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**3.3.2: Number of books and chapters in edited volumes/books published and papers published in national/international conference proceedings per teacher during the last five years.**

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| Sr. No. | Title of Book/Paper   | Page No. |
|---------|---|----------|
| 1       | Madhyakalin Kavya Aur Samajik- Sanskritik Paridrishya   | 1-8      |
| 2       | 21 Sadi ki Hindi Kavita   | 9-14     |
| 3       | Decoding Shakespeare: An Adaptation of Trilogy  | 15-26    |
| 4       | Structural Characterization And Rietveld Refinement Of Ceo <sub>2</sub> / Cofe <sub>2</sub> o <sub>4</sub> Nanocomposites Prepared Via Coprecipitation Method | 27-34    |
| 5       | Synthesis and optimization of ZnFe <sub>2</sub> o <sub>4</sub> /Tio <sub>2</sub> Nano composite   | 35-41    |
| 6       | Highway of Behaviour : Brain and Psychology<br>Neuropsychology  | 42       |
| 7       | Cloud Computing Related Data Security Issues in E-Governance  | 43-64    |
| 8       | Next Green Revolution To Be Powered by IOT  | 65-67    |
| 9       | Dr. Ganeshdatt Sharma Ke Kavyon Ka Shaillivaigyanik Adhyayan  | 68-69    |
| 10      | Chapters 1 to 5 E-Commerce Programme CBCS (Hindi Medium)  | 70       |
| 11      | Chapters 1 to 5 E-Commerce Programme CBCS (English Medium)  | 71       |
| 12      | Chapter 1 The Role of Microinance in Promoting Entrepreneurship   | 72-86    |
| 13      | Social Psychology   | 87       |
| 14      | Oranization &Oranizational Behaviour  | 88       |

# वाल्मीकि 'रामायण' और गोस्वामी तुलसी 'रामचरितमानस' के कथा-प्रसंगों का तुलनात्मक अध्ययन

डॉ. मधु मालती

एसोसिएट प्रोफेसर एवं हिंदी – विभागाध्यक्ष  
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महाकाव्यों के इतिहास में रामचरितमानस तुलसीदास जी की एक व्यापक और पारदर्शी दृष्टि का आधार लेकर अवतरित हुआ। मानस में आद्यावधि मानवीय जिजीविषा की जो जीवनदायिनी अनगिनत तरंगे उठ रही हैं, वे उसकी संपूर्णता एवं सर्वांगीण सफलता का ही निरंतर उद्घोष कर रही हैं। गोस्वामी जी की संपूर्ण काव्य-सर्जना ही सत्काव्य की भूमिका पर संश्लिष्ट एवं निबद्ध है। गोस्वामी जी ने मानस का प्रणयन इतिवृत्त कथन की प्रेरणा से नहीं, प्रत्युत् राम के उदात्त चरित्र को काव्य एवं कला की भूमि पर प्रतिष्ठित कर उसे सहज ही जनमानस में अवतीर्ण करा देने की अदम्य आकांक्षा से किया है।

इस दृष्टि से रामचरितमानस केवल काव्यालंकरण संबंधी सामान्य महाकाव्य नहीं है—वह इससे भी आगे की चीज है। 'मानस' में राम के चरित्र में संपूर्ण भारतीय जीवनदर्शों की प्रतिष्ठा की है। रामचरितमानस की अनवरुद्ध महाप्राणता तथा उसकी व्यापक लोकप्रियता की ओर लक्ष्य करते हुए डॉ. ग्रियर्सन ने कहा है कि गंगा की घाटी में जितना प्रचार इस महाग्रंथ का है, इंग्लैण्ड में बाइबिल भी उतनी लोकप्रिय नहीं।

सन् 1903 के रॉयल एशियाटिक के जर्नल में पृष्ठ 459 पर अंकित विद्वान के कथन<sup>1</sup> के साथ हमें यह कहने में भी आपत्ति नहीं होगी कि

हिंदी के इस अकेले कवि को लेकर पाश्चात्य और प्राच्य विचारकों में जितना विचार-मंथन अब तक हुआ है, वह भी अपने परिणाम में कुछ कम प्रचुर एवं प्रभूत नहीं कहा जा सकता।

मानस की कथाभूमि को विस्तार देने तथा उसके विभिन्न प्रसंगों को काव्यात्मक गरिमा से पुष्ट करने वाले ग्रंथों में विशेष रूप से जिसका नाम लिया जाता है— आदि कवि की वाल्मीकि रामायण।

रामकथा को डॉ. बलदेव प्रसाद मिश्र के शब्दों में इस प्रकार रखा जा सकता है—

“पिता का आदेश मानकर एक राजकुमार वन को जाते हैं, उनकी साध्वी सुकुमारी पत्नी भी उनका साथ देती है। वहाँ एक प्रभुता मदांघ सत्ताधीश उस साध्वी बाला को हर लेता है। जिसकी प्रतिक्रिया में वे राजकुमार वानरों की सहायता से ऐसे प्रबल प्रतिस्पर्धी को भी परास्त करके पत्नी को उन्मुक्त कराते हैं और आदेश पूर्ण होने पर पिता के राज्य का उपभोग करते हैं।”

वस्तुतः रामकथा की मूलभित्ति इतनी ही है और इसके मूलरूप को सबसे पहले छंदबद्ध करने का श्रेय मिला है— आदिकवि वाल्मीकि को। मानसकार ने भी मूलकथा का बाहरी ढाँचा खड़ा करने की प्रेरणा गोस्वामी तुलसीदास जी को वाल्मीकि रामायण से निकलकर मानसी—कथा की धारा में प्रशस्तता आ गई है कि उसकी सुसंगठित तथा आदर्शपूर्ण कथा वाल्मीकि की इतिवृत्तात्मकता से कहीं दूर निकल गई है। प्रस्तुत शोध-पत्र में हम इस अंतर की विशद रूप से चर्चा करना चाहते हैं। वाल्मीकि रामायण एवं मानस के सूक्ष्म कथा-भेदों से परिचित होना आवश्यक है।

महर्षि वाल्मीकि ने राम को विष्णु का ही अंशावतार माना है और व्यावहारिक क्षेत्र में उनके नरत्व की ही विशद विवृत्ति की है। मानसकार ने अपने कथानक में नरत्व को ही महत्ता नहीं दी है, वरन् उसके साथ उनके ‘नारायण’ का भी समाहार सफलता के साथ किया है। तुलसी की दृष्टि में अंशी तो एक मात्र उनके उपास्यदेव राम ही हैं, शेष सब शक्तियाँ उनके अंश से ही उद्भूत हुई हैं।

राजा दशरथ की अभिलाषा और गुरु वशिष्ठ की प्रेरणा के फलस्वरूप शृंगी ऋषि के द्वारा संभावित पुत्रेष्टि यज्ञ के अनंतर पायस-वितरण की जो प्रणाली वाल्मीकि रामायण में अपनाई गई है— वह मानस से भिन्न है, मानस में जो पाथसात्र का विभाजन किया गया है— वह वाल्मीकि रामायण की वितरण-प्रणाली से कहीं अधिक सुंदर बन पड़ा है।

रामायण में रामजन्म का उल्लेख साधारण है जबकि मानस में तुलसी ने

राम का चतुर्भुज रूप दर्शाया है। कौशल्या उन्हें देखकर ईश्वर मानकर उनकी स्तुति करती हैं।<sup>4</sup> इस प्रसंग में भागवत् की प्रतिष्ठा है, क्योंकि भागवत् में भी कृष्ण के जन्म होते ही उन्हें शंख, गदादि से युक्त चतुर्भुज रूप में देखकर वासुदेव और देवकी दोनों ही कृष्ण की स्तुति उसी रूप में करते हैं जैसे मानस में कौशल्या करती हैं।

रामायण में राम-लक्ष्मणादि के जन्म के पश्चात् उनकी बाल-लीलाओं का वर्णन नहीं किया गया, परंतु मानसकार ने केवल राम की बाल-लीला का ही नहीं, अपितु बाल-सौंदर्य का व्यापक उल्लेख भी किया है। तुलसी के राम अलौकिक हैं अतएव बाल्यावस्था में ही उनकी अद्भुत लीलाओं का प्रसंग भी वर्णित है।

वाल्मीकि जी ने जयंत द्वारा चंचु-प्रहार की घटना का उल्लेख सुंदरकांड में जानकी के द्वारा हनुमान के प्रति कराया है<sup>5</sup> मानसकार ने इस घटना को और अधिक संयत होकर देखने की चेष्टा की है। पुत्रवत् हनुमान से माता द्वारा एक ऐसी घटना का यथार्थ वर्णन कराना तुलसी की मर्यादावादी नीति के प्रतिकूल होता। अतएव अपनी परंपरानुवर्तनी रीति-नीति का सम्मान रखते हुए उन्होंने कहा—“सीता-चरण चौंच हति भागा, मूढमंदमति कारन कागा”।<sup>6</sup>

राम द्वारा ताड़क, सुबाहू वध एवं मारीच उत्क्षेपणा प्रसंग भी रामायण में मानस की अपेक्षाकृत अत्यंत विषदता से वर्णित हुए हैं क्योंकि रामायणकार ने राम के पराक्रम संबंधी प्रसंगों का सर्वत्र व्यापक उल्लेख किया है जबकि मानसकार की प्रवृत्ति राम के ओज गुण की अपेक्षा माधुर्य गुण की ओर अधिक रही है।

रामायण में विश्वामित्रादि द्वारा गंगा पार कर मिथिला पहुँचने पर अहिल्या का प्रसंग वर्णित हुआ है, जबकि मानस में अध्यात्म रामायण के प्रसंग की ही भाँति गंगा तट पर ही उक्त कथा का संबंध बताया गया है। रामायण में राम पादस्पर्श से अहिल्या का उद्धार करते हैं।<sup>7</sup> जबकि मानस में पद-रज द्वारा अहिल्या अपने चेतन तेजस्वी रूप को प्राप्त करती है—

**परसत पद पावन सोक नसावन प्रगट भई तप पुंज सही।<sup>8</sup>**

मानस में धनुर्भंग-प्रसंग के पूर्व अनेक प्रसंगों का उल्लेख किया गया है— राम का जनकपुर भ्रमण तथा पुष्प वाटिका प्रसंग। जनकपुर भ्रमण प्रसंग में तुलसी का लक्ष्य यह रहा है कि जनकपुर के नर-नारी भी सीता-विवाह के पूर्व राम के सौंदर्य<sup>9</sup> से प्रेमाभिभूत हो उठें और आनंदित हो जाएँ—

“हियं हरषहिं बरषहिं सुमन सुमुखि सुलोचनि वृंद ।

जहि जहाँ जहाँ बन्धु दोउ तहँ-तहँ परमानन्द ।”<sup>10</sup>

उक्त प्रसंग में भी तुलसी ने मर्यादा को विशेष ध्यान में रखा है। जनकपुर की ललनाएँ, कुलवधुएँ राम-लक्ष्मण के दर्शनार्थ भागकर गलियों में नहीं आती अपितु वे उत्सुक नेत्रों से झरोखों से झाँकती हैं, लोचनों का लाभ पाकर कह उठती हैं—

“सुर नर असुर नाग मुनि माहीं, सोभा असि कहूँ सुनिअत नाहीं ।”

यह प्रसंग बहुत कुछ भागवत के उस विवरण के समान है जबकि कृष्ण को मथुरा भ्रमण करते देख समस्त मथुरा निवासी उनके सुंदर दर्शन पाकर प्रेम-विभोर हो उठते हैं। दोनों ग्रंथों के पुष्प-वाटिका प्रसंग के विषय में अंतर का कारण यह है कि वाल्मीकि के समय में पूर्वराग की प्रथा का प्रचलन नहीं था। इसका प्रचलन समाज एवं साहित्य में 8वीं शताब्दी के बाद हुआ। चंदबरदायी-जगनिक तथा मलिक मुहम्मद जायसी ने क्रमशः पृथ्वीराज रासो, आल्हा तथा पद्मावत में पूर्वराग का व्यापक चित्रण मिलता है। तुलसी ने इस परंपरा प्राप्त पूर्वराग दशा को भी अपने मानस में स्थान देने के लिए ही पुष्प वाटिका प्रसंग की योजना की है।

शूर्पणखा विरूपीकरण का प्रसंग भी वाल्मीकि रामायण में कुछ भिन्न प्रकार से वर्णित है। वाल्मीकि द्वारा प्रस्तुत शूर्पणखा अपने स्वाभाविक दुर्मुखी, विरूमावेश में आती है।<sup>12</sup> जबकि मानस में रुचिर रूप धारण कर आती है<sup>13</sup> बाद में भंयकर रूप प्रकट करती है।

अबहिं मातु मैं जाऊ लिवार्ई, प्रभु आयसु नहीं राम दोहाई।<sup>13</sup>

लंका दहन के प्रसंग में भी अंतर है। रामायण में हनुमान को नगर में घुमाकर फिर पूँछ में आग लगाई गई। अध्यात्म रामायण में भी सारे नगर में हनुमान को चोर कहकर घुमाया <sup>14</sup> परंतु तुलसीदास जी ने मानस में कौतुकमय लीला का वर्णन किया है। <sup>15</sup> अतः हनुमान जी पर कोई कटु आपेक्ष नहीं लगने पाया है।

वाल्मीकि रामायण में रावण द्वारा विभीषण पर चरण-प्रहार किए जाने की घटना का कोई उल्लेख नहीं। सामान्य रूप से ही वह राम के दल में जा मिलता है। मानसकार ने “तुम पितु सरिस भलेहि मोहि मारा” की अभिव्यक्ति कराकर न केवल उसके जीवन-व्यापी साधुभाव को ही व्यंजित किया है वरन् उसके प्रतिपक्ष दल में जाने की घटना को स्वाभाविक बना दिया है।

रामायण में राम के जीवन से सम्बन्धित कतिपय घटनाओं का व्यापक

वर्णन किया गया है,

जिनका मानस में नितान्त अभाव है, वे हैं—शत्रुघ्न द्वारा लवणासुर वध<sup>16</sup> का लव-कुश एवं सीता सहित यज्ञशाला में आगमन, सीता का पृथ्वी प्रवेश, हनुमान, जांबवान, द्विविद को राम द्वारा पृथ्वी पर रहने का आदेश देना तथा राम का परिजन और पुरतनों के साथ महाप्रस्थान।

इन प्रसंगों का विस्तार तुलसी ने अपने रामचरितमानस में करना उचित नहीं समझा, क्योंकि वे अपने काव्य ग्रंथ का निष्कर्ष लिख चुके हैं—

एहि महँ आदि मध्य अवसाना

प्रभु प्रतिपाद्य भगवान् ।।

अतएव भगवान् राम से अतिरिक्त प्रसंगों की ओर उनकी वृत्ति नहीं रमी। लवणासुर वध का प्रत्यक्ष संबंध राम से न होकर शत्रुघ्न चरित से है।  
उपसंहार :

वाल्मीकि कृत रामायण आदिकाव्य है। अतएव इसकी कथा का स्रोत अन्यत्र खोजना असंगत होगा। रामचरितमानस की कथा का मूलाधार वाल्मीकीय रामायण है। रामचरितमानस की कथावस्तु, वर्ण्य प्रतिपादन तथा चरित्र-चित्रण पर संस्कृत के अनेक महत्त्वपूर्ण ग्रंथों का प्रभाव दृष्टिगोचर होता है। रामचरितमानस के प्रारंभ में गोस्वामी जी ने स्वयं इस बात को निम्नलिखित पंक्तियों में स्वीकार किया है—

“नाना पुराणनिगमागमसम्मतं यद्

रामायणे निगदितं क्वचिदन्यतोऽपि ।

स्वांतः सुखाय तुलसी रघुनाथ गाथा

भाषा निबद्ध मति मंजुलमातनोति ।।”

रामकथा पर अनेक काव्य लिखे गए, जिनका गोस्वामी जी पर प्रभाव पड़ना अवश्यभावी था। अतएव उन ग्रंथों के कथा-प्रवाह, भाव, भाषा को अपने कला-निपुणता एवं प्रतिभा द्वारा ग्रहण करके मानस के रूप में अभिन्न स्वरूप प्रदान किया। मानस वस्तुतः एक वह पारदर्शी दर्पण है, जिसमें जीवन-दर्शन ही नहीं अपितु जीवन से परे भी जो कुछ है— वह सभी प्रकाशवान हो उठता है।

उपादेयता की दृष्टि से यदि मूल्यांकन किया जाए तो दोनों ग्रंथ विश्व-विश्रुत हैं। रामायण यदि उपजीव्य काव्य बनकर रामकाव्यों की प्रेरक-शक्ति रखती है तो रामचरितमानस जन-काव्य के रूप में उर-प्रेरक बनकर अत्यंत उपयोगी सिद्ध हुआ है।

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## 21वीं सदी की हिन्दी कविता में स्त्री-अस्मिता के स्वर

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वैदिक काल के पूर्व तथा वैदिक काल में नारी सम्मानित थी। वह अपनी बौद्धिक और आत्मिक उन्नति करने में स्वतन्त्र थी। वेदों का अध्ययन कर सकती थी। वैदिक काल की गार्गी, मैत्रेयी, लीलावती आदि विदुषियाँ इसका प्रमाण हैं। नारी के सहयोग बिना सभी अनुष्ठान अपूर्ण समझे जाते थे।

“यत्र नार्यस्तु पूज्यन्ते रमन्ते तत्र देवताः”

अर्थात् जहाँ नारी की पूजा होती है, जहाँ नारी को श्रद्धा, आदर, प्रेम और विश्वास दिया जाता है, वहाँ देवता निवास करते हैं। परन्तु धीरे-धीरे स्त्री का यह स्थान डावाँडोल होता गया। मध्यकाल तक आते-आते कन्या को अवांछनीय समझा जाने लगा, नारी को अविश्वसनीय, चंचल, अस्थिर बुद्धि की, छल-छद्म से युक्त माना जाने लगा। उस पर बन्धन डाले गये। उसकी स्वतन्त्रता खण्डित हो गयी। उसे पर्दे में बन्दिस्त किया गया। वह अनमेल विवाह, विधवाओं पर सख्ती, सती-प्रथा जैसी कुरीतियों में जकड़ी गयी। पुरुषप्रधान संस्कृति में सदियों से नारी को अधिकारों से वंचित रखा गया। वैदिक काल की 'साम्राज्ञी' आधुनिक काल तक आते-आते बन्धनों के शिकंजे में कसती चली गयी।

आज के वैज्ञानिक तथा तकनीकी युग में समाज में तेजी से परिवर्तन हो रहे हैं। परम्परागत मूल्यों का विघटन हो रहा है तथा नवीन जीवन-मूल्यों की स्थापना हो रही है।

नारी ने अपनी प्रगति के रास्ते ढूँढ़ निकाले हैं, उसमें नयी चेतना विकसित हो रही है। वह मानव रूप में प्रतिष्ठित हो रही है। वह अपना

स्वतन्त्र अस्तित्व, स्वतन्त्र व्यक्तित्व और स्वतन्त्र निर्णय चाहती है। उसे अपनी महत्ता और अस्मिता पर गर्व है। वह जानती है—“एक नहीं, दो-दो मात्राएँ, नर से भारी नारी।”<sup>2</sup>

