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Abstract

Farm workers incur various occupational related risks. The question is whether they are adequately compensated for facing these risks? This paper attempts to measure the wage premiums that farm workers in India receive for health risks associated with their jobs, using a primary survey data collected from 282 farm workers who are pesticide applicators and 100 agricultural laborers who do not handle pesticide from Kerala in 2009-10 and the hedonic wage approach. Results indicate that the farm workers in India receive approximately an additional wage premium of Rs. 20 per hour for facing occupational health risks. Interestingly, the use of protecting gadgets reduces the risk of health damages that emphasizes the necessity of ensuring their usages.

Keywords: *Farm workers, Risk, Morbidity, Hedononic Wage Model*

JEL Codes: *J17, J28, J31*

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INTRODUCTION

Risk management in agriculture is often producer centered. It encompasses the risks associated with price and supply management of inputs, and products as well as technological and climate risks. It, in general, ignores the other stakeholders' risks. For instances, farm workers incur various risks when they handle agricultural machines, implements and tools. They also incur the health risks due to prolonged exposure to sun and other weather factors, bites and allergic reactions due to the flora and fauna in the field, specific aliment due to prolonged posture, and improper sanitation facilities, exposure to agrochemicals (pesticides) etc. Some of the agricultural operations like coconut /areca nut harvesting involve the risk of falling from trees.

As nearly 60 percent of people in countries like India depend on agriculture, the health risks faced by agriculture workers most often exceed that faced by workers in other sectors. As a result, the social cost of health risks is relatively high as compared to other sectors (Navamukundan, 2005; Fernandez, 2006; Wang, 2007; Suk, e*t al.,* 2007). For example, in Philippines, the health cost to farmers exposed to pesticides is 61 percent higher than that of unexposed farmers (Pingali, et al., 1995). Wilson (2002), following the cost-of-illness approach, estimated that a farmer in Sri Lanka on an average incurs one month income as cost per year due to exposure to pesticides. The estimates from Nepal amount to US $ 2.05 (Atreya, 2007). Devi (2007) estimated the value of short term morbidity due to pesticide exposure by the farm worker population (pesticide applicators), and established a very close link between pesticide exposure and health damages. With the modest assumption regarding the proportion of pesticide applicators among the agricultural laborers in Kerala, India, the value of health damage was estimated at Rs. 18 crore for the society as a whole per year.

To our knowledge, no study has emerged to analyze whether farm laborers are adequately compensated for their occupational risks. However, numerous studies emerged to analyze whether manufacturing workers are compensated adequately for incurring job related health risks (Viscusi, 1979, Causineau, Laxroix and Gerard, 1992, Meng, 1989 and Martin and Psachoropoulos, 1982). These studies have used the hedonic wage approach to measure the wage compensation received by manufacturing workers for facing occupational hazards. Studies by Shanmugam (1997, 2000) and Madheswaran (2007) have analyzed whether manufacturing workers in India are adequately compensated for incurring job related fatal and non fatal injury risks.

In this study, an attempt is made to estimate the wage premium received by the farm workers (pesticide applicators) in India for incurring job related health risks. This study proceeds as follows. The next section presents the conceptual framework employed in the study. The following sections explain the data, the model and the variables used in the study. Then, the empirical results are presented and discussed. The final section provides the concluding remarks and policy implications of the study.

CONCEPTUAL FRAMEWORK

The theory of compensating differentials, which was originally conceived by Adam Smith and its reconstruction of hedonic theory by Rosen (1976), forms the basis of this study. This theory develops the relationship between job characteristics and income or wage. Jobs with less desirable characteristics require a wage premium to attract workers. This is in contrast with human capital and screening models in which homogenous conditions of employment are assumed.

Adam Smith (1776) in his *Wealth of Nations* suggests that "the whole of the advantages and disadvantages of the different employments of labor and stock must, in the same neighborhood, be either perfectly equal or continually tending to equality…..The wages of labor vary with ease or hardship, the honorableness or dishonorableness of employment". If non pecuniary advantages and disadvantages of different employments are unequal, then the pecuniary rewards must be unequal in the opposite direction to preserve the equality of total advantages.

