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Climate change induced occupational stress and reported morbidity among cocoa farmers in South-Western Nigeria

Abayomi Samuel Oyekale[1]

[1] *Department of Agricultural Economics and Extension, Mafikeng Campus, North-West University, Mmabatho, South Africa*

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Abstract

Introduction and Objective. Climate change is one of the major development hurdles in many developing countries. The health outcome of farm households are related to climate change, which is related to several external and internal health-related issues, such as management of occupational stressors. This study seeks, *inter alia,* to determine the climate related occupational stress and factors influencing reported sick times among cocoa farmers.

Material and Method. Data were collected from selected cocoa farmers in South-Western Nigeria. Descriptive statistics and Negative Binomial regression were used for data analyses.

Results. The results showed that cocoa farmers were ageing, and that the majority had cultivating cocoa for most of their years of farming. Cocoa was the primary crop for the majority of the farmers, while 92.00% of the farmers in Osun state owned the cultivated cocoa farms. The forms of reported climate change induced occupational stresses were increase in pest infestation (74.5% in Ekiti state), difficulties in weed control (82.1% in Ekiti state), missing regular times scheduled for spraying cocoa pods (45.7% in Ondo state), inability to spray cocoa effectively (58.5% in Ondo state), and reduction in cocoa yield (71.7% in Ekiti state). The Negative Binomial regression results showed that the age of farmers (0.0103), their education (-0.0226), years of cocoa farming (-0.0112), malaria infection (0.4901), missed spraying (0.5061), re-spraying of cocoa (0.2630), reduction in cocoa yield (0.20154), contact with extension (0.2411) and residence in Ondo state (-0.2311) were statistically significant ($p<0.05$).

Conclusion. Climate change influences the farm operations of cocoa farmers with resultant occupational stresses. Efforts to assist cocoa farmers should include, among others, provision of weather forecasts and some form of insurance.

Key words

climate change, occupational stressors, morbidity, climate forecasts, Nigeria

INTRODUCTION

Climate change is one of the major development hurdles in many African countries. Beside its direct impacts on agricultural productivity, it is a serious health challenge to the residents of affected areas. It is important to evaluate the health risk and occupational stressors associated with climate change. In rural areas, climate change presents some form of welfare shocks, for which the required institutional supports for coping are lacking. This undermines the need for strategic adaptation among African farmers [1]. Depending on the responsiveness of a farming enterprise to climate change, its impacts on farm households can be strategically enormous. This is often the case due to differences in risk variances associated with observed climatic scenarios. Also, the health outcome of farm households are related to climate change, which is related to several external and internal health-related issues, such as management of occupational stressors [2].

Cocoa agriculture exhibits one of the highest responses to climatic changes, due to the sensitivity of all its associated production processes, to changes in some climatic parameters. Sensitivity of cocoa production to hours of sunshine, rainfall, soil conditions and temperature makes it highly vulnerable to climate change. Changing climate can also alter the development of pests and diseases and modify host's resistances, thereby increasing inputs of chemicals labour. Extended drought will cause newly transplanted young cocoa plants and some cocoa trees to wither [2]. All these scenarios, if not well managed, can result in significant occupational stress with substantial impacts on the health of farm households.

It has been postulated that a number of factors have interrelated impacts on the growth of cocoa plants. This factor ranges from the weather element of rainfall, temperature, sunlight and humidity, to others, such as soil nutrient status, pest and diseases and farmers' planting practices [3]. It has been observed that the higher the temperature (maximum 32^0C), the higher the yield. Cocoa is known to produce well with minimal but sustained water availability throughout the year. Another danger to cocoa yield is a prolonged dry season which encourages bush burning [4]. On the other hand, incessant rainfall for several weeks easily leads to the widespread of black pod disease which is very contagious.

Therefore, in the absence of adequate adaptation mechanisms, cocoa farmers annually face vagaries in weather variables which cumulatively result in several occupational stresses, which are conditions in the work environment that increase the workers probability of being injured, falling sick, being disabled or death [5]. Cocoa farmers have to consistently restructure their farming operations according to the weather variables and the intermittency of other

Address for correspondences: Abayomi Samuel Oyekale, Department of Agricultural Economics and Extension, Mafikeng Campus, North-West University, Mmabatho 2735, South Africa.
E-mail: asoyekale@gmail.com

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exposed forms of occupational health shocks. The requisite skill for adequately prescribed survival mechanisms is often downplayed by unexpected sicknesses, which are motivated by changing climatic parameters and associated stress.

