



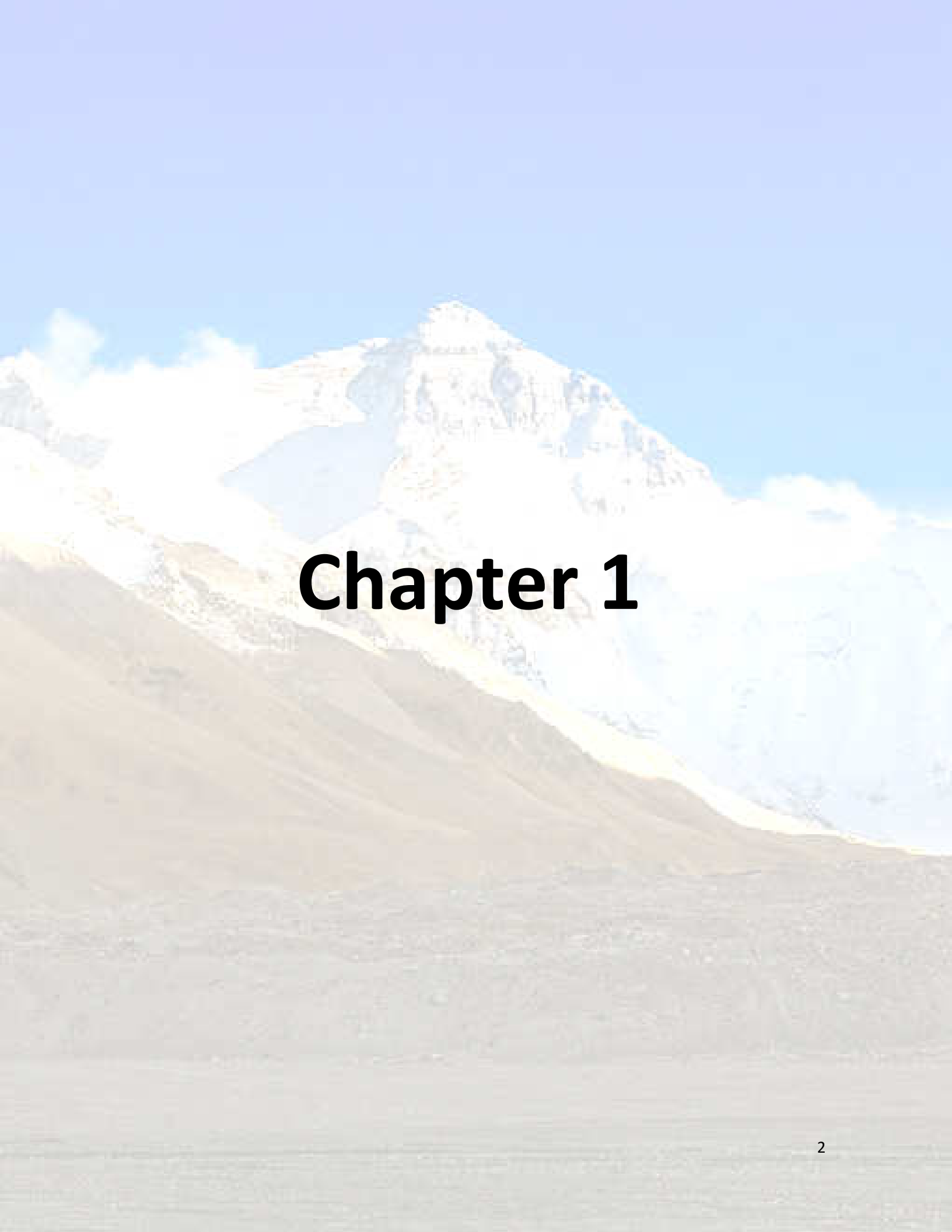
# **Nepal's Action Plan on Co<sub>2</sub> emission reduction 2013**

**(Submitted to ICAO Environment Branch)**



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# Chapter 1

## 1.1 Background

Being the ICAO contracting member states, Civil Aviation Authority of Nepal is committed to follow the ICAO guidelines and support the ICAO mission. Thus Nepal has voluntarily agreed to work under ICAO mission for the reduction of green house gas emission caused by aviation industry of Nepal. Civil Aviation Authority of Nepal will be working towards this mission by taking appropriate measures in support of international financial aid agency.

In October 2010, the international Civil Aviation Organization (ICAO) adopted a new assembly resolution climate change, Resolution A37-19. It set several voluntary goals for international aviation emissions, including.

- A global annual average fuel efficiency improvement of 2 percent until 2020.
- A medium term aspirational goal of keeping the annual global net carbon emission from international aviation from 2020 onward at the same (2020) level; and
- A global aspirational goal of 2 percent annual fuel efficiency improvement from 2021 to 2050.

To help ICAO, under this mission, CAA Nepal has started working to find out the possibilities on the measures that could be undertaken with the scope and viability.

CAA Nepal basically determines the following area:

- a. Amendment of primary legislation to address environmental issue from Nepalese Aviation Industry.
- b. Navigational Aid
- c. Construction of alternate International Airport

## 1.2 Nepal's Aspirational Goals for Aviation

Nepal's Action Plan to Reduce Green House Gas Emissions from Aviation (the Action Plan) describes ongoing and planned activities to reduce Green House Gas Emissions from Nepal's domestic and international aviation activities. These measures will help Nepal to plan and action on activity that will reduce the operational cost providing clean atmosphere to meet the ICAO goals.

