

# ENVIRONMENTAL PLANNING FOR DISASTER RISK REDUCTION AT KADUNA INTERNATIONAL AIRPORT, KADUNA NIGERIA

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**Abstract:** The compatibility of an airport with its environs can be achieved by proper environmental control and planning of the airport, control of pollution-generating sources, and land use planning of the area surrounding the airport are paramount if disasters are to be averted or reduced to the acceptable standard. This study was carried out to assess the compliance to standards of the activities relating to environmental control and planning at Kaduna International Airport as contained in International Civil Aviation Organization (ICAO) and other Airport regulations Guidelines. The objectives including assessing the environmental impact associated with aviation activities, assessing environmental consequence and control measures and assessing land use planning at the Airport. The Airport Environmental Management Handbook, Federal Airport Authority of Nigeria (FAAN) Hand book, ICAO Documents, Maps and other relevant information were consulted. Questionnaires were distributed and percentage distribution was used in analyzing the objectives. Results from this study has shown an acceptable level of compliance in Environmental Planning by the relevant authority of Kaduna International Airport. The results from this study will be useful to FAAN, ICAO and other relevant Agencies in enhancing Environmental Control and Planning at Airports for Disaster Risk Reduction.

**Keywords:** Environmental Planning, Disaster Risk Reduction, Airport, ICAO, FAAN

## 1. Introduction

The types of environmental emergencies at the airport include, but not limited to, fuel and chemical spills and incidents involving dangerous good or hazardous material that may affect the environment, (ICAO, 1997). Some degree of air pollution associated with an airport is unavoidable, but this can be substantially reduced with proper pre-development planning and mitigation measures. Air pollution associated with airports is generated by aircrafts, vehicles and facility operations (FAAN, 2018). Airports are subject to both state and local environmental regulation which may include both quantity and quality discharge limits. Airport waste must be treated before being discharge so as not to pollute ground water or nearby streams (ICAO, 1997). Aircraft maintenance areas, as well as automotive and equipment service ar-

eas, should be provided with oil-water separators which are, in turn, connected to sanitary sewers leading to the municipal waste treatment plant serving the airport, (ACI,1996). The problem of aircraft noise is so serious in the vicinity of many of the world's airports that public reaction is monitoring to a degree that give cause for great concern and requires urgent solution, (ICAO, 1996). The balance approach to noise management consists of identifying the noise problem at an airport and then analyzing the various measures available to reduce noise through the exploration of four principal elements, namely reduction at source, land use planning and management, noise abatement operational procedures and operating restrictions with the goal of addressing the noise problem in the most effective manner. All the elements of balanced approach are addressed in the guidance on the balanced approach to aircraft noise management, (ICAO, 1996). Although in most countries, land-use planning and management are the responsibility of national and/or local planning authorities rather than aviation authorities, the International Civil Aviation Organization (ICAO) has developed guidance material which should be used to assist planning authorities in taking appropriate measures to ensure compatible land-use management around airports to the benefit of both the airport and the surrounding communities (Airport Planning Manual, Part 2, Doc 9184). Location for measuring noise from aeroplane in flight shall be surrounded by relatively flat terrain having no excessive sound absorption characteristics such as might be caused by thick. Matted or tall grass, shrubs or wooded areas. No obstruction, which significantly influences the sound field from aeroplane, shall exist within a conical space above the measurement position, the cone being defined by axis normal to ground and by a half angle from the axis. If the height of the ground at any measuring point on the runway by more than 6m, corrections shall be made (ICAO, 1997). Capacity Constraints at airports and airspace are becoming an increasing challenge to the continued growth of air transport in some regions, the limited availability and/or utilization of infrastructure has already led to serious problems, notably in the form of flight delays, with spillover effects worldwide. Current ICAO forecast estimate an increase in the global demand for air transport at an average annual growth rate of 4.5 percent for the period 1997-2020, with aircraft movements growing at an average annual growth rate of 3.5 percent. In response to this demand the world aircraft fleet is expected to accommodate 2.7 fold increase in passengers traffic and doubling aircrafts movements by the year 2020. These forecasts are predicted on the assumption that sufficient system infrastructure and capacity will be available to handle the demand and this is equally an important aspect of environmental control and land use planning in the airport (ANS CONF, 2000). Selecting a new airport site is a complex, time consuming and expensive proposition. Local governments usually make decision to construct or expand public airports. The money to fund the construction comes from taxes or from the sale of bonds. Airport sites are selected based on airport traffic volume, the nearby population, availability of ground access and existing air traffic flows, (Microsoft Encarta, 2007). A combination of comprehensive planning and zoning, together with real estate disclosure as a legal obligation is considered as the most effective measure for the controlling the use of land around airports especially for new "Green Field" situations. For existing situation the effectiveness of land use planning control is considered limited (ICAO, 1997). Pollution occurring, in and around the airport has the potential to affect not only the immediate area, but also the surrounding area, because it can effect on human health and the ecology of the surrounding area, (Transport Canada, 1994). An effective waste management programme can be enhanced by employee awareness programmes including training, participation in special events, information session and informative newsletters. An effective energy strategy will include a statement of objectives to make all personnel aware of what the organization is committed to achieve, but the pursuit of environmental performance without regard for cost is not a plan for success (ICAO, 1996). Although the ultimate goal of proactive environmental strategy is to minimize the creation of environmental problems in the interim, there is a need for a remedial measures

