Addis Ababa University

College of Social Sciences

Department of Geography and Environmental Studies

An Assessment of Land Use Compatibility in the Vicinity of Addis Ababa Bole International Airport

For the partial fulfillment of the Degree of Master of Art in Land Resource Management

By:*Daniel Asfaw*

Advisor:-Professor Tegegne G/Egziabher

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Daniel Asfaw

Department of Geography and Environmental Studies

APPROVED BY THE HEAD OF THE EXAMINERS
SIGNATURE

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CHAIRPERSON

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ADVISOR

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EXTERNAL EXAMINOR

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INTERNAL EXAMINOR

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Abbreviations

ADM= Aerodrome

ALUC= Airport Land Use Compatibility

ALUP= Airport Land Use Planning

AU= African Union

CAA= Civil Aviation Authority

CLUP= Compatible land use planning

dB= decibels

Doc=document

EAE= Ethiopian airport enterprise

EAL= Ethiopian Airlines

ECAA= Ethiopian Civil aviation authority

FAA= Federal Aviation Administration

FEPA= Federal Environmental Protection agency

HAAB=four later designator of Addis Ababa Bole International Airport

ICAO= International Civil Aviation Authority

RWY= Runway

TWR= Air traffic control Tower

WHMC= Wildlife Hazard Management Committee

WHMP= Wildlife Hazard Management Plan

Definition of terms

Aerodrome: A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft. (ICAO, 2001)

Aerodrome Control towers: A unit established to provide air traffic control service to aerodrome traffic. (ICAO, 2007)

Aircraft: Any machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface. (ICAO, 2001)

Apron: A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance. (ICAO, 2001)

Day and Night Average Noise Level/DNL- is a 24 hour average noise level noise level used to define the level of noise exposure on a community expressed in dB. (Maresi Berry, 1998)

Location indicator*:* A four-letter code group formulated in accordance with rules prescribed by ICAO and assigned to the location of an aeronautical fixed station. (ICAO, 2007)

Operator: A person, organization or enterprise engaged in or offering to engage in an aircraft operation. (ICAO, 2001)

Putrescible waste: Solid waste that contains organic matter capable of being decomposed by micro-organisms and of such a character and proportion as to be capable of attracting or providing food for birds. (ECAA, 2013)

Runway: A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft**.** (ICAO, 2001)

Stop ways: A defined rectangular area on the ground at the end of take-off run available prepared as a suitable area in which an aircraft can be stopped in the case of an abandoned take-off. (ICAO, 2007)

Taxiing: Movement of an aircraft on the surface of an aerodrome under its own power, excluding take-off and landing. (**ICAO**, 2007)

Threshold: The beginning of that portion of the runway usable for landing. (ICAO,2007)

Touchdown: The point where the nominal glide path intercepts the runway. (ICAO, 2007)

Note- "Touchdown" as defined above is only a datum and is not necessarily the actual point at which the aircraft will touch the runway.(ICAO, 2007)

Wildlife: Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring thereof (taking, possession, transportation, sale, purchase, barter, exportation, and importation of wildlife and plants). As used in this advisory circular, wildlife includes feral animals and domestic animals out of the control of their owners. (ECAA, 2013)

Wildlife attractants: Any human-made structure, land-use practice, or human-made or natural geographic feature that can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's AOA. These attractants can include architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands. (ECAA, 2013)

Wildlife hazard: A potential for a damaging aircraft collision with wildlife on or near an airport. (ECAA, 2013)

Wildlife strike: when wildlife and a moving aircraft collide. (ECAA, 2013)

ABSTRACT

Site selection of an airport needs a careful attention. Thus, factors like obstacles, accessibility for ground transport to and from the city, favorable topographic and climatic conditions and others are considered in the task of site selection for an airport so as to secure safety of the society and the aviation industry.

Addis Ababa bole international airport/HAAB serves as a hub of different operators and more than 180 flights per day departed from and arrived to the aerodrome. The issue of land use planning and compatibility concerns are not given due attention at HAAB this moment. Thus, one can see different land use types and developments that are not compatible with the airport environment. Crusher plants, residential, agricultural lands and wildlife attractant sites are common surrounding HAAB that needs careful attention from the concerned

Using qualitative and quantitative research methods the researcher has tried to collect primary and secondary data so as to examine and make analysis on the land use compatibility concerns from safety of the society and safe operation of the airport dimensions. After the analysis of the data, the researcher found that the land use types in the vicinity of the airport are incompatible with the airport environment. The data gathered by different means are presented by means of tables and maps.

The trend of land use developments surrounding HAAB can be said that it is not in accordance with the standards set by the ICAO and Federal EPA.

Chapter One- Introduction

1.1 Background

Aviation is the design, development, production, operation, and use of aircraft, especially heavier-than-air. The word "Aviation" was coined by French writer and former naval officer Gabriel La Landelle in 1873, from the verb "avier" (synonymous flying), itself derived from the Latin word "avis" ("bird") and the suffix "-ation". (Vreizh, Skol (2008).

The history of the aviation industry has its root in the year 1783, when the first human lighter –than-air flight in a hot air balloon but the most remarkable year was 1903 when the Wright brothers fly in a powered and controlled aircraft. Due to the development of designing larger and reliable aircrafts, air transport has begun for passengers and cargo transportation. After this remarkable period, the aviation industry has shown an immense and dramatic development till these days by which air transport is the most reliable, fastest and safest mode of transportation for passengers and cargo compared to other modes of transport. (T. D. Crouch, 2008)

The year 1944 was the most important year in the history of the aviation industry by which the foundation of the International Civil Aviation Organization is realized at Chicago, USA. It is a special part of the United Nations aimed at promoting safe and orderly development of the sector throughout the world. (D. Mackenzie, 2010).

The Organization has responsibility of formulating rules and regulations regarding safety, security, efficiency, regularity and environmental friendly of the sector. In addition it gives standards for airports, licenses for operators and aircraft manufacturers and coordinates with the national aviation authority of its members with the compliance of the rules set by the organization in line with the national laws to bring uniformity. It also inspects and audits the civil aviation of the member states. (J. Huang, 2009)

An **airport** is a location where aircrafts such as fixed-wing aircraft, helicopters, and blimps take off and land. Aircraft may be stored or maintained at an airport. An airport consists of at least one surface such as a runway for a plane to take off and land, a helipad, or water for takeoffs and landings, and often includes buildings such as control towers, hangars and terminal buildings.(Wikipedia the free Encyclopedia)

Airports are vital part of the entire air transport system and key for the economic growth of every nation. This 21st C. provides the aviation industry a great deal of opportunity for long term growth. The industry has a complex nature that has a likelihood of an anticipated success with fastest technical and organizational changes that are redefining the practice of airport systems, planning and design, service offerings and customer and cargo handling manners. (R. de Neufville, 2003)

Traffic will almost certainly continue to grow substantially. Most of the world rarely flies, and the market is far from saturated. Plausible increase in population, national wealth, the length of paid vacations, and the tendency of members of younger generations to fly, even if only a few percent per year, will lead to more traffic. Increased globalization will impel long-distance travel for business and personal reasons, in general only realistically feasible by air. (R. de Neufville, 2003)

Air transport in Ethiopia has started in the year 1929. Gefersa, 18 kilometer west of Addis Ababa, Dire Dawa, Janmeda, Lideta and Akaki were remarkable airstrips and spots that have contributed more for the development and construction of more airports throughout the country and which has increased the role of air transport for the domestic use. It was during the Italian occupation that Lideta Airport, with a length of 1728 meters and width of 45 meters located at 4.2 kilometers from the center of the capital After the Italians left the country this airport had served the nation for not more than two decades as international gateway of the nation. (Ethiopian Airports Journal, 2010)

Problems related with the structure of the runway, the inadequacy to accommodate big and modern jet aircrafts of the time, small size of the runway and obstructions for approaching of aircrafts forced to look for a better location for construction of new airport. As a result new site that fulfils the requirements was found at

bole by the year 1958. (Gabriello, personal communication and Ethiopian Airports Journal, 2010)

Addis Ababa Bole International Airport was established at the beginning of the 1960's. The construction of the runway was commenced in 1961 and completed in 1964. As time goes on, in the 1990's the airport was found inadequate of handling the ever increasing number of both international and domestic passengers and the new heavy passenger and cargo aircrafts that entered into the business. As a result expansion carried out and the runway becomes 3,800 meter in length and 60meter in width plus 100 meter stop ways at both ends of the runway. Thus now the airport has the potential to accommodate huge, modern aircrafts as big as Boeing 747 and MD-11. Currently the Apron can accommodate 53 large aircrafts at a time excluding the cargo apron capacity, the General Aviation parking area of the many small aircrafts and the Ethiopian Airlines Hanger capacity. (Ethiopian Airports Journal, 2010)

1.2 Statement of the problem

Bole International Airport is the main hub of Ethiopian Airlines, the national airline that serves destinations in Ethiopia and throughout the African continent, as well as nonstop service to Asia, Europe, and North America. It is also the base of the Ethiopian Aviation Academy, composed of major pilot training and aircraft maintenance centers in Africa. As of 26 November 2013, more than 180 flights per day are departing from and arriving at the airport. The airport is capable of accommodating the Airbus A380-800, the Boeing 747 and the MD-11.

The compatibility of an airport with its environ is an ideal that can be achieved by proper planning of the airport, control of pollution-generating sources, and land use planning of the area surrounding the airport. The aim is to provide the best possible conditions for the needs of the airport, the community in the surrounding area and the ecology of the environment. (ICAO, 2010)

As stated by Federal Aviation Administration Southern Reigon [FAASR], (1998), the development of land uses that are not compatible with airports and aircraft noise is a growing concern across the country. In addition to aircraft noise, there are other issues, such as safety and other environmental impacts to land uses around airports which need to be considered when addressing the overall issue of land use compatibility.

A cursory observation shows that there are settlements near to the airport that are subject to noise pollution, there are crusher plants/ quarry activities around the airport that emit dust to the environment and creates different ponds and holes that are dangerous to the safe operation of aircrafts. There are settlements and agricultural field very close to the take-off and landing path of the runway in both ends to the East and West direction. The agricultural field is also another treat for the airport environment as it attracts wildlife.

The aviation industry is in a trend of rapid expansion and growth. It requires a very safe environment for its safe and growing operation. Therefore, as a problem, incompatible land use types are becoming common in the vicinity of Bole International Airports. These incompatible land use types are not noticed by concerned bodies or the authorities are negligent and do not take action and enforce the regulations in a collaborative manner. The situation in Addis Ababa Bole International Airport is becoming serious since settlements near to the airport especially those in line with the take-off and landing path of the runway are within safety risk zone and noise pollution and the wildlife hazard report is increasing. Note that most of the accidents in the industry happened near the airport environment or in the areas near to the aerodromes.

The above problem emanates from incompatible land uses that are not safe for the people and the industry. It is therefore, critical to understand the existing land uses, the extent of land use incompatibility and the effects on both the people and the industry in order to mitigate the problem. Research in this area is not available in Ethiopia. As a result the study is hoped to feel the gap in this regard and contribute to the literature.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study is to evaluate the extent to which the current land use practice in the vicinity of Bole International Airport is compatible with the recommended international standards and regulations.

1.3.2 Specific objectives

The specific objectives of the study are:

1. to examine the actual land use in the vicinity of the airport in light of national and international standards;
2. to describe the problems associated with the current and use practices at Addis Ababa Bole International Airport/HAAB on the neighborhoods and the safe operation of aircrafts and
3. to suggest ways of achieving compatible land use.

1.4 Research Questions

In order to meet the above listed objectives, the following basic guiding questions has were developed.

1) Is the current land use trend compatible with the standards set by international organizations like the International Civil Aviation Organization/ICAO?
2) To what extent is the airport land use plan respected?
3) What problems are associated with inappropriate land uses in the vicinity of airports?
4) What are the suggested appropriate land use types in the vicinity of airports?

1.5 Significance of the study

This study will contribute for the safe aviation operation near airports. As a result the final result of the study will help the Addis Ababa/sub-city/woreda land management units and environmental protection offices, the Ethiopian Airport Enterprise/EAE and the

Ethiopian Civil Aviation Authority/ECAA to design and integrate methods of land use plan in the vicinity of the airport and solve the problems in order to contribute for the safe operation of the growing aviation industry.

The study will also helps residents, farmers and investors in the vicinity to consider their activities in line with safe aviation operation and impacts of inappropriate land use planning in the vicinity of the airport.

It will also help different operators basically the Ethiopian Airlines/EAL to consider aircraft standards and its catering services/products and waste disposal systems in line with safe operation of the industry.

Finally this study will be used as a springboard for further research in study area and will give concerned bodies an insight to follow a continuous revision of the land use plan in order to correct inappropriate land use plan in relation with the standards set by the ICAO and federal standards.

1.6 Limitation of the study

The basic limitation of this study is the problem to get local prior experience/ studies on the issue under study so as to take a lesson from. But I have tried to review international works and standards as a means to feel this gap. In addition to this limited experience in the area, the sample data collected on noise using Sound Level Meter is not available for a year but captured only for two days due to the unavailability of the instrument. As a result it was hard to calculate the Day and Night average Sound Level/DNL without having a long term data on noise as a result of aircraft operations.

Therefore the researcher is forced to use local standard developed by the Federal Environmental Protection Agency and UNIDO (2003). The two days recording of a noise generated by an aircraft departing from and landing to HAAB can be representative because the record is conducted on peak hours of the day during the departure moment that ranges from 03:45-05:30 in the morning and the landing moment from 1:00- 02:45 in the evening. Almost the traffic throughout the year is the same although it shows variation during OAU and other international summits. Despite the above facts, the

researcher has exerted maximum effort to accomplish the study in a very fruitful manner to attain the objectives stated.