In order to reduce GHG emissions from Nepalese aviation sector, Nepal has set a target of:

- Average annual improvements in aviation fuel efficiency, by revision of the air route and navigational aid installed in different airports of Nepal.
- Construction of other International airport that will reduce the air-distance covered in Nepal.
- Reducing Air traffic holding and diversion

Through above efforts it is believed that Nepal supports the ICAO said mission.

### **1.3 Nepalese Context**

Nepal is beautiful landlocked country between India and China. It's a country full of mountain and natural resources. Nepal is full of mountains and Himalayas that includes Hindkush Himalayas region and the world's highest peak Mt. Everest. Due to its geographical and environmental complexity the main mode of transport is air. The road access is very limited and being poor economy of country Government of Nepal has to rely on foreign investors for building roads and relevant facility.

Being small country it cannot be said that aviation activity is less in Nepal. In fact air traffic is the second highest in the south Asian region after India and the traffic is increasing day by day. The major percentage of Nepal's economy is based on Agriculture and Tourism.

Tourist comes in Nepal especially to see the natural and cultural diversity. These days due to heavy pollution and CO<sub>2</sub> emission by Transport (Air and Land) the mountains are not visible as the surroundings are Hazy. It has now become extremely important to address these burning issues to save its Tourism Industry.

### **1.4 Nepal's Aviation**

Nepal is a small country but having big aviation activities that are in increasing trend. Both domestic and international aviation activities are in increasing trend. However, there only two Boeing 757 that operates for international flights and are in Nepalese registered. However there are others several operators that operate to and from Kathmandu to other international destination. The fuel consumed by said aircraft and CO<sub>2</sub> produced accordingly its described in Appendix A, with ICAO set guidelines.

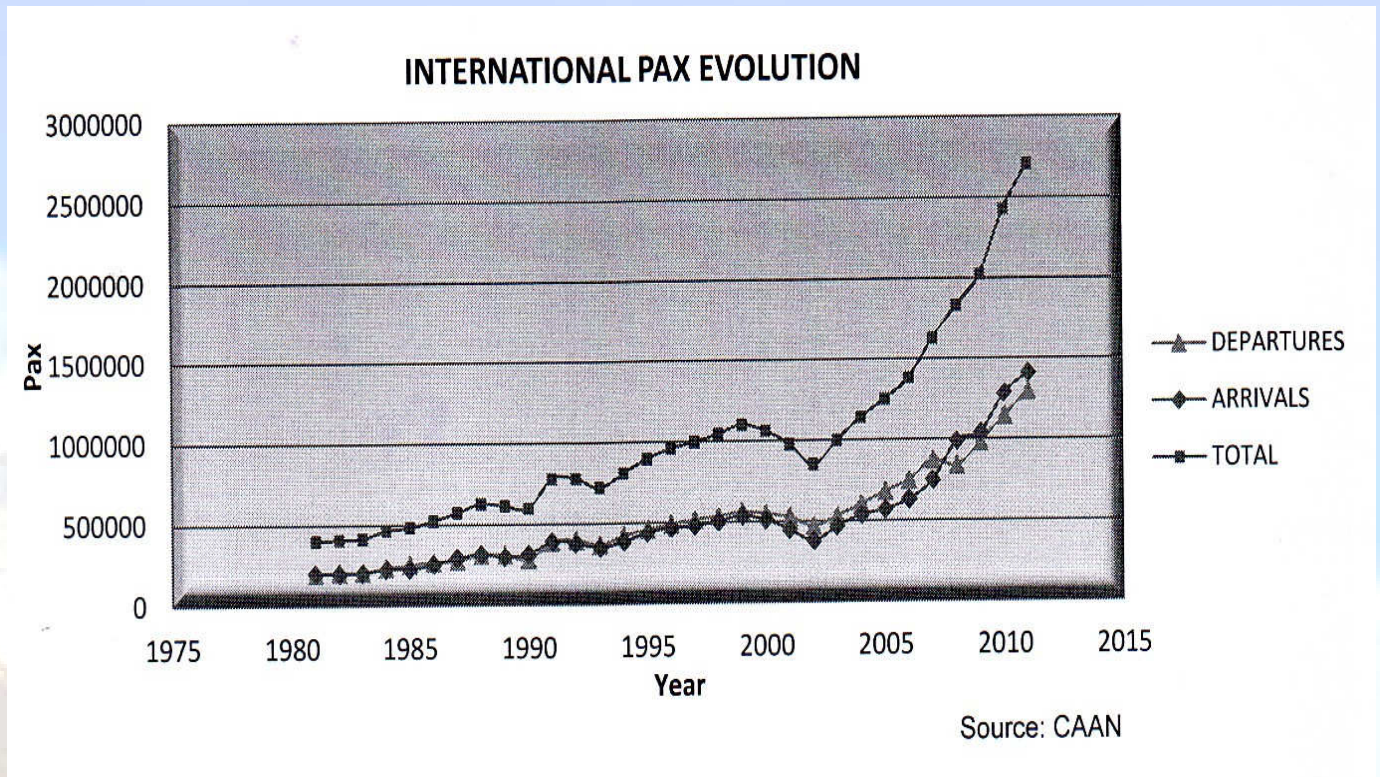
### **1.5 Measures**

Civil Aviation Authority of Nepal and with its synergy partners will work together to address such ICAO mission. The measures will be taken, designed and followed as a continue process. The action will be followed if appropriated resources and support will be available from National and International level.