to correct situations resulting from material handling and management practices of the past (Airport Council International, 1996). Commercial activities can be situated in areas subject to higher noise levels than residential development; they generally cannot be carried out in the areas as industrial operations, which are performed primary indoors and have a higher associated noise level (ICAO, 1997). All agricultural uses have proven to be compatible with aircraft noise with the exception of poultry farm. Location of these farms within approximately 5km of an airport is not recommended because of the adverse reaction of the fowl to high level of aircraft noise. It should be noted that birds may be attracted to some pig farm where garbage is used as fodder (Airport services manual, doc 9137). If land is used for recreation, it should be remembered that it must not present or create hazard to aircraft operation such as attracting birds (ICAO, 1997). The sitting of municipal utilities at an airport is not only compatible but logical. The industrial, residential and commercial growth in the airport creates increasing demand for water, sewage disposal and power utilities and concentration of these municipal activities requirement in the airport has proven to be economical and wise (Airport service manual, Doc 9137). Airport capacity is said to be bottleneck in the growing aviation industry about 20% of the 50% largest European airports have already or almost reached capacity constraints forecast for the year 2025. The European Commission therefore, encourages all actors in the aviation sector to rethink airport capacity and its use (EC, 2007). Capacity constraints are said to be counterproductive to overall economic competitiveness. In North America and Asia, airport expansion and green field developments seems to face less political and legal constraint which can be considered as obstacle to economic growth and this calls for proper environmental control and land use planning (EC, 2007).

## STUDY AREA

Kaduna is located in the northern Guinea savannah zone of Nigeria. It lies between latitudes  $10^{\circ}11'N$  and longitude  $7^{\circ}8'E$  an altitude of 645 m above sea level. The city's central location makes communication with the rest of Nigeria relatively easy. The Kaduna Airport (IATA: KAD, ICAO: DNKA) is an airport serving Kaduna, the capital of Kaduna State in Nigeria. The airport is around 22 kilometres (14 mi) northwest of the city. The airport opened in 1982 with latitude  $10^{\circ}41'45''N$  and longitude  $7^{\circ}19'15''E$  see (Fig. 1).

