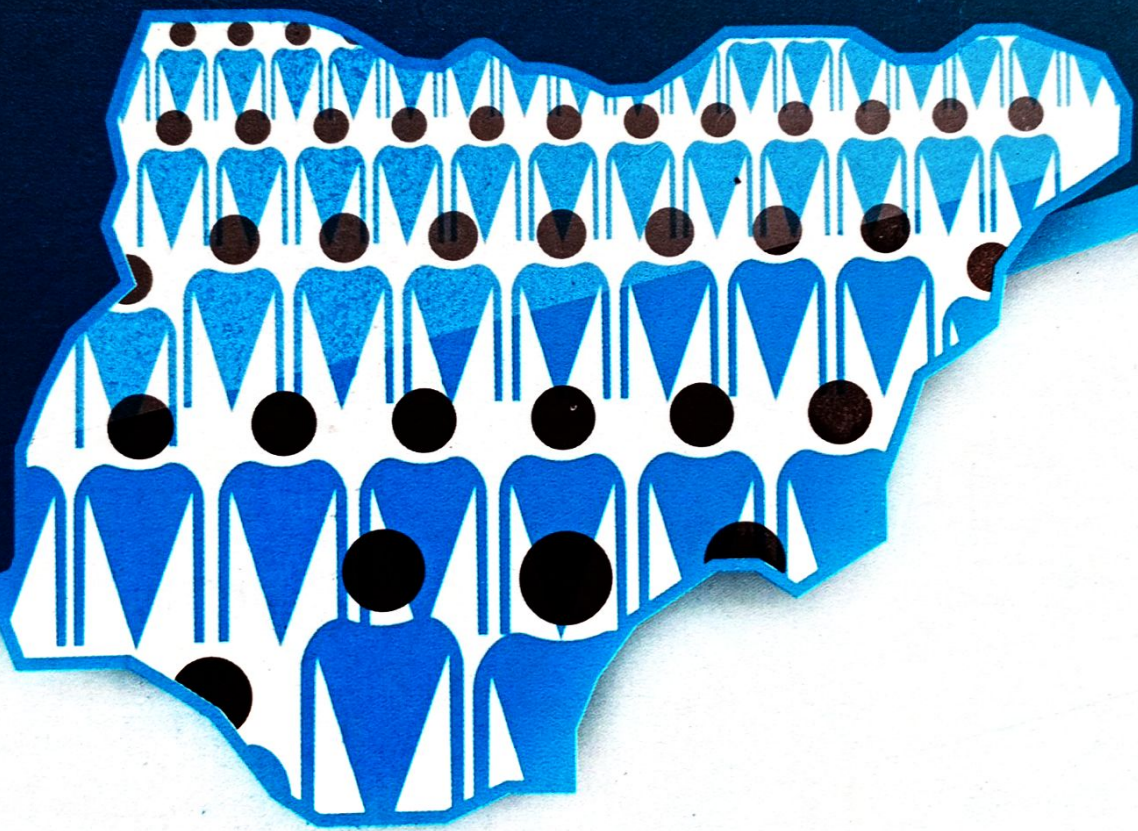


Contemporary Issues in the Nigerian Society



Edited by

Ayodele Jimoh, Ph.D.

Published by
Faculty of Social Sciences,
University of Ilorin, Nigeria

Copyright © 2016 Faculty of Social Sciences, University of Ilorin, Nigeria

A. S. ...

All rights reserved. This book is copyright and no part of it may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, electrostatic, magnetic tape, photocopying, recording or otherwise without the express written permission of the copyright owner.

ISBN: 978-978-54640-8-5

Printed in Nigeria by:

College Press

3, Baale Mosaderin Road, Jericho, Ibadan

08036694838, 08022900793

Table of Contents

Section A: Introduction

Chapter One: Introduction

Jimoh, A.

3

Section B: Economic Development

Chapter Two: Economic Development and the Nigerian State

Jimoh, A.

9

Chapter Three: Looking Backward and Thinking Forward: A Discussion of Fifty Years Economic Performance of Nigeria

Kilishi, A.A.

25

Chapter Four: Economic Planning, Reforms and Inclusive Growth in Nigeria

Yaru, A.A.

43

Chapter Five: Empowerment and Its Outcomes in Nigeria: The Missing Link

Ijaiya, G.T. and Ojuolape, M.A.

59

Section C: Transport and Development

Chapter Six: Weather and Safety Issues in Aviation: The Need for Action in Nigeria

Usman, B.A; Ifabiyi, I.P. and Kekere, A.A.

