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Potential of Generative AI in Supporting Rural Development and Women Empowerment: Empirical Insights from Jammu & Kashmir

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Abstract
Sustainable development strategies for agricultural livelihoods, insufficient infrastructure, and gendered socio-economic hurdles priorities rural development and women's empowerment. This paper analyses women empowerment determinants in Jammu & Kashmir using primary survey data (N = 471). It identifies leverage points where generative AI, such as large language models like ChatGPT, could create scalable, context-sensitive interventions. The study validates the survey instrument (Cronbach's $\alpha = 0.918$) and assesses the impact of education and employment on empowerment using correlation, regression ($R^2 = 0.661$), and ANOVA analyses. Education variables, such as personal growth, economic independence, and awareness of rights, strongly predict empowerment. However, some attitudinal items, such as leadership aspiration, have complex or negative coefficients, highlighting institutional and socio-cultural frictions. Based on these findings, the paper proposes using generative AI to (a) increase access to localised educational content and skills training, (b) aid evidence-based policy design through automated literature synthesis and data interpretation, (c) provide livelihood and market-information services for rural producers, and (d) reduce gender biases through inclusive pedagogy and governance tools. Ethics (data privacy, algorithmic fairness), rural AI-readiness limits, and a phased deployment strategy are all discussed. According to the study, generative AI combined with participatory governance and domain-specific safeguards can accelerate rural development and empower women, but only if capacity building, accountability mechanisms, and localised data governance are also implemented.

Keywords: Generative AI, ChatGPT, Women Empowerment, Rural Development, Jammu and Kashmir, Education, AI for Development

Introduction
The Union Territory of Jammu and Kashmir is situated in the northern region of the Indian subcontinent, next to the Karakoram and western mountain ranges.The Union Territory of Jammu and Kashmir has two different regions: Kashmir and Jammu. The Jammu area is mostly flat and is recognised for its fertile soil and agricultural productivity. The valley in Kashmir is bordered by the Pir Panjal Range to the southwest and the Himalayas to the northeast. Kashmir is renowned for its unique climate and terrain owing to its position in the Himalayas. The area is known for its stunning sceneries, including mountains, hills, rivers, plains, and meadows. The valley has a milder climate. During summer, temperatures range from moderate to warm. The area is a famous tourist and winter sports destination due to its chilly winters and moderate to heavy snowfall. Rural development and the empowerment of women remain pressing policy goals for the Union Territory of Jammu & Kashmir. While structural constraints — including limited market access, gendered labour divisions, and infrastructure deficits — persist, the emergence of scalable digital tools presents new avenues

for inclusive growth. Generative AI and advanced language models (e.g., ChatGPT) can augment human capabilities in knowledge dissemination, localised learning, data interpretation, and decision support. This paper explores the potential of such AI-powered interventions by connecting them to empirically identified determinants of women's empowerment within a representative cross-section of Jammu & Kashmir households (N = 471). The empirical basis comprises a survey conducted in the districts of Anantnag and Baramulla in Jammu and Kashmir, together with an analysis that yields comprehensive metrics on education, employment, governance involvement, and empowerment results.

The Anantnag district is located in the southern part of the Kashmir Valley, with a latitude of 33 degrees 45' N and a longitude of 75 degrees 09' E. The district, with a population of 1.079 million (rural population of 796,000), is ranked third in the Union Territory based on the 2011 census data. The literacy rate stands at 62.69%, while the sex ratio is 927.The Gross District Domestic Product (GDDP) of Anantnag is anticipated to reach ₹16,399.22 Crore at current rates for the fiscal year 2022-23 (2RE). The district's Gross District Domestic Product at constant prices is estimated at ₹9218.56 Crore. District Anantnag is expected to secure the 3rd position in the Union Territory for economic size and is projected to rank 13th in Per Capita Income, with an annual income of ₹109,144. The city of Baramulla, after which the district is named, was established by Raja Bhimsina in 2306 BC. The district is located in the northwestern region of the Kashmir Valley, next to the districts of Kupwara, Bandipora, Budgam, and Srinagar. It is situated at 33 degrees 52' N latitude and 74 degrees 53' E longitude. According to the 2011 census statistics, the district's population is registered at 1.008 million, with the rural population comprising 826,000, ranking it fourth in the union territory by population size. The district's literacy rate is stated at 64.63%, with a sex ratio of 885. The Gross District Domestic Product (GDDP) of Baramulla is estimated at ₹16,351.20 crore at current prices and ₹9,098.15 crore at constant prices for the fiscal year 2022-23 (2RE). The district is projected to rank 4th in the UT for the size of its economy and 11th in Per Capita Income, with an average yearly income of ₹116,271.

