ACIAR SDIP Foresight Program: Status Report

WOMEN'S LABOR FORCE PARTICIPATION IN RURAL INDIA :

Current status, patterns & drivers

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Key Findings

- The share of women engaged in agriculture and labor has fallen from 36% in 2004-05 to 21% in 2015-16 in rural India.
- Simultaneously, the share of women who are out of the labor force has increased from 51% in 2004-05 to 67% in 2015-16.
- Education and labor force participation (LFP) have a U-shaped relationship: women with median levels of education (7 to 10 years) are the least likely to work.
- Wealthy educated women and poor uneducated women have the highest LFP.
- Women who are out of the labor force have a greater number of young children (<5 years of age). They also have lower levels of autonomy and mobility outside the house.
- Working women face higher chances of domestic violence.
- Women whose husbands have out-migrated are less likely to be working than those who are living with their husbands.

1. Introduction

Women's labor force participation (LFP) has been consistently low over the past three decades in India. This is despite rapid economic growth, better educational attainment, and a decline in fertility. The literature predicts a U-shaped relationship between economic growth and women's LFP. As a country's income increases, women who were engaged in sustenance-work, usually involving manual labor, drop out of the labor force. They re-join the labor force after receiving education and gaining access to white-collar jobs. However, India is an extreme outlier compared to other developing countries of similar wealth levels. It has much lower levels of LFP among women than what the U-shaped relationship predicts (**Figure 1**). This presents a puzzle that researchers are only now trying to understand (Fletcher, Pande, & Moore, 2018).

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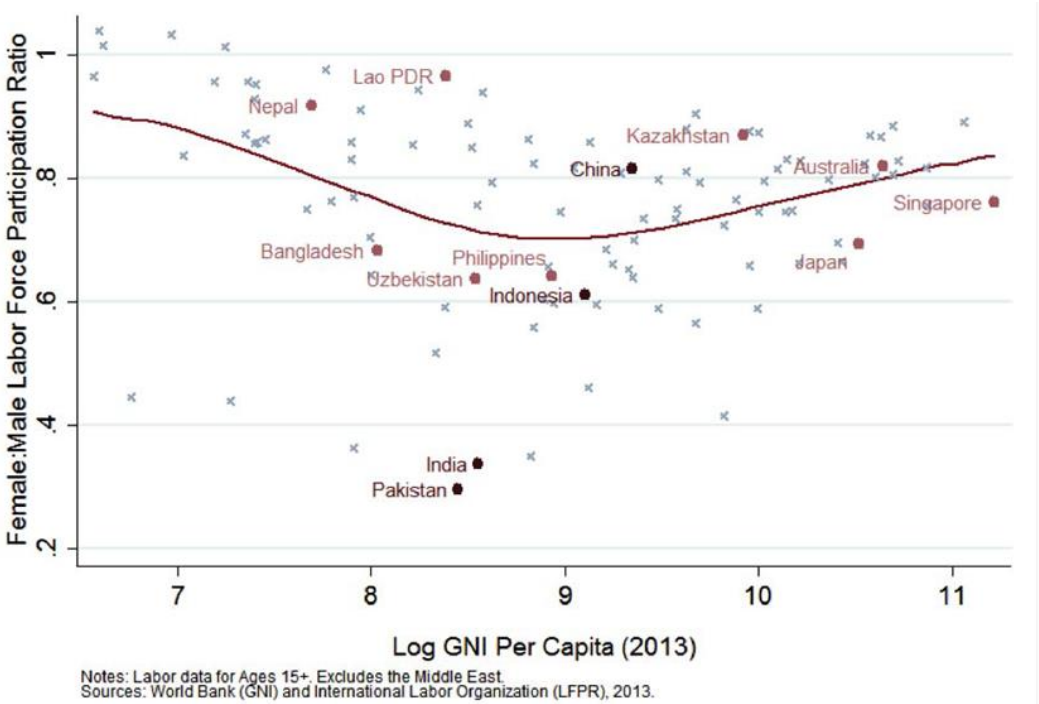

FIGURE 1 THE CROSS-COUNTRY RELATIONSHIP BETWEEN INCOME AND WOMEN'S LABOR FORCE PARTICIPATION

SOURCE: FLETCHER, PANDE, & MOORE, 2018

TAKEAWAY: THERE IS A U-SHAPED RELATIONSHIP BETWEEN ECONOMIC GROWTH AND WOMEN'S LFP, BUT INDIA IS AN OUTLIER COMPARED TO OTHER DEVELOPING COUNTRIES OF SIMILAR WEALTH LEVELS.

In urban India, women's labor force participation rate (LFPR) has been stagnant over the past decade. It decreased by 4 percentage points between 2004-05 and 2011-12 and remained at the same level between 2011-12 and 2017-18 (PLFS, 2019). In rural India, however, women's LFPR has been consistently declining (**Figure 2**). In 2004-05, it was at 50%. It fell by nearly 14 percentage points from 2004-05 to 2011-12 to 36% and by another 11 percentage points between 2011-12 and 2017-18 (PLFS, 2019). In 2017-18, rural women's LFPR is only 25% (**Figure 2**).

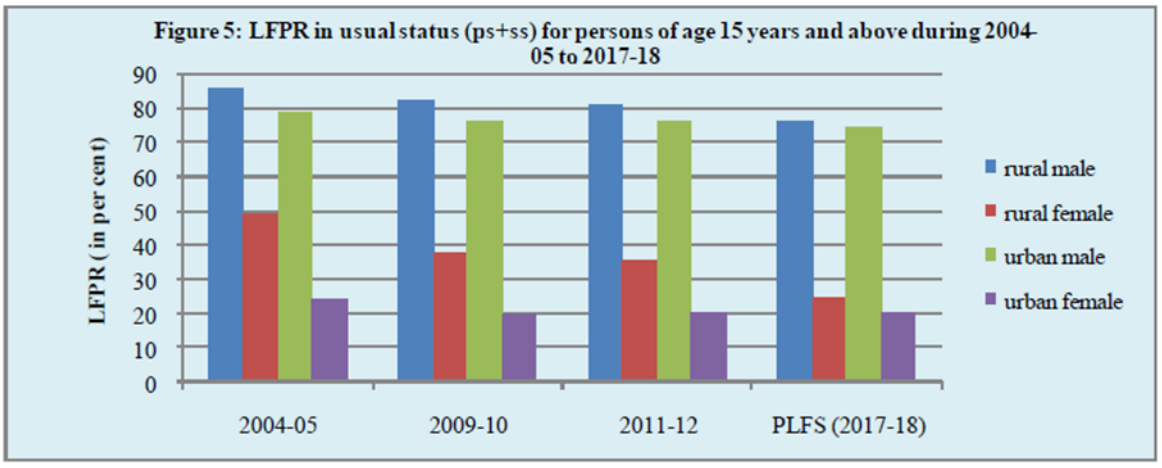

FIGURE 2 LFPR IN INDIA FROM 2004--05 TO 2017-18

SOURCE: PLFS (2019)

TAKEAWAY: RURAL WOMEN'S LFP HAS DECLINED FROM 50% IN 2004-05 TO 25% IN 2017-18.