81

Chapter Seven: Planning for Non-motorised Transport in Nigerian Cities: Rights, Challenges and Prospects

Arosanyin, Godwin Tunde

97

Section D: Health, Agriculture, Climate Change and the Environment

Chapter Eight: Tobacco Use, Cigarette Smoking and Sustainable Development in Nigeria
Bello, R.A. 119

Chapter Nine: Dams and the "Damned": Impact of Dams on Indigenous Communities in Nigeria
Abdullahi, Ali Arazeem 137

Chapter Ten: Precipitation Features as an Index of Climate Change and Its Implications on Agriculture in Kwara State, Nigeria.
Olanrewaju, R.M. 159

Chapter Eleven: Dynamics of Nutrient Cycling in Cocoa Ecosystem in Nigeria
Ajibade, L.T. and Afolayan, O.S. 173

Chapter Twelve: Emerging Challenges in Agricultural Extension Service Delivery: A Perspective of Pastoral Livelihoods in Kwara State, Nigeria
Aderinoye-Abdulwahab, S.A., Adefalu, L.L., Dolapo, A.T. and Ladipo, F.O. 193

Section E: Politics and Development

Chapter Thirteen: Democracy, Local Government and Service Delivery in Nigeria since 1999
Aliu, Fatima O. and Ifejika, Solomon I. 215

Chapter Fourteen: Roles of Civil Society Organisations in Governance Process in Nigeria
Lawal, E. Ejalonibu and Bakare, Adebola Rafiu 235

Chapter Fifteen Enhancing the Performance of Nigeria's Foreign Service
Saliu, Hassan 261

CHAPTER SIX

Weather and Safety Issues in Aviation: The Need for Action in Nigeria

B.A. Usman, I.P. Ifabiyi, and A.A. Kekere

*Department of Geography and Environmental Management
University of Ilorin, Ilorin*

Introduction

From its very beginning, aviation has kept a very close relationship with weather. Although, recent years have seen greater advancements in aircraft technology, development in navigation systems and improvements in pilot training, weather has continued to be an important factor in aviation accidents. While human error continues to be the major direct cause, weather is a primary contributing factor in 23% of all aviation accidents and also accounts for a significant proportion of air delays worldwide. For instance, it accounts for about 70% air delays in the United States. In the same vein, rerouting and diversions resulting from convective hazards en route also increases operating costs and loss of passenger time (Kulesa, 2002).

The importance of weather and climate cannot be neglected in air safety issues. The aviation industry is vulnerable to projected climate change effects as the projected sea level rise of 0.3 m to about 1.0 m by the year 2100 will put at risk many coastal urban mass transits, highways, ports and airports from storm surges (Black, 1998). For instance, up to 34 airports in Europe are known to be at risk from projected sea level rise (European Union, European Aviation Conference (ECAC) and EUROCONTROL, 2010). Furthermore, rising temperatures reduce aircraft lift, with the result that aircrafts require longer take off runs and implying that there will be need for longer runways at many airports. This may also lead to changes in types of aircraft or aircraft maximum pay load. Changes in precipitation patterns will affect airport operations and design requirements. Therefore, many airports across the globe may require investment in drainage infrastructure to avoid disruption of airport operations (Centre for Aviation Transport and the Environment (CATE), 2010).

Air travel will also likely experience greater challenges from severe weather events in the near future. Extreme weather events such as "supercells" which are the highest class of thunderstorms constitute great risk to aircrafts because they are characterized by rain, wind, hail, windshear, turbulence and lightening. Adoption of new materials for building aircraft and higher density of air traffic will further introduce new safety challenges (European Union, European Aviation Conference (ECAC) and EUROCONTROL, 2010).

Africa which accounts for only about 4% of global aircraft, accounts for almost 25% of air accidents and is therefore six times less safe than the world rate (Edeaghe et al, 2006). As a result of incessant air accidents in Nigeria, the country was ranked fifth by the African Airlines Associated among ten African countries with the highest aviation accidents for the period 1998 to 2007 (Nigerian Elites Forum, 2012). However, it is important to note that accidents can never be eliminated in the aviation sector. Air transport has continued to attract increasing patronage as increasing number of people opt for faster, freer and safer means of travel. While commercial air transport is a relatively safe mode, it has a higher potential threat than other modes of transportation (Mercey, 1997). Therefore, achieving higher degree of safety standards require that the aircraft operating environment be adequately understood to reduce hazards (Weir, 1999). Against this background this paper examines the relationship between weather and the safety of air travel with particular reference to the Nigerian environment.

Weather and Air Accidents: The Nexus

Weather is the state of the atmosphere at a particular place and time which could be warm or cold, wet or dry, calm or stormy, clear or cloudy and so on. It refers to the day to day temperature and precipitation activity in an area (Ayoade, 2004). Weather phenomenon is experienced in the lowest part of the atmosphere known as troposphere, which is a section below the stratosphere. Weather is dynamic and it is sustained by air pressure differences between places and some indices of weather include wind, sunshine, cloud, rain, snow, fog and dust (Trewartha and Horn, 1980; Ayoade, 2004). Since air transportation takes place within the lower atmosphere, weather directly plays an important role in aviation operations. Weather is crucial to aviation safety because, aviation procedures such as flight planning, aircraft data link services, aircraft and crew

scheduling and trip planning all depend on weather condition. Due to the fact that natural forces can be unpredictable, dangerous and difficult to physically control or avoid, weather related accidents are generally more disastrous than other forms of accident (Knecht and Lenz, 2010). For instance, the National Transportation Safety Board (NTSB) (2005) reported that about two thirds of all general aviation (GA) weather related accidents are fatal.

