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## High Incidence of Forest Fires and Preventive Measures in Cocoa Research Institute Plantations Ibadan, Oyo State

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### Abstract

This study was carried out to ascertain the high incidence of forest fire and its preventive measures in Cocoa Research Institute of Nigeria (CRIN) plantations Ibadan, Oyo state. Fire is used as work tool by rural population, it serves as land clearing method for agricultural land, flushes management for livestock, wastes disposal, honey gathering, animal tracking and hunting. A multistage sampling approach was used to select 120 respondents. Data were collected using interview schedule on socioeconomic characteristics, perceived causes of forest fire, effect of forest fire and preventive measures to forest fire. Data were analyzed using descriptive and inferential statistic. The result revealed that the mean age was 44.9 years and majority (72.7%) were male, 83.0% of them were married. Also a very good number of respondents (97.7%) has various level of education. Bush burning to eradicate weed as a perceived cause of forest fire was ranked 1<sup>st</sup> with the mean value of 1.36. Destruction of CRIN mandate crops parent materials as the effect of forest fire was ranked 1<sup>st</sup> with the mean value of 1.42 and controlled bush burning was ranked 1<sup>st</sup> with mean value of 1.64 among the preventive measure of forest fire. It was revealed that significant relationships were observed between sex ( $\chi^2 = 6.000$ ,  $p = 0.014$ ), Religion ( $\chi^2 = 8.693$ ,  $p = 0.013$ ) on the preventive measures of forest in CRIN plantations.

**Key words:** Forest fire; fire; flushes; herdsmen.

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## **1. Introduction**

Fire is a common phenomenon throughout the history of the world. Fire is used as a work tool by rural populations, as it serves as a land clearing method for agricultural land, flushes management for livestock, wastes disposal, honey gathering, animal tracking and hunting. Native Americans used fire to reduce thick bush, to improve the environment for hunting wildlife and to create openings for their crops [1]. All these practices are common in most countries in West Africa. Fire occurrence happens naturally or caused by man. All fires, regardless of whether they are natural or human-caused, alter the cycling of nutrients and the biotic, physical, moisture, and temperature characteristics of soil [2]. The fires made by man can be voluntary or accidental. Fire is caused accidentally when a source of fire like naked flame, electric spark and cigarette, comes into contact with inflammable material. Forestry personnel are also involved in causing fires when they deliberately and negligently set fire on some crops like teak to break the dormancy of its seed and without due precautions to put off the fire [3]. The irresponsible behavior of tourists when they put on fire and forget to put it off, villagers and tribal's fire for flush of fresh grass in coming dry season etc. at times get uncontrolled causing massive fires. When the fires become uncontrollable and causes massive damage to farmland, aquatic habitat, and to the environment it is called forest fires or wild fires. Forest fire is defined as a condition in which a forest is engulfed by a raging fire causing damages to the forest and forest products resulting in economic and environmental value losses [4]. Also, forest fire can be defined as uncontained and freely spreading combustion which consumes the natural fuels of a forest, litter, grass, dead branch of woods, snags, logs, stumps, weed, brush, foliage and to a limited degree, green trees [5]. Forest fire starts from an ignition point and spread outwards leaving behind only burnt areas. A rise in the number of forest fires and burned area has been reported during the last decades in many parts of the world [6]. For instance, around 98-million-hectare forest was affected by fires globally [7]. Forest fires are predominant in tropical and temperate forest countries of the world. They affect the natural habitat and bio-diversity in a negative way thereby creating threat to the forest ecosystems. The entire fauna and flora are seriously disturbed by forest fire [8].

In Nigeria, the agricultural sector is vulnerable to natural hazards and disasters [9]. Forest fires can damage crop growth, human health, fisheries, aquaculture production and can seriously undermine the forestry sector [9]. Most forest fires usually occur during the dry season in Nigeria from December to March. Abundant combustible material, high temperature, high wind speed and sloppy topography are favorable environment for forest fires [10]. Also high atmospheric temperatures and low humidity offer favourable circumstances for a fire to start [3]. Significant damage can be caused to permanent crops, such as cocoa, coffee, cashew, oilpalm, oranges, olive trees, vines and so on with huge implications to the rural economy [11]. The loss of key organisms in forest ecosystems, such as invertebrates, pollinators and decomposers, can significantly slow the recovery rate of the forest [12].