वह पुरुष निर्मित प्रतिमानों पर अपना मूल्यांकन करवाना नहीं चाहती। आज नारी केवल भोग का साधन और सन्तान की माता बनकर ही नहीं रहना चाहती, बल्कि अपने व्यक्तित्व की सार्थकता चाहती है। वह परिवार एवं समाज की उन्नति में महत्त्वपूर्ण योगदान देना चाहती है, परन्तु उसे आर्थिक स्वतन्त्रता पाने, आत्मनिर्भर बनने, अपनी क्षमता बनाने का यह रास्ता दुरूह लग रहा है। इसे प्राप्त करने के लिए उसे बड़ी कीमत अदा करनी पड़ रही है।

विगत तीन दशकों से हिन्दी कविता जगत् में स्त्री के प्रति लेखन और रचना की दृष्टि की आहट सुनाई देती है। समकालीन कविताओं में नारी की पीड़ा को व्यापक स्तर पर अभिव्यक्ति मिली है। आधुनिकता के फलस्वरूप अपने अस्तित्व के प्रति सजग और सचेत स्त्री को घर, परिवार तथा बाहर हर स्तर पर पुरुष के वर्चस्व का सामना करना पड़ता है। समकालीन कविता में नारी की इस पीड़ा को पूरी संवेदनशीलता के साथ प्रस्तुत किया है। सविता सिंह, अनामिका, कात्यायनीय, अर्चना वर्मा, निर्मल गर्ग तथा निलेश रघुवंशी की कविताओं में स्त्री-पीड़ा का मर्म कई स्तरों पर उभरा है।

अर्चना वर्मा की कविता ‘दिनचर्या’ में स्त्री की पुरुष के दम्भ से टकराहट इन भावों में अभिव्यक्त हुई है—

“आज उसने तुम्हारे गलत को गलत नहीं कहा  
बच्चे को पड़ा बेबात थप्पड़  
अपने गाल पर सहा  
औरतों की बेअक्कली पर तुम्हारा  
लतीफा सुना  
और सुनने का बहाना किया  
बल्कि खुद को जुटा दिये  
अपनी बेवकूफी के सबूत और  
तुम्हारे दम्भ को सहसाया।”

पुरुष अपने अहं के कारण नारी की स्वतन्त्रता को सहन नहीं कर पाता। कात्यायनी द्वारा रचित कविता ‘शहर को चुनौती’ में पुरुष, नारी की आजादी को समाज के लिए भयंकर खतरा मानता है। वह नारी की आजादी को जड़-मूल से समाप्त करने का आह्वान करता है—

“पकड़ो उसे, मिटा डालो  
कुचल दो, नेस्तनाबूद कर दो  
नहीं तो पूरे समाज पर  
बहुत बड़ा खतरा आ जाएगा।”

समकालीन कवियों ने नारी-जीवन के अनछुए पहलुओं पर अपनी लेखनी चलाई है। इन कविताओं में नारी की कुण्ठा, पीड़ा, संघर्ष सभी रूपों को चित्रित किया है।

समकालीन कविता में स्त्री के लिए न्याय व अधिकारों की माँग करते हुए उसे समाज में पुरुष के समकक्ष दर्जा दिलाने के लिए आवाज उठाई है। स्त्री-अस्मिता का प्रश्न पूरे सशक्त रूप से उभरा है—

“मैं अपने आप को पहचानती हूँ

अपने माँ बनने

और

उसके बाप बनने के बहुत पहले से

मले ही वह मुझ पर अपनी पहचान थोपता है

मगर

मैं उसे

अपनी पहचान नहीं दूँगी”<sup>3</sup>

कवयित्री निर्मला गर्ग स्त्री को दोयम दर्जा देने वाली मानसिकता का विरोध करती हैं। वे इस रूढ़ मानसिकता को ‘बराबर का दर्जा’ कविता में इस प्रकार अभिव्यक्त करती हैं—

“स्त्रियों में बराबर दर्जा दूँ

यानी ठीक अपनी ही तरह समझूँ

यह कितना मुश्किल है

ऐसा मैं कैसे कर पाऊँगा”<sup>4</sup>

पुरुष के वर्चस्व को नकारती आज की स्त्री अपने अस्तित्व को बचाए रखने के लिए हर चुनौती का सामना करने के लिए तैयार है। जीवन की विकट परिस्थितियों से बचने या उनके समक्ष समर्पण करने के बजाय वह उन समस्त चुनौतियों को स्वीकार करने का साहस जुटा चुकी है।

कात्यायनी के भावों में—

“अस्वीकार

इस तरह मरने से अस्वीकार है

स्वीकार मुझे यह अधूरापन

और यह नाउम्मीदी  
उम्मीदों के नाग पर  
लो मुझे स्वीकार है

इस हालात की समूची चुनौतियाँ”<sup>5</sup>

21वीं सदी की हिन्दी कविता में अभिव्यक्त संवेदनाओं का सम्बन्ध समाज के हर वर्ग की स्त्री से है। मध्यवर्गीय कामकाजी स्त्री की दुनिया, उच्चवर्गीय स्त्री के अनेक कड़वे सत्य— इस कविता में उद्घाटित हुए हैं। कवयित्री रेखा मैत्र समाज द्वारा स्त्री के लिए बनाये नियम मानदण्डों को अस्वीकार कर नये रास्ते बनाने वाली स्त्री के मनोभावों को इस प्रकार व्यक्त करती हैं—

“जीवन में मुझे  
अपने रास्ते खुद ही गढ़ने होंगे  
लोगों के बनाये रास्तों पर  
फिर लड़खड़ाऊँगी  
गिरूँगी।”<sup>6</sup>

नीलेश रघुवंशी ने ‘माँ’ कविता में समाज के परम्परागत ढाँचे में घुटती स्त्री का चित्रण अनेक कड़वे सत्यों के साथ किया है—

“जिन्दगी के शोरगुल में  
दिल के दूसरे कोनों में  
अपने बच्चों की मुहब्बत के जुगनू छिपाकर  
मेरी माँ जीती थी।  
जीती क्या, रोज टूटती थी, खत्म होती थी  
माँ मर गयी और अब मैं  
अपने बच्चों की मुहब्बत के जुगनू छिपाकर  
उनकी रोशनी में हँसती, फना होती  
तबाह हो रही।”<sup>7</sup>

उपभोक्तावाद एवं बाजारवादी संस्कृति के बढ़ते वर्चस्व के कारण भारतीय संस्कृति जगत् में जो उठा-पटक हुई है— उसके केन्द्र में स्त्री है। बाजारवादी संस्कृति के केन्द्र में ‘स्त्री देह’ है। सुधीश पचौरी के भावों में— “यहाँ दोहरा संकट बन रहा है। एक ओर स्त्री कर्मक्षेत्र और उपभोक्ता क्षेत्र दोनों में मर्द के दायरे से निकलकर अपनी भाषा बना रही है और इस तरह मर्दों की निरकुंश दुनिया को विचलित कर रही है तो दूसरी ओर ऐसा लगता है कि वह स्वयं उपभोक्तावादी वस्तु बनती जा रही है।”

समकालीन कविता में स्त्री की इस दशा का मार्मिक चित्रण हुआ है। निर्मला गर्ग की कविता 'तू रोये जा रही है' में नारी की संवेदनाओं को कुचलती बाजारवादी संस्कृति का उल्लेख मिलता है—

“लड़की तेरे बाल मुलायम हैं, और मुलायम बना  
लड़की तेरी त्वचा कोमल है, और कोमल बना  
लड़की तू सुन्दर है और सुन्दर दिख।  
नित नयी चीजें बनाई जा रही हैं तेरे लिए  
तेरे लिए ही तो दुनिया सजाई जा रही है  
तेरे लिए, तू है कि रोये जा रही है।”<sup>8</sup>

स्त्री और पुरुष के बीच भेदभाव करने वाली मानसिकता समाज में आज भी व्याप्त है। भारतीय समाज में आज भी कन्या-भ्रूणहत्या जारी है। अनेक राज्यों में लिंगानुपात एक गहरी चिन्ता का विषय बन चुका है। समकालीन कवि ने कन्या-भ्रूणहत्या के खिलाफ आक्रोश प्रकट किया है—

“आखिर क्यों है तुम्हें  
हमारे अस्तित्व से इतनी चिढ़  
हमारे कोमल सपनों से इतनी नफरत?  
घर-बार जीने की चाह में छटपटाती  
और, जन्म से पहले ही  
मरने को मजबूर कर दी जाती  
हम हैं, तुम्हारी अजन्मी बेटियाँ”<sup>9</sup>

समकालीन हिन्दी कविता में स्त्री की अपनी देह की राजनीति और 'स्व' के प्रति सजगता भी प्रकट हुई है। इस सम्बन्ध में कात्यायनी की निम्नलिखित पंक्तियाँ महत्त्वपूर्ण हैं—

“अब इतनी सकत नहीं रही  
कि दिनमर मुस्कुरा सकूँ  
अदाएँ दिखा सकूँ  
या  
दूरदर्शन पर सौन्दर्य-प्रसाधनों का  
विज्ञापन कर सकूँ।”

इस प्रकार कहा जा सकता है कि समकालीन काव्य में नारी के सभी रूपों को कवि ने वाणी दी है। जिन सामाजिक प्रभावों और वैज्ञानिक यान्त्रिक प्रभावों के कारण विश्व जीवन और व्यवहार में अनेक परिवर्तन आये हैं, उन सबका प्रभाव नारी-जीवन पर आना भी स्वाभाविक है। इसी कारण उसके

व्यवहार, विचार, जीवन-शैली तथा संस्कारों में व्यापक परिवर्तन परिलक्षित होते हैं। इन समस्त परिवर्तनों को आज के कवियों ने अपने-अपने दृष्टिकोण से ग्रहण कर अभिव्यक्त किया है।

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3. तरन्नुम रियाज, बीसवीं सदी का नारी पंजाबी साहित्य, पृष्ठ 133
4. निर्मला गर्ग, कबाड़ी का तराजू, पृष्ठ 101
5. कात्यायनी, इस पौरुष समय में, पृष्ठ 139
6. रेखा मैत्र, मुट्ठीभर धूप, पृष्ठ 29
7. नीलेश रघुवंशी, घर निकासी, पृष्ठ 24
8. निर्मला गर्ग, कबाड़ी का तराजू, पृष्ठ 79
9. जगमोहन आजाद, 'पाती : अजन्मी बेटियों की'।

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# KALEIDOSCOPE OF INDIAN CINEMA

From Cacophony of  
Voices to Euphony of Verses

Editors

Manish Kumar C. Mishra • Manjeet Maan

Co-Editors

Manisha Patil • Shaweta Nanda



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# Contents

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|   |             |
|---|-------------|
| <i>Editorial</i>  | v           |
| 1. Foregrounding Male Concern: Revenge, Sympathy and Female Body in Hindi Cinema<br><i>Dr. Anuradha Sharma</i>  | 1           |
| 2. Decoding Shakespeare:<br>An Adaptation of Triology by Vishal Bhardwaj<br><i>Manjeet Maan</i>   | <u>9-16</u> |
| 3. Indian Animation Films: A Dream Unfulfilled<br><i>Dr. Manisha Patil</i>  | 17          |
| 4. Imagined and Real Widowhood in Two Hindi Films:<br>A Case Study of Kati Patang and Prem Rog<br><i>Nirmal Kumar</i>                                   | 22          |
| 5. Stereotyping Women in Indian Cinema<br><i>Dr. Vatika Sibal</i>   | 34          |
| 6. Directing Women Power: Reflections on the Promotion<br>of Feminist Identity in Director Puttanna Kanagal's<br>Kannada Films<br><i>Dr. Vidya H.N.</i> | 44          |
| 7. The New Woman in Indian Cinema: Shattering Myths<br><i>Ekta Sawhney</i>  | 51          |

## 2

# **Decoding Shakespeare: An Adaptation of Trilogy by Vishal Bhardwaj**

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*Manjeet Maan*

Literary adaptations of literary works in Hindi cinema is very popular since ancient times. First adaptation in Hindi cinema came into existence in 1962, in the form of a popular movie Sahib, Biwi Aur Gulam, which is the adaptation of the novel written by the Bengali author Bimla Mitra. Chetan Bhagat 3 Idiots, Hello, Kai Po Che, Two States and very recent Half Girlfriend. Most successful book adaptation in Hindi cinema is Devdas, based on Sharatchandra Chattopadhyay's Parineeta, which is well received by audience. Guide based on R K Narayan's 'Guide', Tere Mere Sapne based on Dr. Cronin's The Citadel, Aisha, 2005, based on Jane Austen's Emma, Junoon, 1978, based on Ruskin Bond's novella, A Flight of Pigeons, Pinjar, 2004 based on Amrita Pritam's partition novel 'Pinjar'. A masterpiece Shatranj Ke Khiladi by Satyajit Ray is an adaptation of Munshi Premchand's book by the same name.

Looters based on The Last Leaf. Saawariya based on a short story by Fyodor Dostoevsky's White Nights.

Adaptation is a process of transformation of a literary work so that it can help to stick out a new destination, a different target and new viewers. Film adaptation is a common form where we use a literary work or any other composition as the presence of a feature film. Cinema provides a definite outline of space and characters full of flesh and blood. Through the adaptation the viewers can grasp the main content of a written work easily. In the film characters are more substantial through which the main context can be introduced in more productive way.

The main form of film adaptation is transformation of a novel or drama as a feature film. But the other literary form like autobiography, comic books, plays, scriptures and other sources can be adopted into films. Technological developments as well as new aesthetic ideals can make a film more appealing. But the film adaptations should be evaluated based on their unique peculiarity. According to a film critic for the New Yorker Paulin Koel—

“If some people could rather see the movie than read the books. This may be a fact of life that we must allow for but let’s not pretend that people get the same thing out of both or that nothing is lost.”

The history of Indian colonial domination inevitably extends the domination of culture. The education of colonised India was dominated by western writers including Shakespeare because his works represented the innermost values of western culture. Shakespeare was a great dramatist of Elizabethan period who presented the difficulties of human life. His greatness is in this fact he projects his characters according to their own experiences and gives voices to voiceless people. Even minor characters play an important role in his plays. This is the main reason that his works are depicted all over world. His works are like ‘Polar Star’ in literature which gives direction to ‘Wandering Bark’ in the sea. According to The Guardian—

A survey of British Council reported that Shakespeare was more popular in emerging economies i.e. India, China, Turkey, Mexico etc. than in Britain. This report also explains the reason for low popularity that Britons were taught Shakespearean works in original form while in other parts people often studied his works in translated form that used a more contemporary language.

Bollywood film industry has considered as a second best film industry in the world. It has a long history of adaptation of popular novels and drama in films.

The universality of Shakespearean works has seen continuous adaptation in Hollywood and Bollywood cinema. Indian film industry has also been inspired by this great dramatist and has kept Shakespeare alive and relevant by frequent adaptation of his works. He was the famous dramatist of Elizabethan age which is considered golden period in the history of English literature.

It is not only in Bollywood movies but also in regional cinema, Shakespeare is very popular in this regard. In Bollywood, it has come in to existence with a popular comedy film 'Angoor' in 1982, based on Shakespeare's famous comedy, Comedy of Errors, in which all characters are innocent and destiny plays the main role in bringing all characters to one place. His works have the universal appeal that works like a polar star which gives directions to every wandering bark.

The most famous adaptation is trilogy by Vishal Bhardwaj, an Indian film producer and director, also inspired by Shakespeare's genius. The history of film adaptation is witnessed that there were many adaptations of Shakespeare's works. But my present research work includes only three major adaptations, *Maqbool* as an adaptation of *Macbeth*, *Omkara* as of *Othello* and *Haider* as *Hamlet*. These films not only impressed the readers with their charm, but also helped the non-readers to enter into the world of literature, without even letting them to know of it.

Macbeth was adopted as a film *Maqbool* by film director Vishal Bhardwaj. In this film the main actor was Irfan Khan who played the role of Macbeth. The role played by Pankaj Kapoor was of Jahangir Khan or Aaji as a powerful underworld Don and his mistress was Tabu named as Nimmi. *Maqbool* was loved by his mistress by his mistress who was his right hand man. But *Maqbool* was very much devoted to Abbaji. The role of corrupt police officers was played by Ompuri and Nasseruddin Shah. They were two symbolic characters representing three witches in the play. Like three witches they also predicted the growth of *Maqbool* taking over the empire of Abbaji. They brainwashed *Maqbool* who was loyal to Abbaji.

In this situation *Maqbool* was very confused whether to be loyal towards Abbaji or to gain authority by overthrowing him and his inclination to be with Nimmi. She also introduces an idea to *Maqbool* of killing Abbaji. Being motivated by Nimmi, he started his mission for becoming Don. He managed to kill him with the assistance of Nimmi because he was overpowered by his ambition. After that they were haunted by the guilt of Abbaji's murder. They were also confronted by the ghost of Abbaji. At last the lovers were dead and in this way they met their tragic ends.

Besides these three tragic heroes there were many other characters that were significant. The role of Ompuri and Nasseruddin Shah were also responsible for the pace in the storyline in the movie. They played the role of both inspector and astrologer as well. Here Vishal Bhardwaj had portrayed their characters in contrast to the Shakespearean play because they were not just inactive soothsayers but were involve in plotting the events. They succeeded in patching clumsily an encounter on Riyaz Boti who was playing the part of Macduff and subsequently setting up an alliance between a rival politician. Guddu, who was playing the role of Fleance also motivated by these corrupt police of dicey.

Masumeh Makhija and Piyush Mishra also played a role in the movie. This movie was very much praised by the critics in the

terms of events and characterisation. The plot of film inspired by Macbeth, a famous tragic play written by Shakespeare. Thought this movie was inspired by play but in the backdrop of the movie we saw Mumbai underworld. In this movie the major events of the play 'Macbeth' had successfully with the intrigues and conspiracies of Mumbai underworld.

After the completion of adaptation of the film Maqbool and the main focus of Vishal Bhardwaj was on the play 'Othello'. The adaptation of Othello was the movie Omkara which was released in 2006 was also directed by Vishal Bhardwaj. In this starring actor Ajay Devgan was playing the role of Othello, and the role of Desdemona was played by Kareena Kapoor. Shaif Ali Khan as Ishwar Langda Tyagi (Lago). The film was very successful from the commercial point also. It was mainly praised for its music by the audience. The lines of the music composed by lyricists, Gulzar was according to today's situation. The plot of the movie was placed in a small town in Uttar Pradesh, Meerut. The politics was the main backdrop of the movie but it is presented well, not only in India but also in other neighbouring countries.

If we see the historical background of cinematic world there are so many films on the politics and crime of Uttar Pradesh. But according to portrayal of incidents and characterisation in Omkara is very different from all these. The main setting of this movie is in Meerut. It's setting, characterisation and plot are major ingredients to win many awards like Film Fare Award and National Awards.