1.7 **Scope**

The researcher's main focal area is the land use compatibility in the vicinity of Bole International Airport. Thus, the researcher has a focus only on the issue of Land Use Compatibility at Addis Ababa Bole International Airport and its vicinity within 1.5Km radius. The reasons to delineate the study area within 1.5km radius are:

a) as the International Civil Aviation Organization/ICAO airport service manual doc.9137 part 3(1991) states, an "on-airport" bird strike occurs between 0-60m (0 to 200ft) for a landing aircraft and 0-150m (0 to 500ft) for departing aircraft. Thus, taking the maximum 500ft, an aircraft taking-off will crosses 500ft above the aerodrome/ground **before 1miles/1.5Km**;
b) the departure/take-off zone of the airport within 1.5Km range is highly concentrated by society settles very close to the airport environment which is highly sensitive area and exposed to noise pollution and aircraft accident hazard;
c) the quarry activities and their effect on the safe operation of the aviation industry are within the delineated area and
d) management requirements of the area in terms of cost, time and other factors.

1.8 Organization of the thesis

This thesis is organized in to six chapters. The present chapter is about the background, the statement of the problem, the objectives, the research questions, the significance, the study area, the scope and the limitations of the study.

The second chapter deals with the related literature about compatible land uses in the vicinity of airports, the need for airport land use plan, problems of incompatible land

uses in the vicinity, detailed land use practices in HAAB, policies to protect airports and other related points.

The third chapter of this thesis discusses on issues related to the study area and its features.

The fourth chapter of this thesis discusses on points related with data types, source, the sample size and sampling techniques, the instruments used so as to collect data, the method of data analysis and presentation are illustrated. How sound Level Meter is used and data is collected using the instrument is also has a part in this chapter.

In chapter five, the analysis of the data is presented. Thus the data collected through observation, Sound Level Meter recording, key informant's questionnaire and document analysis are analyzed and presented with their findings at last.

Finally, in chapter six the conclusion of the study and the recommendation of the researcher are presented.

Chapter two- Related literature

2.1 Compatible land uses in the vicinity of airports

Land use refers to the use of land. As defined by FAO (1997a), it refers to "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it."

As stated in the Airport Service Manual doc 9137, that the concept of compatible land use planning is an outgrowth of the focus of attention on the environmental relationship between airports and their community neighbors. The document indicates the task of planning as simple task with an impressive outcome if the implementation is done with attention and harmony. The task of implementation may be in the form of aviation system plans, legislation for compatible land use, and formation of zoning. (ICAO, 1991)

Land use compatibility with airport refers to those developments that comply with generally accepted restrictions on location, height and activity that provide for the safe Aircraft movement and airport operations, as well as the preservation of public health, safety and welfare for those persons located in proximity to airport environs that includes the airport itself, the navigable airspace for landing and departing aircrafts, and the traffic pattern. (Mead and Hunt, 2011, p.19)

The site selection of an airport needs a careful attention. Airports need to be located by protecting the take-off and landing paths of aircrafts from populated areas. This is done by comprising the two opposing principles for the best merit. But it should be noted that airports need proximity to centers in terms of travelling time and cost of distance and accessibility of goods and services for passengers, shippers of air cargo, aircrafts operators, labor force, etc.(State of California[SC], 2011)

As indicated in Airport Master Planning, the site selection of airports must ensures the safety of aircraft operations and the safety of the surrounding society from hazard or discomfort as a result of the industry in order to achieve the maximum profit from the aviation industry.(ICAO, 1987)

The development of an airport has an important contribution for the growth and development of the society in many spheres and the airport environ also takes many advantages from the near-by society and land use types. This shows the two-way benefit between them. Although there are mutual benefits among them, there is no doubt on the impact of one over the other. Airports have an influence over surrounding society and land use types (like noise, risk of accidents, disturbance of existing land use types during expansion activities, etc) and the surrounding society and land use types has an influence over the safe operation of the aviation industry by creating obstructions, wildlife hazards, contributing for poor visibility, etc.(SC, 2011).

For the issue of land use planning, airports are challenges to planners. The problem of compatible land use is a challenge in local and international airports. Airports are encroached by land use types that are considered as incompatible land uses for airport environment in terms of noise, safety of the people and the industry. Airports demand large area, they influence the area beyond their boundaries, they host growing industry and above all they are vital for economy of a nation. (Aries Consultants Ltd. [ACL], 2009)

Due to this fact government or concerned aviation authority should always think ways to minimize the substantial airport related impacts by means of protecting encroaching development to ensure urban development permitted in the airport environment is compatible or not. By doing this the concerned authority can ensure the long-term development needs of the airport and /or the aviation industry.

It is known that compatible land use plan is very important so as to define the future and scope of the airport by a means of bilateral coordination between the airport and the government. But without this well-defined coordination, incompatible development in the vicinity of airports will be the result by which the safe operation of the aviation industry and the well being of the surrounding community will be endangered. In addition revisions should be made in the airport master plan or land use plan so as to mitigate problems.

Land uses that are considered as incompatible and subject to discourage at or near airport can vary depending on different parameters. These land use types include residential developments, schools and hospitals. (Mead and Hunt, 2011)

It is clear that air transport sector basically the aviation industry has a great deal of effect on state's economy and local business. As a result the government should pay attention on the potential impacts of incompatible land uses on the sector because the aviation industry is forecasted to increase. And therefore, preserving and guaranteeing facilities of the industry has a vital role. Thus, compatible land use planning must be aimed at securing the navigable airspace and the area around the airport so as to increase the wealth generated after investing on the industry and to reduce risks of safety.

As Mead and Hunt (2011) stated, compatibility and incompatibility of land use types is determined by the management, location and their effect in relation to airports. Commercial uses, industrial uses and agricultural activities are considered as compatible uses in relation to airport but they become incompatible when: Commercial uses have dense concentration of people; industrial uses have tall smoke/ ventilation stacks that generate smoke and creates visual obstruction; and agricultural activities attract wildlife that are potential hazard to an aircraft safe operation. Therefore, land use compatibility is determined by comparing proposed land uses against height, noise and safety guidelines.

Safety is first regarding the objective of land use at or near airports. This implies safety of aircraft (including passengers, crew members and the property) while in the air and in the ground and safety of persons in the ground near the airports are considered.

Airspace protection (tall structure, visual obstructions, wildlife and bird hazards), noise issues, over flight and safety issues (concentration of people, financial risk associated with life or property loss) are the four themes that are considered while dealing with the issues of compatibility in the vicinity of airports. (NOTE: among the four themes the researcher will focus on the issue of noise and safety).

For compatible land use planning, the airport authority should enroll the cooperation of concerned bodies and the local residents in the vicinity. Sources indicated that, the Indianapolis Airport Authority (IAA) built the partnerships with the public and local governments that enabled it to move forward with substantial community support and negligible opposition through good planning and the steady pursuit of its vision. (M. R. Johnson, AICP 2011)

2.2 The need for Airport Land Use Plan

Airport land use commission for SSYYC (1999) stated that, the concern of airport land use plan fall in to three categories. These are:

i. Height restriction: protecting the navigable airspace around airports for aircrafts safety
ii. Noise compatibility: minimizing the number of people exposed to noise from aircraft operations; and
iii. Safety of persons on the ground: minimizing the number of people exposed to hazards related to aircraft operations and accidents.

Considering these airport land use plan concern areas must be reflected in every land use policies, regulations and land use plan so as to reduce the exposure of the society from noise and safety hazards, to create conducive environment for aircraft operations and avoid encroachment of the airport by incompatible land use developments. Therefore every land use plan related with airport and its surrounding must secure the airport from incompatible land use developments at/ near airports, protect the nearby society from adverse effects of airport operations and finally guaranteeing the navigable airspace from different structures that may block safe operation.

As indicated by The Airport Land Use Commission of SLOC (2005), airport land use plan has many merits for the development of the industry and for the overall economic development of a nation. The following can be mentioned.

i. To protect the long-term economic viability of the airport by ensuring compatible land uses in the vicinity of the airport to the extent that lands in the airport area are not already devoted to incompatible uses;
ii. To promote to the safety and well-being of the public by ensuring adoption of land use regulations which minimize exposure of persons to hazards associated with the operation of the airport;
iii. To provide a set of policies and criteria to assist the airport land use planners in evaluating the compatibility of proposed local action with the airport land use plan; and

iv. To provide guidance to local agencies in presenting proposed local actions to the airport land use compatibility for review.

Airport compatible land uses are defined as "those uses that can coexist with a nearby airport without either constraining the safe and efficient operation of the airport or exposing people living or working nearby to unacceptable levels of noise or safety hazards. Compatibility concerns include any airport impact that adversely affects the livability of surrounding communities, as well as any community characteristics that can adversely affect the viability of the airport" (PAS 2010, p.39)

An incompatible land use development near the airports will result in a complains between the airport operators and the society which in turn affects the realization of objectives of the airport and airport operators by threatening the airport's ability to operate in an effective and efficient manner to the serve the nation's economy and endangers the wellbeing's of the society.

SC (2011) states, the goal of airport land use compatibility planning as the task of "minimizing the public's exposure to excessive noise and safety hazards" while providing for the "orderly expansion of airports". Developing a compatible land use plan for airport and community surrounding the airport is valuable so as to safe operation of aircrafts, reduces risk of accidents and noise pollution on the people living in the nearby location and balances the land use development in areas near the airport environment.

The land use plan will contribute for the establishment of rules and regulations that reduces the public's exposure to noise and safety hazards and equally will provide an atmosphere for the safe operation of the industry. Beside this it will guarantee the airport and the nearby society from incompatible land uses.

In addition to this, the land use plan helps the surrounding community to be beneficial from the economic gain as a result the airport and other compatible land use types. The Airport Land Use Commission of SLOC (2005) mentions the merits of airport land use plan as follows:

a) to protect the long term economic viability of the airport by ensuring compatible land uses in the vicinity of the airport to the extent that lands in the airport area are not already devoted to incompatible uses,
b) to promote the safety and well being of the public by ensuring adoption of land use regulations which minimize exposure of persons to hazards associated with the operation of the airport,
c) to provide a set of policies and criteria to assist the airport land use planners in evaluating the compatibility of proposed local actions on the part of referring agencies with the airport and in determining the consistency of the proposed local action with airport land use plan; and
d) to provide guidance to local agencies in presenting proposed local actions to the airport land use compatibility for review.

2.3 Problems of incompatible land uses in the vicinity

2.3.1 Noise pollution

Citizens residing in the vicinity of airports are exposed to the noise problem from the operation of the airport. Noise created during take-off and landing moment of an aircraft at low levels in the vicinity of airport is normal by which one can tolerate, but if the societal exposure to noise rises and interferes with the sleep, speech, schooling, business, recreational activities and religious carryout's, then the problem is considered as annoyance.

This annoyance from the noise generated from the airport operations has an effect on activities of individuals or groups of people. Basically the noise problem is due to:

a. the magnitude and duration of the noise from the aircraft operations;
b. the traffic volume that the airport supports and
c. the time of occurrence during the day /day time, evening or night time/

It is obvious that the perceived aircraft noise annoyance is dependent on the time of operation, the noise volume, the length of the noise event, the type of aircraft and other factors. The generation of excessive noise in an environment results in unwanted and

hazard for the society living in the area. The effect of noise which is beyond the limitation produces uncomforting, annoyance and disturbance on the community's wellbeing. Although all people are not equally sensitive to the problem of noise, there is significant effect over the society.

In our local context, still there is no solid rule and regulation or standards regarding noise at federal level. The house of people representatives is concerned of setting such rules on the behalf of the society. Lack of such regulations creates limitations on how to regulate the impact of noise on the environment. But as far as my investigation indicates, the Addis Ababa Environmental Protection Authority tries to use an ambient noise standard and have some studies on different parts of the city on residential, industrial and commercial areas. The objective behind developing guidelines by the authority is basically to minimize the exposure of the people to noise impacts while living or working in sensitive areas like domestic dwellings, hospitals, schools, places of worships, or areas of amenity.

It is fact that sensitivity to noise is higher during night time than day time. The source I have got from the authority states that the noise level at sensitive areas if the total noise level from all sources is taken in to account ideally is indicated in the table below:

Table 01 - Noise level for different categories of land use types

		Limits in dB	
Area code	Category of area	Day time [note 1]	Night time [note 2]
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45

Source: (FEPA and UNIDO, 2003)

Note 1: day time reckoned in between 6-9 pm

Note 2: night time reckoned in between 9-6 am

The above standard for noise limits during day and night time will be reduced or lower noise limits will be used in areas considered. (FEPA and UNIDO, 2003)

Although still the problem of noise has not been given due attention in our local context, attention seeking events are becoming part of our daily life and the problem is emerging as an environmental issue. The effect of noise generated from the airport environment must be always considered in the planning and operation of airports. The noise generated should not exceed the standards set by the authorized state body noise limit for residential land use, which is 55dB during daytime and 45dB during night time. If it is beyond the standard, this will lead to legal taking of the property owners' ability to use and enjoy the property and monetary compensation of owners. (M. Barry, 1998)

M. Berry, (1998) states, the impact level of an airport noise from aircraft engines deafening when the sound levels are at close proximity and disturbing effect of noises in areas near to take-off and landing of aircrafts. That is why as mostly seen people will face difficulties in coping up the noise of an aircraft where there is high volume of aircrafts landing to and taking- off from, during their early period of joining the area.

The noise generated from an aircraft is from the time of engine testing/engine start-up until take-off through pushback and taxiing out and from the time of landing (low approach) through taxiing in to their respective parking area. This noise varies depending on the type of aircraft and the type of engine they have and the number of traffic flow.

The population size in the areas near the airports firmly decides the severity of the noise problem. Locating an airport far away from the society is losing the very objectives by which airports establish. The development/ production of modern aircrafts are contributing more in reducing the impact of noise although there is high rate of increase in traffic volume at global level. In addition the noise as an environment problem it has given due attention by the ICAO.

Although air transport is reliable in transporting people and cargos, it has sometimes demerits regarding safety, i.e. it is not perfectly safe. Thus, airports are better to be located in areas of less densely populated or unpopulated areas. During the moment an airport has developed the area might be safe but through time people prefer to settle

near airports considering the accessibility. For those groups of society noise problem is not a problem for the time being due to lack of awareness.