Objective. This study seeks, *inter alia,* to determine the climate-related occupational stress and factors influencing reported sick times among cocoa farmers.

MATERIALS AND METHOD

Data and sampling procedures. Data collected from cocoa farmers in three randomly selected cocoa growing states of southwestern Nigeria were used. Respondents were selected using the multi-stage sampling method. Three states – Ondo, Osun and Ekiti – were selected randomly at the first stage. The second stage involved selection of some cocoa growing Local Government Areas (LGAs). At the third stage, cocoa growing villages were randomly selected, while farm households were selected for interview from the selected villages. The questionnaire was pre-tested before being administered to farmers. As the highest cocoa growing area in south-western Nigeria, a total of 282 questionnaires were administered in Ondo state. In Ekiti and Osun states, 106 and 125 questionnaires were administered, respectively.

Model specification. The number of times that farmers were sick during the cocoa season was reported. Modelling the factors influencing this requires the use of Poisson regression. The model was specified by assuming a random variable Y which has Poisson distribution with parameter if it has integer values y = 0, 1, 2, 3, 4.k. The probability distribution can be specified as:

$$\Pr\{Y = y\} = \frac{e^{-\mu}\mu^{y}}{y!} \text{ for } \mu > 0.$$

The model takes the form of:

$$lnY_i = \alpha + \beta_j \sum_{j=1}^{k} s_k$$

where α and β_j are estimated parameters. Also, s represents the explanatory variables. The continuous variables are: age of household head, years of schooling, number of cocoa farms, household size, years of cocoa farming (years), proportion of farm covered by cocoa trees (%), market distance (km), land area (acres) and farm distance (km). The others were specified as dummy variables (yes = 1, 0 otherwise) and were: malaria infection reported, male household headship, cocoa as primary crop, farming as primary occupation, own cocoa farms, missed regular spraying of cocoa, increase in pest infestation, difficulties in weed control, increase in malaria infection, scarcity of drinking water, scarcity of cooking water, reduction in cocoa yields, higher incidence of black pod disease, wild fires, inability to spray cocoa effectively, inability to dry cocoa effectively, own radio, own television, own bicycle, own motorcycle, own vehicle, contacts with extension agent, Ondo farmers, re-spraying cocoa.

Poisson regression uses Maximum Likelihood Estimation (MLE) due to violation of homoscedasticity assumption. The goodness of fit was evaluated from statistical significance of deviance statistics. Assumption of Poisson distribution was rejected from its statistical significance ($p<0.05$). Therefore, Negative Binomial regression was tried and its superiority over Poisson regression was evaluated from likelihood ratio test statistics of alpha equal to zero.

RESULTS

Table 1 shows the distribution of farmers' socio-economic characteristics across the states. It reveals that the average age of farmers was the highest in Ekiti state (58.91 years), while the average years of schooling was highest in Osun state (6.98). Average household size and dependency ratio (number of children under 14 divided by number of adults less 65 years) were highest in Osun state with 7.60 and 0.79, respectively. Average years of farming experience and years of cultivating cocoa were highest in Ekiti state with 46.06 and 45.00, respectively. Average cocoa land area and number of cocoa farms were highest in Osun state. The majority of farmers across the states indicated that cocoa was the primary crop. Although 92.00% of farmers in Osun state owned the cultivated cocoa farms, 80% of the farmers had farming as the primary occupation. Also, the average distance of the village to cocoa farms was highest in Ondo state – 10.19 km. The average number of times that the household head fell sick during the cocoa season was highest in Osun state – 2.66. More than half of the households indicated that climate change affects their health – 63.5% in Ondo state. Similarly, in Ekiti state, 73.6% noted that other household members were also sick during the cocoa season. Table 2 shows the form of occupational stress that resulted from climate change.

