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Role of Female Labor Force Participation on Climate Change Risk and Human Security in Selected Districts of Punjab

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Abstract

Our study aims to assess the impact of climate change risk on human security of households in selected districts of Punjab, Pakistan, namely, Rawalpindi, Lahore, Bahawalpur, and Sialkot. We further aim to determine whether female labor force participation in the household leads to an increase in the household's ability to withstand climate change risks to its human security. By incorporating people's perception of climate change, the study is based on data collected from 1,000 households across the four districts of Punjab, with an equal representation of rural and urban areas. Regression analysis indicates that climate change poses a significant security risk and consistently reveals a deteriorating impact on human security. When incorporating female labor force participation into the model, the results show a positive impact of female labor force participation on human security. Furthermore, the interaction term between the climate change risk index and female labor force participation reveals varying yet insightful outcomes for human security and its constituent elements, namely health, food, and economic security. Our data indicate that only 328 out of 1007 households had female earners, while the average proportion of female earners in the households was approximately 16%, which may account for the possibility of a few statistically insignificant coefficients. Although a consistently positive coefficient is a strong indicator of the impact of female labor force participation on enhancing the human security of households by effectively tackling climate change risk, These results highlight the need for the removal of barriers to female labor force participation at the household level to enable them to play their profound role in combating climate change risk and its repercussions for human security.

Keywords: Climate change, human security, female labor force, participation, Punjab
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1. INTRODUCTION

Human security is defined as a condition in which the vital core of human lives is protected and when people have the freedom and capacity to live with dignity (Andorno, 2014), and it is a fundamental human right. It

encompasses various aspects of human life, such as livelihood, nutrition, and health. A lack of security in these areas leads to stress and suffering. At the household level, human security involves food security, health security, and economic security. These are influenced by demographic and macroeconomic factors, and most importantly, climate change.

Climate change poses a severe threat to human security, affecting nutrition, water quality, the emergence of diseases, and the loss of livelihood. *Germanwatch,* a non-profit, non-governmental organization based in Bonn, declared Pakistan notably vulnerable, ranking 8th globally in terms of climate change risk. The country has experienced frequent natural disasters, resulting in substantial economic and human losses. Projections indicate worsening food insecurity and health outcomes, with substantial impacts on the population's well-being and GDP.

Female labor force participation can potentially enhance a household's resilience to climate change. Diversifying income sources (Dey et al., 2018) reduces economic vulnerability, ensuring a steadier flow of resources even when climate-related shocks occur. Women's employment can also lead to improved household decision-making, promoting adaptive strategies such as better resource management and investment in sustainable practices (Kim, 2022; Wang et al., 2020). Furthermore, increased financial independence for women can bolster education and health outcomes for the entire family, enhancing overall well-being. Thus, female labor force participation not only strengthens household economic stability but also fosters a more adaptive and resilient response to climate change challenges.

This study examines the role of female labor force participation in mitigating the impact of climate change on the human security of households in Punjab, Pakistan. By collecting data from diverse districts, namely, Rawalpindi, Sialkot, Bahawalpur, and Lahore, we aim to understand perceptions of climate risk and its effects on human security. Our approach emphasizes the importance of integrating gender-focused economic policies to enhance household adaptability and resilience in the face of climate change risks.

2. LITERATURE REVIEW

Climate change and related calamities affect various dimensions of human security in multiple ways. The impact of climate change on food security is transmitted primarily through three sources: soil, water and crops. Further, when crops fail due to climate-related disasters, it renders farmers unable to support their families. The reduction in food production due to climate-related

disasters may also lead to food insecurity by increasing the price of food (Islam & Wong, 2017). Climate change also reduces the nutritional value and variety of food available by disrupting trade, affecting soil quality, and destroying crops (St. Clair & Lynch, 2010). The empirical work also demonstrates that climatic shocks adversely affect both the quantity and quality of food, potentially leading to food insecurity.

