

Impact of Harmattan Season on Human Health in Keffi, Nasarawa State, Nigeria

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Abstract

Background: Once the year comes to end, around late November up to February, there prevails the dry cold wind originated from the Sahara Desert in North Africa toward the West African countries called Harmattan. The Harmattan season has adverse effects on human health and comfort. There is a wide spread of airborne diseases coupled with the dryness of human skin. Small children are mostly dehydrated. **Aim and Objectives:** This study focused on the impacts of the Harmattan season in Keffi town, Nasarawa state, Nigeria, on human health. **Materials and Methods:** The use of correlation and regression analysis is employed to analyse the data. It also involved the collection of data from the Nigerian Meteorological Agency. The field survey also confined about 100 respondents. **Result:** The results indicate a positive correlation between the Harmattan and its impact on human health, with about 0.64. The climate and anthropogenic factors are mostly the responsible factors influencing the high prevalence of Harmattan. **Conclusion:** Nevertheless, there is the good side of the Harmattan season, such as the lowering of environmental temperature and some crops enjoy the cold season.

Keywords: Comfort climate, Harmattan season, human health, temperature

INTRODUCTION

Harmattan is the dust-laden wind blowing from Sahara. Harmattan is a weather condition in the tropics in which dust particles are blown up into the air by winds defined as from November to February. Some of the dust is trapped on vegetation, while others blow toward the south.^[1] The air in horizontal movement relative to the earth surface and pushes southward from the Sahara desert by the northeast wind.^[2]

The year is marked by changes in the weather, ecology, and amount of daylight, and these changes result from earth's orbit around the sun and earth's axial tilt relative to the ecliptic plane. In the temperate and subpolar region of the earth, there are four seasons in a year; spring, summer, autumn, and winter. In tropical and subtropical regions which Nigeria is one of them, there are two seasons; the rainy (wet or monsoon) season and the dry season (Harmattan); the Harmattan dust constitutes haze, largely from the anthropogenic source of the particulate matter.^[3]

For the purpose of this study, there is an examination of the Harmattan season and its effect on human health and comfort.

It blows during the dry season, which occurs during the lowest-sun months, when the subtropical ridge from high pressure stays over the Central Sahara desert and when the low-pressure inter-tropical convergence zone stays over the Gulf of Guinea. It is characterized by dry and dusty northeast trade wind that blows from the Sahara desert into the Gulf of Guinea between the end of November and the middle of March. On its passage over the Sahara, it picks up fine particles (between 0.5 and 10 micromaterials).^[4]

The depletion ability of Harmattan dust also reduces visibility drastically during the Harmattan season. This depletion characteristic has a multiplier effect. It affects agricultural yield and brings about poor visibility that affects transportation,

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especially the aviation industry. Travelers express their displeasure over the arrival of the Harmattan season as it brings discomfort to people.^[5] Harmattan also affects the economic status of people, as a lot of people have to buy new clothes and sweaters that will enable them to manage the cold and dusty weather condition.^[6]

This research is expected to examine the impact of the changes in human health and comfort attributable to extreme weather and climatic conditions by Harmattan. The high rate of dust concentration has adversely contributed to the condition of human health and the population.^[7]

According to Adepetu *et al.*, 1988,^[8] the chemical composition of Harmattan dust was calculated to have about 29 different elements through neutron instrumental activation analysis. The mean concentrations are (in $\mu\text{g/g}$) as follows: Al, 61100; As, 6.59; Au, 0.16; Ba, 695; Br, 195; Ce, 122; Cl, 6200; Co, 20.9; Cr, 119; Cs, 2.72; Eu, 1.31; Fe, 43 1000; Ga, 21.9; Hf, 8.05; K, 15700; La, 53.9; Mg, 8700; Mn, 825; Na, 6400; Rb, 82.4; Sb, 32.7; Sc, 10.3; Se, 6.61; Sm, 6.50; Th, 14.0; Ti, 4900; U, 6.28; V, 81.6; and Zn, 2200.