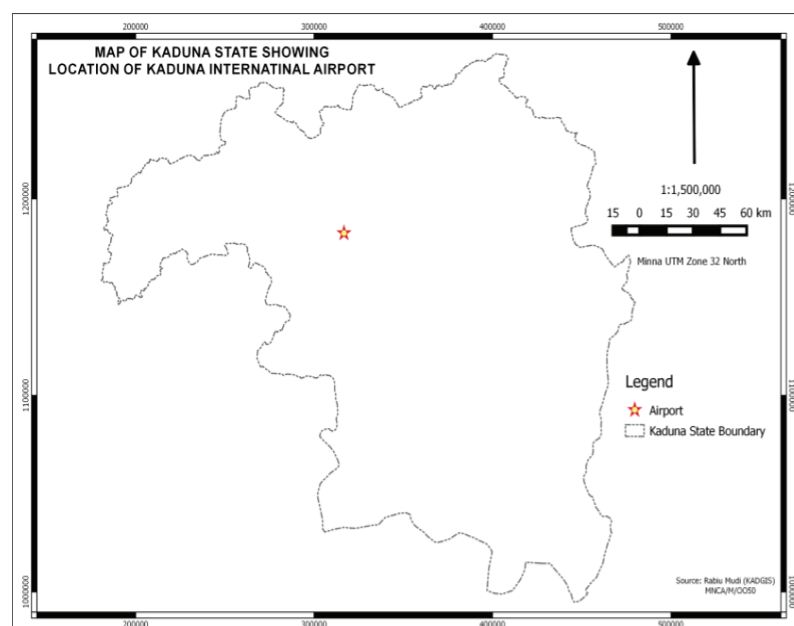


Fig 1: Map of Kaduna Showing the Airport

## Climate

Two major weather systems regulate Kaduna's climate. These are the Sahara high pressure system and the Atlantic low-pressure system. The interface between the two, known as the Inter-tropical Convergence Zone, is a front which moves irregularly in March up to October when it retreats. After October, the Sahara system dominates the weather. The rainy season in the Kaduna city region starts around March and ends in October. Annual rainfall averages around 1200 mm. The rainfall pattern is traditionally characterized as monomodal with peak precipitation between July and August.

The Kaduna area is characterized by a dry season with dry, cold conditions from November to February when the "Harmattan" wind blows from the east-northeast; and a rainy season with warm, humid conditions with southwest winds from March through to October. The mean monthly temperature generally varies between 26 °C and 34 °C with maximum temperatures occurring in February, March and April and minimum temperatures in the "Harmattan" months of November, December and January.

## Soil and Vegetation

Generally, the soil and vegetation are typical red brown to red yellow tropical ferruginous soils and savannah grassland with scattered trees and woody shrubs. The soils in the upland areas are rich in the red clay and sand but poor in organic matter.

However, soils within the "Fadama" areas are richer in Kaolinitic clay and organic matter, very heavy and poorly drained, characteristics of vertisols. Fringe forest in some localities, and especially in the southern local government areas of the state are presently at the mercies of increasing demands for fuel wood in the fast growing towns and urban centres.

## MATERIALS AND METHODS

A reconnaissance survey was carried out in order to familiarize with the study area and make a physical observation of some of the facilities and land that calls for a proper environmental control and land-use planning. Also a visit to some of the departments responsible for environmental management in the Airport i.e. Kaduna International Airport was made.

Questionnaires were administered to the key officers in the departments of land, water and survey, safety and operations of FAAN. In addition, oral interviews were conducted on the staff of other agencies within the industry and some visitors; this was to compliment the research observations and questionnaire findings. Departmental interview were conducted based on the services, functions they provide and how these functions affect environmental.

The heads of safety, land, water and survey and operations departments being the technical departments responsible for environmental management were consulted for technical questions and answers. Relevant question as related to functions and services rendered were presented to the respondents such as the adequacy of expertise and facilities to deal with the issue of environmental control and land use planning. A total of 20 visitors and other facilities users were systematically interviewed.

Percentage distribution statistical method was used for the analysis of data obtained from primary sources. Tables were used to show various distribution and interpretation drawn from them. This equally helps in arriving to a satisfactory conclusion.

## RESULTS AND DISCUSSIONS

The questions presented here were technical and answers were provided by the relevant technical department of FAAN.

**Table 4.1.** *Aircraft noise in the Vicinity of the Airport*

Variables	Number of respondent	Percentage (%)
Disturbing	2	20
Very disturbing	0	0
Acceptable	8	80
Total	10	100

(Source: Authors' fieldwork, 2019)

From the table 4.1, 20% of the respondent believed that the noise is disturbing while 80% indicates that the noise is acceptable. From the observation made during a tour of the airport by the researcher, the noise within the vicinity is acceptable due to the distance of aircraft landing area and the offices of the various agencies.

**Table 4.2.** *Effect from Emissions from the Aircraft*

From the table 4.2 all the respondents attest to the fact that the emissions from aircraft does not affect them, may be because the effect is not visible. My observation is that because of bio-accumulation some may not feel the effect now but later.

Variable	Respondents	Percentage (%)
Yes	0	0
No	10	100
Total	10	100

(Source: Authors' fieldwork, 2019)

**Table 4. 3.** *Disease(s) as a result of Pollutants*

Variables	Respondents	Percentage (%)
Yes	0	0
No	10	100
Total	10	100

(Source: Authors' fieldwork, 2019)

From Table 4.3 all the respondents have not experienced any sickness related to emission from the aircraft as at the time this research was carried out.

**Table 4.4.** *Tap water at the Airport*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	9	90
No	1	10
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.4, ninety percent believe that the water is safe for drinking.