Movie has a great opening with Langda Tyagi, gate crossing baraat, challenging the bridegroom Raager to stop Omkara from the abduction of Dolly Mishra, his bride. But he failed and wedding never takes place. After the abduction of Dolly, her father Rajnath Mishra confronted Omi. He made pressure on Omi to return his daughter but Dolly herself refused to go back. She clarified that she loves Omi and herself eloped with him. After hearing this statement from Dolly her father felt ashamed and never turned back.

Main character in this movie was Omkara, who was a kind of political leader but has the connections with a criminal group for the local politician Tiwari Bhaisahab. After the whole situation, Indu clarified the misunderstanding of Omi against Dolly blaming Langda for the entire situation. At the end, Langda was killed by Indu and Omi committed suicide after killing Dolly.

There was also some other important characters who played important role like, Bipasa Basu as Billo Chamanbahar, Konkana Sen as Indu, Tyagi, Deepak, Dobriyal as Rajan Tiwari, Naseeruddin Shah as Bhaisahab and Komal Tiwari as Advocate Raghunath Mishra.

Besides these two adaptations, Haider is also an adaptation of Shakespearean play Hamlet, which is considered as best movie of the year in the history of film adaptation. It is based on Kashmir's situation in 1990's, a time when its condition was not favourable. Shahid Kapoor played the leading role in the movie as Haider, the significant role of Hamlet. He came back to Srinagar from Ammu after the death of his father. The role of Hamlet's girlfriend Ophelia was played by Sharaddha Kapoor and the role of Gertrude was played by Tabu and Kay Kay Menon as Hamlet's uncle, Claudius.

It was the time of turmoil in Kashmir so after the disappearance of his father Haider turned back to Kashmir and leaves his study. His father was taken away by forces as he was found guilty of helping militants. Later Haider found that his uncle was a traitor and responsible for his father's misfortunes.

There is a clear similarity between the movie and the play. In both the actions, in movie and play, sons want to take revenge of their father's death. Haider, during his journey, he was dropped up into the wrong hands. If he considered that his father was not guilty he should have fought a legal battle which would have not ruined his life.

It is believed by the critics that Bhardwaj had the ability to portray the raw feelings of Hamlet as Haider in the movie while

focusing on Kashmir. Throughout the 1990's, the state was witnessed of it's worst struggle because many militants started their violent attack on Indian army demanding for a separate state. During this time many innocent people killed by the terrorists. Kashmir being the bone of disputes between India and Pakistan since 1947 has seen number of violations on the boarder. Pakistan was continuously warned by India for supporting the militants gang but in the movie called Haider, we didn't see the Indo-Pak rivalry and instead of it we see the human rights violations throughout the movie.

After so many contradictions Kashmir became a burning issue for India. Bhardwaj was criticised by media as well as other Indian groups about the role of armed forces as they all describes it as an 'unfair', but he spoke defending the movie—

“I am also an Indian, I am also a patriot and I also love my nation.

So I wouldn't do anything which is anti-national, but what is anti-human, I will definitely comment on it.”

### **Conclusion**

As I think, adaptation of trilogy is an honest effort by Vishal Bhardwaj in which he tries to decode the characters and situation as per demand of time and place. Without having an 'Indian-tadka', it is not possible to connect the audience with it, by which they can understand this in true manners. The settings of movies in different parts of country as Haider in Kashmir, Omkara in Uttar Pradesh and Maqbool in Maharashtra (Bombay), it also a considerable effort by the director give the universality to Shakespeare.

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## Structural characterization and rietveld refinement of CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> nanocomposites prepared via coprecipitation method

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**Abstract:** The CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> nanocomposites were synthesized through the co-precipitation approach followed by heat-treatment. As-prepared sample were sintered at temp 600°C and 800°C for two hours. To study the structural characterization of the prepared samples X-ray diffraction (XRD) technique was used. The obtained XRD data was further refined through the Rietveld method by using the fullprof suit software. The heat-treated samples exhibit two crystalline phases namely CeO<sub>2</sub> and CoFe<sub>2</sub>O<sub>4</sub>. The refinement confirmed that all the samples are cubic structure. The CoFe<sub>2</sub>O<sub>4</sub> was found to have an fcc cubic structure with space group Fd-3m(227), whereas the crystal structure of CeO<sub>2</sub> has fcc structure with space group Fm-3m(225). In this paper, the lattice parameters, bond length, bond angle, particle size, lattice strain, dislocation density were studied in detail. The Wyckoff positions and interatomic distance have been calculated.

**Keywords:** CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub>, Nanocomposites, Coprecipitation, particle size, lattice strain, dislocation Density.

### 1. INTRODUCTION

From last few decades magnetic nano ferrites of type MFe<sub>2</sub>O<sub>4</sub> have become the source of interest, because of their unique structural, electrical, magnetic, and catalytic properties, where M represents any transition metal ions like Co, Zn, Ni etc. Nano ferrites have found uses in various fields such as magnetic resonance imaging, drug delivery, biomedicine etc [1]. Among the various ferrite materials, cobalt ferrite (CoFe<sub>2</sub>O<sub>4</sub>) with inverse spinel structure in nano form is well known to have some special properties i.e it shows high coercivity, high chemical stability, moderate saturation magnetization (Ms) value, high magnetic anisotropy and mechanical hardness [2]. These strange properties of cobalt ferrite make it fundamental to use in many technological applications such as high-density recording media, cancer treatment and drug delivery, magnetic fluids, magnetic refrigerants [3] etc. To explore the properties of CoFe<sub>2</sub>O<sub>4</sub> in diverse fields it becomes necessary to dope with other metal ions and metal oxide. Ion doping has a great impact on the physicochemical properties of ferrite nanoparticles which leads to the structural disorder, change in particle size, lattice strain and cation redistribution. In past researcher shows that by surface modification, the surface characteristics of ferrite nanoparticles are greatly changed, which will result in some novel performances and applications. Literature reveals that the doping of Gd<sup>3+</sup> in nickel ferrite gives a finite variation in structural and magnetic properties of nickel ferrite [4]. Similarly a change in crystal structure parameter, grain size, saturation magnetization (Ms) and BET surface area of ZnFe<sub>2</sub>O<sub>4</sub> nanoparticles is observed when Ce<sup>3+</sup> is substituted in ZnFe<sub>2</sub>O<sub>4</sub> [5]. Besides, some ferrite composite materials are synthesized to vary surface



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properties and develop new applications using a surface modification method [6]. So to tune the properties of  $\text{CoFe}_2\text{O}_4$  it becomes necessary to make the composites of cobalt ferrite with metal oxide.

In recent year  $\text{CeO}_2$  doped cobalt ferrite nanocomposites has attracted much interest. Cerium is one of the most generous rare earth elements and its oxide ( $\text{CeO}_2$ ) has high dielectric constant and band gap [7]. Nanostructured  $\text{CeO}_2$  has superior physical and chemical properties which make it to widely used in various fields such as catalysis to controlling emissions from vehicles, solar cells, gas sensor etc.[8] The development of nanocomposites of  $\text{CeO}_2$  with magnetic nanoparticles could extend the possible application of these materials, for example, the  $\text{CeO}_2$  doped  $\text{CuFe}_2\text{O}_4$  nanocomposites are widely used in energy storage applications [9]. Similarly,  $\text{Fe}_3\text{O}_4/\text{CeO}_2$  nanocomposites can be used as a magnetically separable catalyst [10].  $\text{CoFe}_2\text{O}_4$  shows strong magnetic behavior so together with  $\text{CeO}_2$  it is can used to produce very strong magnet [11]. Recently  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposite is used as a magnetically separable catalyst [12]. Till now,  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  is less studied systems among researchers. A little work has been reported on successful synthesis of  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposites. Successful preparation of the  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposites by coupling homogeneous precipitation with hydrothermal method was reported by Wetchakun et al. [13]. They have shown that controlled precursors ratios of  $\text{CoFe}_2\text{O}_4$  in  $\text{CeO}_2$  can control the particle size and specific surface area of resultant composite ( $\text{CeO}_2/\text{CoFe}_2\text{O}_4$ ).

So here we have synthesized  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposites using coprecipitation method. In past many techniques like sol-gel, hydrothermal, solid-state reaction, co-precipitation, radiofrequency thermal plasma, etc. were used by the researchers for the synthesis of  $\text{CeO}_2$  and  $\text{CeO}_2$  doped nano composites [14]. Among these methods the coprecipitation method was proved to be less costly, environment-friendly, less time consuming, and easy scale-up [15-16]. Beside synthesis we have also reported the detailed structural characterization of  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposites. We have used XRD to investigate the structural analysis of prepared samples and the accurate resolve of nanostructural parameters has been done using Rietveld analysis. Since, Rietveld refinement is the best method of nanostructure characterization which is able to calculate the reciprocal lattice parameters, lattice strain, change in atomic and direct lattice parameters of relative phase abundances of all the phases in a multiphase scale factor, lattice shift constant, half-width profile parameters, atoms position of nano-crystalline materials, etc. Keeping above facts Rietveld's refinement of X-ray diffraction data has been adopted here. The refinement clearly shows the change in parameters in terms of the bond length, bond angles, and different atomic positions [17-18]. The positions of different atoms create change in the behavior of the same materials and these parameters can be seen behind refinement. However, in the history decade the number of publications which used Rietveld refinement for quantitative phase investigation but to the best of author's knowledge there are limited investigations which report the Rietveld refinement of  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposites.

## 2. EXPERIMENTAL:

$\text{CeO}_2/\text{CoFe}_2\text{O}_4$  nanocomposites with 20wt% of  $\text{CeO}_2$  were prepared by the coprecipitation method. We have used  $\text{FeCl}_3$ ,  $\text{CeCl}_3 \cdot 7\text{H}_2\text{O}$ ,  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$  and  $\text{NaOH}$  as precursors. Magnetic stirring is used to mix these raw materials in their stoichiometric amounts and using deionized water as a solvent. After agitating well,  $\text{NaOH}$  aqueous solution was added drop wise to this mixed solution. During this drop wise addition the pH of the medium was maintained at 11. This will produce precipitate in the solution mixture [19]. Then, the precipitation was aged at  $50^\circ\text{C}$  for 2h. After that the precipitates were washed several times with deionized water and ethanol to remove the water-soluble impurities and free reactants and then dried at  $80^\circ\text{C}$  overnight. The obtained sample was then powdered using agate mortar. This powdered sample was then heated in a muffle furnace at  $600^\circ\text{C}$  (2h) and  $800^\circ\text{C}$  (2h).

### 3. RESULTS AND DISCUSSION:

#### XRD analysis and Rietveld Refinement

XRD is used to determine the presence of crystalline phases of the prepared sample. The XRD pattern has shown in Figure 1. The sample was scanned from 20 degrees to 80 degrees. Rietveld refinement of the XRD data has focused, the phases and structures of the prepared composite sample were determined to investigate the crystal structure which is depicted in Figure 2.

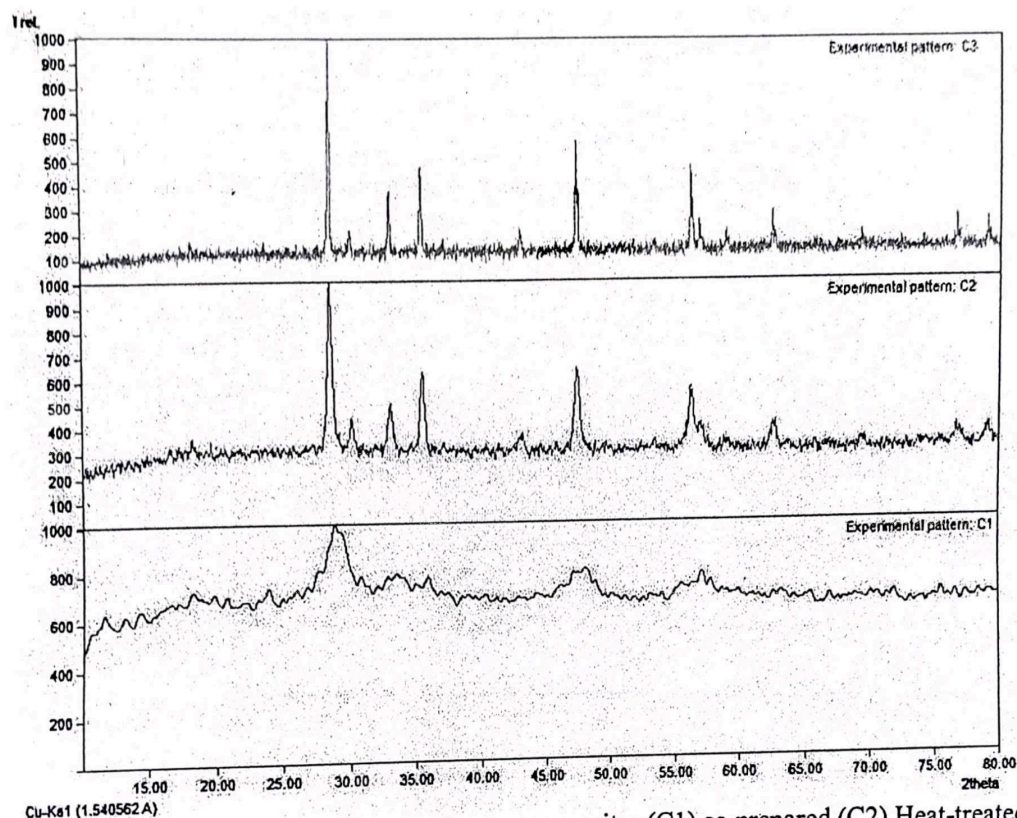


Figure 1. XRD pattern of CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> nanocomposites (C1) as-prepared (C2) Heat-treated at 600°C (C3) Heat-treated at 800°C

The X-ray diffraction (XRD) pattern of powdered sample was obtained at room temperature by using a Philips X ray diffractometer having GIXRD geometry. The diffractometer was operated with a wavelength of radiation 1.5418Å. The diffraction pattern consists of well resolved peaks between 15° and 80° angle indexed as (220),(311),(400),(331),(511),(440) corresponding 2θ- 30.14°, 35.475°, 43.124°, 47.48°, 57.01° and 62.61° respectively are well-matched with the CoFe<sub>2</sub>O<sub>4</sub> ferrite, JCPDS file no. 221086. All the peaks of said diffraction pattern reveals the formation of FCC Cubic structure with space group Fd3m(227)[JCPDS card no-221086].

Further, the peak centred at 2theta- 28.531°(111), 33.14°(200), 47.53°(220), 56.33°(311), 59.06°(222), 76.69°(331), 79.07°(420) give the confirmation of the formation of CeO<sub>2</sub> phase with space group Fm3m(225) (JCPDS file no.810792). The (hkl) plane, 2θ, d-spacing, full width at half maxima, particle size (D), dislocation density(δ) and micro-strain (ε), for the nanocomposite CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> obtained from X-Ray diffraction analysis were shown in table 1 particle size (D) was determined by the scherrer equation (1) and dislocation density (δ) was calculated by the formula (2) are given bellow:

$$D = (0.9 \cdot \lambda) / (FWHM \cdot \cos \theta) \quad (1)$$

$$\delta = 1/D^2 \quad (2)$$

The average particle size was found to be 43.09 nm for CeO<sub>2</sub> phase and 68.89 nm for CoFe<sub>2</sub>O<sub>4</sub> phase. Lattice parameter of cubic CeO<sub>2</sub> with various concentrations of dopant were calculated using relation  $a = [d^2(h^2+k^2+l^2)]^{1/2}$  (results are listed in Table1). Upon increasing the temperature, lattice parameter values tended to decrease because of replacement or may be due to defect formation due to Co ions in the CeO<sub>2</sub> lattice. To observe the effect of Ce doping in Co, Reitveld refinement was done using full prof suit software. Co doping cause lattice contraction as lattice parameter decreases with doping. This contraction occur due to smaller ionic radii of Co<sup>2+</sup> (0.65-0.9Å) than that of Ce<sup>4+</sup>(0.97Å). The Rietveld refinement for the sample CeO<sub>2</sub>/ CoFe<sub>2</sub>O<sub>4</sub> has been shown in Figure 2 by using the FullProf suit software. It could be seen that the profile for observed and calculated ones are matching to each other.

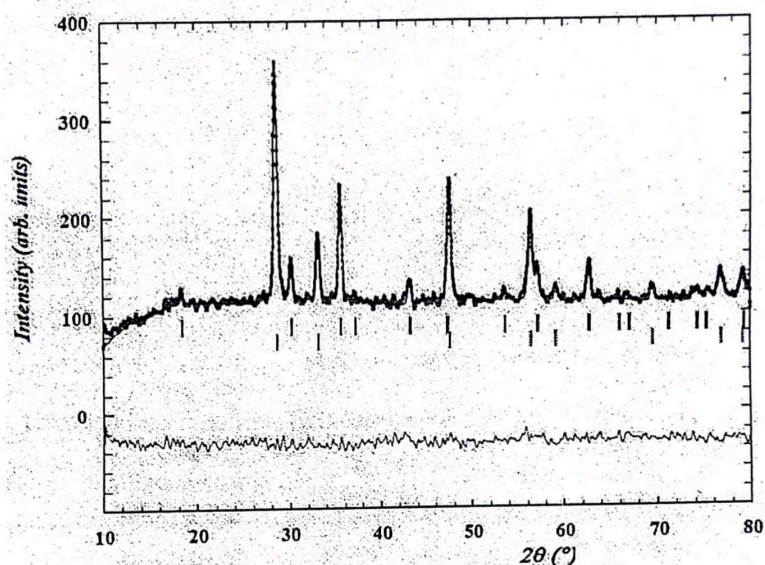


Figure 2. Rietveld refinement of the XRD pattern of CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub>nanocomposite

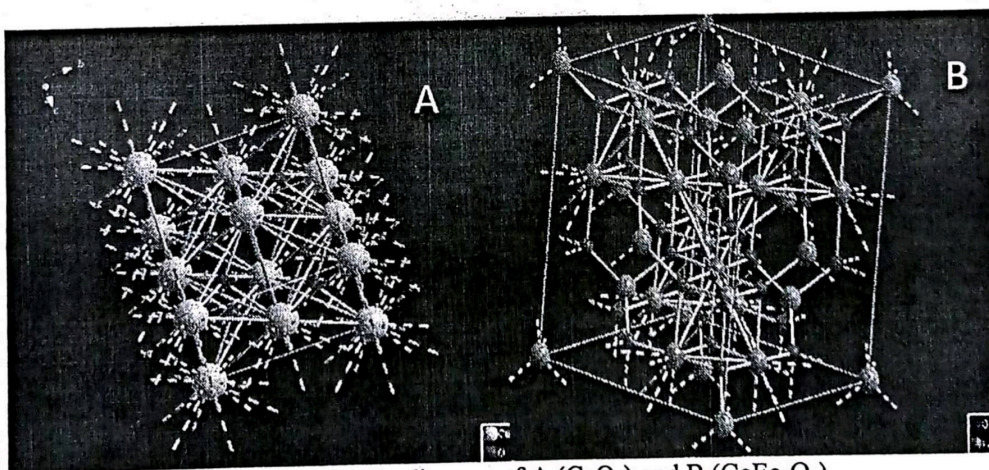


Figure 3. Structure diagram of A (CeO<sub>2</sub>) and B (CoFe<sub>2</sub>O<sub>4</sub>)

Figure 3 shows the crystal structure of CeO<sub>2</sub> (A) and CoFe<sub>2</sub>O<sub>4</sub>(B).The crystal structure of CeO<sub>2</sub> refined in a FCC cubic crystal geomtry (phase 1) with space group Fm3m and the crystal structure of CoFe<sub>2</sub>O<sub>4</sub> successfully refine in FCC cubic crystal geomtry (phase 2) with space group Fd3m. The

refined direct cell parameters for CeO<sub>2</sub> are found to be a = b = c = 5.4089, α = β = γ = 90°. The direct cell volume of CeO<sub>2</sub> are found to be 587.0496 and the refined direct cell parameters for CoFe<sub>2</sub>O<sub>4</sub> are found to be a=b=c=8.3732, α = β = γ = 90° and refined direct cell volume for CoFe<sub>2</sub>O<sub>4</sub> are found to be 587.0496 which is shown in table 2. The Fractional atomic co-ordinates and isothermal parameter of different atoms obtained from the rietveld analysis of XRD patterns for the sample CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> is shown in table 3. The appropriate value of goodness of fit parameters are found to be χ<sup>2</sup>=0.242, Rp = 69.7, Rwp = 34.7, Rexp = 70.51, and bragg R factor for CoFe<sub>2</sub>O<sub>4</sub> is 27.44 and for CeO<sub>2</sub> is 48.41 and Rf factor for CoFe<sub>2</sub>O<sub>4</sub> is 36.07 and for CeO<sub>2</sub> is 57.14 which is shown in table 4. The bond length and bond angles obtained for CoFe<sub>2</sub>O<sub>4</sub> and CeO<sub>2</sub> phase are shown in table 5 and table 6 respectively.