The effect of dust and sand stirred by the wind which known as Harmattan haze has cost airlines in millions because cancelation and diverted flights every year. This dry dust (Harmattan wind), northeast wind occurs in West African north of the Equator. Its effect extends from just north of the Equator in January, almost to the Northern Tropic in July. The Harmattan wind stream occasionally extends south of the Equator during the northern winter as an upper air wind over southwesterly monsoon. The atmospheric haze prevails early morning and occasionally toward the evening; there is an incursion of fog in Northern Lokoja.^[9]

The Harmattan dust particles affect negatively the health of the people causing the respiratory disease to adults and children. Health cases such as cough, catarrh, and respiratory disease are mostly reported in the hospitals during the Harmattan season. The skin is usually dry with accompanying dry cracking of the lips. The results obtained from the spectral radiation in most areas of Southwestern Nigeria show that December has more turbidity coefficient. The Harmattan season is categorized into periods with moderate characteristics called the background Harmattan. The Harmattan parameter seems to decrease as the intertropical discontinuity (ITD) moves toward the north and increase when it migrates to the south. The coefficient α displays an increase toward the northern movement of the ITD and exhibits decrease when it drifts toward the southward.^[10]

The different articles discussed the contributions of dust particles to the atmospheric scattering, reflection, and deflection. The desert dust has more impacts on air quality or human health. The global analysis is concerning about 48% of Asia dust and 39% of Saharan dust, with the remaining 13% being distributed as other sources of dust.^[11]

The Harmattan is a season in the West African subcontinent. The name comes from or is related to Ga Harmattan. “The Harmattan, which is caused by shifting weather patterns,

derives its name from the word for ‘tears your breath apart’ in the West African language. The Harmattan is characterized by the distribution of frequency of occurrence that contained two important variables of thick dust haze and light dust haze.”^[12] The factors responsible for the distribution of the Harmattan are the latitudinal and longitudinal distances from the source and the elevation. It occurs between November and February. Most of the results obtained during the Harmattan season reveals that the effect of the Harmattan is high from November to January but highest in December.^[13]

COMMON ILLNESSES ASSOCIATED WITH HARMATTAN

Cold

It is a viral infection of the upper respiratory tract that affects the nose. Coughing, sore throat, runny nose, sneezing, and fever are signs of the disease. Moreover, you know that the weather can be cold during Harmattan, so it is very important to wear appropriate clothing to keep you warm and the cold out.

Dry skin

This condition is very common during Harmattan. You know your skin feels very dry and rough. To prevent these very uncomfortable feelings, avoid using very harsh soaps this period, apply moisturizers frequently on your skin that can protect the skin from dryness, and make sure you drink lots of water.

Catarrh

This is unpleasant nasal congestion with a build-up of mucus, usually in the nose, throat, or chest. Ensure you take lots of fruits and vegetables with Vitamin C to help boost your immunity and protect you from this infection. Moreover, for those who might have already caught it, just take looks of fruits with Vitamin C and inhaling steam from a bowl of hot (but not boiling) water also helps.

Asthma

This is the best time for asthma patients to take a lot of care to protect them because they usually have a lot of attacks during this period because of the Harmattan dust. Wear appropriate clothing; do not expose yourself to dust or cold.^[14]

Cough

This is a reflex action that helps clear airways of mucus and irritants, such as dust or smoke, which are not alien to the Harmattan period. To prevent this, wear a nose mask when out and about in town. Moreover, for those who might already have it, just increase your fluid intake. What this does is to keep the mucus thin and helps cough it up.

Harmattan also has harmful effects on the respiratory system. This, he/she added, is because this system communicates directly with the atmosphere. The dust particles may overwhelm the system and predispose it to infection. It is a commonplace to experience excessive sneezing, cough, catarrh, and even nasal bleeding. Individuals with pre-existing

chronic chest infections, such as asthma, should take special precautions to reduce exposure to the dusty atmosphere, in addition to having their inhaler with them all the time. In Harmattan season, it is observed that there are a lot more solids in the air because of the dust, so the air is heavier and more irritating to the nose. The inner of the nose is very soft and delicate just like a blanket, and the nose produces this mucus that makes it a lot more comfortable so when there is a lot more dust, that blanket is almost overcome. The nose, in a way, to protect itself or reacts to it, and in some people, this is excess. Moreover, that is what we call allergy. Allergy is a special disease in which the body tries to fight the alien things coming in. You have the dust, pollen, and hay fever.^[7]

