ASSESSING THE EFFECT OF HAZE ON AIR TRANSPORT AT UMARU MUSA YAR`ADUA AIRPORT KATSINA, KATSINA STATE, NIGERIA

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ABSTRACT

It is obvious that weather plays a significant role in all aspect of human being. Weather has tremendous influence on air transport. The measurement of weather elements provides information on the state of any prevailing weather at any point in time thereby preventing accidents, delays, diversions and cancellations of flight as well as economic losses and passengers` inconveniency with a view to promoting the status of the transport industry especially air transport. It is against this background that this paper aimed at assessing the effect of haze on air transport at Umaru Musa Yar`adua airport Katsina State, using the data sourced at the airport from 2005 to 2014. Data obtained for this study were analyzed using descriptive and inferential statistics using product-moment correlation coefficient(R). Results obtained indicate high frequency of flight cancellations in the months of January, December, March and February in the study period from 2005 to 2014 due to haze disaster. Significant correlation also exists at 0.05 significant level between the minimum poor visibility level of flight cancellation (meters) and total number of flight cancellation in January and April both at P-value =0.632 respectively. It recommended based on these findings that the aviation bodies that concerned with safety rules should ensure the accuracy of weather reports and safety regulations to avoid or minimize the impact of haze disaster on aviation in the study area.

Keywords: Effect, Haze, Disaster, Air, Transport

Introduction:

Haze is traditionally an atmospheric phenomenon where dust, smoke and other dry particles obscure the clarity of the sky. The World Meteorological Organization manual of codes includes a classification of horizontal obscuration into categories of fog, ice fog, steam fog, mist, haze, smoke, volcanic ash, dust, sand and snow sources for haze particles include farming (ploughing in dry weather), traffic, industry, and wildfires, (Wikipedia, 2015). Haze may appear brownish or bluish, while mist tends to be bluish-grey. Whereas haze often thought of as a phenomenon of dry air, mist formation is a phenomenon of humid air. However, haze particles may act as condensation nuclei for the subsequent formation of mist droplets; such form of haze is known as "wet haze." The term "haze", in meteorological literature, generally is used to denote visibility-reducing aerosols of the wet type. Such aerosols commonly arise from complex chemical reactions that occur as sulfur dioxide gases emitted during combustion that converted into small droplets of sulfuric acid. The reactions are enhanced in the presence of sunlight, high relative humidity, and stagnant airflow. A small component of wet haze aerosol appears to be derived from compounds released by trees, such as terpenes. For all these reasons, wet haze tends to be primarily a warm-season phenomenon. Large areas of haze covering many thousands of kilometers may be produced under favorable conditions each summer (Wikipedia, 2015). Haze often occurs when dust and smoke particles accumulate in relatively dry air. When weather conditions block the dispersal of smoke and other pollutants they concentrate and form a usually low-hanging shroud that impairs visibility and may become a respiratory health threat. It is also defined by the National Oceanic and Atmospheric Administration (NOAA) as an aggregation in the atmosphere of very fine, widely dispersed solid or liquid particles, or both, giving the air an opalescent appearance that subdues colors (Robert *et al.*,.2011)