Similarly, the European Union, European Aviation Conference (ECAC) and EUROCONTROL (2010) noted that a significant proportion of aviation accidents in the world are weather related with turbulence and icing constituting a significant part. A survey of 1300 fatal air crashes involving commercial aircraft from 1950 to 2009 also show that 12% are directly the result of extreme weather events with another 16% also due to weather related pilot error. Accidents due to pilot error related to weather increased from average of about 13% in 1950 to almost 19% in 2000 (Abbas et al., 2012).

Knecht and Lenz (2010) classified the risk factors involved in weather related accidents into perceptual errors associated with ability to adequately assess the likelihood of risk and skill errors related to deficiency in some particular skills. Others are decision errors associated with taking wrong decisions at critical times and procedural violations associated with not following laid down procedures. Weather related aviation accident may occur as a result of icing, heavy rainfall, windshear, thunderstorm with related lightning and reduced visibility as a result of fog or haze.

Icing and Precipitation

Icing occurs when super-cooled water droplets (water existing in liquid state even at temperatures below 0°C) strikes parts of aircraft whose temperature is colder than 0°C and can have serious consequences on aircraft. Icing on the wings and control surfaces of the aircraft known as structural icing, increases the weight drag of aircraft, increases fuel consumption, decrease lift and cause erroneous instrument readings. Icing on aircraft carburetors, engine air intakes and fuel cells referred to as mechanical icing results in poor engine performance (Kulesa, 2002 and CATE, 2010).

Precipitation is also a factor in air accidents accounting for about 6% of air carrier accidents in United States alone (Kulesa, 2002). Heavy rainfall may also drastically reduce airport operational capacity and could even result in temporary closure of airports, as was experienced at Don Muang Airport, Bangkok in October, 2011 (CATE, 2010).

Windshear

Windshear or wind gradient which refers to difference in wind speed and direction over relatively short distance in the atmosphere, constitute great danger to aircraft especially during take off and landing phases when aircraft is close to the ground and has little room to maneuver, As seen in Figure 1, at (a), a plane entering a microburst gets into headwinds and the pilots will likely react by reducing engine power if they are unaware that they are passing through a windshear. Meanwhile, at (b) as the plane moves through the shear, the wind suddenly becomes a downdraft moving downwards creating an increasing headwind over the wings of the aircraft resulting in sudden lift of the aircraft and increase in airspeed. This is followed by a tailwind at (c), which leads to reduction in the speed of air over the wings, and the loss of the extra lift and speed which makes the aircraft to be vulnerable to sudden loss of airspeed and altitude. In such a situation the pilots may escape the microburst by adding power to the engines. However, reduction of engine power associated with landing makes it difficult for the pilot to increase speed to escape any downdraft which may result in a crash (NASA, 1992 and Amadi, 2013).