Objectives

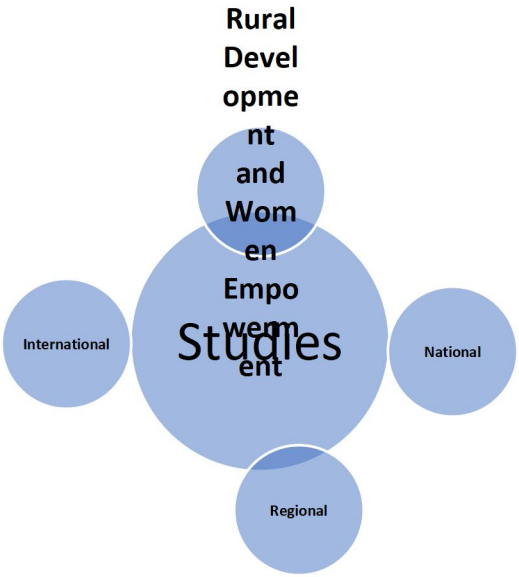
What are the primary socio-economic determinants of women's empowerment in the surveyed population?

Where can generative AI interventions most effectively strengthen rural development and women's empowerment?

What are the practical, ethical, and institutional considerations for deploying generative AI in this context?

Literature Review

A literature review is a fundamental component of any academic research, providing a comprehensive and critical analysis of existing studies, official data, and scholarly works related to the research topic (Khan, 2022). Women empowerment is multi-dimensional — economic, social, political, and psychological — and depends on access to education, paid employment, health services, and participatory institutions (Kabeer, 1999; Sen, 1999; World Bank reports).



Studies from International Context

Moyo and Francis (2025) in their work titled as "Women Empowerment Initiatives for Rural Development in South Africa: The Missing Piece of the Puzzle" reviews secondary data on women's empowerment in rural South Africa, pointing out persistent gaps in access to major resources like informational, financial, material, and social. They argue that such resources are vital for improving nutrition, education, and participation in decision-making process. Community engagement, especially at the grassroots level, improves women's potential and gathers local support. Although progress has been made in creating supportive environments, challenges remain in disseminating information and developing sustainable economic models. Their research recorded the need for inclusive participation particularly involving women, men, and local leaders throughout all phases of empowerment initiatives.

Gupta and associates (2024) explored the disconnection between skill development and job creation in rural areas, highlighting its implications for achieving SDG 5th on gender equality. Their analysis synthesizes data from academic literature, government policies, and practitioner reports to examine the structural barriers limiting rural women's empowerment. Although targeted policies, implementation gaps persist, with many women unable to access or recognize the value of income-generating skills. Notably, over 70% of the global rural poor are women, yet limited industrial and commercial infrastructure constrains employment opportunities. The study underlines the role of skill development in enhancing women's financial autonomy and decision-making power, calling for firm-level interventions that align training with viable employment pathways.

Studies from National Context

Shin et al. (2024) examined women's empowerment in rural Rajasthan through skill development and job creation, aligning with 5th Sustainable Development Goal. Using in-depth interviews with 28 women, their study captured the socio-economic impacts of COVID-19, particularly the collapse of artisanal employment. The authors proposed a framework combining the National System of Innovation and Luhmannian theory, highlighting the importance of collaborative efforts between government, private sector, and educators. The role of social entrepreneurs in bridging skill gaps and enhancing employability emerged as a central theme. While the qualitative richness provides valuable real-world insights, the absence of quantitative validation limits generalizability.

Nevertheless, the study offers a timely and innovative perspective on fostering gender equity through systemic skill-building initiatives in marginalized settings.

