# TRIBHUVAN UNIVERSITY

# INSTITUTE OF ENGINEERING

# PULCHOWK CAMPUS

**THESIS NO:**

**Developing Mode Choice Model for The Effect of Road Transport Service on Air Travel Demand from Jumla to Nepalgunj**

by

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A THESIS

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The undersigned certify that they have read and recommended to the Institute of Engineering for acceptance, a final thesis entitled "**Developing Mode Choice Model for The Effect of Road Transport Service on Air Travel Demand from Jumla to Nepalgunj**" submitted by Yagendra Dharala (2072/MST/270) in partial fulfillment of the requirements for the degree of Master of Science in Transportation Engineering, Nepal is a record of works carried out by him under my supervision and guidance.

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# ABSTRACT

Air transport was the only one mode of transportation to reach Nepalgunj from Jumla before the construction of highway. Now adays people can choose either air transport or road transport according to their interest. Introducing a road transport service shall change the traffic of air transportation. No research is conducted regarding the effect of air trips due to operation of highway in study area. The objective of the study was to assess Developing mode choice model for the effect of road transport service on air travel demand from Jumla to Nepalgunj.

The area for this study is Jumla. Highway, linking Surkhet, Dailekh, Kalikot and Jumla districts.The study follows the analytical and descriptive approach in which the view of concerned key personal and primary and secondary data analysis has been incorporated.The logit model was used in trip as dependent and independent variable.

Large number of trip maker is students who have low income but usually go Nepalgunj than other professions. Privacy is minor factors comparing cost, time, health, comfort and safety while choosing transport modes. Increasing ages and income of the passengers is contributing towards the increasing number of the plane users. The chances of plane users are the highest by business. Male are the active trip maker but female were mostly used plane. The model was able to explan in the variation of 68.4% to 93.1% in the independent variable. The prepared model was made with 95% confidence interval for selected model. In conclusion study has concluded that there is no effect of road transport service on air travel demand from Jumla to Nepalgunj as the growth rate of air traffic is nearly equal before and after operation of road.

**Key Words**:  Air transport, Analytical and descriptive approach, Mode choice, Binary logit model, SPSS.

# ACKNOWLEDGEMENTS

**TABLE OF CONTENT**

# LIST OF TABLE

# LIST OF FIGURES

# ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AD | After Death |
| AMSL | Above Mean Sea Level |
| BS | Bikram Sambat |
| BT | Black Top |
| CAAN | Civil Aviation Authority of Nepal |
| CBS | Central Bureau of Statistics |
| CED | Civil Engineering Division |
| CPS | Center for Postgraduate Studies |
| DoR | Department of Roads |
| DoTM | Department of Transport Management |
| DCC | District Co-ordination Committee |
| DTMP | District Transport Master Plan |
| DTO | District Technical Office |
| ER | Earthen Road |
| ERMC | Environment and Resource Management Consultant |
| Ft | Feet |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GoN | Government of Nepal |
| GR | Gravel Road |
| ICAO | International Civil Aviation Organization |
| Km | Kilometer |

| | |
|---|---|
| LRN | Local Road Network |
| M | Meter |
| MoPIT | Ministry of Physical Infrastructure and Transport |
| M.S. | Master of Science |
| NM | Nautical Mile |
| NRS | Nepalese Rupees |
| RM | Rural Municipality |
| S.N. | Serial Number |
| SPSS | Statistical Package for the Social Sciences |
| sq.km | Square Kilometer |
| SRN | Strategic Road Network |
| TEAM | Transportation Engineering and Management |
| TIA | Tribhuvan International Airport |
| TIACAO | Tribhuvan International Airport Civil Aviation Office |
| WHO | World Health Organization |
| NGO | Non-governmental organization |
| INGO | International non-governmental organization |
| DRCN | District Road Core Network |

## CHAPTER ONE: INTRODUCTION

### 1.1 Background

In Nepal, there is not well developed transportation system. It is because most part of Nepal is full of rugged mountains and valleys. The cheap mode of transport in Nepal is road transport. But it is difficult to develop the road transport in every part of country. According to Gajurel (2011), Nepal's transport sector is dominated by road transportation as a result of the country's landlocked geographical position. While road transportation has dominated the plains and accessible areas, air transportation is the only means of reaching many remote destinations which are not linked to the road network. Only in the major cities and terai have been developed by road way.