As stated by M. Berry (1998), the term **noise mitigation** refers to the efforts by which airport operators are trying to lower the noise impact on the local communities. These lowering means include sound proofing, altered arrival and departure flight paths, aviation easement and property buyouts. Relocating residents who are affected by the noise and making people comfortable in the area they dwell are the two approaches among the noise abatement programs. The combined approach is better.

Noise mitigation programs are expected to be enrolled by every member state of the ICAO. For noise problems due to aircraft operations, the airport operator expected to compensate the society for a legal taking. Developing community outreach program has an advantage to reduce the shock between the community and the airport. Mitigation programs vary depending on the airport traffic volume, i.e. major airports must make a balance between their economic profit and the health of the society. For this surrounding an airport by industrial or commercial uses is an ideal solution to reduce the noise problem. (ICAO, 1987)

2.3.2 Wildlife hazard

Wildlife strikes can result in reduction of safety. The effect of the wildlife strike will be determined by the number and size of wild life involved, phase of flight and the part of the aircraft hit by the wildlife. Wildlife- aircraft strikes have resulted in the loss of hundreds of lives and properties. Wildlife hazards influence the development of the industry.

Many parts in the world have manifested wildlife- aircraft strike that ranges from mild to severe losses of property and the irreplaceable human lives. The case in Bahir Dar, Ethiopia in 1988 has witnessed for a severe wildlife- aircraft strike that resulted in loss of 35 people while a Boeing-737 taking off. When I was discharging my task I have faced an emergency that one light aircraft, of one of the operator at Bole International Airport, had faced a severe bird strike that forced the aircraft to be towed by human beings to clear the RWY. In addition many times strikes of wildlife happened during

take-off and landing of aircrafts and many dead birds and dead animals were cleared by the concerned body after the inspection of the RWY.

Land use practices that attract wildlife near airports have adversely resulted in wildlife-aircraft strike. Different wildlife species create a risk over the safe operation of the sector. They are a serious threat to the safety of an aircraft and lives of the nearby society although all wildlife is not equally hazardous. Airport operators must act jointly on wildlife management programs.

As mostly seen, that many airports have open land that can cause wildlife hazard to the sector. Due to this any wildlife may enter to the approach and/or departure path and traffic circuit/circling area and creates hazards for the operation of an aircraft.

As stated by FAASR (2007), constructed or natural areas like poorly drained locations, detention/retention ponds, roosting habitats on buildings, landscaping, odor causing rotting organic matter, waste disposal operations, wastewater treatment plants, agricultural or aquaculture activities, surface mining, or wetlands can provide wildlife with ideal location for feeding, loafing, reproduction and escape. In addition restaurants can produce attraction for wildlife hazards.

As sources indicated at global level, much wildlife – aircraft strike happened at or near the airport. ICAO (1991), has developed specific advice on land use with the potential to become high risk of wildlife attractants. ICAO stated 13km radius as a benchmark for off-airfield bird hazard assessment in the vicinity of any aerodrome and Ethiopia as a member state must comply the standard. These include:

a) food garbage disposal
b) sewage treatment and disposal
c) artificial and natural lakes
d) abattoirs and freezing works
e) fish processing plants
f) bird sanctuaries and
g) outdoor treats.

Air side habitat management, proactive wildlife control plan and the off airfield management of wildlife hazardous to aircraft operation need due attention. Thus, the concerned authority must establish and enforce an airside habitat management plan so as to minimize exploitable resources for hazardous wildlife. Identified airside wildlife attractants at Bole International Airport are the vegetation, open-fresh water bodies and streams, waste management processes and the built environment. There are many wildlife species that host in the vicinity Bole International Airport like hyenas, rabbits, foxes and the different species of birds are common and reported as a hazard for aircraft operations. They are part of the land use type in the surrounding environment. (Phil Mountain, 2013).

The different land use types in the area near the airport serve that wildlife as home, source of food, reproduction site, etc. Most of the time, these wildlife affected the operation of the airport when they are within the take-off or landing path and circling area. Departures have delayed, landing aircrafts going around and light aircraft in the circling areas has stroked and severely damaged resulting in economical loss and, extra communication has taken place, etc

As stated by Phil Mountain (2013), between the year 2003 and 2012, a total of 58 major wildlife/bird strikes was recorded. This means every year an average of 6.4 major wildlife strikes has been recorded. This is very significant number that reduces aviation safety. As Afework Bekele (2013) stated, wildlife strike has been occurring frequently in many airports of Ethiopia. He stated that between the year 2011 and 2012, nationwide reported strike was about 32 and of this 21 of the strike report has been observed at Bole International Airport which has an average cost of damage about 11million per year.

From the report I collected and from my observation during discharging my task at Addis Ababa Bole International Airport Tower, about 30 bird movement report has been recorded. The table below illustrates the details as follows:

Table 02 - Reported number of bird movement and number of delays

S. No.	Period of the report	Bird movement/ strike	No. of delays	Delays in minutes
1.	07/04/13-20/02/14	30	15	>120 ‘

Note- the period of the report didn’t include months of September, October and November (Source: personal record by the author)

As in the table indicated, the bird movement implies all the events flocks of bird movement and dead animal report in the RWY. And delays indicate that aircrafts didn’t able to take-off or land from and/or at Bole International Airport. In addition, the delays in minutes is the number of minutes by which aircrafts are running engine without take-off or land while they are ready for that. 120 minutes implies an aircraft can use the fuel of 120 minutes for more than two hours in flight.

The land use type at or near the airport environment matters the wildlife species and the size of population attracted. Land use planning decisions and the way by which an existing land use is managed in the vicinity of airports has an adverse effect in creating risks of wildlife hazards. Most of the time airport environments are surrounded by areas that are attractive to wildlife hazard mainly birds. Land use types like agricultural sites, wildlife sanctuaries, wet lands and landfill sites are considered as attractant sites for high number of wildlife which in turn adversely affect the air transport sector.

The surrounding of Bole International Airport is composed of different land use types. The short-final/ undershoot of both sides of the RWY is occupied by quarrying activities and settlements. To the south of the RWY, the land use is dominated by agricultural field used for cultivation of crops and grazing field. North and south of the station is occupied by settlements, illegal slaughtering and waste disposal sites as long as my observation indicates. Water bodies-the rivers, ponds and small marshy areas are also part of the aerodrome vicinity. (Phil Mountain, 2013)

The following are factors for wildlife concentration in the vicinity of the airport.

a. Solid waste disposal- the site and the way by which solid waste is disposed can contribute for the wildlife concentration. Basically different species of birds and mammals will be part of such land use type. Any trash transfer over an open land where uncovered wastes are disposed will have a tendency of attracting wildlife.

Picture 01- The main Apron and waste burning site of EAL (the smoke is while burning waste disposed) (photo by the author-21/11/2013)

Airside waste management should be in a manner so as to reduce hazards for aircraft safe operation. As mostly seen food garbage and other putrescible waste are sorted airside. The way waste disposal in the airport property will be exposed for wildlife can attract them although the problem is easy to manage.

In addition, if settlements near the airport have poor waste management, it has a potential to attract wildlife hazards at airports. The catering services are another problematic area for the wild life attraction, basically birds.

Picture 02 - Waste disposition in to the river- about 1Km northeast of the airport (photo by the author-12/02/2014)

b. Waste water disposal- waste water at or near the airport, ponds built as a result of mining activities of the creature plants and the rivers are common in the area that often attracts potential wildlife hazards.

As part of the river courses, the wetlands are one of the sites that have a potential wildlife hazard. Although they serve the society for many purposes, they contribute for the wildlife hazard. Ponds and small marshy lands around undershoot of RWY 25L and to the south of RWY attract wildlife. (Phil Mountain, 2013)

The ponds to the south of the RWY the result of the quarry activities near the RWY 25. In addition the stream around final position of RWY 25 attracts species like waterfowl, Wattled Ibis Bostrychia Carunculata, Sacred Ibis, Threskiornis Aethiopicus and Spur-winged Plover Vanellus Spinos. (Phil Mountain, 2013)

There are airside attractants of wildlife hazard. These are the sites within the airport property that has a potential for wildlife hazard by means of source of food or place for breeding or perching in the area. The grassland is one of the attractant sites in the airside serves as sources of food. The grassland shares about 60% of the airside environment. Small mammals, insects and reptiles dwell in this land use. Large mammals like spotted hyena, black-backed Jackal, etc are part of the dense vegetation containing

scrub, reeds and trees. Besides, the termites are part of the grassland area that provides food sources for hazardous species. (Phil Mountain, 2013)

Another land use is the airside pond near to the displaced threshold of RWY 25R is an attractant site. In addition the roofs of the Ethiopian Airlines Hangar and the framework supporting the Instrument Landing System/ILS equipment around short final of RWY 7 used as perching site for different birds. Basically the instrument is installed approximately 200m distance from the touchdown. This position is very critical for aircrafts that take-off and land. When concentration of birds is there, landing and departing aircraft will be affected due to birds entering the take-off and landing path of an aircraft.

Phil Mountain (2013), indicated that the Hangars as built environment attracts different bird species congregate to rest. In between the hangars (north of the RWY) and the agricultural field (south of the RWY), there is the RWY that serves aircrafts to depart from and land on to. While the birds flocking and searching food at the agricultural field or perching in the Hangars, they crosses an important flight path of an aircraft (take-off and landing paths) and results in aircraft-bird strikes.

There are ponds and marshy lands and also the bad smell small river within the airport property contribute flush insects and small animals and produces hazardous wildlife currently. The birds or other animals may be part of such LU in order to collect their food from and to feed the insects.

c. Agricultural activities- the phases of some crops may cause wildlife hazard. In addition the livestock production process also may attract flocking birds.

There is a standard for separation distance between airports and land use practices that attract wildlife hazards which is 3km, 8km and 13km radial distance.

d. Crusher plants -there are about nine/9 crusher plants/quarry activities in the vicinity. They are important for the construction sector by producing different construction materials. As sources indicated the crusher plants (large ones) in the area were planted so as to support the RWY construction during the expansion of the airport.

But still now after the expansion of the airport concluded the crusher plants are continuing their production.

Beside the smoke and the dust material emitted to the environment, they resulted in the formation of many ponds that are basically problematic for the safe operation of aircraft and dangerous for the engines of aircrafts. The creature plants are within the take-off path of RWY 07R and landing path of RWY 25L. Such land use types near the take-off and landing path of aircrafts will reduce the visibility; the ponds created as a result of the quarry activities will attract wildlife and will results in the wildlife- aircraft strike. During the moment that I discharge my responsibility of issuing landing and take-off for aircraft, some pilots were complaining the smoke from the creature plants.

2.3.3 Safety risks near the airport

As sources indicate, most of the time accidents are reported near the airport. Basically the initial climb while take-off and the low approach moments while landing are the positions most accidents recorded.

Table 03-Accident Records: 2006–2012 ***Scheduled commercial flights***

Year	Number *of accidents*	Number of fatalities
2006	112	524
2007	122	645
2008	138	524
2009	116	703
2010	121	707
2011	126	414
2012	99	372

S*ource: ICAO 2013 safety report*

The above table indicates that in 2012 the number of accidents and fatalities per millions of scheduled commercial flight departures that occurred globally has shown decrease.

Table 04 -Global Accident Rate accidents per million departures

Year	Accidents per million departures
2006	4.1
2007	4.2
2008	4.8
2009	4.1
2010	4.2
2011	4.2
2012	3.2

S*ource: ICAO 2013* safety report.

The above table illustrates the accident rate change at global level that involves scheduled commercial operations including cargo, mail and passengers transportation.

As ICAO (2013) safety report shows, Ethiopia is among states that have effective implementation above the global average of 61% based on USOAP audit results as of 31December 2012.

2.4 Detailed land use in the vicinity

This title deals about the land use issues and detail discussion of the land use developments at/ near or in the vicinity of airport environment is presented.

1. Urban or built-up land

Urban or built-up land is comprised of areas of intensive use with much of the land covered by Structures. Included in this category are cities, towns, villages, strip developments along highways, transportation, power, and communications facilities, and areas such as those occupied by mills, shopping Centers, industrial and commercial complexes, and institutions.

1.1 Residential

As Anderson, Hardy and Witmer (1976), define this land use includes high density multi-unit structures of urban cores to low density, where houses are on lots of more than an acre on the periphery of urban expansion.

The surrounding of Bole International Airport has manifested that its vicinity is inhabited by people that dwells in the area. From the national standard regarding the

residential sites 55dB for day time and 45dB for night time is used as a benchmark for such land uses. Basically the approach and departure paths of both RWY alignments (RWY 07 and RWY25) are characterized by settlements that are very sensitive to noise pollution and accident hazards from aircraft operations. In addition north of the station is also occupied by settlements.

Saris, St. Yoseph area, Bole Michael, Sefera, Kazanchis, Goro, Gerji, are very sensitive area for both accident hazards and noise pollution problem.

In addition to the noise problem and accident risk, the way the society disposes domestic wastes is also another issue to be addressed. This implies that poor handling of waste will led to the concentration of wildlife hazards which in turn adversely affect the safe operation of the airport. The type of waste, the phase of the waste, the way it is managed and disposed, and the site by which the waste is dumped and other factors matters the wildlife size and their effect on the operation of the airport.

1.2 Industrial

Industrial areas include a wide array of land uses from light manufacturing to heavy manufacturing plants. Surface structures associated with mining operations are included in this category.

Picture 03-Crusher plant site and the heavy trucks (photo by the author-03/02/2014)

Crusher plants are part of the land use at bole International Airport. There are about 9 quarry plant stations around departure and take-off path of RWY25 and RWY07. These quarry plant activities have an adverse effect on the safe operations of the aircrafts by emitting dust and smoke they result in poor visibility and the holes they dig will be changed in to another land use and become wildlife attractant site that in turn results in safety hazards.

2. Agricultural land

Agricultural Land may be defined broadly as land used primarily for production of food and fiber.

The agricultural land has a high wild life attraction risk. The effect of the agricultural land on the safe operation of the airport depends on the distance from the airport, the type of agricultural activities and the type and size of wildlife in the area for various purposes. The land use may be used as source of food, place of breeding and area for soar and ground rest for wildlife hazards.

