



## **Analyzing Aviation Safety Trends in Nepal over the Past Fourteen Years**

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### **Abstract**

**Background:** Aviation industry have become crucial for economic development and connectivity but is still prone to risk. This can be evidenced by the series of accidents that have occurred in past few years. In the remote areas with limited road access, aviation is often the primary means of transportation for people and goods. The Civil Aviation Authority of Nepal (CAAN) is responsible for regulating aviation sector and has introduced various safety measures to improve aviation standards.

**Methodology:** This study presents the data regarding aircrafts accidents that occurred in Nepal from 2010 A.D. to 2023 A.D. The data were collected from the official reports prepared by the Civil Aviation Authority of Nepal (CAAN) which is the civil aviation regulator of Nepal. The study categorizes the accidents based on aircrafts also that is, airplanes and helicopters. To understand more clearly graphical representation including bar graphs and tables are used.



**Results:** The analysis shows that the majority of accidents resulted in 100% fatalities. The declining trend in aviation fatalities from 2010 to 2021 was interrupted by the two major incidents in 2022 and 2023, resulting in 22 and 17 deaths respectively. The drop of flight movements on year 2020 and 2021 played a significant role in making these two years' incident free air in aviation industry.

**Conclusion:** The study concludes that despite of decrease in fatalities in 2010 to 2021, the major accidents in 2022 and 2023 show that aviation risk exists. This highlights the need for better safety measures and rules, especially for tough weather and terrains.

**Novelty:** Analyzing 14 years of aviation accidents in Nepal, highlighting safety trends, and using statistical and graphical methods to emphasize the need for better preventive measures is the novelty.

**Keywords:** aircrafts, aviation, Nepal, safety trends

## **Introduction**

This boundless sky where once birds were supreme leader, it has been more than a century that Wright brother demonstrated that we being a human are capable of sharing this sky with birds. The first successful powered and piloted flight in the history was achieved by Wright brothers on 17<sup>th</sup> December 1903 A.D. [\\_\(Uri, 2023\)](#). With this great success, aviation history also saw its initial crash on 17<sup>th</sup> September 1908 A.D injuring the pilot Orville Wright while Lieutenant Thomas Etholen Selfridge tragically lost his life. This marked first ever fatality caused by a powered aircraft crash [\\_\(Swopes, 2024\)](#).

This tragic incident didn't stop the progress in aviation. Instead, it fueled the further advancement sin safety and technology. Over the years, efforts made by engineers and pioneers have made air travel one of the safest modes of transportation [\\_\(turbli, 2020\)](#). A recent study claims that flying is now safer than ever, with chances of crash lower than before [\\_\(English, 2024\)](#). After tremendous success regarding the successful flight, establishment of various airlines begun. Deutsche Luftschiffahrts-Aktiengesellschaft (DELAG) was the world's first airline. [\\_\(Ai-Che Chang, 2023\)](#)

As Development is exponential, Nepal could not remain deprived of this exponential development any longer. Royal Nepal Airlines now known as Nepal Airlines Corporation was founded on 1<sup>st</sup> July 1958 A.D. Back then it was used for serving royal families [\\_\(Nepal Airlines, 2024\)](#). Nepal being a landlocked country air transportation is the only means of transportation to connect with the outer world. It is the major for global connectivity, trade and tourism too. So, it did not take longer for air transportation to become a vital means of public transportation.

## **Literature Review**

Nepal is too familiar with aero-plane crashes. Though first aircraft to meet with an accident in Nepal was at Simara, in Bara district [\\_\(Republica, 2023\)](#). According to records on 11<sup>th</sup> May 1960, aircraft Douglas DC-3 owned by Royal Nepal Airlines became first Nepalese Registered aero-plane to meet with an accident. In this incident fatality count was four [\\_\(Accident Record of Nepalese Registered Aeroplanes, 2023\)](#). Talking about recent years' data, between 2011 and



2015 fatality rate in airplane incidents stood at 10.3. Similarly, from 2016 to 2020, this rate decreased significantly to 6.4. No fatal incidents involving airplanes occurred on the year 2020 (CAAN report 2019-2020).