Adam Smith (1776) lists five principals of compensating non pecuniary characteristics of employment: agreeableness or disagreeableness of employment, difficulty and expense of learning, constancy or inconstancy of employment, degree of trust required and probability or improbability of success. These have inspired the development of two applied economic models, namely human capital model and hedonic wage model. While the former considers the length of training (formal schooling and informal training) as the principal compensating wage differentials while the latter focuses on quality variations in both worker and job attributes as an explanation for wage differences.

The hedonic approach treats jobs as bundles of characteristics such as working condition, and levels of job risk. Employees are described by the amount they require as compensation for different risk levels while firms (employers) are characterized by the amount they are willing to offer workers to accept different risk levels. An acceptable match occurs when the preferred choice of an employee and that of an employer are mutually consistent. Thus, the actual wage embodies a series of hedonic prices for various job attributes including job related health risk and other prices for worker characteristics.

Suppose that there are m such indicators of worker's personal and job attributes other than job risk level (p), denoted by a vector c = (c_1, c_2, …, c_m). Let w represent the schedule of earnings. Then, w (p, c) reflects the market equalizing differential function. Controlling for other aspects of the job would provide an estimate of the wage premium that workers receive for job risk. Thus the theory considers both sides of the market and examines equilibrium risk choices and either wage levels or price levels associated with these choices.

The farm's demand for labor decreases with the total cost of employing a worker. As providing greater workplace safety is costly to the farm, it must pay a lower wage to offset the cost of providing safe work environment in order to maintain the given level of profits along the iso-profit or wage-risk offer curve. Figure 1 shows wage offer curves for two farms, with wage as an increasing function of risk, OC_1 for farm 1 and OC_2 for farm 2.

The labor supply is characterized subject to several mild restrictions on preferences. With a von Neumann-Morgenstern expected utility approach with state dependent utility functions, u (w) represent the utility of a healthy worker at wage w and v (w) represent the utility of an injured person at wage w. Worker's compensation after an accident is a function of the worker's wage. We assume that the relationship between worker's compensation and wage is subsumed into the functional form of v (w) and that workers prefer health to injury, (i.e., u (w) > v(w)) and that marginal utility of income is positive (i.e., $u^{'}(w) > 0$ and $v^{'}(w) > 0$).

For any given risk level, workers prefer the wage risk combination from the market offer curve with the highest wage level. The outer envelop of these curves is the market opportunities locus w (p). That is, workers choose from potential wage-risk combinations along market opportunities locus w (p) to maximize expected utility. In figure 1, the tangency between the constant expected locus EU_1 of worker 1 and farm 1's offer curve OC_1 represents his optimal job risk choice. Worker 2 maximizes his expected utility when EU_2 is tangent to $OC_{2.}$

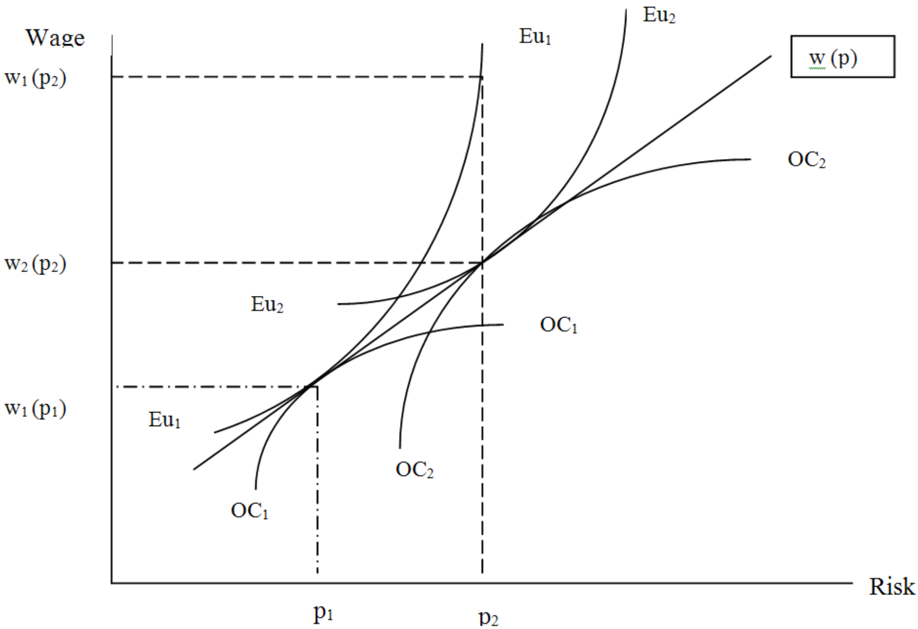

Figure 1: Wage-Risk Trade-off

All wage-risk combinations associated with a given worker's constant expected utility locus must satisfy: Z = (1-p) u (w) + p v (w) and the wage-risk trade-off along this curve is:

$$\frac{dw}{dp} = \frac{-Z_p}{Z_w} = \frac{u(w) - v(w)}{(1-p)u'(w) + p v'(w)} > 0 \qquad (1)$$

Therefore, the required wage rate is increasing in the risk level. The estimated d w/ d p is a local measure of the wag-risk trade-off for marginal changes in risk. This estimated slope is both the worker's marginal willingness to accept risk (WTA) and his marginal WTP for more safety and the farm's marginal cost of more safety and its marginal cost reduction from an incremental increase in risk. That is, it reflects the marginal supply as well as the marginal demand price of risk.

It is noted that the estimated wage-risk trade-off curve w (p) does not imply how a particular employee is compensated for non-marginal changes in risk. In figure 1, worker 2 has revealed a WTA risk p_2 at wage w_2 along EU_2. If risk exposure to employee 1 changes from p_1 to p_2, he will require a higher compensation to keep his utility constant. Thus, with large changes in risk, a worker's wage-risk trade-off will not be the same because the relevant trade-off must be made along the worker's expected utility locus not the estimated market wage-risk trade-off (Viscusi and Aldy, 2003).

Since each point on the hedonic wage function w (p) represents the slope of the expected utility curve, this function is used to estimate the welfare effect of a marginal change in job risk. If all employees have homogenous preferences, then there will be only one expected utility curve, and the observable points on the w(p) will represent the constant expected utility locus. Likewise, if all farms are homogenous, w(p) will approximate the farm's offer curve. Ideally, one needs to estimate the constant expected utility curve in order to estimate the WTP/WTA for risk reduction. However, most studies use the hedonic function as it is the locus of tangencies that is observable in the labor market data.

Since Thaler and Rosen's (1976) pioneering work, numerous studies have emerged to measure the compensating wage differentials for job risks. See Viscusi (1993) and Viscusi and Aldy (2003) for excellent surveys. Basically, the past empirical studies on the topic specify some sort of the following wage equation:

$$\text{Ln wage}_i = \alpha + \beta\, p_i + \textstyle\sum_k \gamma_k X_{ki} + \varepsilon_i \qquad (2)$$

where X is a vector of worker's personal characteristics variables (such as age and education) as well as job characteristics variables (such as type of occupation, working condition) for worker i, p_i represent the job (injury) risk faced by worker i, and ε_i is the regular random error term reflecting unmeasured factors influencing worker i's wage rate. α (a constant term), β and γ_ks are parameters to be estimated using regression analysis.

Regarding job risk, the existing studies use two alternative measures: (i) Objective measure of risk (such as probability of fatal or non-fatal risk for worker) and (ii) Subjective measure of risk (this measure utilizes a danger perception dummy indicator that takes value 1 if the worker believes that his job exposes him to dangerous or unhealthy conditions and 0 otherwise). Gerking et al (1988), Viscusi (1979), and Fairris (1989) find that self-reported riskiness of one's job is significantly and positively related to an individual's wage. Our study uses both subjective and objective measures of risk. The computations of both objective and subjective measures of risk for farm labourers are explained below.

DATA, MODEL AND VARIABLES

This study uses the data collected through a primary survey conducted in 2009-10 from 282 farm workers in Kuttanad in Kerala using multi stage random sampling technique. Kuttanad is the rice bowl of Kerala, and is stretched in three districts: Alappuzha, Kottayam and Pathanamthitta. The main rice crop of the area is known as the *punja* (summer crop) and grown in 27,000 ha. In the next stage, we selected two Community Development Blocks randomly from each of the three districts. Then two panchayats from each block were identified and from each panchayat selected, three padasekharams were chosen at random. We selected (all) 182 pesticide applicators and 100 other agricultural laborers (randomly) from the selected padasekharams. Thus, 282 sample workers were selected for the study. Mostly the pesticide applicators were local workers with this skill. During the off-season when spraying operations were limited, they engaged in other types of agricultural and non-agricultural works. The agricultural labourers engaged in farm operations such as ploughing and land preparation. They did not undertake pesticide spraying.