Crops, depending on their phase of growth cycle, are an attractant to wildlife at or near airports. The type of the crop matters the type and size of wildlife to be attracted, the time and the extent. In our local experience in Addis Ababa Bole International Airport,

the area immediate to the south of the airport is basically an agricultural field that serves wildlife as a source of food, area for soar and for ground rest.

Picture 04-The agricultural field-Guaya (photo by the author-12/03/2014)

During my repeated observation of the area, many flocks of birds with different species were covering the land. This is because the agricultural area used as pasture land for livestock and for cultivation of different crops like teff, wheat, lentil, bean, Guaya, chickpea, barley, etc

Picture 05-Cattles while grazing (photo by the author-10/12/2014)

Picture 06-The agricultural field-harvesting period (photo by the author-10/12/2014)

According to land use sources, an agricultural land use practice that has a potential to attract wildlife that:

i. because of their smaller size, behavioral characteristics, and not particularly far-ranging in their food searching activities, and/or
ii. are of concern as aircraft hazards chiefly during limited time spans only, i.e., migration, infrequent climatic conditions are not recommended to be part of the airport vicinity within 3.2Km or less from the airport reference point.

Among the land uses that are not recommended within 3.2 Km or less from the airport reference point, agricultural practices that produces crops like barley, Oats, wheat, corn, sunflower and clover are included. Most of these crops grows and cultivated in the agricultural land use just to the south of the airport.

Agricultural activities may not be totally considered as incompatible land use but the type of crop matters it. This is because all crops do not attract wildlife. If the type of crop does not attract any wildlife, then the land use is considered as compatible land use. Whereas if the crop by which the land is supporting is type of crop that can attract different species of wildlife then the land use will be considered as incompatible land use.

The airport service manual stated that an agricultural land use as incompatible land use and from my own observation of the study area, even if the field is beyond the airport territory different species of birds flyover and cross the take-off and landing path of RWY to reach the agricultural field.

3. Rangeland

Rangeland is a land where the potential natural vegetation is predominantly grasses, grass like plants and forbs. The Herbaceous Rangeland category encompasses lands dominated by naturally occurring grasses and forbs as well as those areas of actual rangeland which have been modified to include grasses and forbs as their principal cover, when the land is managed for rangeland purposes and not managed using practices typical of pastureland. It includes the tall grass (or true prairie), short grass, bunch grass or Palouse grass, and desert grass regions.

Picture 07-The grassland south of the airport (photo by the author-10/12/2014)

Air side and off air side grass lands as part of the rangeland, they are another attractant site of wildlife. The Adwa park just north of the station within the study area and the pen land just to the south of the RWY are an off-side attractants and the air side grassland which covers about 60% of the total area serves different species of wildlife-mammals, insects and reptiles. Mostly when the grass grows following the rainy season operational personnel's of the HAAB tower/the aerodrome controller, the watch room and pilots of different operators will face a challenge from wildlife species by interfering the daily traffic movement. As a result aircrafts will delay and extra burden will be left for the controller and the watch room personnel's.

4. **Wate**r

4.1 Streams and canals

The Streams and Canals category includes rivers, creeks, canals, and other linear water bodies.

As Phil Mountain (2013) indicates, the case about the stream in the vicinity as it attracts different species of wildlife.

In addition the bad smell of the streams and the poor management of solid wastes (that is disposed in to the river by the locality) increase the potential attractant to the wildlife hazard.

Picture 08-The canal around RWY25 (Photo from Phil Mountain report)

Picture 09-The canal around RWY07 (Photo by author-10/12/2014)

4.2 Ponds

A pond is non-flowing, enclosed body of water, including regulated. Islands that are too small to delineate should be included in the water area.

Ponds are part of the airport environment that is potential wildlife attractant sites. These ponds are created as a result of quarry activities just in the short final of both RWY alignments.

As Phil Mountain (2013) stated, these ponds provided an attractant to migrant and resident species of wildlife.

Picture 10-Pond as a result of quarry activity RWY25 (Photo by author-10/04/2014)

Picture 11-Pond as a result of quarry activity to the south of RWY25 (Photo by author-10/04/2014)

Picture 12-Pond south of the airport (Photo by author-10/04/2014)

5. Wetland

Wetlands are those areas where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established, although alluvial and tidal flats may be non-vegetated. Wetlands frequently are associated with topographic lows, even in mountainous regions. Examples of wetlands include marshes, mudflats, and swamps situated on the shallow margins of bays, lakes, ponds, streams, and manmade impoundments such as reservoirs.

Wetland areas drained for any purpose belong to other land use and land cover categories such as Agricultural Land, Rangeland, Forest Land, or Urban or Built-up Land. When the drainage is discontinued and such use ceases, classification may revert to Wetland.

Wetlands are common both to the north and south of the station and are among the potential sites of wildlife attractant. They supported different species by providing a range of exploitable resources like water, short-grass habitat by accessing insects and

garbage and have a great environmental and societal value at all periods of the season. (Phil Mountain, 2013).

Picture 13-Marshy land south of the airport (Photo by author-10/04/2014)

As E. Cleary and A. Dolbeer (2005) stated, wetlands attract various species of wildlife and if they are within the airport environment/off side or air side, there will be a change in habitat which in turn results in demolishing the safe operations of the sector. And they suggested mitigating the problem soon.

The FAA Southern Region (1998), states a separation criteria/distance for land use practices that attract hazardous wildlife at or near the airport on the basis of:

a) flight patterns of piston-powered aircraft and turbine-powered aircraft,

Airports serving piston-powered aircraft are airports that do not sell Jet-A fuel normally serve piston-powered aircraft. Thus, according to FAA Southern Region (1998), these airports must establish a separation distance of 5000ft for hazardous wildlife attractant sites from the airport operation area/AOA.

Airports serving turbine-powered aircraft- are airports selling Jet-A fuel normally serve turbine-powered aircraft. Thus, according to FAA Southern Region (1998), these airports must establish a separation distance of 10,000ft for hazardous wildlife attractant sites from the Airport Operation Area/AOA.

b) the altitude at which most strikes happen (78% occur under 1,000 feet/0.3048Km and 90 percent occur under 3,000 feet/0.9144Km above ground level).

The other case is the protection of the approach, departure and circling airspace-as the FAA Southern Region (1998), states, a distance of 5 statute miles between the farthest edges of the airport's AOA and the hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace.

Therefore from the above points, HAAB is an airport that serves turbine-powered aircraft and a separation distance of 10,000ft is expected to be respected between the AOA and the potential bird attractant site. But it is not the reality. Air side and off airside wildlife attractants are associated with the airport environment that indicates the airport status from the standards of the FAA.

2.5 Polices to protect airports

The issue of noise and air pollution is a concern of people living near airports. As a result site selection of airports should avoid densely populated areas and clear of obstruction that reduces safety of an aircraft operation and the nearby society. It is fact that airport land is more valuable and society can prefer surrounding it for the purpose of accessibility.

Airport administrators, the civil aviation authority and the city administrator are responsible for creating compatible land use around airports. This is because incompatible land uses have an impact on the safe operation of the aviation sector and limits the competence of the aviation sector in generating income and it highly exposes the local society for environmental problems. Thus, standards and rules must be developed and enforced regarding airport land use to minimize the risk of encroachment of incompatible land use types by addressing safety zones.

The Oregon Department of Aviation (2003), has identified action items in order to tackle the encroachment of airports by incompatible land use types. These actions are listed below.

i. Guiding local jurisdictions in implementing the land use and zoning requirements;
ii. Revising, adopting and implementing the state-level airport land use plan guidelines that helps concerned authorities to establish zoning and land use regulations to preserve airports and avoid future land use conflicts;
iii. Guiding local jurisdictions to develop appropriate zoning to keep RWY protection zones free of all structures;
iv. Coordinating with local jurisdictions regarding the state requirement that proposed construction plans for areas surrounding airports;
v. Using the regular inspections carried out by concerned bodies to identify potential safety hazards;
vi. Promoting the use of state standards to minimize the liability risk for the state or local government and the airport;
vii. Promoting compatible uses of surrounding areas by working with airport operators, affected communities and aviation users;
viii. Identify the extent of residential encroachment and monitor changes and notify local government of hazards.

To bring a sustained land use practices the concerned authorities of the airport proprietor should develop airport safety restriction areas. These airport safety restriction areas are demarcated in order to reduce the aircraft crash hazard on the society residing in the vicinity and minimizing the possibilities of wildlife hazard in the environment. This can be achieved by placing restrictions on land uses in the various safety areas. Basically there are three safety areas as mentioned by Airport land use commission for Sacramento, Sutter, Yolo and Yuba Counties (1999). These are:

a) Clear zone: the area near the end of the RWY and is most restrictive,
b) Approach-Departure zone: is located under the take-off and landing slopes/paths and
c) Over flight zone: the area under the traffic pattern.

As indicated by Airport land use commission for Sacramento, Sutter, Yolo and Yuba Counties (1999) referencing the National Transportation Safety Board (NTSB),

accidents occur within one mile/1.6Km of the airport and thus land use planning within this boundary need attention i.e. most of accidents in the aviation industry occurs in the vicinity of the aerodrome during take-off and landing. This is during take-off while initial climb and during landing while touchdown and rolling phases. Thus actual land use mainly in departure and approach paths must be considered to minimize the problem of safety issues from aircraft operations.

As the Oregon Department of Aviation (2003) reported, there are basically indicators of the status of airports with regard to airport protection from incompatible land uses. These indicators are listed as follows:

a. presence of airport overlay zone;
b. airports with a 55DNL(Day and Night average sound level) noise contour extending beyond airport property
c. presence of incompatible land uses nearby, including residential uses and close–in obstruction (within RWY protection zones)
d. presence of water impoundments within the vicinity of the airport;
e. presence of open landfills within the vicinity of the airport; and
f. presence of bird attractants or migratory area.

The case at Bole International Airport has clearly manifested these indicators. The society is very close to the landing and take-off path of the airport, there are sites of bird attractants within the airport property and outside from the nearby society, the waste disposal ways are another hazardous situation near the airport and the creature plant near the airport and the dust emitted from is also another indicator. The agricultural site also attracts birds that are dangerous for the sector.

The above points, implies the need for compatible land use initiatives to protect the airport from future land use incompatibility issues. Poor planning will result incompatibility on future airport land use plan. In addition to the initiative there must be a periodic follow-up survey, as urban growth is resulting in encroachment of the airport environ. Guaranteeing the sector implies increase in the state economy safeguarding the life of residents and passengers.

Chapter three- The study area

3.1 Study area

The study area is confined to the southeast part of the city at Addis Ababa Bole International Airport and its surrounding/vicinity. Addis Ababa Bole International Airport is located in Bole sub-city woreda 01. Thus, the area includes the airport and the surrounding residential, crusher plants and the agricultural area within 1.5km radius. It includes the natural habitat like wetlands, the small swampy areas and the grassland and the man-made environment- the Hangars, the settlement and installed equipments.

The study area has different land uses that include the airport environment, residential area, water bodies, the crusher plants, commercial centers, civic communities, open land and agricultural fields within 1.5Km radius.

Residential areas are found to the East and West of the airport perimeter. The Southern part of the airport is composed of farmland and the newly emerging Bole Bulbula residential area. The crusher plants are found to the west and east of the station. The agricultural farm lands are located to the south, west and east of the station. The water bodies are found to the northeast, south and west of the airport. Commercial centers occupy the area north of the station and the civic communities are found in all directions.

The airport is controlled by the EAE and the administration is left to the Addis Ababa Bole International Airport Administration. The site is approximately 4430m from east to west and 1867m from north to south extent and it covers about 900ha.

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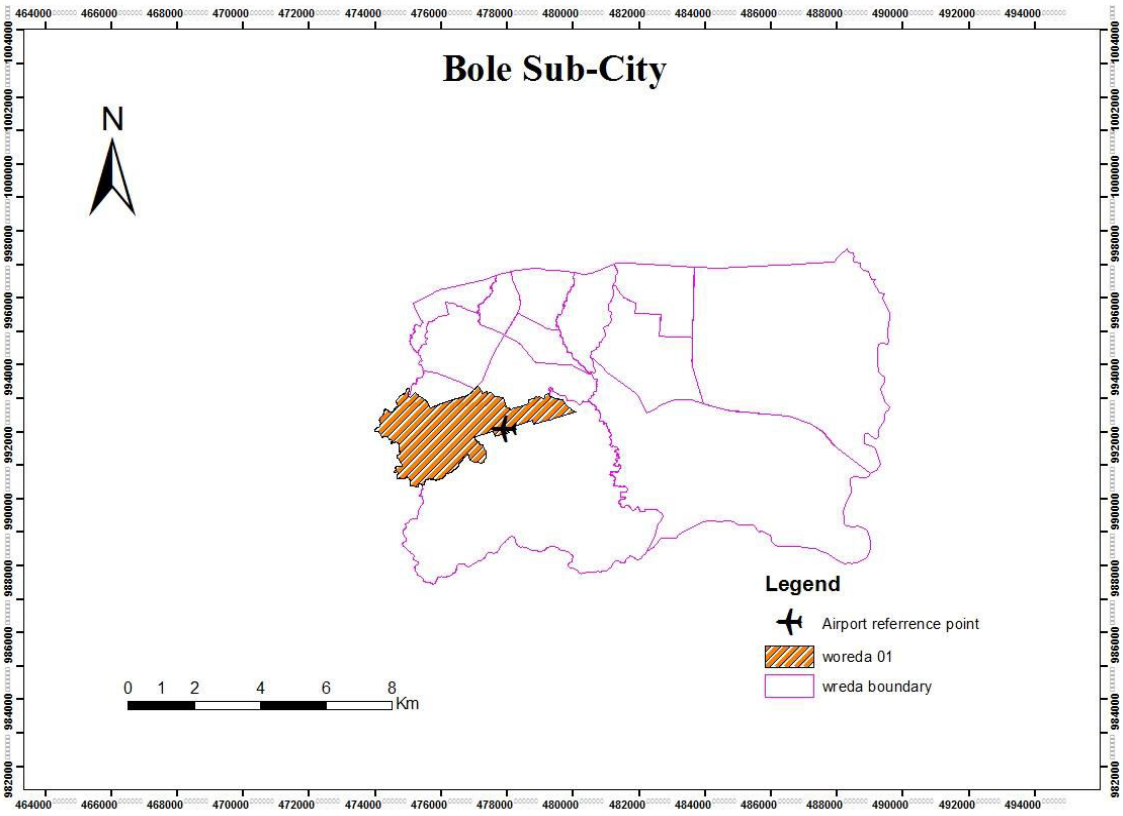


Map 01- The Location of Woreda 01

Headquarters of the EAE, ECAA, EAL, oil depot, the ATC Towers, and the food service facilities are among the airport related buildings that exist to the north of the RWY. The RWY 07/25 lies in a northeast-southwest direction.