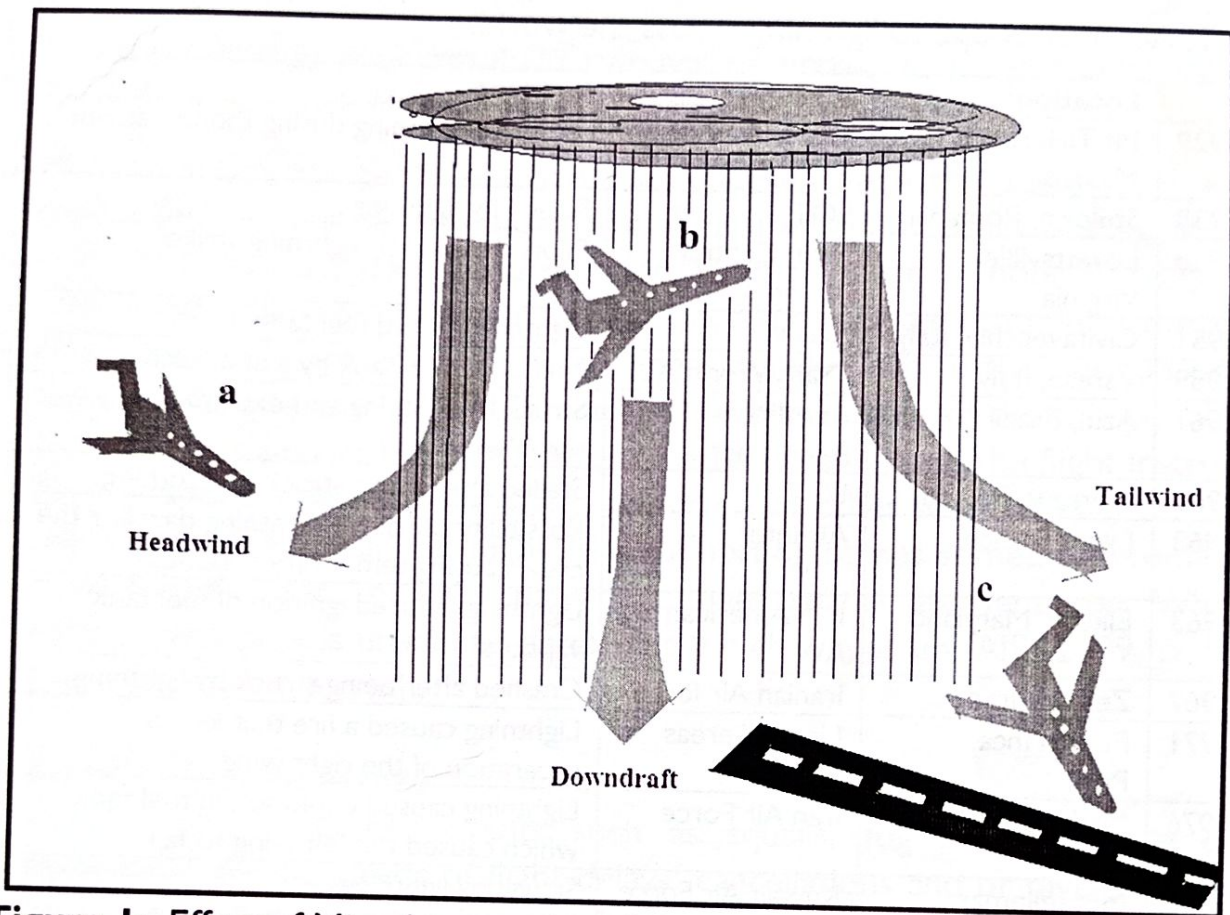


Figure 1: Effect of Microburst on aircraft during landing operation.
Source: Adapted from NASA, 1992.

Thunderstorms

Thunderstorms with related turbulence and lightening may also constitute danger to aircraft. For instance, between 1929 and 2002 a total of 17 air crashes worldwide were directly attributed to lightning strikes (Plane crash Information, 2013). As seen in Table 1, many of these crashes resulted from either ignition of fuel tanks or loss of electric power after the aircrafts have been struck by lightning.

Table 1: Air crashes due to lightning across the world.

Date	Location	Airline	Incident
03/09/1929	Mt Taylor, New Mexico	Trans Con. Air Transport	Struck by lightning during thunderstorm
22/07/1938	Stulpica, Romania	LOT	Struck by lightning
31/08/1940	Lovettsville, Virginia	Penn Central Airline	Pilots disabled by lightning strike
07/01/1951	Civitavecchia, Italy	Alitalia	Lightning ignited fuel tank
26/06/1959	Varese, Italy	Trans World AL	Ignition of fuel tank by static discharge
19/07/1961	Azul, Brazil	Aerolineas Argentinas	Struck by lightning and extreme turbulence
19/12/1962	Warsaw, Poland	LOT	Stalled after being struck by lightning
12/08/1963	Lyon, France	Air Inter	Possibility of flash of lightning dazzling the crew causing temporary blindness
08/12/1963	Elkton, Maryland	Pan American AW	Lightning induced ignition of fuel tank vapours
18/04/1967	Zerand, Iran	Iranian Air force	Crashed after being struck by lightning
24/12/1971	Puerto Inca, Peru	Lineas Aereas Nac	Lightning caused a fire that led to separation of the right wing
09/05/1976	Madrid, Spain	Iran Air Force	Lightning caused explosion in fuel tank which caused the left wing to fail
05/09/1980	Montelinmar, France	Kuwait Air Force	Struck by lightning
08/02/1988	Mulheim, Germany	NFD	Struck by lightning causing complete electrical failure
22/06/2000	Shitai, China	Wuhan AL	Struck by lightning causing the plane to crash
10/10/2001	Off Valencia, Spain	Flightline	Struck by lightning causing loss of electrical power
27/12/2002	Anjouan, Comoros Island	Ocean Airlines	Struck by lightning causing loss of artificial horizon and gyro compass

Source: *Plane Crash Information, 2013.*

However, in recent years a lot has been learnt about how lightning can affect aircrafts which has resulted in the introduction of better protection technology against lightning. Today it is very rare for an aircraft to be brought down by lightning because, of the modern lightning protection on aircrafts (Scientific American, 2006). However, lightning and hail are still responsible for aircraft

damage that may even result in removal of aircraft from operation with huge financial implications for operators (Kulesa, 2002).

In poor weather, spatial disorientation may enhance the severity of weather impact on the pilot of an aircraft. Spatial disorientation occurs when a pilot loses orientation of his position and situation awareness due to poor visibility and or unusual attitude. This results in the pilot not knowing the attitude of the aircraft. Aircraft attitude are normally determined by reference to the horizon or other visual references with the earth's surface. When neither of these is possible, the attitude of an aircraft has to be determined artificially from the flight instruments. Pilots maintain orientation by sight supported by other senses. However, in poor visibility and particularly at night "the supporting senses sometimes conflict with what is seen" and the pilot may experience spatial disorientation. When this happens the pilot is unable to determine which way is up (AIB, 2009, p. 58) and this may result in a crash.