Roads and airports continue to play an important role in Nepal's transport infrastructure and economic development. The first airport of Nepal is Gauchaur Airport which was inaugurated by King Mahendra in 1955 AD and renamed it as Tribhuvan International Airport. The grassy runway transformed into a concrete in 1957 AD. Nepal attained an ICAO membership in 1960 AD (CAAN, 2011).

Between the periods of 1951AD to 1970 AD, the road development policy and strategies also focused to upgrade and equip mountain airports to make it more safe and dependable. But there is not quantitative improvement for 40 years from the policy formulation. Most of the mountain airports now have been upgraded and some airports are in the process of upgrading. The upgrade should focus on navigational aid and radio communication systems also so that air transport becomes more efficient and safe, even during bad weather conditions.

There are 56 airports in the country. However air services are not available in all the airports. There are twenty two airports with bituminous and rests are either gravel or earth strips. Among fifty six airports, thirty two are in operational with regular service and six are under construction (CAAN, 2018).

Most of the remote districts had been connected with provincial or capital city by air transport before linkage by road transport. Now all of the districts except Humla arelinked of road connectivity. Even after the road linkage in remote district, the importance of the air transport is not diminishing.

**Transportation in Jumla District**

Historically, Jumla was a district with the access to road transport facility. However; it had no connection with any national strategic road network before 2010 AD. Such sort of internal set of transportation system was able to provide services only between district headquarter and Jumla Airport.

In regard to existing transport accessibility situation, the district is getting better gradually in comparison to the past. This highway was linked with district headquarter since 2010 AD. But there was difficulty for operation during rainy season.

The district is also equipped with air transport facility that had been operated in the Jumla Airport since 1958 AD. It was the grassy runway.After upgrading (blacktopping) of the runway at the Jumla Airport. This will not only increase the tourist arrival in the region but will also facilitate the local people, who at present suffer from a shortage of sufficient air transport facilities.

Aeroplane was the only one mode of transportation to reach Nepalgunj from Jumla before the construction of major feeder road. After the construction of road people can choose either plane or bus according to their interest. The flow of visiters will be increased due to additional cheap transportation mode.

**1.2 Statement of Problem**

Jumla district had access to Nepalgunj only through Jumla Airport till 2010 AD. Now this district is connected to Nepalgunj by highway. However, the demand for both modes has never been studied. It is known fact that the economics of air service does not permit frequent services if there is insufficient demand. Without understanding the traveler's needs and preferences, upgrading of transportation system will be wastage of resources.

Introducing a new access mode (e.g. road) can substantially change the access mode shares. Transportation between Jumla to Nepalgunj is divided into highway and air transport. The main challenge facing is the lack of number of passengers due to newly constructed highway which will curtail the airlines schedules from Jumla to

Nepalgunj. This problem is made worse by declining aviation passengers and make unsustainable to aviation industry of Jumla district.

## 1.3 Research Questions

Following research questions are set out to assess the development of mode choice model for the effect of road transport service on air travel demand from Jumla to Nepalgunj.

1. What is the existing transportation situation in the study area?
2. What are the travel characteristics of the Jumla district?
3. Which are the preferred modes of transport usually used from Jumla to Nepalgunj?
4. What are the factors for choosing specific type of transport mode?

## 1.4 Objectives of the Study

The main objective of the study was to assess the development of mode choice model for the effect of road transport service on air travel demand from Jumla to Nepalgunj.

The specific objectives are as follows.

1. To find out the existing transportation situation in the study area.
2. To explore the travel characteristics of study area.
3. To find the preferred modes of transport from Jumla to Nepalgunj.
4. To review travel preference survey for trip modes.
5. To explore the factors affecting the mode choice.
6. To develop mode choice model from Jumla to Nepalgunj.

## 1.5 Significance of the Study

➢ This study is very important in planning and implementation of new projects for decision makers to invest on appropriate transportation mode.
➢ It will also help transport entrepreneur to invest on appropriate transportation system according to the public demand.
➢ It assists airline companies to schedule aircrafts at particular airport in effective and efficient way.

**1.6 Scope and Limitation of the Study**

**Scope of the study**

- ➢ This includes study of the transportation system of Jumla district.
- ➢ Historical data is used to study the passenger's trend from Jumla to Nepalgunj.

It explores the factors affecting the modes choice and develop the mode choice model for the effect of road transport service on air travel demand from Jumla to Nepalgunj.