Figure 01- Addis Ababa Bole International Airport and its vicinity (Source: Google earth)

3.2 Topography

Addis Ababa Bole International Airport is located 8kilometers southeast of the city having a designated geographical location of 0**85830.1470N** and **038475.8387E (N.B**. this aerodrome reference point is 400m from the center line at approximate middle of runway 25R and to the left of runway 25R) at an elevation of 2333.5m above mean sea level.

3.3 Climate

Addis Ababa has moderate climatic conditions having two rainy seasons- June – September is the main rainy season and March- May is the short rainy season. The study area has a temperature of 25^{o}C.

Chapter four- Methodology

4.1 Research Approach

The study uses mixed approaches (qualitative and quantitative) in answering the questions. The qualitative approach is employed to understand the attitudes and perception of residents occupying different land uses and those people (experts) knowledgeable about the industry. The quantitative method is employed since there is a need to measure sound level in the study area. Thus, the researcher has attempted to analyze and assess the case under study by describing and analyzing the compatibility of the land use types surrounding the airport from the point of safety of the society, safe airport operation.

4.2 Research Methods

Depending on the nature of the case under study as well as the purpose of the research description and explanation methods is used for the actual land use trend in the vicinity of the Bole International Airport/HAAB. The actual land practices are described and explained in line with the national and international standards.

4.3 Data types and sources

The data types in this research are both primary and secondary data. Primary data were collected from personal observation, focus group discussion and from Key Informants and from field measurements. The secondary data was collected from document analysis of the Ethiopian Airport Enterprise/EAE and Ethiopian Civil Aviation Authority/ECAA and from other different research papers and articles.

4.4 Data collection methods

Basically the researcher has used different instruments to collect data like:

A. **Key informants**: - Questions were posed for key informants according to their departmental concern in order to have information regarding the actual land use

types and their compatibility, the problem associated with them, their influence on the safe operation of the aviation industry and the impact of the industry over the society, the solution for the case under study, etc. A total of three key informant groups having nine individuals were selected purposively.

The first group of key informants gives answers on the issues related with wildlife hazard in the airport and its vicinity. This group encompasses two Air Traffic Controllers of HAAB (Aerodrome Traffic Controllers at Bole Tower) who are responsible for controlling of aircraft on the air and on the ground), two fire fighters (who are responsible for the controlling of fire) and one Airport Safety personnel from the Airport Safety Department (who is in charge of safety issues).

The second group encompasses one personnel from the ECAA Aerodrome Safety and Standard Directorate, who is responsible on wildlife hazard management. The last group encompasses three personnel, two from ECAA Aerodrome Safety and Standard Directorate who are concerned with the Aerodrome Safety and Inspection and one from EAE Airport Facilitation Office.

B. **Focused Group Discussion** was held with farmers, residents, institutions (educational and religious institutions), catering service providers and crusher plant owners. A total of five focused group discussion was formed by which participants were selected purposively.
C. **Observation: -** to have clear background over the case at hand regarding the severity of the problem, how far the LUTs are close to the airport, the effect of the LUs in the vicinity over the safe operation of the aviation sector and vice versa.etc.
D. **Secondary data analysis: -** conducted to consider the rules, regulations and standards set by the local and international organizations. In addition to that the airport land use map is assessed.
E. **Measurement of sound**: - a Digital Sound Level Meter has been used in collecting noise data in order to make analysis of the noise pollution in the study area.

The ***Extech 407730 Digital Sound level Meter*** measures and displays sound pressure levels in dB from 40 to 130dB. It has user selectable features that include *frequency weighting* ('A' and 'C'), *Response Time* (Fast and Slow), *Max Hold*, and *max/Min* recording.

Picture 14-The Extech 407730 Digital Sound level Meter (Photo by the author-18/05/2014)

Measurement is conducted after powering on the power button and holding the meter away from the body and any other reflective object and from 1.5 meters above the ground.

During recording the sound created by an airtraffic departing from or landing to the HAAB from the RWY25L and RWY07R, **'A'** weighting is used. This is because the frequency response of the meter is similar to the response of the human ear and it is because it is mostly used for noise measurement.

The **Fast response** (125ms second) time is used during the record in order to capture the noise peaks. **Max/Min** recordings at each measurement area for the day time and night time have been conducted. It is the average of the two that was taken as the sound at that specific position for the night time and day time.

Measurement considerations as specified by the operation of the Sound Level Meter has been considered like using the supplied windscreen to cover the microphone because the blowing wind across the microphone area will result in increase in the noise measurement.

Traffic density is not evenly distributed throughout the day rather there are pick traffic hours that manifests high traffic volume. Mainly the departure moment of the day time that covers from 02:00 to 05:30 (about 27 departure traffics at average per day) and the night time departure that covers from 03:30 to 07:30 (about 21 departure traffics at average per day) and the landing moment that covers from 12:30 to 03:30 during night time (about 27 landing traffics at average per day) and from 11:30 to 01:30 of the morning time (about 21 landing traffics at average per day).

Sample data on sound was collected from the pick hour (maximum traffic volume moment) of the morning departure and the pick hour (maximum traffic volume moment) of the night time landing traffics. The measurement has Max and Min value as indicated by the Sound Level Meter. Therefore, both the day time and night time average sound level are calculated and analyzed. Finally, the average value at each measurement area is compared with the federal Environmental Protection Agency and UNIDO standard around residential areas.

4.5 Method of data analysis and presentation

All the data gathered by the above ways are analyzed to check whether the land uses are compatible or not from the issues of noise pollution, wildlife hazard management, safety of the aviation industry and safety of the society in case of accidents in the vicinity of the airport.

The analysis of qualitative data is conducted by creating themes that has some logical connection one with the other. Thus points that have commonalities are collected together. Whereas, the analysis of quantitative data collected from the field measurement is conducted by means of interpolation method using the kriging tool- interpolating a raster surface from points using the kriging tool. Thus the tool estimates the sound level using the recoded data as reference and then comparison from the standards set by the FEPA and UNIDO (2003) has been done.

Finally the data generated explained and interpreted by means of tables, maps and charts.

4.6 Sampling

The study populations are those inhabitants within 1.5Km of the airport field. The population is stratified by land use types they occupy. The land use types found are: Residential, Catering services, Agricultural land, Quarry activities, the religious and educational institutions, Commercial centers and the rivers and small marshy lands.

Residents, catering service providers, farmers, crusher plant owners and those working in educational and religious institutions were then selected purposively to be member of the focus group discussion. A total of five focus groups were formed with each focus group discussion comprising six members. The focus group from educational and religious institution however has four members because two participants of the group were absent during the discussion.

Chapter five-Data Analysis

This chapter deals with the analysis of the data gathered by means of different tools- question from Key Informants, Focus Group Discussion/FGD, actual field measurement, observation and secondary data analysis.

5.1 The airport and the land use types in the vicinity

Topographic factors like the elevation of the area, climatic factors-the atmospheric condition and wind direction, accessibility-for ground transport to and from the main city, issues related with obstacles-interference with residential, man-made features are used as criteria for site selection of an airport.

Relocation from other parts of the city, accessibility to goods and services and business related factors are among the factors that serve as a driving motive for the different land use types to prefer the area. The livelihoods in these land use types are various-there are day workers, farmers, professionals, shoppers, etc.

The airport environment has created positive and negative impacts on the land uses in the vicinity of the airport. For the catering service providers the airport environment has created positive impact for their business. Whereas, the residential and farmers are affected by the airport operation. Residents are subject to noise pollution and safety risks and the farmers asserted as they lost their land with less compensation for the reason of airport expansion and as a result their production is declining due to small size of their cultivable land.

Safety of the nearby society and safe operation of the industry is mentioned as the need for compatible land use plan at or near airports. Thus, the stakeholders of the industry, the society and the nation as a whole are beneficiaries from the compatible land use plan at or near airports. In this regard those land use types that are free of obstacle for the safe operation of aircrafts, that do not attract wildlife and those settlements out of noise sensitive areas are considered as compatible land uses with airport environment.

1. Residential land use type

This land use type in the study area is encroaching the airport environment. There are people reside to the north, east, west and south of the airport. It implies that all the downwind of both the RWY alignments are occupied by settlements. But the most sensitive area of the take-off and landing paths of RWY25 and RWY07 need a high attention. This area is very sensitive because aircrafts use it for low approach and initial climb purpose. During initial climb and low approach there is high noise created by the aircrafts. In addition to this noise issue, if in case there is an overshoot of aircraft during take-off from or landing to the RWY, the immediate result might be accident. This affects the society reside in this critical position of take-off and landing paths.

Basically, the approach and departure paths of both RWY alignments (RWY 07 and RWY25) are characterized by settlements that are very sensitive to noise pollution and accident hazards as a result of aircraft operations.

2. The agricultural land use

This land use type is found to the south, east and west of the airport. Agricultural activities are mentioned as one factor for wildlife concentration in the vicinity. Although the existence of these farm lands is before the development of the airport in the area, now it is considered as incompatible land use type with the airport environment. Crops like teff, wheat, bean, lentil, Guaya, chickpea, barley, etc are among the cultivated crops in the area but they are not recommended to be produced at or near the airport.

The agricultural land is also important in serving the wildlife as a source of food. Wildlife especially birds use the area to soar and to search for food by crossing the RWY-take-off and landing path. The agricultural land serves as a grazing land for cattle of the farmers.

3. Crusher plants

Crusher plants are found near the airport just immediate to the boundary of the airport located to the east of the RWY25 and west of the RWY07 in the take-off and landing path of the RWY.

There are holes, gorges and ponds created by crusher activities. These holes, gorges and ponds serve as an active attractant site or wildlife. In addition, people use the ponds as a swimming pool and for washing of cloths.

Those crusher plants have an adverse effect on the safe operation of the aircrafts-the holes they create changed in to another land use and become wildlife attractant site that in turn results in safety hazards.

Business land use

There are many catering service providers in the vicinity of the airport that provides indoor and outdoor services for their customer. Workers in the airport environment are the customers of the service in addition to the passengers and their families or friends.

Although there is improvement in their waste handling practices, still there are problems of waste management of the food garbage. Sometimes customers of the service took food and drop the food garbage in the ramp. These land use types are considered as on-airport wildlife attractant sites.

5.2 Problems of the land use types in the vicinity of the airport

The different and uses in the vicinity has created problems over the safe operation of the aviation industry and the lives of the nearby society.

1. Wildlife hazard

There is a wildlife hazard report at HAAB by different units and this report is recorded for further action. As respondents told different species of birds, different species of mammals-Sylvicapra Grimma (ማጂዳቋ), black kite, common Jackal, small antelope, Rabbit, common Duiker and hyenas ,Reptiles like Snake and Lizard, amphibians like frog are among the reported wildlife that sometimes delays and hold aaircrafts for minutes.

The **climatic condition**, the **topographical** factors (gorges and holes), **habitat related** factors (the area is inhibited by different species of organisms, plants, birds and mammals), **poor waste disposition practices** (availability of landfills and abattoirs) and

poor infrastructural developments (poor fencing and wildlife controlling mechanisms) are the mentioned factors contributing for the occurrence of movement of wildlife hazard in the vicinity of the airport. In addition, societal factors like cultivation of crops that are not recommended at or near airport and the crusher plants and their effects have contributed for wildlife concentration in the area.

Proactive and reactive measures are taken in order to minimize the wildlife hazard although reactive measures are given due attention. Destroying the habitat of the wildlife has employed as proactive measures in order to mitigate the problem from the source, whereas the reactive measures like chasing off/removing the wildlife by scaring and shooting at the wildlife are taken to alleviate or minimize the wildlife hazard during their observation.

Wildlife hazard in the vicinity of the airport will result aircraft-wildlife strike and harm on the society like transfer of diseases or large mammals may harm the lives of the people or animals. The possible effects of aircraft-wildlife strike are loss of life, loss of property, delays in aircraft operation, closure of the airport and loss of national image. These all in turn jeopardize the industry.

2. Waste management practices

Poor waste management practice in the vicinity of the airport is among the factors for wildlife hazard concentration. Plantation of different crops and trees, formation of holes, gorges and ponds and waste disposition ways are among the mentioned societal factors contributing for wildlife hazard concentration in the vicinity of the airport. Although there are improvements in this regard still there are problems. There are small enterprises that collect waste in some parts of the vicinity to collect waste but still there are people throwing waste in to the river and in an open field. Bole Kazanchis-east of the airport, Weregenu and Riventi-to the south, Bole Kotebe to the north of the airport are among the sites that poor waste management has manifested. The rest of the study area uses trashcan that is picked by the city administration solid waste collector trucks.

Picture 15 - waste disposition in to the river-northeast of the airport (photo by the author-12/02/2014)

Picture 16-trashcan near St. Yoseph Church (photo by author-18/04/2014)

The catering service providers in the compound of the airport have different ways of food garbage disposition ways. Some of them rent the food garbage for individuals, others dropped it in a trash to be collected by trucks and others provide it for day workers in the compound that is subject to be dropped in the field and attract wildlife.