The measures to reduce Green House Gas Emission, in Nepal from aviation will include from formulation and amendment of Nepalese legislation to the working platform on the said issue.

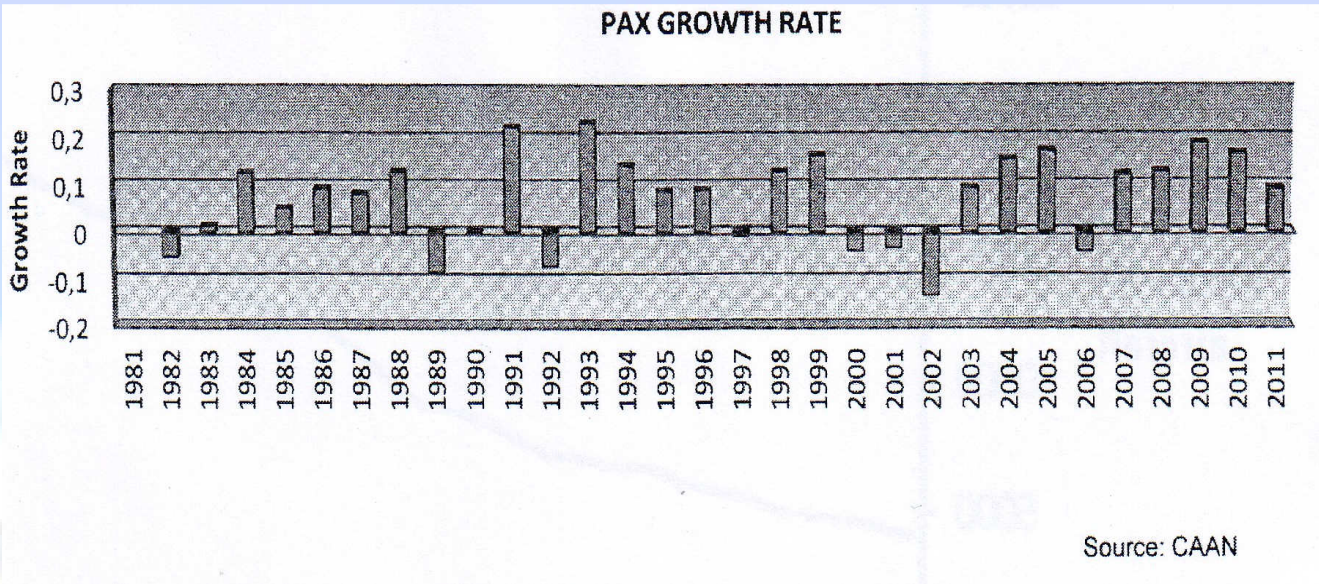
CAA Nepal proposed measures on reduction of Green House Gas Emission from Nepalese Aviation Sky is described in Chapter 2.

## 1.6 Air Traffic Demand Historical Evolution



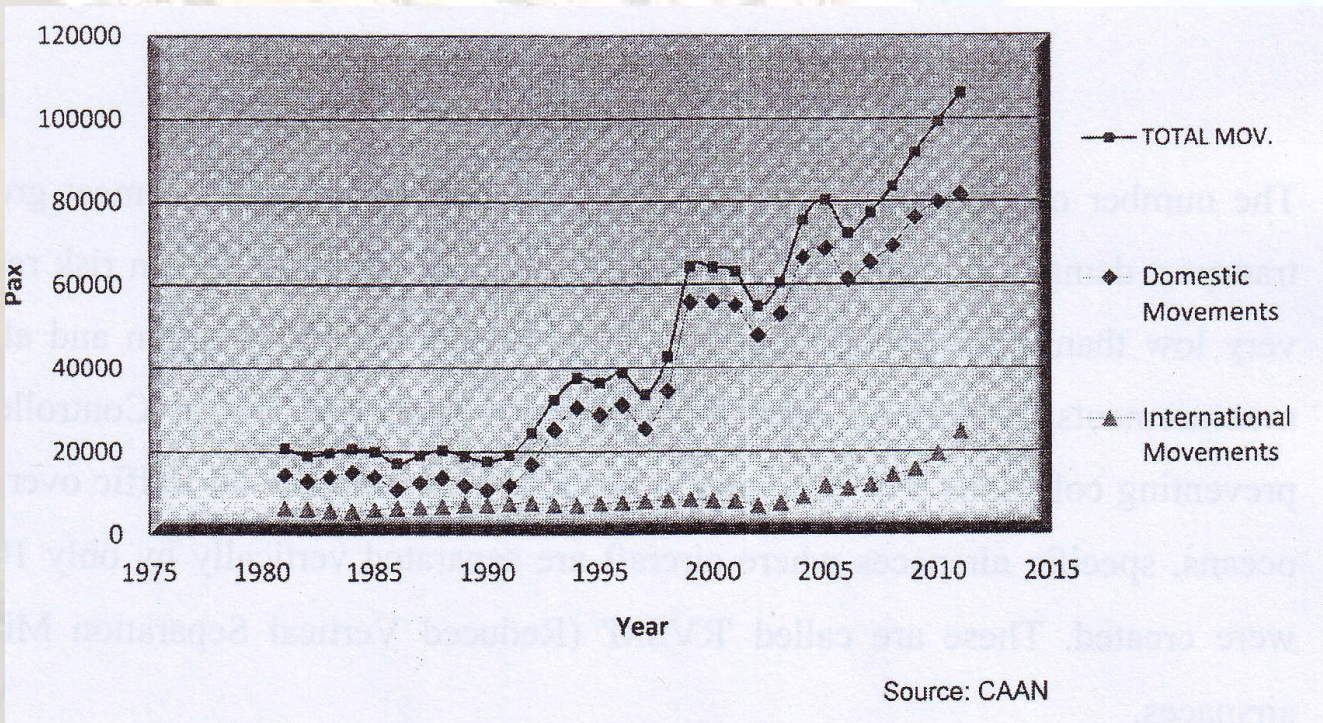
The above graph shows the expected growth rate of international passenger movement rate in Tribhuwan International Airport.