**Limitation of the study**

- ➢ Jumla airport has the flight for Surkhet Airport but this data has not been included in this research work.
- ➢ This study does not focus on other variables such as tourism and migration which are the main influential variables for transportation system.
- ➢ The passengers through highway using private vehicles is not considered in this study.
- ➢ The model showed the accuracy of only 67.33 % when validated against the data that were not used to develop the model.
- ➢ Only 7 variables were seen to be significant out of the 9 variables.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Transportation Systems

Air transport service is a key factor in the transport system in remote regions. They allow human and natural resources to be used more efficiently. Air transport is very important for long distance travels and for connecting remote areas to the rest of the world. Air transport itself is a product which is delivered partly as intermediate products for other industries, partly as final demand like leisure travels (Braathen, 2011).

Road transport in Nepal is dominant for moving passenger and freight but with road density at 11.8km of road per 100 $km^2$ resulting a lack of access also constrains economic development (MoPIT, 2015). The National road network comprises of national highways, feeder roads, urban roads, district roads and village roads. The Strategic Road Network (SRN) is the backbone of the national road network. At present the Strategic Road Network has altogether 12,494 km (51% blacktop, 13% gravel and 36% earthen roads) (DoR, 2014).

Access to road service is considered the basic requirement for economic development of rural area in Nepal. Of the total 53,143 km Local Roads Network (LRN), only 1,697 km has been black-topped, 38,898 km is earthen and 12,548 km has been gravelled. About 38,768 km falls under fair-weather road category which is 73 percent of total local road network under local government (DoLIDAR, 2015).

## 2.2 Existing Transport Situation of Jumla District

Table 2. 1: District road core network in Jumla district(km)

| Code | Name of Road | Total length (km) | Earthen (km) | Fair weather (km) |
|------|--------------|-------------------|--------------|-------------------|
| 63DR010 | Jumla-Urthu-Dillichaur | 16.02 | 16.02 | 16.02 |
| 63DR011 | Dillichaur-Chhumchaur | 4.60 | 4.60 | 4.60 |
| 63DR012 | Dillichaur-Talfi-Pere-Syalagad | 6.10 | 6.10 | 6.10 |

| Code | Name of Road | Total length (km) | Earthen (km) | Fair weather (km) |
|------|--------------|-------------------|--------------|-------------------|
| 63DR09 | Chandannath-Garjyangkot-Guthichaur-Chotra | 21.71 | 21.71 | 21.71 |
| 63DR04 | Acharyalihi-Dhitallihi-Sanigaun | 6.26 | 6.26 | 6.26 |
| 63DR06 | Dansangu-Khalla-Haku-Ghodesing | 11.04 | 11.04 | 11.04 |
| 63DR01 | Bagbazar-Patharkhola | 2.64 | 2.64 | 2.64 |
| 63DR0 | Acharyalihi-Narakot | 3.00 | 3.00 | 3.00 |
| 63DR07 | Gachchusangu-Dhimichaur-Lekpor-Kotghar | 10.00 | 10.00 | 10.00 |
| 63DR05 | Kudari-Tamti-Topla | 12.20 | 12.20 | 12.20 |
| 63DR08 | Jumla-Urthu Bumramadi-Bulbule | 22.81 | 22.81 | 22.81 |
| Total | | 116.38 | 116.38 | 116.38 |

(Source: DTMP, 2013)

Earlier the villagers of Jumla district needed to walk quite a long distance to get vehicles from remote places. But nowadays most of the villages have been provided with dry weather road linking to national highway. Transportation is a vital component of economic development, social progress and quality of life for the people of study area. The inadequacy of transportation infrastructure can dramatically reduce agricultural production and market opportunities and make population suffer from reduced cultural and social contacts as well as limiting business and employment opportunities in this study area.

