

## COMPENSATING WAGES OF AGROCHEMICAL EXPOSURE RISKS OF COCOA FARMWORKERS

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### Abstract

*Occupational risk is a major factor reducing productivity of farm workers as it impairs their physical capacity and increase their vulnerability to ill health, diseases and injuries. Agrochemical exposure risk has been attributed to work demand and unhealthy work environment that these workers are subjected to which they are often not compensated. Consequently, this study estimated the compensating wages of life quality for agrochemical exposure risks of cocoa farm workers in Idanre Local Government Area, Ondo State, Nigeria. Multistage sampling technique was used to select 180 cocoa farm workers while data on factors affecting agrochemical exposure risks. Data were analyzed using descriptive statistics and linear hedonic regression. Linear hedonic regression revealed that temperature ( $\beta = 5.02$ ), health index ( $\beta = 9.65$ ) and participating in agrochemical spraying ( $\beta = 44.71$ ) had positive and significant ( $p < 0.05$ ) influence on compensating wages while smoking ( $\beta = -41.77$ ) and use of personal protective gadgets during spraying ( $\beta = -31.67$ ) had negative and significant ( $p < 0.05$ ) influence. Cocoa farm workers received ₦75.00k per day as the compensation for incurring occupational risks. The study concluded that appropriate use of personal protective equipment minimizes agrochemical exposure risks. It was therefore recommended that educational programs that will enhance farmer's knowledge, skills and attitude to adopt safety measures in pesticide usage should be adequately planned.*

**Key words:** compensating wages, cocoa farm-workers, hedonic wage approach

### INTRODUCTION

Cocoa is the one of the main cash crop that contributed eminently to Nigeria's economy.

Though Nigeria foreign exchange earnings came from crude oil, yet cocoa remains the Nigeria's highest foreign exchange earning among all agricultural commodities, of which the country is the fifth largest exporter of Cocoa in the world [19].

Nigeria export earning on cocoa in the last 20 years has drastically reduced. Within the 60s Nigeria produced about 540,000 tonnes of cocoa annually and was the second largest producer of the crop in the world [26]. In the 70's cocoa output reached 308,000 tonnes [1]. However, cocoa output in recent years ranges between 185,000 and 215,000 tonnes [19].

Previous authors has stated that overdependence on crude petroleum as the Nigerian source of foreign exchange, small

farm holdings, low yield, inconsistent production pattern, disease incidence, pest attack and climate change are the key factors decreasing cocoa production in Nigeria. [17,18].

In Nigeria cocoa is the most valuable cash crop among farmers in the major producing areas. About 20 million people depend directly on cocoa for their livelihood, 90% of the productions are exported in the form of beans or semi-manufactured coca products [25].

Compensating Wages is the extra income that a given worker must be offered in order to motivate them to accept given undesirable job, relative to other workers in other occupations [22]. Compensating wages is the difference in wages offered to offset the desirability or undesirability of a job. If the job is considered unwanted because of elements of risk, the differential is positive in

the form of increased wages to offer incentives to the employee to take the job [11]. If the job is considered desirable, the differential is negative in the form of lower wages.

Occupational risk can be described as a condition surrounding a work environment or state of a work environment that increases the likelihood of death, illness or disability to a worker while hazard is defined as the native property of a substance or process that could cause injury or damage [30].

Farm can be source of life-threatening [14], farmers experience many fatal injuries happen to them when working with familiar equipment on the field. While doing tasks that they have been performing for years. Quick and chronic illness of farm workers and family members are caused by harmful agricultural materials like pesticides, herbicides, flammable liquids and other solvents and farm mechanization such as tractor, plough and other mechanized equipment make the farm works easier and increase the output of the farm. However, mechanization has contributed to severe injuries in agriculture significantly to the health risks [14].

In many countries, the use of agrochemical is highly regulated. Occupational risks are injuries that occur at the location of a person's employment which can include exposure to chemicals or other substances as well as accidents. Occupational accidents, work injury, work-related injury are other names for occupational injuries. The main cause of occupational injuries is the result of exposure to harmful agents usually toxins, gases, inhalants, etc. while working [5].

The World Health Organization (WHO) and the United Nations Environmental Programme (UNEP) estimated that one to five million cases of pesticide poisoning occur among agricultural workers each year with about 20 000 fatalities [30].

Agrochemical exposure risk can be measures by:

(i)Objective measure of risk is the measurement of the likelihood of fatal or non-fatal injury of the worker.