According to the Aviation Safety report-2023 prepared by CAAN total 24,560 international flight movements happened in 2022 which is a significant increase when compared to previous year's record which is 11,760 (CAAN, 2023). Due to lockdown during COVID pandemic there was significantly less flight movements on year 2020 and 2021 (CAAN, 2022). Air traffic movement is obviously related to aircraft accidents as when there are more aircrafts in operation there is more risk of occurring incidents. As air traffic movements decreased in huge margin on year 2020 and 2021, the aviation industry saw incident free year on those two years. Even on year 2015, when flight movements decreased due to earthquake there were no airplane accident on that year. However, it's to be noted that on that year Aviation industry saw two helicopter crash taking life of 4 people. (CAAN)

Aviation safety report prepared by CAAN mentions that throughout 2021 CAAN engaged in various activities promoting and encouraging the culture of safety in aviation sector. As safety is very important in aviation industry CAAN ensures that all the service providers follow safety rules properly and Nepal's aviation industry runs safely (Aayush Bhattarai, 2022). National Aviation Policy, 2050(1993) was issued with a vision of encouraging the development of safe, accessible and efficient air transport. It also aims to uplift the level of Nepal's aviation industry by constructing advanced airports, encouraging private investors, partnering globally, ensuring safety and what not (CAAN, 2006). Recently member states of International Civil Aviation Organization (ICAO) has tasked it with pursuing a new global target of achieving zero aviation fatalities by 2030 (ICAO, 2019). The 193 nations including Nepal among who cooperate under ICAO are working towards their agreed global safety objective of zero fatalities by 2030. Along with this CAAN is also working on enhancing the regulatory capacities and publishing the Aviation safety report annually to share the state of safety information (CAAN, 2022). According to aviation safety report book 2023 Nepal have made significant progress in implementing its State Safety Program reaching 92.9% completion at level 3 (CAAN, 2023).

### **Methodology**

Safe flights over TIA could be challenging due to turbulent atmospheric conditions and complex terrain (GREEMA REGMI, 2020). Annually CAAN updates the information regarding the aircraft accidents occurred in Nepal so, data from report prepared by CAAN was used and to get up-to-date information regarding the aircraft accident in Nepal. For comparison of number of flight movements, various reports prepared by Civil Aviation Authority of Nepal (CAAN) was thoroughly studied. Also reports, journals, monograph was studied to understand the reality of airplane-crash in Nepal. Going through the data from 2010A.D to 2023A.D information regarding number of incidents, death and survival was collected. This information was demonstrated in table. To make clear understanding regarding the pattern of accidents, Airplanes accident is represented in line graph (Accident Record of Nepalese Registered Aeroplanes, 2023). Similarly, two more bar graph is prepared showing number of incidents,



death and survival on each year on those fourteen years during helicopter accidents and total aircraft accidents respectively\_(Accident Record of Nepalese Registered Aeroplanes, 2023). The data used in graph representing the number of domestic and international air traffic movements was taken from the aviation safety report prepared by CAAN on year 2020 and 2023\_(CAAN, 2023)\_(CAAN, 2020).

### Results and Discussion

#### Results

Variations were observed in number of incidents and deaths that occurred in various years which can be analyzed by the peak and its descending manner as seen on Figure 1. At a quick glance it can be seen that the number of Airplane accidents have significantly declined in past few years whereas the number of Helicopter accidents have significantly increased in these years. Including the number of incidents, deaths and survival during various aircraft accident the following table was prepared.

TABLE 1: INCIDENTS, DEATH AND SURVIVAL DURING AIRCRAFT ACCIDENTS IN NEPAL

Year	Aircraft accidents in Nepal								
	Aero-planes Accident			Helicopters Accident			Total Accident		
	Incident	Death	Survival	Incident	Death	Survival	Incident	Death	Survival
2010	2	36	0	1	2	0	3	38	0
2011	2	19	0	1	0	0	3	19	0
2012	2	34	6	0	0	0	2	34	6
2013	2	0	29	1	1	5	3	1	34
2014	1	18	0	1	1	0	2	19	0
2015	0	0	0	2	4	0	2	4	0
2016	4	27	12	2	7	1	6	34	13
2017	2	3	18	0	0	0	2	3	18
2018	0	0	0	4	7	13	4	7	13
2019	1	0	0	2	7	1	3	7	1
2020	0	0	0	0	0	0	0	0	0
2021	0	0	0	0	0	0	0	0	0
2022	1	22	0	0	0	0	1	22	0
2023	1	72	0	2	7	3	3	79	3
	18	231	65	16	36	23	34	267	88

The Table 1 shows the number of aircraft accidents that occurred from year 2010 A.D. to 2023 A.D. in Nepal. Table1 shows that highest number of aircraft accident occurred on year 2016 A.D. On that year, 4 airplane accidents occurred along with 2 helicopter accidents. Similarly, on year 2020 A.D. and 2021 A.D. no aircraft accidents occurred at all. Death toll was 72 on the year 2023 A.D. On year, 2013 A.D. despite occurrence of 3 aircraft accidents death count was 1 and luckily 34 people survived which is highest survival number in past fourteen years.