Compounding the impact of climate change risk on food are its implications for human health. Climate-related natural disasters can lead to contamination of water sources used for hydration and agricultural practices (IPCC, 2014). Heat and extreme events contribute to mortality through exposure. Poor air quality results in chronic respiratory issues, while diminished food production causes malnutrition. Extreme heat increases the risks of heat exhaustion, heat stroke, and death, particularly for individuals who must work outdoors (IPCC, 2014). In urban areas, climate change has instigated a state of perpetual threat of injury and loss, which may create chronic stress. IPCC (2014) identifies that the health effects of climate change are a composite of sensitivity and exposure to climate-related dangers. Further, sensitivity to climate change risks is unevenly distributed (IPCC, 2014). These arguments have been supported by empirical literature conducted in various economies worldwide.

Climate change risk can be considered a shock that affects both the demand and supply sides of the economy, including infrastructure, transportation, telecommunications, tourism, and financial services. Global warming and higher temperatures can also lead to economic losses by reducing labor productivity and agricultural output (Al-Naber & Shatanawi, 2004). Similarly, on the demand side, extreme weather events (for example, storms and floods) can adversely affect households' wealth and, hence, consumption. There is a vast body of literature that empirically proves the harmful economic effects of climate change (Dellink et al., 2019).

The ability of societies to cope with climate change depends upon a number of factors. Among these, women's active economic role is considered to be an important factor in formulating a response to climate change. Financially independent women have been proven to be more likely to invest in sustainable and climate-resilient practices and infrastructure (UNDP, 2019; UNEP, 2019). Additionally, economically active women have a voice in decision-making and are more likely to advocate for climate-friendly policies (WEDO, 2018). Women have also been empirically proven to be an important agent in the climate change adaptation process (Matinda, 2010; Mitchell et al., 2007; Al-Naber & Shatanawi, 2004). Studies have also shown that women's

active role in the labor force contributes towards reducing the harmful effects of climate change on households' well-being. Increased income resulting from increased female participation in the labor force aids the household's energy transition (Burke & Dundas, 2015).

3. METHODOLOGY

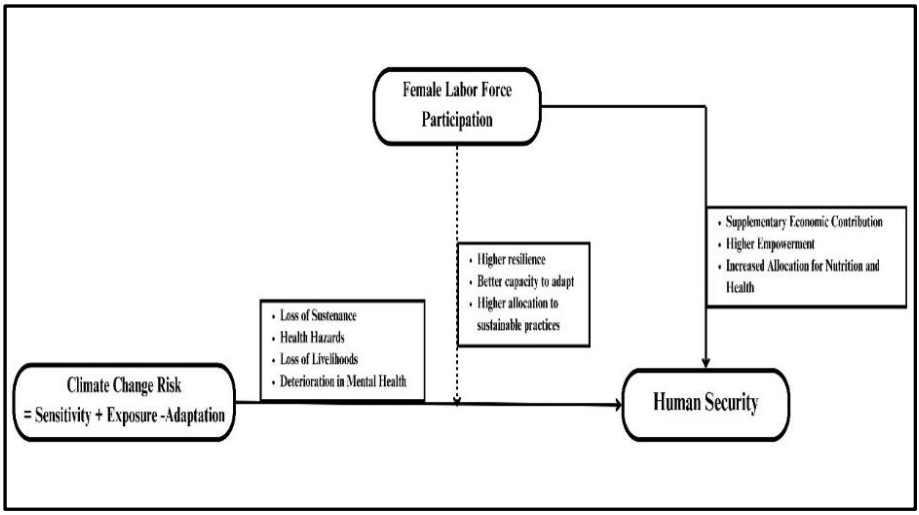
3.1. Theoretical Framework

The role of women in improving the human security of a household is multifaceted. Women who participate in the labor force supplement household income, gain enhanced skills, and exercise greater control over economic allocations, improving overall welfare by enabling the consumption of a diverse and nutritious diet, facilitating access to healthcare, sanitation, and health insurance, and reducing risks associated with single-source earnings. Furthermore, women's labor force participation may increase their bargaining power, leading to a prioritization of spending on nutrition, education, and health.

Climate change risk, characterized by extreme weather events and environmental degradation, presents significant challenges to households' human security. Female labor force participation (FLFP) can act as a moderating factor in this relationship by changing how households respond to climate-related shocks. Climate risks disrupt agricultural productivity and access to nutritious food. Additionally, climate-related extreme weather events and environmental changes exacerbate health risks through malnutrition, diseases, and reduced access to healthcare. Livelihoods for many households tend to be climate-sensitive, resulting in increased volatility in earnings.

