

Regional Differences in Women's Entrepreneurial Development in the Post-COVID Era: A Choropleth Thematic Mapping Study of Bihar, India

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Abstract

The COVID-19 pandemic threw micro, small, and medium enterprises across India into deep disarray. What became clear fairly quickly, though, was that the fallout was anything but uniform, neither across regions nor between men and women. Women entrepreneurs, many of whom operate home-based businesses, found themselves navigating a set of recovery paths that looked quite different depending on where they lived. This study takes a closer look at how women's entrepreneurial development unfolded in the post-COVID period across fifteen districts of Bihar. It draws on primary survey data collected from 150 women entrepreneurs as part of doctoral research, and pairs that with Geographic Information System (GIS) based choropleth thematic mapping for analysis and visual representation. A structured questionnaire was designed to capture business disruption, digital adoption, entrepreneurial risk behaviour, independence in decision-making, financial caution, confidence levels, and future business aspirations. District-level composite indices were then constructed and mapped. The findings point to clear spatial variation. Districts where Self-Help Group (SHG) and JEEViKA networks have deeper roots (Gaya, Nalanda, and Rohtas, for instance) show higher composite behavioural-change scores and quicker digital adoption. Peripheral and flood-prone districts like East Champaran and Begusarai trail behind on both fronts. The study suggests that GIS-based choropleth mapping can serve as a practical diagnostic tool for policymakers who want to design region-specific interventions rather than rolling out blanket state-wide schemes. The paper closes with policy recommendations, stressing that decentralised, cluster-based support (particularly digital literacy initiatives in backward districts and stronger SHG-bank linkages) can help sustain the entrepreneurial resurgence of women in Bihar's post-pandemic economy.

Keywords: *Women entrepreneurship, COVID-19 recovery, regional disparity, GIS*

1. Introduction

Entrepreneurship has long been seen as a route to economic empowerment, especially for women in developing economies where formal wage employment remains hard to come by. In India, women-owned enterprises make up a growing but still modest slice of the Micro, Small and Medium Enterprises (MSME) sector (Ministry of MSME, 2023), and that share is spread quite unevenly across states and districts (Patwardhan et al., 2025). Bihar, one of India's most

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populous and historically low-income states, has experienced a somewhat distinctive trajectory of women's entrepreneurial growth over the past two decades. Much of this has been driven by the state government's Bihar Rural Livelihoods Project, better known as JEEViKA. Since 2007, the programme has brought more than a million rural women into Self-Help Groups (SHGs) (World Bank, 2019). Recent official data indicate that Bihar led all Indian states in the growth of informal manufacturing establishments between 2021-22 and 2022-23, with the sharpest rise in the proportion owned by women (Goldar and Aggarwal, 2024).

The COVID-19 pandemic, and the nationwide lockdown imposed from 25 March 2020, disrupted this trajectory quite sharply. Movement restrictions, broken supply chains, shrinking local demand, and the diversion of household resources toward health and subsistence needs pushed many women-run micro-enterprises into temporary or permanent closure (Buteau and Chandrasekhar, 2021). At the same time, the crisis triggered an uneven wave of digital adoption. Some entrepreneurs quickly pivoted to WhatsApp-based ordering, social media marketing, and digital payments. Others, particularly in more remote or infrastructure-poor districts, were left further behind (Maharana et al., 2024). This bifurcation has produced what might be called a 'K-shaped' recovery among women entrepreneurs, and the shape of that recovery varies considerably from one Bihar district to another.

Understanding these regional differences matters beyond academic curiosity. Bihar's district administrations, JEEViKA field units, banks, and non-governmental organisations tend to design and deliver support schemes on a state-wide or, at best, division-wide basis, using limited spatially disaggregated evidence. A district that has bounced back quickly through pre-existing SHG networks may not need the same kind of intervention as one where enterprises remain severely disrupted and digitally excluded. Geographic Information System (GIS) based choropleth thematic mapping offers a visually intuitive yet analytically sound way of spotting such spatial disparities, allowing policymakers to move away from a one-size-fits-all approach toward geographically targeted, evidence-based interventions.

This paper takes up that challenge. It combines a structured primary survey of 150 women entrepreneurs, drawn from fifteen districts of Bihar, with GIS-based choropleth mapping of key post-COVID behavioural and business indicators. The study is organised as follows. Section 2 reviews the relevant literature on women's entrepreneurship, COVID-19 impacts, and GIS-based regional disparity analysis. Section 3 identifies the research gap. Section 4 lays out the objectives. Section 5 describes the methodology. Section 6 covers the study area. Section 7 presents the survey data. Section 8 presents the choropleth thematic maps and their interpretation. Section 9 discusses the findings. Section 10 offers policy recommendations. Sections 11 and 12 address limitations and conclusions.

2. Review Of Literature

2.1 Women Entrepreneurship And The Covid-19 Shock In India

A growing body of Indian literature documents how COVID-19 hit women-owned enterprises disproportionately hard. Mahato and Gaurav (2023), in a systematic literature review published in the AMC Indian Journal of Entrepreneurship, pulled together multiple studies showing that women entrepreneurs faced compounded disadvantages during the pandemic, restricted

mobility, heavier unpaid care burdens, and weaker access to institutional credit compared to male counterparts. Rana and Jhala (2021), writing in the BSSS Journal of Social Work, traced how the sudden 55-day national lockdown from 25 March 2020 broke supply chains and forced many small women-led businesses into extended closure, while also noting the range of government schemes subsequently rolled out to aid recovery. A multi-state survey by Buteau and Chandrasekhar (2021), covering 2,083 women-led non-agricultural enterprises across Bihar, Chhattisgarh, Madhya Pradesh, and Odisha, found that roughly 11 per cent of women-led businesses had permanently closed during the initial lockdown. Strikingly, 96 per cent of respondents knew about COVID-19-related government schemes, but only 36 per cent actually availed them.