(ii)Subjective measure of risk this measure use of danger perception (occurrence of risk) dummy indicator that takes the value 1 if the worker believes that his job exposes him to harmful or unhealthy conditions and 0 otherwise). [27] Revealed that self-reported riskiness of one's job is considerably and positively related to an individual's wage. Subjective measures of risk were used for the study.

Main constraints of cocoa production are cocoa mass spraying programme, merged with a powerful increase in fertilizer use [28]. The cocoa sector continues to face problems such as occupational risks, inadequate storage facilities, pest and diseases, and child labour issues [15].

Occupational risk is a major factor reducing productivity of farm workers as it impairs their physical capacity and increase their vulnerability to ill health, diseases and injuries [16]. This study was carried out to estimate the expected compensating wages received by the workers incurring job related health risk and Identify factors causing agrochemical exposure.

## MATERIALS AND METHODS

### Study Area

The study was carried out in Ondo State, Nigeria. Ondo state is within the south-western part of Nigeria with its capital at Akure. The state lies entirely in the tropics, with the longitude of 4<sup>0</sup>E and 6<sup>0</sup>E of the Greenwich Meridian and latitude 5<sup>0</sup>N and 8<sup>0</sup>North of the Equator. Ondo state is bounded by Ekiti and Kogi State in the north; Edo State in the east; Ogun and Osun States in the west and the Atlantic Ocean in the south [24]. The state has an estimated population of 4,724,870 according to the Nigerian 2006 National Census [8] and covers an area of 14,793km<sup>2</sup>. The state made up of 18 Local Government Areas (LGAs).

Agriculture is the main source of income of the Ondo state and about 65% of the state labour force depends on agriculture as the main occupation [9]. Ondo State is the largest cocoa producing state in Nigeria; produce about 50% of Nigeria's annual cocoa

production [2]. Other cash crops like oil palm and rubber are produced in large scale in the state. Maize, yam and cassava and others food crops are also produced in large quantities. The state is also blessed with very rich forest resources where indigenous and exotic timber species in Nigeria abound. Idanre Local Government Area is Nigeria's largest cocoa producing area [4]. Idanre Local Government Area covers an area of 1,914km<sup>2</sup> and a projected population of 177,183 [8] the Local Government Area is bounded to the north-west by Ondo east and ile-oluji/oke-igbo local government, to the north-east by Ifedore, Akure South and Akure North local government areas.

Multistage sampling technique that guaranteed cocoa farmers who could provide desired information on the basis of the objectives of the study was adopted in selecting respondents. The first stage was the purposive selection of Idanre Local Government Area as the Nigeria's leading cocoa producing area.

The second stage is the random selection of 12 communities/villages namely Oke-idanre, Baale-ojumu, Owomofewa, omilifon, Apomu, Ala-Elefosan, Owena, Atosin, Arapa, Obatedo, Apefon and Iramuje were selected for the study from the selected LGA. The last stage is the random selection of 15 cocoa laborers working with cocoa farmers from each village. Making a total sample size of one hundred and eighty (180) respondents.

The use of primary data was employed for this study. Primary data was collected from cocoa farm workers through the use of structured interview schedule or guide, data collected was on socioeconomic characteristics such as age, sex, marital status, level of education, Farming experience, etc. Pattern of payment questions was collected to estimate the compensating wage received by the respondents,

Data for this study was analysed with both descriptive and econometrics techniques, the descriptive techniques that was employed include; frequency counts, percentages, means and standard deviation, was used to analysed factors causes of agrochemical exposure, various human factors leads to the pesticides

exposure risk and the parameters that was described are residue violation, illiteracy and ignorance, lack of awareness of personal protective equipment, smoking habit etc The econometric techniques was employed Ordinary Least Square(OLS) regression analysis to estimate expected compensating wages received by cocoa farm workers.

$$W_i = \alpha + \beta p_i + \sum_k \gamma_k X_{ki} + \varepsilon_i \quad \dots\dots\dots (1)$$

[27] Specified that where:

X = worker's personal characteristics variables (such as age, education, wearing of personal protective gadget and smoke) and job characteristics variables (such as temperature and agrochemical participation) for worker 'i',  
 pi = job (injury and or fatal) risk faced by worker 'i', and

ε<sub>i</sub> = Disturbance or error term reflecting unmeasured factors influencing worker i's wage rate.