Data collection was done through a structured pre-tested questionnaire, by the personal interview method, and through farm diary maintained by the respondents. The data included both qualitative and quantitative attributes. Direct observations were also made wherever possible. The data set for the study consisted of three components:

i) Each applicator was contacted several times during the spraying season, which lasted for five weeks and data on the spraying details, health status after spray operations (within a period of 24 hours) etc were gathered. That is, we gathered risk-dose responses of workers based on how many times they were engaged in pesticide applications. Although the number of dose-response details for individual workers varied, on an average for each respondent 6.41 dose available and the total data set included 1166 observations;
ii) During off-season each of 182 applicators undertook wage labor in farms or other sectors. They were contacted during the off-season to gather the data from them. This forms an additional 182 observations; and
iii) Data from 100 agricultural laborers were collected once.

Thus, there are 1448 sample observations in the data set: (i) 1166 from pesticide applicators during the spraying seasons, (ii) 182 from pesticide applicators during off season, and (iii) 100 from agicultrual workers not handling pesticide. Since pesticide application is a skilled work, only male workers did the job. Majority of agricultural workers surveyed were also males. 53 percent of sample workers were in the age group of 50-60 and 38.6 percent in the 40-50 age group. While a few respondents in the applicator group were graduated, most others completed only high school education and below.

Pesticide application is of shorter duration than any other wage labour in the agricultural and non-agricultural sectors (Table 1). The average work hour is 4.19 hours a day. In other cases it varies between 5.71 hours to 10 hours, averaging at 6 hours. Pesticide applicators are paid nearly twice the wages in the agricultural sector on an hourly basis. While the payment for the former is Rs 64.27 per hour, the latter is paid only around Rs.39.15 per hour. Although payments are slightly higher in non agriculture sector, it is not as high as in pesticide application work. However, for the coconut climbing work, which is a risky job, the average wage is Rs. 54.71. The wages for weeding and transplanting activities which are generally undertaken by women workers average at a low Rs.125/day but the working hours and drudgery are more.

Table 1: Wage Rate of Farm Workers in Kuttanad Area

Sl. No.	Type of work	Average Wage Rate		
		Rs/day	Rs/hr	hours/day
I. AGRICULTURAL				
1	Pesticide application (M)	269.32	64.27	4.19
2	Other works in rice fields (M)	241.29	39.15	6.16
3	Transplantng (W)	125	19.23	6.50
4	Weeding (W)	125	19.33	6.47
5	Coconut climbing (M)	312.5	54.71	5.71
6	Fishing (M/W)	230	34.52	6.66
7	Rubber tapping (M)	287.5	40.42	7.11
II. NON AGRICULTURAL				
1	Coolie (M)	251.09	39.6	6.34
2	Electrical works (M)	300	43.68	6.87
3	Plumbing (M)	250	41.67	6.00
4	Construction (M)	250	41.67	6.00
5	House maid (M)	100	12.5	8.00
6	Other service sector jobs (M)	250	40.32	6.01

Note: M: Man & W: Woman.

In this study, the extent of compensating differential for agricultural workers is investigated using an earnings equation of the following form:

$$W = \beta_0 + \beta_1 \text{ RISK (or CHEMICAL)} + \beta_2 \text{ AGE} + \beta_2 \text{ AGE}^2 + \beta_3 \text{ EDU1} + \beta_4 \text{ EDU2} + \beta_5 \text{ MITIGATION} + \beta_6 \text{ SMOKE} + \beta_7 \text{ TOBACCO} + \beta_8 \text{ HI} + \beta_9 \text{ TEMPR} + \beta_{10} \text{ WORK} + \varepsilon_i. \quad (3)$$

where, W - hourly wage rate (in Rs.). RISK is a subjective measure of risk; it is a dummy indicator that takes value 1 if the worker believes that his job exposes him to dangerous or unhealthy conditions (such as sickness after pesticide spray operation) and 0 otherwise. CHEMICAL is an alternative risk measure; it is the amount of chemical dose handled; it is measured as: CHEMICAL=(Quantity of formulation applied X concentration of the formulation)/volume of water.