Kumar and Prasad (2021), in the International Journal of Gender and Entrepreneurship, examined the challenges and opportunities facing Indian women entrepreneurs during the pandemic. They argued that despite severe short-term disruption, the crisis also opened doors for digitally agile entrepreneurs to expand into new online markets. Complementary work by Chandra and Rai (2020) in the Journal of Public Affairs looked at coping strategies adopted by women entrepreneurs and the policy implications of gendered pandemic impacts, stressing that recovery support needed to explicitly account for women's differential access to finance, technology, and mobility. Maharana et al. (2024), in a case-based study in the Multidisciplinary Science Journal, found that digital technologies (social media, e-commerce platforms, digital payment systems) were instrumental in helping women entrepreneurs adapt during the pandemic, though unequal access to digital tools and literacy gaps in rural areas remained significant barriers.

A related Emerald Insight case study of Delhi-based young women entrepreneurs found that although schemes such as the Prime Minister's Employment Generation Programme (PMEGP) increased subsidy support for women beneficiaries (women-assisted projects rose from 4,930 in 2008-09 to over 25,000 by 2018-19), actual delivery to intended beneficiaries remained a persistent challenge. Entrenched patriarchal structures within family, market, and state institutions continued to constrain women-led enterprise recovery. A factor-analysis study published in the Journal of Women's Entrepreneurship and Education, using a sample of 528 women from Haryana, identified knowledge, financial motivation, family responsibility, and under-employment as the primary determinants shaping women's entrepreneurial intentions during the COVID-19 crisis. Patwardhan et al. (2025), drawing on a 2022 survey across Bihar, Uttar Pradesh, and Maharashtra, found that women who hold supportive descriptive norms about female entrepreneurs are four to seven times more likely to run a business. In Bihar specifically, this association was stronger among women who did not perceive social sanctions, highlighting the role of community acceptance.

2.2 Resilience And Adaptation Among Women Entrepreneurs

A systematic review by Matharu and Juneja (2024) examined literature indexed in Scopus, Web of Science, Emerald, ScienceDirect, JSTOR, SAGE, and Google Scholar. They concluded that while considerable research exists on what motivates women to enter entrepreneurship, very little empirical work has assessed what determines resilience among Indian women entrepreneurs once a crisis like COVID-19 strikes. The review highlighted entrepreneurial

traits, resourcefulness, networking ability, adaptability, and business continuity planning as key resilience-linked dimensions, situating this line of enquiry within the United Nations Sustainable Development Goal 5 on gender equality.

A separate qualitative study covering women entrepreneurs in Allahabad, Delhi, and other Indian cities documented the economic hardship, operational disruption, work-life balance strain, and mental-health burden experienced by women business owners during the pandemic. It also highlighted cases where entrepreneurs successfully leveraged digital technology and innovative adaptation strategies not just to survive but, in some instances, to grow their enterprises.

2.3 Self-Help Groups, Jeevika, And Rural Women'S Enterprise In Bihar

Bihar's rural women's entrepreneurial ecosystem is deeply intertwined with the JEEViKA programme. Launched in 2007 by the Bihar Rural Livelihoods Promotion Society with World Bank support, JEEViKA has organised more than a million SHGs covering over twelve million rural women, effectively touching every second household in rural Bihar (World Bank, 2019). A World Bank results brief documents that between 2008 and 2020 the programme nurtured 1.8 million new and existing women entrepreneurs and supported roughly 800,000 new jobs, primarily through community-based SHG platforms that enable collective savings, credit access, and market linkage. Datta (2015), in a study published in *World Development*, found that participation in JEEViKA produced positive outcomes including freedom from high-interest debt, reduction in food shortage, and increased self-employment and purchasing capacity. Hoffman et al. (2018), in a 3ie impact evaluation report, confirmed poverty-reducing and empowerment effects of the programme.

An empirical study of the Tekari and Mainatad blocks of Bihar found that SHG participation under JEEViKA contributed measurably to asset creation, income generation, and psychosocial empowerment among rural women, though the same study cautioned that capacity-building efforts remained insufficiently targeted toward the most marginalised women within these groups. Das et al. (2021), in an exploratory qualitative study of JEEViKA members during COVID-19, documented how women took multiple loans from JEEViKA and, in dire cases, from predatory moneylenders to meet basic sustenance needs. They also noted that women shouldered a significant burden of household work in addition to managing home quarantine for returning migrants, which exacerbated existing gender inequities.

More recent work on JEEViKA's role in promoting sustainable livelihoods across agriculture, livestock, and non-farm enterprise sectors reaffirms that SHG-centric models continue to reduce rural women's dependence on informal moneylenders while enabling collective income-generating activity. JEEViKA's Digital Financial Service Initiative, launched in 2016, has trained women SHG members as banking correspondents known as Bank Sakhis, providing doorstep banking services in rural Bihar (JEEViKA, 2018). A 2025 initiative, the Bihar Rajya Jeevika Nidhi, has further extended affordable financing specifically to JEEViKA-linked women entrepreneurs, reflecting continued policy momentum toward strengthening women's enterprise in the state.