In some countries in West African like Ghana and Nigeria, the heavy amount of dust in the air can severely limit visibility and block the sun for several days, comparable to a heavy fog. The dry air can break the trunks of trees growing in the region. The effect caused by these winds is known as the Harmattan Haze, which cost airlines millions of dollars and diverted flight each year, (Wikipedia, 2015). Poor visibility is the single most important weather hazard to all forms of transportation especially air transportation (Ayoade, 2004). Shadere (2005) reported that poor visibility is perhaps a greater danger to safe plane landing because control over it is more difficult than flooding on the runway. Poor visibility can be caused by thick fog, snow, rain, thunderstorm, Harmattan dust, mist, volcanic ash or smoke, urban smoke, low ceilings and even smog. Study by Riehl (1965) has shown that low ceilings and visibilities cause the major traffic disruptions at airport terminals, and the problem remain unchanged over the years. In addition, Smith (1975) reported that despite increasing sophistication of automatic landing equipment, poor visibility from layer of fog, mist or thick haze and low cloud ceilings is probably the major impediment to airport operations throughout the world. For instance, the Sosoliso plane crash in 2006 was partly cause by poor visibility because of thunderstorm and rain when trying to land in Port Harcourt airport (Ayigbe, 2006). Also NiMet (2019) revealed that, the accepted state of the atmosphere in the comings days will likely disrupt flight operation, cancellation and delay of flights at some airports across the country are anticipated especially over the Northern States. It furthered stated that fresh dust plume would propagate into Nigeria and this would deteriorate horizontal visibilities across the country. Road users are also advised to exercise caution and avoid over speeding especially during early morning period when horizontal visibility is impaired by fog, mist or dust haze (NiMet, 2019). Despite high rate of growth and reasonable financial results generated by the aviation sector, during the haze there is a decline in the number of passengers that tend to travel by air, leading to low income to the airport or aviation sector as the case for Umaru Musa Yar`adua Airport Katsina, in Katsina State, Nigeria. Haze has been a threatening factor on air transport in this airport because whenever the level of Haze density is high; there was always massive flight cancellation and flight diversion that lead to customers' uncomfortable and discouragement. Abubakar and Nurudeen (2011) also reported the cases of flight delay and cancellation because of poor visibility. They reported that flights from Kano, Abuja, Yola and other parts of the North especially, were delayed for 2 hours and above due to poor visibility. NIMET (2011) reported that the year 2010 witnessed a few instances of disruptions due to severe weather conditions. According to Rieka (2015), he said at least six airlines canceled flights on Tuesday from Sultan Thaha Airport in Jambi city due to the intensity of haze. The haze, caused by farmers who burn forests to clear their land for agriculture, is an annual occurrence that sends smog wafting northward to Singapore and Malaysia. Climatology can anticipate significant changes in local weather as well as severe weather pattern, heavy rain, thunderstorms, hailstones, haze, cyclones are all common, resulting in losses in the aviation industry as well as delayed or cancelled flights (WMO, 2007) It is against this background this paper attempted to investigate the effect of haze on air transport at Umaru Musa Yar`adua airport, Katsina from 2005 to 2014. Specifically, the study intended to achieve the following objectives:

i. Determine the minimum visibility level of flight cancellations in the study area from 2005 to 2014

ii. Identify the number of flight cancellations in the study area from 2005 to 2014

iii. Describe the patterns of flight cancellations in the study area from 2005 to 2014

iv. Relate the minimum visibility level of flight cancellation with monthly total number of flight cancellation in the study area from 2005 to 2014

Material and Methods:

The Study Area

Umaru Musa Yar'adua Airport lies on the latitude 13°00´28´´N and longitude 007°39´37´´E, located at the North- East of Katsina city, 4 kilometers away from the city center of Katsina on the highway from Katsina to Daura in Katsina city (Figure 1). It is the only airport serving Katsina state, named after the late president Umaru Musa Yar'adua. It provides excellent flight services to destinations in Nigeria and Saudi Arabia during Hajj period, (FAAN, 2009). Katsina lies between latitudes 12°54´N and 13°49´N, longitudes 7°36´E and 7°41 north of the equator. It is bordered with Kaita to the north, Jibia local government Area to the west and Batagarawa Local Government Area to the south and Rimi local Government Area to the east (Figure.2).