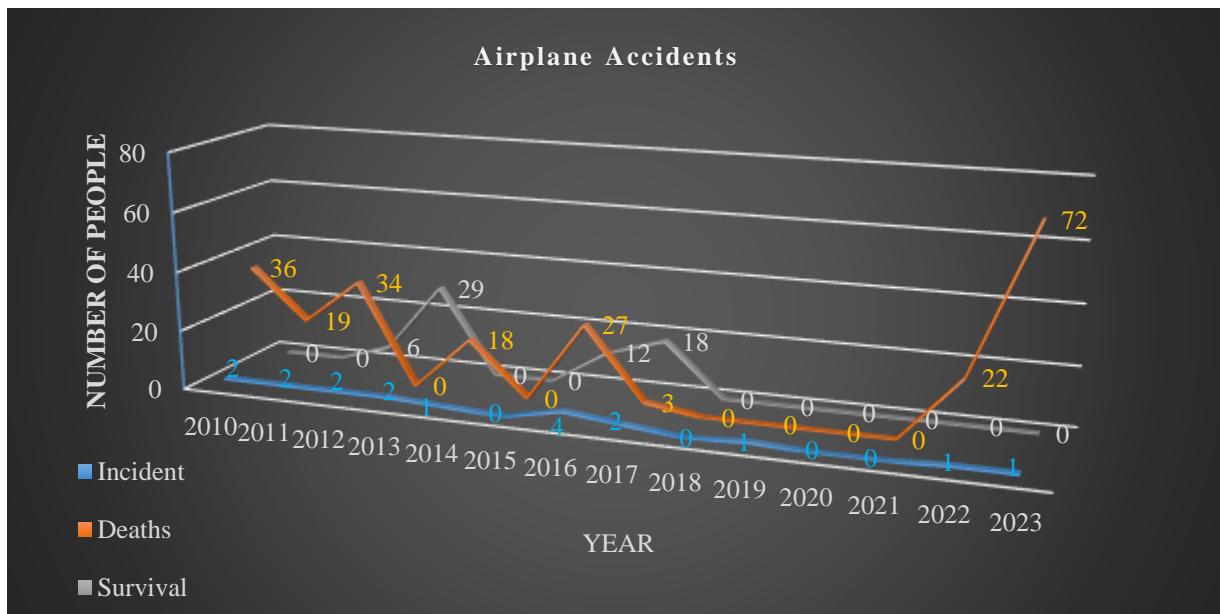


FIGURE 1: INCIDENTS, DEATH AND SURVIVAL DURING AIRPLANE ACCIDENTS IN NEPAL

The [figure 1](#) shows the comparison between number of incidents, death and survival during airplane accidents from year 2010 A.D. to year 2023 A.D. In terms of airplane accidents, highest number of incidents occurred on year 2016 A.D. (i.e. 4) where as highest number of death was seen on year 2023 A.D.(i.e.72). Similarly there are no documented records of Airplane accidents on year 2015 A.D.,2018 A.D.,2020 A.D. and year 2021 A.D.