Human as a product of the environment is affected both negatively and positively by the later just as the environment is in turn influenced by him/her. The climate of all the environmental factors is the most important, affecting health indirectly through its influence on plants, animals, insects, and microbes and directly by affecting the body's physiological reserves. Murtala maintains that Harmattan wind is accompanying by different types of disease which affects human health. During this period, the eyes are directly exposed to the harsh weather, especially the dust particles carried by the wind. This itching, foreign-body sensation, and redness may be common, especially in individuals with allergic eye disease. The respiratory system, because of its direct communication with the atmosphere, is heavily and badly affected. The resultant effect is damage to the system predisposing to infection. Excessive sneezing, cough, and catarrh are some of the symptoms common to most people. The Harmattan is not the best of the weather for people with a pre-existing chronic chest infection; worthy of mention is asthma, a chronic (long-term) disease that makes it hard to breathe due to the inflammatory congestion in the lower respiratory tract. The dry, cold, and dusty wind associated with Harmattan also triggers sickle cell crises in affected individuals. Sickle cell anemia to recall is a genetic disease in which the red blood cells become sickle under a condition of low oxygen tension, leading to blockage of small blood vessels.^[14]

Humidity drops to as low as 15% which can result in spontaneous nosebleeds for some people. Other health effects on humans may include the condition of the skin, eyes, and respiratory system, including aggravation of asthma.^[15]

GEOGRAPHICAL RISKS ASSOCIATED WITH HARMATTAN

Fire outbreaks

Fire outbreaks constitute one of the common risks during Harmattan. This is as a result of the Harmattan, which is associated with dryness and wind. Between November and March, quite a lot of fire outbreaks are often recorded since there is the dry wind, which makes it easy for the fire to spread at the slightest ignition.

Poor visibility

The Harmattan haze with extremely dry dusty wind blows

from the Sahara toward the Western Coast of Africa. This can reduce visibility. Pilots should also take note that visibility is reduced due to the high concentration of dust particles in the air which may sometimes impede air travel.

Health hazards

Allergies

Since there will be severe cold mixed with dust, people with asthmatic conditions and any sort of inhalant allergies are advised to take precautions because this is the period when they will be inhaling all sorts of dust. This is the period when the asthmatic suffers more crises. Many also suffer pneumonia and bronchitis, especially the very young and the aged. Those who are allergic to cold should also endeavor to go for thick clothing that can cover them up.

Skin

The skin is usually dry with accompanying cracking of the lips, sole of the feet, and even the skin itself. The skin can be kept healthy by topical application of oily creams and weather-friendly dressing. This is perhaps the best time to explore the cultural advantage of wearing flowing attire and suits.

Eyes

The eyes are directly exposed to the harsh weather, especially the dust particles carried by the wind. Thus, itching, foreign body sensation, and redness may be common, especially in individuals with allergic eye disease. Proper eye hygiene in the form of washing with clean water, reduced exposure to dust, and protective spectacles are advocated.

Sickle cell anemia

The dry, cold, and dusty wind associated with Harmattan also triggers sickle cell crises in affected individuals. Sickle cell anemia to recall is a genetic disease in which the red blood cells become sickle under a condition of low oxygen tension, leading to blockage of small blood vessels. The reduced blood supply to the tissues results in pain, especially from the bones. The blood oxygen is usually reduced in extremes of temperatures, cold in this case. "Sicklers," as the patients are often referred to, should be vigilant and keep warm as much as possible to prevent crises.

Foodborne diseases

Because of the dusty atmosphere, there is a need to imbibe healthy food preservation culture, especially food hawkers such as fruits and vegetables, to prevent foodborne diseases. Fruits and vegetables should be properly washed before eating. Our drinking water containers should also be properly covered.

Dehydration

Lots of fluid should be taken to compensate for the loss of water from the body into the atmosphere through respiration perspiration and urinating. Harmattan is the period when the throat gets sore, sneezing is frequent, sometimes the eyes become watery or reddish, frequent headaches, sputum in your

saliva because of catarrh, and then cold and over time, cough, all these symptoms for just one season.