**Table 4.5.** *The source of the Drinking Water*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Pipe	0	0
Bore-Hole	10	100
Well	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.5 shows that the airport depends entirely on bore-hole as a source of water supply.

**Table 4.6.** *The Effects of Construction/Expansion on Commercial Activities*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	2	20
No	8	80
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.6 results, it is clear that construction/expansion work has not displaced any business activity, only 20 percent believed that construction has affected commercial activities.

**Table 4.7.** *Effect of Displacement on Socio-Economic Activities*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Fair	8	80
Poor	2	20
Devastating	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.7 shows that 80 percent of the respondents believe that construction/expansion has not affected the socio-economic activities in the airport while 20 percent believes it does.

**Table 4.8.** *Effect of Washing of Aircraft in terms of Environmental Management*

Variables	Respondents	Percentage (%)
Satisfactory	9	90
Poor	1	10
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.8 shows that washing activities in the airport is regulated since 90 percent of the respondents believed it is satisfactory.

**Table 4.9.** *Oil Leakages from the Aircrafts*

Variables	Respondents	Percentage (%)
Wash and Drain	10	100
Just wash/Clean	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.9, 100% of the respondents attested to the fact that oil leakages from the aircraft are washed and drained.

**Table 4.10.** *Drainage System in the Airport*

Variables	Respondents	Percentage (%)
Yes	6	60
No	4	40
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.10, 40 percent of the respondent believed that the drainage system in the airport should be improved.

**Table 4.11.** *Waste Treatment Plant in the Vicinity of the Airport*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	0	0
No	10	100
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.11, all respondents stated that the airport has no waste treatment plant.

**Table 4.12.** *Waste Disposal*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Transport and dispose	10	100
Contracted out	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

From the result in table 4.12, waste generated from the airport is transported and disposed.

**Table 4.13.** *Constant Electricity Supply by KAEDCO*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	7	70
No	3	30
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.13 shows that 70% of electricity supply is from the distribution company.

#### *4.2.3 Extent of land use in the Airport*

**Table 4.14.** *Land allocated in the airport*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
State or LGA	0	0
FAAN	10	100
Total	10	100

(Source: Authors' fieldwork, 2019)



From table 4.14 Land allocation within the airport is the sole responsibility of FAAN.

**Table 4.15.** *Community Involvement in Land Use Management*

Variables	Respondents	Percentage (%)
Yes	8	80
No	2	20
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.15 shows that 80 percent of the respondents indicate that the community within the vicinity and surrounding of the airport are taken into consideration in terms of land matters while 20 percent believed that the community is not involved.

**Table 4.16.** *Land Reclamation*

Variables	Respondents	Percentage (%)
Naturally	1	10
Artificially	0	0
Both Natural and Artificially artificial	9	90
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.16 shows that land is reclaimed from using both natural and artificial ways as indicated by the respondents.

**Table 4. 17.** *Revenue Generated from Land Uses*

Variables	Respondents	Percentage (%)
Yes	10	100
No	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

From 4.17 all respondents stated that revenue is generated from the use of land.

**Table 4. 18.** *Land Planning Schedule in the Airport*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	10	100
No	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.18, respondents attest to the presence of land planning schedule

**Table 4.19.** *Land use According to ICAO Standard*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	0	0
No	10	100
Total	10	100

(Source: Authors' fieldwork, 2019)

Land uses are planned according to ICAO standards as shown in the table 4.19.

EIA as one of the key components of environmental management, development or modification of infrastructure in the airport must undergo a socio-economic or technological impact assessment.

**Table 4.20.** *Environmental Impact Assessment (EIA) in Land Development*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	10	100
No	0	0
Total	10	100

(Source: Authors' fieldwork, 2019)

From the responses on table 4.20, it is clear that the airport is using EIA on any developmental projects.

**Table 4. 21.** *Environmental Control and Land Use Planning in the Airport*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Very Good	6	60
Fair	2	20
Poor	2	20
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.21 shows that 60 percent believed that environmental control and land use planning at the airport is very good, 20 percent said it is fair while another 20 percent believed it is poor.

**Table 4.22.** *Airport in terms of Environmental Friendliness*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Very Good	5	50
fair	2	20
Poor	3	30
Total	10	100

(Source: Authors' fieldwork, 2019)

From table 4.22, 50 percent believed that the environmental friendliness of the airport is very good, 20 percent believed it is fair while 30 percent believed it is poor.