α = Constant term,

β and γ<sub>k</sub> = parameters to be estimated using regression analysis,

This model follow [5] specification that β is a parameters to be estimated using regression analysis. Agrochemical exposure risk (fatal and non-fatal) is an objective measure of risk:

$$W = \alpha + \beta_1 \text{Risk} + \beta_2 \text{Age} + \beta_3 \text{Education} + \beta_4 \text{Wearing of personal protective gadget} + \beta_5 \text{Smoke} + \beta_6 \text{Temperature} + \beta_7 \text{agrochemical participation} + \beta_8 \text{Body health mass index} \dots\dots\dots(2)$$

where:

W = Daily wage rate (₦)

X<sub>1</sub> = Risk (1= workers expose to dangerous conditions or unhealthy, 0= otherwise)

Risk is a subjective measure of risk; it is a dummy variable indicate that worker believes that his job exposes him/her to dangerous or unhealthy conditions (such as sickness after pesticide spray operation)

X<sub>2</sub> = Age of the workers (Years)

X<sub>3</sub> = Level of education (Years)

X<sub>4</sub> = Wearing of personal protective gadget (1= Use of Personal Protective Equipment during spraying, 0= otherwise)

X<sub>5</sub> = Smoke (1= smoking during pesticide application, 0= otherwise)

X<sub>6</sub> = Temperature (atmospheric temperature °C during spraying period)

X<sub>7</sub> = agrochemical participation (1= participating in agrochemical spraying, 0 = otherwise)

X<sub>8</sub> = Body mass index = (Wt/Ht<sup>2</sup> x 100).

[6] Specified that

**Compensating wage = coefficient of risks (β<sub>1</sub>) ..... (3)**

## RESULTS AND DISCUSSIONS

### Factors Causing Agrochemical Exposure are:

- (a) Permissible residue violation
- (b) Illiteracy and ignorance
- (c) Lack of awareness of personal protective equipment
- (d) Smoking Habit

#### *Permissible residue violation*

Table 1 shows majority of the respondent (57.8%) violated the residue prescriptions, while 42.2% did not violate the chemical residue. toxic nature of some pesticide, deposits residues on the plant and the residues are dangerous to the consumption of the farmer and his environment. Since cocoa serve as a major cash crop used in foreign exchange, non-compliance with the stated rule and regulations, overuse and too frequent applications of the chemical become potential source of danger, injury or harm to the applicator and the environments.

Good Agricultural Practice (GAP) revealed that Maximum Residue Levels are the maximum concentration of pesticide residue expressed as milligrammes of residue per kilogramme likely to occur in or on food and feeding stuffs after the use of pesticides. [7] highlighted that Residue may be violated when the pesticide applicator failed to apply agrochemical in line with the recommendation label on the product such as application rate, number of applications, formulation, timing and pre-harvest interval.

Table 1. Factors Causing Agrochemical Exposure

Variables	Frequency	Percentage
Residue Violation		
Yes	104	57.8
No	76	42.2
Total	180	100
Reading Instruction		
Yes	20	11.1
No	160	88.9
Total	180	100
Awareness of Protective Equipment		
Yes	63	35
No	117	65
Total	180	Total
Smoking Habit		
Yes	44	24.4
No	136	75.6
Total	180	100

Source: Field Survey, 2019.

#### *Illiteracy and ignorance*

Table 2 shows that majority of the farm workers were unable to read the instructions written on pesticides containers, because most of the farmers are illiterate. 11.11% of the respondents can always read instructions written on the containers while 88.9% report that they sometimes read the instruction and sometimes did not. This result supports the findings of [12], that pesticides bottle labels where helpful to the farmers;

This result corroborates with the findings of [3] and [23] that ignorance among cocoa farmers about the health risks caused by the usage of high dosage of agrochemical. In accordance with findings [13] that it's a difficult task for illiterate farmers to comprehend with written instructions on agrochemicals and unable to access other useful information or details unless it is imparted verbally or through some practical demonstration.

#### *Lack of awareness of personal protective equipment*

Majority of the cocoa farm workers (65%) in the study area not aware of PPE while 35% are using protective equipment. Respondent that are not compliance with wearing of protective gear can be easily expose to pesticide toxicity, the exposure can occur through the mouth(oral), inhalation (respiratory), skin(dermal), and eyes(visual). [5] highlighted that human exposure to agricultural pesticides may be through

ingestion (oral), inhalation (respiratory), skin (dermal), and eyes (visual). The implication of this is that the cocoa farmers prone to experiencing health symptoms such as skin irritation, respiratory disorder and redness of eyes among others due to their exposures to pesticides. Respondents were asked about their use of Personal protective equipment (gloves and masks) and more than half did not use, while few always use PPE to protect themselves from direct pesticide exposure. Therefore, uneducated farmers may not serious with wearing of personal protective equipment (PPE). This conform the findings of [21] that compliance with usage of personal protective equipment during application of Actara26WG, Ridomil and Nordox75WP was very low among some field crop farmers.