Figure 2.1: Trend of air passengers through Jumla Airport

**passenger movement decreases as the flight movement decreases after operation of highway**
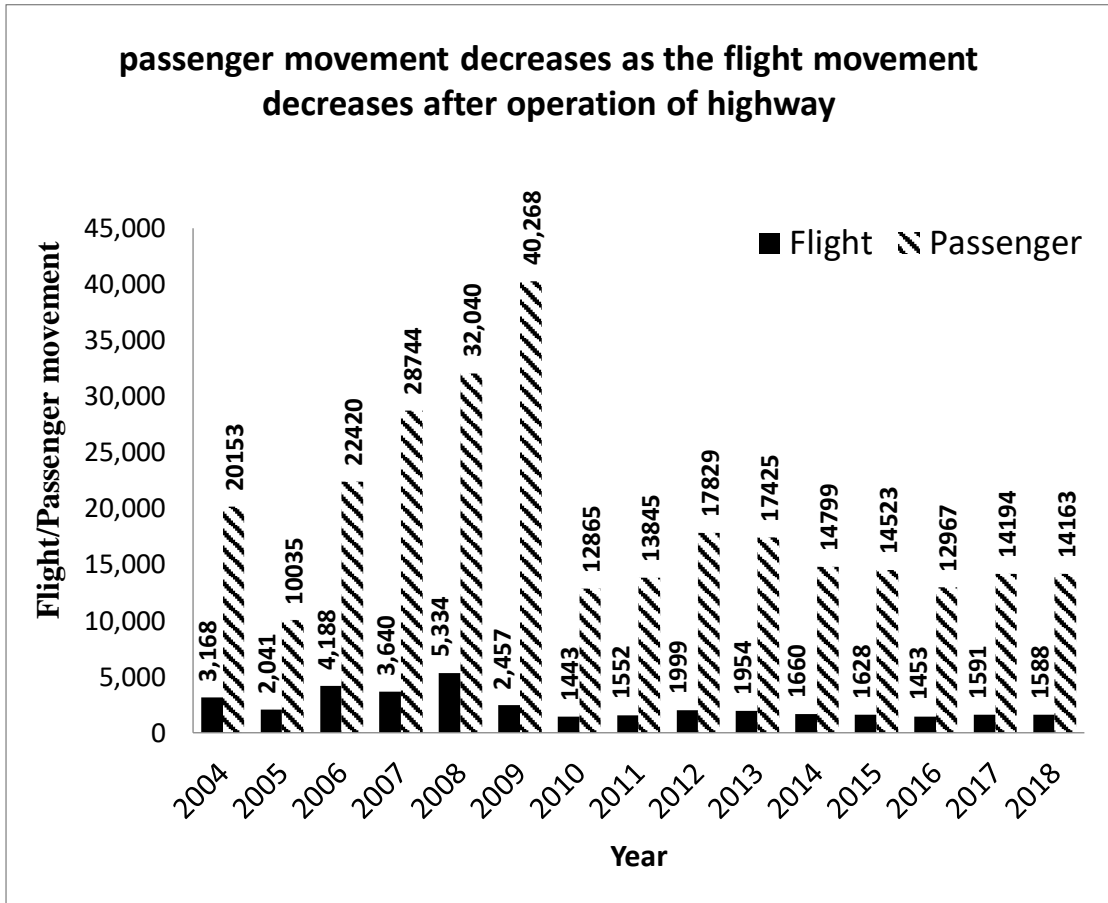
(Source: CAAN Report, 2011-2012 and 2018)

## 2.3 Trend of Air Transport Worldwide

Trend analysis consists of calculating the growth rate over a historical period of time and projecting that growth rate to continue into the future. This implicitly assumes that the factors that drove passengers' growth in the past, such as income growth or changes in fares, will be the same in the future (Dunlay, 2012). Also, the resulting forecasts can be very sensitive to the period of time selected to calculate the historical growth rates. Monthly and weekly distributions represent the distribution of annual passengers and operations by month and the share of weekly passengers and operations by day-of-the-week.
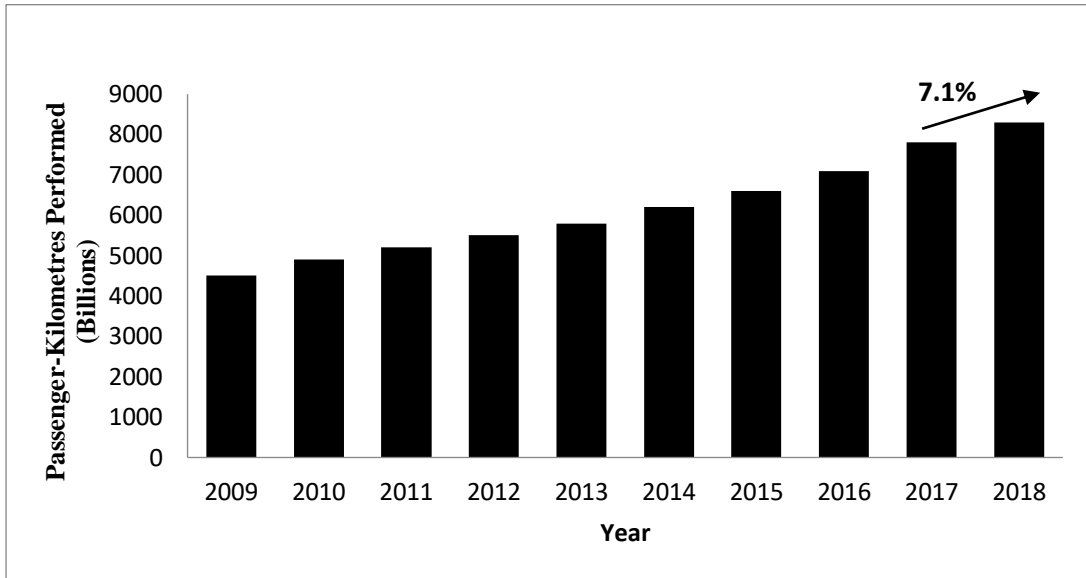
**Figure 2.2: Air traffic trend worldwide**