### 1.7 Pax Growth Rate

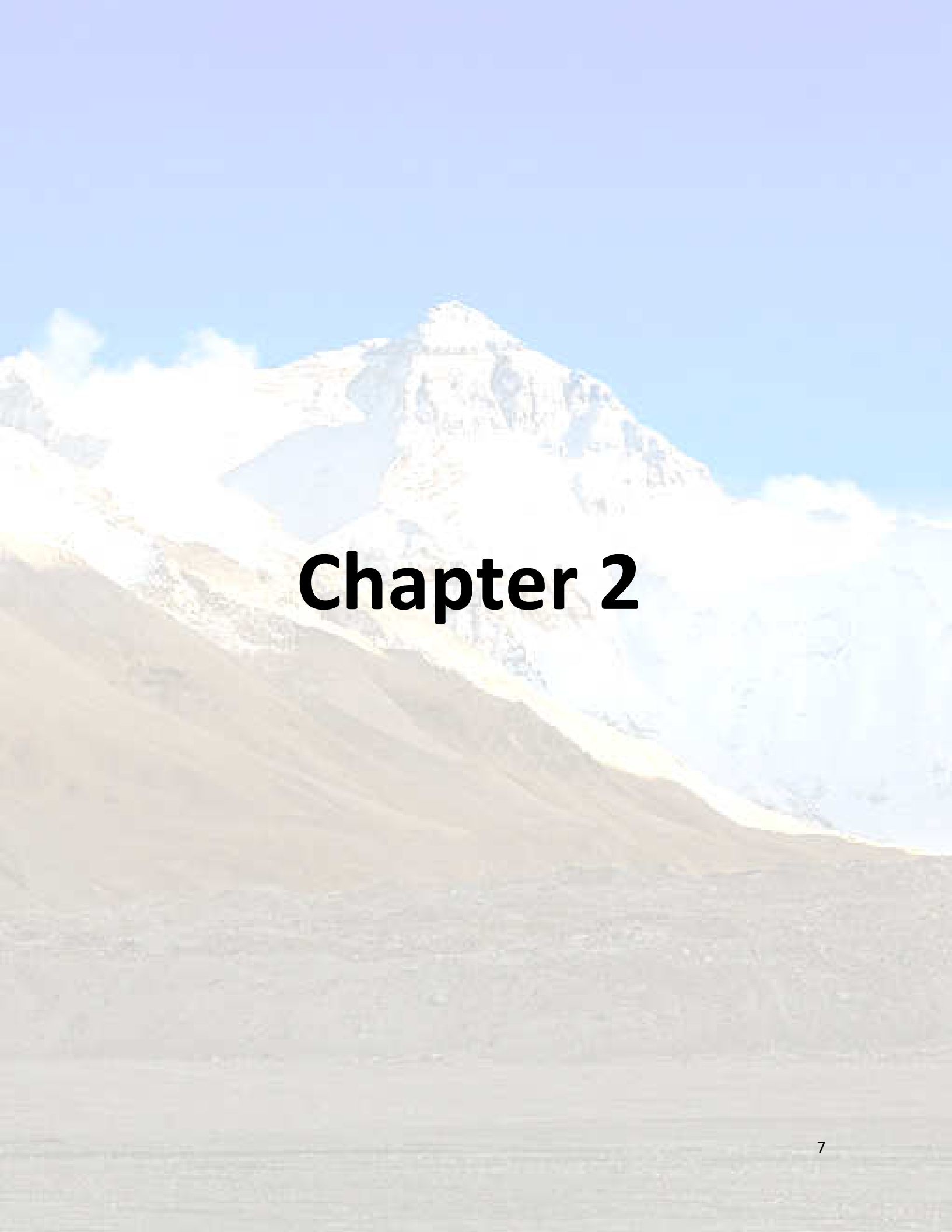


The above graph shows the expected growth rate Passenger movement rate in Tribhuwan International Airport.

### 1.8 Total Aircraft Movement Evolution



The above graph shows the expected growth rate Aircraft movement rate in Tribhuwan International Airport.



# Chapter 2



## **CAA Nepal proposes the following measures to address the issue.**

### **2.1 Formulation and amendment of legislation**

Nepal lacks Rules and Regulations to address environment (Aviation Emission) issue any measures to address this issue will be dependent. Hence, this issue is with Nepalese consultant INECO and will be addressed in new regulations that are proposed to be approved by Government of Nepal by 2014.