#### **Smoking Habit**

The data in Table 1 indicate that 24.4% of the respondents smoke during pesticide application, while 75.6% answer that never smoke during pesticide application. The practice of smoking while spraying agrochemicals was also reported among cocoa farmers. This is quite risky because it increases the likelihood of direct oral ingestion of agrochemicals. [5] Highlighted that exposure of farm workers to agrochemicals increases when the basic recommendation of properly washing hands after spraying or before eating is not observed.

#### **Protective Equipment Used by Cocoa Farm Workers**

Majority of the respondents (65%) does not used hand glove, 35% of the respondents wear hand glove, nose guide (4.4%) and eye cover (6.7%) during application of agrochemicals. 54% of the respondents wear boot to farm while 44% of the workers did not wear farm boot. This is in line with the findings of [19] that 65% of farmers in Nigeria do not use Personal Protective Equipment (PPE) in their farming activities. The absence of nose guide, hand gloves and eye cover usage among farm workers may lead to high incidence of headache, severe fever, skin rashes/irritation, chemical inhalation and spillage on their bodies.

Table 2. uses of Personal Protective Equipment

Personal Protective Equipment	Frequency	Percentage
Foot protection	97	53.9
Eye cover	12	6.7
Hand glove	63	35
Nose cover	8	4.4
Total	180	100

Source: Field Survey, 2019.

#### **Estimation of Compensating Wages Received by Farm Workers incurring job-related Health Risk**

Compensating wages is the difference in wages offered to offset the desirability or undesirability of a job. If the job is considered unwanted because of elements of risk, the differential is positive in the form of increased wages to offer incentives to the employee to take the job. If the job is considered desirable, the differential is negative in the form of lower wages.

Multicollinearity was not a problem given the low value 1.04 of the computed Variance Inflation Factor (VIF) [29]. R-squared indicated that 50.1% variation in estimation of compensating wages was jointly explained by the significant explanatory variables. The probability of F showed that the variables in the model are fit to explain the estimation of compensating wages. The Ramsey Reset Test revealed that the null hypothesis of specification error was rejected; this implies that the model was rightly specified.

Table 3 shows the results of estimation of compensating wage, which revealed that Age is positive ( $p < 0.1$ ), Education is positive ( $p < 0.01$ ) this result supports the findings of [6] that the returns of workers with lesser education in agricultural job is higher than the returns for workers with higher education. This implied that workers with less education are more productive in the agriculture job than workers with more education, because the job options are rather low.

WEARING OF PPE is associated with a negative ( $p < 0.05$ ), indicating that workers with adequate care receive less wage compensation than workers without care. The implicit meaning is that usage of personal



protective equipment ensures safe work environment and so less wage compensation. The workers' personal habits variables Smoke having negative parameters ( $p < 0.05$ ). This means that the wages for workers with the habit of smoking are less than workers without the habit. The result shows that workers with smoking habits are risk lovers or risk takers so that they demand less or no compensation for occupational hazards. This is in line with the findings of [27], that smokers are more likely to take risks or get injured than non-smokers. Temperature variable is also associated with a positive coefficient ( $p < 0.05$ ). This implies that

working under hot sun will pose workers into health risks. Such workers supposed to demand higher wages as per the expectation of the compensating differential theory. Health index variable is associated with a positive coefficient but not significant indicating that healthy workers with high wages are more productive, but this result is not supported by t-value. The variable of interest is RISK. It influences the wage rate positively ( $p < 0.01$ ), indicating that workers on jobs which they perceive as being dangerous (lead to sickness) earn an earnings premium ₦75 per day.

Table 3. Regression Estimation of Wage Equations

WAGE	Coeff	Std. Err.	t-value	p>t
Constant	902.6092***	332.5037	2.71	0.007
AGE	0.933146	1.019236	0.92	0.361
EDUCATION	1.045793**	0.402493	2.59	0.011
RISK	74.79754***	26.80494	2.8	0.006
TEMPERATURE	5.017797**	2.016404	2.5	0.013
HEALTH INDEX	9.208049	8.371428	1.10	0.273
WEARING PPE	-31.66634**	13.52674	-2.34	0.022
SMOKE	-41.78657**	20.90020	-2.00	0.045
R-squared	0.501			
F-value	4.30			
P>F	0.3412			
Mean VIF	1.04			
Ramsey Reset Test	0.413			

Source: Field Survey, 2019.

