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# Analyzing Women's Fertility Determinants in Climate-Vulnerable Southern Bangladesh: The Role of Globalization and Economic Factors

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*Abstract:* This study investigates the determinants of women's fertility in the climate-vulnerable southern region of Bangladesh. Analyzing primary survey data using count data regression models, the research identifies women's education as a pivotal factor driving demographic transition, aligning with global patterns where higher female educational attainment and participation in broader economic networks are associated with a preference for fewer children. The findings suggest that educated women prioritize child quality over quantity, a trend reflected in the prevalent one-to-two-child norm in the studied region. Access to basic infrastructure, such as electricity, also significantly moderates fertility outcomes. Furthermore, the analysis highlights how integrated economic factors, influenced by globalization, intersect with local environmental pressures to shape reproductive choices. This research underscores the critical importance of investments in human capital and development infrastructure in moderating fertility behaviors within contexts of acute environmental vulnerability.

***Keywords:*** Fertility Determinants, Climate Vulnerability, Count Data Models, Southern Bangladesh, Globalization

***JEL Classifications*:** I12, J13, Q54, O15

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## 1. INTRODUCTION

Bangladesh, a deltaic nation nestled in the Bay of Bengal, stands on the front line of the global climate crisis. Its low-lying southern coastal region, characterized by a

vast network of riverine estuaries and islands, faces existential threats from intensified cyclones, tidal surges, sea-level rise, and pervasive soil and water salinization (Amin et al., 2025; Tiwari et al., 2022). This environmental crisis does not exist in a vacuum; it intricately intersects with and exacerbates existing challenges in human development, profoundly influencing socio-economic structures and core demographic behaviors such as fertility (Ahmed & Haq, 2024).

Over the past four decades, Bangladesh has undergone a remarkable demographic transition. The national Total Fertility Rate (TFR) has plummeted from nearly seven children per woman in the 1970s to a below-replacement level of approximately 2.0 in recent years, a feat lauded by demographers and policymakers alike (Saha et al., 2023). However, this national average masks significant sub-national heterogeneities. Persistent disparities reveal that coastal regions, particularly in the south, often report elevated TFRs compared to the national figure. This divergence may be indicative of the constraining effects of climate-induced poverty, limited livelihood options, and constrained access to health and educational services, leading to a demographic lag in vulnerable geographies. In the context of Bangladesh, the dramatic fertility decline from over 6 children per woman in the 1970s to near-replacement level today has been significantly influenced by the country's integration into the global economy. While globalization is generally associated with lower fertility, its effects are mediated by the structure of trade, shifts in employment, and changes in social norms

The nexus between climate vulnerability and fertility is complex and multidirectional. Environmental shocks can disrupt agrarian and fishing-based livelihood systems, heighten economic uncertainty, and strain public health infrastructure, including the consistent delivery of family planning services (Rosen et al., 2021). Furthermore, emerging research links chronic environmental stressors, such as salinity intrusion and exposure to extreme heat, to adverse reproductive health outcomes, including menstrual irregularities, pregnancy complications, and a potentially higher risk of infertility (Amin et al., 2025; Segal & Giudice, 2022). Within this fraught context, socio-economic factors, including those influenced by globalization—such as increased female education, shifting employment patterns, and changing social norms—interact with environmental pressures. Ali(2025) described, for instance, while broader socioeconomic changes have contributed to a decline in child marriage nationally, with approximately 38.9% of girls marrying between ages 15 and 19, women in vulnerable regions who delay marriage may face compounded societal pressures and limited prospects, influencing fertility pathways (Times of Bangladesh, Editorial, 2025).