Kumar et al. (2024) identified a significant positive relationship between digital literacy and empowerment ($r=0.153$, $p=0.009$), with social media exposure notably amplifying this effect ($t=3.350$, $p<0.001$). Their study highlights how digital skills enhance access to information, economic opportunities, and social engagement. Despite its practical implications for bridging the gender digital divide, the limited geographic scope and sample size constrain its broader applicability. Nonetheless, it calls for increased investment in digital training to foster gender equity in rural India.

Khan et al. (2024) employed a phenomenological approach to explore the educational deprivation experienced by tribal women in Ganderbal district of Kashmir. The study involved 30 women participants. Data were collected using a semi-structured interview schedule and observational methods and analyzed through Moustakas' modified Stevick-Colaizzi-Keen phenomenological method. The findings emphasized entrenched cultural norms that prioritize men's education while confining women to domestic roles, significantly limiting tribal women's access to education. These restrictive norms have led to harmful outcomes such as child marriage, forced and child labor, exclusion from economic activities, social alienation, exploitation, limited decision-making power, and high dropout rates. The study emphasizes the urgent need for the effective implementation of the National Education Policy (NEP) 2020 and the importance of raising awareness among both tribal men and women about the negative impacts of socio-cultural and economic exclusion on educational mobility which has impacted tribal women's empowerment.

Younis (2018) concluded programmes for rural development are prominently featured in both the state's economic planning and the centre. Without uplifting rural populations, we can quicken the turn in global socioeconomic growth. These projects aim to improve a variety of aspects of rural development, such as creating jobs, enhancing sustainable livelihoods, generating productive assets and skills, empowering rural women, and promoting social security and equity. However, none of the components can be completed without enough public engagement. It's important for the people to grasp this and become involved in the development work for the same because the major goal of the rural development project is to increase the economic and social level of the rural people. The general development of the J&K state has improved significantly thanks to the execution of several state and federally funded programmes, but much work remains. As a result, rural development must be given top priority in our planned initiatives because the majority of the people in our nation resides in rural regions.

Additionally, Recent scholarship has begun to assess the role of digital technologies in bridging rural service gaps: mobile-based advisory services, e-learning platforms, and digital market linkages have shown positive impacts on productivity and female participation (Aker & Mbiti, 2010; Agarwal et al., 2019). Generative AI, as a new class of tool, extends these capacities by enabling automated tutoring, translation, personalised content, literature synthesis, and conversational interfaces that can operate at scale (Bender et al., 2021; Topol, 2019). However, mainstream AI literature also warns of biases, data privacy risks, and the potential to exacerbate inequalities if digital access and literacy are uneven (Eubanks, 2018).

This paper bridges the empirical findings from Jammu & Kashmir with these emerging AI capabilities to present context-sensitive policy proposals.

3. Data and Research Methodology

3.1 Data Source and Sample

The analysis uses both primary survey data (N = 471) collected from two districts, Baramulla and Anantnag, as well as secondary data collected from Books, Journals, various publications and surveys from the Directorate of Economics and Statistics, Digest of Statistics J&K 2023-24, "District Domestic Product - 2022-23" sources, Research publications, Census reports etc. These data gave a contextual knowledge of socioeconomic situations. The chosen research locations in District Baramulla are located within Tehsil Watergam, an administrative division that includes many rural communities. The principal villages chosen for the research are Behrampora A, Behrampora B, Botingoo, Chaklo, Chatloora, Dangerpora, Nadihal A, Chatloora Ladoora, Warpora, and Ladoora, all located under the authority of Watergam Tehsil. These villages exemplify the usual socio-economic and demographic traits of rural Baramulla, rendering them appropriate for studies on rural development and women's empowerment. Similarly, in District Anantnag, the research sites were chosen from three development blocks—Bijbehara, Anantnag, and Qazigund—to reflect regional socio-economic disparities in the southern Kashmir Valley. Each block encompasses many villages exhibiting distinct livelihood frameworks, educational attributes, and degrees of women's involvement in local administration. The chosen villages within Bijbehara Block are Pazalpora, Mahama, and Arwani. The villages of Anantnag Block include Mirgund, Chichriora, and Matipora, whilst Qazigund Block consists of Y. K. Pora A, Y. K. Pora B, and Sransoo. These communities collectively provide a representative cross-section of rural Anantnag, rendering them suitable research sites for examining trends of rural development and women's empowerment.