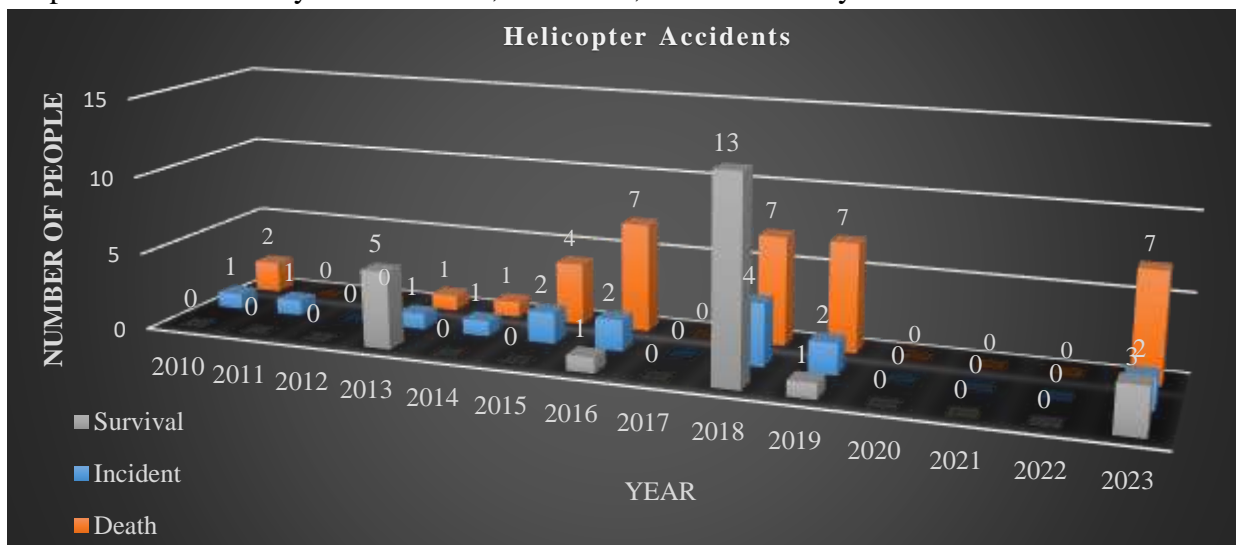
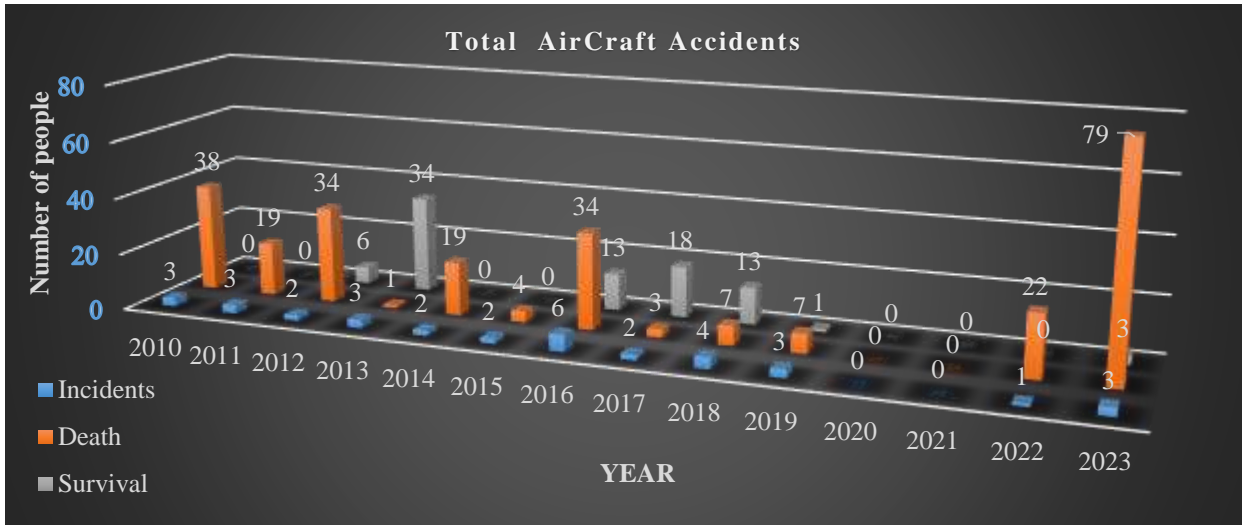


FIGURE 2: INCIDENTS, DEATH AND SURVIVAL DURING HELICOPTER ACCIDENTS IN NEPAL

The [figure 2](#) represents the comparison between number of incidents, death and survival during helicopter accidents from year 2010 A.D. to year 2023 A.D. In terms of incident, the year 2018 A.D. witnessed highest number of helicopter accidents (i.e. 4) and the year 2016 A.D., 2018A.D., 2019 A.D. and 2023 A.D. experienced highest number of fatalities in helicopter



accidents (i.e. 7). Similarly, there is no evidence of helicopter accidents on year 2012 A.D., 2017 A.D., 2020 A.D., 2021 A.D., and 2022 A.D.