### **2.2 Revision and implementation of Air Navigation System at Tribhuwan International Airport**

#### ***2.2.1 Performance Based Navigation***

As stated in the ICAO Resolution A36/23 "All the contracting states should have a PBN implementation plan in place by 2009 to ensure a globally harmonized and co-ordinate transition to PBN by 2016" Nepal as being one of the contracting states of ICAO, had to develop a PBN implementation roadmap and implement PBN operations into the Nepalese aerodromes and airspace according to the established schedule in the roadmap. So CAAN developed Nepal PBN implementation plan, April 2011 which contains planned PBN activities of the country.

By introducing PBN system the core element of which is GNSS technology, CAAN wishes to facilitated more skilled use of airspace and more flexibility for procedure design which in integrated way, results in improved safety, capability predictability, efficiency economy and environment friendly.

#### ***2.2.1.1 Outcomes from Introducing and Implementing PBN approach***

Nepal wishes to achieve the following goal by introducing and implementing PBN in Nepalese sky, in comparison to its present scenario. The table described below shows the effects on environmental aspects after introducing and implementing PBN approach.

S.No.	Particular	Conventional Navigation	Performance Based
1	Infrastructure Aspects	Compulsory need of installation of ground based infrastructures like VOR, DME, NDB, ILS, etc.	On-board and satellite based infrastructures are sufficient for aircraft navigation. However, the application of ground based navigation is also possible. (GNSS and/or some other on-onboard equipment like INS, IRU, FMS, etc including different navigation sensors are required.)
2	Operational Aspects	Visibility minima can be high. So, the chances of aircraft diversions and go around are high.	Visibility minima can be significantly reduced thereby possible reduction in aircraft diversions and go around man oeuvres.
		Aircraft avionics cannot be appropriately utilized and therefore the navigation is inefficient.	Most appropriate use of avionic is possible and therefore, it increases the efficiency of aircraft operation.
3	Procedural Aspects	Complex and inflexible procedures, unstable approaches, more CFIT related occurrence	Flexibility designing the procedures reduces the procedure complexities, easy mane uverability and enhanced safety.
		Routes are usually longer as they have to pass over the ground based NAVAIDS.	Routes are more direct as they pass through the waypoints. Locations of waypoints can be fixed as per the operational need.
		Usually the bigger protection area covering more terrain and topography to be evaluated.	Relatively smaller protections are covering lesser terrain and topography to be evaluated.
4	Environmental Aspects	Longer route, complex procures and therefore, tougher energy management and more fuel exhaust in the environment	Good energy management therefore less fuel consumption and less Carbon emission, and therefore more environment friendly.
5	Investment Aspects	High investment on ground based infrastructures, longer routes, less cost effective	Investment on ground based infrastructures is relatively very low or almost none. Routes are relatively shorter. Hence, more cost effective.

## ***2.2.2 Existing provisions and future Action Plan***

The following activities of CAA Nepal shows that it is committed to work on the environmental issue by revising its existing Navigational measures to reduce Green House Gas Emission from aviation.

### ***2.2.2.1 Issuance of AIC 001/2011 ATC Requirements for PBN in Nepalese Airspace.***

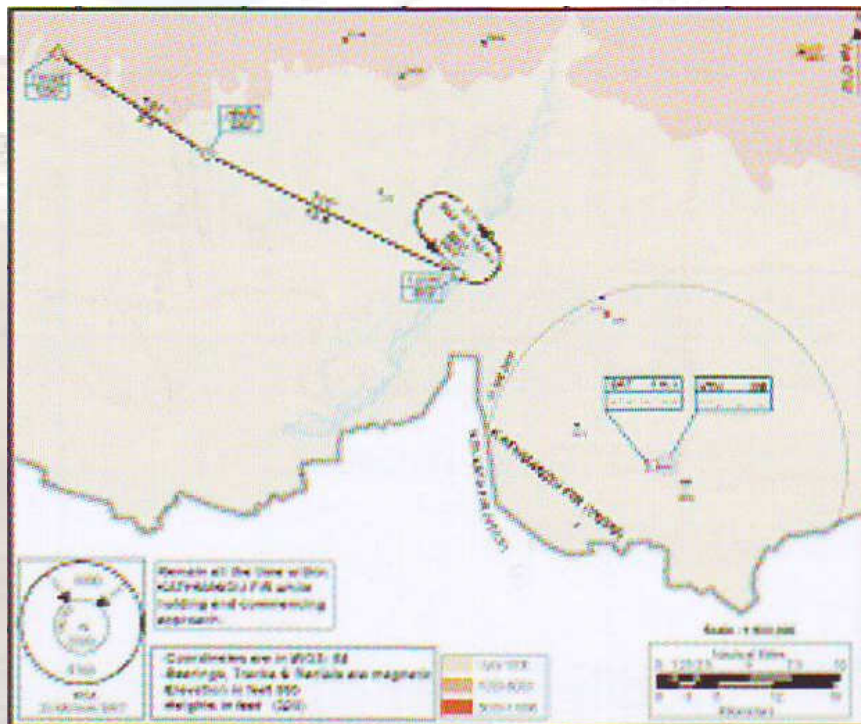
### ***2.2.2.2 Issuance of PBN operational approach Hand Book.***