A multi-stage sample method was employed to systematically choose respondents from various administrative levels. Baramulla and Anantnag districts were intentionally chosen to exemplify rural development trends in the Kashmir Valley. Primary data were gathered using a standardised questionnaire with 46 items across various constructs: Education, Employment, Economic Autonomy, Consciousness, and entitlements, Leadership and Engagement, Decision-making proficiency on social and personal levels. Quantitative data analyses were conducted using SPSS Version 26. The analytical procedures included descriptive statistical analysis, where frequencies, percentages, and measures of central tendency and dispersion were employed to concisely present the socio-economic characteristics of the respondents. Reliability assessment was performed using Cronbach's Alpha, with the overall scale yielding a coefficient of $\alpha = 0.918$, indicating excellent internal consistency. Correlation analysis was utilised to examine the associations between key educational attributes and various dimensions of women's empowerment. Furthermore, a multiple linear regression model was applied to assess the combined effect of education, employment, and attitudinal variables on empowerment outcomes, thereby identifying the most significant predictors within the dataset. Each question was evaluated using a Likert scale ranging from Strongly Agree to Strongly Disagree.

Measurement and Instrument Reliability and Empirical approach

The instrument comprised 46 items measuring constructs related to education, employment, governance participation, and empowerment. Reliability analysis shows Cronbach's alpha =

0.918 for the 46-item scale, indicating excellent internal consistency. Scale statistics show mean and variance consistent with reliable measurement properties (scale mean ≈ 157.64; variance ≈ 717.76). Item-total statistics identify a few items with lower corrected item-total correlations, but overall the instrument proved robust for multivariate analysis.

Descriptive statistics, correlation analysis, multiple regression, and ANOVA tests were all incorporated in the empirical approach: Pairwise relationships between education/employment items and empowerment scores can be found using correlation analysis. Education-driven personal growth (r ≈.721) and empowerment-related understanding of rights (r ≈.553) were important positive associations. Multiple regression using eight education-related metrics as independent variables (ED1–ED8) and "Empowering Women" as the dependent variable. A significant amount of the variation was explained by the model (R2 = 0.661; Adjusted R2 = 0.655), suggesting that empowerment is strongly predicted by factors connected to schooling. Among the important predictors were: Personal development is facilitated by education ($\beta_7 = 0.52$, $p < .001$). Higher educated women had greater economic independence ($\beta^2 = 0.17$, $p < .001$). Awareness of rights is influenced by education ($\beta_8 = 0.13$, $p < .001$).Women with higher levels of education are more prone to question conventional gender norms ($\beta_3 = 0.05$, $p < .01$).Some of the coefficients were substantial and negative (e.g., education promoting leadership positions $\beta_4 = -0.18$, $p < .001$), indicating complicated dynamics where institutional opportunities may not meet ambition. ANOVA and post-hoc comparisons revealed statistically significant group differences in employment perceptions and empowerment across education levels (one-way ANOVA results reported in Chapter 4; multiple comparisons show strong divergence between "no formal education" and higher education groups on key outcomes).

Empirical Findings and Discussion

Education, Employment and Empowerment: Key Empirical Patterns

The dataset reveals three principal empirical patterns:

1. **Education is a central enabler of empowerment**, but its effects are multi-dimensional. The regression model ($R^2 = 0.661$) demonstrates that education-driven personal growth, economic independence, and rights awareness are the strongest predictors of empowerment. Thus, education that fosters awareness and self-improvement has outsized effects.
2. **Employment matters for the agency but interacts with education**. Descriptive and ANOVA results show that women with lower formal education often perceive employment as more critical for economic independence (e.g., mean for “employment provides economic independence” highest among those with no formal education). Simultaneously, highly educated women show higher perceived ability to make independent financial decisions. These patterns show that employment interventions must be tailored by educational strata.
3. **Aspirations versus structural barriers**. Certain education-related items (e.g., leadership pursuit) bear negative regression coefficients. These counter-intuitive results imply that while education increases aspiration, structural obstacles — social norms, limited political opportunity, or lack of institutional support — may prevent aspiration converting into empowerment. This indicates the need for institutional reforms alongside capability-building.