In this paper, we use the latest available data to document the status of women's LFP and its change over time and understand some of the potential factors that result in low LFP in rural India. We use machine learning models to identify the factors which predict a woman's LFP and the relative importance of these factors. We also perform non-parametric linear polynomial regressions to understand the relationship between these factors and women's LFP. Throughout, we highlight results from rural Bihar and West Bengal and compare trends in the two states to the rest of rural India.

Women's work is determined by both supply and demand-side factors in rural India. On the supply side, it is affected by socio-cultural norms that reward housework and child-rearing – the responsibility for both falling disproportionately on women. Working outside the house is also considered a social-stigma or a low-status activity (Eswaran et al., 2013). As a result, only the poorest women engage in wage work out of necessity and once their family income increases, they withdraw from the workforce (Rao et al., 2010, Klasen & Pieters, 2012). On the demand side, factors like gender discrimination in hiring, gender wage gaps, un-safe environment, un-suitable transport/commute, and lack of jobs can result in low LFP among women (Fletcher, Pande, & Moore, 2018). Our analysis re-examines several of the above hypotheses using the latest data on women's LFP in rural India.

The second part of our analysis explores the role of migration of spouses of married women. The recent National Family Health Survey (NFHS-4) shows that husbands of 29% of women in rural Bihar live away from them as migrants. Migrants send remittances that can increase family income. Thus, we hypothesize that out-migration also plays a role in explaining women's LFP.

2. Data

We use the nationally representative dataset NFHS-4 (National Family Health Survey-4) conducted in 2015-16 consisting of 699,686 women aged 15-49 years across all 29 states and 7 union territories of India (IIPS, 2017). The survey has information on work-status and occupation types for a representative sub-sample of 77,597 women from rural India.

Our main outcome variable is LFP which is defined as follows. LFP is equal to 1 if a woman has been engaged in any paid work outside the house in the past 1 year and 0 otherwise.

We use sixteen demographic and socio-economic variables for training machine learning models to predict the LFP of sample women in rural India. These include age, years of education, caste, religion, household wealth, husband's occupation, state of residence, indicators of domestic violence, indicators of household infrastructure and health environment, number of children, number of children below 5 years of age, and indicators of mobility outside the house.

Additionally, we use NFHS-3 (National Family Health Survey-3) conducted in 2005-06 consisting of 83,567 women from rural India to study the change in women's LFP and occupation types over the decade.

Note that the statistics presented from NFHS in the rest of this paper do not exactly match those presented from the National Sample Survey (NSS) in the introduction. While the National Sample Survey (NSS) is more commonly used to study LFP in India, the latest round of data, the Periodic Labour Force Survey (PLFS) conducted in 2017-18, is yet to be released. In its absence, NFHS-4 is the most recent information available to us. A rich set of demographic and socio-economic variables helps in investigating the role of different factors in influencing women's work. Unlike the NSS, NFHS-4 is

district-representative, allowing for district-level analysis and mapping. Thus, the rest of our analysis is based on NFHS data.

Moreover, NFHS-4 allows matching married women to their respective husbands. We use this information to study the role of husband's out-migration on women's LFP. We identify migrant husbands as follows. A woman has a migrant husband if she reports that her husband is currently not living with her.

3. Methods

We map women's LFPRs across states in India in 2015-16 and the percentage change from 2004-05 to 2015-16. To understand the inter-state variation related to policy, infrastructure, and job opportunities, we map district-level LFPR in Bihar and West Bengal.

We classify sample women into the following occupations – professional/technical/managerial, clerical/sales, agricultural, and skilled/unskilled manual labor – and document the change in rates of participation in each occupation over time.

Further, we use machine learning to identify the variables in our dataset that predict women's LFP. We train an ensemble Gradient Boosting Decision Tree (GBDT) model using LightGBM (Ke et al., 2017). Using the sampling weights provided in NHFS-4, we create a test set with 5% of the data and use the remaining 95% for training our model.

To understand the relative importance of the variables in predicting LFP and the direction of their effect on LFP, we use the SHAP feature attribution framework. SHAP values of a variable (such as education) measure how important that variable is (compared to all other variables) in predicting the outcome of a model (woman's LFP). SHAP summary plots show predictions for the entire dataset as each point on the graph is one woman. We also use SHAP values to study the relationship between wealth, education, and work status. Since we use a nationally representative dataset, these plots depict country-level patterns.

The role of other important predictive variables is further analyzed using non-parametric linear polynomial regressions. We plot the correlations between wealth, mobility outside the home, the number of children younger than 5 years of age, and LFP. We also graphically depict the correlation between husband and wife's occupations.

To study the role of husband's out-migration on a woman's LFP, we tabulate the LFP and occupation types of women whose husbands have migrated. We also document the occupations of the migrated husbands. Furthermore, we use non-parametric linear polynomial regressions to analyze the relationship between wealth, migration, and women's LFP.

We focus on the states of Bihar and West Bengal throughout our paper and compare the observed patterns to all-India patterns.

4. Results

The all-India average LFPR among rural women is 33.64% in 2015-16. There is wide variation in rural women's LFPRs across the states of India. It varies from 16.2% in Jammu and Kashmir to 64.3% in Telangana (**Figure 3**). The northern states of Rajasthan, Jammu and Kashmir, Uttarakhand, Bihar, Jharkhand, Assam, and Arunachal Pradesh have had the highest fall in LFPR from 2004-05 to 2015-16 (**Figure 4**). These state-level variations are likely from differences in state-specific labor policy, gender wage gaps, cultural barriers, infrastructure, and availability of jobs.