Aviation has the highest growth rate of all modes of transport. Annual global growth rates of air passenger were approximately 6% in the 1990s and had values of 8% in the 2008s (Whiteleg, 2009). Average growth of vehicles is about 5.6% worldwide from 1970-2008 (Dargay et al., 2009). It shows that the growth of air transport is more than road transport worldwide. Its contribution for the economy is increasing rapidly.

According to ICAO's preliminary compilation of annual global statistics, the total number of passengers carried on scheduled services rose to 4.3 billion in 2018, which is 6.4 per cent higher than the previous year, while the number of departures reached 37.8 million in 2018, (ICAO, 2018). The annual growth rate of Air traffic trend worldwide +7.1% as shown in Figure 2.2.

## 2.4 Air Transport in Nepal

At present there are 56 airports including six under construction. Among these airports, 32 airports are operational with regular air services. International Airport. Tribhuvan International Airport in Kathmandu.Pokhara International Airport, Gautam Buddha International Airport and Nijgadh International Airport are being constructed and converted into the second, third and fourth international airport of Nepal. (CAAN, 2018).

Nepal is a mountainous country and most of the areas in western side are not linked even by road, so the air transport is the one and only mean of transportation. The Government has been demanded to build new airports because of social connectivity. Maintenance of many domestic airports is problematic and new airports are being built under political pressure (ERMC; Pointec, 2013).

Inflow of the domestic air passenger is more than outflow in Tribhuvan International Airport as shown in Figure 2.3. Domestic air passenger had decreased from 8,71,818 to 7,48,391 from 2001 AD to 2002 AD. This may be due to the parliamentary election was held in 2001 AD. Here both outflow and inflow had decreased from 2001 AD to 2002 AD. Then the air traffic touched peak point at 2005 AD and then it decreased at 2006 AD significantly. In 2006 AD, Peace process was established and more people had returned to their home so the inflow decreased from 5, 26,245 in 2005 AD to 4, 26,267 in 2006 AD. Then the domestic air traffic is continuously increasing from 2006 AD to 2010 AD and nearly constant from 2010 AD to 2013 AD and decreases in 2014 AD, 2015 AD due to the parliamentary election and then rapidly increasing from 2016AD to 2018 AD (CAAN, 2018).
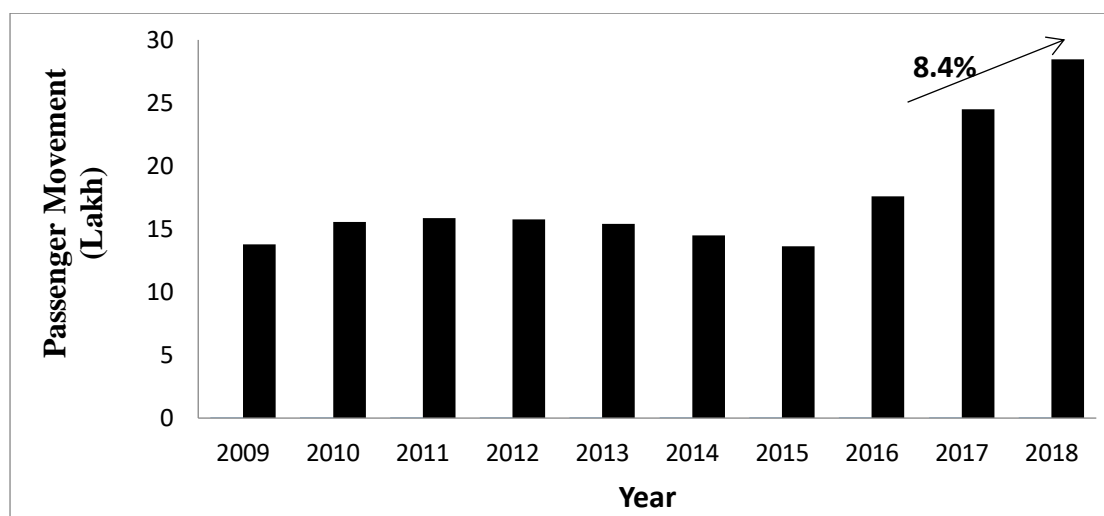