AGE represents the age of the worker in completed years. EDU 1 and EDU 2 are dummy indictors for education levels of workers (i.e., up to 4 years and 5-7 years of education respectively). MITIGATION is a dummy indicator, taking value 1 if worker has adopted any of the personal protective gadgets and 0 otherwise. SMOKE and TOBACCOR are dummy indictors for whether worker has smoking habits and chews tobacco. TEMPR is the atmospheric temperature (^{0}c) during the spraying period. HI is the Body Mass Index (=Wt / Ht^2 x 100) and WORK is a dummy indicator to show whether the worker applies pesticides or not. The model parameters βj's are estimated using the Ordinary Least Square Method. The descriptive statistics of the study variables are shown in Table 2.

Tabel 2: Descriptive Statistics of the Study Variables

Variables	Definition	Mean	Std.Dev
WAGE	Computed hourly wage rate (Rs.)	64.2706	69.220
RISK	Health Risk Dummy Variable: 1 if worker answered yes to sick after spraying pesticides; 0 otherwise	0.70373	0.457
CHEMICAL	Chemical dose handled*	335.016	494.462
AGE	Age of the respondent in years	45.5318	9.175
EDU1	Education dummy variable: 1 if up to 4 years of schooling; 0 otherwise	0.14434	0.352
EDU2	Education dummy variable: 1 if 5-7 years of schooling; 0 otherwise	0.51588	0.500
EDU3	Education dummy variable: 1 if 8-10 years of schooling; 0 otherwise	0.32113	0.467
EDU4	Education dummy variable: 1 if more than 10 years of schooling; 0 otherwise	0.01865	0.135
MITIGATI ON	Mitigation dummy variable: 1 if worker has adopted any of the personal protective gadgets; 0 otherwise	0.55471	0.497
SMOKE	Smoking habits dummy variable: 1 if worker is a smoker; 0 other wise	0.54075	0.499
TOBACCO	tobacco chewing habit dummy variable: 1 if worker chews tobacco; 0 otherwise	0.04765	0.213
ALCOHOL	Alcohol consumption dummy variable: 1 if worker drinks alcohol; 0 otherwise	0.23964	0.427
HI	Body mass index (=Wt x Ht^2 * 100)	21.8282	2.170
WORK	Occupational dummy variable; 1 if pesticide application work; 0 otherwise	0.78384	0.412
TEMPR	Temperature	33.3647	0.756
N	Number of Observations	1448	

* It is defined as the ratio between (quantity of formulation applied x concentration of the formulation) and volume of water.

EMPIRICAL RESULTS

We have used WAGES in its absolute form and its Log form in alternative specifications as in past studies. The empirical results without WORK variable (specification 1) and with WORK variable (specification 2) are presented in Tables 3 and 4 respectively. Column (1) of Table 3 shows the OLS estimation results of semi-log wage equation (i.e., in this column the dependent variable is the natural log of hourly wage rate). One of the human capital variables, age and its square are not statistically significant at 5 percent level. But the two education dummies are positive and statistically significant at 5 percent as predicted by the human capital theory.[1] The returns for workers with education 5-7 are higher than the returns for workers with education below 5 years as per the expectation of the human capital theory. As expected, the mitigation dummy is associated with a negative and significant coefficient, indicating that workers with adequate care (i.e., using personal protective gadgets) receive less wage compensation than workers without care. The implicit meaning is that usage of private gadgets ensures safe work environment and so less wage compensation.

[1] However, it is noted that the left out (reference or base) group is workers with above 7 years of schooling. The results reveal that compared to agriculture workers with more than 7 years of schooling, the workers with less than 7 years of schooling receive more returns for their education. This result implies that workers with less education are more productive in the agriculture job than workers with more education, because the job option are rather low.