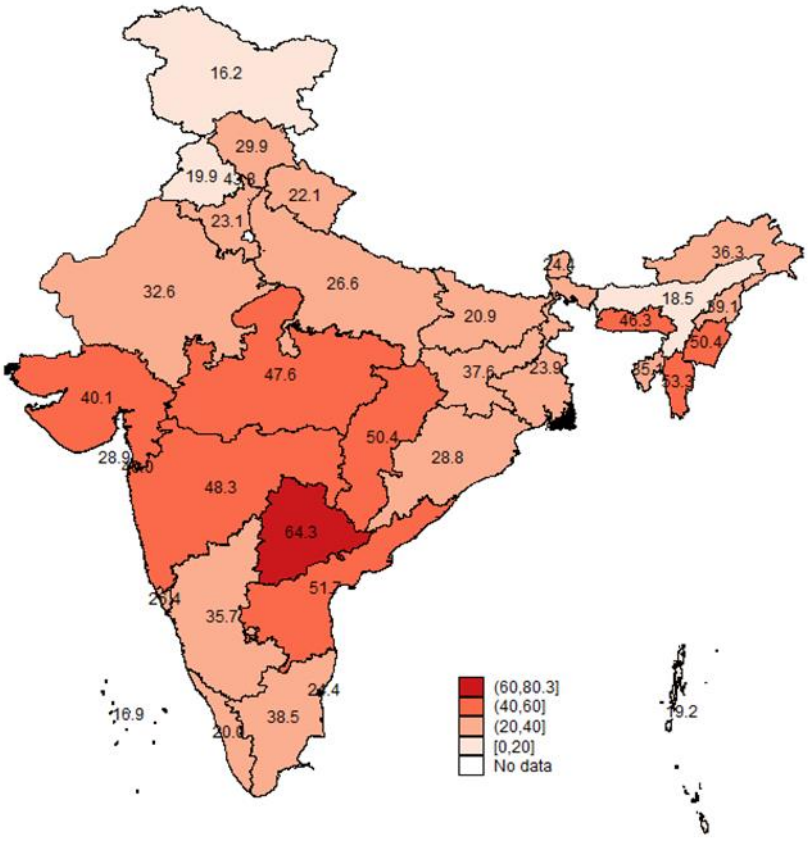

FIGURE 3 LFPR OF WOMEN IN RURAL INDIA IN 2015-16 (%)
SOURCE: AUTHORS' CALCULATION USING NFHS-4

We observe wide variations in LFPRs even within the states of Bihar and West Bengal. Bihar has an average LFPR of 20.9% among rural women, but it varies from 10.4% in Gopalganj district to 37.6% in Araria district. Similarly, West Bengal has an average LFPR of 23.9%, but it varies from 10.8% in Pashchim Medinipur district to 33.6% in North 24 Parganas.

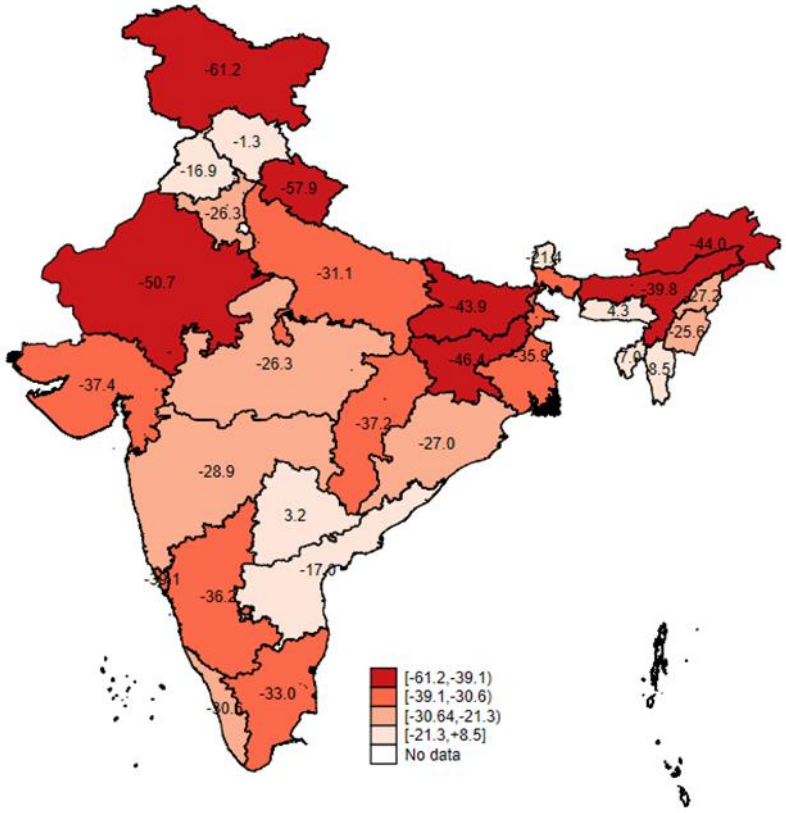

FIGURE 4 PERCENTAGE CHANGE IN WOMEN'S LFPR FROM 2005-06 TO 2015-16 (%)

SOURCE: AUTHORS' CALCULATION USING NFHS-3 AND NFHS-4

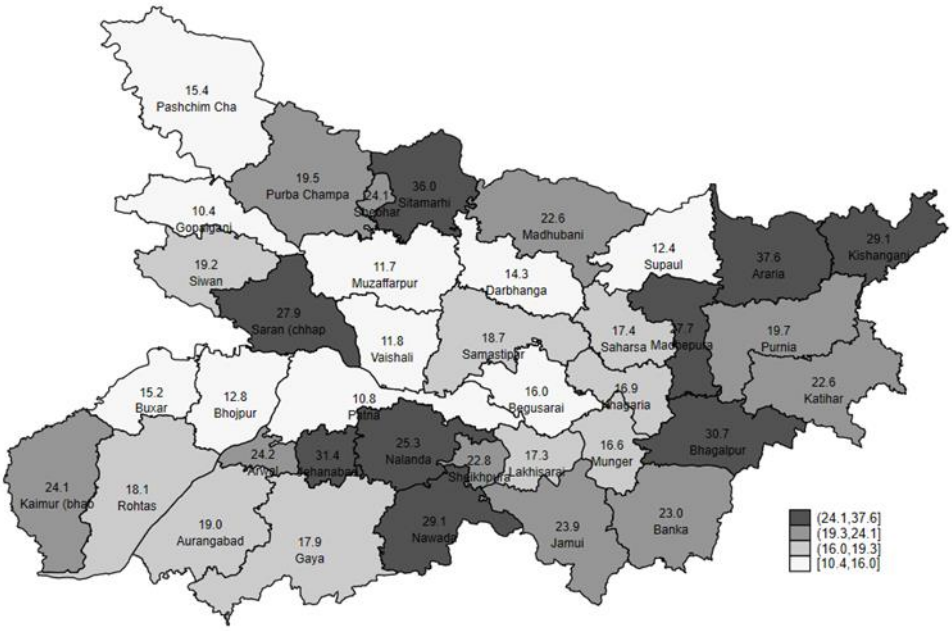

FIGURE 5 LFPR OF WOMEN IN DISTRICTS OF RURAL BIHAR IN 2015-16 (%)

