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Growth Dynamics and Gender Wage Inequality in Indian Agricultural Sector: Study across Various Population Hierarchies of Villages

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Abstract

This paper studies three important issues of Indian agricultural sector, namely, the determinants of the agricultural wages in India, the extent to which gender inequality is present in it, and the variations in this inequality within various population hierarchies of Indian villages. The paper employs robust regression technique to deal with the presence of outliers and heteroskedasticity. Results suggest that there are four major factors that determine the agricultural wages, namely, non-farm wage factors, accessibility factors, production factors, and individual factors. Gender wage disparity is to an extent of 23% against women in comparison to the men. Furthermore, village growth is detrimental to the agricultural wages in comparison to non-farm wages and female agricultural wages are more disadvantaged with growing dynamics of villages.

Keywords

Agricultural Wages, Wage Inequality, Wage Equation, Indian Villages, Robust Regression

1. Introduction

India is a land of diversity. Besides its 55 million plus populated cities [1], it also consists of 597,608 habitable villages [2]. Out of these villages, population of 337,683 villages are less than one thousand, and 235,592 number of villages have a population between 1000 - 5000 and only 23,333 number of villages have more than 5000 population [3]. This paper has three objectives, namely, studying the determinants of the agricultural wages in India, finding the extent to which women wage disparity exists in India, and understanding the village growth

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dynamics on the extent of women wage disparity. Our research is important because of three reasons. First, the current Central Government of India gives a lot of emphasis on the development of women. However, the core of the problem of the majority of Indian women is not put forward. Second, rural India is more than two times bigger in population than urban India. Third, the agricultural sector is one of the biggest employment providers to men and women both. Therefore, our research directly impacts one third of the rural population and indirectly to the total rural population which is two-third of the total Indian population.

Agriculture plays a major role in the Indian Economy. It is the main source of livelihood for a good proportion of the population. Furthermore, agriculture provides the bulk of wage goods required by non-agriculture sectors and most of the raw materials for the industrial sector [4]. The 2011 census of India illustrates that the agricultural labour force in India accounts for 48.8% of the total labour force. Although there is a declining trend in the share of agricultural labour force due to the migration of labours to the urban areas, this sector still plays a dominant position in the Indian labour market. **Table 1** demonstrates this fact along with the declining trend. Agricultural sector is facing mass migration of labourers in India. Around two million people were added to the agricultural workforce since 2004-2005 till 2013-2014 compared to around 12 million people that were added to the workforce every year on an average between 1990-2000 and 2004-2005 [5]. The main reasons attributed to declining proportion of agricultural work force are higher remuneration and growth of opportunities in alternate sectors. Furthermore, another fact that agricultural wages have grown at a very low rate is equally responsible for it. In addition, there are many government sponsored schemes such as MGNREGA that has given the incentive for many farm labourers to shift to alternate employment sectors.

As reported by 2011 census of India, the rural population accounts for 68.8% of the total population [6] [7]. Out of this 32.2% of the rural household population is employed as agricultural workers [8]. The global comparison of agriculture labour force participation suggests that the proportion of agricultural labour in a developed country is far less than in India. Sanghvi [9] and Basu *et al.* [10] also illustrate the problem of surplus employment in Indian agricultural sector.

As explained above, overcapacity of labour force and unemployment issues has led to exploitation of agricultural labour in India. This exploitation has resulted in very low wage rates for agricultural work in India. **Table 2**

Table 1. Number of agricultural and non-agricultural workforce in India (1999-2000, 2004-2005, 2009-2010 and 2011-2012) (in Millions).

Years	Total Work Force	Agri-Work Force	Non-Agri-Work Force	Share of Agri-Labour Force
1999-2000	397	238	159	59.9
2004-2005	457	259	198	56.7
2009-2010	460	245	215	53.3
2011-2012	467	228	239	48.8

Source: Department of agriculture and cooperation, ministry of agriculture, Govt. of India (16,682).

Table 2. Gender wise comparison of wage and agricultural workforce population.