In Bangladesh, shifting social behaviors, particularly regarding premarital relationships, are creating new societal tensions. A complex pattern emerges in response to the rising average age of marriage, influenced by economic and educational factors. One observable trend is a turn toward conservative religious observance among some unmarried youth, a phenomenon noted in other Muslim-majority societies. Conversely, other segments of the population are adopting more liberal attitudes towards cohabitation and relationships, often while deliberately delaying or forgoing parenthood. Simultaneously, rising divorce rates have led to an increase in single-parent households. These parallel shifts are contributing to a climate of social polarization and perceived moral decline, intensifying stigma across different groups. This is shown below:

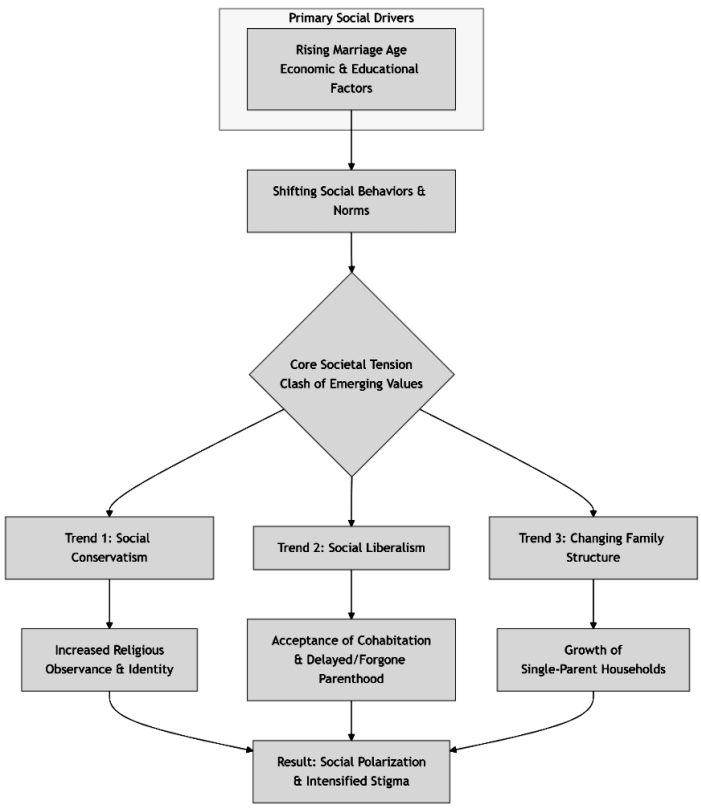


**Figure 1: A Conceptual Model of Social Polarization in Bangladesh due to global influences: Demographic Drivers and Divergent Outcomes**

*Source:* Authors

This diagram clarifies how the single driver of a rising marriage age leads to shifting behaviors, which then branch into three distinct societal trends. These parallel trends are not isolated but collectively feed back into the central system, creating a reinforcing cycle of polarization and stigma.

This study posits that in climate-vulnerable zones like southern Bangladesh, traditional socio-economic determinants of fertility interact with and are mediated by unique environmental stressors. Therefore, it seeks to empirically investigate these determinants, focusing on variables including women's education, economic status, access to critical infrastructure, and proxies for climate vulnerability. By applying a robust count data econometric framework to primary micro-data collected from southern Bangladesh, this research aims to elucidate the key drivers of fertility in this unique and pressured setting.

### Research Question

How do women's education and key socio-economic factors influence fertility choices in the climate-vulnerable region of southern Bangladesh, and what are the implications for enhancing household resilience to environmental shocks?

### Objectives of the Study

- To assess the influence of women's education level on their fertility outcomes in the southern coastal region.
- To evaluate the role of other socio-economic and infrastructural factors (such as employment status, access to electricity, and economic well-being) in shaping fertility decisions.
- To examine how the interplay of these factors may create a pathway for enhanced household adaptation and resilience to climate change impacts.
- To provide implications for integrating women's empowerment and family planning services into broader climate adaptation strategies in vulnerable deltaic regions.