Table 3: Regression Estimates of Hedonic Wage Equations

(Specification 1)

Variables	Log Wage (1)		Wage (2)		Log Wage (3)		Wage (4)	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	1.3130	1.711	-95.2282	-1.126	0.8818	1.121	-126.4640	-1.471
RISK	0.2803*	8.001	21.2272*	5.498	-	-	-	-
CHEMICAL	-	-	-	-	0.0001*	3.407	0.0082*	2.229
AGE	-0.0012	-0.091	-1.2672	-0.868	0.0086	0.638	-0.5309	-0.361
AGE SQUARE	0.0000	-0.113	0.0089	0.548	-0.0001	-0.875	0.0003	0.018
EDU1	0.1201**	2.345	16.3788*	2.902	0.1141**	2.177	15.8297*	2.766
EDU2	0.2010*	5.256	18.2449*	4.327	0.2146*	5.473	19.2033*	4.484
MITIGATION	-0.0015*	-4.939	-0.3449*	-10.468	-0.0014**	-4.448	-0.3353*	-10.107
SMOKE	-0.0122	-0.372	-5.7528	-1.596	0.0321	0.978	-2.4051	-0.670
TOBACCO	-0.3641*	-4.789	-21.6802*	-2.587	-0.3983*	-5.154	-24.2668*	-2.875
HI	0.0072	0.903	-1.1180	-1.276	0.0114	1.386	-0.8197	-0.915
TEMPR	0.0678*	3.268	5.9695*	2.609	0.0759*	3.588	6.5626*	2.840
R Square	0.1087		0.1140		0.0765		0.0985	
F	17.5300		18.4900		11.9000		15.7000	
N	1448		1448		1448		1448	

* Significant at 1% level
** Significant at 5% level

The two workers' personal habits variables-SMOKE and TOBACCO are having negative parameters. But only the coefficient of TOBACCO is statistically significant. This means that the wages for workers with the habit of chewing tobacco (or smoking) are less than workers without the habit. This result is interesting as it reveals that workers with these habits are risk lovers or less risk averter so that they demand less or no compensation for occupational hazards. The health index variable is associated with a positive coefficient, indicating that healthy workers are more productive and receive higher wages. But this result is not support by t ratio. The temperature variable is also associated with a positive coefficient and it is statistically significant at 1 percent level. This implies that workers pose higher health risk while under hot sun demand higher wages as per the expectation of the compensating differential theory.

The variable of interest is RISK (it is a subjective measure). It influences the wage rate positively and significantly, indicating that workers on jobs which they perceive as being dangerous (lead to sickness) earn an earnings premium of Rs. 18.02 per hour.[2] Column (2) of Table 3 shows the OLS estimation results of wage equation (i.e., in this column the dependent variable is the absolute amount of hourly wage). The results of non risk variables are more or less the same as indicated in Column-1. The RISK variable is positive and statistically significant at 1 percent level of significance. The estimated coefficient implies that the workers who perceive job hazards are getting an additional compensation of Rs. 21.23 per hour.

Columns (3) and (4) of Table 3 show the results of log wage and wage equations with an alternative risk measure, CHEMICAL. In both Columns, results of non risk variables are more or less similar to what was shown in Column-2. In both columns, the risk variable CHEMICAL has a positive and significant coefficient at 5 percent level. The results indicate that workers receive 2 paise per hour for using one extra percent of chemical dose (Column-3) and 3 pasie per hour (Column-4).

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[2] It is noted that since the dependent variable is in log form, the wage-risk premium is computed by: $\partial Y / \partial RISK = \beta_1$ Mean Wage.

Table 4: Regression Estimates of Wage Equations

(Specification 2)

Variables	Log Wage		Wage		Log Wage		Wage	
	(1)		(2)		(3)		(4)	
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio
Constant	1.5098**	2.074	-86.1390	-1.027	1.6726**	2.266	-87.0519	-1.023
RISK	0.1328*	3.774	14.4169*	3.555	-	-	-	-
CHEMICAL	-	-	-	-	-0.0001***	-1.769	-0.0005	-0.127
AGE	0.0047	0.376	-0.9931	-0.685	0.0083	0.663	-0.5428	-0.374
AGE SQUARE	-0.0001	-0.554	0.0061	0.378	-0.0001	-0.899	0.0005	0.034
EDU1	0.2257*	4.581	21.2602*	3.745	0.2189*	4.416	21.0519*	3.685
EDU2	0.1818*	5.006	17.3552*	4.148	0.1698*	4.612	16.9699*	3.999
MITIGATION	-0.0013*	-4.751	-0.3390*	-10.370	-0.0013*	-4.431	-0.3308*	-10.096
SMOKE	-0.0242	-0.781	-6.3095***	-1.765	-0.0103	-0.334	-4.5207*	-1.271
TOBACCO	-0.2396**	-3.292	-15.9292***	-1.900	-0.2326*	-3.177	-16.0056***	-1.897
HI	0.0163*	2.157	-0.6946	-0.796	0.0151**	1.970	-0.6328	-0.715
TEMPR	0.0427*	2.159	4.8096**	2.110	0.0384***	1.923	4.6930**	2.040
WORK	0.5112*	12.695	23.6161*	5.090	0.5874*	14.362	29.2756*	6.209
R Square	0.1987		0.1297		0.1925		0.1221	
F	32.36		19.46		31.11		18.15	
N	1448		1448		1448		1448	