Olaifa *et al.*, 2013^[16] stated that the Harmattan season differs from winter because it is characterized by cold-dry wind, heavy dust-laden particles, and wide fluctuations in day and night ambient temperatures. The Harmattan wind is considered a natural hazard because, during its passage over the desert, it picks up fine dust particles and can push large quantities of sand and dust, facilitating the spread of wind-borne diseases for thousands of kilometers. In spite of the deleterious effects of the Harmattan season on humans and its wide coverage through the Sahara desert into the Gulf of Guinea, temperatures can easily be as low as 90°C (48°F) all day, but sometimes in the afternoon, the temperature can also soar to as high as 30°C (86°F) while the relative humidity drops under 10%. The air is particularly dry and desiccating when the Harmattan blows over the region. The Harmattan brings desert-like weather conditions; it lowers the humidity, dissipates cloud cover, prevents rainfall formation, and sometimes creates big clouds of dust, which can result in dust storms or sandstorms. Humidity drops to as low as 15% which results spontaneously in nose bleeding for some people. The health effects on humans may include the condition of the skin, eyes, and respiratory system, including aggravation of asthma.

Figure 1 is the level of Harmattan as it affects West Africa and Northern/Central Nigeria.

MATERIALS AND METHODS

Study area

Keffi is an urban settlement situated near to the Federal Capital Territory, Abuja; the site is attractive that most of the workers in the capital settled in the town and its environs. The original founder of the city is dated back 1804 of the renown Fulani Jihadist called Abdul Zanga. The presence of many servicing industrial and institutions had made the city rapid development. The population sprawled.

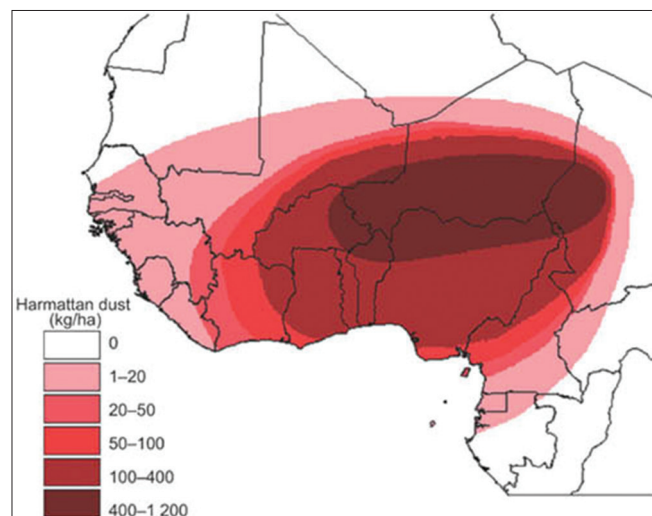


Figure 1: Harmattan in West Africa

Location

The study area is located at Latitude 8°51'57.16"N, Longitude 7°51'40.49"E and Latitude 8°50'42.19"N Longitude 7°54'52.16"E [Figure 2].

Climate and vegetation

The southward retreat of the ITD introduces dry season conditions when the tropical continental air prevails. The area is located in the humid zones of the tropics. Rainfall is bimodal and ranges from 1500 to 2000 mm, which occurs from April to early November yearly^[17] Harmattan wind or the cool northeastern wind blows in the area and it is intense in January and February. This is characterized by thin dust from the Sahara. Relative humidity varies from 80% between July and August to 60% between January and February. The monthly average temperature ranges from 28°C to 29°C in July and August and 34°C to 36°C in February and March.^[18]

However, due to persistent clearance of this area for farming and urbanization with deforestation, fuel wood, and timber extraction, bush burning, and animal grazing during the dry season also degrade the forest and putting it at different stages of regrowth and which made the Harmattan haze more pronounced.^[19]

Data collection and presentation

For the purpose of this study, the samples were collected in the field which responses are based on the random sample with an interval from 01-05-10-15 are selected from the field randomly. Respondents in the study area cover adults, comprising male and female who are presumably involved in responding to the questions allocated about the Harmattan and its impacts on human health. About 100 samples of data were administered. The raw data are processed using multiple regression analysis and correlations. The percentage and the model fit from the root mean square error (R^2) and regression analysis are analyzed.