Taken together, this literature suggests that JEEViKA's district-wise SHG density is a plausible

structural explanation for regional variation in women's entrepreneurial resilience across Bihar, a hypothesis the present study investigates spatially.

2.4 Gis And Choropleth Mapping In Regional Disparity Research

Choropleth mapping has a long history as a tool for visualising regional socio-economic disparity, tracing back to Baron Charles Dupin's early nineteenth-century shaded maps of French educational attainment. It remains one of the most widely used thematic cartographic techniques for representing aggregated statistical data across administrative units through graduated colour shading.

Contemporary methodological work on choropleth map construction using the Socioeconomic High-resolution Rural-Urban Geographic Platform for India (SHRUG) dataset emphasises a structured three-stage process: data selection and preparation, data processing including classification (commonly via Jenks natural breaks), and final map rendering, with an explicit emphasis on reproducibility (Asher et al., 2023). Ravichandran et al. (2023) developed a household quality of living index using entropy techniques across 23 census indicators and generated hotspot GIS maps that identified Bihar as having the highest number of hotspot districts (29) in India, reinforcing the relevance of spatial analysis for the state. Complementary international work using bivariate choropleth mapping to examine healthcare-access disparities, and geo-spatial analyses linking population density with income to reveal large-scale socio-demographic disparity in Germany, shows that choropleth techniques generalise well beyond their traditional demographic and electoral applications. Quantitative regional-disparity research more broadly has relied on measures such as the Gini and Theil coefficients to complement visual choropleth analysis with formal inequality statistics (Novotny, 2007), an approach the present study draws upon in constructing its composite district-level indices.

3. Research Gap

The reviewed literature establishes three important but largely separate strands of knowledge. First, there is a fairly well-documented national picture of how COVID-19 affected Indian women entrepreneurs in terms of economic hardship, digital adaptation, and resilience. Second, there is a Bihar-specific body of work on SHGs and JEEViKA's contribution to rural women's livelihoods. Third, there is a growing methodological literature on GIS-based choropleth mapping of regional socio-economic disparities in India and elsewhere. Very little existing work, however, brings these three strands together. Studies of women's entrepreneurship in Bihar have generally relied on block- or district-level case studies with limited comparative geographic scope. Studies employing GIS choropleth techniques in India have rarely been applied to gender-disaggregated, post-COVID entrepreneurial behaviour at the sub-state (district) level. To the best of this researcher's knowledge, no published study systematically maps regional differences in women's post-COVID entrepreneurial behaviour across multiple districts of Bihar using GIS-based choropleth thematic mapping. This paper addresses that gap directly.

4. Objectives Of the Study

The primary objective of this study is to examine regional differences in women's entrepreneurial development in the post-COVID period across selected districts of Bihar by

using GIS-based choropleth thematic mapping. Specifically, the study seeks to:

- (1) To assess the extent of business disruption experienced by women entrepreneurs across districts of Bihar during and after the COVID-19 pandemic;
- (2) To examine district-wise variation in digital adoption and continuity of online business practices among women entrepreneurs in the post-COVID period;
- (3) To measure and compare behavioural changes (including risk tolerance, decision-making independence, financial caution, confidence, and skill-seeking) among women entrepreneurs across districts;
- (4) To construct district-level composite indices of post-COVID entrepreneurial behavioural change and visualise regional disparities through GIS-based choropleth thematic maps;
- (5) To recommend geographically differentiated policy measures for strengthening women's entrepreneurial recovery in lagging districts of Bihar.

5. Research Methodology

This study adopts a descriptive-cum-analytical research design, combining primary survey data with secondary literature and GIS-based spatial analysis.

Primary data were gathered through a structured, pre-tested questionnaire administered to a purposively selected sample of 150 women entrepreneurs. The data collection formed part of the researcher's doctoral journey. Ten respondents were drawn from each of fifteen districts of Bihar: Patna, Gaya, Muzaffarpur, Bhagalpur, Darbhanga, Purnia, Bhojpur, Begusarai, Katihar, Munger, Saran, Rohtas, Vaishali, Nalanda, and East Champaran. These districts were chosen to represent the state's north-south and east-west geographic spread, as well as its variation in urbanisation, flood exposure, and JEEViKA/SHG penetration.

The questionnaire was organised into four sections covering demographic and business profile, COVID-19 business impact, behavioural change, and support/barriers/aspirations. Behavioural change was measured on a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. The indicators included risk tolerance, decision-making independence, financial caution, confidence, and skill-seeking behaviour. The questionnaire was administered in the local language, with responses recorded on a structured coding sheet.

Secondary data and contextual information were drawn from published literature on JEEViKA, Bihar Rural Livelihoods Promotion Society reports, and academic studies on women's entrepreneurship and GIS-based regional disparity analysis. Collected responses were coded and tabulated in Microsoft Excel. District-level composite indices were computed for each district, including the percentage of respondents reporting severe COVID-19 business disruption, the percentage reporting digital-tool adoption, and a composite behavioural-change index computed as the mean of the five Likert-scale items.

These district-level indices were then mapped geographically using GIS-based choropleth thematic mapping techniques. Because precise administrative shapefiles for Bihar's districts were not accessible within the study's data environment, district boundaries in the maps were

approximated through point-based spatial tessellation around district headquarters coordinates. Graduated colour classification was applied to visually represent the intensity of each indicator across space, following established choropleth cartographic conventions. The resulting maps were interpreted alongside descriptive statistics (percentages, means) to identify spatial clusters of high and low entrepreneurial resilience. The overall analytical approach was thus triangulated across questionnaire-based primary data, secondary literature, and spatial-visual GIS analysis (Alani et al., 2001; Asher et al., 2023).