Selected States	Female Wage	Female Workforce	Male Wage	Male Workforce
Andhra Pradesh	78.23	7,386,920	107.53	6,431,834
Bihar	50.83	4,729,352	93.92	8,798,532
Haryana	123.33	563,739	168.61	712,404
Himachal Pradesh	114.09	37,645	142.97	55,116
Jharkhand	77.62	1,370,111	82.66	1,491,828
Karnataka	109.75	3,613,282	113.94	2,595,871
Rajasthan	72.08	1,490,938	126.3	1,038,287

Source: IndiaStat.com: (a) Agricultural workforce figures are based on 2001 Census (b) Wage Figures are based on 2008-2009 data, Ministry of agriculture, Govt. of India (ON316).

illustrates the average wage of male and female in India across some chosen states for the year 2008-2009. Exploitation further aggravates based on gender. The range of average female wage across the state in 2008-2009 varies from 78.23 INR in Andhra Pradesh to 123.33 INR in Haryana. Similarly, the range of average male wage varies from 107.53 INR in Andhra Pradesh to 168.61 INR in Haryana.

Not only wages but due to the multiple problems present among Indian agricultural labourers, this subject is of interest to many researchers [11]. Previous researchers have focused mainly on knowing the antecedents of agricultural wages. Acharya and Papanek [12] found that agricultural wages are influenced by factors outside the agriculture sector. For example, the author observes that the wages in Kerala have been affected by the direct and indirect demand for labour created by migration to other countries. Similarly, Punjab has seen a demand for labour in non-agricultural activities. Therefore, it is not appropriate to assign only agricultural sector variables to predict agricultural wages. These arguments are in full support of Bardhan [13]. He found multiple factors affect the agricultural wages of India. His paper discusses how non-agricultural employment opportunities impact the wage rate of a particular region. Therefore, we argue that non-farm factors are important determinants of agricultural wages. The study also indicates that production factors are an important predictor of agricultural wages. Production factor includes irrigation facilities, multiple cropping, and gross domestic product of that particular state. Other factors include accessibility of the village as its location, communication infrastructure between places, etc.

Chavan and Bedmatta [14] go a step further. They researched on the nature of gender wage disparity across time and found time trend in gender disparity of agricultural wages. Wage disparity between male and female workers has increased over the years. This is an important finding for policy maker that gender wage disparity is not reducing with time but increasing. Furthermore, this paper found that the daily wage of male workers exceeded the minimum wage rate prescribed by the government but in most of the cases it is not for female workers. Jose [15] studied the nature of gender wage disparity across Indian states. He concluded that there is a good amount of variation across states with regard to the disparity. Large disparity states include Maharashtra, Rajasthan and Tamil Nadu; whereas, states like Punjab and West Bengal belong to the category of small gender disparity states. Deininger [16] questions the economic development policies of rural India and he concludes that it has failed to reduce the wage disparity. He also discusses the means of reducing the wage disparity in gender by advocating the need for self-employment, opportunities for female agricultural labourers. Furthermore, it also examines how the accessibility of assets alters the participation of men and women in the labour market. Besides all the above explained factors Indian cast system has very important influence on the socio-economic development. Caste based wage disparity had existed in the agriculture sector since long [17].

Above mentioned literature review suggests that wage is very well studied subject in Indian agricultural context. However, wage disparity researches are focused across states, time, and cast. We could find only two studies that address gender wage disparity in Indian agricultural sector [15] [16]. Furthermore, gender wage discrimination across physical growth dynamics of Indian villages is not addressed to best of our knowledge. We argue this study to be important because, understanding the interaction of gender wage disparity and physical growth dynamics will put forward the correct village entities to be addressed while dealing with the agricultural wage issue. This issue becomes further important as this sector is one of the largest employment providers in India.

2. Methodology and Data

Analyzed literature supported that there are four major factors that govern the agricultural wages. They are non-farm wages, accessibility factors, production factors, and individual factors. We use India Human Development Survey (IHDS) data prepared by the University of Maryland and National Council of Applied Economic Research, New Delhi for our research [18]. IHDS is a national level dataset that contains surveys of different socio-economic status of 41,554 households in 1503 villages and 971 urban neighborhoods across India. Besides Government of India, some portion of the funding this survey has been obtained from Ford Foundation and World Bank. There are two such surveys IHDS-1 and IHDS-2. We have considered IHDS-1 for our analysis because of its closer and direct relevance to our research. The number of individuals interviewed for IHDS-1 is 64,753. The state-wise sample sizes can be obtained from the official website [18]. Broadly the information in the data set is Geographic, Consumption, Education, Employment, Household Assets, Income, Poverty and Social Groups. This includes farm and non-farm wages across villages for both the gender, land holding patterns