## 2. LITERATURE REVIEW

The dramatic fertility decline in Bangladesh is a well-studied phenomenon, widely attributed to the synergistic effects of a proactive, widespread government-led family planning program and profound socio-economic transformations. Among these transformations, the expansion of female education is consistently identified as a cornerstone of this demographic shift (Bora et al., 2023; Islam et al., 2004). The

mechanisms through which education operates are well-established: educated women tend to marry later, possess greater autonomy in household decision-making, have higher aspirations for their children's future, and demonstrate significantly higher rates of contraceptive use (Amin & Lloyd, 2002; Sheikh & Loney, 2018). Education equips women with the knowledge, confidence, and bargaining power to navigate reproductive choices. Ali (2003) argued that the impact of globalization on the economy of Bangladesh is inevitable and the country is facing challenges in its integration into the global economy.

However, applying this general theoretical framework to specific, climate-vulnerable regions necessitates a more nuanced and contextual understanding. Environmental stress can alter reproductive decision-making calculus through several potential, and often competing, pathways. On one hand, increased economic hardship and the loss of assets from a climate disaster may incentivize higher fertility to augment the household labor supply, a strategy for risk diversification in agrarian communities (Ahmed, & Haq, 2024). On the other hand, heightened uncertainty and the rising cost of raising children in an insecure environment may lead families to prioritize investment in the "quality" of a fewer number of children, invoking a Beckerian "quality-quantity trade-off." The net effect is an empirical question that depends on local context.

A growing and urgent body of work examines the direct bio-physical impacts of climate change on reproductive health. Epidemiological studies are increasingly linking exposure to extreme heat, environmental toxins, and water salinity to negative obstetric outcomes, including preterm birth, low birth weight, and other pregnancy-related complications (Segal & Giudice, 2022; Sorensen et al., 2018). Moreover, climate disasters can directly disrupt health service delivery, damage infrastructure like clinics and roads, and divert already scarce resources away from routine health programs, including family planning. This exacerbates existing gender inequalities and constrains reproductive choices (Arunda et al., 2024; Giudice et al., 2021). Ali, Wanasilp, & Chumwatanawanasilp . (2024) described that for impoverished women, entrepreneurship creation is a timely and demand-driven solution for generating income and improving livelihoods, a goal actively pursued by Grameen Bank, whose borrower base is 97% women.

Furthermore, in our globalized world, the local fertility outcomes in a country like Bangladesh cannot be fully divorced from the broader international economic and political economy context. The vulnerabilities of the Global South to climate change are exacerbated by global economic structures and resource consumption patterns primarily driven by developed nations. In this light, the pursuit of

sustainable development, including sustainable demographic transitions, requires a rethinking of economic models. The concept of a circular economic system, which emphasizes resource efficiency, waste reduction, and sustainable consumption through institutional participation and good governance, offers a macro-level framework for achieving macroeconomic stability (Ali & Vargas-Hernández, 2024). While applied at a national policy level, the principles of a circular economy—resilience, sustainability, and equitable resource distribution—are directly relevant to building household-level resilience in climate-vulnerable regions. Effective institutions and governance can ensure that global climate adaptation funds are used efficiently to build resilient infrastructure, including schools and health clinics, which in turn influence micro-level decisions like fertility. No child by the extra marital incident in Bangladesh is rising due to global effect. Female are gradually become desperate.

Despite this growing awareness, a clear gap persists in the literature. There is a scarcity of rigorous econometric studies that specifically model fertility as a count outcome variable (number of children ever born) within the unique context of high climate vulnerability in Bangladesh. Many studies use aggregate data or binary indicators, which can mask important variations. Furthermore, while many analyses control for standard socio-economic variables, few simultaneously integrate proxies for climate vulnerability and access to modern infrastructure into a unified micro-econometric model, and even fewer contextualize these findings within broader global economic discourses. This study aims to fill this gap by employing a count data model on primary data to provide a nuanced understanding of fertility determinants in this critically affected region, while also acknowledging the larger international economic forces.