Squalls, Fogs and Haze

Various other weather events such as squalls, fog and haze are directly responsible for hundreds of flight delays, cancellations and or diversions globally every year. Poor weather has also been indirectly responsible for air crashes in various parts of the world, such as when adverse weather delay aircraft landing resulting in fuel starvation. For instance, as seen in Table 2, several air crashes resulted from fuel starvation due to bad weather during the period 1937 to 1998.

Table 2: Some Air crashes due to fuel starvation as a result of bad weather.

Date	Location	Airline	Incident
02/07/1937	Lae, New Guinea	Purdue Res. Found	Crashed after flying higher than expected and used extra fuel due to storm
11/01/1947	Lympne, England	BOAC	Ran out of fuel due to poor weather throughout the flight
30/01/1948	Near Bermuda	British So. AM AW	Encountered strong head winds and ran out of fuel
02/12/1977	Al Bayda, Lebanon	Balkan Bulgarian AL	Crew could not locate alternate airport due to fog and ran out of fuel
04/09/1982	Rio Branco, Brazil	GiaBras de Tratores	Ran out of fuel in poor weather
31/10/1995	Piedras Negras, Mexico	TACSA	Ran out of fuel trying to land in fog
13/01/1998	Tor Kach, Pakistan	Ariana Afghan AL	Crashed after being diverted to alternate airport due to bad weather

Source: *Plane Crash Information, 2013.*

The risk of weather related accidents increases with factors such as failure to get preflight weather briefing, low quality weather forecast or when weather turns out worse than predicted, poor weather related training and experience and lack of weather information handling/avoidance equipment on aircraft. Furthermore, there are non-weather related compounding factors such as time decision making error, time pressure, fatigue, aircraft equipment problems and distraction by passengers or crew (Knecht and Lenz, 2010).

Weather Related Air Accidents in Nigeria

In Nigeria the dry season is usually associated with dust haze in many parts of the country severely reducing visibility. This often results in flight delays, cancellations and or diversions. For instance, The Nigerian Meteorological Agency (NIMET) data shows that flight operations were disrupted and some cancellations experienced in Lagos, Abuja, Kano, Minna, Sokoto, Maiduguri, Port Harcourt, Owerri, Calabar and Enugu airports in March, 2010. Flight disruptions were also experienced during the wet season in several parts of the country due to heavy downpour, severe thunderstorms and squalls (NIMET, 2011). Table 3 shows episodes of dust haze spells and their effects on visibility in the country in 2010. As seen in Table 3, dust haze spells are more common in the northern parts of the country.

Table 3: Dust haze spells and the effects on visibility in Nigeria (2010).

Date	Number of dust spells	Effects
January 15-17	1	Visibility reduced to 700-800 m in the North (Potiskum, Maiduguri)
February 4-10 and 24-27	2	Visibility reduced to 400-800 m in the North and Central parts of the country (Kano, Nguru, Maiduguri, Abuja, Ilorin, Minna) and some Southern parts (Lagos)
March 3-5	1	Visibility less than 800m over Kano and some isolated places in the North
March 18-24	1	Visibility reduced to 100-900 m all over the country
April 7-9	1	Visibility reduced to 100-800 m in the North (Gusau, Kano, Maiduguri) and isolated Southern cities
October 27-30	1	Visibility reduced to less than 800 m over isolated places in the North
November 20-24	1	Visibility reduced to less than 100 m over isolated places
December 25-30	1	Visibility reduced to less than 900 m in the Central states and Akure

Source: NIMET, 2011

Similarly, the year 2011 recorded widespread haze in many parts of Nigeria also resulting in flight disruptions in various airports across the country. For instance, in the month of January 2011, visibility was reduced to between 100-1000m in most parts of the country with Ilorin, Ikeja, Owerri and a few other cities

experiencing very low visibility of 50-800 m (NIMET, 2012). In addition, flight operations were also disrupted in the rainy season as a result of thunderstorms and heavy rainfall. Table 4 gives a summary of flight disruptions at Abuja International Airport from 2008 to 2011. As seen in Table 4, flight disruptions increased over the years peaking in 2010, before slightly declining in 2011.

Table 4: Flight disruptions at Nnamdi Azikiwe Airport, Abuja (2008-2011).

Month	2008	2009	2010	2011
January	2	5	13	67
February	0	9	12	2
March	0	8	55	1
April	0	3	3	0
May	0	2	6	1
June	6	0	0	4
July	1	1	0	5
August	1	0	5	2
September	5	1	1	2
October	2	1	3	1
November	0	5	3	4
December	12	5	12	10
Total	29	40	113	99

Source: NIMET, 2012.