3. Sound pollution

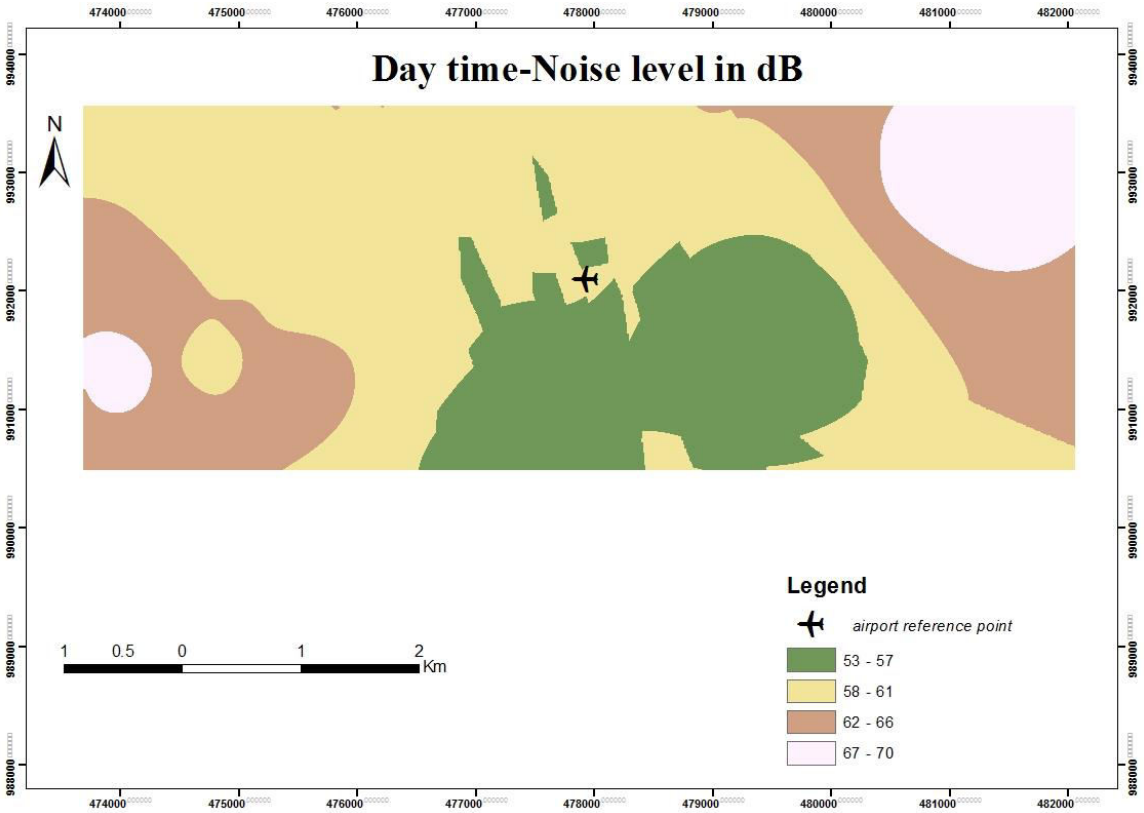
Sound pollution in the vicinity of the airport is considered as a problem. The noise created by aircrafts during landing and take-off moments has an influence on the lives of the people near the airport. Interference during face to face and line speech, during entertainments-TV, radio, etc and during religious gatherings are mentioned beside the health problem in the area. In addition, high magnitude sound as a result of aircraft operation gives advantages for robbers to break houses and fences of the nearby society during night moments and exposed the society for robbers.

HAAB has a noise contour map that is generated on the basis of the Americans experience. As the data from field measurement indicated, the area to the south of the airport is free of sound pollution. The immediate area in the take-off and landing path-Bole Kazanchis, St. Yoseph and Chereka Sefer are highly exposed areas. These dwellers do not apply any mechanism to minimize the pollution by the sound proofing alternatives or any other.

Table 05- Measured day time Sound level and their attribute

location	Latitude	Longitude	Elevation	Daytime Max	Daytime Min	day Time average
1	479029	993434	2300	66.2	54	60.1
2	479015	993556	2318	66.3	59.9	63.1
3	479328	993527	2314	79.5	42.6	61.05
4	479864	993247	2294	81.4	42.6	62
5	480207	993081	2281	80.7	42.2	61.45
6	479861	991840	2291	60.8	42.6	51.7
7	479413	991601	2280	56.6	44.2	50.4
8	478808	991302	2276	67.1	42.6	54.85
9	477879	990907	2303	67.2	43.6	55.4
10	476858	990489	2298	58.8	44.1	51.45
11	475644	991120	2285	78.4	52.9	65.65
12	475085	991809	2292	76.3	55.6	65.95
13	475245	991916	2295	66.4	48.3	57.35
14	475408	992114	2304	68.7	51.1	59.9
15	475538	992277	2313	68.5	49.3	58.9
16	473692	991145	2318	78	60.1	69.05
17	473855	991268	2320	79	63.2	71.1
18	474083	991270	2320	74.8	62	68.4
19	474372	991389	2315	79.9	57.8	68.85
20	474592	991392	2280	80.2	66	73.1
21	480761	992971	2279	87.2	65.1	76.15
22	480968	992940	2292	86.2	66.4	76.3
23	481358	992928	2309	79.9	63.6	71.75
24	482057	993188	2316	78.6	61.8	70.2

Source-Personal record of the author



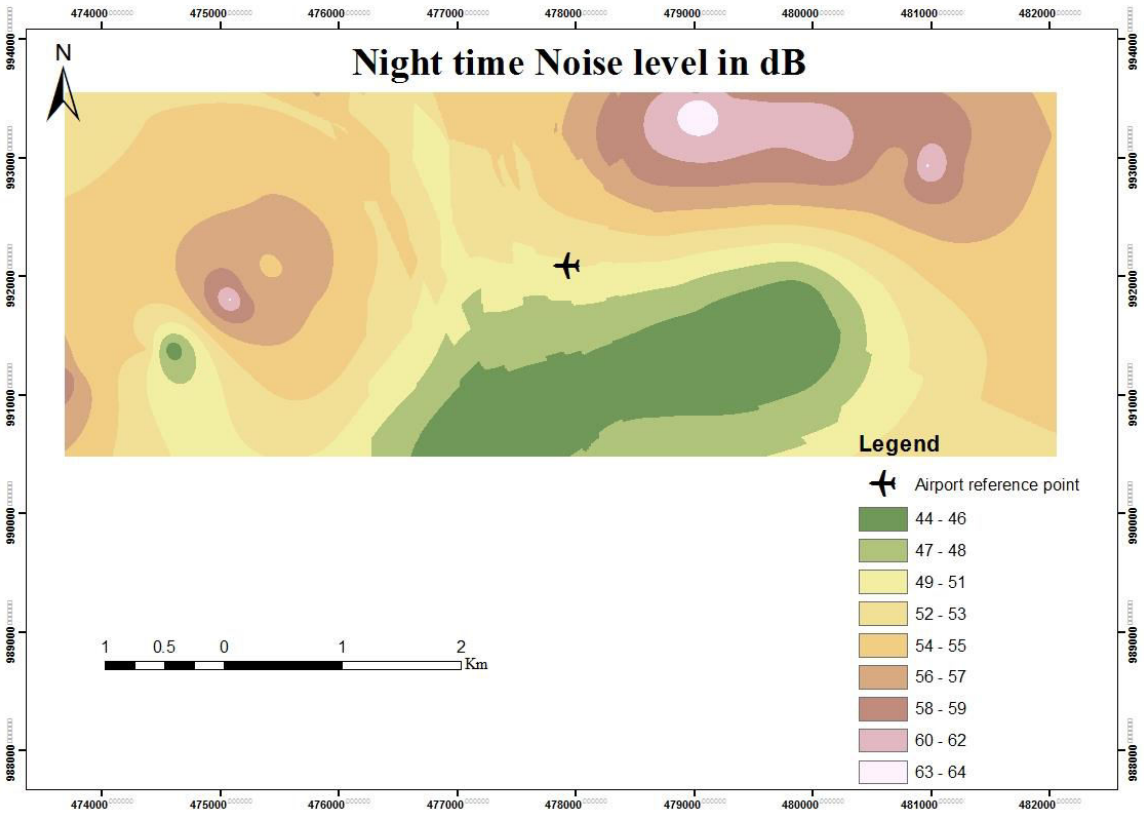
Map 02-Day time noise level in dB

The map shows that most of the area south of the airport has less noise level in decibel. Whereas, the area along the take-off and landing paths show contradiction with the federal standard and they are within noise sensitive areas showing noise pollution. It has manifested that the area is not in a safe manner so as to continue life regarding the noise pollution issue.

Table 06- Measured night time Sound level and their attribute

Location	Latitude	Longitude	Elevation	Night Max	Night Min	night time average
1	479029	993434	2300	65.7	61.8	63.75
2	479015	993556	2318	69	49	59
3	479328	993527	2314	67.3	51.1	59.2
4	479864	993247	2294	66.5	53	59.75
5	480207	993081	2281	68	52.8	60.4
6	479861	991840	2291	48.7	40.3	44.5
7	479413	991601	2280	46.5	42.3	44.4
8	478808	991302	2276	45.9	43.1	44.5
9	477879	990907	2303	50.0	40.1	45.05
10	476858	990489	2298	46.0	42.8	44.4
11	475644	991120	2285	60.4	47.6	54
12	475085	991809	2292	68.1	55.6	61.85
13	475245	991916	2295	66.1	45.5	55.8
14	475408	992114	2304	66	43.1	54.55
15	475538	992277	2313	70.8	40.8	55.8
16	473692	991145	2318	58	45.4	51.7
17	473855	991268	2320	59.3	47	53.15
18	474083	991270	2320	60.1	47	53.55
19	474372	991389	2315	64.1	41.7	52.9
20	474592	991392	2280	65.4	46.2	55.8
21	480761	992971	2279	68.1	43.6	55.85
22	480968	992940	2292	70	45.7	57.85
23	481358	992928	2309	64.9	47.3	56.1
24	482057	993188	2316	63.6	46.3	54.95

Source-Personal record of the author



Map 03-Night time noise level in dB

The map shows that the residential along the take-off and land paths of both RWY alignments have dB level that show deviation from the national standard of 45dB set for residential area. This implies that again during night time the area is exposed to noise pollution and therefore, it is difficult to lead normal life in the area.

Now a day, the society is becoming negligent of the noise generated by aircrafts during take-off/landing moments. This is because of adaptation of the problem although it is not normal. But strangers to the area are sensitive to the problem of noise.

5.3 Achieving CLUP at or near the airport

The current land use types in the vicinity are considered as incompatible land use types-crusher plants that are sources of gorges, holes and ponds that attract wildlife, residential area within noise sensitive area, crops from the agricultural field which are not recommended at or near the airports, etc. This incompatible land use developments in the vicinity of the airport is due to shortage of land in the vicinity, reluctance to abide

regulations, lack of awareness and loose power to enforce rules and regulations. As a result of those incompatibilities noise pollution, safety risks, limitation in operation of the airport and dissatisfaction has manifested.

Table 07- Compatible/Incompatible status of the different land use types in the vicinity of the airport

Land Use Types	Compatible/Incompatible status
quarry activity	Incompatible
Settlements	Incompatible
bird attractant sites	Incompatible

The above table shows that from the analysis of different documents and from the personal observation of the researcher, the actual land practices in the vicinty of Addis Ababa Bole International Airport are incompatible with the airport environment and the aviation industry as a whole.

The concerned bodies like the city administration, the Addis Ababa Environmental Protection Authority, the EAE and ECAA did not create/arrange awareness on the issues related with how to minimize the effect of sound pollution, how and what types of crops to produce, how to handle the activities of crusher plants, how to manage waste and how to co-exist with the airport environment, etc for the different land use types available in the vicinity.

The ECAA, EAE and the Addis Ababa EPA did not undertake sound level measurement in the vicinity in order to take actions to improve the lives of the society and the safe operation of the industry. This is basically due to lack of clear cut national standards and unavailability of the sound level meter.

Poor coordinated approach among stakeholders of the industry, a continuous evaluation of the land use plan of the airport and poor performance in implementing the

wildlife hazard management plan/WHMP are manifested and resulted change in land use types in the vicinity. As a result the land use plan of the airport and the current land use practice in the vicinity do not match and show variations.

The land use plan of the airport shows that abattoirs or any industry that produce goods, that attract birds or that emit smoke that obscure visibility should not be allowed to exist but there are abattoirs and crusher plants. Again the land use plan of the airport shows that residential house and apartments should be avoided and houses to have acoustic protection to reduce the sound pollution but there are residential in the take-off/landing path and do not apply any acoustic protection means to minimize the sound level. A 13Km radius to avoid any wildlife attractant site-landfill, abattoir, etc is not respected.

Achieving compatible land use plan at or near airports implies achieving the goal and mission of the aviation industry. To realize this, CAA Proclamation No. 616/2008 serves as a legal basis to restrict incompatible land use developments in the vicinity. Although the issue of safety is every bodies concern, the lion share is left for EAE and ECAA as the proprietor of the airport and regulatory organ of the industry, respectively. The city administrator, the Addis Ababa Environmental Protection authority, Ethiopian Airlines and other operators and the nearby society are expected to take their part in this regard.

The respondents indicated the roles of different agents: EAE to provide proper facilities, infrastructures and man power; ECAA to set out standards and control their implementation; airline operators to check their waste disposition of the food garbage and their catering service provision; the society to give attention and be aware of the effect of poor waste management and other activities on the safe operation of the airport and in turn on their lives and properties; the city administrator to pay attention on the land use practices and issues related with environmental protection, etc.

The respondents said that, a coordinated approach among the concerned bodies including the society,

Using latest aviation industry aircraft technologies, sound proofing means of housing, stakeholders discussion regarding safety and noise problems, creating awareness for the society reside in the vicinity, covering the holes and draining them, employing better management practices to solve wildlife hazard issue and proper waste management practices, conducting in depth study on the issue of noise pollution, proper planning at all stages, developing airport land use plan, coordination among different units and continuous supervision and if the worst happens relocation of settlements in the vicinity of airports are suggested as possible means to achieve land use compatibility by the respondents.

