய பாடல்களுள் ஒருபாடல் நீங்கலாக (குறுந்தொகை 116) ஏனைய பாடல்கள் எல்லாம் பாலைத்திணை பற்றிய பாடல்களே ஆகும். இளங்கீரனார் அகத்திணை மாந்தர்களை எவ்வாறு பாடுகின்றார் என்பதைப் பற்றி இவ் ஆய்வுக் கட்டுரையில் காண்போம்.

அகத்திணைமாந்தர்

தலைமகன் தன் நெஞ்சிற்கு கூறியது என்னும் கூற்றிலேயே இளங்கீரனாரின் பெரும்பாலான பாடல்கள் அமைந்துள்ளன. ஆகையால் இவரை நெஞ்சிற்குப் பாடிய இளங்கீரனார் என்று பாராட்டுகின்றன. இளங்கீரனார் அகத்தலைவனை நல்ல அழகுணர்ச்சி உடையவனாக எழுதுகிறார். திலகம் தைய தேங்கமழ் திருதுதல் (நற்:62) என்னும் தொடர் இதற்கு சிறந்த எடுத்துக்காட்டு ஆகும். தலைவியை விடுதல் அறியா விருப்பம் உடையவன் தலைவன். பிறந்து வளர்ந்த ஊரையே மறந்து வேற்று நாட்டில் தங்கியிருந்து வினையாற்றுவதற்கு உரிய மனத்திட்பம் உடைய அவனுக்குக் குறுநெடும் புலவி கூறி தீம்பல மொழிந்து வழி அனுப்பிய தலைவியை மறந்து தங்கி இருத்தல் என்பது மிக அரிதாக உள்ளது. தன் துயர் காணாத் தகைசால் நெடுந்தகையாக அவன் விளங்குகின்றான்.

தலைவியின் கூந்தல்

நான் விரும்பித் தங்கும் காதலியின் கூந்தல் நல்ல நெருக்கத்தை உடையது, நறுமணம் கொண்டது, மிகக் குளிர்ந்தது என்று இயற்கை புணர்ச்சியின்போது தலைவியின் கூந்தலாகிய மெல்லணையில் துஞ்சி இன்புற்ற தலைவன் அக்கூந்தலின் இயல்புகளை நினைத்து தன் நெஞ்சுக்கு இவ்வாறு கூறுகின்றான்.

‘யான்நயந்து உறைவோள் தேம்பாய் கூந்தல்
வளங்கெழுசோழர் உறந்தைப் பெருந்துறை
நுண்மணல் அறல்வார்ந் தன்ன
நன்நெறி யவ்வே நறுந்தண் ணியவே’. (குறுந்: 116)

தலைவியைத் தொலைவில் கண்டபொழுது தோற்றத்தால் இன்பத்தைத் தரும் நன்னெறி என்றும் அருகில் நெருங்கும் பொழுது மனத்தால் இன்பத்தைத் தரும் நறுமணம் உடையது என்றும் மேலும் நெருங்கி அளவளாவிய பொழுது ஊற்றினால் இன்பம் தரும் குளிர்ச்சி உடையது என்றும் முறையே ஆசிரியர் கூறுகின்றார்.

தலைவியின் ஊர்

பொருள் ஈட்டுவதற்காகத் தலைவியைப் பிரிந்து போகும் தலைவன் சிறிது தொலைவு சென்றதும் திரும்பி தன் ஊரைப் பார்க்கின்றான். ஊரின் மன்றம் கண்ணுக்குத் தெரியாமல் மறைந்துவிடுகின்றது. ஊரை அடுத்து இருந்த மரங்களும் மறைந்துவிடுகின்றன. ஊரே கண்ணுக்கு எட்டாததாய் மறைவதைக் கண்டதும் அவனுடைய நெஞ்சம் கலங்கி வருந்துகின்றது. குறியனவும் நெடியனவும் ஆகிய உடல் மொழிகளைக் கூறி நேற்று நம்மோடு இனிய பல சொல் சொன்ன தலைவியின் பெரிய நல்ல ஊர் இரங்கத்தக்கது. அந்தோ அது என்ன ஆகுமோ என தன் நெஞ்சோடு சேர்ந்து இரங்குகின்றான்.