* Significant at 1% level; ** Significant at 5% level; *** Significant at 10% level

Table 4 shows the OLS results of wage equations which additionally include WORK variable (specification 2), which is dummy indicator for whether worker handles pesticides or not. In Columns (1) and (2), RISK variable is used. The results of other non risk variables are more or less the same as in respective Columns in Table 3 except that the health index (HI) variable turns to be significant. The risk variable is positive and statistically significant at 1 percent level in both Columns. The results indicate that workers receive an additional compensation of

Rs. 8.54 per hour (Column-1) and Rs. 14.42 per hour (Column-2) for facing occupational hazard. In Columns (3) and (4), the CHEMICAL variable turns out to be insignificant. This may be due to high correlation with WORK variable. This variable is positive and highly significant in all four Columns indicating that workers handling pesticides receive significantly higher wages than their counterparts who do not handle it.

Finally we can compare our results with the results in Madheswaran (2004) which estimates that workers in manufacturing firms receive a positive compensating wage differential of Rs. 2.33 per hour for job related health risks (subjective measure) in Chennai district in Tamil Nadu and Rs. 3.92 per hour in Mumbai district of Maharastra in India in 2001 prices. In our study he farm workers receive Rs. 8.54 per hour as compensation in 2009 prices.

CONCLUSION AND POLICY IMPLICATIONS

The health risks associated with farm labour involve both morbidity and mortality, in the short and long run. The short term morbidity risks associated with pesticide application works is estimated to be significant and the higher wages enjoyed by these workers are justified. Earlier studies have reported higher risk level associated with more toxic chemicals and there is no differential wage rate for spraying chemicals of varying toxicity level. This is the contribution of the study which has estimated that farm workers receive approximately 75 paise per hour for a 100 percent increase in the chemical dosage they handle.

Better awareness may lead to a market signal of higher wages for more toxic chemicals, which can act as an economic instrument to restrict the use of such chemicals. We find that the use of protective gadgets reduces the risk of health damage, which emphasizes the necessity for ensuring the use. Better health conditions and safe personal habits also minimize the chances of morbidity. Higher temperature levels increases the chances of health damage and so workers demand higher wage for this risk.

These results highlight the need for creating better understanding on the importance of adopting scientific practices in handling the pesticides and a mechanism to ensure the adoption and monitoring. The labour welfare programme should include the health insurance scheme specifically designed for these groups of workers and health monitoring system to ensure their safety.

In developing countries the safety arrangements are so poor that many accidents occurring during work are due to the nature of work (handling of machines, dangerous chemicals, animals) or unhygienic work environment and poor sanitary arrangements. More importantly the major victims of the indiscriminate use are the vulnerable sections of the population who ignore health hazards, either due to lack of awareness or financial factors. Considering the importance of promoting the welfare of village dwellers, in the wider interest of whole human kind the 16th International Congress on Rural Health approved the "Lodi Declaration on Healthy Villages" in 2006. Their approval launched the Global Movement on Healthy Villages, an official campaign of World Health Organisation (WHO). Similarly, International Labour Organization has launched a training programme for improving the safety and health of farmers. Work Improvement in Neighbourhood Development (WIND) is becoming popular in many countries. It basically involves participatory training support to farmers through farm visits, checklist exercises and group discussions. The aim is to improve the understanding on the importance of healthy environment and provide knowledge on farming activities that ensure the same. There should be an initiative from the part of concerned departments to extend the WIND programme in all villages so that the larger goal of healthy villages can be attained.

REFERENCES

Adam Smith (1776), "The Wealth of Nations", Reprint Ed., New York: Modern Library.