RESULTS AND DISCUSSION

Evaluation of the impact of Harmattan on human health in Keffi

The respondents from the study area are identified with different symptoms emanating from the impact of Harmattan.

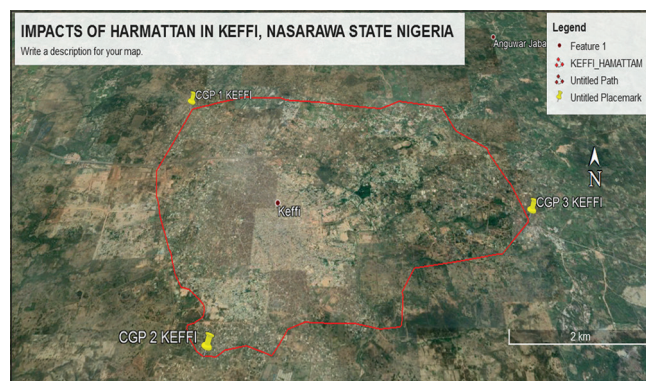


Figure 2: Satellite captured the Harmattan-affected area in Keffi

Table 1: Impact of Harmattan on human health in Keffi

| Serial number | Impacts of Harmattan | Respondents |
|---------------|--|-------------|
| 1 | Poor visibility and transport accident | 30 |
| 2 | Affect human health | 10 |
| 3 | Slowdown economic and production rate | 10 |
| 4 | All of the above | 50 |
| Total | | 100 |

Table 1 illustrates the problems associated with the ill-health condition during the hard season of Harmattan in Keffi.

The impacts of Harmattan have positive regression analysis with 0.16. On the basis of analysis, the respondents with highest percent agreed that Harmattan is the causes unhealthy conditions in Lokoja with 50% [Figure 3]. Poor visibility results in road accident with 30%. In addition, it is give impact on both human health and the slowdown of economic growth have 10% each.

Table 2 confirms the data on the effect of Harmattan on human health. Those who agreed strongly about the ill-health condition of Harmattan in Keffi have the highest percentage of 71%. From the regression analysis, it can indicated as positive result as stated in figure 4.7 with 0.67. People are somehow well prepared for the Harmattan season because of the awareness of the devastating effect of the Harmattan on human health [Figure 4].

The common diseases affecting people during the Harmattan period include catarrh, sexually transmitted diseases, and dryness of the skin and lips as shown in Table 3.

All the common diseases associated with Harmattan are perfectly fit with 0.64 positive regression analyses as in Figure 5. Figure 5 illustrates 40% to be the highest percentage. Most of the respondents confirmed that they are severely affected and experienced dryness of the skin and lips during the Harmattan season in Keffi. While over 20% suffered from flu and catarrh, there are also reports of sexually transmitted disease due to cold temperature which culture bacteria, especially in humid tropical.

The months of the commencement of Harmattan vary from place to place in Nigeria, depending on the proximity to the Northeast trade wind that blows from the Sahara desert as stated by de Longueville *et al.*, 2010;^[11] this result agrees with the above statement. Table 4 presents the data on the months of Harmattan severity in Keffi.

50% of the respondents stated that December to January has high severity of Harmattan wind, dust, and haze as clearly presented in Figure 6. Based on the analysis, the Harmattan commences from November and increases around late February. However, the model fit had shown that 0.23 of the regression analyses have confirmed the time of the Harmattan commencement in Keffi.