SOURCE: AUTHORS' CALCULATION USING NFHS-4

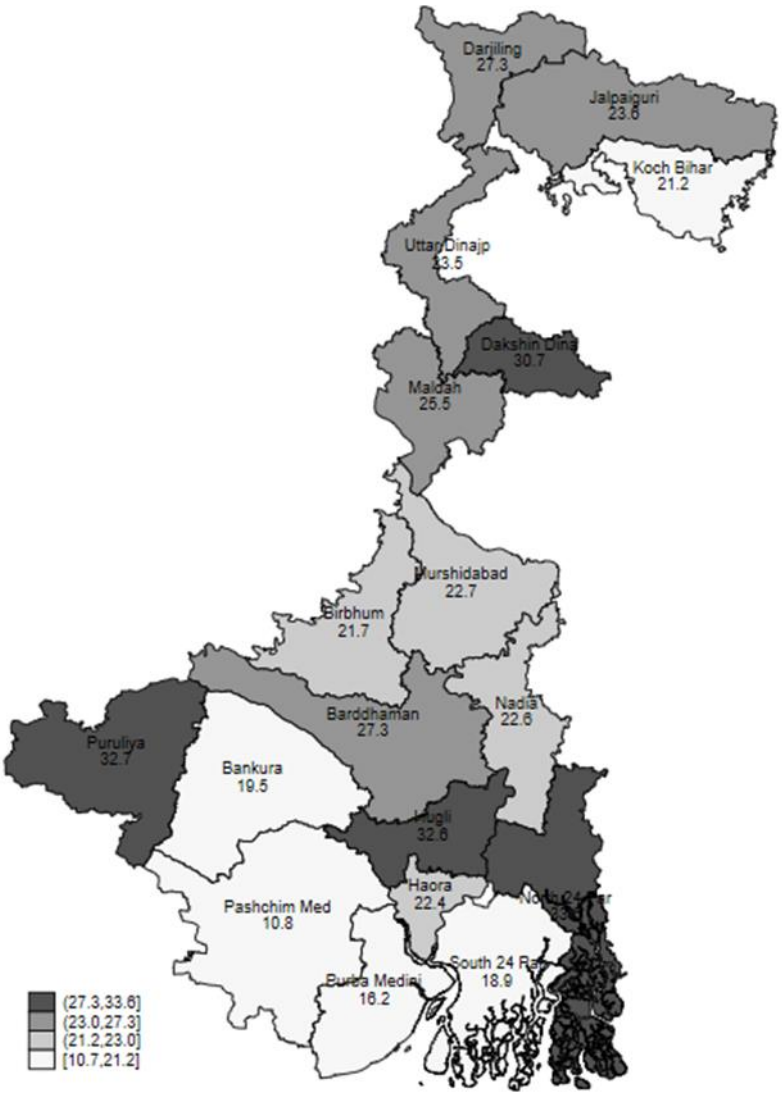

FIGURE 6 LFPR OF WOMEN IN DISTRICTS OF RURAL WEST BENGAL IN 2015-16 (%)
SOURCE: AUTHORS' CALCULATION USING NFHS-4

Comparing two rounds of NFHS, we find that the percentage of women in rural India who report having no occupation (or are engaged in unpaid work) has increased from 50.69% in 2004-05 to 66.65% in 2015-16 (Table 1). The percentage of women engaged in professional/technical/managerial or clerical/sales work is very low at 1.75 and 1.30% respectively. There is a marginal fall in clerical/sales and an increase of a similar magnitude in professional/technical/managerial work, possibly indicating a shift for a small subset of rural women. The largest fall has been in agricultural occupations. It has fallen from 35.9% in 2004-05 to 21.2% in 2015-16.

Overall, Table 1 indicates that rural women are dropping out of the labor force mainly from agricultural and other labor-intensive work. And this labor is not absorbed into other occupations. This signals a lack of jobs in other sectors in rural India that can absorb women farmers and agricultural laborers.

In rural Bihar, we find that women have dropped out of agricultural and professional / technical / managerial work (Table 1). There has been a marginal increase in the percentage of women engaged in manual labor and services/household and domestic work. A similar pattern is observed in rural West Bengal, however, there is a fall in manual labor as well (Table 1).

TABLE 1 OCCUPATION TYPES OF WOMEN IN RURAL INDIA FROM NFHS 3 (2005-06) TO NFHS 4 (2015-16)

	Rural India		Rural Bihar		Rural West Bengal	
Occupation (% women)	NFHS-3	NFHS-4	NFHS-3	NFHS-4	NFHS-3	NFHS-4
no occupation/unpaid work at home	50.69	66.65	62.78	79.11	62.79	76.14
professional/technical/managerial	1.45	1.78	0.69	1.59	1.78	1.61
clerical/sales	1.50	1.30	1.21	0.70	1.52	1.03
agricultural	35.91	21.21	32.82	11.31	17.54	7.53
services/household and domestic	1.44	2.44	0.3	2.93	2.51	3.02
manual - skilled and unskilled	8.97	5.59	2.2	2.52	13.86	9.24
N (sample size)	83,567	77,597	7,974	7,841	7,195	6,045

NFHS-4 has a rich set of supply-side variables that we use for analysis. Using machine learning methodology outlined in the previous section, we predict women's labor force participation. **Figure 7** shows the impact of each dependent variable on the LFP of sample women (i.e., the model's output). Each dot in the figure is an individual woman. The dots cluster together to depict frequency. The variables are arranged in order of importance (in predicting LFP) from top to bottom. They are colored by their magnitude - blue to pink depicts increasing magnitude - as shown in the scale on the right of **Figure 7**.

We find that a woman's age, household wealth, years of education, husband's occupation, number of young children (<5 years of age), whether she can travel outside the village alone, and whether she has experienced (relatively less severe) forms of domestic violence, are the strongest predictors of her labour force participation. It is also worth noting that the state is the topmost predictor of LFP, indicating the importance of demand-side factors.

Positive SHAP values mean that the variable increases LFP. Negative SHAP values mean that the variable decreases LFP. Magnitudes of SHAP values are interpreted as follows. SHAP value of 0 means that there is no effect on LFP. Larger positive values imply a larger increase in LFP and larger negative values imply a larger fall in LFP.

Thus, from **Figure 7**, we can also interpret the correlations between each variable and LFP. Women's LFPR is decreasing with increasing household wealth levels. Years of education and LFP have a U-shaped relationship. LFPR is higher for women with low levels of education, however, SHAP values are close to 0, implying that low education is not an important factor in predicting LFP. Women with higher education levels are more likely to work, but those around the median levels are the least likely to work. Other studies have also found this U-shaped relationship between education and LFP. We plot the individual SHAP relationships between wealth and LFP, and education and LFP in **Figure 8** and **Figure 9** as well.