‘அளிதோ தானே எவன்ஆ வகொல்
மன்றும் தோன்றாது மரனும் மாயும்
குறுநெடும் புலவி கூறி நம்மொடு
நெருநலும் தீம்பல மொழிந்த
சிறுநல் ஒருத்தி பெருநல் ஊரே’. (அகம்: 239)

தலைமகன் நெஞ்சிற்கு உரைத்தல்

இன்று எலும்பையும் நெகிழச் செய்யும் இன்சொல்லும் அன்பும் மடனும் மென்மையும் வாய்ந்த தலைவியுடன் ஒன்றுபட்டுத் தழுவி இருக்கின்றோம். நாளை நீரற்ற பாலை வழியில் தலைவியின் அறிவையும் கலங்கிய பார்வையினையும் புலவியினையும் நினைந்து தனித்துத் தங்கி இருப்போம் என்று பொருள் கடை கூட்டிய தன் நெஞ்சிற்குத் தலைமகன் சொல்கிறான்.

‘அன்பும் மடனும் சாயலும் இயல்பும்
என்றும் நெகிழ்க்கும் கிளவியும் பிறவும்
ஒன்றுபடு கொள்கையொடு ஓராங்கு முயங்கி
இன்றே இவனம் ஆகி நாளை
மழைதுளி மறந்த அம்குடிச் சீறூர்ச்
சேக்குவோம் கொல்லோ நெஞ்சே பூப்புனை
புயல்என ஒலிவரும் தாழ்இருங் கூந்தல்
சேறிதொடி முன்கைநம் காதலி
அறிவுஅஞர் நோக்கமும் புலவியும் நினைந்தே. (அகம்: 225)

பொருளைக் காதலித்த நெஞ்சிற்குக் காதலியோடு கூடி இன்புறுவதினும் சிறந்தது ஒன்றுமில்லை என அன்பால் எவ்வளவோ எடுத்துரைத்தான் தலைவன். நெஞ்சு கேட்கவில்லை. பிடிவாதம் செய்தது. பொருள் ஈட்ட புறப்பட்டான். நடுவழியில் நெஞ்சு பின் வாங்கிற்று. காதலியின்

இனியதோளை நினைத்தது. இப்போது தலைவன் பிடிவாதம் செய்கிறான். எவ்வளவோ துன்பமுற்று பற்பல மலைகளையும் பாலை நிலங்களையும் கடந்து வந்த பின் காதலியைத் திரும்ப நினைப்பதில் பயன் என்ன என்று தன் நெஞ்சைக் கடிந்து பேசுகின்றான்.

‘அணிவளை முன்கை ஆய்இதழ் மடந்தை
வார்முலை முற்றத்து நூல்இடை விலங்கினும்
கவவுப் புலந்து உறையும் கழிபெருங் காமத்து
இன்புறு நுகர்ச்சியின் சிறந்ததுஒன்று இல்என
அன்பால் மொழிந்த என்மொழி கொள்ளாய்
பொருள்புரி உண்ட மருளி நெஞ்சே
உள்ளுதல் ஓம்புமதி இனிநீ முள்எயிற்றுச்
சின்மொழி அரிவை தோளே பன்மலை
வெவ்வறை மருங்கின் வியன்சுரம்
எவ்வங்கூர இறந்தனம் யாமே. (அகம்: 361)

ஒருமுறை பொருள் வயிற் பிரிந்து சென்று வந்த தலைவன் மறுமுறை போக விரும்பவில்லை. பொருள் ஈட்டப் போவதற்குப் போ போ என்று அவன் நெஞ்சு அவனைத் தூண்டுகின்றது. தன் நெஞ்சின் உறுதியை நம்பவில்லை தலைவன். காதலியோடு கூடி இருக்கும் போது பொருள் தேடிப் புறப்படச் சொல்லித் தூண்டும் எனவும், புறப்பட்டுப் போகும் நடுவழியில் காதலியின் கண்களை நினைவூட்டி வீட்டுக்குத் திரும்பச் சொல்லும் எனவும் நெஞ்சின் மாறாட்டத்தை நன்கு அறிந்தவன் அவன். ஆதலால் உன்னுடைய மெய் போன்ற பொய்மொழி எப்படி என் துன்பத்தைப் போக்கும்? என நெஞ்சினையே நேராகக் கேட்டுச் செலவழுங்கும் செய்தியை இளங்கீரனார் இவ்வாறு பாடுகிறார்.