(Source: CAAN, 2018)

**Figure 2.3: Domestic air traffic Flow from 1998 to 2018**

## 2.5 Trend of Air Transport in Nepalgunj Airport

Nepalgunj Airport is the regional hub airport of the mid western region of Nepal. Plane service started in this airport from 1961 AD (CAAN, 2018). This airport also

has a night landing facility. Presently it has flights to Kathmandu, Humla, Jumla, Rara, Dolpa.

The runway of this airport has 1554 m in length and 30 m in width. Runway surface is the bituminous at an elevation of 540 ft from mean sea level (MSL). Figure 2.4 shows the growth of air passengers from 2009 AD to 2018 AD was about 13.17% annually. The minimum passengers was about 78,284 in 2008 AD and maximum passengers was about 4,26,661 in 2018 AD. Below table shows the overall trend of air passengers from Nepalgunj Airport (CAAN, 2018).
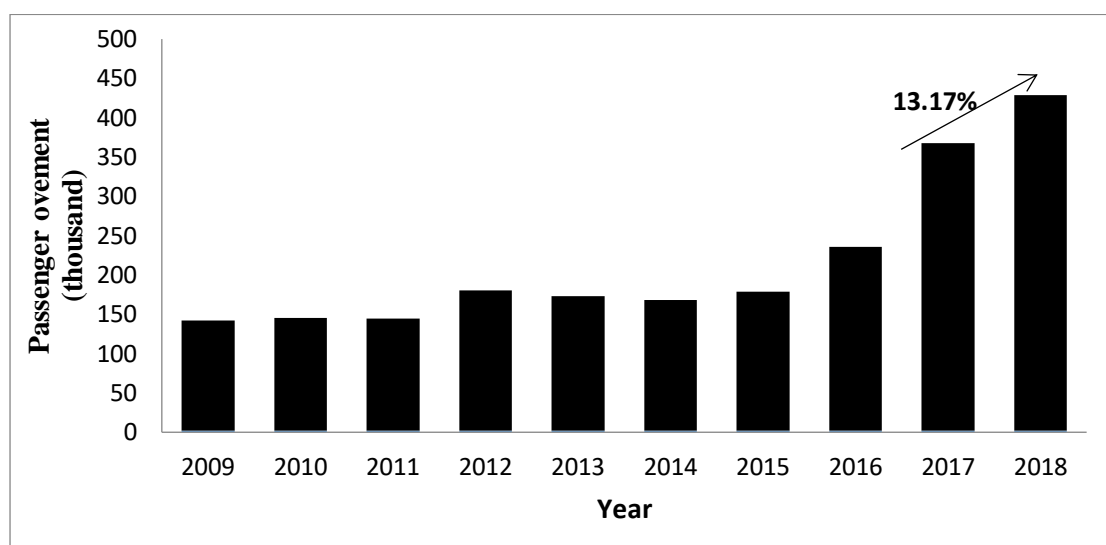


(Source: CAAN Report, 2018)

**Figure 2.4: Trend of air passengers through Nepalgunj Airport**

## 2.6 Trend of Air Transport in Surkhet Airport

Surkhet Airport is the airport of the karnali province of Nepal. a night landing facility (Only five of them are Tribhuwan International Airport, Gautam Budha Airport, Nepalganj Airport, Simara Airport and Biratnagar Airport in Nepal). This airport also has Flights to Jumla, Mugu, Dolpa and Humla but now flights has been closed after the operation of highway. Presently it has flights to Kathmandu only.

The runway of this airport has 1200 m in length and 30 m in width. Runway surface is the bituminous at an elevation of 3,937 ft from mean sea level (MSL). Figure 2.5 shows the air passengers decreases from 2009 AD to 2018 AD was about 2.47% Flightmovement decreases from 2009 AD to 2018 AD was about 10.3% annually.

10

Figure 2.5 shows the overall trend of air passengers and flight from Surkhet Airport (CAAN, 2018).