**Table 1.** Crystal Structure parameters of CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> obtained from X- ray Diffraction Pattern

| 2 theta (degree) | particle size(nm) | d-spacing [Å] | (hkl) | FWHM  | Cell paramet er (a) | dislocation density (nm-2) | Strain   |
|------------------|-------------------|---------------|-------|-------|---------------------|----------------------------|----------|
| 28.547           | 76.55198          | 3.124         | (111) | 0.107 | 5.41                | 0.184842884                | 0.00045  |
| 30.14            | 68.50795          | 2.963         | (220) | 0.12  | 5.92                | 0.168918919                | 0.000506 |
| 33.08            | 75.97182          | 2.7057        | (200) | 0.109 | 5.4114              | 0.184795062                | 0.00045  |
| 35.475           | 71.84931          | 2.5284        | (311) | 0.116 | 8.3857              | 0.119249861                | 0.00048  |
| 43.124           | 105.3803          | 2.096         | (400) | 0.081 | 8.384               | 0.119274809                | 0.000329 |
| 47.486           | 90.33987          | 1.913         | (331) | 0.096 | 8.3385              | 0.119924582                | 0.000384 |
| 57.018           | 120.458           | 1.632         | (511) | 0.075 | 8.4801              | 0.117922846                | 0.000288 |
| 59.06            | 76.03488          | 1.562         | (222) | 0.12  | 5.41                | 0.184842884                | 0.000456 |
| 62.616           | 104.4059          | 1.482         | (440) | 0.089 | 8.3834              | 0.119283346                | 0.000332 |
| 76.691           | 87.27148          | 1.2416        | (331) | 0.116 | 5.412               | 0.184774575                | 0.00039  |
| 79.073           | 111.9038          | 1.21          | (420) | 0.092 | 5.411               | 0.184808723                | 0.00031  |

**Table 2.** Rietveld refinement, Cell parameters for CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> nanocomposite

| Materials                        | System configuration and space group | Direct cell parameters       | Direct and reciprocal cell volume | Reciprocal lattice parameter             |
|----------------------------------|--------------------------------------|------------------------------|-----------------------------------|--|
| CoFe <sub>2</sub> O <sub>4</sub> | FCC (Fd3m)                           | a=b=c=8.3732<br>α=β=γ=90.000 | 587.0496 and<br>0.00170343        | a*=b*=c*=0.1194<br>29<br>α*=β*=γ*=90.000 |
| CeO <sub>2</sub>                 | FCC(Fm3m)                            | a=b=c=5.4089<br>α=β=γ=90.000 | 158.2425 and<br>0.00631942        | a*=b*=c*=0.1848<br>81<br>α*=β*=γ*=90.000 |

**Table 3.** Fractional atomic co-ordinates and isothermal parameter of different atoms obtained from the rietveld analysis of XRD patterns for the sample CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub>

| Materials                                  | Atom | Wyck. | Site | x/a     | y/b     | z/c     |
|--|------|-------|------|---------|---------|---------|
| CoFe <sub>2</sub> O <sub>4</sub><br>(Fd3m) | O    | 32e   | .3m  | 0.38000 | 0.38000 | 0.38000 |
|  | Co   | 8a    | -43m | 0       | 0       | 0       |
|  | Fe   | 8a    | -43m | 0       | 0       | 0       |
|  | Fe   | 16d   | -.3m | 5/8     | 5/8     | 5/8     |
|  | Co   | 16d   | -.3m | 5/8     | 5/8     | 5/8     |
| CeO <sub>2</sub><br>(Fm3m)                 | Ce   | 4a    | m-3m | 0       | 0       | 0       |
|  | O    | 8c    | -43m | ¼       | 1/4     | ¼       |

**Table 4.** Result of rietveld refinement for CeO<sub>2</sub>/ CoFe<sub>2</sub>O<sub>4</sub>

| Phase                            | χ <sup>2</sup> | RP   | Rwp  | RE    | Rb    | RF    |
|----------------------------------|----------------|------|------|-------|-------|-------|
| CoFe <sub>2</sub> O <sub>4</sub> | 0.242          | 69.7 | 34.7 | 70.51 | 27.44 | 36.07 |
| CeO <sub>2</sub>                 | 0.242          | 69.7 | 34.7 | 70.51 | 48.41 | 57.14 |

**Table 5.** Bond lengths (Å) and selected angles(degree) of CoFe<sub>2</sub>O<sub>4</sub>

| Atom1 | Atom2 | Atom3 | D 1,2  | D 1,3  | Angle   |
|-------|-------|-------|--------|--------|---------|
| O     | fe co | fe co | 1.8853 | 2.0523 | 123.611 |
| O     | fe co | fe co | 1.8853 | 2.0523 | 123.611 |
| O     | fe co | fe co | 1.8853 | 2.0523 | 123.611 |
| O     | fe co | fe co | 2.0523 | 2.0523 | 92.313  |
| O     | fe co | fe co | 2.0523 | 2.0523 | 92.313  |
| O     | fe co | fe co | 2.0523 | 2.0523 | 92.313  |
| fe co | O     | O     | 1.8853 | 1.8853 | 109.471 |
| fe co | O     | O     | 1.8853 | 1.8853 | 109.471 |
| fe co | O     | O     | 1.8853 | 1.8853 | 109.471 |
| fe co | O     | O     | 1.8853 | 1.8853 | 109.471 |
| fe co | O     | O     | 1.8853 | 1.8853 | 109.471 |
| fe co | O     | O     | 1.8853 | 1.8853 | 109.471 |
| fe co | O     | O     | 2.0523 | 2.0523 | 92.361  |
| fe co | O     | O     | 2.0523 | 2.0523 | 87.639  |
| fe co | O     | O     | 2.0523 | 2.0523 | 180.00  |
| fe co | O     | O     | 2.0523 | 2.0523 | 87.639  |
| fe co | O     | O     | 2.0523 | 2.0523 | 92.361  |
| fe co | O     | O     | 2.0523 | 2.0523 | 92.361  |
| fe co | O     | O     | 2.0523 | 2.0523 | 87.639  |
| fe co | O     | O     | 2.0523 | 2.0523 | 180.00  |
| fe co | O     | O     | 2.0523 | 2.0523 | 87.639  |
| fe co | O     | O     | 2.0523 | 2.0523 | 180.000 |
| fe co | O     | O     | 2.0523 | 2.0523 | 92.361  |
| fe co | O     | O     | 2.0523 | 2.0523 | 87.639  |

**Table 6.** Bond lengths(Å) and selected angles (degree) of CeO<sub>2</sub> phase

| Atom1 | Atom2 | Atom3 | D 1,2  | D 1,3  | Angle   |
|-------|-------|-------|--------|--------|---------|
| Ce    | O     | O     | 2.3418 | 2.3420 | 70.529  |
| Ce    | O     | O     | 2.3418 | 2.3420 | 70.529  |
| Ce    | O     | O     | 2.3418 | 2.3420 | 70.529  |
| Ce    | O     | O     | 2.3418 | 2.3422 | 109.471 |
| Ce    | O     | O     | 2.3418 | 2.3422 | 109.471 |
| Ce    | O     | O     | 2.3418 | 2.3423 | 179.989 |
| Ce    | O     | O     | 2.3420 | 2.3420 | 109.471 |
| Ce    | O     | O     | 2.3420 | 2.3420 | 109.471 |
| Ce    | O     | O     | 2.3420 | 2.3422 | 70.529  |
| Ce    | O     | O     | 2.3420 | 2.3422 | 179.989 |
| O     | Ce    | Ce    | 2.3420 | 2.3420 | 109.471 |
| O     | Ce    | Ce    | 2.3420 | 2.3420 | 109.471 |
| O     | Ce    | Ce    | 2.3420 | 2.3423 | 109.471 |
| O     | Ce    | O     | 2.3420 | 2.7043 | 125.264 |
| O     | Ce    | O     | 2.3420 | 2.7043 | 54.736  |
| O     | Ce    | O     | 2.3420 | 2.7043 | 54.736  |
| O     | Ce    | O     | 2.3420 | 2.7045 | 54.736  |

#### 4. CONCLUSION:

CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> nanocomposites were synthesized through coprecipitation method. The structural characterization of composite had done using XRD and Rietveld Refinement. The crystal structure of CeO<sub>2</sub> has Fcc cubic geometry with space group Fm3m and the crystal structure of CoFe<sub>2</sub>O<sub>4</sub> has cubic geometry with space group Fd3m. The(hkl) plane, 2 theta, d-spacing, FWHM, particle size, Lattice strain and dislocation density value of nano sized CeO<sub>2</sub>/CoFe<sub>2</sub>O<sub>4</sub> phase was estimated. The goodness factor parameters of our samples are found to be  $\chi^2=0.242$ , Rp= 69.7, Rwp= 34.7, Rexp=70.51 and

braggR factor for  $\text{CoFe}_2\text{O}_4$  is 27.44 and for  $\text{CeO}_2$  is 48.41 and Rf factor for  $\text{CoFe}_2\text{O}_4$  is 36.07 and for  $\text{CeO}_2$  is 57.14. The agreement factors (R-factors) and  $\chi^2$  using fullproof program shows good fitting. The structural refinement of  $\text{CeO}_2/\text{CoFe}_2\text{O}_4$  samples is in good agreement with XRD results.

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Impact factor - 0.415

# Synthesis and Optimization of ZnFe<sub>2</sub>O<sub>4</sub>/TiO<sub>2</sub> Nanocomposite

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**Abstract.** Nanocomposite of ZnFe<sub>2</sub>O<sub>4</sub>/TiO<sub>2</sub> was synthesized by sol-gel method. Fractional Factorial Design was used to investigate the effect of the process (synthesis) parameters like concentration of precursors and annealing temperature on the particle size of resultant composite. Response surface method (RSM) was used to investigate the design of the creation process and the statistical analysis of the effect of process parameters. The RSM results were then used as objective functions for optimization of the response parameters. In the experimental design, quadratic polynomial model was fitted to predict the response value and the best fitted linear model was statistically tested through analysis of variance (ANOVA). The model validity was analyzed through the analysis of residuals.

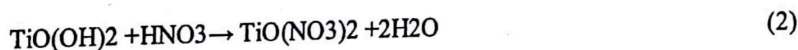
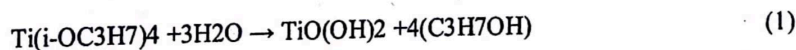
## INTRODUCTION

The study of metal oxides especially metal oxide doped ferrites have attracted the attention of material science researchers and scientist due to their optical, electrical, magnetic, mechanical and catalytic properties, which make them technologically useful [1]. Recently Titania has been widely studied for its wide application in photocatalysis, solar cells and hydrogen production [2]. Nanosized Titania has high photoactivity and superior property in photoelectric conversion under ultraviolet, while nanosized zinc ferrite is sensitive to visible light. In this paper, composite of zinc ferrite doped Titania powder was prepared by sol-gel method with the aim of extending the light absorption spectrum toward the visible region. Structure, texture and chemical composition of resultant powdered composite is possible by carefully monitoring the preparation parameters. Here we have optimized the said parameters using Response surface methodology (RSM).

RSM (combination of mathematical and statistical techniques) has been widely used to acquire the optimal operation conditions for both laboratory and industrial processes [3]. This methodology includes various types of experimental Design such as central composite, 2 level factorial, BoxBehnken and D-optimal. The selection of experimental design is depending on the objectives of the experiment and the number of factors to be investigated. Central composite design is one of the most popular response surface designs and advantage of such methodology is to provide less experimental runs and time thus provides more efficient optimization [4]. In the present study we report synthesis of nanocomposite of ZnFe<sub>2</sub>O<sub>4</sub>/TiO<sub>2</sub>. These composite find uses in a wide variety of applications, such as aquatic environmental pollutant remover, X-ray imaging, photocatalytic decoloration agent of dyes used in textiles etc.

## EXPERIMENTAL

ZnFe<sub>2</sub>O<sub>4</sub>/TiO<sub>2</sub> nanopowders with various amount of zinc ferrite were prepared by sol-gel method. High purity AR grade ferric nitrate, zinc nitrate, titanium isopropoxide and citric acid were used for synthesis. The first step was to synthesize titanium nitrate from titanium isopropoxide using water and nitric acid [5].



The metal nitrate solutions were mixed in the required stoichiometric ratios in distilled water. The pH of the solution was maintained between 9 and 9.5 using ammonia solution. The solution mixture was slowly heated with constant stirring to obtain a fluffy mass. The mass was then aged and dried to powder form.

## RESULT AND DISCUSSION

### Statistical method and data analysis

The four major processing parameters generally used for the wet chemical synthesis of ZnFe<sub>2</sub>O<sub>4</sub>/TiO<sub>2</sub> composites, were optimized using 2-level, 4-factor central composite experimental design. The concentrations of ZnNO<sub>3</sub> (X1), the concentration of ferric nitrate (X2), concentration of TiO<sub>2</sub> (X3) and calcinations temperature (X4) were used as the independent variables on the basis of preface trials. Particle size was selected as the dependent variable and the effect of the independent variables on particle was studied at 2 levels i.e., low (-1) and high (+1). The experimental design and statistical analysis of data were done using the Design Expert software (version 7.0.0.0). Experimental Design for Variable for which the test are conducted are summarized in Table 1 and the Response Summary for 30 observations for particle size of powdered samples were based on the results of a preliminary set of experiments, and are shown in Table 2. The Run table or the design summary of combinations of different levels of precursors by Design expert software for 30 observations is shown in Table 3.

**Table 1.** Experimental Design for Variable, sets at two different levels (High level coded value=1, and Low level coded value= -1).

| Factor | Name             | Units | Type    | Low Actual | High Actual | Low Coded | High Coded | Mean    | Std. Dev. |
|--------|------------------|-------|---------|------------|-------------|-----------|------------|---------|-----------|
| (X1)   | Zn               | Mole  | Numeric | 1.00       | 1.25        | -1.000    | 1.000      | 1.125   | 0.112     |
| (X2)   | Fn               | Mole  | Numeric | 1.00       | 2.00        | -1.000    | 1.000      | 1.500   | 0.447     |
| (X3)   | TiO <sub>2</sub> | Mole  | Numeric | 1.00       | 10.00       | -1.000    | 1.000      | 5.500   | 4.025     |
| (X4)   | Calci.Temp       | Deg   | Numeric | 300.00     | 700.00      | -1.000    | 1.000      | 500.000 | 178.885   |

**Table 2.** Response Summary for 30 observations for Particle Size

| Response | Name           | Units | Obs | Analysis    | Minimum | Maximum | Mean   | Std. Dev | Ratio | Trans | Model      |
|----------|----------------|-------|-----|-------------|---------|---------|--------|----------|-------|-------|------------|
| Y1       | Partic-le size | nm    | 30  | Polynom-ial | 0.000   | 45.000  | 20.733 | 12.458   | N/A   | None  | Quadra-tic |

The statistical analysis was made using the Design Expert-7 software. In this study, the optimum operating conditions for particle size were obtained by analyzing the relationships between the variables (Con. ZnNO<sub>3</sub>, Con.FeNO<sub>3</sub>, Con.of TiO<sub>2</sub>, calcinations. temperature) and the response (particle size). The performance of the RSM in this study was expressed by the following second-order polynomial equation.

$$Y = A_0 + \sum_{i=1}^n A_i X_i + \sum_{i=1}^n A_{ij} X_i^2 + \sum_{i=1, j=1}^n A_{ij} X_i X_j + \varepsilon \quad (3)$$

where Y is the response variable, A<sub>0</sub> is the value of the fixed response at the center point of the design; A<sub>i</sub>, A<sub>ij</sub>, A<sub>ij</sub> represents the linear, quadratic and second order effect regression terms; n is the number of independent variables; and ε is the random error.

The Coefficient of determination (R<sup>2</sup>) was used to describe the accuracy of the model. In Table 4 detail of ANOVA Test Result has been shown. In this, values for R-Squared Analysis, Std. Dev., Mean, coefficient of variance (C.V. %) also known as relative standard deviation (RSD), R-Squared, Adj R-Squared and Pred R-Squared for ratio has given.