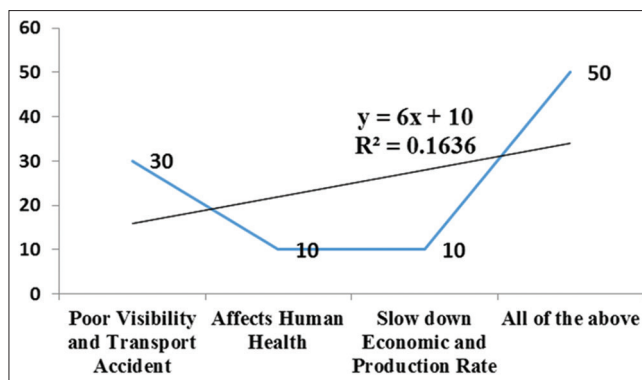


Figure 3: Equation showing the impact of Harmattan in Keffi

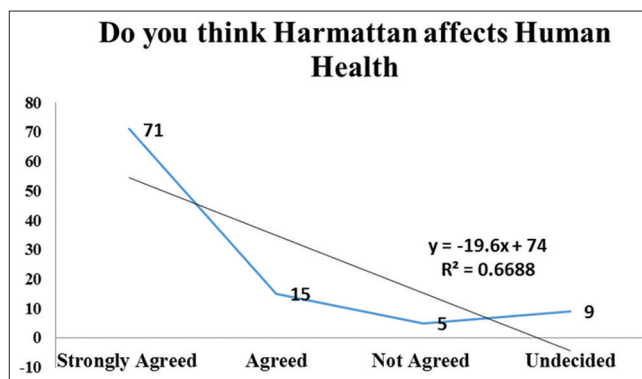


Figure 4: Effects of Harmattan on human health in Keffi

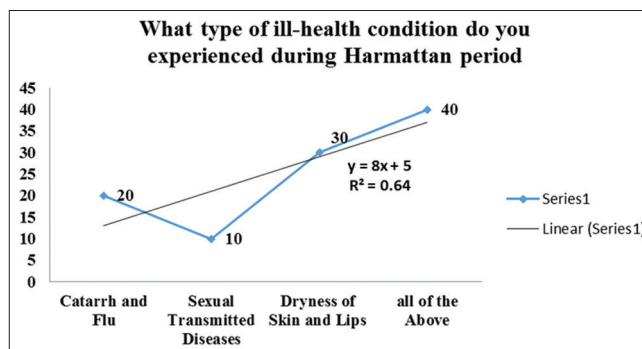


Figure 5: Ill-health condition experienced during Harmattan

Examining the effects of the Harmattan on human comfort in Keffi

The various factors are associated with Harmattan being spell out in the field. These include the human, geomorphic, and climatic factors as presented in Table 5.

Figure 7 shows the result obtained about the factors influencing Harmattan in Keffi. 40% of the respondents have chosen climatic factor to be the dominant factor in controlling Harmattan. 19% have chosen the anthropogenic factor, 11% have agreed on the geomorphic factor, while over 30% selected all the factors which influence Harmattan in the study area.

Harmattan is considered to be a threat in the regional environment such as Keffi that adversely has an impact on human health. The

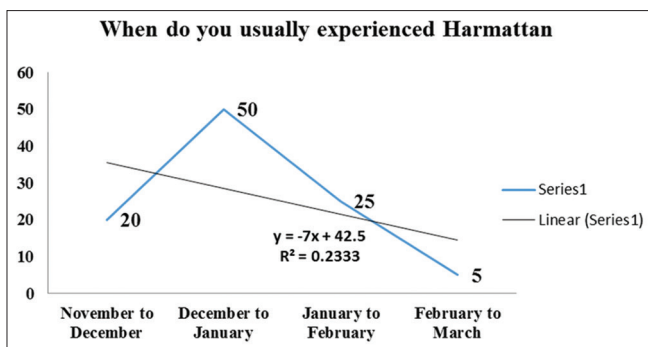


Figure 6: Highest months severe Harmattan in Lokoja

| Serial number | Effect of Harmattan | Respondents |
|---------------|---------------------|-------------|
| 1 | Strongly agreed | 71 |
| 2 | Agreed | 15 |
| 3 | Not agreed | 5 |
| 4 | Undecided | 9 |
| Total | | 100 |

| Serial number | Ill-health conditions | Respondents |
|---------------|----------------------------|-------------|
| 1 | Catarrh | 20 |
| 2 | Sexual transmitted disease | 10 |
| 3 | Dryness of skin and lips | 30 |
| 4 | All of the above | 40 |
| Total | | 100 |

| Serial number | Severe months of Harmattan | Respondents |
|---------------|----------------------------|-------------|
| 1 | November to December | 20 |
| 2 | December to January | 50 |
| 3 | January to February | 25 |
| 4 | February to March | 5 |
| Total | | 100 |

| Serial number | Harmattan influence | Respondents |
|---------------|----------------------|-------------|
| 1 | Anthropogenic factor | 19 |
| 2 | Geomorphic factor | 11 |
| 3 | Climatic factor | 40 |
| 4 | All of the above | 30 |
| Total | | 100 |

analysis indicates that an increase in Harmattan dust and haze reduces the rate of visibility in the town. The temperature trend in Keffi has shown an increase in long-term annual temperature because of global warming and anthropogenic activities.