Chapter six-Conclusion and Recommendation

6.1 Conclusion

Air transport is in a rapid advancement in its service and the technologies applied within it. Passengers and their cargos are transported using the air transport from one part of the world to the other. Air transport provides the safest and fastest services for its customers when compared with other modes of transport. This fact is also true in Ethiopian context.

The aviation industry to be more safe and efficient there must be a collaborative approach among the stakeholders of the industry and there must be mutual understanding of the society and the government. To realize this, the need for land use plan has no doubt. In addition to this land use plan, the airport proprietor has to develop its own airport land use plan in order to manage its own land. In the context of Ethiopia, Addis Ababa Bole International Airport has a land use plan although its enforcement is questionable. This is because the land use plan is not fully implemented as a result one can see incompatible land use developments in the vicinity of the airport. Due to lack of a coordinated approach the airport is currently surrounded by those incompatible land uses.

Those different incompatible land uses in the vicinity of the airport are resulting in limitation of the operation of the airport and bringing the society under strain. Those

incompatible land use developments may result wildlife-aircraft strike, loss of life and property, exposure of the society to noise problem, etc.

The EAE and ECAA are not in a position to carry out their individual role in bringing compatible land use development in the vicinity as expected. This incompatible land use development in the vicinity of HAAB might be an indicator of the other domestic and international airports of the country although it is needed to be justified. This is beyond the standard of the ICAO and also the standards set locally like the ambient noise standard set by the Federal EPA. This indicates the extent by which respecting and go in line with the land use plan of the airport is poor.

The other point to be mentioned as a conclusion in this study is that the land use plan produced by the EAE is not respected. For instance, there are settlements, crusher plant and abattoirs within the airport zone.

The problem of implementing rules and regulations, lack of continuous monitoring of the land uses in the vicinity of the airport and lack of a coordinated approach among concerned bodies can be a major problem to be mentioned as factors contributing for incompatible developments.

Finally the trend of land use developments surrounding HAAB can be said that it is not in accordance with the standards set by the ICAO and national EPA and concluded as incompatible land use development in the vicinity of the airport.

6.2 Recommendations

The following points are presented as a recommendation for the findings of the study. Although the study has focused on Addis Ababa Bole International Airport, these recommendations can also serve the rest of local and international airports of the country. The recommendation points are presented in three aspects. The first point is regarding the noise abatement, the second is about wildlife hazard mitigation and finally about the issue of land use.

1. Noise abatement

The ECAA as a regulatory body of the aviation industry, it has a role of creating safe aviation industry in the country. To realize this mission, it is must to act on the different issues of noise. Thus, ECAA has to consider the issue of noise while giving landing and take-off permission and license for the aircraft to operate in the Aerodrome/ADM. In addition, working with EAE to prepare the noise contour map based on the local context of air traffic volume and its trend will have a contribution to limit and act on future developments of residential land use types in areas of high noise exposure.

The EAE as responsible body for providing quality airport infrastructures and services in a safe manner, the following tasks are left for the EAE in dealing with the issue of noise and its abatement. Thus, the EAE has to revise the existing noise contour map and develop new noise contour map based on the local context of air traffic volume and its trend.

2. Wildlife hazard and its mitigation

ECAA has to establish a follow-up on environmental management program of the EAE and ensure the availability and implementation of long-term environmental management activities parallel with the short-term remedial action on wildlife hazard management. Beside this, ECAA has to make active the WHMC to implement the WHMP.

The following tasks are left for the EAL and other airline operators in dealing with the issue of wildlife and its abatement. Thus, they have to report to the concerned aviation regulatory any confirmed wildlife strikes and significant concentration of wildlife both inside and outside the airport.

In dealing with the issue of wildlife hazard and its abatement, the EAE has to provide appropriate fencing around the ADM boundary to prevent wildlife from entry to the airport and to establish an assessment on wildlife attractant sites.

3. Land use issues

ECAA has to develop land use rules and regulations and adopt different measures to protect the airport from incompatible land use developments and their activities by clearly specifying the limit or the extent of residential encroachment, control the activities of crusher plants and agricultural activities and waste disposal ways in the vicinity. To achieve this, ECAA has to develop a checklist to monitor the change and act on incompatibilities.

The aviation regulatory has to suggest ideas for revision, and follow-up the implementation of the airport land use plan and establish airport land use commission that has a role of conducing airport land use compatibility planning together with EAE.

The EAE has to revise and implement the current airport land use plan by developing a coordinated two ways approach with the aviation regulatory and the city administrator. The EAE also has to implement land use rules and regulations and notify changes in land use developments for the concerned body to monitor the change and to act on incompatibilities. In addition removing grasses within the airport compound as soon as possible to protect from insect movements is another recommendation.

The city administrator has the following tasks in addressing the issue of land use. Thus, it has to participate in the Compatible Land Use Planning Task Force and relocate the residential from the noise sensitive areas.

Catering service providers are expected to cover food garbage containers and to improve their waste disposal practices.

Crusher plant owners are expected to fill the holes that they create during their activities and drain the ponds/lakes and to be sure that their activities are not problem for the aviation industry.

Residential in the vicinity have to apply sound proofing ways to minimize the noise created as a result of airport operation and develop their waste disposal ways.

Relocation of the settlements in the vicinity of the airport basically in the take-off and landing path of both RWY alignments/RWY07 and RWY25 is another

recommendation. This is because relocation of settlements can be achieved with less cost compared to the cost required to relocate the airport.

Finally, the aviation regulatory, EAE and the city administrator have to create awareness for the residential, crusher plant owners, farmers, catering service providers and different institutions in the vicinity on the issue of noise pollution and its abatement, wildlife hazard and its mitigation and proper land use issues for the safety of the society and safe operation of the aviation industry.

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Appendix 01

Addis Ababa University College of Social Science and Environmental Studies

Department of Geography and Environmental Studies

Questionnaire distributed for Key informants (Group 1)

Dear respondents, saying thank you in advance, you are cordially requested to fill and answer this questionnaire. This is prepared so as to get reliable information on the issue related with **An Assessment of Land Use Compatibility in the vicinity of Addis Ababa Bole International Airport.**

The information you are going to give will help me to assess and make analysis on the issues related to wildlife hazard, their effects and the possible solutions with respect to safe operation of the aviation industry and the safety of the nearby society. Be confident for your answer that it is kept and used for the case understudy only.

1. How many reports of wildlife movement you are receiving daily?
   a. 1-5
   b. b. 5-10
   c. ›10
2. Do you log all kind of wildlife hazard movement and strike report at your office? If yes, how many of the reports get appropriate answer and what actions are taken for the reports?

   _____

   _____

   _____
3. Can you mention the wildlife frequently observed/reported at HAAB/bole International Airport?

   _____

   _____

   _____

4. What factors can be mentioned for the occurrence and movement of wildlife hazard at or near the airport?

_____

_____

_____

5. What factors are associated with the society living in the vicinity of HAAB that contributes for the wildlife hazard?

_____

_____

_____

6. How can wildlife hazard deter and influence the growing aviation industry?

_____

_____

7. What will be the effect of wildlife hazard in endangering the safety of the society in the vicinity?

_____

_____

_____

8. What are the possible effects of A/C-wildlife strike?

_____

_____

_____

9. What are the possible solutions for the problem associated with wildlife hazard expected from the society living in the vicinity/ at or near the airport?

_____

_____

_____

_____

10. Have you conducted an inventory of wildlife attracting sites in the vicinity/at or near the airport?

    If yes, state the interval of inventory period_____

    If no, why it is?

    _____

    _____

    _____

11. Are the On-airport sites or off-airport sites are considered/ observed more hazardous for the safe operation of aircrafts?

    _____

    _____

12. Can we say that the land use types at or near HAAB have contributed for the concentration and movement of wildlife?
    a. Yes
    b. No
13. Do you have a regular discussion with concerned authorities and local community regarding wildlife hazardous movement?
    a. Yes
    b. No
14. Is the wildlife hazard management plan implemented/WHMP at HAAB?

    If yes, is it effective in attaining its very objective?

    _____

    _____

    If no, what is the reason for that?

    _____

    _____

    _____

15. Does HAAB have a wildlife hazard working committee/WHWC?

a. If yes, what is the main role of the committee?

_____

_____

b. If no, why it is not established?

_____

_____

16. What actions are taken to deter or reduce the hazardous wildlife?

_____

_____

17. Who is responsible in order to reduce the effect of wildlife hazard on the safety of the aviation industry and the safety of the society in the vicinity?

_____

_____

18. What is expected from each individual party you mentioned for the question number 9?

_____

_____

_____

With best regards,

Daniel Asfaw

Questionnaire distributed for Key informant (Group 2)

Dear respondents, saying thank you in advance, you are cordially requested to fill and answer this questionnaire. This is prepared so as to get reliable information on the issue related with **An Assessment of Land Use Compatibility in the vicinity of Addis Ababa Bole International Airport.**

The information you are going to give will help me to assess and make analysis on the issues related to wildlife hazard, their effects and the possible solutions with respect to safe operation of the aviation industry and the safety of the nearby society. Be confident for your answer that it is kept and used for the case understudy only.

1. How many reports of wildlife movement you are receiving daily?
   d. 1-5 b. 5-10 c. ›10
2. Can you mention the wildlife frequently observed/reported at HAAB/bole International Airport?

   _____

   _____
3. What factors can be mentioned for the occurrence and movement of wildlife hazard at or near the airport?

   _____

   _____
4. What factors are associated with the society living in the vicinity of HAAB that contributes for the wildlife hazard?

   _____

   _____
5. Do you log all kind of wildlife hazard movement and strike report at your office? If yes, how many of the reports get appropriate answer and what actions are taken for the reports?

   _____

   _____

   _____

6. What will be the effect of wildlife hazard in endangering the safety of the society in the vicinity?

   _____

   _____

   _____

   _____

7. What are the possible effects of A/C-wildlife strike?

   ---

8. What are the possible solutions for the problem associated with wildlife hazard expected from the society living in the vicinity/ at or near the airport?

   _____

   _____

   _____

   _____

9. Who is responsible in order to reduce the effect of wildlife hazard on the safety of the aviation industry and the safety of the society in the vicinity?

   _____

   _____

   _____

10. What is expected from each party you mentioned for the question number 9?

    _____

    _____

    _____

Best regards,

Daniel Asfaw

Questionnaire distributed for Key informants (Group 3)

Dear respondents, saying thank you in advance, you are cordially requested to fill and answer this questionnaire. This is prepared so as to get reliable information on the issue related with **An Assessment of Land Use Compatibility in the vicinity of Addis Ababa Bole International Airport.**

The information you are going to give will help me to assess and make analysis on the issues related to compatible land use and their merits, incompatible land use and their effect on the airport environ and the impact of the different land use types on the airport environment and vice versa, the possible solutions with respect to safe operation of the aviation industry and the safety of the nearby society. Be confident for your answer that it is kept and used for the case understudy only.

1. What factors are considered in airport site selection?

   _____

   _____

   _____

2. Does HAAB is capable of accommodating and handling the ever increasing domestic and international traffic volume that is with fast growth?
   a. Yes
   b. No
3. What is the reason for the need of compatible land use at or near the airport?_____

   _____

4. Who is going to be benefited from compatible land use?

   _____

   _____

5. What type of land uses are considered as compatible land uses with the airport environs?

   _____

   _____

   _____

6. What type of land uses can be considered as incompatible land uses?_____
_____
_____

7. What is/are the effect/s of these incompatible land uses on the airport environment?_____
_____
_____
_____

8. What are the possible means for achieving compatible land use at or near the airports?
_____
_____

9. Does HAAB have land use plan?
   a. Yes b. No

10. Are the land uses in the vicinity of HAAB compatible with the airport environment?
    a. If yes, mention the land use types that are compatible with the airport environ
    _____
    _____
    _____
    b. If no, mention the land use types that are incompatible with the airport environ
    _____
    _____
    _____

11. What are the features of compatible land uses with the airport environ?
_____
_____
_____

12. What are the features of incompatible land uses with the airport environ?

_____

_____

_____

13. What actions are taken to deter or reduce incompatible land uses in the vicinity of HAAB?

_____

_____

14. What factors are there associated with incompatible land use developments in the vicinity of HAAB?

_____

_____

_____

15. What will be the effect of incompatible land use developments in endangering the safety of the society in the vicinity?

_____

_____

_____

16. Is there any legal bound that restricts incompatible land use development in the vicinity of airports?

    a. Yes
    b. No

17. What are the possible ways of mutual coexistence among the different types of land use in the vicinity of airports?

_____

_____

_____

18. Do the airport enterprise/ the civil aviation have a coordinated approach in order to prevent incompatible land use developments in the vicinity of the airport?

    a. Yes b. No

19. Do you have a regular discussion with concerned authorities and local community regarding wildlife hazardous movement, noise problem and other safety related issues?
    a. Yes b. No
20. Do your organization arranges a panel discussion or public awareness programs for residential, farmers and quarry plant owners in the vicinity of HAAB regarding how to coexist with the airport environ, how to cope up with the challenges raised from the aviation industry and how to minimize their influence on the airport industry?
    a. Yes b. No
21. Do you conduct an inventory of land use developments in the vicinity/at or near the HAAB?

    If yes, state the interval of inventory period and mention the very objective of conducting an inventory.

    _____

    _____

    If no, why it is not conducted?

    _____

    _____

19. Have your organization ever received a complaint from the society that live in the vicinity regarding the noise pollution?
    a. Yes
    b. No
20. Have you ever conducted sound measurement in the vicinity of HAAB so as to develop noise sensitive areas?
    a. If yes, what was the result of the analysis? Are the society is well clear of the noise sensitive area or not?

    _____

    _____

    _____

b. If no, what is the reason not to do so?