based on social classification, accessibility of the village to nearby town and urban centres, availability of educational facilities etc. Based on our requirement we found three types of wages representing non-farm wages, namely, wages of domestic service (Wage (DS)), unskilled wages (Wage (Un)), and wages of construction workers (Wage (CW)). Similarly, accessibility factors are also represented by three variables, namely, the number of buses coming to the village in a day (No (Bus)), distance of the nearest bus stop (Dist (BS)), distance of the nearest railway station from the village (Dist (RS)). Per capita income of the state, proportion of irrigated land and per hectare yield of the agricultural land is taken as quasi for production factor. To know the gender disparity on women wages gender is considered as a dummy variable. Furthermore, studies have shown that the size of the village is significantly associated with the level of wages in the village [19] [20]. Therefore, village size in dummy variable form is also used in the wage equation. Based on the availability of the data there are three types of villages included in the research. The small village has a population less than 1000; medium villages have a population of 1000 - 5000, and large villages having a population more than 5000. Considering all these factors we run the first OLS regression as represented in Equation (1).

$$\begin{aligned} \mathrm{Wage(M1)} = {} & \mathrm{Wage(DS)} + \mathrm{Wage(Un)} + \mathrm{Wage(CW)} && \text{(Non-farm wage factors)} \\ & + \mathrm{No(Bus)} + \mathrm{Dist(BS)} + \mathrm{Dist(RS)} && \text{(Accessibility factors)} \\ & + \mathrm{Income} + \mathrm{Irrig} + \mathrm{Yield} && \text{(Production factors)} \\ & + \mathrm{Gender} + \mathrm{Village(D)} && \text{(Individual factors)} \end{aligned} \tag{1}$$

We analyzed the first model for the presence of outliers and for the absence of multi-collinearity and heteroskedasticity. **Figure 1** illustrates the output of box-plot.

Box-plot of the dependent variable indicates that there are outliers that are significantly different from average wages. Furthermore, the distribution of data suggests that it is not normally distributed. Therefore, ordinary OLS may give a biased result. To know the level of multicollinearity we have calculated Variance Inflation Factor (VIF). The value of VIF is found out to be 2.347. The general accepted thumb rule for multicollinearity is VIF <= 5 [21]. Therefore, multicollinearity issue is not present in our model. Furthermore, we analysed the first equation to know the presence/absence of heteroskedasticity in the error term. We run studentized Breusch-Pagan test and found that residuals of Equation (1) are significantly related to the explanatory variables. Hence, the presence of heteroskedasticity cannot be rejected. Therefore, we reject the OLS regression Equation (1) and adopt robust regression that is robust to both the anomalies, the presence of outliers and to the presence of heteroskedasticity. Robust regression is forced to treat outliers [22]. Robust regression treats the outliers in such a way that outliers have little influence on the coefficient values [23] [24]. Equation two, three, and four uses robust regression method. To understand the influence of gender and village size separately we formulated two equations. Equation (2) uses gender as a dummy variable and does not include village. Therefore, in Equation (2), we have the impact of gender on wages in the absence of village size dummy.

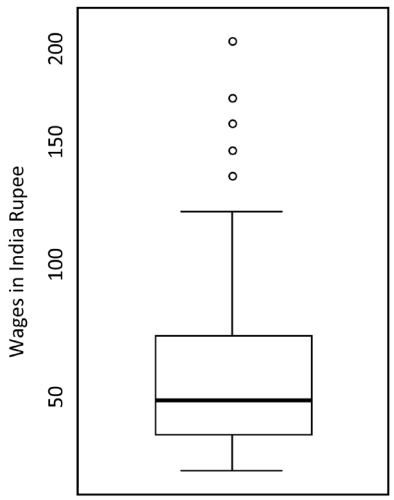

Figure 1. Box-plot of Indian agricultural wages.

$$\begin{aligned}\text{Wage}(\text{M2}) = {} & \text{Wage}(\text{DS}) + \text{Wage}(\text{Un}) + \text{Wage}(\text{CW}) && (\text{Non-farm wage factors}) \\ & + \text{No}(\text{Bus}) + \text{Dist}(\text{BS}) + \text{Dist}(\text{RS}) && (\text{Accessibility factors}) \\ & + \text{Income} + \text{Irrig} + \text{Yield} && (\text{Production factors}) \\ & + \text{Gender} && (\text{Individual factors})\end{aligned} \quad (2)$$

In Equation (3), we use village size as a dummy variable and do not include gender. This helps us to recognize the impact of growing village size on the wages of individual worker and equation is devoid of gender.