**Table 4.23.** *Aircraft Noise*

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	3	15
No	12	60
Indifferent	5	25

(Source: Authors' fieldwork, 2019)

From the table 4.23 only 15 percent of the respondents stated that aircraft noise constitute nuisance to them while 25 percent are indifferent.

**Table 4.24. Airport Rating in Terms of Facilities**

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Very Good	3	15
Fair	12	60
Poor	5	25

(Source: Authors' fieldwork, 2019)

Table 4.24 shows that 60 percent of the respondent believed that facilities in the airport are fair, 15 percent says they are very good while 25 percent believed they are poor.

**Table 4.25. Threat to Life due to Aircraft Activities**

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Yes	4	20
No	16	80
Total	20	100

(Source: Authors' fieldwork, 2019)

**Table 4.26. Threat Related Issues**

<b>Variables</b>	<b>Respondents</b>	<b>Percentage (%)</b>
Emissions	0	0
Noise	2	10
Birds	2	10
None	16	80
Total	20	100

(Source: Authors' fieldwork, 2019)

AS seen from the responses on table 4.26, 80 percent believed that there are no threats from all the factors mentioned 10 percent believed that birds posed a threat to the aircraft and 10 percent stated that noise is a serious threat and a nuisance.

**Table 4.27. Sanitation Related Facilities in the Airport**

Variables	Respondents	Percentage (%)
Good	6	30
Fair	8	40
Bad	6	30
Total	20	100

(Source: Authors' fieldwork, 2019)

As seen from the table 4.27, 30 percent says the sanitation related facilities in the airport are bad, 40 percent stated that they are fair while another 30 percent believed they are good.

**Table 4.28. Large-scale Agricultural/Industrial Activities in the Airport.**

Variables	Respondents	Percentage (%)
Yes	0	0
No	20	100
Total	20	100

(Source: Authors' fieldwork, 2019)

From table 4. 28 all respondents show that they have not seen any large-scale Agricultural/ Industrial activities in the airport.

**Table 4.29. Environmental Control and Land use Planning in the Airport**

Variables	Respondents	Percentage (%)
Good	12	60
Poor	8	40
Total	10	100

(Source: Authors' fieldwork, 2019)

Table 4.29 shows that 60 percent believed it is good and 40 percent believed it is poor.

## CONCLUSION

In this study an attempt was made to look into the Environmental control and Land Use Planning at Kaduna International Airport, Kaduna state, Nigeria. During the course of the research, both primary and secondary data were used. Questionnaires were designed to elicit relevant information from respondents.

The heads of safety, land, water and survey and operations departments being the technical departments responsible for environmental management were consulted for technical questions and answers. Relevant question as related to functions and services rendered were presented to the respondents such as the adequacy of expertise and facilities to deal with the issue of environmental control and land use planning. A total of 20 visitors and other facilities users were systematically interviewed.

Results from this study has shown an acceptable level of compliance in Environmental Control and Planning by the relevant authority of Kaduna International Airport. The results from this study will be useful to FAAN, ICAO and other relevant Agencies in enhancing Environmental Control and Planning at Airports.

Environmental management is a very vital tool to the achievement of a safe and sustainable environment in the aviation industry. Aviation industry is a very sensitive sector where proper environmental management should be the order of the day. The control and planning of the environment in the aviation industry will lead to a better and safer environment in terms of flying and dwelling. Based on the data presented, it is clear that environmental control and land use planning in Kaduna International Airport has attain an acceptable level according to the ICAO standards. More efforts are being articulated by the Federal Ministry of Aviation to innovate ways for a better and sustainable way of managing the environment. All the Aviation agencies are collaborating with the airlines operators to achieve this quest.

## **RECOMMENDATIONS**

Based on the research findings, the following recommendations are made:

- The land use system in place should reflect an integrated approach adopted jointly by the airport operators, the state government and the local authorities.
- Commercial building and houses in the airport should adequately be sound- proofed.
- Airport environment should be given special control to keep the land free from food and shelter for birds.
- There must be as appropriate a Comprehensive Environmental Impact Assessment (EIA) for any airport improvement to assess the technological and socio-economic impact of improvements.
- Government with the support of private participation should made fund available to the airport for a better land use and environmental control.
- Training and re-training of personnel especially those involved with environmental management should be given due consideration.
- Air quality test should be conducted at intervals to check the safety of the air.
- Further research can be done specifically on waste management at the airport.

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