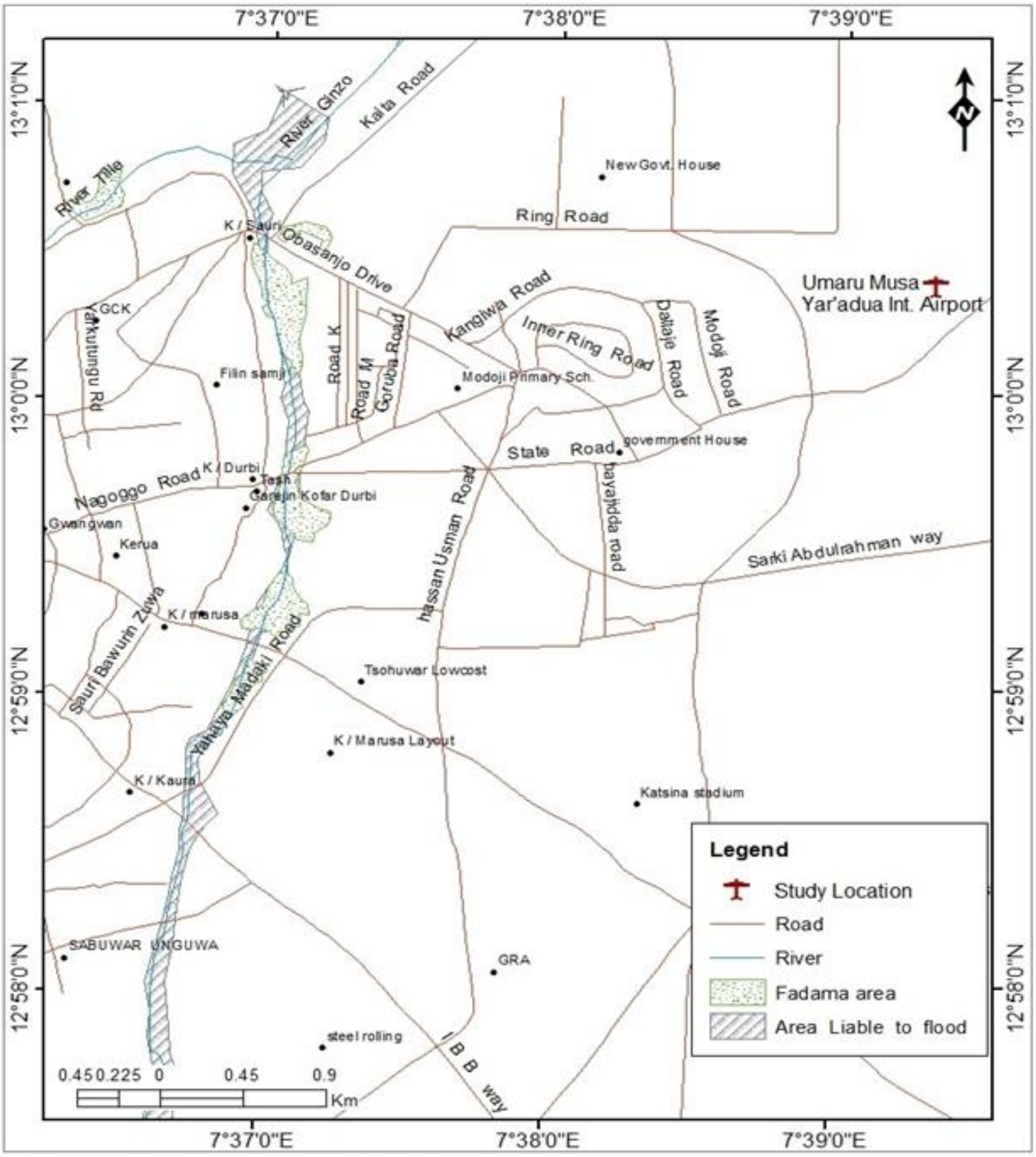


Figure 1: Study Location and it's Neiboring Settlements.
Source:- Geography Department UMYU, 2015.