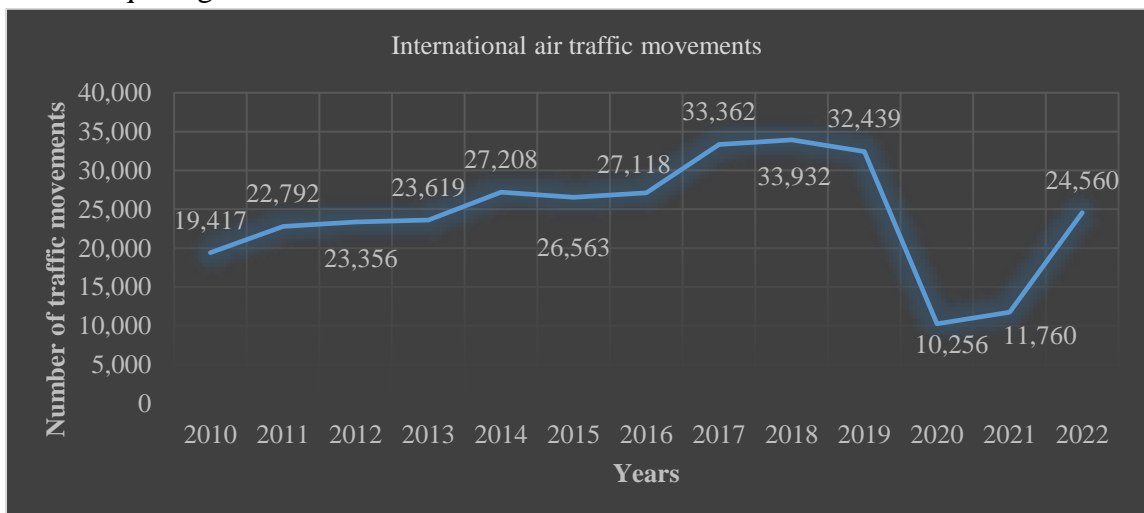


**FIGURE 3: INCIDENTS, DEATH AND SURVIVAL DURING AIRCRAFT ACCIDENTS IN NEPAL**

**Figure 3** represents combined number of incidents, death and survival during aircraft accidents in Nepal from year 2010A.D to year 2023A.D. This visual representation allows a thorough understanding of aviation incident in Nepal throughout the time period. From the above graph it can be seen that 2016A.D recorded highest number of aviation incidents in Nepal. In contrast both year 2020A.D and 2021A.D reported no aircraft accidents. The unfortunate peak in fatalities can be seen on year 2023 marking the highest number of death count in single year. Similarly, in 2013A.D despite occurrence of three aircraft accidents, only one person lost life while luckily 34 people survived making it highest survival count in past fourteen years.

**A quick look on air traffic movements in Nepal**

Using the information published by CAAN the graph including domestic as well as international air traffic movements was prepared which helps in analyzing the air traffic movements at a quick glance.



**FIGURE 4: INTERNATIONAL AIR TRAFFIC MOVEMENTS IN NEPAL**



Figure 4 shows the total number of international air traffic movements in Nepal from year 2010 to 2022A.D. From the above figure it can be seen that the international air traffic movement have continuously increased from year 2010 to 2019. But during 2020 the air traffic moment was decreased by 68.38% due to restriction in international flights due to the global COVID-2019 pandemic. Similarly, the travel restriction for international flights continued on 2021 showing slight but no significant increase in international flights. A significant increase in flight movements can be seen on year 2022 as compared to previous years which is 108.84% which is still less than of year 2019 but still a significant growth.

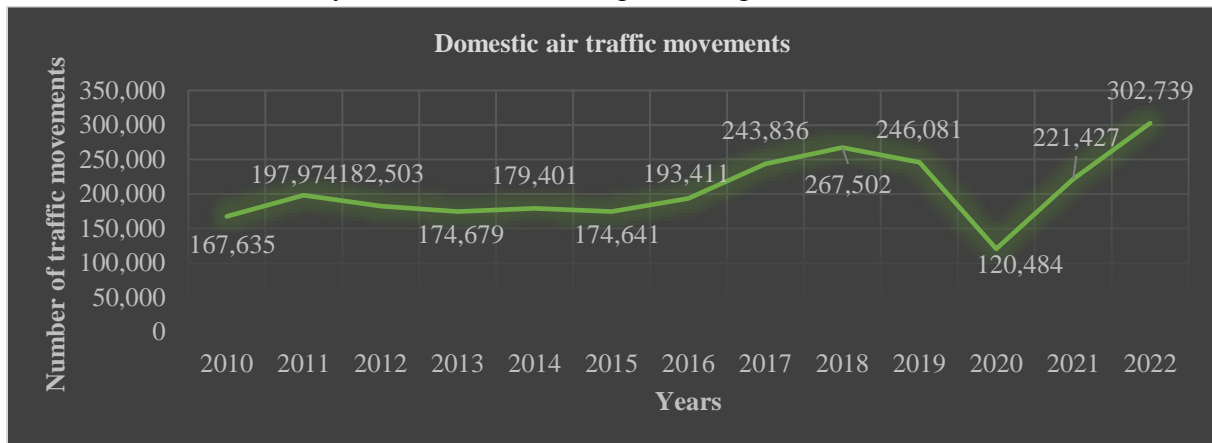


FIGURE 5: DOMESTIC AIR TRAFFIC MOVEMENTS IN NEPAL

Figure 5 represents the total number of domestic air traffic movements in Nepal from year 2010 to 2022 A.D. From the above graph it can be seen that the flight movement has increased from year 2010 to 2011 which began decreasing till next two years. Then on 2014 the movement escalated by 2.7%. Again, the movement decreased on 2015 by 2.65%. This decrease in domestic aircraft activity can be partially linked to significant earthquake that struck the country on April of that year. After 2015, again the bar of domestic flight movement began raising till 2018. From the above line graph, it can be seen that domestic traffic movement have also decreased by 51.04% on 2020 A.D. As restriction gradually eased traffic movement began to escalate resulting in highest ever domestic traffic movement on year 2022 on fourteen years of data.