\*\*\*, \*\* and \* significant at 1%, 5% and 10% respectively

### Estimation of Compensating wages Received by Farm Workers handles pesticide

Multicollinearity was not a problem given the low value 1.05 of the computed Variance Inflation Factor (VIF) [29]. R-squared indicated that 60.5% variation in estimation of compensating wages was jointly explained by the significant explanatory variables. The probability of F showed that the variables in the model are fit to explain the estimation of compensating wages. The Ramsey Reset Test revealed that the null hypothesis of specification error was rejected; this implies that the model was rightly specified.

Table 4 shows the estimation results of wage equation which additionally include Agrochemical participation variable, which is dummy indicator for whether worker participating in agrochemical spraying or not.

Age is positive statistically significant ( $p < 0.05$ ). This result support the findings of [10] that age of the farmers have to do with the longer history of agrochemical exposure and have a generally lower health status especially if they have suffered from sickness or illnesses caused by pesticide exposure.

Health Index variable is associated with a positive coefficient and statistically ( $p < 0.05$ ). The result Indicate that healthy workers are more productive and receive higher wages.

Education is positive ( $p < 0.1$ ).

The RISK variable is having a positive and significant ( $p < 0.05$ ) effect on wages. The results indicate that workers participating in agrochemical spraying receive an additional compensation of ₦86 per day for facing occupational hazard.

Agrochemical participation variable is positive and significant ( $p < 0.05$ ) these

indicating that worker handling pesticides receive significantly higher wages than their counterparts who do not handle it.

Temperature variable is also associated with a positive coefficient and it is statistically significant ( $p < 0.05$ ). This implies that workers pose higher health risk while applying pesticides under hot sun demand higher wages than other workers on the cocoa farm. This is in accordance with the compensating differential theory.

Wearing of PPE is associated with a negative and significant coefficient ( $p < 0.05$ ), indicating that workers with personal

protective equipment receive less wage compensation than workers without care. [21] Found that compliance with wearing of protective gear during application of chloroyrifo, thiamethoxam, and cyanazine was very low among some field crop farmers. This finding also corroborated with the finding of [18] that cocoa farmers in Nigeria are occupationally exposed to the toxic nature of insecticide application for mirid control in their cocoa plantations. The implicit meaning is that usage of PPE ensures safe work environment.

Table 3. Regression Estimation of Wage Equations by Farm Workers handles pesticide

WAGE	Coeff	Std. Err.	t-value	p>t
Constant	843.2508***	330.8206	2.55	0.012
RISK	85.95385**	40.02263	2.15	0.033
AGE	0.7059785**	0.356555	1.98	0.048
EDUCATION	0.5815242	3.966553	0.15	0.884
TEMPERATURE	4.207083**	1.752951	2.40	0.018
HEALTH INDEX	9.65034**	4.106527	2.35	0.020
WEARING PPE	-36.07781**	17.618269	-2.05	0.044
SMOKE	-33.6305	25.17818	-1.34	0.183
AGROCHEMICAL PARTICIPATION	44.71282**	22.02243	2.03	0.045
R-squared	0.605			
F-value	4.57			
P>F	0.1627			
Mean VIF	1.05			
Ramsey Reset Test	0.1075			

Source: Field Survey, 2019.

\*\*\*, \*\* and \* significant at 1%, 5% and 10% respectively

## CONCLUSIONS

Based on the findings the study concluded that appropriate use of personal protective equipment minimizes agrochemical exposure risks. Application of agrochemical under higher temperature (above 25<sup>0</sup>C) increases the chances of health damage and so workers demand higher wage for this risk [20].

Low usage of Personal Protective Equipment also exposes farmers to the risk of being exposed to agrochemicals. These constitute some serious health risk as a consequence of the toxicity contents of some chemical compounds that these agrochemicals contain. We find that the use of personal protective equipment minimizes the risk of health damage and less compensation for risk, which emphasizes the necessity for ensuring the use of protective equipment on the farm fields

against the risk exposed due to pesticide application.

This study have reported higher risk level associated with more toxic chemicals contents 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 ₦86 per day for the chemical dosage they handle as compensation wage for agrochemical exposure risk. It was therefore recommended that educational programs that will enhance farmer's knowledge, skills and attitude to adopt safety measures in pesticide usage should be adequately planned. Appropriate use of personal protective equipment to reduce exposure to pesticides and the risks involved in the misuse and abuse of pesticides. In addition, training in Integrated Pest Management (IPM) methods, which are

environment friendly and could reduce the potential exposures to pesticides. Receiving higher compensation wages by cocoa farm workers will act as an economic instrument to restrict the use of high toxic chemicals.

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