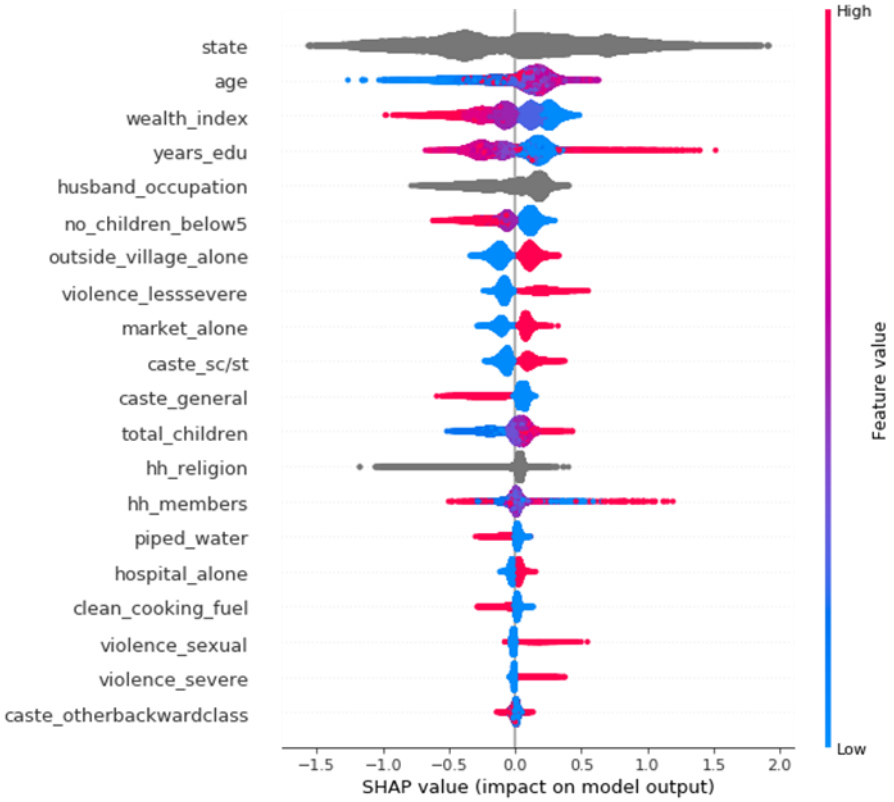

FIGURE 7 PREDICTING WOMEN'S LABOR FORCE PARTICIPATION USING MACHINE LEARNING

TAKEAWAY: A WOMAN'S STATE OF RESIDENCE, AGE, HOUSEHOLD WEALTH, YEARS OF EDUCATION, HUSBAND'S OCCUPATION, NUMBER OF YOUNG CHILDREN (<5 YEARS OF AGE), WHETHER SHE CAN TRAVEL OUTSIDE THE VILLAGE ALONE, AND WHETHER SHE HAS EXPERIENCED (RELATIVELY LESS SEVERE) FORMS OF DOMESTIC VIOLENCE, ARE THE STRONGEST PREDICTORS OF HER LABOUR FORCE PARTICIPATION.

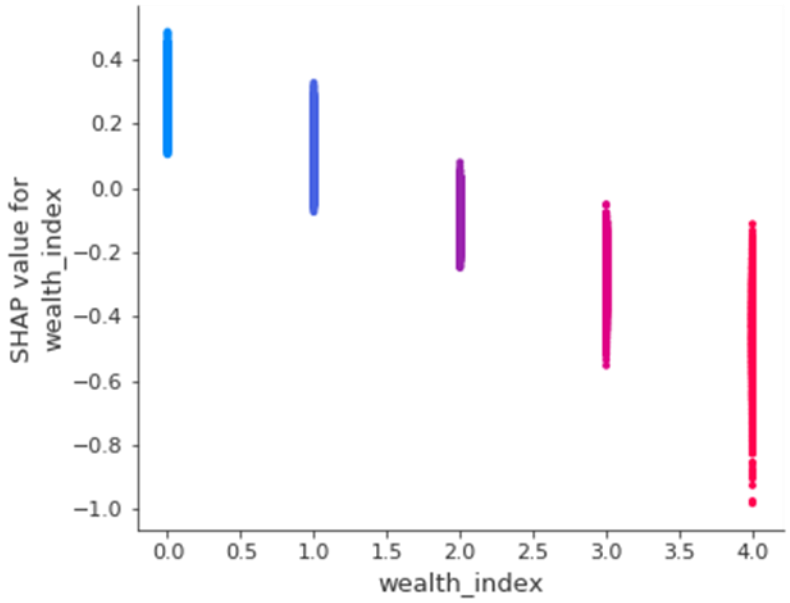

FIGURE 8 THE EFFECT OF WEALTH IN PREDICTING A WOMAN'S LFP IN RURAL INDIA

TAKEAWAY: WOMEN'S LFPR IS DECREASING WITH INCREASING HOUSEHOLD WEALTH LEVELS.

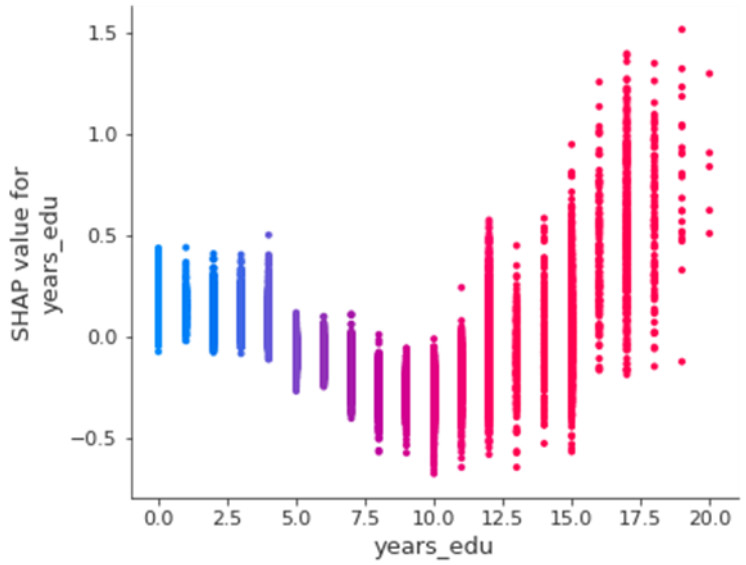

FIGURE 9 THE EFFECT OF EDUCATION IN PREDICTING A WOMAN'S LFP IN RURAL INDIA

TAKEAWAY: YEARS OF EDUCATION AND LFP HAVE A U-SHAPED RELATIONSHIP. WOMEN WITH HIGHER EDUCATION LEVELS ARE MORE LIKELY TO WORK, BUT THOSE AROUND THE MEDIAN LEVELS ARE THE LEAST LIKELY TO WORK.

To understand the interactions between household wealth and education, we classify the effect of wealth on women's LFP by their years of education (**Figure 10**). We find that among the wealthiest households, women with high education are more likely to be working. While those with low education in wealthy households are the least likely to be working (in the entire sample). On the other hand, the poorest women have the lowest education and highest LFP.