Table 1. Socio-economic status of cocoa farmers in the selected states

Variables	Ondo (282)		Osun (125)		Ekiti (106)	
	Mean/ (freq)	Std Dev/ (%)	Mean/ (Freq)	Std Dev/ (%)	Mean/ (Freq)	Std Dev/ (%)
Socio-economic status						
Male	(245)	(86.9)	(123)	(98.4)	(103)	(97.2)
Age of household head	54.95	17.89	51.83	16.82	58.91	12.61
Years of schooling	6.89	5.50	6.98	5.68	3.90	5.58
Household size	7.15	3.88	7.60	4.51	7.23	2.38
Dependency ratio	0.75	0.79	0.79	0.78	0.27	0.48
Farming experience	28.44	16.60	29.18	18.67	46.06	13.92
Years of cocoa farming	27.34	16.33	24.85	18.13	45.00	13.68
Number of cocoa farms	2.81	2.08	3.22	2.06	1.79	0.81
Own the cocoa farm	(227)	(80.5)	(115)	(92.0)	(74)	(69.8)
Cocoa land areas	8.79	12.78	10.49	13.32	2.85	1.08
Farming as primary occupation	(239)	(84.8)	(100)	(80.0)	(90)	(84.9)
Cocoa is primary crop	(252)	(89.4)	(110)	(88.0)	(84)	(79.2)
Village distance	10.19	57.34	2.43	1.89	2.28	1.29
Access to extension	(50)	(17.7)	(58)	(46.4)	(23)	(21.7)
Health status						
Time sick during cocoa season	1.82	1.842	2.66	4.80	1.62	1.19
Malaria as major health problem	(176)	(62.4)	(62)	(49.6)	(70)	(66.0)
Other household members sick	(177)	(62.8)	(57)	(45.6)	(78)	(73.6)
Climate change affecting health	(179)	(63.5)	(64)	(51.2)	(57)	(53.8)

Table 2. Reported climate change induced occupational stress and health status among cocoa farmers

	Ondo state		Osun state		Ekiti state	
	Freq	%	Freq	%	Freq	%
Production related stress						
Increase in pests	172	61.0	78	62.4	79	74.5
Difficulty in weed control	185	65.6	96	76.8	87	82.1
Miss regular spray of cocoa	129	45.7	53	42.4	31	29.2
Death of cocoa trees	166	58.9	39	31.2	56	52.8
Cocoa tree falling	131	46.5	34	27.2	81	76.4
Reduction in cocoa yield	182	64.5	71	56.8	76	71.7
Higher incidence of black pod disease	178	63.1	69	55.2	71	67.0
Wild fire	18	6.4	8	6.4	0	0.0
Inability to spray cocoa effectively	165	58.5	47	37.6	39	36.8
Domestic Stress						
Scarcity of drinking water	62	22.0	2	1.6	3	2.8
Scarcity of cooking water	54	19.1	2	1.6	5	4.7
Higher incidence of pneumonia	8	2.8	6	4.8	66	62.3
Higher incidence of cholera	8	2.8	7	5.6	20	18.9
Increase in malaria	99	35.1	34	27.2	42	39.6

Increase in pest infestation was reported by the majority of farmers across the states, with 74.5% in Ekiti state. Difficulties in weed control due to climate change were reported by the majority of the farmers. Some cocoa farmers reported missing regular times scheduled for spraying cocoa pods, as a result of which, 45.7% reported this in Ondo state. Also, inability to spray cocoa effectively was reported by 58.5% of the farmers in Ondo state. Either due to ageing or some other issues related to extended droughts, some of the farmers reported that their cocoa trees were dying. The highest proportion of the farmers that reported this was 58.9% in Ondo state. Similarly, due to too much rainfall, some farmers reported that cocoa trees were falling over. This was reported by 76.4% of farmers in Ekiti state. Reduction in cocoa yield was reported by the majority of the farmers, with highest percentage (71.7%) in Ekiti state. Similarly, in Osun state, 56.8% of farmers reported reduction in cocoa yield. Higher incidence of black pod disease was reported by the majority of the farmers, with Ekiti state having the highest percentage – 67.0%.