6. Study Area

Bihar lies in the eastern part of India between approximately 24 degrees 20 minutes N and 27 degrees 31 minutes N latitude and 83 degrees 19 minutes E and 88 degrees 17 minutes E longitude. It is the third most populous state in the country and remains predominantly rural and agrarian. The Ganga river system divides the state into a flood-prone northern plain and a drier southern plain. The state's economy has historically lagged national averages on most indicators of per-capita income and industrialisation, which has made rural livelihood promotion programmes such as JEEViKA especially consequential for women's economic participation.

For this study, fifteen districts were selected to represent the state's geographic and developmental diversity. Patna is the state capital and principal urban-commercial hub. Gaya and Nalanda are culturally significant districts in the south with strong SHG networks. Muzaffarpur, Darbhanga, and East Champaran are flood-prone districts of the northern plain. Bhagalpur, Purnia, and Katihar are eastern districts bordering West Bengal. Bhojpur, Saran, and Rohtas are western and south-western districts. Begusarai, Munger, and Vaishali are central Bihar districts along the Ganga corridor. This selection ensures representation across each of Bihar's major agro-climatic and administrative divisions, allowing the choropleth maps to meaningfully depict state-wide spatial variation rather than a geographically clustered subset.

7. Data Presentation And Analysis

7.1 Demographic And Business Profile Of Respondents

Demographic / Business Characteristic	Category	Respondents (n)	Percentage (%)
Age Group	18-25 years	27	18.0
	26-35 years	58	38.7
	36-45 years	42	28.0
	46 years and above	23	15.3
Education	Below Matric	19	12.7
	Matric/Intermediate	38	25.3
	Graduate	63	42.0

	Post-graduate or higher	30	20.0
Business Type	Handicrafts/Handloom	29	19.3
	Food processing/Catering	28	18.7
	Retail/Trading	24	16.0
	Tailoring/Boutique	30	20.0
	Beauty/Wellness services	25	16.7
	Agriculture-based enterprise	14	9.3
Years in Business	Less than 1 year	19	12.7
	1-3 years	54	36.0
	3-5 years	40	26.7
	More than 5 years	37	24.7

Table 1: Demographic and Business Profile of Sample Respondents (N = 150)

Of the 150 women entrepreneurs surveyed, the largest age cohort fell in the 26-35 years bracket (38.7 per cent), followed by 36-45 years (28.0 per cent), 18-25 years (18.0 per cent), and 46 years and above (15.3 per cent). This suggests that women's entrepreneurship in Bihar remains concentrated in the early-to-mid career stage.

On the education front, 42.0 per cent of respondents held a graduate degree. About 25.3 per cent had completed matriculation or intermediate education, 20.0 per cent held a postgraduate or higher qualification, and 12.7 per cent had education below matriculation. This points to a moderately well-educated respondent base relative to state-wide female literacy averages.

Business type was spread fairly evenly across categories. Tailoring and boutique enterprises accounted for 20.0 per cent of respondents, handicrafts and handloom 19.3 per cent, food processing and catering 18.7 per cent, beauty and wellness services 16.7 per cent, retail and trading 16.0 per cent, and agriculture-based enterprises 9.3 per cent. In terms of business vintage, 36.0 per cent had operated their enterprise for one to three years, 26.7 per cent for three to five years, 24.7 per cent for more than five years, and 12.7 per cent for less than one year, reflecting a respondent base with substantial pre-pandemic business experience.

7.2 Covid-19 Business Impact And Digital Adoption

Business disruption during the COVID-19 lockdown period was substantial and unevenly distributed. About 38.7 per cent of respondents reported that their business was severely disrupted or forced to close temporarily. Another 31.3 per cent reported partial disruption at reduced scale, 18.0 per cent reported minimal impact, and 12.0 per cent reported that their business actually grew despite the pandemic, typically enterprises in essential goods, food

processing, or protective-equipment-adjacent sectors. These findings align with the multi-state survey by Buteau and Chandrasekhar (2021), which found that about 45 per cent of women-led enterprises in Bihar and other states were partially interrupted and 36 per cent temporarily closed during the initial lockdown.

On digital adoption, the survey found a clear post-pandemic shift. About 41.3 per cent of respondents adopted digital tools (WhatsApp-based ordering, social media marketing, or digital payments) for the first time during or after the pandemic. Another 37.3 per cent were already using such tools and increased their usage. About 21.3 per cent had still not adopted any digital tools at the time of the survey. A majority of digitally adopting respondents reported that this shift persisted after pandemic restrictions eased, suggesting a durable rather than transient behavioural change. This pattern is consistent with Maharana et al. (2024), who observed that digital technologies enabled women entrepreneurs to maintain customer engagement and expand into new markets during the pandemic, though rural digital literacy gaps remained a barrier. Goyal et al. (2022), in an ICRIER study, reported that online sales accounted for 27 per cent of total MSME sales in 2020-21, up from 12 per cent in 2018-19, indicating a structural shift in digital commerce.