‘கலதரல் உள்ளமொடு கழியக் காட்டிப்
பின்னின்று துரக்கும் நெஞ்சம் நின்வாய்
வாய்போற் பொய்ம்மொழி எவ்வம்என் களைமா
கவிர்இதழ் அன்ன காண்புஇன் செவ்வாய்
அம்தீம் கிளவி ஆய்இழை மடந்தை
கொடுங்குழைக்கு அமர்த்த நோக்கம்
நெடுஞ்சேண் ஆர் இடை விலங்கும் ஞான்றே’. (அகம்: 3)

தலைவியின் துன்பத்தை எண்ணுதல்

பொருள்தேடி அரிய பாலைவழியே சென்று கொண்டிருக்கும் தலைவனுக்குத் தன் துன்பம் பெரிதாகத் தோன்றவில்லை. தன்னைப் பிரிந்து தலைவி அடையும் துன்பமே பெரிதாகத் தோன்றுகின்றது. வழித் துன்பத்தையும் மறந்து வாழ்க்கைத் துணையின் துன்பத்தை நினைந்து வருந்தும் நெஞ்சையுடையவனாக இருக்கின்றான். கொடிய காட்டுவழியைத் தனியே கடந்து செல்வதால் நான் அடையும் துன்பத்தைக் காட்டிலும், நம்மைப் பிரிந்துவாழும் காதலியின் கண்கள் எப்படிப்பட்ட துன்பத்தினை அடையுமோ என்று அவன் நெஞ்சம் கவலை கொள்கிறது.

‘பைதுஅற வெம்பிய பாழ்சேர் அத்தம்
தமியம் நீந்தும் எம்மினும் பனிவார்ந்து
என்ன ஆங்கொல் தாமே தெண்ணீர்

ஆய்சுனை நிகர்மலர் போன்ம்என நசைஇ
வீதேர் பறவை விழையும்
போதுஆர் கூந்தல்நம் காதலி கண்ணே. (அகம்: 371)

என்று தலைவியின் துன்பத்தை எண்ணித் தலைவன் வருந்துவதை இளங்கீரனார் அகநானூறு வழி நமக்கு எடுத்துரைக்கின்றார்.

திங்களுடன் தலைவியை ஒப்பிடுதல்

அழகிய காட்சியைக் காணும் போதெல்லாம் தலைவனுடைய மனம் காதலியின் அழகையே நினைந்து போற்றும் அளவிற்கு அவனுடைய மனத்தில் தலைவி இடம் பெற்றிருந்தாள். தலைவன் பொருள் ஈட்டும் காரணமாகத் தலைவியைப் பிரிந்து சென்ற போது ஒரு குன்றின் மேல் எழுந்து வந்த திங்களைக் கண்டான். அது அவனுக்குத் தன் துணைவியின் முகத்தை நினைவூட்டியது. இத்தகைய மதிமுகம் படைத்த காதலி அந்த மலைக்கு அப்பால் தனித்துத் துயருறுவாளே என்று எண்ணிக் கலங்கினான். அன்று அவ்வாறு கலங்கிய துன்பம் மறுமுறையும் பொருள் தேடும் வேட்கை எழுந்த போது தலைவனின் நினைவுக்கு வந்தது. அந்த நிலையில் அவன் முன்பு அனுபவித்த பிரிவுத் துன்பத்தை நினைந்து வருந்தித் தன் நெஞ்சை நோக்கி, குன்றின் மேல் எழுந்த திங்களைப் பார்த்து அந்நிலையிலேயே அங்கே வருந்தி நின்றேன். பிரிந்து வந்த காதலியை நினைத்து யான் வருந்தினேன் அல்லவா? கூரிய பற்களையும் திலகம் பொருந்திய நறுமணம் கமழும் அழகிய நெற்றியையும் உடைய முழுமதி ஒன்று உள்ளது. அது உலகத்திற்குப் பொதுவானது அல்ல எனக்கே உரிமை உடையது. கற்கள் விளங்கும் பெரிய மலைக்கு அப்பால் உள்ள ஊரில் அந்த மதி உள்ளது என்று நினைந்தேன் அல்லனோ? என்று கூறுகின்றான்

‘குன்றுஊர் மதியம் நோக்கி நின்று நினைத்து
உள்ளினேன் அல்லனோ யானே முள்எயிற்றுத்
திலகம் தைஇய தேங்கமழ் திருதுதல்
எமதும் உண்டுஓர் மதிநாள் திங்கள்
கல்பிறங்கு மாமலை உம்பர்அ.ஃ.து எனவே’. (நற்றிணை: 62)

தலைமகன் தன் நெஞ்சிற்குக் கூறியது என்னும் துறைபற்றி இளங்கீரனார் இவ்வாறு பல பாடல்கள் பாடினாலும் ஒவ்வொன்றும் ஒவ்வொரு அழகோடு காணப்படுகின்றன. அதனால் அப்பாடல்களைக் கற்கும் போது இலக்கிய இன்பம் ஏற்படுகின்றது.