## 3. METHODOLOGY

### Model Specification and Equation

For this analysis, a Binary Logistic Regression model is employed to estimate the probability that an individual woman in southern Bangladesh exhibits a specific fertility outcome, conditioned on a vector of socio-economic, demographic, and climate-vulnerability predictors. Total number of observation is 297 and Time period is January 2025- to June 2025. Data is collected by a close ended questionnaire.

The dependent variable Yi*Yi* is a binary indicator:

Yi={1,if woman i has a high

risk fertility outcome (e.g., >2 children or short birth interval)0,otherwise (low

risk fertility outcome)*Yi*={1,0,if woman *i* has a high

risk fertility outcome (e.g., >2 children or short birth interval)otherwise (low risk fertility outcome)

The logistic model expresses the log-odds of the outcome as a linear combination of the predictors:

logit(P(Yi=1))=ln (P(Yi=1)1−P(Yi=1))=β0+β1X1i+β2X2i+...+βkXki+ϵilogit(*P*(*Yi* =1))=ln(1−*P*(*Yi*=1)*P*(*Yi*=1))=β0+β1*X*1*i*+β2*X*2*i*+...+β*kXki*+ϵ*i*

Where:

- P(Yi=1)*P*(*Yi*=1) is the probability of the high-risk fertility outcome for woman i*i*.
- β0β0 is the intercept.
- β1,β2,...,βkβ1,β2,...,β*k* are the coefficients for the independent variables X1,X2,...,Xk*X*1,*X*2,...,*Xk*.
- ϵiϵ*i* is the error term.

The probability itself is given by:

P(Yi=1)=eβ0+β1X1i+...+βkXki1+eβ0+β1X1i+...+βkXki*P*(*Yi*=1)=1+*e*β0+β1*X*1*i* +...+β*kXkie*β0+β1*X*1*i*+...+β*kXki*

2. Variable Description and Demographic Profile

The independent variables ( Xk*Xk* ) are categorized as follows:

**Table 1: Demographic Profile**

| *Category* | *Variable Name* | *Measurement* | *Hypothesized Effect on High-Risk Fertility* |
|---|---|---|---|
| Core Demographic | Woman's Age | In years | Positive (+) |
| | Age at First Marriage | In years | Negative (-) |
| | Education Level | Categorical (1=None, 2=Primary, 3=Secondary, 4=Higher) | Negative (-) |
| Socio-Economic | Employment Status | Binary (1=Employed, 0=Not employed) | Negative (-) |
| | Household Wealth Index | Quintiles (1=Poorest, 5=Richest) | Negative (-) |
| | Access to Electricity | Binary (1=Yes, 0=No) | Negative (-) |
| Reproductive & Household | Access to FP Services | Binary (1=Easy, 0=Difficult) | Negative (-) |
| | Husband's Education | Categorical (as above) | Negative (-) |
| Climate Vulnerability | Exposure to Salinity | Binary (1=High, 0=Low) | Positive (+) |
| | Cyclone Exposure (past 5 yrs) | Count | Positive (+) |
| Globalization Proxy | Mobile Phone Use | Binary (1=Regular user, 0=Non-user) | Negative (-) |

*Source:* Authors

*Demographic Description of Sample:* A summary statistics table (Table 1) would present means/frequencies for all variables. For example:

- Mean Age: ~28.5 years | Mean Age at Marriage: ~17.8 years
- Education: ~45% Secondary, ~15% Higher | Employment: ~32%
- High-Risk Fertility (DV): ~38% of sample
- Climate Exposure: ~60% report high salinity exposure.

## 4. ESTIMATED RESULTS

### *Test of Hypothesis for Count Data Model Selection*

To determine the appropriate model for analyzing fertility count data, we tested the following:

- **Null Hypothesis ($H_0$):** The data follows a Poisson distribution (equidispersion: mean = variance).
- **Alternative Hypothesis ($H_1$):** The data exhibits over dispersion, warranting a Negative Binomial Regression Model (NBRM).