Nigeria experienced 131 air accidents involving both fixed wings aircraft and helicopters from 1967 to 2012 and resulting in the loss of thousands of lives (Vanguard online, 2012; Nigerian Elites Forum, 2012). Although, the causes of most of these crashes are not weather related, some have been directly attributed to weather, while in some others weather has been reported to be a contributory factor. The first air crash associated with weather in Nigeria occurred on June 24, 1956, when an aircraft which took off from Kano airport encountered a thunderstorm microburst with associated wind shear crashed and killed 32 people. Some of the air crashes that occurred in Nigeria in recent times are also traceable to weather effects. Specifically, the Sosoliso Airline crash of December 10, 2005 and the ADC Airline crash of October 29, 2006 are

associated with windshear (Amadi, 2013). Table 5 gives a summary of major air crashes experienced in Nigeria within the last four decades. As seen in Table 5, the period 2000 to 2010 was a bleak period for the country's aviation sector because of the very high level of air crashes recorded.

Table 5: Major air crashes in Nigeria from 1969 to 2012.

Period	Number of crashes	Fatalities
1956	1	32 killed
1969	1	87 killed
1970-1979	2	192 killed
1980-1989	2	Over 100 killed
1990-1999	8	557 killed
2000-2010	24	530 killed
2011 to date	5	Over 170 killed

Source: Fletcher, 2012; Nigerian Elites Forum, 2012; The Guardian online, 2012 and Amadi, 2013.

In its report on the Sosoliso crash, the Accident Investigation and Prevention Bureau (now known as Accident Investigation Bureau) concluded that "windshear activity on approach" and reducing visibility due to thunderstorm were contributory factors (Federal Ministry of Aviation, 2006, p. 23).

Similarly, on the ADC Airline crash, the Accident Investigation Bureau (AIB) (2008) in its report observed that the decision of the pilot to take-off in known adverse weather conditions and his inability to apply the required windshear recovery procedure were among the causal factors for the crash. Furthermore, "the use of inappropriate equipment for windshear recovery procedure during" simulation exercises and absence of a "Standard Operating Procedures for flight operations in adverse weather conditions" were identified as contributory factors (AIB, 2008, p. 71). The accident was therefore due to weather related pilot error. The DHL aircraft crash that occurred at the Murtala International Airport, Lagos on September 7, 2006, was also due to pilot error related to weather. The final accident report shows that the causal factor was the decision of the aircraft crew to land "despite the prevailing adverse weather condition" (AIB, 2013, p. 3). In some other air accidents in the country, where weather was neither a causal or contributory factor, poor weather has contributed to the magnitude of the

disaster. An example is the Chachangi Airline's accident of February 22, 1998, at Kaduna Airport. Poor visibility (600m) as a result of haze prevented the Air Traffic Controller and other people around from noticing the smoke around the aircraft, when fire started from the brake unit during take off operations. Although, no casualties were recorded in the accident, the aircraft was completely burnt to ashes (Federal Ministry of Aviation, 2013).

Although, the report of the Belview air crash of October 22, 2005, was inconclusive due to inability to locate both the Flight Data and the Cockpit Voice Recorders, a combination of factors including poor maintenance cultures, inadequate flight crew training/competence and poor flight coordination in adverse weather were believed to have directly or indirectly contributed to the crash. However, while poor weather is believed to have played a role in the accident, inadequate evidence made it impossible to determine the extent to which weather and spatial disorientation contributed to the accident (AIB, 2009).

Weather Related Problems of Facilities and Services in the Nigerian Aviation Industry

Poor facility provision has been the bane of the aviation sector in Nigeria. For instance, a self audit (introspection) conducted by NIMET in 2007 showed that, only four of the 36 synoptic stations in the country scored 50% and above in terms of instrument availability. It is on record that before 2008 there was no Low Level Windshear Alert System in any airport in the country. A lot of instruments required for measuring weather variables were either not available or not functional. Most of those that were functional were obsolete and provided unstable weather information (Nkwazema, 2013).

There is also the problem of inadequate monitoring of the activities of airline operators in the country. This can be seen in the investigations on the ADC aircraft accident which showed that the airline did not have a standard and up to date policy on adverse weather operations for its crew members (AIB, 2008). Similarly, the report of the Bellview plane crash indicated that the aircraft should not have been cleared to fly because, multiple defects in the plane were not properly corrected. Furthermore, official laxity gives room for malpractices in the industry such as illegal extra working hours for aircrew. Pilots are known to overwork themselves for financial reasons which increase the risk of fatigue with

serious negative effects on pilots' performance especially at times of emergencies. For instance, fatigue is suspected to be a factor in the Bellview aircraft accident because the pilot's cumulative flight hours in ten months was 1,864.45 hours, far in excess of the recommended 1,000 hours in twelve months (AIB, 2009).