$$\begin{aligned}\text{Wage}(\text{M3}) = {} & \text{Wage}(\text{DS}) + \text{Wage}(\text{Un}) + \text{Wage}(\text{CW}) && (\text{Non-farm wage factors}) \\ & + \text{No}(\text{Bus}) + \text{Dist}(\text{BS}) + \text{Dist}(\text{RS}) && (\text{Accessibility factors}) \\ & + \text{Income} + \text{Irrig} + \text{Yield} && (\text{Production factors}) \\ & + \text{Village}(\text{D}) && (\text{Individual factors})\end{aligned} \quad (3)$$

Equation (4) combines these two dummy variables in the single equation so that we may know the impact of one influencing variable in the presence of other. Furthermore, we employ the interaction effect of gender and village to understand the wage inequality pattern across varying village sizes.

$$\begin{aligned}\text{Wage}(\text{M4}) = {} & \text{Wage}(\text{DS}) + \text{Wage}(\text{Un}) + \text{Wage}(\text{CW}) && (\text{Non-farm wage factors}) \\ & + \text{No}(\text{Bus}) + \text{Dist}(\text{BS}) + \text{Dist}(\text{RS}) && (\text{Accessibility factors}) \\ & + \text{Income} + \text{Irrig} + \text{Yield} && (\text{Production factors}) \\ & + \text{Gender} + \text{Village}(\text{D}) + \text{Gender} * \text{Village} && (\text{Individual factors})\end{aligned} \quad (4)$$

Next in **Table 3** we illustrate the descriptive statistics of our data. All the reported wages are in INR. Per capita state domestic product (NSDP) is in 10,000 INR. Yield is in KG per hectare of irrigable land. There are three categories of villages, namely, population less than 1000, population between 1000 - 5000 and population above 5000.

3. Result and Analysis

In the data and methodology section we have explained that we reject the first model that was OLS model-M1. This rejection was due to the presence of outliers and heteroskedasticity in model-1. In model-2 (**Table 4**), we

Table 3. Descriptive statistics.

Variables	Min	1st Quantile	Mean	Median	3rd Quantile	Max
Agricultural Wages (Dependent Variable)	15	40	50	57.81	70	200
Wage (Domestic Service)	10	35	50	55.27	60	300
Wage (Unskilled)	10	40	50	61.83	80	300
Wage (Construction)	20	100	110	119.7	150	280
Buses per day	0	0	2	9.001	10	90
Distance to Bus Stand (KM)	0	0	0	1.926	3	29
Distance To Railway Station(KM)	0	7	16	24.38	35	95
Per Capita State Domestic Product (NSDP)	0.6772	1.3311	1.9367	1.8088	2.2975	4.5394
Percentage of Irrigated Land (Irrper)	6.23	22.89	30.95	37.96	53.97	95.02
Yield	1018	1496	1946	1989	2251	3694
SEX (1 = male, 2 = female)	1	1	1	1.371	2	2
Village Category (POPCAT)	1	2	2	1.987	2	3

Table 4. Regression results.

Regression-Output	M1	M2	M3	M4
Intercept	1.181	2.481	−4.754	1.513
(Std. Error)	1.201	0.883	0.992	0.928
(t-value)	0,983	2.809	−4.791	1.630
Pr (>|t|)	0.325	0.005	0.000***	0.103
Wage (Dom.Ser)	0.162	0.169	0.152	0.175
(Std. Error)	0.009	0.022	0.021	0.023
(t-value)	18.434	7.631	7.221	7.737
Pr (>|t|)	0.000***	0.000***	0.000***	0.000***
Wage (Unskill)	0.278	0.291	0.302	0.290
(Std. Error)	0.011	0.023	0.024	0.023
(t-value)	34.258	12.654	12.360	12.378
Pr (>|t|)	0.000***	0.000***	0.000***	0.000***
Wage (Const.)	0.183	0.129	0.135	0.130
(Std. Error)	0.008	0.007	0.007	0.007
(t-value)	22.604	19.462	18.799	19.316
Pr (>|t|)	0.000***	0.000***	0.000***	0.000***
Buses per day	0.141	0.137	0.118	0.138
(Std. Error)	0.018	0.019	0.024	0.020
(t-value)	7.746	7.028	4.931	7.078
Pr (>|t|)	0.000***	0.000***	0.000***	0.000***
Distance to Bus Stop	−0.034	0.190	0.136	0.172
(Std. Error)	0.090	0.066	0.069	0.065
(t-value)	−0.373	2.875	1.972	2.639
Pr (>|t|)	0.709	0.004**	0.049*	0.008**
Distance to Railway Stn.	−0.026	−0.015	−0.009	−0.019
(Std. Error)	0.011	0.008	0.009	0.008
(t-value)	−2.300	−1.872	−1.053	−2.340
Pr (>|t|)	0.021*	0.061	0.292	0.019*
NSDP	1.739	2.230	3.186	2.059
(Std. Error)	0.526	0.442	0.517	0.435
(t-value)	3.307	5.046	6.165	4.731
Pr (>|t|)	0.001***	0.000***	0.000***	0.000***
Irrper	0.049	0.066	0.110	0.062
(Std. Error)	0.015	0.011	0.013	0.011
(t-value)	3.358	6.029	8.350	5.642
Pr (>|t|)	0.001***	0.000***	0.000***	0.000***