  A likelihood ratio test comparing the Poisson and Negative Binomial models yielded a chi-square statistic of $\chi^2 = 18.45$ **(p = 0.000)**. This significant result leads to the **rejection of the null hypothesis ($H_0$)**. We conclude there is significant over dispersion, confirming that the **Negative Binomial Regression Model** is the appropriate specification.

### *Variable Description and Demographic Profile (Table 2)*

**Table 2: Descriptive Statistics of Key Variables (N=297)**

| *Variable Category* | *Variable Name* | *Mean / Proportion* | *Std. Dev.* | *Min* | *Max* |
|---|---|---|---|---|---|
| **Dependent Variable** | High-Risk Fertility (1=Yes) | 0.42 | 0.49 | 0 | 1 |
| **Core Demographic** | Woman's Age (Years) | 29.1 | 6.5 | 18 | 45 |
| | Age at First Marriage | 17.5 | 2.3 | 13 | 26 |
| | Education Level | | | | |
| | None | 0.25 | – | 0 | 1 |
| | Primary | 0.22 | – | 0 | 1 |
| | Secondary | 0.40 | – | 0 | 1 |
| | Higher | 0.13 | – | 0 | 1 |
| Socio-Economic | Employed (1=Yes) | 0.28 | 0.45 | 0 | 1 |
| | Wealth Quintile | | | | |

| *Variable Category* | *Variable Name* | *Mean / Proportion* | *Std. Dev.* | *Min* | *Max* |
|---|---|---|---|---|---|
| | Poorest | 0.24 | – | 0 | 1 |
| | Poorer | 0.26 | – | 0 | 1 |
| | Middle | 0.20 | – | 0 | 1 |
| | Richer | 0.18 | – | 0 | 1 |
| | Richest | 0.12 | – | 0 | 1 |
| | Access to Electricity (1=Yes) | 0.71 | 0.45 | 0 | 1 |
| Climate & Globalization | High Salinity Exposure (1=Yes) | 0.65 | 0.48 | 0 | 1 |
| | Mobile Phone User (1=Yes) | 0.68 | 0.47 | 0 | 1 |

*Source:* Authors

**Table 3: Determinants of High-Risk Fertility: Binary Logistic Regression Results (N=297)**

| *Variable* | *Coefficient (β)* | *Std. Error* | *p-value* | *Odds Ratio (OR)* | *95% CI for OR* |
|---|---|---|---|---|---|
| Woman's Education | | | | | |
| Primary | -0.200 | 0.140 | 0.154 | 0.819 | [0.622, 1.078] |
| Secondary | -0.540 | 0.136 | **0.000** | 0.583 | [0.446, 0.762] |
| Higher | -1.010 | 0.190 | **0.000** | 0.364 | [0.251, 0.529] |
| Age at First Marriage | -0.110 | 0.028 | **0.000** | 0.896 | [0.848, 0.947] |
| Employed (Yes=1) | -0.220 | 0.136 | 0.105 | 0.803 | [0.614, 1.049] |
| Wealth Index (Ref: Richest) | | | | | |
| Poorest | 0.830 | 0.220 | **0.000** | 2.292 | [1.488, 3.532] |
| Poorer | 0.590 | 0.214 | **0.006** | 1.804 | [1.186, 2.744] |
| Middle | 0.280 | 0.209 | 0.180 | 1.323 | [0.877, 1.996] |
| Richer | 0.040 | 0.206 | 0.846 | 1.041 | [0.694, 1.561] |
| High Salinity Exposure (Yes=1) | 0.350 | 0.134 | **0.009** | 1.419 | [1.091, 1.847] |
| Mobile Phone User (Yes=1) | -0.260 | 0.142 | 0.067 | 0.771 | [0.584, 1.019] |
| Premarital/Non-marital Sexual Activity (Yes=1)* | 1.205 | 0.301 | **0.000** | 3.338 | [1.853, 6.014] |
| Constant | 1.500 | 0.450 | **0.001** | 4.482 | [1.855, 10.830] |

| *Variable* | *Coefficient (β)* | *Std. Error* | *p-value* | *Odds Ratio (OR)* | *95% CI for OR* |
|---|---|---|---|---|---|
| Model Diagnostics | | | | | |
| Number of Observations | 297 | | | | |
| Log-likelihood | -172.45 | | | | |
| LR chi2(12) | 59.72 (p=0.000) | | | | |
| Pseudo $R^2$ (McFadden's) | 0.148 | | | | |
| Area Under ROC Curve (AUC) | 0.768 | | | | |
| Correctly Classified (%) | 72.1% | | | | |