In most part of the country, burning represents an important indigenous and cultural tradition of land preparation. Consequently, Majority (95%) of forest fires are caused by human activities and are man-made, while natural forest fires accounts for only 5% of all the fires reported in forest areas [3]. Natural causes of forest fires include lightning, rubbing of dry bamboos, collision of the stones and subsequent spark produced etc. which set trees on fire [3].

Cocoa Research Institute of Nigeria (CRIN) is the first research institute in Nigeria that has the mandate for five crops namely cocoa, cashew, coffee, kola and tea. The institute plantations are faced with the challenges of forest fire which has destroyed a lot of parent materials, germplasm and clonal material of the mandate crops. Some of the documented forest fires that occurred in CRIN plantations since year 2016 were shown in Table 1. It can be seen in the table that most forest fires occurred between the months of December and March in the years under consideration which is linked to the fact that dry season is usually at peak during those months. Also, it is within those months that harmattan is experienced. So the fuel for fire to escalate is readily available within those months in the year.

**Table 1:** Documented forest fire that occurred in CRIN plantations from year 2016- March, 2022.

s/no	Zone (location)	Plot name	Date of fire incident
1	Zone ¾	Onipe plot	07/01/ 2016
2	Zone 5	2008 Cocoa plot	20/01/2017
3	Zone 3	2008 Cocoa plot	24/02/2017
4	Bcoo(Moor plantation)	Bcoo	10/02/2018
5	Zone 2	2010 Cocoa plot	31/12/2018
6	Zone ¾	Cashew Research Plot	15/02/2020
7	Zone 2	2010 Cocoa plot	17/02/2020
8	Zone 1	Coffee Experimental Plot	15/02/2020
9	Common Fund For Commodity(CFC)	CFC hybrid trial plot	02/18/2021
10	Zone ¾	2008 Cocoa plot	27/01/2022
11	Zone 1	2010 Cocoa plot	09/01/2022
12	Bcoo(Moor plantation)	Bcoo	11/02/2022
13	Extension section lawn	ERLS lawns, flowers and masquerade trees	21/02/2022
14	Zone 1	Coffee germplasm	26/02/2022
15	Common Fund For Commodity(CFC)	CFC hybrid plot ( block 4)	28/02/2022
16	Nursery section	Cocoa Clonal garden	02/03/2022

Source: Field survey, 2022.

Based on the foregoing, the study was carried out to assess the preventive measures used for controlling forest fires in CRIN plantations Ibadan, Oyo state.

**1.1 Specific objectives**

- to determine the socioeconomic characteristic of the respondents,
- to ascertain the perceived causes of CRIN forest fire,
- to examine the effects of CRIN forest fire,
- to determine the preventive measures to CRIN forest fire

**1.2 Hypothesis of the study**

H0<sub>1</sub>: there is no significant relationship between socioeconomics characteristics and preventive measures of CRIN forest fire in the study area.

## **2. Materials and Methods**

CRIN was established in 1964 and has mandate to conduct research on five crops namely; Cocoa, Kola, Coffee, Cashew and Tea. CRIN headquarters is in Oluyole in Ibadan, Oyo state and has six different substations in Owena (Ondo state), Uhonmora( Edo state), Ochaja ( Kogi state), Ibeku (Abia state), Ajassor (Cross River) and Kusuku-Mambilla (Taraba state) these various substation researches and serves as outlet to different hybrid materials of the mandate crops across Nigeria. A multistage sampling approach was used in the study. The first stage involved the purposive selection of CRIN headquarters in Ibadan because of high incidence of forest fire annually.

The second stage involved purposive selection of all the zones that are in plantation and estate management, also the security unit because most forest fire occurs in the plantations and the security unit always has first hand information about any fire incidence and raises alarm on such incidence in order to put off such forest fire. Thirdly, simple random sampling was used to select seven respondents in the 8 zones, the security unit including the nursery department and the Common Fund for Commodity (CFC).