Women's participation in the labor force introduces additional income sources, reducing dependency on climate-sensitive earnings and enhancing financial capacity to invest in adaptive measures. Female labor force participation also results in greater resilience, as it enables households to access savings and insurance products that help them manage climate-induced shocks. Women's incomes are more likely to be allocated toward health, nutrition, and education, which improve long-term adaptive capacities.

Figure 1: Conceptual Framework



3.2. Econometric Model

Based on our theoretical framework, the following econometric model is constructed to assess the impact of climate change risk on human security:

$$HSI_i = \alpha_o + \alpha_1 CCRIndex_i + \alpha_2 FE_i + \alpha_3 (CCRIndex_i * FE_i) + \sum_{j=4}^{n} \alpha_j X_{ij} + \mu_i \ldots (1)$$

Where HSI_i stands for the value of Human Security Index for household *i,* $CCRIndex_i$ is the climate change risk faced by household *i,* FE_i is the dummy for whether there are female earners in the household and X_{ij} represents control variables related to household *i* which are the gender of the head of household, region, secondary occupation of household head, family type and indebtedness.

Our dependent variable is the household's human security. Household human security will be measured through an index that considers several aspects, including food security, health, and livelihood. Our indicator of human security comprises three dimensions: food security, health security, and economic security. Food security is defined as access to safe, nutritious, and sufficient food. Health security refers to a household's overall health status and vulnerability to illnesses. Finally, economic security is defined as the means of earning a livelihood, as well as its reliability and sustainability. Together, these three elements combine to formulate a household's human security.

We hypothesize that female labor force participation and climate change risk are two key determinants of household human security. Female labor force participation is operationalized as a dummy for whether the household includes a female earner. The female earner in the household is

likely to contribute to improved food security, health, and economic security. Kiefer et al. (2005) find that women have more awareness about nutrition and hygiene as compared to men. Sangwan & Kumar (2021) elicit that female labor force participation is linked with dietary diversity and the household's production. According to Burke & Dundas (2015), female labor force participation is associated with positive health outcomes for households.

Climate change risk faced by households comprises three essential components: sensitivity, exposure, and adaptation. Once we understand climate change risk and its constituents, we must recognize that climate change poses the greatest threat to human security. Climate change risk can affect the human security of households through any of its components, as climate change can adversely affect access to food, deteriorate health, and devastate livelihoods. Hence, we can assert that the climate change risk faced by a household will lead to the deterioration of its human security. Climate change places a heavy toll on the quality of life and general wellbeing. It adversely affects production and availability of food, creates physical and psychological health hazards, devastates livelihood, destroys assets and reduces the ability to work.

The role of female labor force participation in moderating the effect of climate change risk on household human security is explored through the interaction between climate change risk and the female labor force participation dummy. Female earners also play a key role in managing household resources to build resilience to climate change. Mavisakalyan and Tarvedi (2019) hold the view that women, whenever given the opportunity, demonstrate more environmentally conscious preferences. This view was reinforced by Kim (2022). That translates into a reduction in emissions due to female labor force participation (Wang et al., 2020). Dey et al. (2018) are of the view that women play a notable role in nutrition and resource management of households, which contribute to household resilience to climate change risk. Achuo et al. (2023) link female labor force participation to environmental sustainability, neutralizing the impact of climate change. Md et al. (2022) establish that female labor force participation enables higher levels of adaptation as well as partially insulates the household from exposure to economic shocks, reducing the risk posed by climate change to the household's human security.

The gender of the head of the household has been taken as a control variable. Households headed by men are expected to have a higher level of human security as compared to female-headed households, and in the case of a country like Pakistan, women generally become heads of their households as outcomes of serious shocks like loss of male earner due to death, disability, or abandonment. Indebtedness is also taken as a dummy variable, taking a value

of 1 if the household is currently indebted. We expect that indebted households have a low level of human security as compared to non-indebted households. This is so because indebted households have economic liabilities that add to the economic stress and lower household's ability to withstand any economic or health related shock resulting in lower human security outcomes.[1] Further, the dummy for household head having a secondary occupation is also incorporated to assess whether more than one sources of income improves human security of households. It is expected to have a positive sign as it not only supplements the primary source of income improving the economic situation of the household but also insulates the household from unforeseen shocks caused by climate change. We have also added the dummy for nuclear families with the expectation that a joint family system provides the necessary family support for withstanding uncertain situations.