The Nigerian aviation sector is also confronted with problem of manpower training and manpower capacity building. Aircrews are poorly trained while retraining and recertification of pilots and technical staff are not usually taken as very important. Cases of arbitrary breaches of operating protocol are also common sometimes resulting in gross disregard for safety regulations (Edeaghe et al., 2006). For instance, the training of the pilot-in-command of the Bellview aircraft was found to be inadequate (AIB, 2009). There are also instances where pilots take off in known adverse weather as seen in the case of the ADC plane that crashed in Abuja in 2006 (AIB, 2008). Furthermore, conditions of service are poor and this negatively affects staff moral and creates conditions that encourage operational malpractices in the industry.

Current Developments in the Nigerian Aviation Sector

The embarrassingly high number of air crashes recorded in Nigeria some few years ago forced the Federal Government to embark on massive overhaul of the aviation sector. Thus, in recent years over 40 weather observatories in the country have been re-equipped with modern instruments. For instance, seven Lightning and Thunderstorm Detectors have been installed in Kaduna, Ibadan, Owerri, Port Harcourt, Enugu, Kano and Yola. Also, six Integrated Aviation Weather Observatory and Display Systems were recently installed in Enugu, Ilorin, Owerri, Katsina, Calabar and Maiduguri airports. In addition, four Upper Air Stations have been resuscitated at Enugu, Kano Maiduguri and Oshodi (Amadi, 2013).

Furthermore, the Aeronautical Information Service (AIS) now provides regular weather reports, which airline operators and pilots must obtain before start-up and take-off. It provides pilots with destination weather information that assist them in making decisions on whether or not to take off from one airport to another. This is very vital to aviation safety in the country because, it prevents incidents of avoidable air returns due to unfavourable weather conditions (Jetlife Magazine, 2012).

The Federal Government has also recently established the National Weather Forecasting and Climate Research Center at Abuja Airport while nine new Synoptic Stations are to be established at Abeokuta, Azare, Benin, Damaturu, Dutse, Owerri and Sokoto. In addition, four Marine Observation Stations are to be established at Aiyetoro, Mahim, bonny and Calabar (Amadi, 2013). With all these recent developments, NIMET's ability to track hazardous weather around the country's airports has greatly improved and it is now able to provide necessary Early Warning Systems for the aviation sector.

Conclusion

While weather is not the only cause of aviation accidents, adverse weather is responsible for a significant proportion of air crashes worldwide. In Nigeria, various air accidents have been attributed to adverse weather conditions and some of these accidents would most likely have been avoided if modern weather facilities were adequately available in the country. In addition, problems of official laxity, corruption and low manpower quality have remained the bane of the Nigerian aviation sector, with serious consequences for the safety of air transportation in the country. In order to improve the safety of air transportation in Nigeria, it is suggested that emphasis should be placed on providing modern weather equipments in all the country's airports. The government should ensure that the on going installation of Low Windshear Alert Systems in all airports in the country is completed very soon. This will improve the quality of weather information in the country.

In addition, all relevant Nigerian aviation regulatory agencies must ensure that all airlines that operate within the country's airspace develop standard and up to date policies on adverse weather operations for their crew members. This will increase the ability of pilots to make better decisions when confronted with adverse weather conditions. The quality of aircrew training in the country should also be closely monitored, while the procedure for screening of foreign licensed aircrew should be improved on to ensure compliance with the highest possible standards. Furthermore, airline pilots should be trained to have sound working knowledge of actual and forecast weather reporting system in the country.