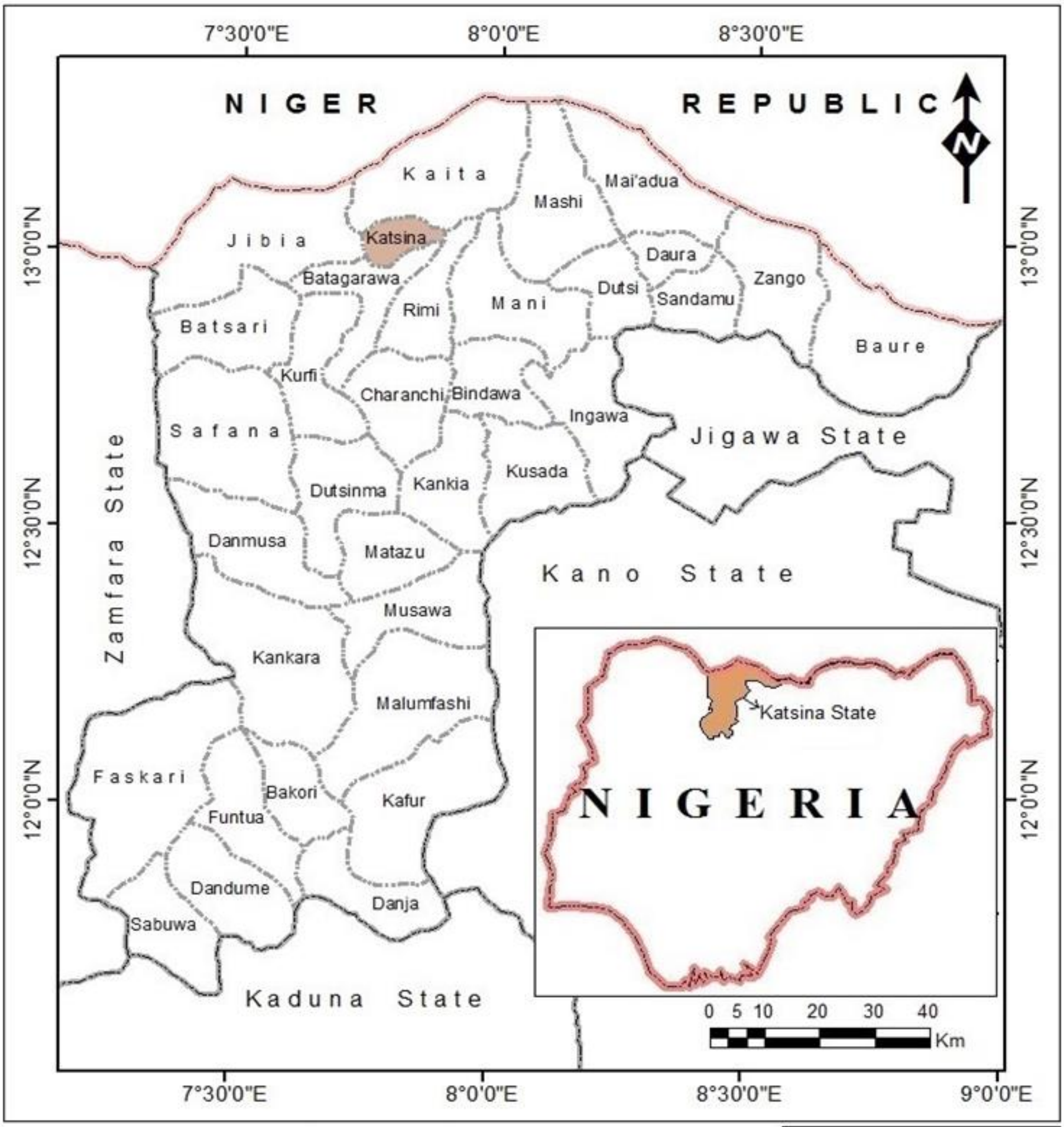


Figure 2: Katsina State Showing Katsina Local Government Area.
Source:- Geography Department UMYU, 2015.

Legend
- State boundary
- L.G.A. boundary
- Int.boundary
- Study Area

Types of Data Utilized

The types of data utilized in this study include, visibility level in meters of flight cancellation, annual and monthly number of flight cancellations for period of ten years (2005-2014),

Sources of Data

Data for this study were sourced from secondary source. The data on visibility level and level of flight cancellations were sourced from the Meteorological Department of Umaru Musa Yar'adua Airport for the period from 2005 to 2014. Data on the number of flight cancellations were sourced from the visibility data of the Department.