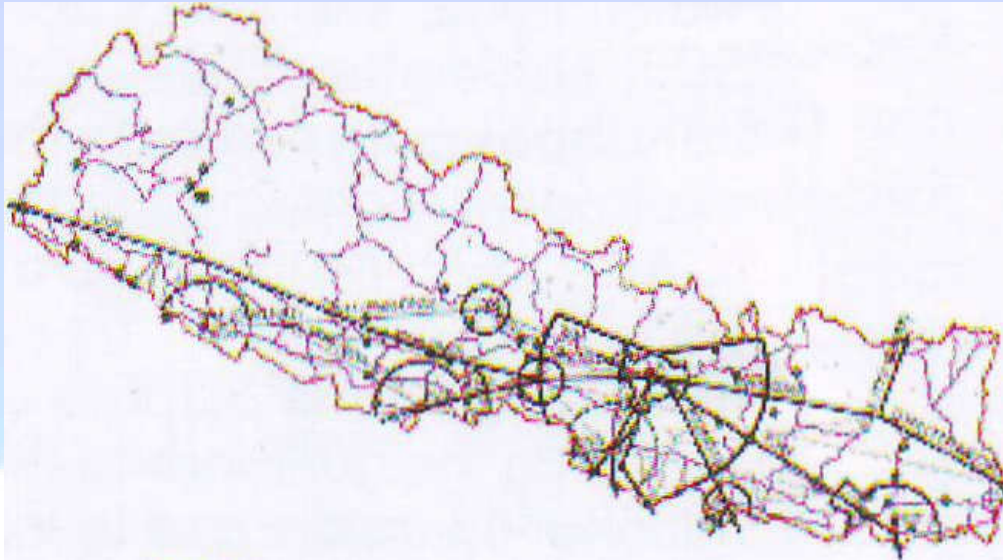
#### **Existing Provisions and Future Plan**

- Issuance of AIC 001/2011 'ATC Requirements for PBN in Nepalese Airspace' This AIC was issued with the aim of providing information and guidelines concerning the introduction of Performance based navigation (PBN) Operations in Nepalese FIR and became effective from 1 September 2011. This AIC provides the basis for establishing the ATC Procedures in case of Performance Based Navigation Operation.
- Issuance of PBN Operational Approval Handbook CAAN developed PBN Operational Approval Handbook in October 2011 which came into effect from 30<sup>th</sup> November 2011. This handbook supplements the information contained in the ICAO PBN Manual (Doc 9613) and has been developed for the purpose of providing the guidance to the national operators and to the personnel responsible for the assessment of the applications for operational approval to conduct PBN operations into Nepalese FIR.
- Implementation of Nepal PBN Implementation Plan
  - I. CAAN formulated Nepal PBN Implementation Plan and submitted to ICAO APAC Office in Apr 2011.
  - II. Later after the feedback from ICAO, CAAN developed the modified version of Nepal PBN Implementation Plan Apr 2011 V 1.0 in July 2012 and submitted to ICAO for final review.
  - III. The plan has three phases; Short Term (2010-2012), Medium Term (2013-2016) and Long Term (2017-2025).
  - IV. Short term plan is finishing soon by the end of December this year and within this period, Nepal intended to extend and redefine L626 (RNP10) route direct to Western destinations without over flying Delhi in consultation with India. Basic RNP1 STARs for transitioning from en-route to approach mode have been implemented in Terminal Operations at Kathmandu and Biratnagar Airports. Design of RNP AR APCH for TIA and RNP APCH for Biratnagar Airport were developed in this phase which came effect since 28 June 2012. AIP AIRAC Supplements 2010/2012 and 2011/2012 were issued to notify all concerned about the Implementation of RNAV/GNSS STARs and APCH Procedure at Biratnagar Airport (Figure 1 and 2) and Implementation of RNP AR APCH procedure and associated STARs at Tribhuvan International Airport respectively.

- Qatar Airways has been performing the RNP APCH at TIA since 1<sup>st</sup> October 2012. Some other international operators like Fly Dubai, Korean Air, China Southern and Air China are also interested in this approach. Hopefully, they will soon apply for the authorization to execute this approach.

- I. In medium term, CAAN intends to extend L626 route to MECHI to materialize the proposed Himalayan Route in consultation with India. CAAN also wishes to develop new RNAV5 routes as part of future ATS route network for Domestic operations (Figure 3). RNAV1/RNP1 STARs and RNP APCH (LNAV) will be introduced in some major airports like Bhairahawa, Pokhara, Nepalgunj, Simara and Chandragadi.
- II. In long term, CAAN intends to redefine its selective ATS routes like B345, G348, R325 as RNAV5 routes in consultation with adjacent FIRs as a process of transitioning from conventional to PBN route structure. RNP1 STARs/SIDs will be fully implemented in all major airports and overall terminal operations will be fully transitioned to PBN operations by 2025.





## **2.3 Other Navigational approach to reduce GHG.**

### **2.3.1 L626 RNP Route**

CAA Nepal prepared L626 RNP Route and implemented from 19 Nov 2009, and was expected for implementation by end of December 2012. This permitted for straight route in arrival. This results in reducing air distance to be covered while making approach at Tribhuvan International Airport. The air distance expected to be reduced by 1.5min/ft.

This approach is focused in reducing fuel consumption by aircraft and thus reducing GHG by aircraft entering and making approach to Nepal.

### **2.3.2 RNP-AP Approach**

The approach procedure of Tribhuvan International Airport has been revised and international operators are encouraged to make RNP AP APCH which is also constant Descent Approach. This will help in reducing air distances and thus reducing GHG. Qatar Airways has been performing the RNP AP APCH at TIA since 1<sup>st</sup> October 2012.