References

- Abass, I.I. Ojo, J.K. and Igbru, P.A. (2012) The Impacts of Extreme Weather and Climate Events on Aviation. *Environment, Ecology & Management*, 1 (1): 12-20
- AIB (2008) Report on the Accident to ADC Airline's Boeing 727-2B7 Registration 5N-BFK at Tungar Madaki, Abuja on 29th October, 2006. Air Accident Report 4/2008 (ADC/2006/10/29/F) Retrieved on September 03, 2013 from http://www.aib.gov.ng/reports_%20publications_Page2.html
- AIB (2009) Report on the Accident involving Bellview Airlines Ltd B737-200 Reg. 5N-BFN at Lisa Village, Ogun State, Nigeria on 22 October 2005. Aircraft Accident Report 2/2009 (BLV 2005/10/22/F). Accident Investigation Bureau, Lagos.
- AIB (2013) Report on the Accident Involving DHL, Registration Z5-DPF, at Murtala Muhammed International Airport, Ikeja, Lagos, Nigeria on 7 September, 2006. Aircraft Accident Report AIB/DHL/2006/09/07/F http://www.africanmanager.com/site_eng/detail_article.php?art_id=19723
- Amadi, M. (2013) Impact of Bad Weather on Nigeria' Airspace. *The Economy Magazine*. Retrieved on July 25, 2013, from <http://theeconomyng.com/news5278.html>
- Ayoade, J.O. (2004) *Introduction to Climatology for the Tropics*. Ibadan; Spectrum Books Limited.
- Black, W.R. (1998) Sustainability of Transport. In Hoyle, B. and Knowles, R. (eds.) *Modern Transport Geography*. Edition 2. Chichester; Wiley.
- Centre for Aviation Transport and the Environment (CATE) (2010) Impacts of Climate on Aviation. Manchester Metropolitan University. Retrieve on August 19, 2013, from <http://www.cate.mmu.ac.uk/research-themes/climate-change/impacts-of-climate-on-aviation/>
- Edeaghe, E; Esosa, O and Idiodi, H. (2006) Comparative Analysis of the Bellview and Sosoliso Air Crashes in Nigeria: Matters Arising. *The Internet Journal of Rescue and Disaster Medicine*, 5 (2)
- European Union, European Civil Aviation Conference (ECAC) and EUROCONTROL (2010) Effects of Climate Change on Aviation Safety. Paper presented at High Level Safety Conference 29 March to 1st April, 2010, Montreal, Canada. Retrieved on August 6, 2013, from [http://www2.icao.int/HLSC/InformationPapers/HLSC 10 IP 016 I Reven\(2\).pdf](http://www2.icao.int/HLSC/InformationPapers/HLSC%20IP%20016%20I%20Reven(2).pdf)
- Federal Ministry of Aviation (2006) Final Report on the Accident to Sosoliso Airlines DC 9-32 Aircraft Registered 5N-BFD at Port Harcourt International Airport on 10th December, 2005. Civil Aviation Accident Report No FMA/AIPB/424. Federal Ministry of Aviation, Abuja.
- Federal Ministry of Aviation (2013) Final Report on the Accident of Chachangi Airline's Boeing 737-200 Aircraft Registered YU-ANU, which occurred at Kaduna Airport on Sunday the 22nd February, 1998. Accident Report No. 04/365
- Fletcher, P. (2012) "Factbox: Nigeria has history of major air accidents". Retrieved on July 26, 2013 from <http://www.reuters.com/article/2012/06/03/us-nigeria-air-accidents-idUSBRE8520BA20120603>
- Jetlife Magazine (2012) Airport Safety and Security. December, 2012. <http://www.jetlifenigeria.com/2012/12/nimets-vital-work-in-weather-forecasting/>

- Knecht, W. R. and Lenz, M. (2010) *Causes of General Aviation Weather-Related, Non-Fatal Incidents: Analysis Using NASA Aviation Safety Reporting System Data*. Final Report, DOT/FAA/AM-10/13, Office of Aerospace Medicine, Federal Aviation Administration, Washington, DC.
- Kulesa, G. (2002) *Weather and Aviation: The Potential Impacts of Climate Change on Transportation*. Retrieved on July 12, 2013 from <http://climate.dot.gov/documents/workshop1002/kulesa.pdf>
- Mercey, P. (1997) *probabilistic Risk Assessment modeling of Passenger Aircraft Fire Safety*. Ph. D. Thesis, Cranfield University, April 1997.
- NASA (1992) *Making the Skies Safe from Windshear*. <http://www.nasa.gov/centers/langley/news/factsheets/Windshear.html>
- Nigeria Elites Forum (2012) *Brief History of Air Disasters - Crashes in Nigeria*. Retrieved on August 09, 2013 from <http://www.nigerianelitesforum.com/ng/transportation/14296-history-of-air-plane-crashes-mishaps-in-nigeria-html>
- NIMET (2011) *Nigeria Climate Review Bulletin 2010*. NIMET, Abuja.
- NIMET (2012) *Nigeria Climate Review Bulletin 2011*. NIMET, Abuja.
- Nkwazema, S. (2013) *Nigeria: Every Airline Now Rely On Our Weather Forecasts, Says NIMET*. AllAfrica.com News, 17 August, 2013. Retrieved on August 29, 2013 from <http://allafrica.com/stories/201308190184.html?viewall=1>
- NTSB (2005) *Risk Factors Associated with Weather-Related General Aviation Accidents*. Report NTSB/SS-05/01. Retrieved on October 15, 2013 from www.nsb.gov/pulictn/2005/SS01.pdf
- Plane Crash Information (2013) Retrieved on August 11, 2013 from <http://planecrashinfo.com/cause.htm>
- Scientific American (2006) *What happens when lightning strikes an airplane?* <http://www.scientificamerican.com/article.cfm?id=what-happens-when-lightn>
- The Guardian online (2012) *2012- Air Crashes Too Many in Nigeria*. Saturday, December 15 2012. Retrieved on August 4, 2013 from <http://www.nguardiannews.com/index.php/national-news/107842-2012-air-crashes-too-many-in-nigeria>
- Trewartha, G.T. and Horn, L.H. (1980) *An Introduction to Climate*. Fifth Edition. Auckland; McGregor Hill.
- Vanguard Online (2012) *"Nigeria loses 1,166 lives in 131 crashes – AON"*. December 04, 2012. Retrieved on August 18, 2013, from <http://www.vanguardngr.com/2012/12/nigeria-loses-1166-lives-in-131-aiaccidents-aon/>
- Weir, A. (1999) *The Tombstone Imperative: The Truth About Air Safety*. London; Simon and Schuster.