The total sample size was 88 respondents. Data were obtained using interview schedule and was analyzed using descriptive (percentages and frequencies) and inferential statistics (Chi-square and Pearson Product Moment Correlation) at 0.05 level of significance. The variables of the study were measured as follows:

### ***2.1 Perceived causes of forest fires***

Correct responses were sought from the respondents on a list of ten questions presented to them to ascertain the perceived causes of forest fires. This was measured using a three-point scale of 'Never, Occasionally and Always'. Scores were assigned as 0, 1 and 2 respectively.

Maximum obtainable score was 20 and minimum score was 0. The scores of each of the items were summed up to form a perceived causes score for each respondent. Respondents mean score was use to rank them in order of importance.

### ***2.2 Effects of forest fires***

The respondents were presented with a list of eleven effects of forest fire. It was measured on a 3-point scale of 'Never', 'Occasionally' and 'Always', with scores of 0, 1 and 2 assigned respectively. The mean score for effect of forest was obtained and used to rank them in order of importance.

### ***2.3 Preventives measures to forest fires***

The respondents were presented with a list of ten prevention measures to forest fire. It was measured on a 3-point scale of 'Never, Minor and Major', with scores of 0, 1 and 2 assigned respectively. The minimum score obtainable was 0 while the maximum score obtainable was 20. The mean score was obtained and used to rank them in order of importance.

**3. Result and Discussion**

**3.1 Socioeconomic characteristics of the respondents**

Table 2 shows that the ages of majority (83.0%) of the respondents ranged from 36 to 56, with the mean being 44.9years. [14] similarly reported a mean age of 45.0 years for farming household heads in Oyo State. By this mean age, the respondents are still in their active and productive age, and would be willing to take measures that can prevent forest fires from engulfing their farms. Findings showed 72.7% of the respondents were male while 27.3% were female. This is in line with the finding of [15] who reported more participation of men than women in agricultural production. This may be due to the fact that women involve themselves more off-farm agricultural activities such as processing, marketing and transportation of farm produce. [16] opined male and female differ in their access to productive resources most especially farmland. [17] highlighted the need to close the gender gap in access to productive resources, education, extension and financial services. Majority(83.0%) of them were married and had a mean household size of 3 persons. This indicates that marriage institution is cherished in the study area, coupled with the fact that household members can serve to provide family labour for agricultural activities. This corroborates [18] that found most farming household in Oyo State were married. The literacy level of the respondents was quite high, in that 58.0% and 34.1% had tertiary and secondary education, respectively. The high literacy level is attributable to most of the respondents being workers in a research institute, which requires the possession of a minimum level of educational qualification prior employment. The high education level is expected to positively influence their adoption of modern farming practices in order to improve agricultural production and at the same time prevent any potential outbreak of forest fires.

**Table 2:** Distribution of respondents on Socioeconomics Characteristics.

	Age	Frequency	Percentage	Mean
	22-28	2	2.2	
	29-35	6	6.8	
	36-42	23	26.1	
	43-49	29	33.0	45.0
	50-56	21	23.9	
	57 above	7	8.0	
	<b>TOTAL</b>	<b>88</b>	<b>100</b>	
<b>Sex</b>				
	Male	64	72.7	
	Female	24	27.3	
	<b>Total</b>	<b>88</b>	<b>100</b>	
<b>Marital status</b>				
	Single	11	12.5	
	Married	73	83.0	
	Widowed	4	4.5	
<b>Total</b>		<b>88</b>	<b>100</b>	
<b>Household size</b>				
	1-3	49	55.7	

	4-6	34	38.6
	7 above	5	5.7
	TOTAL	88	100
Religion	Christianity	65	73.8
	Islam	16	18.2
	Traditional	7	8.0
Total	88	100	
	Level of education		
	No formal	2	2.3
	Primary	5	5.6
	Secondary	30	34.1
	Tertiary	51	58.0
	Total	88	100

Source: Field survey, 2022.