### **2.3.3 Radar Vectoring Approach**

This is Radar heading guide method for aircrafts making approach at TIA. This is a direct method of approach rather than making conventional approach AIS at TIA is implementing this method whenever there is possibility. This approach will be encouraged at TIA in as action plan to reduce GHG from aircraft. While using this method, it is expected that air distance reduced from 8 to 10 nautical miles than normal approach.

2.3.4 Other CAA Nepal efforts to reduce GHG from Aviation CAA Nepal is committed to work on ICAO's mission to reduce Green House Gas emission from aircraft that are operated in Nepalese sky. In

addition to above measures, but not limited to CAA Nepal plans to work on the following issues to show that it is partner with ICAO in addressing and working on environmental issue:

- a) CAAN has been trying very hard for the implementation of direct ATS routes to minimize the fuel consumption and reduction of carbon emission.
- b) Lobbying for direct routes (Himalaya-1, Himalaya-2 and Trans-Himalaya Routes) to reduce air distance. Nepal proposed for Himalayan 2 route, to years before that will join Kathmandu and Kunming reducing more than 100 nautical miles, that are aimed to reduce CO<sub>2</sub> emission in huge amount caused by international aviation.
- c) Introducing ATFM avoid unnecessary holdings on ground as well as on the air.
- d) Educating all stake holders about the amount of emission and its probable effect on the atmosphere.

By. Requirements set out for making RNP AP approach by Domestic/International operators by CAA Nepal.

- The RNP-AP APCH procedure for Nepal is so designed to take into account of the proximity of high terrain and the steep approach angle of the Conventional approach into TIA.
- Kathmandu RNP AP procedures approved by CAAN in April 2012 and issued AIRAC AIP Supplement S011/2012 of RNP-AP APCH procedure dated 03 May 2012 effective from 28 June 2012. The flexibility provided by the new Kathmandu RNP AP Approach procedure allows circumnavigating the terrain currently overflown using the conventional VOR/DME approach.

The RNP AP procedure is available for all airlines flying to Kathmandu as it is published in CAAN Aeronautical Information Publication (AIP) in May 3, 2012 all airlines flying to Kathmandu may take full benefits of the new procedure provided their aircraft are RNP capable and crews are trained.

In Kathmandu RNP AP the foreign operators first seek the operational approval from their Civil Aviation Authority and apply in CAAN Authorization from Civil Aviation Authority Nepal is mandatory to fly the RNP AP APCH procedure as published in the CAAN AIP Supplement.

It will be policy of CAA Nepal to encourage operators to proceed for RNP-AP Approach in time with requirements for reduction of CO<sub>2</sub> emission with more direct routes and less fuel burn.

## **2.4 Renewal of Fleets**

CAA Nepal aims to encourage its national operators for addition of new fleets. Government of Nepal has policy on the restriction of importation of aircraft under Nepalese Aircraft operator certificate. It restricts importation of aircraft for more than 15 years of aged aircraft in case of pressurized and 20 years in case of non-pressurized.

National carrier Nepal Airlines Corporation aimed to add new fleets for their international routes. This will be encouraged by CAA Nepal in an aim to address ICAO environmental issue.

## 2.5 Construction of Second International Airport

The second international airport of Nepal is already proposed and project is under progress for construction of second international airport is proposed at Nijgadh, Bara and When it will come into operation, it will reduce 30 nautical miles of air distance GHG emission reduce holding time period of aircraft.

However, the actual scenario on CO<sub>2</sub> emission by International Aviation after construction of this Airport is subjected for verification.

**Note:** Summary of Tables of measures is shown in Apppendix B.



# Appendix A

(Fuel Consumption and CO<sub>2</sub> Emission)



A1

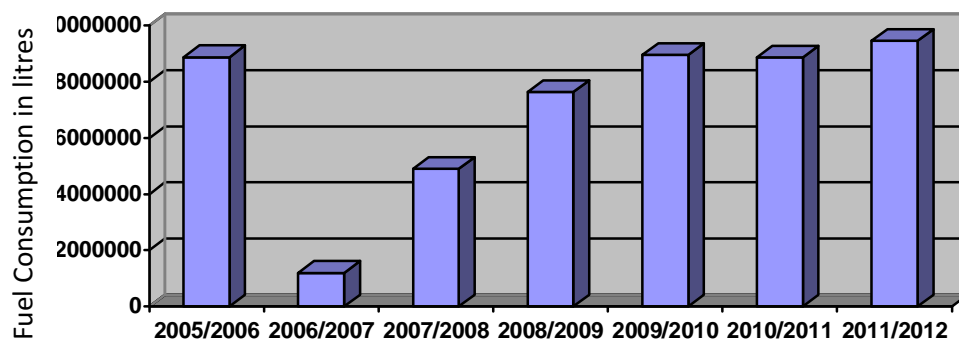
## Fuel Consumption

The following table shows fuel consumption by two B 757-200 operated by Nepal Airlines Corporation for international sector.

Type B757

Year	Fuel Consumed in liter
2005/2006	8869322
2006/2007	1199299
2007/2008	4905406
2008/2009	7633632
2009/2010	8957533
2010/2011	8859031
2011/2012	9459591

Fuel Consumption By Nepal Airlines (International)



Year

S.N.	Year	Fuel Consumed (litres)	Fuel Consumed (kg)	Fuel Consumed (Tonnes)	Fuel Consumed (kt)
1	2005/2006	8869322	7095457.6	7095.4576	7.095
2	2006/2007	1199299	959439.2	959.4392	0.959
3	2007/2008	4905406	3924324.8	3924.3248	3.924
4	2008/2009	7633632	6106905.6	6106.9056	6.106
5	2009/2010	8957533	7166026.4	7166.0264	7.166
6	2010/2011	8859031	7087224.8	7087.2248	7.087
7	2011/2012	9459591	7567672.8	7567.6728	7.567

**Note:** Amount of Fuel Available for Nepal Airlines BY two B757 is in litres. The density factor 0.8kg/ltr value is used as given in ICAO Fuel form.