3.3. Sample and Data Collection

The data was collected from four Districts of Punjab namely Rawalpindi, Sialkot, Lahore, and Bahawalpur. In order to ensure uniform representation from North and South Punjab, we have opted for an equal sample size from each district and within districts from each tehsil.[2] A total of 1,000 households were selected for data collection through a questionnaire, which was filled out during interviews with the household heads using a non-probability purposive sampling technique. The questionnaire comprises three sections: demographic profile, household human security, and climate change risk faced by the household.[3]

3.4. Construction of Indices

Our analysis involves the construction of two household-level indices for human security and climate change risk. The responses collected through the questionnaire were used to construct both the indices. Detailed descriptions of the process of index development are discussed in the subsequent two sub-sections.

3.4.1 Climate Change Risk (CCR) Index

[1] The table of Summary Statistics is provided in Appendix A1.

[2] From Bahawalpur all five tehsils namely, Hasilpur, Khairpur Tamewali, Ahmadpur East, Yazman and Bahawalpur were selected. We also accessed data from all four tehsils of Sialkot district namely, Daska, Pasrur, Samrial and Sialkot. In Rawalpindi district data was collected from tehsils, Gujar Khan, Kahuta, Kallar Syedan, Murree, Taxila, Kotli Sattian and Rawalpindi City. Lastly, all four tehsils of Lahore district namely, Model Town, Raiwind, Shalimar and Lahore were also accessed for data collection.

[3] Questionnaire can be provided on demand.

The sensitivity of a household to climate change refers to the extent to which it is impacted by climate change effects. The household's exposure to climate change risk encompasses the experiential dimension of climate change, namely the degree to which the household has encountered climate change risks, irrespective of the actual impact on the household. Both sensitivity and exposure combine to reflect the overall level of climate change risk. However, the role of adaptation in mitigating the climate change risks experienced by households cannot be overlooked. Adaptation is the ability of the household to respond and adjust to climate change using various strategies, which would reduce climate change risk. Thus, the net climate change risk faced by a household is the aggregate of its sensitivity and exposure, discounted by the household's level of adaptation. The study uses the Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability for Climate Change Risk (CCR) as given below.

$$CCR = Exposure + Sensitivity - Adaptability \quad (2)$$

The climate change risk is the degree to which a system is vulnerable to the adverse effects of climate change, including variability and extreme climate conditions. The risk in itself is the function of the character, magnitude, and rate of climate variations to which the system is exposed, sensitive, and reflects adaptive capacity. Four major climatic events, namely temperature, rainfall, floods, and windstorms, are considered. The calculated values of the Climate Change Risk Index (CCR Index) lie between 0 and 1. Here, 0 means no risk, while 1 means the highest risk.

3.4.2 Human Security Index

To construct the human security index, we have taken three core dimensions of human security: food, health, and economic security. For each of these dimensions, we have calculated individual indices and then constructed an overall human security index based on the three-dimensional indices.

For the food security index, we have adapted the Food and Agriculture Organization's (FAO) Food Insecurity Experience Scale (FIES), developed in 2014. This scale, consisting of 8 questions, has been widely used to measure food security at the household or individual level, based on respondents' experiences with food security. After obtaining yes/no responses on all eight questions, the total score has been obtained. The obtained score is then divided by 8 (maximum score). This way, the range of the index of food security becomes 0-1, with 1 meaning complete security and 0 meaning complete insecurity.

$$Food\ Security\ (FS) = \frac{Total\ obtained\ score}{maximum\ possible\ score} \quad (3)$$

Similarly, for health security, there are fourteen items, and for economic security, there are eleven items. The indices for both health security and economic security are constructed by the authors based on an extensive literature review. The items comprise yes/no questions. For both indices, the total score is first obtained and then divided by the maximum possible score, as in equation 4. Here, 1 indicates complete security and 0 indicates complete insecurity.