Hypothesis

The null and its corresponding alternative hypothesis for this study is stated as follows:

i. H_0: There is no significant correlation between the minimum visibility level of flight cancellation(meters) and monthly number of flight cancellations from 2005 to 2014 in the study area

ii. H_1: There is significant correlation between the minimum visibility level of flight cancellation(meters) and monthly number of flight cancellations from 2005 to 2014 in the study area.

Statistical test was carried out using Product-Moment Correlation Coefficient (R) and population correlation coefficient (P) at 0.05 significant level two- tailed test.

Data Analysis

Descriptive and inferential statistics using product- moment correlation coefficient (r) were employed for data analysis. The data obtained on the visibility level, level of flight cancellations and the number of flight cancellation in the study were analyzed and presented in frequency tables and bar graphs using Microsoft Excel statistical package. Data on visibility level of flight cancellations were correlated with monthly total number of flight cancellations using Product- Moment Correlation Coefficient (R) for the study period.

Results and Discussion

Visibility levels Resulted in Flight Cancellations

The visibility levels resulted in flight cancellation due to haze in the study area from 2005 to 2014 are presented in Table1. Data presented in the Table indicate that the visibility level of flight cancellations ranges between 00-800m, which is the lowest visibility range level and has the highest frequencies of disruptions due to haze condition in the airport. It was the substantial level of disruptions of the airport for poor visibility.

Table 1: Visibility Level Resulted in Flight Cancellations due to Haze

Years	Visibility Level of Flight Cancellations (Meters)
2005	00-800
2006	100-800
2007	150-800
2008	100-800
2009	50-800
2010	50-800
2011	100-800
2012	150-800
2013	100-800
2014	100-800

Source, UMY Airport Katsina, 2015

Annual Number of Flight Cancellations Due Haze

The annual number of flight cancellations due to haze were analyzed and presented in Figure 3