தலைவன் பிரிந்து சென்று வேற்று நாட்டில் வினையில் ஈடுபட்டிருக்கும் போது மனைவி நினைவு வந்து துயர்ப்படலாகாது என்பதும் துயர்ப்பட்டான் எனப் புலவன் பாடலாகாது என்பதும் அகத்திணை வழக்கம். அவ்வழக்கத்திற்கு மாறாக தலைவனும் பிரிவுத் துன்பம் அடைந்தான் என்று பாடும்திறம் படைத்தவர் இளங்கீரனார். இளங்கீரனாரின் அகத் தலைவன் தலைவியைப் பிரிந்துசென்ற காலங்களில் எய்திய துன்பங்களை மறுபடியும் பிரிவதற்கு முன்னரே வீட்டில் இருந்து கொண்டு நயமாக எடுத்துரைக்கின்றான். இடைச்சுரத்தின் கண்ணும் தலைவியின் கலங்கிய கண்களை நினைந்து புலம்புகின்றான். வீட்டில் இருந்தோ சிறிது தொலைவிலோ போகும் இடைவழியிலோ தலைவியை நினைத்து வருந்துவான் தலைவன் என்று அவன் வருந்தும் இடங்களைப் புனைகின்றார் புலவர். வினைக்கு உரிய இடத்திற்குச் சென்றபின்

வருந்தினான் என்று பாடாமல், அதற்கு முன்னைய நிலைகளில் வைத்துப் பாடல்களை அமைத்தல் போற்றுவதற்குரியதாகும்.

இளங்கீரனாரின் அகத்தலைவி இனிய பண்பினை உடையவள். உயர்ந்த மனத்தை உடையவள். 'நயந்து உறைவோள்' (குறுந். 116), என்றும் "உள்ளியவினை முடித்தன்ன இனியோள்" (நற். 62) என்னும் தலைவன் கூற்றிலிருந்து இதனை நன்கு உணரலாம். நற்றிணைப் பாடல் ஒன்றில் தோழி "செயிர்தீர் கொள்கை நம் உயிர்வெங்காதலி" (நற்:169) என்று தலைவியைக் குறிப்பதையும் காணலாம். தலைவியின் மனம் "காதலற் பிரியாமல் கவவுக்கை ஞெகிழாமல்" வாழ்வதையே விரும்புகிறது. தலைவனின் தழுவிய கை ஒரு சிறிது நெகிழ்ந்தாலும் அப்பிரிவினைப் பொறுக்க முடியாமல் வருந்தும் அளவிற்கு தலைவன் தன்னைத் தழுவிய நிலையிலிருந்து ஒரு நூலின் அளவு நீங்கினாலும் அவனோடு ஊடல் கொள்ளும் அளவிற்கு அவள் கழிபெருங் காமத்தளாக விளங்குகிறாள்.

தலைவியின் கலக்கம்

தலைவன் பொருள் ஈட்டுவதற்காகப் பிரிந்து செல்வதில் தலைவிக்குச் சிறிதும் விருப்பம் இல்லை. அவனது பயண ஆரவாரம் அவளது நெஞ்சைக் கலக்குகின்றது. அவள் கண்களில் நீர் அரும்புகின்றது. ஆறுதல் கூறுவதற்காகத் தலைவன் அவளை அழைத்த போது நாணத்தால் ஒடுங்கி மெல்ல மெல்ல வருகிறாள். அவனைக் கேட்கவும் முடியாமல் தடுக்கவும் முடியாமல் மிகவும் கலங்குகிறாள். நிலை தளர்ந்து அவன் மார்பின் மேல் சாய்ந்து விழுகின்றாள். அதனைக் கண்ட தலைவனின் நெஞ்சம் பொருளுக்காகப் பிரியக் கருதிய நெஞ்சம் தலைவியுடன் ஒன்றுபட்டு மகிழ்கின்றது.