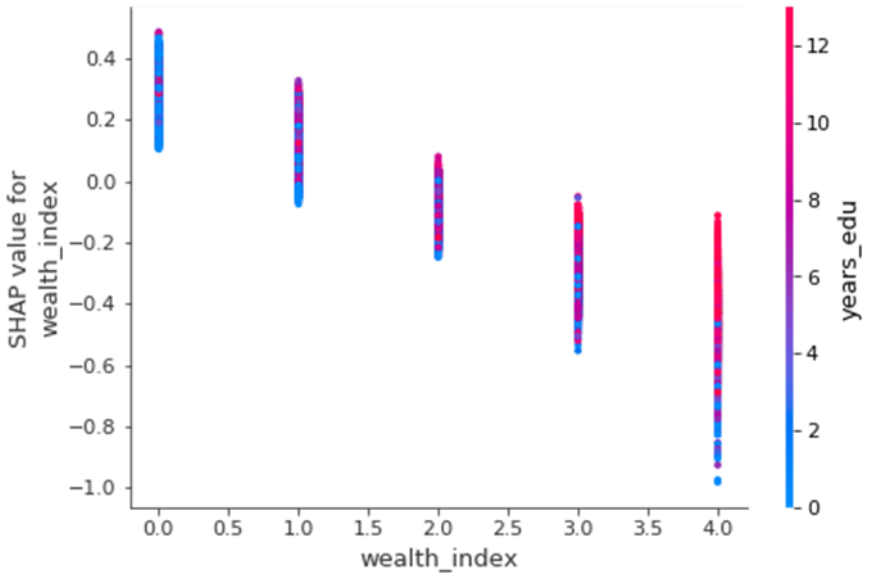

FIGURE 10 THE EFFECT OF WEALTH ON WOMEN'S LFP CLASSIFIED BY YEARS OF EDUCATION

TAKEAWAY: WEALTHY EDUCATED WOMEN AND POOR UNEDUCATED WOMEN HAVE HIGHER LFP THAN THEIR COUNTERPARTS.

Next, we focus on the relationship between the husband's occupation and wife's LFP (**Figure 11**). Most of the women who are out of the labor force have husbands who are engaged in agricultural work,

followed by manual labor and services. A smaller share of them also have husbands who are in clerical/sales and professional/technical/managerial jobs.

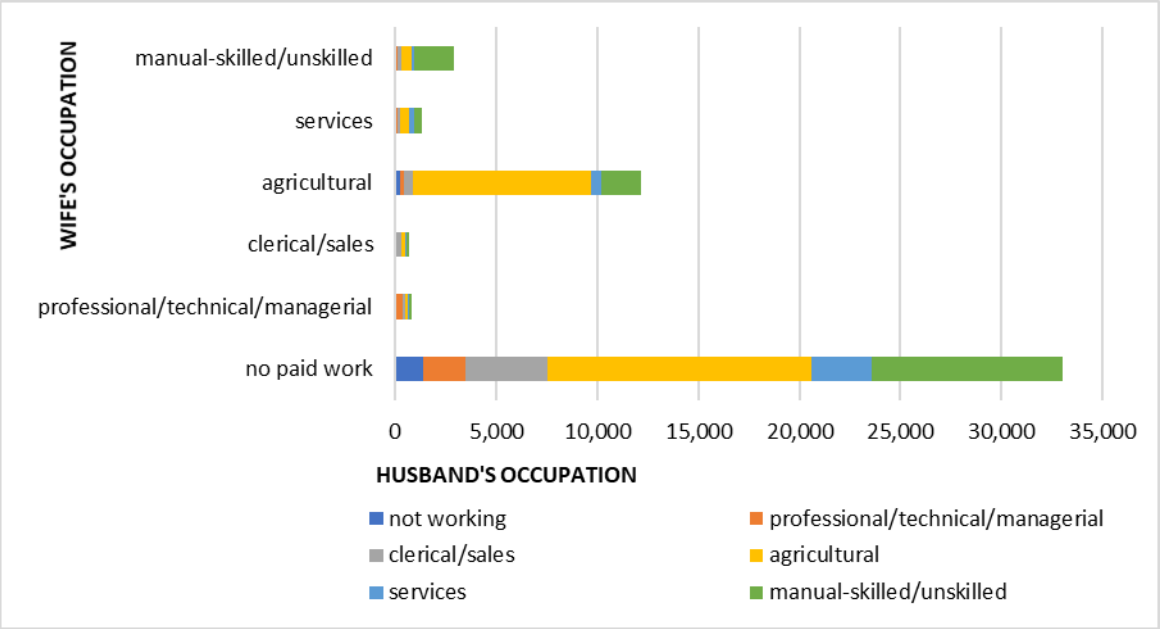

FIGURE 11 MARRIED WOMEN'S OCCUPATION CLASSIFIED BY THEIR HUSBAND'S OCCUPATION

TAKEAWAY: MAXIMUM NUMBER OF WOMEN WHO ARE OUT OF THE LABOR FORCE HAVE HUSBANDS WHO ARE ENGAGED IN AGRICULTURAL WORK, FOLLOWED BY MANUAL LABOR AND SERVICES.

Two other important predictors of LFP are having young children and having the autonomy to go outside the village alone. From **Figure 7**, we find that a higher number of children below 5 years of age is correlated with lower LFPR. And the autonomy to go outside the village alone is correlated with higher LFPR. A similar pattern is observed for other mobility variables like going to the market alone. Interestingly, we also observe a higher incidence of domestic violence (severe, less severe, and sexual violence) among women with higher LFP.

Using linear polynomial regressions, we find that women who have young children have lower LFPRs at all but the highest wealth quintile in rural India (**Figure 12**). The gap in LFPR between women with young children and other women is almost 10% for the lowest quintile and decreases with increasing wealth. We also plot a similar relationship for mobility outside the village, finding again that women who can go outside the village alone, have higher LFPRs at every wealth level (**Figure 13**).