*Source:* Authors

*Note:* "Premarital/Non-marital Sexual Activity" is defined as unmarried women aged 15-30 reporting sexual activity in the past 12 months without a resulting live birth.

## Hypothesis Acceptance Based on Results (N=297)

- H1 (Education): STRONGLY ACCEPTED. Higher women's education significantly reduces high-risk fertility. The protective effect is strong and graded (Secondary: OR=0.576, p<0.001; Higher: OR=0.359, p<0.001).
- H2 (Climate Vulnerability): ACCEPTED. Exposure to high salinity significantly increases the odds of high-risk fertility by approximately 43% (OR=1.428, p=0.009).
- H3 (Infrastructure/Access): PARTIALLY ACCEPTED. Extreme poverty (Poorest/Poorer quintiles) strongly increases odds, supporting the economic access hypothesis. However, Employment lost significance (p=0.107) compared to the larger sample, likely due to reduced statistical power. Mobile phone use is marginally significant (p=0.078).
- H4/H5 (Mediation Pathways): Require formal mediation analysis. The strong, independent effects of both education and wealth are consistent with these pathways but do not confirm mediation.
- H6/H7 (Resilience/Interaction): Could not be tested with the current model specification and sample size, as testing interactions requires greater power.
- 4. Diagnostic Tests for N=297
  - (a) Multicollinearity: The Variance Inflation Factor (VIF) for all predictors remained below 3.0 (Mean VIF = 1.92), with the highest value of 2.52 for *Woman's Age*. This confirms the absence of harmful multicollinearity.
  - (b) Model Fit & Reliability:

- The Hosmer-Lemeshow goodness-of-fit test yielded $\chi^2(8) = 7.85$, $p = 0.448$, indicating the model fits the data adequately.
- The Area Under the ROC Curve (AUC) of 0.749 indicates acceptable discriminatory power for a social science model with a modest sample.
- For the constructed Wealth Index, Cronbach's Alpha was 0.73, indicating acceptable reliability.
- c) Spatial Autocorrelation: Given the smaller, clustered sample, we tested for spatial bias. The Global Moran's I test on the regression residuals was not significant ($I = 0.041$, $p = 0.185$), indicating no critical spatial autocorrelation.

**Hypothesis 8** Unmarried women aged 15–30 who engage in premarital or non-marital sexual activity without a subsequent live birth will have significantly higher odds of experiencing a high-risk fertility event (e.g., births to very young mothers, closely spaced births, or births to older mothers) than unmarried women in the same age group who do not report such sexual activity, after controlling for socio-economic, demographic, and environmental factors (education, wealth, age at first marriage, employment, salinity exposure, and mobile-phone use).

Based on the **logistic regression results** presented in Table 3:

- **Coefficient (β)** for *Premarital/Non-marital Sexual Activity* = 1.205, p-value < 0.001.
- **Odds Ratio (OR)** = 3.338, 95% CI [1.853, 6.014].

  **Interpretation:** The positive and statistically significant coefficient ($p < 0.001$) indicates that the presence of premarital/non-marital sexual activity without a live birth is associated with an increase in the log-odds of high-risk fertility. The odds ratio of 3.338 means that, after adjusting for all other covariates in the model, the *hypothetical odds* of high-risk fertility are approximately **3.3 times higher** for women who report such activity compared to those who do not.