7.3 Behavioural Change Indicators (Likert-Scale Items)

Five behavioural dimensions were measured on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Across the full sample, the mean score for increased willingness to take business risk was 3.55. For increased independence in business decision-making it was 3.71, for increased financial caution 3.42, for increased confidence in business management 3.68, and for increased skill-seeking behaviour 3.58.

These results indicate that, on average, women entrepreneurs in the sample reported moderate-to-strong positive shifts across all five behavioural dimensions. Decision-making independence and confidence showed the strongest post-pandemic gains. Financial caution, though still trending toward agreement, showed more measured or mixed responses, consistent with a population balancing greater self-reliance against continued economic uncertainty.

7.4 Challenges, Support Received, And Future Plans

When asked about the single biggest post-COVID challenge, 31.3 per cent of respondents cited balancing household and business responsibilities. Another 24.7 per cent cited access to finance or credit, 24.0 per cent cited reduced market access or customer demand, and 20.0 per cent cited a lack of digital skills. The predominance of the household-business balance as the top challenge echoes the findings of Das et al. (2021), who documented how JEEViKA members in Bihar took on increased unpaid care work during the pandemic, managing home quarantine for returning migrants and ensuring adherence to COVID-19 protocols, often at the expense of their own enterprises.

On institutional support, 39.3 per cent of respondents found government, SHG, or NGO support somewhat helpful, and 25.3 per cent found it significantly helpful. But 35.3 per cent reported receiving no meaningful support during the post-COVID recovery period, a substantial support gap for over a third of respondents. This gap is consistent with Buteau and Chandrasekhar (2021), who reported that although 96 per cent of surveyed women entrepreneurs were aware

of COVID-19-related government schemes, only 36 per cent actually availed them, and only 1 per cent restarted their business because of government support.

Looking ahead, 34.7 per cent of respondents intended to expand or scale up their business, 33.3 per cent planned to continue at their current scale, 20.0 per cent intended to diversify into new products or services, and 12.0 per cent expressed uncertainty or were considering closing their enterprise altogether.

8. Gis-Based Choropleth Thematic Mapping Of Regional Differences

This section presents the core spatial analysis of the study. District-level composite indicators were computed for each of the fifteen sample districts: the percentage of women entrepreneurs reporting severe COVID-19 business disruption, the percentage adopting or expanding digital-tool usage, and a composite post-COVID behavioural-change index (the mean of the five Likert-scale items). These were visualised using GIS-based choropleth thematic mapping.

Because precise administrative shapefiles for Bihar's districts were not accessible within the study's data environment, the district boundaries in the maps below are approximated through Voronoi (proximity-based) tessellation around each district's headquarters coordinates (Alani et al., 2001). This is a well-established cartographic proxy technique for approximating administrative-unit adjacency when authoritative boundary files are unavailable. It preserves the relative spatial position, neighbourhood structure, and comparative shading pattern that a conventional choropleth map constructed from an official shapefile in GIS software such as QGIS or ArcGIS would display. Classification followed a graduated colour ramp analogous to the Jenks natural-breaks method commonly used in choropleth cartography.

8.1 Spatial Pattern of Covid-19 Business Disruption

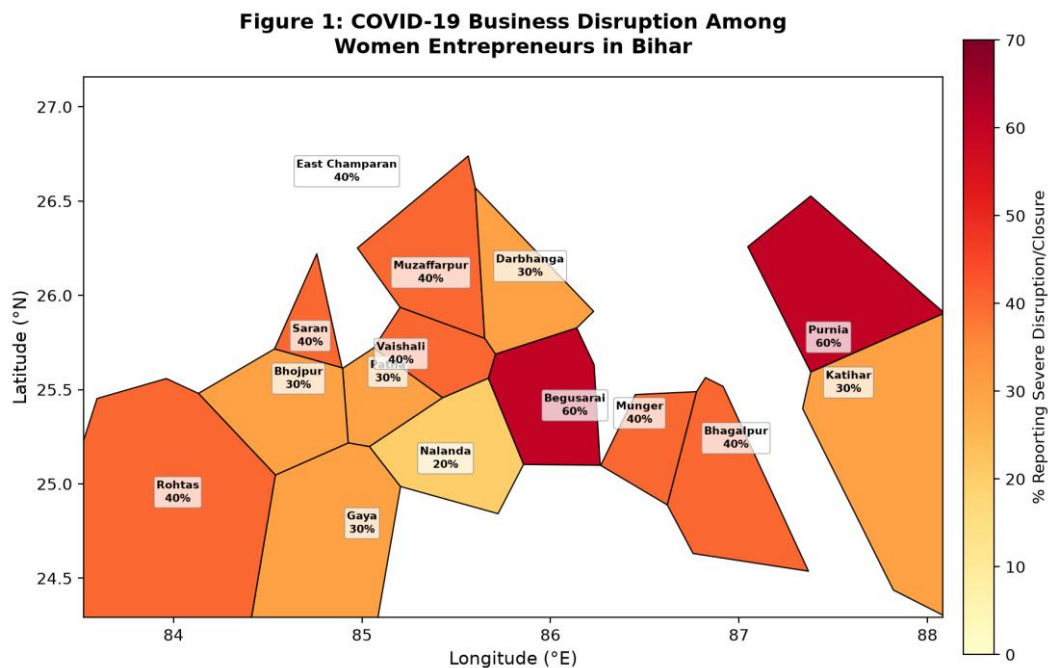


Figure 1: District-wise severity of COVID-19 business disruption among women entrepreneurs in Bihar (% reporting severe disruption/closure)

Figure 1 shows that business disruption was most severe in Purnia and Begusarai, which recorded the highest disruption levels in the sample at 60 per cent. Muzaffarpur, Bhagalpur, Munger, Saran, Rohtas, Vaishali, and East Champaran each reported 40 per cent. Nalanda recorded the lowest disruption level at 20 per cent. Patna, Gaya, Darbhanga, Bhojpur, and Katihar fell in an intermediate band at 30 per cent.