Implications for Intervention Design

From an empirical standpoint, interventions that enhance (a) personalised learning and skills, (b) market access and livelihood support, and (c) rights-awareness and governance participation are likely to have the largest impact. Generative AI offers scalable methods to deliver each of these intervention types in a way that is inherently responsive to local language, literacy, and socio-cultural constraints.

How Generative AI Can Strengthen Rural Development & Women's Empowerment

The study suggests a number of AI-enabled intervention domains, implementation strategies, and safety measures based on the empirical drivers.

Domain 1 — Localized, Personalized Education & Skill-Building

Rationale based on data: The best indicator of empowerment is education-driven personal progress ($\beta^2 = 0.52$). However, access and quality differ between rural and urban areas and educational levels.

AI application: Deploy AI-powered adaptive learning platforms (chatbot tutors, curriculum generators, microlearning modules) that:

Provide education-level-appropriate literacy, vocational, financial literacy, and rights education content that is localised in Kashmiri, Urdu, and English. To assist users with inadequate literacy, utilise conversational interfaces (speech + text).

Provide entrepreneurship scaffolded modules (horticulture value chains, poultry, fisheries, small agribusiness) that connect to local mandi data. Higher aspiration-realisation alignment, better learning retention, and the transfer of marketable skills that lead to employment and income are the anticipated results.

Domain 2 — Market Information, Agribusiness Advisory and Value-Chain Support

Rationale from data: Baramulla's economy is centred on horticulture (Sopore mandi, etc.); access to markets determines employment and income. Women's economic agency is increased through employment and market connections.

AI application: Build AI agents to:

Use SMS, audio, and WhatsApp integrations to deliver real-time mandi pricing, crop care advice, weather-adaptive crop recommendations, and post-harvest storage recommendations. Create straightforward business plans and microloan applications specifically for women-owned SHGs (Self Help Groups) and microenterprises. Help cooperatives with buyer matching, demand forecasting, and template papers. Reduced information asymmetry, increased bargaining power for female farmers, increased incomes, and expansion of value-added agro-enterprises are the anticipated results.

Domain 3 — Civic Awareness, Governance Participation, and Rights Education

Rationale from data: Empowerment is positively impacted by awareness of rights ($\beta^2 = 0.13$). However, institutional gaps obstruct leadership pathways.

AI application: Use generative AI to:

Make easily accessible, locally relevant explainers about municipal procedures, Panchayati Raj roles, and entitlement systems. Use role-plays and simulated governance scenarios to train female leaders. Create basic grievance templates and summarise local government proceedings.

Expected outcomes: enhanced local leadership among women, increased civic engagement, and increased entitlement utilisation.

Limitations

Due to the respondent sample age variation and male predominance (62.4%), generalisations should be made with caution. Infrastructure and digital literacy are key factors in determining AI readiness in rural areas; before scaling up, empirical pilots are required. External randomised controlled trials of AI interventions are not included in this study; instead, it is advised that pilots be created to generate causal evidence.

Conclusion and Policy Recommendations

This study links useful AI-enabled treatments to solid empirical data on education, employment, and empowerment. The following are the main conclusions:
The best tool for empowerment is education, particularly when it comes to rights, knowledge and personal development. Personalised education and skill training tailored to local need can be scaled with generative AI. For women, particularly those with lower levels of education, employment and market access are crucial routes to agency. AI-driven business support agents and market information systems can lower asymmetries and increase earnings. However, institutional obstacles prevent aspirations from becoming leadership; therefore, AI tools should be used in conjunction with local institution capacity building and governance changes. Above all, the use of AI should be ethical; human monitoring, bias audits, and data governance are not only important but also necessary prerequisites. Pilot AI-driven adaptive learning and market information projects in panchayats dominated by horticulture, and assess impacts on incomes and participation of women. Establish district-level AI units, with an embedded gender specialist, that can translate evidence, surveys and administrative interventions. Make disclosure and auditing of all AI tools being used in public service delivery mandatory, and include community feedback loops. Finally, generative AI has the potential to accelerate rural development and amplify women's empowerment-but only through deliberate, rights-based, participatory deployment.

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