#### Classification of accidents on the basis of outcomes

Accidents lead to various outcomes. On the basis of survival and fatality count, outcomes of aircraft accident I have classified aircraft accidents into four categories. This can be explained by the chart as shown below

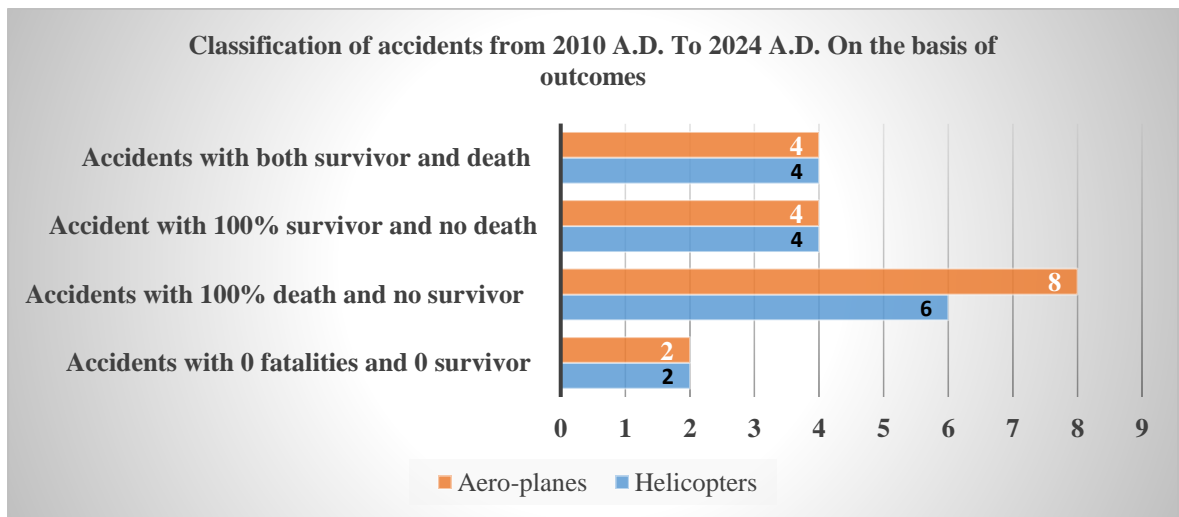


FIGURE 6: CLASSIFICATION OF ACCIDENTS ON THE BASIS OF OUTCOMES

Figure 6 shows the classification of accidents on the basis of outcomes. Here data from 2010 to 2023 is used to display four kinds of accident outcomes. From the graph it can be observed that the minimum number of aircraft accidents has 0 fatalities and 0 survivors whereas maximum aircraft accidents does have 100% death and no survivors. The figure shows that in both aero-plane and helicopter accidents the number 100% death count is more (44.44% in case of aero-planes and 37.5 in case of helicopter) as compared to other outcomes. It shows that surviving an aircraft accident is quite difficult in Nepal.

**Peeking on some past data**

Going through the aviation history of Nepal, total of 39 Nepalese registered helicopters and 53 Nepalese registered aero-planes have experienced accident till this point. When categorized on the basis of outcomes mentioned earlier following data was obtained.

TABLE 2: CLASSIFICATION OF ACCIDENTS SINCE FIRST ACCIDENT ON THE BASIS OF OUTCOMES

Type of aircraft accident	Aero plane	Helicopter
Accident with 0 fatalities and 0 survivors	14	8
Accident with 100% fatality and no survivors	23	10
Accidents with 100% survivors and no death	8	13
Accidents with both survivors and death	8	8
Total	53	39

Table 2 presents the total number of aircraft accidents recorded from the first aircraft accident until present. From Table 2 it can be seen that upto this point of time altogether 92 Nepalese registered aircraft have beeninvolved in accidents out of which 39 were helicopters and 53 were aero-planes. It can be seen that the data of accident containing both survivors and death contributes less to the table whereas the data with 100% fatality contributes highest.