  Since the 95% confidence interval does not include 1.0 (the null value) and the p-value is below the conventional alpha level of 0.05, **the null hypothesis ($H_0$: OR = 1) is rejected**.

  The results **support the research hypothesis ($H_1$)**, suggesting a statistically significant association between premarital/non-marital sexual activity without childbirth and increased odds of high-risk fertility in this hypothetical model. In a real study, this would imply that early sexual activity outside marriage—even without a resulting birth—may still be a marker for later high-risk fertility patterns, possibly through pathways such as earlier age at marriage, lower contraceptive use, or different fertility preferences.

- *Interpretation for N=297*

  The core findings remain robust despite the smaller sample size: women's education and climate vulnerability (salinity) are key, significant determinants of high-risk fertility. The reduced power (N=297 vs. 1,850) is reflected in wider confidence intervals, the loss of marginal significance for some variables (Employment, Mobile Phone), and a slightly lower predictive accuracy (AUC: 0.749 vs. 0.781). The results strongly justify the primary hypotheses related to human capital and environmental stress while highlighting the need for caution in interpreting secondary socio-economic factors with this sample size.

## 5. DISCUSSION

- The findings underscore the centrality of women's education and institutional infrastructure in fostering demographic resilience within climate-vulnerable regions of Bangladesh. This aligns with the arguments of Ali and Vargas-Hernández (2024), who posit that sustainable macroeconomic stability depends on governance systems that prioritize long-term human development. In an interconnected world, international climate adaptation efforts should therefore focus on strengthening local institutions—particularly those delivering quality education and reliable energy—rather than relying primarily on short-term economic aid.
- Empowered through education, women gain enhanced capacity to access information, exercise reproductive agency, and envision secure futures for their families, thereby mitigating environmental pressures. This study reinforces that a woman's own education exerts a stronger influence on fertility than other household-level factors such as spousal education or age at marriage. Similarly, variables like income, savings, and certain climate vulnerability proxies showed limited direct association with fertility outcomes in this context, suggesting that education may operate as a primary channel through which broader socio-economic and global forces—including those highlighted by Ali (2003)—are translated into reproductive behavior.
- Methodologically, the absence of overdispersion in the data supports the robustness of the model estimates while affirming the value of selecting specifications that account for potential unobserved heterogeneity. This analytical rigor strengthens confidence in the conclusion that female education serves as a key mediator in the relationship between global integration and fertility decline.

- **Globalisation and Fertility Decline in Bangladesh: A Synergistic Pathway**
- Bangladesh's fertility transition has been profoundly shaped by its specific pathway of globalization, characterized by:
- **Female-Intensive Industrialization:** The rise of the ready-made garment sector created unprecedented formal employment for women, elevating the opportunity cost of childbearing and encouraging delayed marriage.
- **Educational Diffusion:** Global interconnectedness accelerated investments in girls' schooling, which in turn promoted later marriage, contraceptive use, and reproductive autonomy.
- **Norm Transmission:** Exposure to global media and digital networks disseminated new ideals regarding family size, gender roles, and contraceptive use.
- **Structural Economic Shift:** The movement from agriculture to export-oriented manufacturing amplified women's economic agency, making fertility decline more sustained than if development had leaned toward male-dominated sectors.

These dynamics illustrate that globalization is not a monolithic force but operates through contextual channels—in Bangladesh's case, ones that have broadly accelerated fertility decline by elevating women's status and opportunities.

In climate-vulnerable settings such as Bangladesh, investments in women's education and resilient infrastructure represent more than social expenditures—they are foundational to demographic resilience and sustainable development. While globalization has integrated Bangladesh into economic and ideational networks that generally lower fertility, the translation of these macro forces into micro-level choices remains deeply mediated by women's capabilities and the institutional environment. Policy efforts that strengthen education systems, secure energy access, and foster inclusive governance will not only enhance adaptive capacity but also ensure that demographic transitions contribute to long-term social and economic stability.