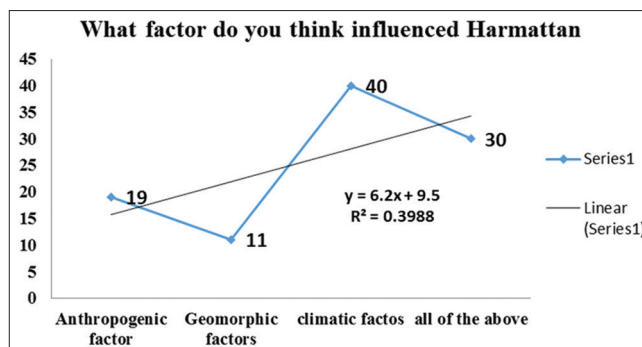


Figure 7: Factors influencing Harmattan in Keffi

Adefolalu, 1984^[9] viewed Harmattan with respect to the particulate matter and aerosol that has a long effect on human health. In this study, the general perception of individuals agreed that Harmattan has great impacts on human health. Adeniran *et al.*, 2018^[20] used meteorological data to access the impact of Harmattan and its exposure to respiratory diseases. This can be compared with the section of climatological ambient such as temperature to assess the effects of Harmattan on human health in Keffi.

Adeyefa *et al.*, 1995^[10] classified Harmattan season into moderate or background Harmattan in Nigeria. However, in another study similar to this, Adepetu *et al.*, 1988^[8] collected six different samples from Harmattan dust and analyzed about 29 elements using instrumental neutron activation analysis.

This study confirmed that Harmattan immates from the northeastern part of Nigeria from December to January every year, which is slightly different from the study done by Breuning-Madsen and Awadzi, 2005,^[11] in Ghana whereby their Harmattan season lasting from February to March.

The study made by Dimari *et al.*, 2008^[21] traced out heavy metals from the Harmattan dust (As, Cd, Cr, Cu, Fe, Ni, and Pb) that portends influence and impacts on human health such as cardiovascular diseases and the environment. This study has to portrait the major diseases such as flu, sexually transmitted diseases, dryness of skin and lips having prevalence and having more impacts on human health during the Harmattan season.

The Harmattan dust particle affects negatively on the health of the people causing the respiratory disease to adult and children. Health cases such as cough, catarrh, and respiratory disease are mostly reported in the hospitals during the Harmattan season.^[22] The skin is usually dry with accompanying dry cracking of the lips. The Harmattan season is perhaps the best period to explore the cultural advantage of wearing Babban Riga and suits as it pleases one to keep warm. As we use various means depending on one's socioeconomic status to keep ourselves and our homes warm, extra caution must be taken to prevent fire outbreaks. The need for shelter cannot be overemphasized at this cold dusty period.^[21]

CONCLUSION

The common diseases affecting people during the Harmattan

period include catarrh, sexually transmitted diseases, and dryness of the skin and lips as shown in Table 3. All the common diseases associated with Harmattan are perfectly fit with 0.64 positive correlation analyses as in Figure 5.

The regression analysis in Figure 7 has shown a positive slope with all the results agreed that both climate and the environment, as well as human activities, induce the rate of Harmattan in Keffi, a middle belt of Nigeria. The atmosphere is usually filled with a lot of dust in suspension and carried a long distance in wind regimen with dire consequences on human health and comfort.

The maximum and minimum temperature during the Harmattan season has a great effect on human health and comfort. Harmattan arises due to synoptic scale gradients that align north–south across the Saharan desert, and it is one of the major wind systems of Africa. However, for the local population and for the global climate system, the Harmattan remains extremely important as a significant quantity of mineral dust is advected southward across the region, leading to a major impact on local visibility.

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Conflicts of interest

There are no conflicts of interest.

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