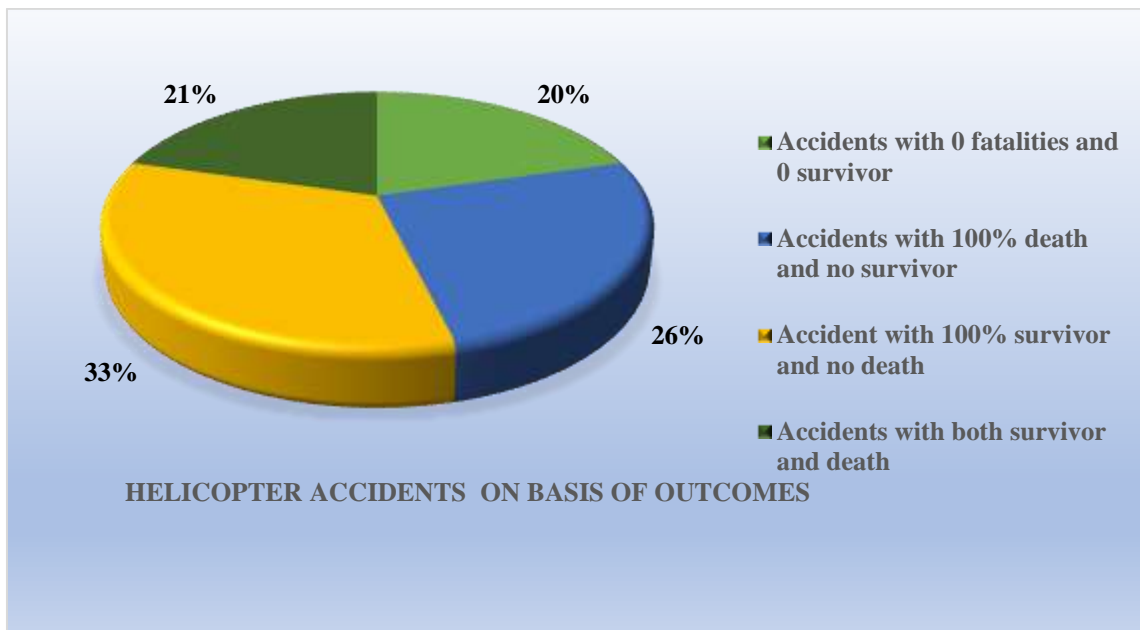


FIGURE 7: CLASSIFICATION OF HELICOPTER ACCIDENTS SINCE FIRST TILL 2023 ON THE BASIS OF OUTCOMES

The [figure 7](#) shows classification of helicopter accident on the basis of outcomes till 2023. From the chart it can be seen that the majority of the accidents were those with 100% survivor and no any death count (i.e. 33%). Similarly, least accident was those in which there was 0 fatality and 0 survivors. (i.e. 21%).