After obtaining the indices on each of the dimensions of human security separately, a composite index of human security has been constructed by using the weighted average of these indices as follows

$$HSI_i = 1/3(FS_i + HS_i + ES_i) \quad (4)$$

The value of the Human Security Index also ranges between 0 and 1, meaning completely insecure and completely secure, respectively.

3.5. Estimation Techniques

The econometric model is estimated using simple Ordinary Least Squares (OLS). Since we are using cross-sectional data for the analysis, the most likely problem that can occur is Heteroscedasticity. Heteroscedasticity tends to increase the variance of the coefficients, resulting in lower p-values. The issue can be detected using Breusch-Pagan (BP) and White tests of heteroscedasticity. The null hypotheses for both tests imply homoscedasticity. We have used both the tests for confirmation and since the tests indicate existence of heteroscedasticity, we have employed robust estimate of variance independently.

4. RESULTS AND DISCUSSION

This section presents and discusses empirical findings. The first section deals with descriptive analysis while the second section reports and discusses regression results.

4.1. Descriptive Analysis

Data presented in Table 1 shows that most of the households (73%) have moderate human security, while only 8.2% of households are highly secure in the selected sample. In terms of food security, about 73.3% of the households are highly secure, of the remaining households about 20.1% are highly insecure. The average value of food security index is quite high (0.79). Similarly, about 11.5% of the households have high health insecurity, while

13% are highly secure. The average value of the health security index is 0.76. In terms of economic security, about 61% of households are moderately secure, while about 20% of households are experiencing high economic insecurity. The overall human security index has an average value of 0.723, with only about 8% of the households in the sample being highly secure, compared to 19% coping with high human insecurity.

Table 1: Frequency Distribution of Forms of Security and its Dimensions

	Human Security	Food Security	Health Security	Economic Security
Highly Insecure	190 (18.9)	202 (20.1)	116 (11.5)	200 (19.9)
Moderately secure	734 (72.9)	67 (6.7)	761 (75.6)	617 (61.3)
Highly Secure	83 (8.2)	738 (73.3)	130 (12.9)	190 (18.9)
Total	1007 (100)	1007 (100)	1007 (100)	1007 (100)

Looking at the climate change risk and its dimensions, about 89% of the households in our sample are facing a moderate to high level of climate change risk. The average value of the climate change risk index is 0.56. We have also studied the constituents of climate change risk, i.e., exposure, sensitivity, and adaptation. On the extremes of the spectrum, about 15% of the households experience high exposure to climate change risk, while 12.3% of households experience low exposure. Somewhat different trends can be seen for sensitivity. About 18% of households are considered low sensitive to climate change risk, compared to 12% that are highly sensitive. About 70.5% of households have moderate sensitivity to climate change risk. Most households in our sample (75.4%) have moderate levels of adaptation. Of the remaining 24.5% most have low adaptation (13%). The average adaptation scores are also low at about 0.521.

Cross-tabulation (Appendix-Table 3) between female labor force participation and human security index shows that about 20% of highly insecure households have no female earners compared to 7.36% of highly secure households without female earners. In contrast about 10% of households with female earners are highly secure and 17% are highly insecure. Cross-tabulation between climate change risk and the human security index reveals that approximately 22% of highly insecure households face high climate

change risk, whereas only 3.6% of highly secure households are affected by high climate change risk.

4.2. Regression Results and Interpretation

The regression results of human security, female labor force participation, and climate change risk are presented in Table 2. The impact of climate change on human security is consistently significant and negative. This depicts that climate change risk reduces human security. This effect is consistent with our expectation and its implications tend to be dire. Climate change risk may expose the household to severe uncertainties by reducing food production, leading to loss of employment opportunities, and increasing morbidity and health-related expenses. This renders households vulnerable to various insecurities, including food, health, and economic ones. Our results, however, do indicate that climate change risk is statistically insignificant for food security.