_____

_____

21. Does HAAB have noise contour map?

a. Yes b. No

22. If the answer for Q.21 is yes, what is the date of publication of the noise contour map? _____

23. What was the reference used for the production the noise contour map of HAAB?

_____

_____

24. Does your organization regularly evaluate the land use plan of the airport so as to revise it?

a. Yes b. No

25. Are the land uses during the period that the airport land use plan of HAAB produced and the current land use types in the vicinity of the airport the same?

a. Yes b. No

26. What criteria must be fulfilled for the development of new land use in the vicinity of the airport?_____

_____

27. Who is responsible for compatible land use planning and development in the vicinity of the airport?

_____

_____

28. What is expected from each individual party you mentioned for the question number 19?

_____

_____

Thank you,

Daniel Asfaw

Appendix 02- Questions for the Focus Group Discussion

Addis Ababa University College of Social Science and Environmental Studies

Department of Geography and Environmental Studies

1. Focus Group Discussion with farmers

1. በዚህ አካባቢ ለምን ያህል ጊዜ ኖራችኋል?
2. በአካባቢያችሁ የሚኘው ሜዳ ለምን ዓይነት አገልግሎት ትጠቀማቸሃላችሁ?ለምንስ ሚጣቸሁት?
3. ምን ዓይነት የሰብል ዓይነቶች በአካባቢያችሁ ይመረታሉ?
4. በዓመት ስንት ጊዜስ ምርት ትሰበስባላችሁ?
5. ምን ያህል ምርትስ በዓመት ይገኛል?
6. እንስሳትን በሚርባትስ ትጠቀማላችሁ? የእንስሳት ዓይነቶቸንና የእርባታ ዘዳዎቻችሁን ወይም መንደነቻችሁን ብትገልጹልኝ
7. እንስሳትን በሚርባት ወይም የእርሻ ተግባርን በማከናወን ዙርያ-ለምሳሌ ምን አይነት የሰብል አይነቶችን ማምረት እንዳለባችሁ የእንስሳትን እዳሪ እንዴት መጠበቅ እንዳለባችሁ አእዋፋትን እነዚህን ተግባራት ከምታከናውኑባቸው አካባቢዎች እንዴት መከላከል እንዳለባችሁ-ከሚሰላካታቸው የወረዳ ወይም የቀበሌ አካላት የተሰጣችሁ የግንዛቤ ማስጨመጫ ትምህርት አለ?
8. በአካባቢያችሁ የቆሻሻ አሰባሰብ/አወጋገድ በምን ሁኔታ ይከናወናል?-በቆሻሻ ማጠራቀያ ገንዳ/በጉድጓድ ወይስ በምን ዓይነት ሁኔታ
9. ደካማ በሆነ የቆሻሻ አወጋገድ ምክንያት አእዋፋት በአካባቢያችሁ ሊራቡ/ሊበራከቱ እንደሚችሉ ይህም ለአወሮፕላን ጠፍጣ የበረራ ሂደት እንቅፋት በመሆን አደጋ ሊፈጥር እንደሚችሉ ያውቃሉ-?

ለዚህ ችግር መፍትሔው ምንደነው ይላሉ?

10. አዕዋፋት/የዳር እንስሳት በአካባቢያችሁ ይገኛሉ?-አዕዋፋት ካሉ አካባቢያችሁን ለምን ይጠቀማቸሃል?-ለማሰያ፣ ምግብ ማግኛ ወይስ ሌላ
11. በአካባቢው የሚኘው አየር ሚፊያ ምን ዓይነት መልካም ሁኔታዎችን አስገኘላችሁ?
12. በአካባቢው የሚኘው አየር ሚፊያ በእናንተ የግብርና ስራ ላይ የፈጠረው ተፅዕኖ አለ?ለምሳሌ ከአየር ሚፊያ የሚፋፉት ስራዎች ጋር ተያይዞ የፈጠረባችሁ ተጽዕኖ ምንደነው?
13. በአካባቢው የሚኘው አየር ሚፊያ በእናንተ ሕይወት ላይ የፈጠረው ተፅዕኖ አለ? ካለ የፈጠረባችሁ ተጽዕኖ ምንደነው?

ለምሳሌ አየር በሚርፍበትና በሚሳበት ሰዓት ወቅት ያለው የድምፅ ችግር በቀንና ሙሉ የእናንተን ሕይወትና እንቅስቃሴ ይረብሻል በየትኛዎቹ ሰዓታት ላይስ ከፍተኛ የድምፅ ችግር/ብክለት ይስተዋላል?

ለችግሮቹስ መፍትሔ ሊሆን የምትሉአቸው ሃሳቦች ምንድናቸው?

14. በአካባቢው ከሚኘው አየር ሚፊያ ጋር ተስማምቶ ለመኖር እንድትችሉ የተሰጣቹሁ የግንዛቤ ማስጨበጫ ትምህርት አለ?

2. Focus Group Discussion with **catering service providers**

1. For how long you are here delivering catering service?
   a. 1-3
   b. 4-6
   c. ≥ 6 years
2. Who are the customers of the services you are providing?
   a. Workers
   b. Passengers
   c. The society

d. Everybody can use

3. What type of services you are providing?
   a. Fast foods
   b. Soft and alcoholic drinks
   c. Different types of domestic and international foods
   d. Combination of the above
4. Why do you provide this service in the airport area?
5. Is the service you are delivering an indoor or outdoor service?
   a. Indoor
   b. Outdoor
   c. Both
6. In what way that you are disposing the food garbage?

   _____

   _____

   _____

   _____

7. Have you ever received a lesson from concerned authorities about how to handle the waste disposal?
   a. Yes
   b. No
8. Do you know that poor handling of waste attracts wildlife and endanger the operation of the airport?
   a. If yes, what kind of treatments you are taking to prevent wildlife from your compound?

      _____

      _____

   b. If no, what will be the solution for this?

      _____

      _____

9. What impact does the airport operation have on your business?
   a. Positive
   b. Negative

3. Focus Group Discussion with **residential**

1. በዚህ አካባቢ ለምን ያህል ጊዜ ኖራችኋል?
2. ይህን አካባቢ ለምን መረጣችሁት?
3. የምትኖሩበት ቤት ይዞታው
   ሀ. የግል
   ለ. የኪራይ
4. የምትኖሩበት መሬት ካርታ አለው?
   ሀ. አለው
   ለ. የለውም
5. ምን በማስራት ትተዳደራላችሁ?
6. እንስሳትን የሚባት/የእርሻ ተግባር ያከናወናሉ ከሆነ ምን አይነት ሰብሎችን ያመርታሉ?ምን አይነት እንስሳትን ያረባሉ?

7. እንስሳትን በሚርባት ወይም የእርሻ ተግባርን በሚከናወን ዙርያ-ለምሳሌ ምን አይነት የሰብል አይነቶችን ማምረት እንዳለባችሁ የእንስሳትን እዳሪ እንዴት መጠበቅ እንዳለባችሁ አእዋፋትን እነዚህን ተግባራት ከምታከናውኑባቸው አካባቢዎች እንዴት መከላከል እንዳለባችሁ-ከሚሰላካታቸው የወረዳ ወይም የቀበሌ አካላት የተሰጣቸሁ የግንዛቤ ማስጨመጫ ትምህርት አለ?
8. በአካባቢያችሁ የቆሻሻ አሰባሰብ/አወጋገድ በምን ሁኔታ ይከናወናል?-በቆሻሻ ማጠራቀያ ገንዳ/በጉድጓድ ወይስ በምን ዓይነት ሁኔታ
9. አዕዋፋት/የዳር እንስሳት በአካባቢያችሁ ይገኛሉ?-አዕዋፋት ካሉ አካባቢያችሁን ለምን ይጠቀማሉታል-ለማስለያ፣ ምግብ ማገኛ ወይስ ለእረፍት
10. ደካማ በሆነ የቆሻሻ አወጋገድ ምክንያት አእዋፋት በአካባቢያችሁ ሊራቡ/ሊበራከቱ እንደማይችሉ ይህም ለአወሮፕላን ጠፍጣ የበረራ ሂደት እንቅፋት በማሆን አደጋ ሊፈጥሩ እንደማይችሉ ያውቃሉ?-ለዚህ ችግር መፍትሔው ምንድነው ይላሉ?
11. በአካባቢው የሚገኘው አየር ሚፊያ ምን ዓይነት መልካም ሁኔታዎችን አስገኝላችሁ?
12. በአካባቢው የሚገኘው አየር ሚፊያ በእናንተ ሕይወት ላይ የፈጠረው ተፅዕኖ ምንድነው?

ለምሳሌ አየር በሚርፍበትና በሚሳበት ሰዓት ውቅት ያለው የድምፅ ችግር በቀንና ሙሉ የእናንተን ሕይወትና እንቅስቃሴ ይረብሻል በየትኛዎቹ ሰዓታት ላይስ ከፍተኛ የድምፅ ችግር/ብክለት ይስተዋላል?

13. አወሮፕላን በሚርፍበት ወይም በሚሳበት ወቅት አደጋ ይፈጠራል የሚል ስጋት ታስቧችሁ ያውቃል?
14. አሁን የምትኖሩበትን ቤት በምትሰሩበት ጊዜ የድምጽ ብክለትን ለመቀነስ ያደረጋችሁት የመፍትሔ ተግባር አለ?
15. ከሚሰላከታቸው የወረዳ/የቀበሌ አስተዳደር አካላት እንዴት የድምጽ መጠንን መቀነስ እንደሚቻል የተሰጣቸሁ የግንዛቤ ማስጨመጫ ትምህርት ነበር?
16. በአካባቢው ከሚገኘው አየር ሚፊያ ጋር ተስማምቶ ለመኖር እንድትችሉ የተሰጣቸሁ የግንዛቤ ማስጨመጫ ትምህርት አለ?
17. የድምፅ ብክለት ችግሩን በምን ዓይነት መንገድ መቀነስ ይቻላል?
18. እናንተ ይህንን ችግር ለመቅረፍ የምትጠቀሙት የመፍትሔ ሃሳብ ምንድነው?

4. Focus Group Discussion with **Crusher Plant owners**

1. ለድንጋይ ጠጠር ምርት ተግባር ይህንን የቦሌ አየር ሚሬፊያ አካባቢ ለምን መረጣቹሁ?
2. በቦሌ አየር ሚሬፊያ አካባቢ በሜደን ቁፋሮ/በድንጋይ ጠጠር ምርት ተግባር ምን ያህል ጊዜ ተሳተፋቹሁ?
3. ድርጅትዎ ምን ያህል ሠራተኞችን ያስተዳድራል?
4. የዚህ የድንጋይ ጠጠር ምርት ተግባር ለሀገሪቱ የኮንስትራክሽን ዘርፍ/ለሀገሪቱ እድገት ያለው አስተዋጽኦ ምንድነው?
5. ወደዚህ አካባቢ ለድንጋይ ጠጠር ምርት ተግባር ስትሰማሙ የተሰጣቹሁ የግንዛቤ ማስጨበጫ ትምህርት አለ?
6. ምን አይነት የሜሪቻ መሳሪያዎችን ትጠቀማላቹሁ?
7. በድንጋይ ጠጠር ምርት ተግባር ጊዜ የምትቆፍሯቸው ጉድጓዶች አሉ ጉድጓዶቹ ለምን ያህል ጊዜ ይቆያሉ?
8. እነዚህ ጉድጓዶች ወሃ በማቆር የተለያዩ እንስሳትን ሊስቡና ለእንስሳቱ መባራከት አስተዋጽኦ ሊያበረክቱ እንደሚቹሉ ይህም ለአወሮፕላን ጠፍጣ የበረራ ሂደት እንቅፋት በመሆን አደጋ ሊፈጥሩ እንደሚቹሉ ያውቃሉ?-ለዚህ ችግር መፍትሐው ምንድነው ይላሉ?
9. ድርጅትዎ የሜጥረው የድምጽ መጠን ተለክቶ ያውቃል?አስለክተውት ያውቃሉ?
10. ሠራተኞች በሜሪት ተግባር ጊዜና አወሮፕላን በሚሳበትና በሜርፍበት ጊዜ የሜጠረውን ከፍተኛ የድምጽ ብክለት ሊቀንሱበት የሚቹሉበት ምን አይነት የመፍትሔ ተግባራቶችን ይጠቀማሉ?
11. በሜሪት ተግባር ሂደት ወሰጥ ለፈጠር የሚለወጥ ጫክ/አቧራ አለ ይህን ጫክ/አቧራ ለአካባቢ ብክለት ከሜበረከተው ጉዳት ወጪ ለአወሮፕላኖች በሚሰብትና በሜርፉበት ጊዜ እይታን እንዳይቀንስ በምን አይነት ዘዴ ትቆጣጠሩታላቹሁ?
12. በአካባቢው ከሚኘው አየር ሚሬፊያ ጋር ተስማምቶ ለመኖርና ተግባራቹሁን በሚባ ለማከናወን እንድትችሉ የተሰጣቹሁ የግንዛቤ ማስጨበጫ ትምህርት አለ? ከሌለ በምን አይነት ሁኔታ ተቻችሎ መኖር ይቻላል?
13. እናንተ ይህንን ችግር ለመቅረፍ የምትጠቁመት የመፍትሔ ሃሳብ ምንድነው?

5. Focus Group Discussion with **institutions-educational and religious institutions**

1. For how long you are here in this location providing the service for the society?
    a. A. 1-4 b. 5-8 c. >=9
2. Why do you prefer this are for the service you are providing?
3. How do you get the land you are giving service currently?-is that by means of rent? Institutional ownership? Or other
4. What benefits do you get being in the area or located near to the airport environment?
5. What is the influence of the airport and its operation on your business?
6. Have you ever received a complaint from your customers on the sound pollution created by the airport operation? Or have you seen any remark of discomfort while A/Cs are taking-off or landing in the airport?
7. Do you think that sound pollution is a problem in this area
   If yes how

   _____

   _____

   _____

   If no how

   _____

   _____

   _____

   _____
8. Do you have any fear of accident or do you think that there might be occurrence of accident in the airport environment?
9. Have you measured the sound level at your specific compound?
10. Is there any means that you used to reduce sound pollution as a result of airport operation while you constructed this building?
11. Have you ever received any lesson from concerned bodies like the EAE, ECAA or the EPA regarding how to reduce sound pollution inside the class, or how to co-exist with the airport environment?

12. Can you mention any suggestion points that help as in reducing the sound pollution problem in the area?