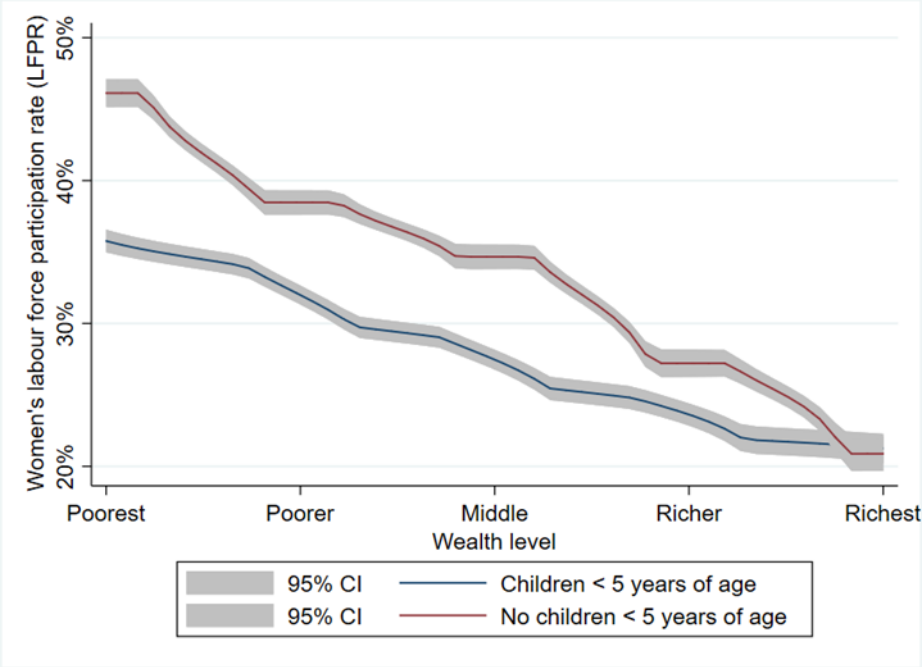

FIGURE 12 RELATIONSHIP BETWEEN HOUSEHOLD WEALTH AND WOMEN'S LFP BY THE PRESENCE OF YOUNG CHILDREN

TAKEAWAY: WOMEN WITH YOUNG CHILDREN HAVE LOWER LFPRS AT EVERY WEALTH LEVEL, EXCEPT AT THE TOPMOST WEALTH QUINTILE.

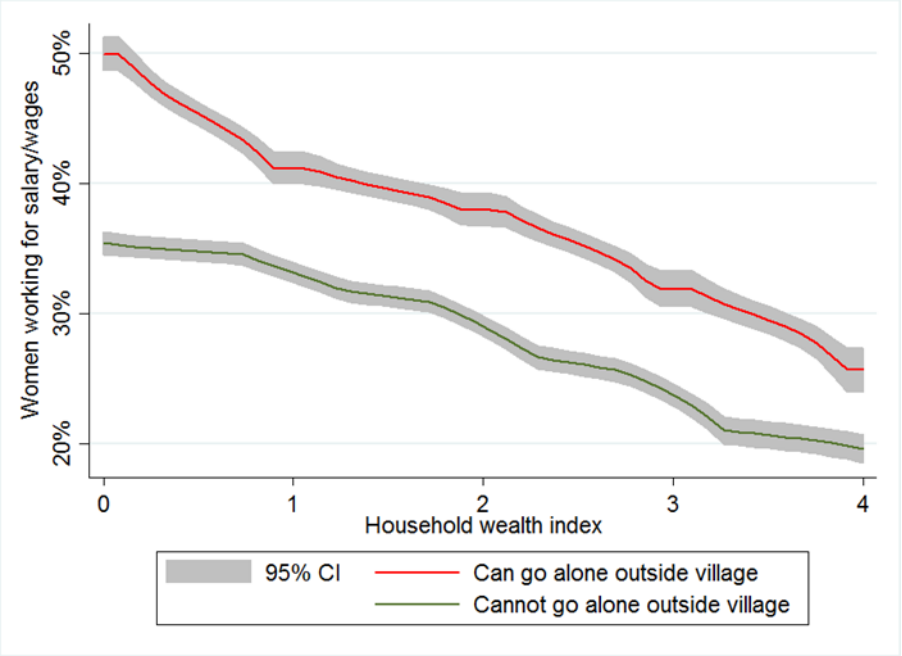

FIGURE 13 RELATIONSHIP BETWEEN HOUSEHOLD WEALTH AND WOMEN'S LFP BY MOBILITY OUTSIDE THE HOUSE

TAKEAWAY: WOMEN WHO CAN GO OUTSIDE THE VILLAGE ALONE, HAVE HIGHER LFPRS AT EVERY WEALTH LEVEL.

Further, we are interested in learning the impact of husbands' out-migration on their wives' LFP and occupation types. **Figure 14** shows the percentage of married women in rural Bihar, West Bengal and India whose husbands were not living with them (migrants) at the time of NFHS-3 and NFHS-4. There has been only a small decline in the share of such women from 2004-05 to 2015-16. At 28%, rural Bihar

has the highest share of women whose husbands have migrated—nearly three times the all-India rural average of 10%.

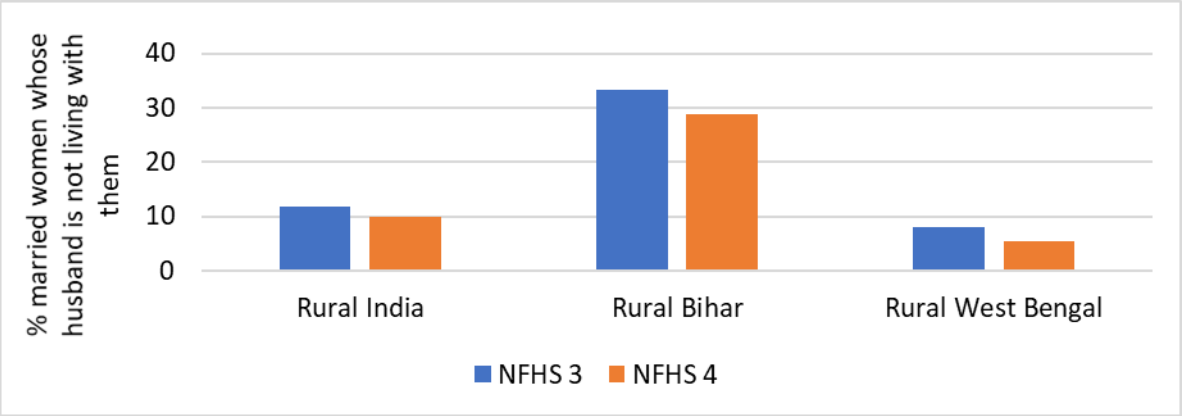

FIGURE 14 WOMEN WHOSE HUSBANDS ARE MIGRANTS

We find that 75% of married women whose husbands have migrated are not part of the labor force in 2015-16 (**Table 2**). This is nearly 10 percentage points higher than the average for the total sample of women and has increased in the past decade. Meanwhile, the share of women engaged in agriculture has declined from 32% in 2004-05 to only 15% in 2015-16. A similar pattern is observed in rural Bihar and rural West Bengal (**Table 2**). However, in both states, the share of women who are out of the labor force is 5% higher than the all-India average. And the share engaged in agriculture is 5% lower than the all-India average.