Female labor for participation is found to have positive effect on human security as its constituents. The coefficient is also statistically significant for human security, food security and economic security. Women's participation in the labor force boosts household income, improving consumption capability, and reinforcing economic stability. This added financial resource supports essential needs like food, shelter, healthcare, and children's education, thereby diminishing vulnerability to shocks. Moreover, by diversifying the sources of income within the household, women's employment reduces their vulnerability to economic shocks such as job loss or fluctuations in the economy. This, in turn, contributes to greater resilience against poverty and strengthens the overall stability of the household's financial well-being. When women participate in the labor force, they contribute to the household income, which often results in greater purchasing power for food. This enables families to afford a wider variety of nutritious food items, essential for a balanced diet. This is evident from the positive and significant coefficient of female labor force participation in relation to food security.

The role of female labor force participation in the relationship between household human security and climate change risk is examined by including the interaction between climate change risk and female labor force participation in the model. Women who contribute to household income not only manage resources effectively but also exhibit environmentally conscious behaviour (Mavisakalyan & Tarvedi, 2019; Kim, 2022). This contributes to reduced emissions (Wang et al., 2020) and enhances household resilience to climate

change through resource management (Dey et al., 2018). Research also indicates that female labor force participation encourages environmental sustainability and mitigates the impact of climate change by fostering adaptation and shielding households from economic shocks (Achuo et al., 2023; Md et al., 2022).

Table 2-Regression Estimates for Human Security & Its Constituents

Variables	(1)	(2)	(3)	(4)
	Human Security Index	Economic Security	Food Security	Health Security
Climate Change Risk	-0.1031*** (0.0363)	-0.1063*** (0.0422)	-0.0811 (0.0719)	-0.1132*** (0.0212)
Female Earners (if household has female earners=1)	0.0782*** (0.0311)	0.1372*** (0.0372)	0.1165** (0.0587)	0.0086 (0.0283)
Female Earners * Climate Change Risk	-0.0900* (0.0551)	-0.1304** (0.0640)	-0.1513 (0.1077)	-0.0101 (0.0132)
Gender of Household Head (if female=1)	0.0622*** (0.0197)	0.0761*** (0.0221)	0.1035*** (0.0563)	0.0071 (0.0151)
Indebtedness (if indebted=1)	-0.1563*** (0.0167)	-0.1681*** (0.0163)	-0.2562*** (0.0351)	-0.044*** (0.0112)
Secondary Occupation of Household Head	0.0642*** (0.0138)	0.0805*** (0.0164)	0.1000*** (0.0269)	0.0119 (0.0108)
Family Type (if Nuclear= 1)	-0.0042 (0.0119)	-0.0137 (0.0134)	-0.0123 (0.0240)	0.0133 (0.0086)
Intercept	0.1695* (0.1392)	0.6211*** (0.0345)	0.7704*** (0.0563)	0.8202*** (0.0202)
R^2	0.1531	0.1645	0.0985	0.0567
BP Test χ^2 (p-value)	26.51*** (0.0000)	0.63 (0.4283)	54.79*** (0.0000)	7.05*** (0.0079)
F-Statistic (p-value)	25.91*** (0.000)	34.85*** (0.000)	13.82*** (0.000)	8.75*** (0.000)
N	1005	1005	1005	1005

Note: * Shows significant at 1% while ** shows significant at 5% and *** shows significant at 10%. Standard Errors are reported in parentheses.

Our results depict that female-headed households tend to have higher human security as compared to male-headed households. Women develop strong coping strategies and are very resourceful when managing household resources. This adaptability is vital in traversing environmental shocks, which allows female-headed households to sustain themselves more effectively (Fuller & Lain, 2020). Ardi et al. (2022) demonstrate that female-headed households employ diverse livelihood strategies, which can mitigate risk and reduce vulnerability. The diversification of livelihoods acts as a buffer against climate change risk, leading to improvement in human security.

Indebtedness is also taken as a dummy variable, taking a value of 1 if the household is currently indebted. The results depict that indebted households generally experience lower levels of human security compared to those without debt. This is primarily due to economic liabilities that increase stress and reduce the household's resilience against economic or health-related shocks, thereby leading to worsening of human security outcomes. Furthermore, a dummy for household heads with a secondary occupation is also incorporated to assess whether having more than one source of income improves the human security of households. The coefficient of the secondary occupation dummy has a positive sign, indicating that having a secondary occupation not only supplements the primary source of income, thereby improving the household's economic situation, but also insulates the household from unforeseen shocks. Family type is found to be statistically insignificant.