**Table 3.** Design summary of combinations of different levels of precursors by Design expert software for 30 observations.

| Std | Run | Block   | Factor1<br>A:zn<br>m | Factor2<br>B:fn<br>M | Factor3<br>C:tio2<br>M | Factor<br>D:Temp<br>deg | Response1<br>Particle size<br>nm |
|-----|-----|---------|----------------------|----------------------|------------------------|-------------------------|----------------------------------|
| 8   | 1   | Block 1 | 1.25                 | 2.00                 | 10.00                  | 300.00                  | 34                               |
| 25  | 2   | Block 1 | 1.13                 | 1.50                 | 5.50                   | 500.00                  | 33                               |
| 15  | 3   | Block 1 | 1.00                 | 2.00                 | 10.00                  | 700.00                  | 12                               |
| 16  | 4   | Block 1 | 1.25                 | 2.00                 | 10.00                  | 700.00                  | 26                               |
| 3   | 5   | Block 1 | 1.00                 | 2.00                 | 1.00                   | 300.00                  | 7                                |
| 9   | 6   | Block 1 | 1.00                 | 1.00                 | 1.00                   | 700.00                  | 18                               |
| 12  | 7   | Block 1 | 1.25                 | 2.00                 | 1.00                   | 700.00                  | 22                               |
| 1   | 8   | Block 1 | 1.00                 | 1.00                 | 1.00                   | 300.00                  | 14                               |
| 26  | 9   | Block 1 | 1.13                 | 1.50                 | 5.50                   | 500.00                  | 45                               |
| 24  | 10  | Block 1 | 1.13                 | 1.50                 | 5.50                   | 900.00                  | 28                               |
| 11  | 11  | Block 1 | 1.00                 | 2.00                 | 1.00                   | 700.00                  | 3                                |
| 20  | 12  | Block 1 | 1.13                 | 2.50                 | 5.50                   | 500.00                  | 2                                |
| 13  | 13  | Block 1 | 1.00                 | 1.00                 | 10.00                  | 700.00                  | 4                                |
| 6   | 14  | Block 1 | 1.25                 | 1.00                 | 10.00                  | 300.00                  | 19                               |
| 5   | 15  | Block 1 | 1.00                 | 1.00                 | 10.00                  | 300.00                  | 5                                |
| 10  | 16  | Block 1 | 1.25                 | 1.00                 | 1.00                   | 700.00                  | 12                               |
| 23  | 17  | Block 1 | 1.13                 | 1.50                 | 5.50                   | 100.00                  | 0                                |
| 27  | 18  | Block 1 | 1.13                 | 1.50                 | 5.50                   | 500.00                  | 33                               |
| 17  | 19  | Block 1 | 0.88                 | 1.50                 | 5.50                   | 500.00                  | 33                               |
| 28  | 20  | Block 1 | 1.13                 | 1.50                 | 5.50                   | 500.00                  | 33                               |
| 21  | 21  | Block 1 | 1.13                 | 1.50                 | -3.50                  | 500.00                  | 33                               |
| 14  | 22  | Block 1 | 1.25                 | 1.00                 | 10.00                  | 700.00                  | 23                               |
| 22  | 23  | Block 1 | 1.13                 | 1.50                 | 14.50                  | 500.00                  | 33                               |
| 7   | 24  | Block 1 | 1.00                 | 2.00                 | 10.00                  | 300.00                  | 7                                |
| 30  | 25  | Block 1 | 1.13                 | 1.50                 | 5.50                   | 500.00                  | 33                               |
| 19  | 26  | Block 1 | 1.13                 | 0.50                 | 5.50                   | 500.00                  | 30                               |
| 18  | 27  | Block 1 | 1.38                 | 1.50                 | 5.50                   | 500.00                  | 33                               |
| 2   | 28  | Block 1 | 1.25                 | 1.00                 | 1.00                   | 300.00                  | 9                                |
| 4   | 29  | Block 1 | 1.25                 | 2.00                 | 1.00                   | 300.00                  | 28                               |
| 29  | 30  | Block 1 | 1.13                 | 1.50                 | 5.50                   | 500.00                  | 10                               |

**Table 4.** Coefficient of determination ( $R^2$ ) ANOVA Test Result

|           |         |                |         |
|-----------|---------|----------------|---------|
| Std. Dev. | 12.07   | R-Squared      |         |
|           |         | Adj R-Squared  | 0.5307  |
|           |         | R-Squared      |         |
| Mean      | 20.73   | Adj R-Squared  | 0.0927  |
| C.V. %    | 58.21   | Pred R-Squared | -1.0975 |
| PRESS     | 9765.84 | Adeq Precision | 3.750   |

These parameter are important because the standard deviation of data shall always be understood in the frame of reference of the mean of the data. As from Table 4, C.V. % has a value 58.21, which is higher value, means variance is very high. Mathematically, it can be obtained by the ratio of the standard deviation to the mean (or its absolute value).

$$CV = \sigma / \mu \tag{4}$$

Here the extent of variability shown in relation to the mean of the population. The "Pred R-Squared" of -1.0975 is not close to the "Adj R-Squared" of 0.0927. This indicates a large block effect or a possible problem with our model and data.

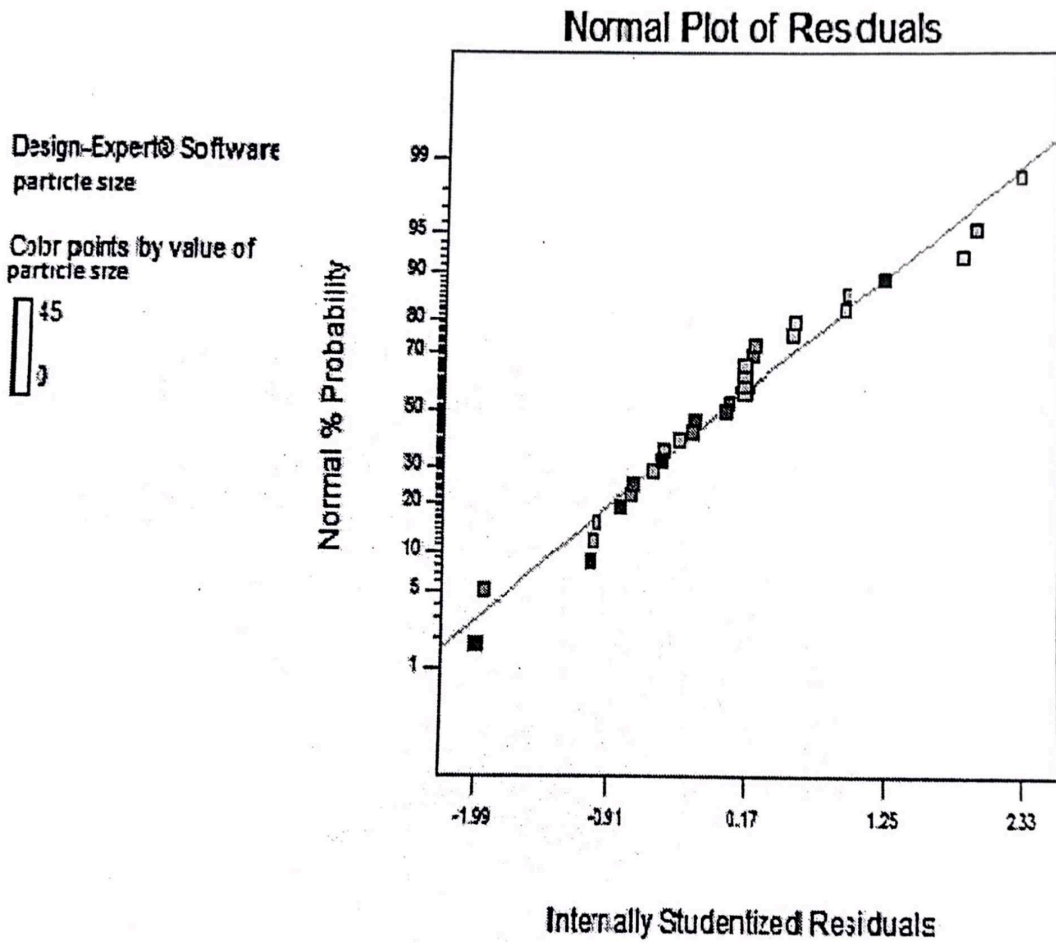


FIGURE 1. Normal plot for residuals by RSM

Fig 1. shows the normal plot in which the assumptions of normality are followed by many statistical tests and intervals. The assumption of normality often leads to those tests which are simple, mathematically tractable, and powerful compared to tests that do not make the normality assumption. But some time, many real data sets are in fact not normal. However, an appropriate transformation of a data set may often yield a data set that follows a normal distribution. Due to this we can see increases the applicability and usefulness of statistical techniques (based on the normality assumption). The correlation computed between the vertical and horizontal axis variables of the probability plot and is a convenient measure of the linearity of the probability plot and we know that the more linear the probability plot, the better a normal distribution fits the data. The red line was produced by the software based on the externally studentized to define outlier as shown in the diagnostics plots Fig 2.

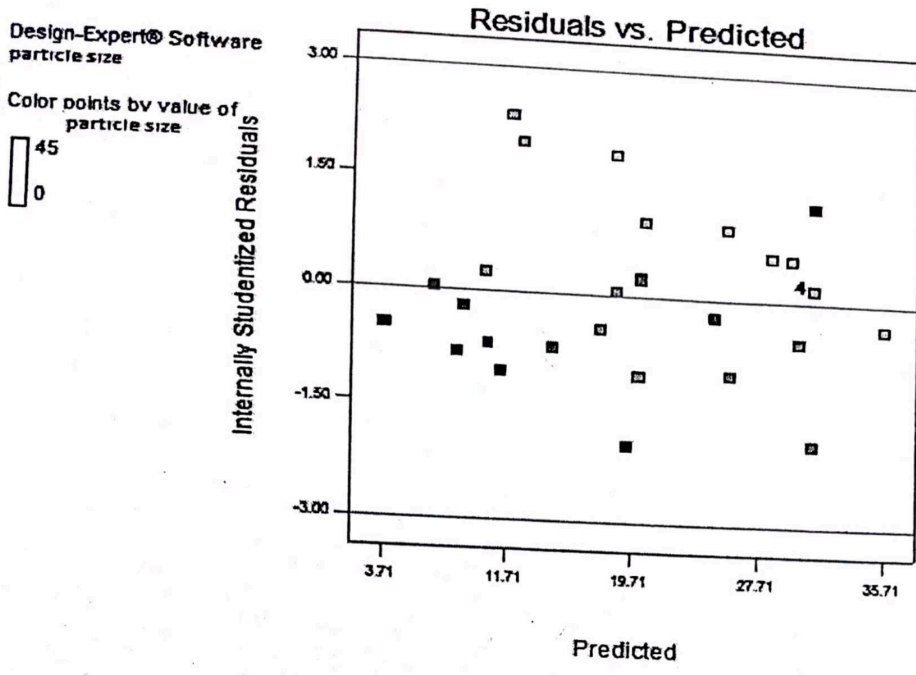


FIGURE 2. Externally studentized residuals to look for outliers (influential values) for particle size

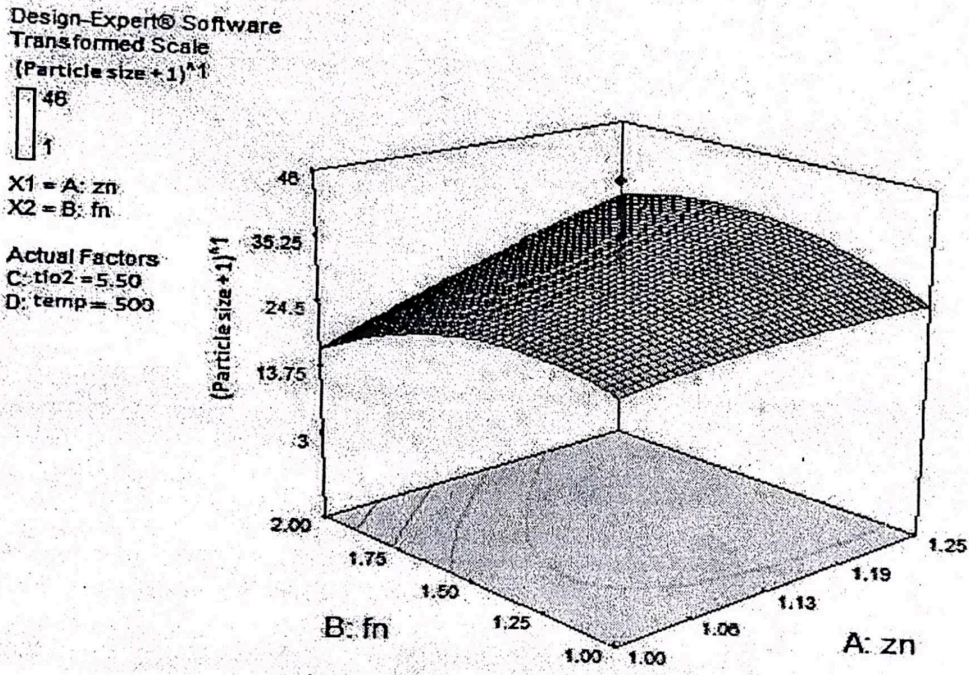


FIGURE 3. Three-dimensional plot by RSM for Joint effect of concentration of  $Fe_2NO_3$  and concentration of  $ZnNO_3$  on particle size.

Fig 3 indicates that particle size increases slowly as concentration of zinc nitrate and ferric nitrate increases. along the z-axis a significant decreasing trend was found as temperature and concentration increases together. Three-dimensional plots were drawn using the RSM to investigate the effects of the concentration of zinc nitrate and ferric

nitrate factors on the particle size of Zn-Ti ferrite. Based on the ANOVA results obtained, the concentration was found to have significant effects on the particle size. With the help of this statistical model we have tried to find out the significant terms in the variables. Studentized residuals versus predicted values are to check for constant error. Externally studentized residuals are to look for outliers, i.e., influential values. The data obtained by the difference between an observed value and the corresponding fitted value called a residual (the value predicted by the model). Points patterns give information about the residuals correlation. Ideally, the residuals on the plot should fall randomly around the center.

Design-Expert® Software  
particle size

Color points by value of  
particle size

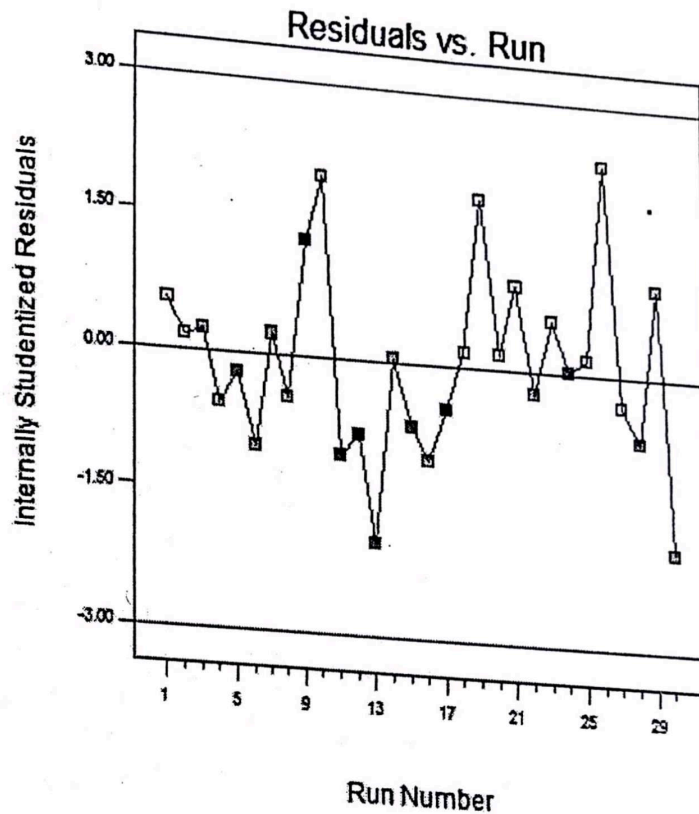


FIGURE 4. Relations of residuals vs. Run

It has been shown in Fig.4 the relations of residuals vs Run. It checks for lurking variables that may have influenced the response during the experiment.

### ACKNOWLEDGMENT

One of the authors is highly thankful to Prof Dr.G.K.Tyagi , Director, TIT&S Bhiwani for allowing to conduct experiment at Material Science lab TIT&S, Bhiwani.

### CONCLUSIONS

In this analysis the role of RSM based on two variables, the concentration and calcinations temperature, was successfully applied in the synthesis of  $ZnFe_2O_4/TiO_2$ . The regression analysis, statistical significance and response surface were applied using Design Expert Software for forecasting the responses in all experimental areas. Models were developed to correlate variables to the responses. Process optimization was carried out and the experimental values acquired for the concentration and calcinations temperature were found to agree satisfactorily with the values predicted by the models.

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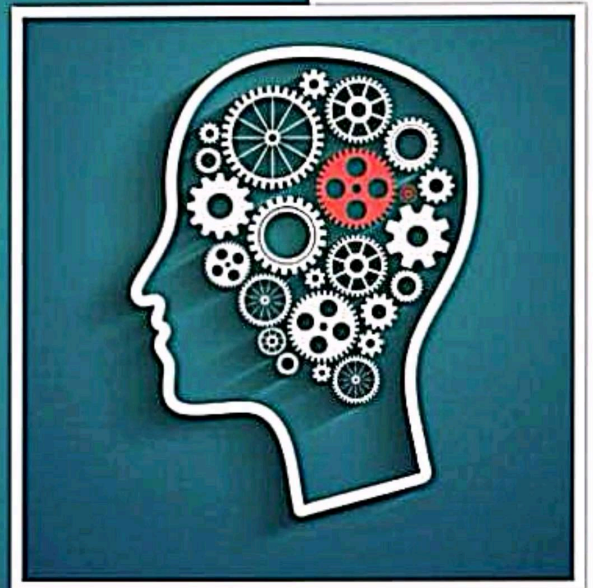
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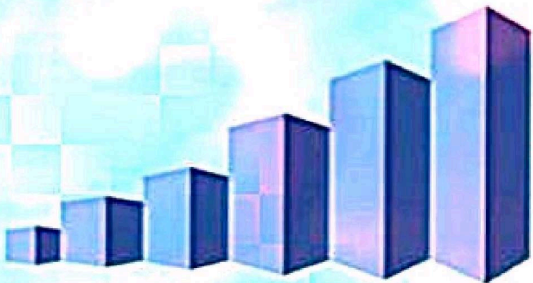


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# **NEW TRENDS IN SCIENCE, TECHNOLOGY, MANAGEMENT & HUMANITIES**



**EDITORS**

**Prof. Sumer Singh  
Prof. I. S. Yadav  
Prof. N. S. Rathee  
Prof. Varun Arora**

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**Bhavnes Chander Kumar**  
(Former Scientist/ Engineer SG)



### *FOREWORD*

It gives me immense pleasure in writing this Foreword for the Edited Book for Research Papers and Abstract of Papers for "International Conference on Recent Trends in Science, Technology, Management & Humanities, (ICRTSTMH-2022)" organized jointly by Jagannath University, Bahadurgarh, Haryana (India).

There has been rapid transformation in Science and Technology during last 2 decades. It is an opportune time to conduct such a conference to make the students conscious to improve their skills. In view of present situation, it is apt to organize such a conference. I hope that the event is targeted at bringing together researchers, professionals and educators by sharing the innovative ideas, issues, recent trends and future directions in the area of Science and Technology. Young researchers would find the contents helpful to set the roadmap for future endeavors.

I send my best wishes to the organizers for the success of conference and young researchers for putting their hard work. I hope that deliberations of conference would be helpful to move a step forward in exploring new pathways for building powerful science and technology base and set goals for the future endeavors.

**Prof. B. C. Kumar**



**CHAUDHARY CHARAN SINGH HARYANA AGRICULTURAL  
UNIVERSITY HISAR, HARYANA (INDIA)**

**Dr. S K Pahuja**  
**Dean, College of Agriculture**



**FOREWORD**

The entire concept of science and technology is not just an integral part of today's world, rather it is the foundation of the advanced world we are part of today and the world we wish to build tomorrow. Science and technology is the major key for development in fields like agriculture, economy, health, education, and every field we can possibly think of. Our day to day life is a clear example of the impact, science and technology has in these fields and need to treat science and technology as tools that prepare us for the journey we want to take.