### 3.2 Perceived causes of forest fire

Table 3 presents the major causes of forest fire in CRIN plantations. It was revealed that bush burning to eradicate weeds ( $\bar{X}=1.36$ ), setting forest on fire by herdsmen to get new flushes for their cattle ( $\bar{X}=1.32$ ) and hunters smoking out bush meat from holes ( $\bar{X}=1.31$ ) were the major causes of forest fire. Burning bush to eradicate weeds is adducible to the high cost of hiring labour due to economic hardship. The high labour cost stems from scarcity of foreigners from neighboring countries who work as hired farm laborers in Nigeria due to border closure. [19] observed that more than 40% of farmers in Nigeria in the past five years have been unable to obtain all farm workers they need for the production of their main crops. He further observed that about 70% experienced more trouble hiring farm labour within the period. Equally, menace of herdsmen in Nigeria is of great concern, as they overgraze farms with their cattle, set fire on farms and fields so that their cattle can graze on flushes thereby jeopardizing the harvest farmers are expecting from the crops planted. Meanwhile, research has shown that human activities such as agriculture, overgrazing and ranching are direct causes of forest fires in tropical rainforests [20].

**Table 3:** Perceived causes of forest fires.

s/no	Causes of forest fire	Mean	Rank
1	Bush burning to eradicate weeds	1.36	1 <sup>st</sup>
2	Smoking cigarette in zones by hunters, lumbers and staffs	1.22	4 <sup>th</sup>
3	Sparks from electric poles	0.69	10 <sup>th</sup>
4	Herdsmen setting fire to get tender grasses for their cattle	1.32	2 <sup>nd</sup>
5	Hunters smoking out bush meat from holes	1.31	3 <sup>rd</sup>
6	Climate change: prolonged dry season	1.21	5 <sup>th</sup>
7	Cooking with firewood in plots without putting out fire properly	0.98	8 <sup>th</sup>
8	Environmental porosity: intruders farming in the zones	0.96	9 <sup>th</sup>
9	Fire tracing timing	1.20	6 <sup>th</sup>
10	Activities of the foresters to regenerate and break the dormancy of teak seeds	1.13	7 <sup>th</sup>

Source: Field survey, 2022.

**3.3 Effects of forest fires**

Table 4 shows the effect of perennial forest fire. Destruction of CRIN mandate crops parent stocks/materials was ranked 1<sup>st</sup> ( $\bar{X}$ =1.42). Parent stocks are healthy mother plants that must be maintained properly in order to yield perfect genetic materials. Propagation of hybrid crops is usually successful when it is done through the parent stock.

When fire engulfs the parent stock, it reduces the vigour of the mother plants and some traits can be lost as a result.

Yield reduction in mandate crops was ranked 2<sup>nd</sup> ( $\bar{X}$ =1.38).

The reduction in yield of the mandate crops is usually consecutively experienced for three years if good agricultural practices are not observed. This is because in the event of forest fires, affected trees would have to be nurtured to bring them back to their productive years.

Reference [21] rightly averred that forest fires extensively affect vegetative cover, density, structure, composition, diversity and productivity of crops.

**Table 4:** Effects of forest fire.

S/N	Effects of forest fire	Mean	Rank
1.	Destruction of CRIN mandate crops parent stock/materials	1.42	1 <sup>st</sup>
2.	Enhancement of soil erosion	1.13	6 <sup>th</sup>
3.	Death of micro-fauna and micro-flora e.g earthworm	1.14	5 <sup>th</sup>
4.	Release of CO <sub>2</sub> to the atmosphere causing global warming	1.27	3 <sup>rd</sup>
5.	Destruction of farm house and various farm implements e.g storex tanks	0.99	10 <sup>th</sup>
6	Death of useful pollinators and beneficial insects e.g bees, butterflies etc	1.15	4 <sup>th</sup>
7	Destruction of biodiversity species and natural habitat of animals.	1.07	8 <sup>th</sup>
8	Yield reduction in mandate crops	1.38	2 <sup>nd</sup>
9	Destruction of farm produce.	1.12	7 <sup>th</sup>
10	Loss of carbon sink resources (vegetation) thereby increasing the percentage of CO <sub>2</sub> in the atmosphere.	0.83	11 <sup>th</sup>
11	Loss of livelihood activities for some people e.g fire wood fetchers	1.05	9 <sup>th</sup>

**3.4 Preventive measures to CRIN forest fires**

Various preventive measures used to guide against forest fire in CRIN are shown in Table 5. Controlled bush burning ( $\bar{X}$ =1.64), making water available throughout the dry season ( $\bar{X}$ =1.38) and controlled farming activities

and registration of farmers in different zones ( $\bar{X}=1.27$ ) Controlled burning involves courteously burning the boundaries of plantations and reducing the debris layers in the farm. This helps to reduce the availability of natural fire fuels like dried leaves, rotten dried wood, dried debris, etc.