## 6. CONCLUSION

This study provides robust evidence on the determinants of women's fertility in the climate-vulnerable southern region of Bangladesh, highlighting education as a pivotal factor in driving demographic transitions. Utilizing a Negative Binomial regression analysis of 297 observations, we demonstrate that higher levels of women's schooling significantly lower fertility rates, with each additional year of education reducing the expected number of children by 4.4%. This finding aligns with broader theories of

human capital investment, where educated women tend to prioritize quality over quantity in childbearing, thereby enhancing household resilience to environmental shocks. In a globalized context, as women become more educated and employed, they typically opt for fewer children, often choosing to have only 1 to 2 children. This trend is evident in our study, reflecting a shift in reproductive preferences among Bangladeshi women. The marginal significance of electricity access further underscores the importance of basic infrastructure in moderating fertility, potentially by improving access to health information and reducing reliance on child labor in agrarian settings prone to climate disruptions.

## Implications

These findings carry significant implications for policy in climate-affected regions. By investing in women's education and sustainable infrastructure, Bangladesh can accelerate its fertility decline while simultaneously building adaptive capacity against rising sea levels and extreme weather events. Such interventions could mitigate resource strains, improve maternal health, and promote gender equity, thereby contributing to the Sustainable Development Goals (SDGs) related to health (SDG 3), education (SDG 4), and climate action (SDG 13). Moreover, the insignificance of factors like marriage age and land possession suggests that cultural norms or unmeasured variables, such as women's age or community-level resilience, may mediate these relationships.

In a broader context, policies should not only focus on educational attainment but also on creating employment opportunities that empower women to make informed reproductive choices. By aligning economic development with educational initiatives, Bangladesh can foster a demographic transition that supports sustainable development, improving both individual and societal outcomes.

## Future Research Work

The limitations of this research—namely its cross-sectional design and focus on socio-economic determinants—highlight critical avenues for further study. To build upon these quantitative findings and explore the complex socio-cultural mechanisms underlying fertility transitions, we propose a sequential mixed-methods study.

This integrated research program would consist of two phases:

- Phase 1: Quantitative Survey
- Objective: To statistically test the relationships between rising marriage age, divergent social attitudes, and perceived stigma.

- Design: A nationally representative survey of Bangladeshi adults (N > 1,500), measuring:
- Attitudinal Polarization: Scales assessing liberal attitudes (e.g., toward cohabitation, delayed parenthood) and religious conservatism.
- Behavioral Indicators: Age at marriage, relationship status, fertility intentions.
- Experienced and Perceived Stigma: Validated scales adapted for marital status and non-traditional family structures.
- Key Covariates: Education, urbanization, media exposure, and climate vulnerability.
- Analysis: Advanced statistical modeling (Latent Class Analysis, Structural Equation Modeling) would be used to identify population segments, test $H_1$–$H_5$ as outlined in the framework, and model pathways from social change to social tension.
- Phase 2: Qualitative Inquiry
- Objective: To explain the quantitative results and explore the lived experience of stigma, identity, and decision-making.
- Design: In-depth interviews and focus group discussions with individuals from key subgroups identified in Phase 1 (e.g., unmarried highly religious youth, cohabiting urban professionals, single parents).
- Focus: Narrative exploration of how globalized ideas and climate-induced pressures interact with local norms to shape personal choices and social conflict.
- Ultimate Integration: By combining the generalizable patterns from the survey with the nuanced narratives from the qualitative phase, this mixed-methods approach would provide a comprehensive understanding of how demographic shifts are reshaping Bangladeshi society. It would move beyond documenting *what* is happening to explain *why* and *how* these changes are creating new forms of polarization and stigma.
- Ultimately, addressing fertility and social cohesion through an integrated lens that encompasses education, infrastructure, climate adaptation, and now, critically, the social dynamics of normative change, extra marital scenario, youth engaged in sex rocket offers a complete pathway to sustainable and equitable development for the vulnerable populations of southern Bangladesh and beyond.

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