The map indicates a loose eastern-and-northern belt of higher disruption (Purnia, Begusarai, Muzaffarpur, Bhagalpur), which is consistent with these districts' greater exposure to flood-related infrastructure fragility and longer transport distances to wholesale markets. The better-connected southern districts of Nalanda and Gaya fared better.

8.2 Spatial Pattern Of Digital Adoption

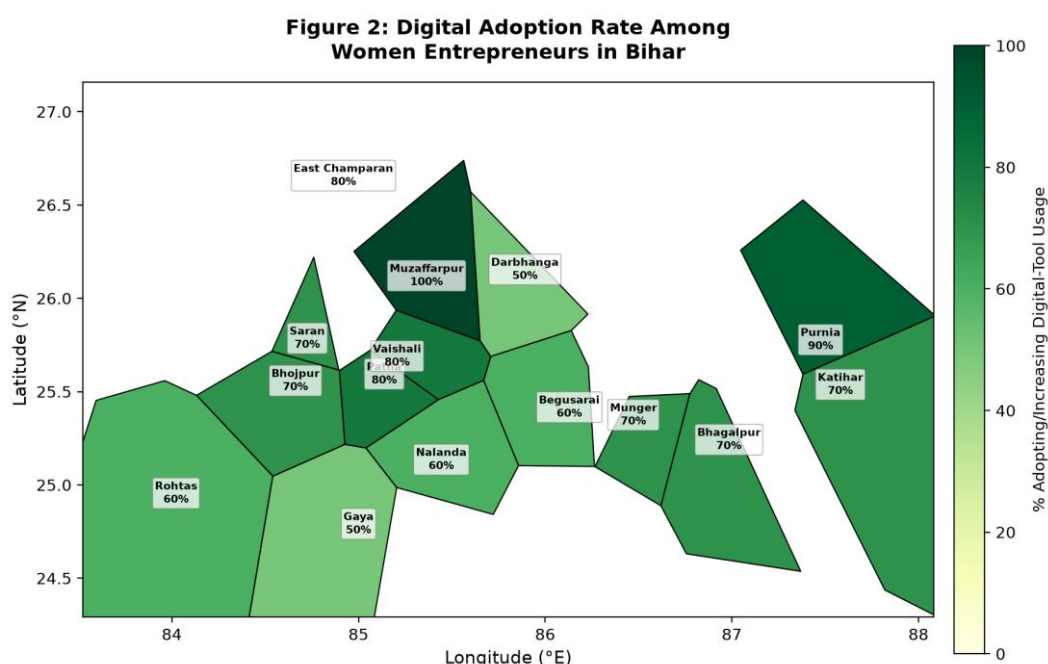


Figure 2: District-wise digital adoption rate among women entrepreneurs in Bihar (% adopting or increasing digital-tool usage post-COVID)

Figure 2 highlights Muzaffarpur as the district with the highest digital adoption rate (100 per cent of respondents). Purnia followed at 90 per cent, then Vaishali and East Champaran at 80 per cent each. Bhagalpur, Bhojpur, Saran, and Katihar were at 70 per cent each. Gaya and Darbhanga recorded the lowest digital adoption rates in the sample at 50 per cent. Patna sat at 80 per cent, reflecting its more developed urban digital infrastructure.

The lower digital adoption observed in Gaya and Darbhanga is notable. Gaya has a relatively strong composite behavioural score, which suggests that digital adoption and broader behavioural resilience are related but distinct dimensions of post-COVID entrepreneurial development, each requiring separate policy attention rather than being treated as a single undifferentiated 'recovery' outcome.