Passenger 2.47 % decreases and
Flight 10.3 % decreases annually

**Figure 2.5: Trend of air passengers through Surkhet Airport**

## 2.7 Trend of Air Transport in Rara Airport

Mugu is a premier international trekking and mountaineering destination. The opening of the Rara airstrip in 1975 AD spurred tourism in the area, with numbers that rapidly increased due to improved air access, promotion and publicity. Rara is situated at 9,810 ft which is a popular place for visitors to the Himalayas near Rara national park (lake).

Rara Airport lies in mugu district which is the Northen boarder of Jumla district. This airport has bituminous surface and runway has 580 m in length and 20 m in width at an elevation of 9,810 ft from mean sea level. The passengers' growth on this airport is about 26.42% from 2012 AD to 2018 AD as shown in Figure 2.6. Maximum in 2018 AD was about 19,360 and minimum in 2012 AD was about 3,750 numbers of air passengers (CAAN, 2018).
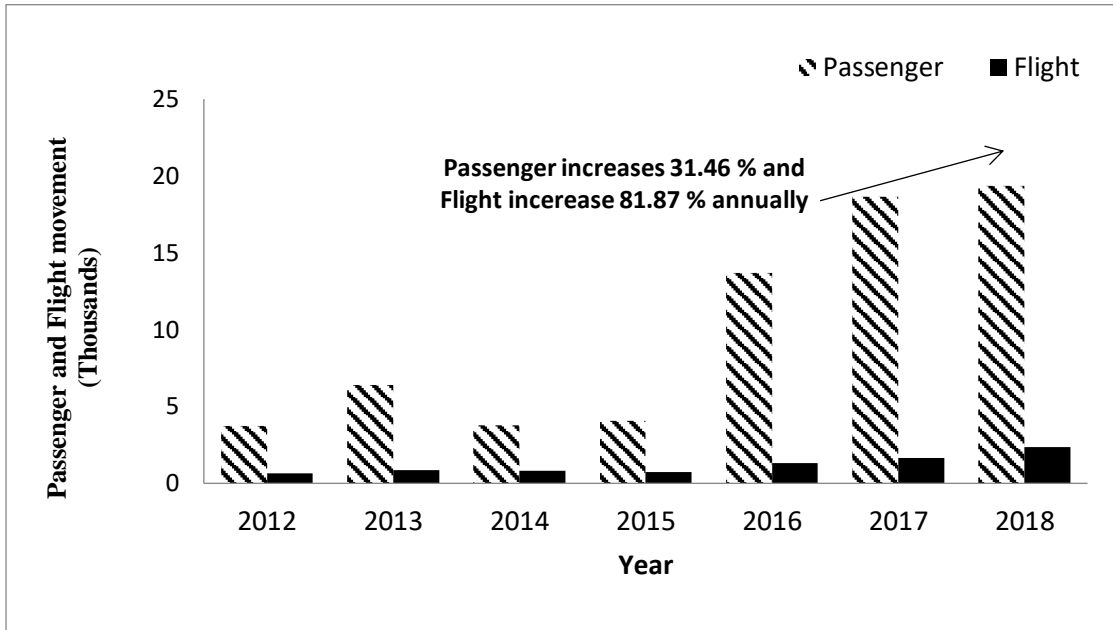
**Figure 2.6: Trend of air passengers through Rara Airport from 2012 to 2018**

## 2.8 Comparison between Air Transport and Road Transport

Transport geography is concerned with the movements that take place over space. The features of this space impose major constraints on transportation systems, in terms of the mode that can be used, the extent of the service, its costs, capacity and reliability (Comtois, 2013). Road transport is undertaken through artificial tracks and ways and involves comparative small investment. It is useful for internal trade and carried on over short distance through surface infrastructures. It has cheap operating and maintenance cost than air transport. One of its most important attributes is the flexibility of route choice, once a network of roads is provided. Road transport has the unique opportunity of providing door to door service for both passengers and freight.

Features such as mountains and valleys have strongly influenced the structure of networks, the cost and feasibility of transportation projects. The main land transport infrastructures are built usually where there are the least physical impediments, such as on plains, along valleys, through mountain passes, or when absolutely necessary through the digging of tunnels (Rodrigue et al., 2013). Road infrastructures

are moderately expensive to provide, but there is a wide divergence of costs, from a gravel road to a multi-lane urban expressway.

Air transport is generally considered the most expensive in terms of infrastructure and equipment (including means of transport – helicopters, fixed wing 'planes, etc.)- Although this is debatable, especially where landing fields are literally fields and the other elements of infrastructure are absent (Sedden, 2012). But this is the fastest both for passenger and goods transport. Air transportation is more valuable for Countries with difficult terrain and large distances between centers of habitation.