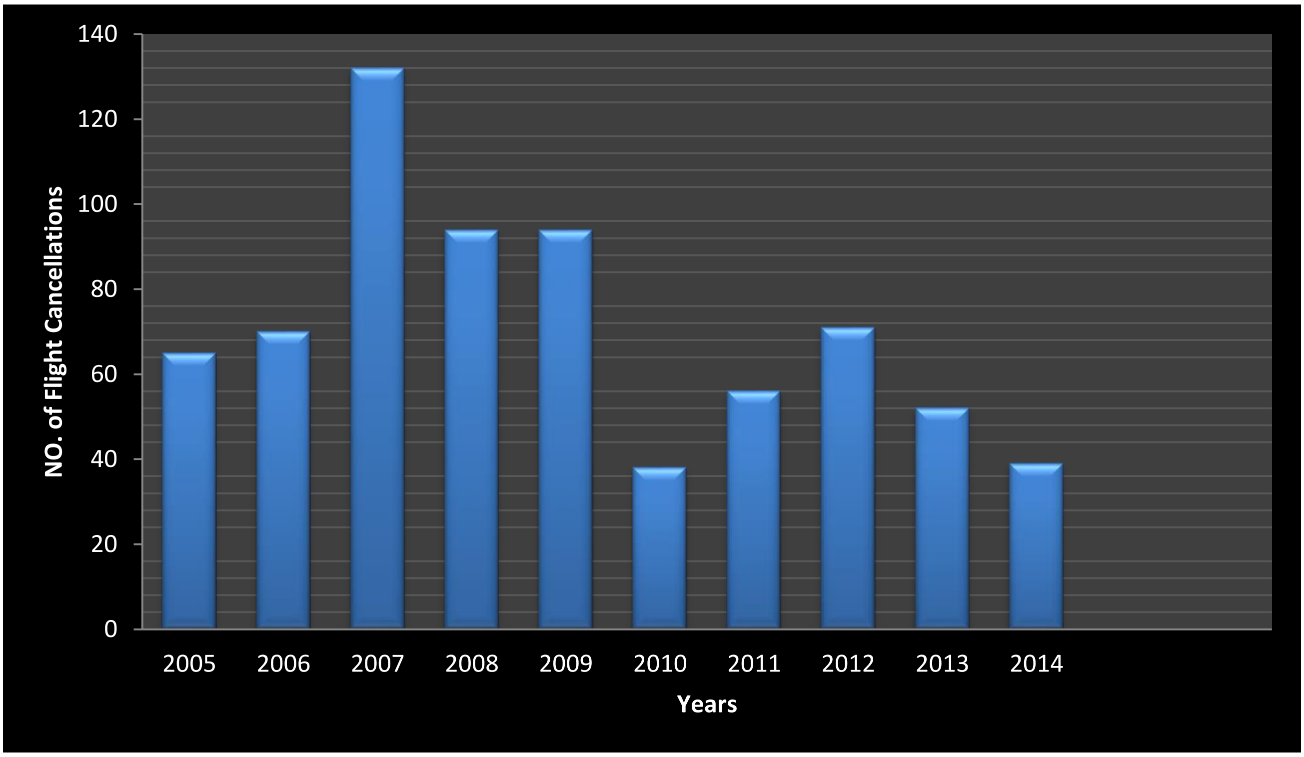


Figure 3: Annual Number of Flight Cancellation due to Haze from 2005 to 2014

Data presented in Figure 3 indicates that the recorded highest flight cancellation was in 2007 with 132 cases of flight cancellations. This indicates that 2007 experienced much haze dust than the other years in the study period. The year 2010 and 2014 recorded the least cases of flight disruption, with 38 and 39 cases of flight cancellations respectively.

Pattern of Monthly Number of Flight Cancellations Due to Haze

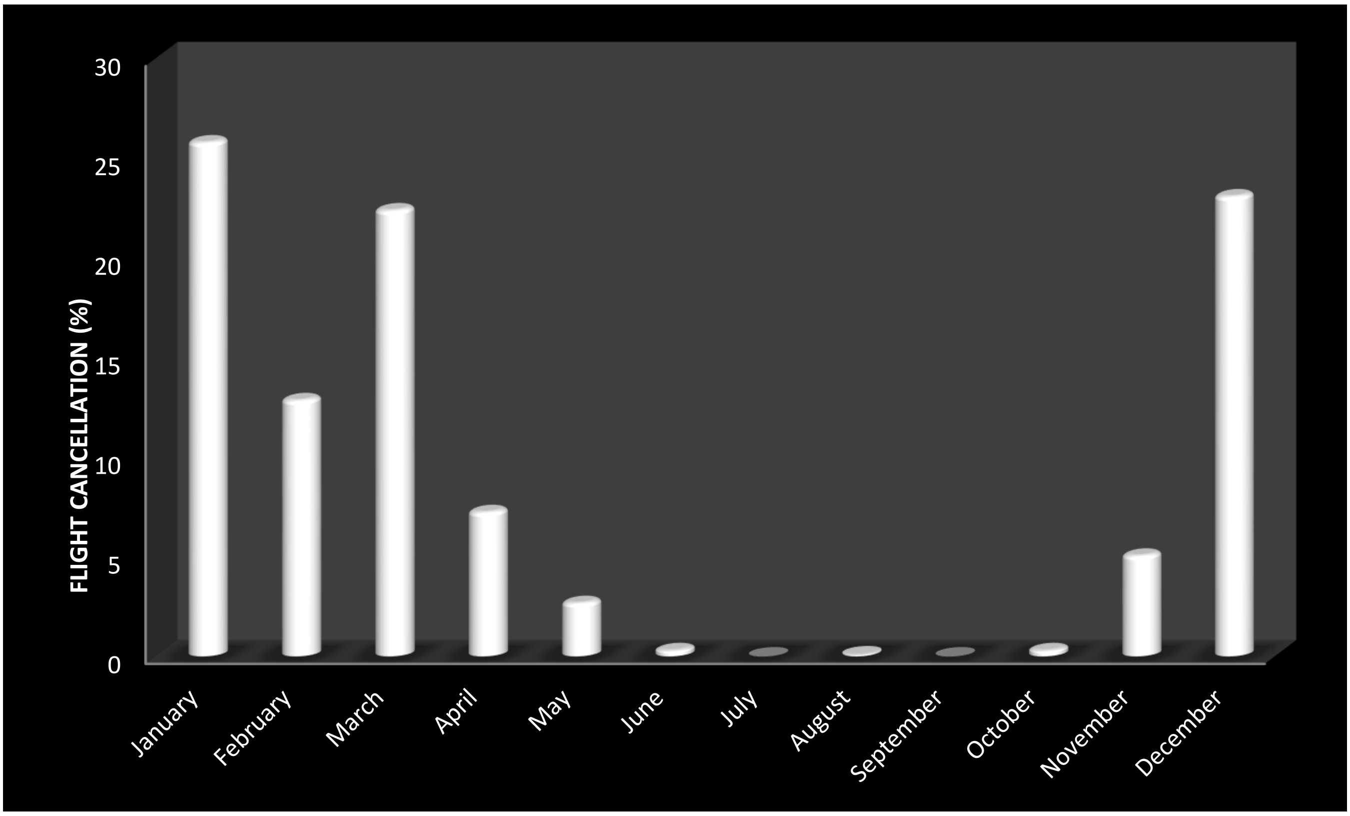
The distribution pattern of monthly number of flight cancellations due to haze in the study period is presented in Table 2.