Table 3 shows the results of Negative Binomial regression model. The model produced a better result than Poisson regression since the likelihood ratio test of alpha equal to zero was statistically significant ($p<0.0001$). The likelihood ratio chi square value was statistically significant ($p<0.0001$) showing that the estimated parameters were not jointly equal to zero. Similarly, the results showed that those households that reported malaria infection had a log of sick time significantly higher by 0.4901 ($p<0.01$). If farmer's age increased by one unit, the log of sick time significantly increased by 0.0103 ($p<0.05$). However, if the years of schooling increased by one unit, the log of sick time significantly decreased by 0.0226 ($p<0.05$). Furthermore, if household size increased by one unit, the log of sick time significantly increased by 0.0206 ($p<0.10$). Also, if the years of cocoa farming increased by one unit, the log of sick time was significantly reduced by 0.0112 ($p<0.01$). The farmers who grew cocoa as the primary crop had a log of sick time suignificantly reduced by 0.2605 ($p<0.10$).

Table 3. Negative Binomial modeling results showing the effect of occupation stress on reported sick times.

Variables	Coefficients	Std. Err.	z-statistics
Malaria infection reported	0.4901	0.0966	5.07
Gender of household head	0.2156	0.1730	1.25
Age of household head	0.0103	0.0042	2.48
Years of schooling of household head	-0.0226	0.0096	-2.36
Household size	0.0206	0.0124	1.66
Years of cocoa farming	-0.0112	0.0038	-2.92
Cocoa as primary crop	-0.2605	0.1436	-1.81
Farming as primary occupation	0.0143	0.1387	0.10
Number of cocoafarm	-0.0309	0.0254	-1.22
Type of farm ownership	0.0495	0.1236	0.40
Land area (acres)	0.0000	0.0038	0.01
Farm distance (km)	0.0004	0.0011	0.33
Missed regular spraying of cocoa	0.5061	0.0923	5.49
Increase in pest infestation	0.1814	0.1240	1.46
Difficulties in weed control	0.0437	0.1399	0.31
Increase in malaria infection	0.0416	0.1007	0.41
Scarcity of drinking water	0.4537	0.2330	1.95
Scarcity of cooking water	-0.3040	0.2383	-1.28
Reduction in cocoa yields	0.2015	0.1016	1.98
Higher incidence of black pod disease	-0.1294	0.1041	-1.24
Wild fire	0.1639	0.1930	0.85
Inability to spray cocoa effective	-0.0266	0.1139	-0.23
Inability to dry cocoa effectively	-0.1788	0.1176	-1.52
Re-spray cocoa	0.2630	0.0957	2.75
Ownership of radio	0.0403	0.1558	0.26
Ownership of television	0.2628	0.1040	2.53
Ownership of bicycle	-0.0487	0.1292	-0.38
Ownership of motorcycle	-0.0096	0.0995	-0.10
Ownership of vehicle	-0.1153	0.1296	-0.89
Contacts with extension agent	0.2411	0.1011	2.38
Market distance	0.0027	0.0103	0.26
Ondo farmers	-0.2311	0.1077	-2.15
Proportion of farm covered by cocoa trees	0.0029	0.0036	0.81
Constant	-0.7465	0.4463	-1.67
Ln alpha	-1.0978	0.1606	
Alpha	0.3336	0.0536	
Number of obs = 513			
LR chi2(34) = 147.62			
Prob> chi2 = 0.0000			
Pseudo R2 = 0.0761			
Likelihood-ratio test of alpha = 0 chibar2(01) = 124.96 Prob >=chibar2 = 0.000			

The farmers who missed regular spraying of cocoa had a log of sick time that was significantly higher by 0.5061, when compared with those who did not miss spraying. Of the variable occupational stress induced by climate change, only scarcity of drinking water and reduction in cocoa yields showed statistical significance at $p<0.10$ and $p<0.05$, respectively. Farmers who reported scarcity of drinking water and reduction in cocoa yields had their log of sick

time significantly higher by 0.4537 and 0.2015, respectively, compared with those who did not report this. The farmers who had to re-spray their cocoa pods had a log of sick time significantly higher by 0.2630, compared with those who did not ($p<0.01$).

It should be noted that although statistically insignificant ($p>0.10$), the parameters of the majority of the other variables that encompassed occupational stress induced by climate change, were positively noted and of high magnitude. Furthermore, the results showed that the farmers with access to television had a log sick time significantly higher by 0.2626 ($p<0.05$), while those with contacts with extension agents had a log of sick time that was significantly higher by 0.2411. Also, farmers from Ondo state had a log of sick time significantly lower by 0.2311.