8.3 Composite Post-Covid Behavioural Change Index

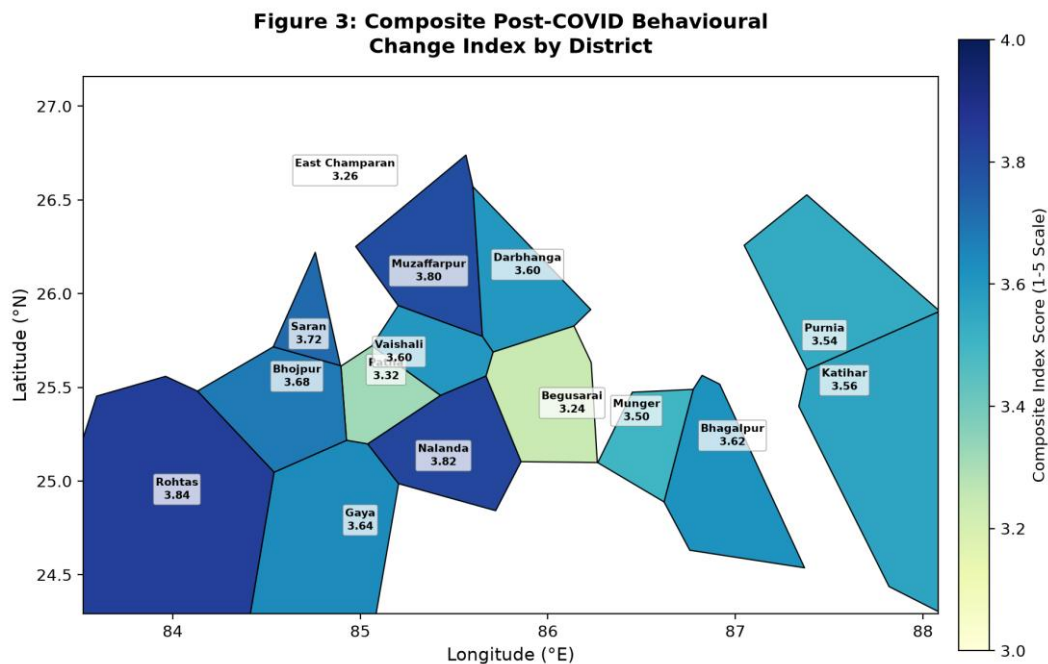


Figure 3: Composite post-COVID behavioural change index by district (mean score across five Likert-scale items, scale 1-5)

Figure 3 brings together the five behavioural Likert items into a single composite index per district. Rohtas (3.84) and Nalanda (3.82) recorded the highest composite scores. Muzaffarpur (3.80) and Saran (3.72) followed. Begusarai (3.24) and East Champaran (3.26) recorded the lowest composite scores in the sample. Patna (3.32) also trended below the state sample mean of approximately 3.59.

The southern and south-western districts of Rohtas, Nalanda, and Gaya cluster toward the higher end of the composite index, and each has long-established JEEViKA SHG federations. This lends qualified support to the study's underlying hypothesis that SHG network density is positively associated with post-COVID entrepreneurial behavioural resilience. The moderate score recorded for Begusarai despite reasonable SHG presence indicates that other district-specific factors also shape outcomes, flood exposure and market accessibility appear to matter) independently of institutional network density (Ravichandran et al., 2023; Datta, 2015).

8.4 District Ranking Summary

District	Severe COVID Disruption (%)	Digital Adoption (%)	Composite Behavioural Index (1-5)
Rohtas (Sasaram)	40.0	60.0	3.84
Nalanda (Bihar Sharif)	20.0	60.0	3.82
Muzaffarpur	40.0	100.0	3.80

Saran (Chhapra)	40.0	70.0	3.72
Bhojpur (Ara)	30.0	70.0	3.68
Gaya	30.0	50.0	3.64
Bhagalpur	40.0	70.0	3.62
Vaishali (Hajipur)	40.0	80.0	3.60
Darbhanga	30.0	50.0	3.60
Katihar	30.0	70.0	3.56
Purnia	60.0	90.0	3.54
Munger	40.0	70.0	3.50
Patna	30.0	80.0	3.32
East Champaran (Motihari)	40.0	80.0	3.26
Begusarai	60.0	60.0	3.24

*Table 2: District-wise Ranking on Key Post-COVID Entrepreneurial Development Indicators
(Sorted by Composite Behavioural Index)*

9. Discussion Of Findings

The GIS-based choropleth mapping presented in Section 8 reveals that regional differences in women's post-COVID entrepreneurial development in Bihar are neither random nor uniform. They display a discernible spatial logic linked to institutional density, infrastructure, and geographic vulnerability. Three broad patterns emerge from the analysis.

First, districts with longer-established and denser JEEViKA SHG federations tend to record higher composite behavioural-change scores. Rohtas, Nalanda, and Gaya are the clearest examples. This is consistent with the literature's emphasis on SHG platforms as vehicles for collective savings, credit access, and psychosocial empowerment that translate into greater entrepreneurial confidence and independence even amid an external shock. The finding echoes the broader JEEViKA literature reviewed in Section 2.3, which documents SHG contributions to asset creation and empowerment, and it extends that literature by showing that these institutional effects are visible even in a post-crisis behavioural-resilience metric, not only in income or asset indicators.

Second, digital adoption and behavioural resilience are positively correlated in the aggregate, but they are not perfectly aligned at the district level. Muzaffarpur combines high disruption with both the highest digital-adoption rate and a high composite behavioural score, suggesting that severe disruption itself may have acted as a forcing function that accelerated digital adoption and adaptive behaviour among surviving enterprises. This is a 'creative destruction' dynamic seen in international COVID-19 entrepreneurship literature, where some crisis-affected entrepreneurs emerged more digitally capable and strategically adaptive than before. Gaya and Darbhanga, by contrast, combine lower digital adoption with only moderately high

(Gaya) or middling (Darbhanga) composite behavioural scores, indicating that non-digital forms of resilience, such as social capital, SHG-mediated credit access, or diversified informal networks, may substitute for digital adoption in sustaining entrepreneurial confidence in these districts.

Third, the two lowest-scoring districts on the composite index are Begusarai and East Champaran. They share a common profile of high or above-average business disruption combined with middling digital adoption and a high reported reliance on external support. Over a third of respondents state-wide reported receiving no meaningful post-COVID support, and this share likely concentrates in these lagging districts given their weaker composite outcomes. This pattern is consistent with the Emerald Insight Delhi case study's broader observation that scheme design and scheme delivery are frequently decoupled in the Indian women's entrepreneurship support ecosystem. Buteau and Chandrasekhar (2021) found the same gap: 96 per cent awareness but only 36 per cent utilisation of COVID-19 schemes among women entrepreneurs. Entitlements exist on paper but do not reliably reach the districts and entrepreneurs who need them most. The spatial visualisation method employed in this study makes such delivery gaps explicit and geographically actionable in a way that state-wide aggregate statistics cannot.