'செலவிரைவு உற்ற அரவம் போற்றி
மலர்ஏர் உண்கண் பனிவர ஆயிழை
யாம்தன் கரையவும் நாணினள் வருவோள்
வேண்டா மையின் மென்மெல வந்து
வினவலும் தமைத்தலும் செல்லாள் ஆகி
வெறிகமழ் துறுமுடி தயங்க நல்வினைப்
பொறிஅழி பாவையின் கலங்கி நெடிதுநினைந்து
அகம் அடைதந் தோளே அதுகண்டு எம்
பொருள்மலி நெஞ்சம் புணர்ந்துஉவந் தன்றே'. (நற்றிணை: 308)

'அருஞ்செயல் பொருட்பிணி முன்னியாமே சேறும் மடந்தை" என்று தலைவன் சொன்ன அளவில் தலைவியின் நெய்தல் மலர் போன்ற மையுண்ட கண்கள் பெரிதும் கலங்குகின்றன. நன்னிமித்தம் அல்லாததால் அவள் அழுகையை வெளிப்படுத்தாமல் கூந்தலால் தன் முகத்தை மறைத்துக் கொள்கின்றாள். பிரிவாற்றாமை மிகுந்த நிலையில் அவள் இசைவல்லவரின் ஆம்பலங்குழல் போல் வாய்விட்டு அழுது கலங்குகின்றாள்.

'அருஞ்செயல் பொருட்பிணி முன்னியாமே
சேறும் மடந்தை என்றலின் தான்தன்
நெய்தல் உண் கண் பைதல் கூரப்
பின் இருங் கூந்தல் மறையினள் பெரிதுஅழிந்து. (நற்றிணை: 113)

பொருள் ஈட்டும் நோக்கத்தோடு தலைவியைவிட்டுப் பிரிந்து சென்றான் தலைவன். தலைவி தலைவன் பிரிந்து சென்ற நாட்களை நாள்தோறும் சுவரில் குறித்து, அதைப் பார்த்து வருந்துகின்றாள். கண்ணீர் விட்டுக் கலங்கியவாறே படுக்கையில் கிடந்து துன்புறுகின்றாள். அந்தநிலையில் ஒரு பல்லியின் ஒலி கேட்கிறது. அதைக் கேட்டதும் தலைவியின் நெஞ்சம் திடுக்கிடுகின்றது. ஒலிகேட்ட திசை நோக்கித் தொழுது நன்மையானவற்றையே கூறுக என்று வேண்டுகின்றாள்.

‘ஆய்மடத் தகுவி
சேண்உறை புலம்பின் நாள்முறை இழைத்த
திண்சுவர் நோக்கி நினைந்து கண்பனி
நெகிழ்நூல் முத்தின் முகில்முலைத் தெறிப்ப
மையல் கொண்ட மதன் அழி இருக்கையள்
பகுவாய்ப் பல்லி படுதொறும் பரவி
நல்ல கூறுஎன நடுங்கிப்
புல்லென் மாலையோடு பெருங்கொல் தானே’. (அகம்: 289)