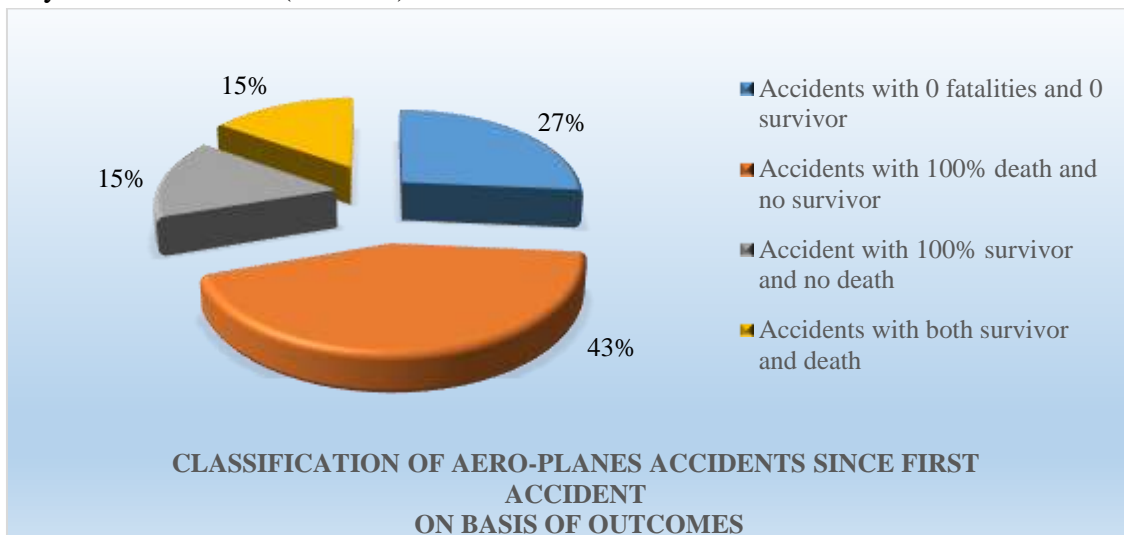


FIGURE 8: CLASSIFICATION OF AERO-PLANE ACCIDENTS SINCE FIRST TILL 2023 ON THE BASIS OF OUTCOMES

The [figure 8](#) shows classification of aero-plane accidents based on of four different outcomes up to 2023. From the pie chart it can be observed that majority of the pie represents accidents with 100% death and no survivors (43%). Accidents with 100% survivors and accidents with both survivor and fatalities each take away a minority slice of the pie.



## **Discussion**

After observing data of past fourteen years from CAAN official report it was observed that in past fourteen years in total 34 aircraft accidents have occurred in Nepal causing death of 267 people. The year 2023A.D saw highest number of fatalities with 3 incidents. In contrast, the year 2013A.D saw 3 incidents and only one death count. Remarkably 34 people survived aircraft accident that year. Also there was no evidence of aircraft accident on the year 2020A.D and 2021A.D. The plain region for 3 years shows no trace of helicopter accidents at that time period, but again on year 2023, 7 people died because of helicopter accident.

Similarly, Observing the line graph of international air traffic movement it can be seen that in most of the cases the air traffic movement has shown decent increment each year whereas on year 2020 and 2021 the decrease in international air traffic movement is due to the restrictions on international flight movement during the global pandemic. The line graph representing the domestic air traffic movement shows that overall there was a steady increase in domestic air traffic movement from year 2010 to 2022 with occasional fluctuations. The year 2020 marked a significant decline in domestic air traffic movement due to the global pandemic, but a notable recovery was observed in year 2021 and 2022.

Due to declination in air traffic movement Aviation history saw incident free year for two years continuously. When the number of aircraft accidents of last fourteen years was categorized on the basis of its outcomes into four different categories it was seen that majority of the aircraft accident result in 100% fatality rate. When data from first ever aircraft accident was categorized into same four categories it was found that 43% of the total aero-plane accident result in 100% fatality and only 15% have 100% survival rate and 15% were incident with no death and survival count. Similarly, the data from first ever helicopter accident tells us a different story. According to it 33% of helicopter accident have 100% survivor and 26% have 100% death count.

## **Conclusion**

Hence when the aircraft accidents in past fourteen years was thoroughly studied and presented, it was seen that the number of aero plane accidents decreased significantly from year 2010 A.D. to 2021 A.D. whereas the number of helicopter accidents increased in significant number from year 2010 A.D. to 2018 A.D. The main reason behind no flight accidents on year 2020A.D. and 2021A.D. is lockdown due to global pandemic COVID-19. During these years, the number of international and national flight movement was so less as compared to previous years. It was found that out of 34 total aircraft accidents that have occurred in past fourteen years, 22 (64.706% of total) were fatal (i.e. 22 accidents at least had one death count) and 12(35.294% of total) were non-fatal (i.e. 12 accidents did not have death count at all) It was also concluded that probability of survival during an aircraft accident in Nepal is very less as compared to probability of death. In 14 out of 34 (41.176% of total) accidents everyone lost their life resulting in 100% fatality rate in those accidents. Observing data since the beginning it was found that 43% of total aero plane accidents that have occurred till now has 100% fatality rate whereas 26% of helicopter accidents have 100% fatality rate. Similarly, the steep down graph



in aero plane accidents in past years is also due to hard work by CAAN focusing on safety in aviation industry including the common objective of ICAO a new global target of achieving zero aviation fatalities by 2030.

### **Acknowledgements**

First off all I am very grateful towards Tri-Chandra Multiple Campus for providing necessary resource and facilities. Similarly, I want to thank CAAN for preparing annual safety report each year and keeping up to date information regarding aircraft crashes and flight movement each year. These data were the key for preparation of my report as without this data my report could never be prepared. Also, I would like to thank authors whose reports and articles helped me a lot in adding some of the important information that made my report a lot more sensible.

### **Author Contribution**

Pitri Bhakta Adhikari sir came up with the idea for the study, provided the site, and helped with the methodology and editing. Laxmi Gautam did literature review, handled the introduction, results, and conclusions, and prepared the graphs and tables. Bipana Koirala took care of the abstract, discussion of the results, and gave detailed feedback by reviewing the paper.

### **Conflict of Interest**

The authors confirm that they have no competing interest.

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