The role of science and technology in the world is ever-changing. With the increase in challenges in both the fields, new discoveries and inventions will continue to develop and get commercialized, For instance, the development of high yielding , possessing good quality, resistant to biotic and abiotic stresses varieties and hybrids of various crops and horticultural plants , new breeds of milch animals etc. has helped the farmers to boost up their income and made the country self sufficient in food and milk production .These are just simple instances of the power science give us when applied properly. We have a rich culture in Ayurveda that date back are being proved today with scientific facts, logistics, and evidence. Herbs like tulsi, turmeric, garlic, ginger etc. are vital parts of our day to day diet for centuries. But, their scientific importance has been popularized in recent days. Instead of blindly following the rituals and traditions we were taught, now we have scientific research to back them.

From understanding our history to exploring the galaxy, science and technology are everywhere. There was a time when human thought, " The Earth is the center of the world and it is flat" and today we have images of black holes rendering in space stations. We have come a long way. Thus, science and technology have the ability to blend in with every discipline of life. Globalization and digitalization have made it possible for us to explore the world from any corner. The pace with which technology is advancing is exponential. As human beings continue to try and make this world a better place, science and technology will act as our helping hands.

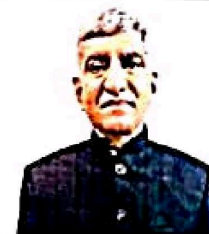
I congratulate the editors of the book entitled "New Trends in Science, Technology, Management & Humanities" which will be of high value for times to come.

**Professor S K Pahuja**



**CHAUDHARY CHARAN SINGH HARYANA AGRICULTURAL  
UNIVERSITY HISAR, HARYANA (INDIA)**

**Dr. K D Sharma**  
**Dean, Post Graduate Studies**



### **FOREWORD**

It gives me immense pleasure in writing this Foreword for the Edited Book on New Trends in Science, Technology, Management and Humanities published by Jagannath University, Bahadurgarh, Haryana (India).

Science and technology play an important role in modern life and it has influenced human civilization by going deep into it. Technical advancement in modern life has given us very much insight into the whole world. Scientific revolutions caught their full speed in the 20th century and became even more advanced in the 21st century. We have entered into a new century with all the systems for good for new ways and people. Modern culture and civilization have become dependent on science and technology because they have become an integral part of life according to the need of the people.

India has become an important source of creative and fundamental scientific development and in all the perspectives around the world. All great scientific discoveries and technical achievements have improved the Indian economic situation in our country and have created many new approaches to the new generation to develop a technologically advanced environment. Many new scientific research and development is possible in the field of agriculture, technology, health, etc. The introduction of scientific research, ideas and techniques in the field of education has brought a huge change in the new generation at large and has given a variety of new and innovative opportunities to work in their own interests. Modern science in India has made people aware of their constant and hard efforts by the scientists. India's scientist is great, who has made scientific progress of the highest international caliber.

After independence, for the national development, our country has started promoting the spread of science. Various policies created by the government have emphasized on self-sufficiency and sustainable development and growth throughout the country. Both Science and Technology have done exceptionally well in economic development and social development in the country.

The editors of the book deserve appreciation and hope this book will be very helpful for the students and academicians.



*Professor K D Sharma*

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| <b>S. No.</b> | <b>Title Of Paper / Abstract</b>  | <b>Author(S)</b>   | <b>Page No.</b> |
|---------------|---|--|-----------------|
| 1.            | Issues And Challenges in Implementing NEP-2020  | Sumer Singh, Niranjan Singh Rathee, I.S. Yadav & Varun Kumar                           | 01              |
| 2.            | Mobile and Internet in Ervention for Digital Empowerment of Women in Agriculture  | Madhu Priya and Beena Yadav  | 10              |
| 3.            | Plant Tissue Culture: A Lab Technique for Propagation of Plant Species  | Jogrnder   | 17              |
| 4.            | Cloud Computing Related Data Security Issues in E-Governance  | Preeti and Poonam  | 23              |
| 5.            | Challenges and Opportunities for Fisherwomen  | Karuna Bamel, Rachna Gulati and Keshav Bamel   | 35              |
| 6.            | Adherence Tracking With Smart Watches for Shoulder Physiotherapy in Rotator Cuff Pathology  | Harshita Mittal, Himanshu Sharma and kanchan kholiya                                   | 45              |
| 7.            | Emerging Science and Technology in Agriculture for Ensuring Quality of Life Through Food  | Jyoti  | 54              |
| 8.            | The Analyses of The Shopping Behaviour of Male and Female Using Different Clustering Algorithm With Weka Tool                             | Teena Vats and Kavita Mittal   | 64              |
| 9.            | Groin Injury in Athletes: A Review  | Shamama Athar, Knachan Kholiya and Himanshu Sharma                                     | 74              |
| 10.           | Integration of Farming System Activities A Way Forward for Doubling Farmers Income of Marginal and Small Farmers of Haryana               | R. S. Dadarwal, Kavita, Kautilya Chaudhary and R. D. Jat                               | 83              |
| 11.           | To Study The Arrival of Big Data Analytics & Its Applications in The World of ICT   | Harnamo Ram and Rashmi   | 91              |
| 12.           | Next Green Revolution To Be Powered by IOT  | Nutan Sharma   | 102             |
| 13.           | Cereals Trade Status Under WTO Reform   | Kavita and V.P. Mehta  | 105             |
| 14.           | Advance Approaches of Rehabilitation for Traumatic Brain Injury (TBI): A Review   | Harshika Gupta   | 116             |
| 15.           | Public Relation An Effective Strategy for Service Marketing   | Nisha Singh  | 123             |
| 16.           | Women Empowerment Through Science and Technology  | Naaz Bano Ekta and Rajesh Dahiya   | 129             |
| 17.           | Sustainable Crop Production Through Crop Diversification by Crop Rotation and Intercropping   | Raj Kumar*, Preetam Kumar and Kavita   | 130             |
| 18.           | Greenhouse Screening of Finger Millet Germplasm for Drought Tolerance With Respect To Morphological, Biochemical and Physiological Traits | Ankit Kumar*, A.S. Jeena, H.S. Chawla and Rohit  | 131             |
| 19.           | Influence of Quinoa Supplementation in Maize Flour on Nutritional Properties of <i>Chapati</i>  | Jyoti, Veenu Sangwan and Varsha Rani   | 132             |
| 20.           | Evaluation of Sorghum Population For Resistance To Stem Borer   | Neha Rohila*, Satyawan Arya, Pummy Kumari and Pinki                                    | 133             |
| 21.           | Land Management Practices for Improving Soil Health   | Manu Rani, Diksha, Simran Jasht and Rajni Yadav  | 134             |
| 22.           | Effect of Menthe Nanoformulation for Shelf Life Enhancement of Guava Fruit  | Pernika Gupta, Anju Rani and Jayanti Tokas   | 135             |
| 23.           | A Comparative Study on Occupational Stress and Organizational Climate Among Teachers Across Gender  | Pinki and Duhan K.   | 136             |
| 24.           | Strategies for Empowering Rural Youth Through Agro-Based Enterprises in District Mahendergarh   | Poonamyadav, Ramesh Kumar, Jai Lal Yadav, Narender Singh, Ashish Shivran & Ankit Kumar | 137             |
| 25.           | Reprocess The Scarp of Wool   | Neenu Poonia, Vinod Kadam, Neelam M Rose, Saroj Yadav and Shalini                      | 138             |

|     |   |  |     |
|-----|---|--|-----|
| 26. | Mushroom As A Mechanism Of Nutritional, Health Properties And Economic Poverty-An Overview                                    | Narender Singh, N.K.Yadav, R.S.Chauhan, Poonam Yadav and J.L. Yadav                    | 139 |
| 27. | A Perspective on Financial Inclusion of People With Disability Through Micro Finance: In The Indian Context                   | Hanisha Bhagat & Ankit Singh   | 140 |
| 28. | Micro Irrigation: An Emerging Eco- Friendly Technology for Food Security and Economic Stability of Farming Community          | Mohinder Singh, Sonia Goel and Samunder Singh  | 141 |
| 29. | Effect of Priming Treatments on Accelerated Aged Guava Seed   | Neha Sharma and Jeet Ram Sharma  | 142 |
| 30. | Leaching Behaviour of Volium Flexi (Chlorantraniliprole 8.8 % + Thiamethoxam 17.5 %Sc) at Different Depths of Sandy Loam Soil | Preeti Dhanker, Rahul Dhankar and Anil   | 143 |
| 31. | Current Uses of Nanofertilizers for Sustainable Agriculture and Their Future Prospects  | Charan Singh, Parmod Kumar, Shilpa, Garima Dahiya and Ritambhara                       | 144 |
| 32. | Evaluation of Different Nutrient Management Practices in <i>Bt.</i> Cotton and Wheat Under Different Planting System          | Rajni Yadav, V. Goyal, K.K. Bhardwaj and Pradip Dey                                    | 145 |
| 33. | Agriturism: A Review and References Analysis  | Santosh and Beena Yadav  | 146 |
| 34. | Soil Microbial Biomass Carbon (MBC) and Nitrogen (MBN) as Influenced By Long Term Inmafter Post-Harvest of Wheat Crop         | Manju Kumari, Sunita Sheoran, Dharam Prakash, Apurva and Satender Kumar                | 147 |
| 35. | Available Nitrogen, Phosphorus and Potassium Content Variation under Plantation of different Tree Species                     | Asha, P. K. Yadav and Ramprakash   | 148 |
| 36. | Potential Of Crispr/Cas9 in Legume Improvement  | Sachin, Ravika Sheoran and Rajesh Yadav  | 149 |
| 37. | Solar Energy An Overview and Applications in Agriculture  | Vinay Kumar, Mukesh Kumar and Nirmal Kumar   | 150 |
| 38. | Opportunities and Challenges for Women Entrepreneurship   | Sarita, Monika and Manju Mehta   | 151 |
| 39. | Genomics for Enhancing Salinity Stress Tolerance in Crop Plants   | Deepak Kaushik   | 152 |
| 40. | AI: Artificial Intelligence in Agriculture  | Bhawana Kumari & Vinay Kumar   | 153 |
| 41. | Drone: A Boom in Agriculture Sector   | Ashok  | 154 |
| 42. | Single Use Plastic in Environment   | Anil, Preeti Dhanker and Rahul Dhankar   | 155 |
| 43. | Effective Mechanization Technologies Forin-Situ Crop Residue Management for Sustainable Crop Production                       | Shiv Ram Samota, R.S. Chhokar, Neeraj Kumar, Nitesh Kumar, S.C. Gill and Sandeep Kumar | 156 |
| 44. | Lichenicolous Fungi Effects on Lichen Host: A Case Study  | Arti Falswal, Garima Verma and Priyanka Mishra   | 157 |
| 45. | Length -Weight Relationship in <i>Schizothorax Richardsonii</i> and <i>Schizothoraxp Lagiostomus</i> from River Alaknanda     | Padma Vashist  | 158 |
| 46. | Analysis of Chemical Composition and Antibacterial Activity of Essential Oil From <i>Rosa Brunonii</i> Lindl.                 | Naveen Kumar and J. S. Jangwan   | 159 |
| 47. | Effect of Drought Stress on Yield Parameter of <i>Capsicum annum</i>  | Chanchal Garg  | 160 |
| 48. | Integratednutrient Management Practices on Yield and Yield Attributes of Pearl Millet Crop Under Dryland Condition            | Sandip Kumar Gautam, Kautilya Chaudhary and Rajni Yadav                                | 161 |
| 49. | Therapeutic Use of Surya Namaskar   | Monika, Sarita and Kiran Singh   | 162 |
| 50. | Efficacy of Hydrogel and Salicylic Acid for Enhancing Yield Potential of Indian Mustard Under Rainfed Condition               | Neelam Rani and Neeraj Kumar   | 163 |
| 51. | Doubling The Farmer's Income yy Zero Budget Natural Farming   | Manpreet Kaur and Gurpreet Singh   | 165 |
| 52. | Yoga: Self-Esteem Towards Positive Psychology   | Sarita, Gurpreet and Monika  | 166 |

|     |   |   |     |
|-----|---|---|-----|
| 53. | Breeding Approaches to Develop Herbicide Resistance in Pulse Crops  | Reenu and Priyanka Dahiya   | 167 |
| 54. | Evaluation of Cape Gooseberry ( <i>Physalisperuviana</i> L.) Genotypes Under Jammu Plains   | Priyanka Dahiya and Reenu   | 168 |
| 55. | Crispr/Cas: A New Breeding Technology for Crop Improvement  | Kavita Rani, Khushiram Battan and Vikram Singh  | 169 |
| 56. | The Potential Health Benefits of Resveratrol as A Nutritional Supplement  | Abhay Prakash Mishra  | 170 |
| 57. | Physico-Chemical Parameters Analysis and Diversity Status of Endemic Stream-Fishes in Palani Hills Western Ghates of Southern India   | S. Kalaimani and C. Kandeepan   | 172 |
| 58. | Preliminary phytochemical Investigations of <i>Prunus domestica</i> L. (Leaves)   | Rishi Kumar Shukla and Kishan   | 173 |
| 59. | Preliminary Phytochemical Screening of Different Solvent Extracts of <i>Curcuma caesia</i> Roxb   | Ajay Kumar  | 174 |
| 60. | Precision Agriculture: An Advanced Emerging Technology for Nitrogen Management in Pulses for Achieving Sustainability   | Akshay Pareek, Satyajeet, Sumit Bhardwaj and Mehak Nagora                                       | 175 |
| 61. | Genome-Wide Identification and Expression Analysis of the Thioredoxin ( <i>Trx</i> ) Gene Family Reveals Its Role in Leaf Rust Resistance In Wheat ( <i>Triticum aestivum</i> L.) | Ramesh  | 176 |
| 62. | Multicomponent Synthesis of Chromone Containing Fused Heterocycles  | Deepak Wadhwa And Vikram Kumar  | 177 |
| 63. | Crop Diversification: A Boon to Sustainable Agriculture   | Mehak Nagora, Shweta, Sharad Nagora and Sumit Bhardwaj  | 178 |
| 64. | An Overview: Nutritional and Therapeutic Properties of Chia Seeds   | Mamta Rani  | 179 |
| 65. | Effect of Sequential Application of Herbicides on Weed Control in Guava CV. L-49  | Pooja and R. K. Goyal   | 180 |
| 66. | Commercialization of Surrogacy in India: A Critical Analysis  | Divya Kataria   | 182 |
| 67. | Opinion of Experts Regarding Kathiawar Embroidered Jackets  | Pooja, Vivek Singh and Nisha Arya   | 183 |
| 68. | Evaluation of Nutritional Potential of <i>Heterospatha elata</i> Fruit  | Abha Shukla and Supriya Dubey   | 184 |
| 69. | Stability Analysis of Yield Attributes in Mungbean Under Different Environments   | Versha, Rajesh Yadav and Ravika   | 185 |
| 70. | A Study of Eco-System Services Management by Municipal Corporations in Haryana  | Lovely  | 186 |
| 71. | An Analysis of the Impact of Green Technologies Initiatives on Consumer Buying Behaviour In automobile industry   | Shashi Kumari   | 187 |
| 72. | Comparative Analysis of Modelling Approaches Towards Futuristic Fish Production Trends in a North-Eastern State Having High Per Capita Demand                                     | Anil Kumar Yadav, Simanku Borah, Pronob Das, Birendra Kumar Bhattacharjya and Basanta Kumar Das | 188 |
| 73. | Prisoners in India: Rights And Beyond   | Disha Pande and Himanshu Shukla   | 189 |
| 74. | The Immediate Effect of Snags on Heart Rate in Upper Cervical Dysfunction Subjects  | Jyoti, Sweety & Meenu   | 190 |
| 75. | An Analytical Study on Digital Media News Program   | Tanvi Tyagi & Diwakar Dubey   | 191 |
| 76. | Current Trends in Pharmacovigilance and Drug Safety in India  | Deepak Garg and Amit Sharma   | 192 |
| 77. | Resveratrol: As a Potent Antioxidant  | Ashok Kumar, Amit Sharma, Varun Kumar & Pragi   | 193 |
| 78. | Language Laboratory: A Grangly Role Among English Language Learners   | Suman Devi  | 194 |
| 79. | Nano-Medicine As An Emerging Technology   | Deepika Sharma  | 194 |

## **CLOUD COMPUTING RELATED DATA SECURITY ISSUES IN E-GOVERNANCE**

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### **ABSTRACT**

Cloud computing is the practice of using a network of remote servers hosted on the internet to store, manage, and process data. E-government has brought various advantages, particularly empowering government to enable their residents on self-service organization, encourage communications among natives, and association of native with government staff. Moreover, e-government raises cooperation of individuals to get to information, evacuate layers to overall population service, and accelerate basic leadership through public supposition. Besides, e-government can be utilized to encourage assessments or at some point thoughts through interpersonal organizations. Government sector uses cloud computing for e-governance. But, it has some issues related to data security. Therefore, it becomes important to access data security related issues using cloud computing. Present study is a descriptive study and it focus on role of cloud computing technology in e-governance, security& privacy issues in cloud computing, challenges for security in government organization, and challenges for security in government organization.

### **1. INTRODUCTION**

Cloud computing is a computing paradigm in which a large pool of systems are connected in private or public networks to provide dynamically scalable infrastructure for application, data and file storage. With the advent of this technology, the cost of computation, application hosting, content storage and delivery has been reduced significantly. It is a practical approach to experience direct cost benefits and has potential to transform a data centre from a capital-intensive set up to a variable priced environment. The idea of cloud computing is based on a

very fundamental principal of reusability of IT capabilities. The difference that cloud computing brings compared to traditional concepts of "grid computing", "cloud computing", "utility computing", or "autonomic computing" is to broaden horizons across organizational boundaries.

In cloud computing worldview, a cloud supplier makes, conveys and deals with the assets, application and services relying upon the supplier. Multi tenure and virtualization are the key highlights to make productive usage of the current assets and applications. A solitary server, computing office, data focus and working framework has numerous users by utilizing virtualization. An extensive number of users are getting served by a cloud supplier by this idea of assets sharing. Data assurance, correspondence, asset the executives for separation and virtualization are a portion of the security issues emerging due to multi-occupancy and virtualization in the cloud environment.

Many cloud services are available in the market with their points of interest and highlights. Security mindfulness toward services is genuine criteria for customers to pick one among the available in light of their essentials and solicitation. A cloud customer who need to pick a particular service based the security issues tended to by the suppliers, requires a couple of instruments or situating service for cloud advantage appraisal. A structure which evaluates the security of cloud services is the solicitation by cloud customers to pick a particular service in light of their security needs. Recommendation is focusing on the security quality evaluation of the cloud services.