Table 2: Distribution Pattern of Monthly number of Flight Cancellations Due to Haze from 2004 to 2014

Months/Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
January	46	5	39	21	17	5	22	6	11	12	184
February	5	0	3	29	35	2	1	5	6	6	92
March	4	1	43	6	35	21	6	39	2	2	159
April	2	7	16	14	0	4	0	1	3	5	52
May	2	0	7	1	0	4	0	0	0	5	19
June	0	0	1	1	0	0	0	0	0	0	2
July	0	0	0	0	0	0	0	0	0	0	0
August	0	0	0	0	1	0	0	0	0	0	1
September	0	0	0	0	0	0	0	0	0	0	0
October	0	0	1	1	0	0	0	0	0	0	2
November	6	18	0	10	2	0	0	0	0	0	36
December	0	39	22	11	4	2	27	20	30	9	164

Source: UMYU Airport Katsina, 2015

Table 2 indicates the distribution pattern of monthly number of flight cancellations due to haze from 2004 to 2014. It could be observed that there was 164 number of flight cancellations in the study period with month of January recorded the highest occurrence of flight cancellations with 184 flights cancelled followed by December with 164 flights cancelled, then March, February, April, December and May with 159, 92, 52, 36 and 19 flights cancelled respectively. This indicates that the months in which haze occurs and encourage flight cancellation in the study area are January, December, March and February and sometimes extend to April and May. The months of August, June, July and October recorded the least number of flight cancellations in the study period. In these months, the occurrence of dust haze hazard was rarely and any flight cancellation in these months could be due to the effect of rain. The percentages distribution patterns of monthly number of flight cancellations are illustrated in Figure.4.



Source: Data Analysis, 2015

Figure 4: Pattern Percentages of Monthly Flight Cancellations due to Haze

Data presented in Figure.4 reveal that January recorded the highest percentage of flight cancellation of 25.8% due to the effect of haze disaster, followed by December and March with 23.1% and 22.4% respectively. This finding reveals that the density of haze disaster is so great in the months of January, December and March and affected flight operations in the study area. These months corresponded to the time of low –Sun (winter) period in the area.

Test of Relationship

The test of relationship between the minimum poor visibility level of flight cancellation and monthly total number of flight cancellation in the study period was done with the reference to Table1 & 2. The summary results of this test are presented Table 3.