So the aggregated methodology is used to calculate Co<sub>2</sub> emission from fuel consumption by Nepal Airlines using in international airlines.

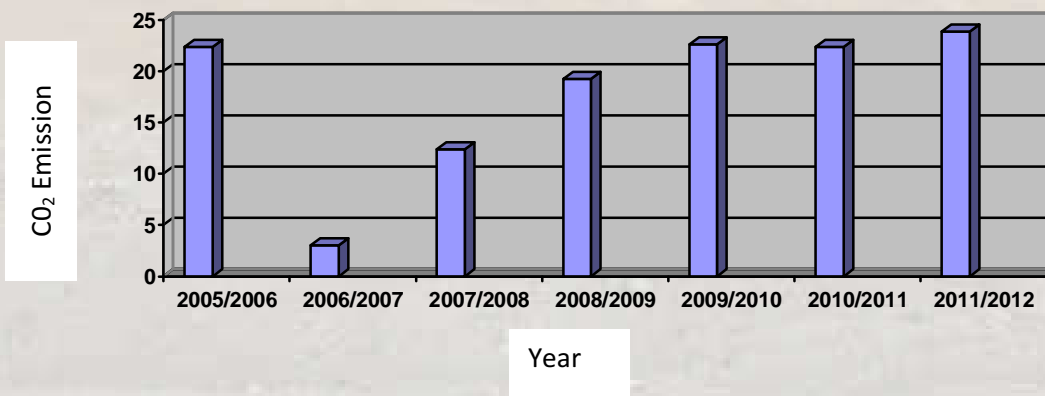
**Source:** The above data is obtained from Nepal Oil Corporation data source, for the fuel uploaded in two B757 operating in international sector.


## A2

### Co<sub>2</sub> emission

The total Co<sub>2</sub> emissions from international services can be calculated as follows:

S.N.	Year	Co <sub>2</sub> Emission (kt)
1	2005/2006	22.3989
2	2006/2007	3.0275
3	2007/2008	12.3881
4	2008/2009	19.2766
5	2009/2010	22.6231
6	2010/2011	22.3736
7	2011/2012	23.8890





# Appendix B

(Summary of Measures)

## Summary Table of Measures

S.N.	Measure	Description	Start Date	Date of Full Implementation	GHG/Fuel Efficiency Impact	List of Stake Holders
1	Formulation and amendment of legislation	Regulations and Requirements to be amended in Nepalese legislation to address aircraft emission issue	On-going	2014 A.D. (Expected)	Provisioning strong legislation will help CAA Nepal to work for aircraft emission issue	CAA Nepal
2	PBN Approach	Nepal PBN implementation plan, which contains planned PBN activities of the country	April 2011	Ongoing	This approach will reduce longer route with impaction tougher energy management thus resulting in less fuel consumption and less carbon emission and therefore more environment friendly	Different operators operating in Nepal
3	L626 RNP Route	Design of this route permitted straight route making	November 2011	Ongoing	It reduce distance of 1.5,om/flt thus reducing fuel consumption	CAA Nepal and different operators
4	RNP-AP Approach	This approach made constant Descent Approach at TIA	October 2012	Ongoing	CAA Approach at TIA reduces Air distance thus consuming less fuels and less carbon foot prints.	International operators, CAA Nepal
5	Radar Vectoring Approach	Direct method f making approaching at TIA, rather than conventional method	Ongoing	Ongoing	Reduces 8 to 10 nautical miles of air distance at making approach at TIA	ATS, CAA Nepal
6	ATS Route	Implementation of direct ATS route	Ongoing	Ongoing	Reduced Shorter distance	ATS, CAA Nepal
7	Himalay1, Himalay-2,	Lobbing for these route to	Ongoing	Ongoing	Kathmandu Kunming route will be	CAA Nepal and other States Stake

	Trans Himalaya Route	different			reduces to more than 100 nautical miles	holders
8	ATFM	Installation of RTFM at TIA Airport	To be Determined	To be Determined	Avoid unnecessary holdings on ground as well as on Air thus reducing carbon foot prints	CAA Nepal
9	2 <sup>nd</sup> International Airport	Construction of 2 <sup>nd</sup> International airport at Nijgadh, Bara	Ongoing	To be Determined	Operation of 2 <sup>nd</sup> international airport will reduce air distance of 30-nautical miles and will be milestone step in reducing carbon emission from airport  However, the actual scenario on CO <sub>2</sub> emission by International Aviation after construction of this Airport is subjected for verification.	CAA Nepal
10	Renewal of Fleets	Addition of new fleets for international by national career	Ongoing	To be Determined	National career plans to add new fleets for international flights	Nepal Airlines
11	Education	Educating all concern for A/C emission	Ongoing	Ongoing	Education	All Concern

**Note:** CAA Nepal is committed to work on environmental issue raised by ICAO. But most of the action plan is on implementation phase and for rest seeks international co-operation in Technology Transfer, Training and assistance for building financial capability.

## Thank You