Atreya, Kishore (2007), "Pesticide Use Knowledge and Practices: A Gender Differences in Nepal", *Environmental Research*, vol 104, pp. 305-11.

Brown, C. (1980), "Equalizing Differences in the Labor Market", *Quarterly Journal of Economics,* 94(1), pp. 113-134.

Cousineau, Jean-Michel, Robert Lacroix and A.M. Girard 1992. "Occupational Hazard and Wage Compensating Differentials", *Review of Economics and Statistics*: 166-69.

Devi, P.I(2007), "Pesticide Use in the Rice Bowl of Kerala: Health Costs and Policy Options", Working Paper. No.20. *South Asian Network for Development and Environmental Economics*, Kathmandu, Nepal.

Fairris, D. (1989), "Compensating Wage Differentials in the Union and Nonunion Sectors", *Industrial Relations* 28(3), pp.356-372.

Fernandez,I.(2006), "Memorandum to Keep the Ban on Paraquat". http://geeklog.teneganita.net/article.php?story=20050422171701740 2005. *Asian- Pacific Newsletter on Occupational Health and Safety*, 14, pp.60.

Gerking, Shelby, M.De Haan and William Schulz (1988), "The Marginal Value of Job Safety: A Contingent Valuation Study", *Journal of Risk and Uncertainty*, (2), June 185-99.

Navamukundan,A.(2005), "Malaysia Goes for Tripartism on Safety and Health". http://www.ilo.org/public/english/dialogue/actror/publ/126/navapdf. In Occupational safety and health challenges in agriculture in Malaysia, Hamedon,T.R. *Asian- Pacific Newsletter on Occupational Health and Safety*. 14, pp.58.

Madheswaran, S. (2007), "Measuring Value of Statistical Life: Estimating Compensating Wage Differentials among Workers in India", *Social Indicators Research*, vol. 84, p.83-96.

Marin, Alan and George Psacharopoulos 1998 "The Reward for Risk in the Labor Market: Evidence from the United Kingdom and a Reconciliation with Other Studies", *Journal of Political Economy* 90(4): 827-53.

Meng, Ronald (1989), "Compensating Differences in the Canadian Labor Market", *Canadian Journal of Labour Economics,* 22, pp.413-24.

Pingali, P.L. and P. A. Roger (1995), " Impact of Pesticides on Farmer Health and the Rice Eco-System", *Kluwer Academic Publishers*, Boston, Massachusetts, U.S.A.

Rosen (1976), "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition", *Journal of Political Economy*, 82, 34-55.

Shanmugam, K.R. (1997), "Compensating Wage Differentials For Work Related Fatal Injury Accidents", *The Indian Journal of Labour Economics,* 40(2), pp.251-262.

Shanmugam, K.R. (2000), "Valuation of Life and Injury Risks", *Environmental and Resource Economics,* 16, pp.379-389.

Suke, L. K., Ran, K. K., Chul, K.Y and Soo, K.K.(2007),"Governmental Intervention of the Republic Of Korea in Agricultural Health and Safety". *Asian- Pacific Newsletter on Occupational Health and Safety*.14,pp.66.

Thaler, R. and S. Rosen. (1976), "The Value of Saving a Life: Evidence from the Labor Market". In N.E. Terleckyj (ed.), Household Production and Consumption". New York: Columbia University Press, pp. 265-300.

Viscusi,W.K.(1979), "Employment Hazards: An Investigation of Market Performance", *Cambridge University Press.*

Viscusi, W.K. (1993), "The Value of Risks to Life and Health". *Journal of Economic literature,* 31(4), pp.1912-46.

Viscusi, W. Kip and Joseph E. Aldy (2003), "The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World", *Journal of Risk and Uncertainty* 27,pp. 5-76.

Wang, S.(2007), "Occupational Safety and Health Challenges in Agriculture in China", *Asian- Pacific Newsletter on Occupational Health and Safety,* 14, pp.60.

Wilson, Clevo (2002), "Pesticide Avoidance: Results from a Sri Lankan Study with Health Policy Implications", in Darwin C. Hall, L. Joe Moffitt (ed.) *Economics of Pesticides, Sustainable Food Production, and Organic Food Markets (Advances in the Economics of Environmental Resources, Volume 4)*, Emerald Group Publishing Limited, pp.231-258.

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