Table 3: Summary results on Test of Relationship between Minimum Visibility Level of Flight Cancellations (meters) and Monthly Total Number of Flight Cancellation Using Product-Moment Correlation Coefficient (R)

Months	Years	Degrees of Freedom (N-2)	Significant level Two-Tailed -Test	R-values	P – values	Remark
January	2005 to 2014	8	0.05	0.67	0.63	Rejected
February	2005 to 2014	8	0.05	-0.18	0.63	Accepted
March	2005 to 2014	8	0.05	-0.21	0.63	Accepted
April	2005 to 2014	8	0.05	0.87	0.63	Rejected
May	2005 to 2014	8	0.05	0.47	0.63	Rejected
November	2005 to 2014	8	0.05	0.13	0.63	Rejected
December	2005 to 2014	8	0.05	-0.37	0.63	Accepted

It could be observed from Table 3 in January at 0.05 significant level with 8 degrees of freedom, R-value 0.67 > P-value 0.63**.** Similarly, in April at the same significant level and degrees of freedom R-value 0.87 > P – value 0.63. Based on these the null hypothesis against each of these months is rejected. Meaning that there is significant positive correlation between the minimum visibility level of flight cancellation and the total number of flight cancellations in January and April from 2005 to 2014 in the study area. In February, March, May, November and December all theirs R-values were less than the P-values. For instance, in February the R-value was -0.18 and P- value 0.63, in March the R-value was -0.21 and P- value 0.63, in May R- value was 0.47 and P-value 0.63, in November the R-value was 0.13 and P-value 0.63 and in December the R-value was -0.37 and P- value 0.63 at 0.05 significant level respectively using two-tailed test. The null hypothesis against each of these months is accepted, because R-values were less than the P-values. Meaning that there is no significant correlation between the minimum visibility level of flight cancellation and the total number of flight cancellation in February, March, May, November and December from 2005 to 2014.

Discussion of Results

The study attempted to find out the extent or degree of the effect of haze on air transportation at Umaru Musa Yar`adua Airport, Katsina, Katsina State, Nigeria. Since the establishment of this Airport, it observed that very day especially during low-sun period; haze is one of major problems of flight operations causing much cancellation of flights in the Airport. Results of this study clearly revealed the effect of haze on air transportation in relation to visibility level of flight cancellation, annual and monthly number of flight cancellations and the distribution pattern of flight cancellation in the study area.

Table 1 indicated the visibility level of flight of cancellation was from 00 to 800 meters, indicating 800 meters being the minimum level of flight cancellation. This result was in line with that of Ehigiator and

Orakpo (2010) who reported places around Maiduguri, Potiskum, Nguru and Kano experienced severe Harmattan dust haze with the associated reduction in horizontal visibility level to less than 800metres, and in some days, horizontal visibility reduced in Maiduguri and Yola to less than 300metres. Data presented in Figure 3 revealed that the highest number of flight cancellation recorded was in 2007 and lowest in 2010. Result of 2010 was in line with NiMet (2011) which reported that 2010 witnessed a few instances of disruptions due to severe weather conditions. However, the month of March recorded a severe dust hazy spell, which reduced horizontal visibility to between 200m – 800m for several days and this caused many disruptions in operations across the country. This finding corresponded with the result obtained in Figure 3 and Table 2 in 2010. Results presented in Table 2 and Figure 4 revealed the monthly distribution patterns of flight cancellation due haze in the study period. The findings indicated the high frequency of flight cancellations due to haze hazard were so great in the months of January, December and March. The findings on test of relationship in Table 3 indicated significant positive correlation between the minimum visibility level of flight cancellation and the total number of flight cancellations in January and April from 2005 to 2014 in the study area This mean as poor visibility level of flight cancellation increases from 00-800meters due to haze, number of flight cancellations increase in January and April.

Conclusion

It had been observed that since the establishment of Umaru Musa Yar`adua Airport (UMYUA), weather variables played major problems to flight operations. Haze is one of major weather variables causing these major problems to flight operations in the airport. The study revealed the lowest visibility range level of 50 to 800m for flight cancellation due to effect of haze. The highest of number of flight cancellation in the study period (2005 to 2014) recorded was in 2007, 2008, 2009, and 2012. The distribution pattern of monthly number of flight cancellation revealed the month of January recorded the highest number of fights cancellation of 184 cases followed by December with 164 flights cancelled caused by haze disaster. Based on these results it recommended that the aviation bodies that concerned with safety rules should ensure the accuracy of weather reports and safety regulations to avoid or minimize the impact of haze disaster on aviation in the study area.

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