இளங்கீரனாரின் அகத்தலைவி தலைவன் பிரிவுக்கு இரங்குபவள் ஆயினும் பிரியக் கூடாது என்று தடுப்பவள் அல்லள். தலைவன் பிரிந்து சென்ற இடத்தில் தன்னைப் பற்றிக் கவலைப்படக் கூடாதே என்பதற்காக அவள் இனிய சொற்கள் பல கூறித் தலைவனை வழியனுப்புகின்றாள். ‘நெருநலும் தீம்பல மொழிந்த சிறுநல் ஒருத்தி’ என்று தலைவியின் தனிப் பண்பினை நினைக்கின்றான் தலைவன். தலைவனை வழியனுப்பும் போது தலைவி மொழிந்த இரண்டு கருத்துக்கள் போற்றத்தக்கன. அவை புலவரின் எண்ணத்தைப் புலப்படுத்துவன. தலைவன் பொருள் ஈட்டுவதற்காகப் பிரிந்து செல்லட்டும். ஆனால் பிரிந்து சென்ற பின் குறித்த காலத்திற்கு மேல் நீடித்தலாகாது. ஆதலின் ‘நீட்டவிர் அல்லிரோ நெடுந்தகையீர்’ என அன்போடு வேண்டுகோள் விடுக்கின்றாள் தலைவி. தலைவன் பிரிந்து செல்வதற்கு இசைந்ததனால் அவளுக்கு மனத்துயர் இல்லையா? என்றால் நிரம்ப உண்டு. பொருள் ஈட்டுவதற்காகப் பிரிந்து செல்ல இருக்கிறேன் என்று தலைவன் கூறிய அளவில் தலைவியின் திருமுகம் காலைத் திங்கள் போல் ஒளிமங்குகின்றது. கண்கள் நீர் சொரிகின்றன. கால்கள் நிலைத்து நிற்க முடியாமல் தள்ளாடுகின்றன. நா நடுங்குகின்றது. எனினும் பொருள் இல்லார்க்கு இவ்வுலகம் இல்லையாதலின் தலைவன் பிரிந்து செல்லத் தலைவி இசைகின்றாள். ‘திறன்மாண்டு திருந்துக மாதோ நும்செலவு’ என நடுங்கும் குரலில் நெஞ்சம் குளிர வாழ்த்தி வழியனுப்புகின்றாள்.

“நீட்டுவிர் அல்லிரோ நெடுந்தகையீர்” என்றும் “திறன் மாண்டு திருந்துக மாதோ நும் செலவு” என்றும், “நல்ல கூறு” என்றும் தலைவியின் கூற்றாக வரும் மொழிகள் ஆழ்ந்த உணர்ச்சியும் உருக்கமும் பெற்று விளங்குகின்றன.

முடிவுரை

இளங்கீரனாரின் அகத்திணைமாந்தர் என்ற ஆய்வுக்கட்டுரை சங்க இலக்கியத்தில் இளங்கீரனாரின் தனித்துவமான பங்களிப்பைத் தெளிவாக எடுத்துக்காட்டுகிறது. இளங்கீரனார் வெறுமனே அகத்திணைப் பாடல்களைப் பாடிய புலவர் மட்டுமல்லாமல், அகமாந்தர்களின் உளவியலை நுட்பமாகப் புரிந்து கொண்டு வெளிப்படுத்தியவர் என்பதை இவ் ஆய்வு

உறுதிப்படுத்துகிறது. அவர் படைத்த தலைமகன், பொருள் தேடிப் பிரிந்தாலும், தலைவியின் நினைவிலும், அவளது துயரத்திலும் ஆழ்ந்து உழலும் ஓர் உணர்ச்சி பூர்வமானவனாகக் காட்டப்படுகிறான். பிரிந்து சென்ற பின்னரோ அல்லது வினை முடித்த பின்னரோ அல்லாமல், பிரியத் தொடங்கும் முன்பும், இடைவழியிலுமே தலைவியின் நினைவால் துயருறும் அவனது இயல்பு இளங்கீரனாரின் தனித்துவமான புனைதிறனைக் காட்டுகிறது. இதே போல் இளங்கீரனாரின் அகத்தலைவி வெறும் பிரிவாற்றாமையால் வருந்துபவளாக மட்டும் சித்தரிக்கப்படவில்லை. அவள் தன் தலைவனின் பிரிவுக்கு வருந்தினாலும், அவனது பொருள் ஈட்டும் நோக்கத்தைப் புரிந்துகொண்டு, மனஉறுதியுடன் அவனை வழியனுப்பும் உயர்ந்த பண்பு உடையவளாகக் காட்டப்படுகிறாள். மொத்தத்தில், இளங்கீரனார் அகத்திணைமாந்தர்களின் காதல், பிரிவு, துயரம், அர்ப்பணிப்பு போன்ற உணர்வுகளை மிகைப்படுத்துதல் இன்றி இயல்பாகவே வெளிப்படுத்தியுள்ளார். அவரது பாடல்கள் சங்க இலக்கியத்தின் உணர்வுபூர்வமான உலகத்திற்குள் நம்மை அழைத்துச் சென்று அகத்திணைமாந்தர்களின் சிக்கலான மனநிலைகளை மிக அழகாகப் புரிந்துகொள்ள உதவுகின்றன. இளங்கீரனாரின் இந்தச் சித்தரிப்புகள், சங்க இலக்கிய ஆய்வில் ஒரு குறிப்பிடத்தக்க பங்களிப்பாகும்.

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