E-government has brought various advantages, particularly empowering government to enable their residents on self-service organization, encourage communications among natives, and association of native with government staff. Moreover, e-government raises cooperation of individuals to get to information, evacuate layers to overall population service, and accelerate basic leadership through public supposition. Besides, e-government can be utilized to encourage assessments or at some point thoughts through interpersonal organizations. The discussion rising up out of informal organizations can improve public attention to community's advantage. Residents taking an interest in these interpersonal organizations can share information and worries about public undertakings, arrangements, and other information. The idea of correspondence in interpersonal organizations is unstructured and casual. This can give new bits of knowledge to individuals associated with the organization and public service.

Governments throughout the world are promoting services in the best possible way to perform daily activities, especially in government's offices that have direct interaction with citizens. The use of the latest technologies is critical to reduce required time for the processing processes and in order to improve interaction with citizens through providing efficient and effective services. E-government can change the provided services to citizens, Provide access to information for citizens, and enable them to participate in the economic and social opportunities So that they can make a better life for themselves and future generations.

Today, the use of ICT in order to improve efficiency and effectiveness, transparency and comparability of financial and information exchanges within the government, between the government and its subordinate organizations, between government and citizens, and between government and the private sector, is called "E-government".

E-government provides the government processes such as digitization of government records, automation of tax collection, receive community feedback, information dissemination collection of data/information, conducting elections management, etc. with the use of modern information and communications technologies such as the Internet, local and global network, Mobile, etc. 24 hours a day. Realization of E-government projects is done aimed at achieving different goals and these goals are meant to observe the following principles.

Government sector uses cloud computing for e-governance. But, it has some issues related to data security. Present study focus on data security issues in e-governance.

## **2. CLOUD COMPUTING TECHNOLOGY FOR GOVERNMENT**

Cloud computing envelops an entire scope of Governance and can be facilitated in an assortment of behaviour, contingent upon the way of the administration included and the information/security needs of the contracting association. Cloud registering is quick making an upheaval in the way data technology is utilized and obtained by associations and by people. As per the IEEE Computer Society Cloud Computing.

A paradigm in which information is permanently stored in servers on the Internet and cached temporarily on clients that include desktops, entertainment centres, table computers, notebooks,

wall computers, handhelds, etc."Cloud computing is the collection of scalable, virtualized resources, which is capable of hosting application and providing required services to the users and can charge as per the uses like utility.

The main goal of cloud computing is to provide ICT services with shared infrastructure and the collection of many systems. In cloud computing every facility is provided in terms of service. It provides infrastructure as a service, software as a service, platform as a service, network as a service, and data storage as a service. The main philosophy of cloud computing is to provide every required things as a service.

In order to be clearer, the services in the cloud can be thought in layer architecture where various resources are available in different layers. For individuals, cloud computing means accessing web based email, photo sharing and productivity software, much of it for free. For organizations, shifting to the cloud means having the ability to contract for computing services on-demand, rather than having to invest to host all the necessary hardware, software and support personnel necessary to provide a given level of services. According to the concept of cloud computing, instead of purchasing hardware or software, a user purchases remote access to them via the Internet.

- Infrastructure as a Service – IaaS
- Platform as a Service – PaaS
- Software as a Service – SaaS

**Infrastructure as a Service (IaaS):** It comprises in conveying COMPUTER infrastructure as an administration. The infrastructure can incorporate servers, storage room; arrange hardware and infrastructure software like working infrastructures and database infrastructures. The infrastructure is given as virtual environment. The applications are open from different customer gadgets through a thin customer interface, for example, a web program from the customer's perspective it looks and works precisely like standard infrastructure, while in actuality it is one of the numerous virtual situations facilitated at the same time on the same physical infrastructure assets.

**Platform as a Service (PaaS):** It comprises in conveying application improvement environment. It underpins the full life cycle of planning, actualizing, testing, and conveying web applications and Governance. Architecture's, extend supervisors, and analysers are not required to download or introduce any improvement software on their neighbourhood Computers. The ability gave to the customer is to send onto the cloud infrastructure shopper made or obtained applications made utilizing software dialects and instruments bolstered by the provider.

**Software as a Service (SaaS):** It comprises in conveying complete applications, for example, client relationship administration or venture asset arranging over the Internet. A customer buys an entrance to these applications as opposed to obtaining licenses and misusing them locally. The ability gave to the purchaser is to arrangement handling, stockpiling, systems, and other crucial registering assets where the buyer can convey and run subjective software, which can incorporate working infrastructures and applications.

### **3. SECURITY AND PRIVACY ISSUES IN CLOUD COMPUTING**

According to the definition gave by the National Institute for Standards and Technology (NIST), "cloud computing is a model for empowering helpful, on-request organize access to a mutual pool of configurable processing assets (e.g., systems, servers, stockpiling, applications, and Governance) that can be quickly provisioned and discharged with insignificant administration exertion or administration provider association".

It speaks to an outlook change in data technology a significant number of us are probably going to find in our lifetime. While the clients are energized by the changes to diminish the capital expenses, and the opportunity to strip themselves of infrastructure administration and concentrate on centre skills, or more all the spryness offered by the on-request provisioning of figuring, there are issues and difficulties which should be tended to before an omnipresent reception may happen. Cloud computing alludes to both the applications conveyed as Governance over the Internet and the equipment and infrastructures software in the data centres that give those Governance. There are four essential cloud conveyance models, as delineated by NIST, in light of who gives the cloud Governance.

The offices may utilize one model or a mix of various models for the proficient and streamlined conveyance of users and business Governance. These four conveyance models are: (i) Private cloud in which cloud Governance are given exclusively to an association and are overseen by the association or an outsider.

This Governance may exist off-site. (ii) Public cloud in which cloud governances are accessible to the general population and claimed by an association offering the cloud Governance, for instance, Amazon cloud benefit. (iii) Community cloud in which cloud Governance are shared by a few associations for supporting a particular group that has shared concerns (e.g., mission, security necessities, approach, and consistency contemplations).

These governance might be overseen by the associations or an outsider and may exist offsite. An extraordinary instance of group cloud is the Government or G-Cloud. This sort of cloud computing is given by at least one officer (benefit provider part), for use by all, or most, government organizations (client part). (iv) The hybrid cloud which is a structure of various cloud computing infrastructure (open, private or group). A case for half and half cloud is the information put away in private billow of a travel organization that is controlled by a program running in people in general cloud. From the viewpoint of administration conveyance, NIST has recognized three fundamental sorts of cloud administration offerings.

These models are (i) Software as an administration (SaaS) which offers leasing application usefulness from an administration provider instead of purchasing, introducing and running software by the client. (ii) Platform as an administration (PaaS) which gives a platform in the cloud, whereupon applications can be produced and executed. (iii) Infrastructure as an administration (IaaS) in which the sellers offer computing force and storage room on request. From an equipment perspective, three viewpoints are new in the worldview of cloud computing.

These parts of cloud computing are: (i) The fantasy of interminable processing assets accessible on request, subsequently disposing of the requirement for cloud computing clients to prepare for provisioning. (ii) The end of an in advance responsibility by cloud clients, in this way permitting organizations to begin small and increment equipment assets, just when there is an expansion in their requirements. (iii) The capacity to pay for utilization of registering assets on a fleeting premise as required and discharge them when the assets are not required, along these lines

remunerating protection by releasing machines and capacity when they are no more extended valuable.

More or less, cloud computing has empowered operations of massive scale server farms which has prompted to a massive decline in operational expenses of those server farms. On the purchaser side, there are some conspicuous benefits gave by cloud computing. An excruciating reality of running IT Governance is the way that in a large portion of the times, crest request is altogether higher than the normal request. The resultant gigantic over-provisioning that the organizations for the most part do is to a great degree capital-serious and inefficient. Cloud computing has permitted and will permit considerably more consistent scaling of assets as the request changes. Disregarding the few favorable circumstances that cloud computing carries alongside it; there are a few concerns and issues which should be explained before omnipresent selection of this processing worldview happens.

In the first place, in cloud computing, the client might not have the sort of control over his/her information or the execution of his/her applications that he/she may require, or the capacity to review or change the procedures and approaches under which he/she should work. Diverse parts of an application may be in better place in the cloud that cans adverse affect the execution of the application.

Following controls might be troublesome particularly when discussing cross-outskirt issues – it ought to likewise be noticed that directions still should be created to consider all parts of cloud computing. It is entirely common that checking and support is not as straightforward an assignment when contrasted with what it is really going after sitting in the Intranet.

Second, the cloud clients may chance losing information by having them bolted into exclusive organizations and may lose control over their information since the devices for checking who is utilizing them or who can see them are not generally given to the clients. Information misfortune is, hence, a possibly genuine hazard in some particular arrangements. Third, it may not be anything but difficult to tailor Service level agreement (SLAs) to the particular needs of a business. Pay for downtime might be lacking and SLAs are probably not going to cover the associative harms.

It is sensible to adjust the cost of ensuring inside uptime against the upsides of picking the cloud. Fourth, utilizing cost focal points may not generally be conceivable dependably. From the point of view of the associations, having almost no capital venture may really have assessed burdens. At last, the benchmarks are youthful and inadequate for taking care of the quickly changing and developing advancements of cloud computing.

In this way, one can't simply move applications to the cloud and anticipate that they will run effectively. At last, there are dormancy and execution issues since the Internet associations and the system connections may add to idleness or may put a limitation on the accessible data transmission.

#### **4. CHALLENGES FOR SECURITY IN GOVERNMENT ORGANIZATION**

In the course of recent years, web and electronic governance have become quickly and have been utilized by numerous organizations. Be that as it may, the cost of information stockpiling and the power utilization by the equipment is expanded. In the meantime real organizations began broad studies to lessen costs, better using of existing assets furthermore to bolster their own business. In these studies, they found another answering for answer their difficulties, to utilize and to get most extreme benefits from the assets and it was only cloud computing.

The new technology is the thing that which can answer a large number of their equipment and software needs. Today, the novel attributes of cloud computing has swung it to a significant technology. To such an extent that is viewed as the most blazing theme in Research focuses and colleges identified with the field of data technology. Consistently the development and many-sided quality of the E-governments is being watched, So that the Size of their computational information is expanding day by day. Hence, an appropriate model for actualizing e-government is required to incorporate System efficiency and client fulfilment.

As it specified some time recently, Cloud Computing was presented in different styles, for example, Grid registering and benefit situated architecture which objective of these styles is handling expansive amounts of information utilizing groups of Computers. Such high-volume computational issues can be explained effortlessly and in a suitable way with the development and advancement of cloud computing.

Alternate benefits of cloud computing in e-government ought not to be overlooked obviously. Which cost Reduction, combination and reusability of Governance can be noted? Because of the cloud computing oddity, keeping in mind the end goal to distinguish cloud computing benefits and shortcomings, it is fundamental that this technology get totally recognized for the advancement and utilization of it in e-government architecture, and its diverse areas ought to be viewed as much as would be prudent to be utilized as a part of the e-government and should've attempted to defeat its deficiencies.

Cloud computing have various definitions which some have been brought here. The definition of the national institute of standard and technology of America is as follows: "Cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

On other common & acceptable definition is of Mater et al. "A very exact scalable instrument, capable of technology-enabled service, which is available easily on the internet when needed." Following the definition of cloud computing, we should comprehend their important features, developed models, the way of using services and also the way of protecting it, in order to know well and accept it. Here are the five key features of cloud computing.

- **Service demand on self:** Using this feature when needed the customer can easily and automatically access to computing facilities like server, net, storage and soon from any provider
- **Ubiquitous network access:**It implies that the facilities are accessible on the net and they can be used following standard methods. The methods which support weak and strong clients like laptop and mobile phones.
- **Location-independent resource pooling:** This features pools different customers needed resources in the same place dynamically by the providers. These resources can include the storage, memory, the bandwidth of net and virtual machines.

- **Rapid elasticity:** Using this feature, the facilities can be provided rapidly and with high elasticity and can be expanded or release fast. In other words the services can always be updated and improved and accessible for the users.
- **Measured service.** This feature enables monitoring, control and reporting of the resources, and can apparently control and report the amount and quantity of resource using for both customer and the provider of the infrastructure. In other words all these features cover the coherence and appearance of the clouds.

## **5. IMPACT OF CLOUD COMPUTING TECHNOLOGY ON E- GOVERNMENT**

E-Governance cloud service system; includes secure process and control of the system. This system provides the system enhancement as per the strategy in cloud environment service. As large scale capacity, e-government needs large investment monetary from the government. The reduction of cost comprises with the field of some new inventions of computing technologies as could be expected under the circumstances, while additionally developing the flexibility and effectiveness of government sectors. The cloud computing is such invention, which provides the services of computing and information as benefits. Cloud-based e-government provides the services of best possible to its businesses and citizens at reasonable expense. This is because governments don't need to purchase and introduce the ICT equipment on their premise. In this chapter, the application and the elements of cloud computing are analysed in the e-government context.

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## **NEXT GREEN REVOLUTION TO BE POWERED BY IOT**

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### **ABSTRACT**

As per The World Bank, while agriculture's share in India's economy has progressively declined to less than 15% due to the high growth rates of the industrial and services sectors, the sector's importance in India's economic and social fabric goes well beyond this indicator. First, nearly three-quarters of India's families depend on rural incomes. Second, the majority of India's poor (some 770 million people or about 70 percent) are found in rural areas. And third, India's food security depends on producing cereal crops, as well as increasing its production of fruits, vegetables and milk to meet the demands of a growing population with rising incomes. To do so, a productive, competitive, diversified and sustainable agricultural sector will need to emerge at an accelerated pace.

### **1. INTRODUCTION**

These indicators highlight a **CRITICAL** need to for **NEXT GREEN REVOLUTIONS** to meet our nations food security and also uplift the 70% rural masses of the country depending on agriculture. Both government and private players within the sector agrees that this much needed growth is only possible with large scale adoption of IoT technology or incorporating Agtech companies with the mainstream framing in the country.

#### **1.1 WHAT is IOT in Agriculture**

Agtech companies offering IoT products to farmers have only scratched the surface of a market worth \$4 billion in the US, which could be down to a lack of awareness and understanding of what's available to them, according to a new report.

The *Agriculture IoT Solutions* report from research firm Alpha Brown estimates that 10% to 15% of farmers are using IoT solutions on the farm across 3.1 billion acres and 250,000 farms, and collectively they're spending around \$960 million.

IoT (Internet of things) in an agricultural context refers to the use of sensors, cameras, and other devices to turn every element and action involved in farming into data. Weather, moisture, plant health, mineral status, chemical applications, pest presence and much more can all be turned into large data sets that allow big data engineers to draw out insights about the farm at varying levels of granularity via software algorithms. IoT is not a product or particular tool, but a family of technologies.

### **1.2 Need of IoT in Indian Agriculture Sector**

With adverse climatic conditions, an India farmer can't predict and plan farming activities. Therefore, there is dire need for a system that provides precise and accurate information about the crop cultivation needs.

The aim of most agriculture IoT products is to enable farmers to use these insights to make operational decisions around planting, irrigating, harvesting and more. IoT is also closely tied to automation, so less human input and fewer workers are required. The resulting increase in crop yield and decrease in overhead and logistical cost make farming more profitable.

### **1.3 Major Concerns with IoT Adoption**

The biggest challenge in large scale adoption of IoT technology within agriculture sector is lack of knowledge, large scale investment and lack of infrastructure. The government and private sector is making all the efforts to speed up the adoption rate with loans and perks. The interest of large private player in commercial framing will also help the cause. The bust of startups working with the domains is also encouraging sign for the sector but still going by the requirements the overall progress is very slow.

### **Conclusion**

According to the UN Food and Agriculture Organization (FAO), the global population is expected to surpass 9 billion people by 2050. To produce enough food for the given population, agriculture production volumes have to increase by 50%. If we need to keep but with the food security of fastest growing population the NEXT GREEN REVOLUTION must be powered by IoT.

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डॉ. गणेशदत्त शर्मा  
के  
काव्यों का शैलीवैज्ञानिक अध्ययन

लेखिका

डॉ. सुमन

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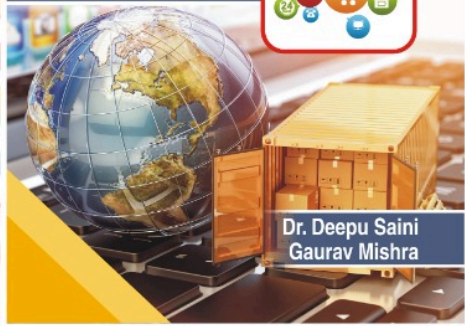


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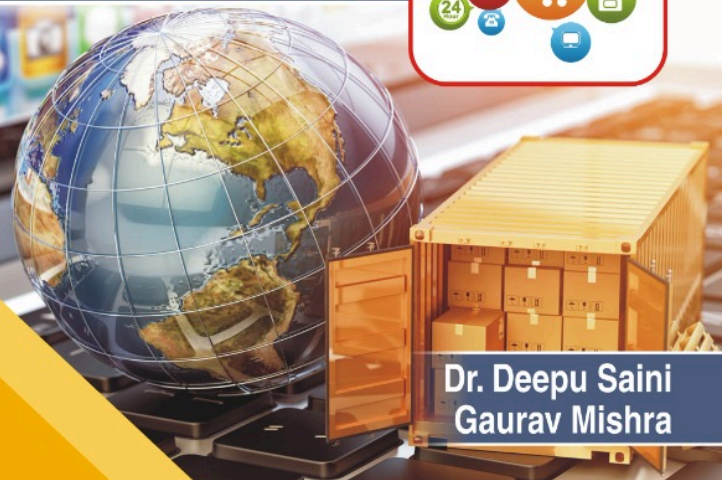
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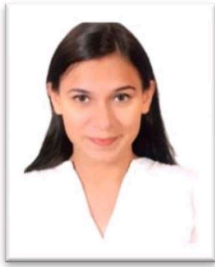


**RECENT TRENDS**  
**IN**  
**MULTIDISCIPLINARY**  
**SUBJECTS**

Dr. Vineeta Kaushik



# Dr. Vineeta Kaushik



Dr. Vineeta Kaushik is a dedicated individual with an outstanding academic record. Her scholarly work has made significant contributions to the field of economics.

She is born and brought up in Delhi in a joint family. Her father Mr. Mukesh Kaushik always inspired her to work hard and be focused in your work, while her mother Mrs. Sarita Kaushik motivated her to grow and achieve better things in life. Her husband Dr. Gaurav Sharma and her son Madhav are the biggest strength in her life.

Dr. Vineeta has completed her schooling from Salwan School. She pursued BA Hons Economics in Shivaji College, DU. She completed her Masters in Economics from Department of Economics, MDU, Rohtak. She is gold medalist in her Masters. Further she completed her PhD in Economics from Department of Economics, MDU. She started and embarked on her teaching career while working as an Assistant Professor of Economics in Department of economics, MDU. Further, she got selected in HPSC and joined in Dronacharya Government College, Gurugram. Currently, she is working as an Assistant Professor in PT. NRS Govt. College, Rohtak.

Apart from teaching, Dr. Vineeta actively participated in extra-curricular activities. She is a versatile character. She completed her internship in Financial market company to know the actual functioning of financial system. She further did internship in Institute of Economic Growth from University Enclave, University of Delhi and started her research journey.