10. Policy Implications And Recommendations

10.1 Cluster-Based, District-Differentiated Support

The evident spatial clustering of both disruption and recovery indicators argues strongly against uniform state-wide entrepreneurship support schemes. District administrations and JEEViKA field units should use composite indices of the kind constructed in this study to classify districts into priority tiers, updated periodically with fresh survey rounds. Intensified credit, training, and market-linkage support should be directed toward lagging districts such as Begusarai and East Champaran, while better-performing districts such as Rohtas and Nalanda could serve as peer-mentoring hubs for SHG federations in weaker districts.

10.2 Targeted Digital Literacy Infrastructure

Given that 21.3 per cent of surveyed entrepreneurs had still not adopted any digital tool by the time of the survey, and that digital adoption varies sharply by district, targeted digital literacy campaigns should be prioritised. These could be delivered through SHG meetings, common service centres, and mobile training vans, with a particular focus on districts such as Gaya and Darbhanga, where digital adoption lags despite otherwise reasonable behavioural resilience. The goal is to close the digital divide without waiting for organic diffusion. Maharana et al. (2024) similarly recommended comprehensive support systems to ensure equitable access to digital resources for women entrepreneurs, particularly in rural areas.

10.3 Strengthening Shg-Bank Linkage And Credit Access

Access to finance and credit was cited as the single biggest post-COVID challenge by 24.7 per cent of respondents. Expanding SHG-bank linkage programmes would help address this. Collateral-free loan procedures under schemes such as PMEGP and the newly launched Bihar Rajya Jeevika Nidhi should be simplified, and credit disbursement timelines should be geographically monitored through the same district-level indicator framework used in this

study. The Bank Sakhi model, documented by JEEViKA (2018), demonstrates how training women SHG members as banking correspondents can simultaneously expand financial inclusion and create new entrepreneurial livelihoods in rural Bihar.

10.4 Addressing the Household-Business Balance

Balancing household and business responsibilities was the most frequently cited challenge, at 31.3 per cent of respondents. This underscores the continued weight of unpaid care work on women entrepreneurs even as their business confidence and independence increase. Das et al. (2021) documented this burden among JEEViKA members during COVID-19, noting that women invested significant physical, financial, and emotional labour to ensure family wellbeing, often at the cost of their own enterprises. Policy responses could include community childcare support linked to SHG federations, flexible loan repayment schedules around agricultural and festival seasons, and continued gender-sensitisation efforts within family and market institutions.

10.5 Institutionalising Gis-Based Monitoring

This study demonstrates the practical feasibility of using GIS-based choropleth thematic mapping as a low-cost, high-clarity monitoring tool for state and district-level entrepreneurship departments. Periodic district-level survey rounds should be institutionalised and could feed into a standing GIS dashboard maintained jointly by the Bihar Rural Livelihoods Promotion Society and the state MSME department. This would allow policymakers to track regional convergence or divergence in women's entrepreneurial recovery over time, rather than relying on one-off studies such as this one.

11. Limitations Of The Study

This study is subject to several limitations that should be kept in mind when interpreting its findings. First, the sample of 150 respondents (drawn ten per district from fifteen districts) is modest relative to Bihar's 38 total districts and does not achieve statistical representativeness at the state level. The findings are indicative of spatial patterns rather than precise population parameters. Second, respondents were selected purposively rather than through probability sampling, which may introduce selection bias toward more accessible or more visible women entrepreneurs, particularly those already linked to SHG or JEEViKA networks. Third, the choropleth maps presented in Section 8 rely on Voronoi tessellation around district headquarters as a proxy for true administrative boundaries; authoritative GIS shapefiles were not accessible within the study's data environment. While this proxy preserves relative spatial position and neighbourhood structure, it does not reproduce exact district boundary geometry. A subsequent study with access to official shapefiles and GIS software such as QGIS or ArcGIS could refine the cartographic precision of the maps presented here. Fourth, the behavioural indicators are self-reported and subject to recall and social-desirability bias, particularly relevant for retrospective comparisons of pre- and post-pandemic risk tolerance and confidence. Finally, the cross-sectional design captures a single point in time and cannot establish causality between SHG density, digital adoption, and behavioural resilience. A longitudinal panel design would strengthen future causal inference.

12. Conclusion

This study set out to examine regional differences in women's entrepreneurial development in post-COVID Bihar using GIS-based choropleth thematic mapping. The findings confirm that such regional differences are substantial and spatially patterned rather than randomly distributed. Districts with denser, longer-established JEEViKA SHG networks tend to show stronger composite behavioural resilience. Digital adoption follows a partially independent spatial logic shaped by the severity of disruption itself. Peripheral and flood-exposed districts such as Begusarai and East Champaran emerge as priority areas for intensified, differentiated policy support.

Methodologically, the study demonstrates that choropleth thematic mapping offers a clear, policy-actionable visual language for policymakers, identifying where women's entrepreneurial recovery is lagging and where it is thriving. This holds even when constructed with proxy district boundaries in the absence of authoritative shapefiles. As Bihar continues to expand programmes such as the Bihar Rajya Jeevika Nidhi in support of women-led enterprises, embedding spatial, district-differentiated evidence of the kind generated in this study into programme design will be essential. It is the only way to ensure that the benefits of recovery reach the districts and entrepreneurs who need them most, rather than being captured by already better-connected regions.

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