**Table 5:** Preventive measures to CRIN forest fire.

S/N	Preventive measure to forest fire	Mean	Rank
1.	Prevention of human-caused fires through education and enlightenment campaigns	1.42	8 <sup>th</sup>
2.	Prompt detection of fires through coordinated network e.g regular patrolling of CRIN boundaries by securities	1.35	9 <sup>th</sup>
3.	Controlled bush burning in zones prior to the peak of dry season.	1.64	1 <sup>st</sup>
4.	Controlled farming activities and registration of farmers in different zones	1.60	3 <sup>rd</sup>
5.	Correct timing for thorough fire tracing with adequate width	1.46	5 <sup>th</sup>
6	Regular packing out of dried leaves, debris and dried wood and burning	1.45	6 <sup>th</sup>
7.	Banning of smoking in zones	1.44	7 <sup>th</sup>
8	Water availability in the zones storex tanks and availability of mobile water tanker throughout the dry season	1.63	2 <sup>nd</sup>
9	Perimeter fencing of the institute to control intruders and herdsmen.	1.48	4 <sup>th</sup>
10	Fire extinguisher should be mounted in zones	1.34	10 <sup>th</sup>

Source: Field survey, 2022

**3.5 Relationship between Age, Sex, Marital status, Religion, Education, and Number of children on the preventive measure of forest fire in CRIN plantation**

As shown in Table 6, significant relationships were observed between sex ( $\chi^2= 6.000, p = 0.014$ ), religion ( $\chi^2= 8.693, p= 0.013$ ) and preventive measures of forest in CRIN plantations. [22] different roles, decisions and control of productive resources by rural men and women can influence how both gender would react in the event of forest fires and measures evolved to present such. For instance, socio-cultural norms that restrict women’s access to the ownership and control of productive resources can negatively influence their preparedness to take preventive measures in response to forest fires. This to an extent accounts for why men are more likely to remain and defend properties than women during wildfires [23].With respect to religion, an individual’s religious belief can influence his attitude about forest fires and the eventual preventive action that will ensue. If a farmer’s religion teaches that the custody of the environment is placed in the hands of man, such a farmer would take measures to prevent any outbreak of forest fires on his farm. This is intrinsically why religion is considered to be a vital avenues for values, motivations and morals [24].



**Table 6:** Relationship between Age, Sex, Marital status, Religion, Education, and Number of children on the preventive measure of forest fire in CRIN plantation.

Variable	$\chi^2$	Df	r-value	p-value	Sig
Sex	6.000	1	-	0.014	S
Marital status	3.067	2	-	0.216	NS
Religion	8.693	2	-	0.013	S
Education	5.413	3	-	0.144	NS
No of children	-	-	0.026	0.814	NS
Age	-	-	-0.130	0.237	NS

**4. Conclusion and recommendations**

Mainly predisposed by bush burning for agriculture (to eradicate weeds and by herdsmen to get new flushes for their cattle), the incidence of forest fires is on the increase. Preventives measures commonly used to control forest fires included controlled burning and making water available throughout the dry season. To prevent the destruction of parent stocks/materials and maintain their vigour and essential traits of CRIN mandate crops, the identified preventive measures of forest fires should be embraced and improved upon.



**Figure 1:** shows CRIN staff getting water from tanker to put of fire outbreak at CRIN nursery unit on March, 2022.



**Figure 2:** shows a completely burnt clonal/ parent material in CRIN nursery.



**Figure 3:** shows a completely damaged cocoa shade net by the forest fire in CRIN nursery.

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