Dr. Vineeta Kaushik is an accomplished researcher, having published many research papers in prestigious national and international peer reviewed/ referred /UGC Care listed journals. Her work addresses critical economical issues and presents innovative perspectives. She actively participates in seminars, conferences, workshops, and faculty development programs, sharing her knowledge and inspiring fellow educators.

She has also gained experience as a member of various committees such as Program officer in NSS, member of Women cell, IQAC, NAAC committee, Fine arts club, Admission committee etc. she used innovative method of teaching. Her passion for teaching and research is commendable.

Dr vineeta kaushik aims to continuously work towards the betterment of an economy and society as a whole.



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## **PREFACE**

The global economic and technological environment is undergoing transformation, thus managing change is vital to ensure sustainable growth. Innovation and emerging opportunities have become one of the key strategic tasks. This edited book on “Recent Trends in Multidisciplinary subjects” aims to explore new horizons of emerging trends from leading academicians, researchers, and industry experts. It also provides a multidisciplinary platform to them. This book further helps us to know the growth of society and global economy in post covid era.

This edited book mainly focuses on various topics of arts and humanities subject. Most of the time the complicated research problems cannot be solved by a particular discipline and it necessitates the collaboration of people of diverse expertise across a range of discipline together to achieve the research goal. Many a times any individual research member or an individual discipline often develop a shaft dream and may feel difficult to imagine beyond the routine knowledge. By making a collaborative team of multidisciplinary experts it becomes conceivable to think beyond the routine knowledge. So, multidisciplinary research connects the members of diverse expertise to solve a particular research problem.

| <b>CHAPTER NO</b> | <b>CHAPTE R DETAILS</b>  | <b>Page No</b> |
|-------------------|--|----------------|
| <b>1</b>          | <b>THE ROLE OF MICROFINANCE IN PROMOTING ENTREPRENEURSHIP</b><br><br>Ms Neerja Parmar  | <b>1-9</b>     |
| <b>2</b>          | <b>TELEVISION AND WOMEN EMPOWERMENT</b><br><br>Dr. Pankaj  | <b>10-11</b>   |
| <b>3</b>          | <b>IMPROVING SPOKEN ENGLISH</b><br><br>Dr. Ekta Sharma   | <b>12-15</b>   |
| <b>4</b>          | <b>ROLE OF EDUCATION IN THE FEMALE LABOUR FORCE PARTICIPATION IN INDIA</b><br><br>Vidhi Jain<br>Dr. Anju Rani  | <b>16-30</b>   |
| <b>5</b>          | <b>EMERGING IMPORTANCE OF CORPORATE SOCIAL RESPONSIBILITY (CSR) IN INDIA</b><br><br>Jyoti  | <b>31-41</b>   |
| <b>6</b>          | <b>COVID-19 PANDEMIC AND HEALTH OF BANKING SECTOR: EMERGENCE OF NARCL A NEW COMPANY</b><br><br>Jyoti   | <b>42-50</b>   |
| <b>7</b>          | <b>ANALYSING THE NOVEL THE WHITE TIGER THROUGH THE GRAMSCIAN MODEL OF HEGEMONY AND FOUCAULDIAN INTERPLAY OF POWER &amp; RESISTANCE</b><br><br>Ms Medhavini Yadav | <b>51-55</b>   |
| <b>8</b>          | <b>CHANGE IN OCCUPATIONAL STRUCTURE: A STUDY OF VILLAGE JASSIA</b><br><br>Nitin Kumar , Divya, Anshu Siwach, Dr. Devendra Sindhu                                 | <b>56-63</b>   |
| <b>9</b>          | <b>SUSTAINABLE DEVELOPMENT AND EDUCATION</b><br><br>Bhavya Dua   | <b>64-70</b>   |
| <b>10</b>         | <b>NEW EDUCATION POLICY 2020 OF INDIA: A THEORETICAL ANALYSIS</b><br><br>Bhavya Dua  | <b>71-82</b>   |

|    |   |         |
|----|---|---------|
| 11 | शक्ति और चेतना का काव्य : परशुराम की प्रतीक्षा<br>डॉ० शौकीना देवी,                        | 83-88   |
| 12 | हिंदी साहित्य में प्रवासी साहित्यकारों की भूमिका<br>डॉ. सुमन राठी<br>रेनू कुंडू, शोधार्थी | 89-97   |
| 13 | मानवता और सामाजिक वज्ञान<br>डॉ. कमलेश देवी  | 98-99   |
| 14 | हिन्दी के मनोविश्लेषणवादी रचनाकारों का साहित्य में योगदान<br>डॉ० रामरती<br>ममता,          | 100-104 |
| 15 | भूमण्डलीकरण और स्त्री विमर्श<br>सुमन  | 105-109 |

# **THE ROLE OF MICROFINANCE IN PROMOTING ENTREPRENEURSHIP**

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## **ABSTRACT**

Entrepreneurship development can lead to the creation of jobs and the eradication of poverty in any country. In India, for instance, small businesses need financial support to grow. However, the government financial institutions are not able to provide them with the necessary resources. Microfinance has played an important role in economic development by providing financial support to small businesses in Bangladesh. Following its emergence as a model for economic growth, the country is now using this mode for development. India is also experimenting with the same approach. In addition to being instrumental in economic development, microfinance has also played a vital role in the development of entrepreneurship in India. The country's small businesses need working capital to succeed. This paper is made using secondary data collected by the researcher. Tables and simple percentage were used in data presentation. For analysis the two broad variables kept in center in the study. First is entrepreneurship development as a dependent variable and second is microfinance as an independent variable. The research paper is divided in three sections. First section reveals the success of microfinance in different regions across the country for entrepreneurship development. The second section discloses the relationship between microfinance and entrepreneurship development in the country. The third section concludes the result of the research that there is a positive impact of microfinance institution lending on entrepreneurship development in India.

**Keywords-** Entrepreneurship, Microfinance, Lending, Development, Financial Institution etc.

## INTRODUCTION

Entrepreneurship and its development are some of the most critical issues that need to be resolved in order to ensure the continuous growth of both the economy and society. This is why the importance of entrepreneurship has not been lost on policymakers and scholars. Despite the positive effects of microfinance on entrepreneurship, the debate about its role in the development of the country has been heated. According to experts such as Obamuyi and Sussan, entrepreneurship is a key driver of economic growth in developing and developed countries. In 2018, a study conducted by GEM revealed that countries that have high levels of entrepreneurship are more likely to experience higher economic growth. The continuous pursuit of entrepreneurship is needed in order to accelerate the country's economic growth. It is also noteworthy that the positive effects of entrepreneurship are widely acknowledged. It is in this context that there has been an emerging trend towards the adoption of entrepreneurship worldwide especially in developing countries.

Accordingly, the importance of the concept of entrepreneurship has attracted much attention of researchers, practitioners, and policymakers. With the importance of microfinance in mind, it is deemed appropriate to mention that Muhammad Yunus is widely recognized as the Father of Modern Microfinance because he managed to come up with Grameen Bank aimed at financing the poor (Hinrichsen, 2019).

In 2013, India's national bank NABARD introduced the concept of microfinancing after it was inspired by the pioneering approach taken by Bangladesh's Grameen Bank. Several programs related to this concept were launched in the country. These include the SHG-Bank Linkage, JLG, and Group Lending programs. Following the effective implementation of microfinance programs, India witnessed a rapid growth of clients as evidenced by the fact that microfinance institutions served about 35.1 million customers from 2017 to 2018 (Sa-Dhan, 2018). It is imperative to note that there is an increase in the provision of microfinance services to the poor and SMEs in India through alternative approaches (Mohammed & Waheed, 2019). The emergence of entrepreneurship has raised the need for further studies on how to improve our understanding of this field in the post-Pandemic era. The increasing unemployment rate and fragile economies are some of the factors that have prompted people to rethink their entrepreneurship strategies. Despite the increasing number of studies on entrepreneurship, it is still important to take into account the various contexts that influence the development and

operation of this field. For instance, the historical, socio-economic, and national contexts of entrepreneurship should be considered when conducting research. It has been noted that there is a dire need to have more empirical evidence on the entrepreneurship field from developing countries. It is important to note that entrepreneurs are responsible for creating value by continuously improving the products and services they provide. This has led to an increase in the number of Small and Medium Enterprises (SMEs) globally. Undoubtedly, the SMEs are playing a crucial role when it comes to the economic development in many countries as they are the seed-bed of innovation and the key pillar of youth employment creation.

## **OBJECTIVES**

1. To analyze the development of micro financing in India.
2. To analyze the entrepreneurship development in the context of microfinance.

## **RESEARCH METHODOLOGY:**

The basis of this paper is secondary data. Information is taken from various books, different websites, RBI reports, NABARD report and recent research articles posted on various websites.

## **LITERATURE REVIEW**

Baporikar.N.(2022) in her study critically review the role of microfinance for entrepreneurship development. Further, she provides solutions and recommendations for proper microfinancing to boost entrepreneurship development.

Taiwo, J. N., and K. N. Benson in their study advocates the recapitalization of microfinance banks to enhance their capacity to support small business growth and expansion and also to bring to the knowledge of the management of microfinance banks and institutions the impact of the use of collateral as a condition for granting credit to small businesses.

Vetrivel, S. C., and S. Chandra Kumarmangalam in their study envisaged the conceptual framework of a microfinance institution in India. The successes and failures of various microfinance institutions around the world have been evaluated and lessons learnt have been incorporated in a model microfinance institutional mechanism for India.

Rehman, Huma, Dr Amani Moazzam, and Nighat Ansari in their study concluded how women empowerment is important for economic development and the role of microfinance in empowering women and also acknowledges its' significance in alleviating poverty.

Jha, Srirang in his paper study the unique role of MFIs in social development especially in Indian context. The paper provides a comprehensive review of some of the interventions triggered by MFIs in India so as to empower the people living on the fringes without any hope of redemption. Besides, the paper also emphasizes the need for providing financial incentives to the MFIs engaged in social development of the poor by the state agencies as well as large banks which are supporting these institutions.

Pravesh and Dr Sushil K Singh in their study concluded that The micro finance playing a vital role in entrepreneurial development in rural area by providing micro loan to several SHGs across the region. The number of SHG is increasing and amount of disbursement of loan is also increasing year by year but the growth rate of SHGs bank linkage, loan and refinance assistance to SHGs is decreasing.

## **CONTEXT OF MICROFINANCE IN INDIA**

In India, micro finance is a type of financial service that provides low-income individuals with access to capital. It allows them to take small loans and develop their businesses in a manner that is ethical. There are various ways that this type of financial service can be extended in the country. There are two main types of financial services that are commonly offered by micro finance institutions in India: the bank-led SHG-BLP and the MFI-led model. These two types of financial services are usually provided to low-income individuals. There are various types of financial services players in the Indian micro finance industry. These include banks, non-profit financial institutions (MFIs), small finance banks, and NBFCs. These entities are regulated by the Reserve Bank of India (RBI). The non-profit sector is mainly registered as Trusts or Societies. Microfinance is a type of financial service that is provided to individuals who otherwise would not have access to other financial services. Through micro finance, people can get small business loans in a way that is consistent with their ethical lending standards. There are two different ways that people can access this type of financial service in India. One of these is the SHG-BLP, which is a bank-led approach, while the other is the MFI-led approach. In

India, the micro finance industry is characterized by various players that provide various financial services to low-income households. These include banks, non-profit financial institutions, small finance banks, and NBFCs. The Reserve Bank of India (RBI) is the central authority that oversees the various types of financial services that are offered by these players. Non-profit organizations are also regulated by different Acts.

## **REGION WISE SHGs ACROSS THE COUNTRY**

According to report of status of microfinance in India 2021-2022 ( NABARD) there are every region of India except southern region have good potential to open SHGs because huge range of village are not covered by existing SHGs in that region. In the northern region of the country 6,80,143 SHGs is currently functioning but several village was not covered by them and potential of the region to formation of new SHGs is around 680628. The north eastern region of the India has also good potential of new SHGs formation around 162643. Present time 6,80,845 SHGs is functioning in this region. The number of functioning SHGs in eastern region of the country is 32,43,980. Here it is notable that it covering only half of total need of SHGs in the region. The region has great potential to new SHGs formation around 1450466 that is second biggest potential to open new SHGs. This region has major market for SHGs across all regions in the country. The central region of the country has 13,55,564 SHGs. That cap only small portion of the potential of the region. The region has biggest potential of new SHGs formation across the entire region of the country, which is number of 1793117. The western region of the country has second greater number of SHGs. Now 16,88,451 SHGs is working in this region. The potential of formation of new SHGs in the region is 246033. The region has second lowest potential for new SHGs formation across entire the region of the country. The southern region of the country is rich and enough by number SHGs. The region has 42,44,070 SHGs as on 31 March 2015. Number of SHGs in the region is more greater than scenario of SHGs among all the region of the country. It is only one region of the country which has enough number of SHGs by number of population. The region has zero potential for new SHGs formation.

**Table-1: Region wise context o f SHGs in India:**

| Region-wise context of SHGs in India |                 |             |
|--------------------------------------|-----------------|-------------|
| Sr. No                               | Region          | No. Of SHGs |
| 1                                    | Northern Region | 6,80,143    |
| 2                                    | NE Region       | 6,80,845    |
| 3                                    | Eastern Region  | 32,43,980   |
| 4                                    | Central Region  | 13,55,564   |
| 5                                    | Western Region  | 16,88,451   |
| 6                                    | Southern Region | 42,44,070   |
| 7                                    | Total           | 1,18,93,053 |

*Source – NABARD (2021-22) status of microfinance in India*

## **PROGRESS OF MICROFINANCE PROGRAM**

The SHG-BLP model is one of the most successful and effective microfinance programmes in the world, with an outreach to 14.20 crore families. The overall progress under the programme between 2019-2020 and 2021-22 in terms of SHG linkage with the banking sector is presented in Table 2

| Progress under SHG-Bank Linkage Programme (2019-20 to 2021-22) (Number in lakh/r in crore) |                                  |                   |                       |                    |                       |                   |                       |
|--|----------------------------------|-------------------|-----------------------|--------------------|-----------------------|-------------------|-----------------------|
| Particulars  |                                  | 2019-2020         |                       | 2020-2021          |                       | 2021-2022         |                       |
|  |                                  | No. Of SHGs       | Amount                | No. Of SHGs        | Amount                | No. Of SHGs       | Amount                |
| Loans disbursed to SHGs during the year  | Total No. of SHGs extended loans | 31.46<br>(16.60%) | 77659.35<br>(33.17%)  | 28.87 (-<br>8.23%) | 58070.68<br>(-25.22%) | 33.98<br>(17.71%) | 99729.22<br>(71.74%)  |
| Loans outstanding against SHGs as on 31st March  | Total No. of SHGs linked         | 56.77<br>(11.82%) | 108075.07<br>(24.08%) | 57.8<br>(1.81%)    | 103289.71<br>(-4.43%) | 67.40<br>(16.61%) | 151051.30<br>(46.24%) |
| SHG savings with Banks as on 31st March  | Total SHG Nos.                   | 102.43<br>(2.29%) | 26152.05<br>(12.12%)  | 112.23<br>(9.57%)  | 37477.61<br>(43.31%)  | 118.93<br>(5.97%) | 47240.48<br>(26.05%)  |

*Source – NABARD (2021-22) status of microfinance in India*

## **MICRO ENTERPRISE DEVELOPMENT PROGRAMME (MEDP)**

NABARD has been supporting Micro Enterprise Development Programme (MEDPs) since 2006. The programme enables SHG members to be up skilled to take up income generating livelihood activities. The main objective of the programme is to enhance the capacities of participants through appropriate skill up-gradation in existing or new livelihood activities in farm or non-farm activities and enrich knowledge of participants on enterprise management, business dynamics and rural markets. Cumulatively, MEDP programmes (under FIF) have covered over 4.66 lakh SHG members as on 31 March 2022. Under both FIF and WSHG Development Fund, the cumulative number of trainees were 5.47 lakh as on 31 March 2022.

## **Relationship Between Micro Finance And Entrepreneurship**

The growth of the economy can be driven by the efforts of financial institutions such as microfinance, which provide credit to firms. In India, the revolution in microfinancing has revealed that it is a vital part of the fight against poverty. In order to encourage the growth of microfinancing, the Reserve Bank of India has granted licenses to two new financial institutions. These institutions will be able to provide credit to small and medium-sized enterprises. This will help them increase their productivity and spread the credit supply. The objective of this project is to promote financial inclusion by providing credit to the poor and to micro enterprises. It goes beyond merely helping the productive poor and provides support to entrepreneurship. In addition, through collaboration with other non-government organizations, it can remove the traditional obstacles to micro and entrepreneurship. One of the biggest factors that contributes to the production of rural areas is the availability of capital. This is because the rural entrepreneurs face the issue of capital when it comes to the exploitation of the various production factors for their economic activities. Now, with the help of microfinance, it is very feasible for young entrepreneurs to start their businesses in rural areas. Through micro finance, the poor in India can now start new businesses and expand their existing operations. This is very beneficial for the country's economy as it allows small businesses to contribute a huge portion of the country's GDP. In the past, the lack of access to capital had prevented many people from entrepreneurship.

## **CONCLUSION**

The micro finance sector plays a vital role in the development of rural areas by providing loans to various SHGs. The number of these organizations is increasing year by year, and the amount of loan that they are able to distribute is also increasing. However, the growth rate of their bank linkage and loan refinance assistance is decreasing.. In order to support small enterprises, MFIs are working to make their services better, by the way of understanding unique needs of small entrepreneur. In developing nations like India, the concept of micro finance loans and micro finance institutions has been embraced. Now, Micro finance lending has become the lifeline for the small businesses. Such Institutes help many deprived sections of the society, so that they can become able to integrate with the main stream.

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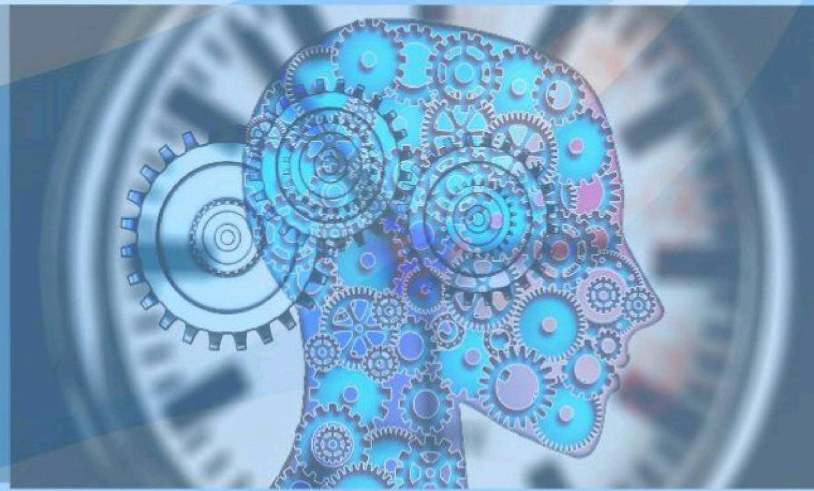
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