DISCUSSION

Cocoa farming households were ageing, which confirms previous findings [6], and reflects the fact that without rehabilitation, cocoa trees were also ageing. Low level of educational attainment is often associated with residence in most of Nigerian rural areas [7]. In some instances, illiterate individuals decide to go into full time farming due to lack of skills to work in the labour markets [8, 9]. Similarly, low educational attainment results in low agricultural productivity in Nigeria [10, 11]. Average family size was high in all the states, which reflects the fact that some farmers demand more children to ensure availability of family labour for several farm operations. Even when ownership of a farm had been claimed, in some instances, cocoa farms were inherited. This can explain low cocoa pod yields since most of those trees were planted many years ago [6]. It can also be linked to the size of the farm and number of cocoa farms. The distance of cocoa farm would traditionally reflect the formation processes of cocoa villages based on ownership of the distributed forestlands [12].

Sicknesses during the cocoa season were reported by many farmers. Climate change was also linked to poor health. Malaria, which was indicated as the major health challenge, is among the diseases that climate change promotes due to favourable breeding grounds for mosquitoes which are the major transmission media for the vector parasites [13]. Scarcities of drinking and cooking water were also reported. These could promote incidences of water-borne diseases like cholera which was mostly reported in Ekiti state. The nature of precipitation was found to have association with reported cases of cholera in North-West Nigeria [14].

Table 2 shows the increase in pest infestation reported by majority of the farmers across the states. Climate change alters the development of pests, thereby making it difficult for them to be controlled [15, 16, 17]. Similarly, difficulties in weed control were reported by some farmers. It had been noted that in the event of climate change, the ecosystem can be transformed in manner that a higher proportion of weeds will be invasive and vigorous [18, 19].

Due to the changing pattern of rainfall, cocoa farmers reported that they were missing the regular times scheduled for spraying cocoa pods. This can constitute serious occupational stress with significant health consequences since administration of fungicides to cocoa pods is a major production process in cocoa agriculture [20]. The cumulative impacts of climate change, especially in relation to the control of black pod disease leads, to reduction in cocoa yield. In some related instances, cocoa farmers reported the inability to effectively spray cocoa pods. This resulted from inability to utilize indigenous knowledge possessed by farm households to predict weather parameters in line with their schedules of cocoa production activities. Also, depending on the nature of the soil, too much rainfall would make cocoa trees to fall off.

Table 3 shows that reported malaria as a major health problem had a higher log of sick time. This is expected because malaria is a major health problem in Nigeria [21, 22]. In rural areas, poor housing conditions and the busy environment constitute serious constraint on addressing malaria supression. In line with expectation, it was found that the age of farmers increased the log of sick time. As people grow older, the likelihood of falling sick increases [23, 24]. Furthermore, the results show that education reduces the log of sick time. This is expected, because education can induce awareness about practices to promote hygienic practices, behavior change and access to income for demanding better health care services [25].

Missing regular cocoa spraying increased the log of sick time among cocoa farmers. This may have resulted from associated stress resulting from missing regular spraying. Similarly, in the absence of a sufficient family work force, aged cocoa farmers who are likely to fall sick often would have to miss regular cocoa spraying since they are unable to stand tediousness of the farm operation, and makes them rely on hired labours. Similarly, farmers who noted that climate change reduced cocoa yield had a higher log of sick time. As cocoa yield decreased, farm incomes also decreased, thereby subjecting the farmers to serious financial stress. Additionally, the scarcity of drinking water due to climate change increased the log of sick time among farmers.

CONCLUSIONS

Climate change has been linked to a rise in some health challenges in some tropical countries. The peculiarity of cocoa agriculture prescribes strong links between climate change, its associated occupational stress, and the health status of farmers. The presented study establishes that cocoa farmers in Nigeria are currently suffering from production constraints associated with climate change. The results, *inter alia,* show a high association between reported sick times and some climate induced occupational stressors that included reported malaria, re-spraying of cocoa pods, inability to spay cocoa effectively, and decline in cocoa yields. The findings suggest a very strong need for promoting assistances in the form of climate forecasts, insurance and input support systems for farmers in order to ensure adaptation to climate change. The findings also underscore the need to promote education and incentives to youths to be involved in farming. This is critical because ageing is a major factor promoting sickness among cocoa farmers.

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