Our results are more or less in line with expectations. The impact of climate change on human security consistently shows significant and negative effects. This vulnerability encompasses insecurities related to food, health, and economic stability. Various studies underscore the detrimental impact of climate change on human security through various channels. Female labor force participation, on the other hand, exerts a positive influence on human security. Women's engagement in the workforce significantly boosts household income, enhancing consumption capabilities and economic stability. Additionally, the interaction between climate change risk and female labor force participation highlights that women not only manage resources effectively but also demonstrate environmentally conscious behavior, leading to reduced emissions and enhanced household resilience to climate change impacts (Mavisakalyan & Tarvedi, 2019; Kim, 2022; Wang et al., 2020; Dey et al., 2018; Achuo et al., 2023; Md et al., 2022). This highlights the role of female labor force participation in promoting environmental sustainability and mitigating climate-related vulnerabilities for households.

5. CONCLUSION

Our study aims to evaluate the impact of climate change risk on household human security in selected districts of Punjab, Pakistan—namely, Rawalpindi, Lahore, Bahawalpur, and Sialkot—and to investigate whether female labor force participation enhances households' resilience against climate change risks. The regression analysis reveals that climate change poses a significant security risk, consistently lowering the human security of households in our sample, whereas female labor force participation demonstrates a positive impact on human security. Women's participation in the workforce plays a crucial role in raising household income, which in turn enhances consumption capabilities and fosters economic stability. This improved financial standing not only supports better living conditions and access to healthcare and nutrition.

Furthermore, the economic empowerment of women has been linked to more resilient and adaptable households, as it diversifies income sources and reduces the vulnerability to shocks. Women who contribute to household income manage resources effectively and exhibit environmentally conscious behaviour, reducing emissions and enhancing household resilience to climate change (Mavisakalyan & Tarvedi, 2019; Kim, 2022). Overall, women's workforce engagement is a critical factor in achieving sustainable economic progress and societal well-being.

In conclusion, our study underscores the impact of climate change and female labor force participation on household human security in selected districts of Punjab, Pakistan. The findings highlight that climate change poses a significant threat to household security, necessitating the development of effective mitigation strategies. Conversely, female labor force participation emerges as a significant factor in bolstering household resilience, enhancing financial stability, and promoting environmentally conscious practices. These insights highlight the importance of integrating gender-focused economic policies to enhance household adaptability and resilience in the face of climate change risks. Promoting female labor force participation not only advances gender equality but also contributes to broader sustainable development goals, ensuring a more secure and prosperous future.

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Appendix

Table 3: Cross Tabulation of Female Labor Force Participation & Human Security

Human Security	Female Labor Force Participation		Total
	No	Yes	
Highly Insecure	133	57	190
	(13.21%)	(5.66%)	(18.87%)
Moderately Secure	496	238	734
	(49.26%)	(23.63%)	(72.89%)
Highly Secure	50	33	83
	(4.97%)	(3.28%)	(8.24%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	0.0428**		
Economic Security			
Highly Insecure	146	54	200
	(14.5%)	(5.36%)	(19.86%)
Moderately Secure	418	199	617
	(41.51%)	(19.76%)	(61.27%)
Highly Secure	115	75	190
	(11.42%)	(7.45%)	(18.87%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	0.079**		
Food Security			
Highly Insecure	146	56	202
	(14.5%)	(5.56%)	(20.06)
Moderately Secure	38	29	67
	(3.77%)	(2.88%)	(6.65%)
Highly Secure	495	243	738
	(49.16%)	(24.13%)	(73.29%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	0.0218		
Health Security Risk			
Highly Insecure	77	39	116
	(7.65%)	(3.87%)	(11.52%)
Moderately Secure	507	254	761
	(50.35%)	(25.22%)	(75.57%)
Highly Secure	95	35	130
	(9.43%)	(3.48%)	(12.91%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	-0.0359		