TABLE 2 OCCUPATION TYPES OF WOMEN WHOSE HUSBANDS HAVE MIGRATED

Occupation of married women whose husband is not living with them (%)	Rural India		Rural Bihar		Rural West Bengal	
	NFHS-3	NFHS-4	NFHS-3	NFHS-4	NFHS-3	NFHS-4
no occupation/unpaid work at home	59.63	75.26	65.05	80.56	65.84	80.55
agriculture	31.95	14.93	31.19	10.67	13.86	4.07
manual - skilled and unskilled	5.46	4.02	2.04	2.16	16.83	10.2
others	2.95	4.68	1.73	5.00	3.47	3.71
N (sample size)	7,551	6,814	2,197	2,007	461	400

The highest number of migrant husbands are engaged in manual labor, although it has fallen over the decade from 56.5% in 2004-05 to 40.53% in 2015-16 (**Table 3**). The patterns are similar in rural Bihar and West Bengal. Other major sectors where migrant husbands are employed are services/household and domestic work, agriculture, and sales.

TABLE 3 OCCUPATION TYPES OF MIGRANT HUSBANDS

Occupation of married women's husband who is not living with them (%)	Rural India		Rural Bihar		Rural West Bengal	
	NFHS-3	NFHS-4	NFHS-3	NFHS-4	NFHS-3	NFHS-4
no occupation	0.91	5.35	0.94	7.27	0	1.15
professional/technical/managerial	3.92	7.98	3.76	7.95	3.96	2.93
clerical	4.27	2.55	3.92	1.77	1.98	1.58
sales	11.69	9.87	10.97	10.09	11.39	4.26
agriculture	10.38	14.55	12.38	15.42	13.86	15.13
services/household and domestic	11.61	17	7.05	15.72	11.39	17.74
manual - skilled and unskilled	56.56	40.53	60.82	38.64	57.43	56.29
N (sample size)	7,551	6,814	2,197	2,007	461	400

Using linear polynomial regressions to control for the effect of wealth, we find that women with migrant husbands are less likely to be part of the labor force at each wealth level (**Figure 15**). This indicates that factors other than wealth are at play.

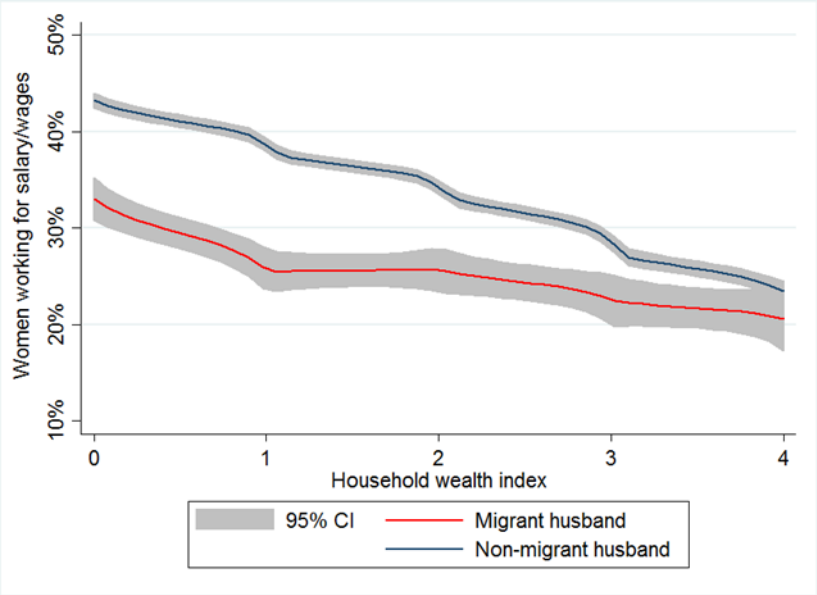

FIGURE 15 RELATIONSHIP BETWEEN HOUSEHOLD WEALTH AND WOMEN'S LFP BY HUSBAND'S MIGRATION STATUS

TAKEAWAY: WOMEN WITH MIGRANT HUSBANDS HAVE LOWER LFPRS AT EACH WEALTH LEVEL.

5. Conclusions

Between 2005-06 and 2015-16, there has been a large drop in the share of women engaged in agriculture and labor, and a simultaneous increase (of a similar magnitude) in the share of women who are out of the labor force. We observe some movement into services/household and domestic work in rural Bihar. But overall, women are not moving into other sectors of work. Whether this is due to a lack of availability of jobs, lack of safety and suitable infrastructure, or gender-biases and discrimination, merits further research.

On the supply-side, household wealth, years of education, husband's occupation, number of young children (<5 years of age), mobility outside the village, and experience of domestic violence are the strongest predictors of LFP.

Wealthier women have lower rates of LFP. Education and LFP have a U-shaped relationship: women who are around the median levels of education (approximately 7 to 12 years of education), are the least likely to work.

The combination of wealth and education also matters in determining women's LFP. It is the educated wealthy women and the uneducated poor women who have the highest LFP. At middle-income levels, education does not seem to matter.

Women who are out of the labor force have a greater number of young children (<5 years of age) and are engaged in childcare. They also have lower levels of autonomy and mobility outside the house. There is a positive correlation between LFP and domestic violence that merits future research. It seems that working women face higher chances of domestic violence, likely due to unobserved socio-cultural norms.

Women whose husbands have migrated are less likely to be working than those who are living with their husbands. This relationship holds across all levels of household wealth, indicating that factors other than wealth explain this difference in LFP.

Our analysis also identifies important questions for future research that will help to further understand the low LFP of women in rural India.

One, what factors explain the large state-level and inter-state-level variations in LFP across rural India? Two, what other demand-side factors can be investigated? There is a need to fill the data-gap on demand-side factors like job availability, the role of state-level policies, transportation and safety issues, and infrastructural development. Three, what explains the positive correlation between LFP and domestic violence? Four, why do women with out-migrant husbands have lower labor force participation rates regardless of their household wealth?

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Foresight for Food Systems Status Reports

The Foresight for Food Systems in the Eastern Gangetic Plains (EGP) is a project led by IFPRI that seeks to lay down the groundwork for an open, scientifically informed and participatory foresight for food exercise in the EGP region led by regional scientists and engaging with other stakeholders like policy-makers, private investors, and farmers. A set of status reports on different components of the food system for better understanding of the current status, future challenges, research and knowledge gaps has been prepared for informed policy making for a sustainable future. The status reports will provide inputs into foresight and scenario building exercises in the region.

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SDIP initiatives aim to build technical capacity, share and generate knowledge, facilitate transboundary dialogue and mobilise the private sector and civil society in support of this objective. The focus area for SDIP initiatives is the three Himalayan river basins – the Indus, Ganges and Brahmaputra – which cover parts of India, Pakistan, Bhutan, Nepal and Bangladesh.

SDIP is a 12-year strategy (2012-2024), recognising that many of the critical interventions required for improving the integrated management of water, food and energy at the river basin level require sustained engagement to build regional cooperation and capacity over time. The Australian Centre for International Agricultural Research (ACIAR) is one of seven partners in SDIP. ACIAR SDIP funds research and development activities that improve agriculture's contribution to sustainable food systems. For further information on the project please visit https://aciarsdip.com/component-2