Continued

Yield	0.005	0.004	0.003	0.004
(Std. Error)	0.001	0.000	0.001	0.000
(t-value)	8.023	8.129	6.354	8.821
Pr (>|t|)	0.000***	0.000***	0.000***	0.000***
factor(Sex)2	−15.293	−13.458	-	−9.492
(Std. Error)	0.507	0.375	-	0.624
(t-value)	−30.183	−35.890	-	−15.213
Pr (>|t|)	0.000***	0.000***	-	0.000***
factor(POPCAT)2	−1.854	-	−1.049	0.172
(Std. Error)	0.623	-	0.428	0.483
(t-value)	−2.976	-	−2.453	0.356
Pr (>|t|)	0.003**	-	0.014*	0.722
factor(POPCAT)3	−0.325	-	−1.409	3.548
(Std. Error)	0.820	-	0.683	0.803
(t-value)	−0.396	-	−2.064	4.420
Pr (>|t|)	0.692	-	0.039*	0.000***
factor(Sex)2:factor(POPCAT)2	-	-	-	-3.427
(Std. Error)	-	-	-	0.802
(t-value)	-	-	-	-4.273
Pr (>|t|)	-	-	-	0.000***
factor(Sex)2:factor(POPCAT)3	-	-	-	-10.730
(Std. Error)	-	-	-	1.108
(t-value)	-	-	-	-9.686
Pr (>|t|)	-	-	-	0.000***
Residual Standard Error	19.63	13.04	14.38	12.97
R Square	0.5739	0.6929	0.6183	0.7011
Adjusted R Square	0.5732	0.6924	0.6177	0.7004

study all the four factors except the village category. Model is found to be significant and the amount of disadvantage in wages for women is 23% to that of male. In model-3 we study influence of village size on general agricultural wages. For larger villages agricultural wages are significantly lesser to the degree of 1.04 INR and 1.41 INR in comparison to non-agricultural wages. Model-4 combines model-2 and 3 along with the interaction effect of being female in different categories of villages. Results of model-4 suggest that the gender disparity widens as the size of the village increases. Common gender wage disparity is 9.49 INR as per model-4; it further increases to 3.40 INR in medium villages and 10.7 INR in a larger village. Therefore, the level of wage disparity is 9.49 INR, 12.92 INR, and 23.65 INR respectively for smaller, medium, and larger villages (**Figure 2**).

4. Conclusions

All the four hypothesized factors: a) non-farm wage factor; b) accessibility factor; c) production factor; and d) individual factors are found to be a significant predictor of agricultural wages in Indian villages. As the

Figure 2. Wage inequality in agriculture wages of women's.

population of village increases agricultural wages are significantly deprived in comparison to the other non-agricultural wages. The study revealed that in larger villages the growth in wages of women's relative to men's were significantly lower. This study finds that gender wage inequalities in the agriculture sector of India widen as the size of the village increases. Therefore, we conclude that women employed in the Indian agricultural sector have a double disadvantage. First, as the village grows the advantages of growth are harnessed by rest of the sectors and not by the agriculture sector. Second, the impact of disadvantage keeps on growing as the population size of the village grows.

This research contributes to the existing literature by integrating the village growth dynamics in wage equation and its impact on the determination of agricultural wages specifically women wages. Our research has very important policy implication for village policy makers of India. Based on earlier stated conclusion we argue that with increasing villages the need to promote rural non-farm employment is clearly discerned to push up the pathetic condition of Indian women. Non-farm employment will not only raise the income of rural women but also reduce their present exploitation happening in the farm sector.

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