Even in developing countries (Chad, Mali, Nepal, Bhutan), air travel is now within the economic and social 'grasp' of a wide range of people (Sedden, 2012). Sometimes air transport can be used as life saving (flying doctors, relief services of all kinds, emergency food supplies and other kinds of equipment). Even in developing countries (like Nepal), there is lively competition between air travel and transport companies and considerable demand, not only among the wealthy but also among the reasonably well-off and, for special purposes the less well-off. The transport, particularly of high-value, low-bulk goods, which may be subject of deterioration over time, is particularly effective by air (Sedden, 2012).

## 2.9 Effect of Socio-demographic Variables on Mode Choice

Travel is typically regarded as a derived demand rather than valuing travel for its own sake. Trip makes are presumed to choose their travel routes and modes on the basis of the cost and convenience of getting from a pre-selected origin to one or more pre-selected destinations (Landis, 2002). Many of the papers reviewed discussed the importance of a range of socio- demographic variables that can influence the choice of travel mode and the frequency of trips. Curtis (2006) mentions various important variables that affect the mode choice which are the following:

- ➢ Gender
- ➢ Age
- ➢ Income
- ➢ Employment status
- ➢ Educational status
- ➢ Household composition

Impact of socio-demographic variables has relationships between travel behavior and variables such as age, gender, household composition, income. Newbold et al (2005) studied the travel behaviours of Canadians aged 65 years or more to determine if their travel patterns were different from younger Canadians. Older Canadians do make fewer daily trips than younger Canadians but this could be caused by the fact that the participants in the study were no longer employed and hence were no longer making travel-to-work journeys. Thus daily trip numbers and duration decreased significantly due to changes in employment and health status.

Overall the author found that there were significant differences in the total number of trips or distances travelled between older and younger. They found that older people made fewer journeys than younger.

**2.10 Trip Making Charateristics**

Given a particular socioeconomic activity system, the demand for travel manifests itself in terms of trips made at given times by individuals from point to point within the urban area. Miller (2001) mentions the number of attributes of trip making charateristics as follows.

**a) Characteristics of the trip maker**

The characteristics of the trip makers are Car availability and/or ownership, Household structure (Student, Businessman, retired, singles, etc.), Income and ResidenNepalgunjl density (number of members in a family)

**b) Characteristics of the journey**

The Characteristics of the journey areThe trip purpose and Time of the day when the journey is undertaken.

**c) Characteristics of the transport facility.**

The Characteristics of the transport facility are Relative travel time: in-vehicle, waiting and walking times by each mode, Relative monetary costs (fares, fuel and direct costs), Comfort and convenience, Reliability and regularity and Protection, security

**2.11 Factors affecting Mode Choice**

A high level of satisfaction with public transportation services reflects public confidence and the willingness of people to use the service. It is also an important performance measure for transport service providers and a determinant of mode choice. However, determining the level of satisfaction is not easy because of the complicated and unique characteristics of travelers. People tend to be satisfied when their perceptions of the service they receive match their expectations(Takano, 2008).

According to Takano (2008), when the service falls short of their expectations, they tend to be dissatisfied. Different factors such as efficiency, reliability of the service and responsiveness of the service provider contribute to people's perceptions and levels of satisfaction with service. The absence of some of these factors can have a strong impact on dissatisfaction levels, while the presence of others may sometimes be taken for granted; hence better service may always not lead to higher satisfaction levels. Moreover, people may be willing to tolerate small variations in some of these factors without any impact upon their level of satisfaction with service.

Mode choice models typically specify level-of service attributes such as travel time, cost, access time, wait time or headway, and transfers. These attributes are considered strong predictors of mode choice, and they are also readily quantifiable, making it easier to measure their importance to travelers and to incorporate them in travel models (Outwater et al., 2014).

Todd (2013) indicates that the prices are the direct, perceived costs of using a good. Transport prices can include monetary (money) costs, plus travel time, discomfort and risk. Price changes can affect trip frequency, route, mode, destination, scheduling, vehicle type, parking location, type of service selected, and location decisions. Transport price affect transport activity, including changes in fuel prices, road tolls, parking fees, fares, and transport service quality, for various modes, user groups and travel conditions. Although these impacts vary widely, it is possible to identify certain patterns which allow these relationships to be modeled. Todd (2013) states some examples of relation between cost and travel pattern which is given as below.

- Transport pricing impacts can vary, including changes in trip generation, mode, destination, route, vehicle type and parking location. Pricing of one mode or service can affect demand of others.
- Higher value travel, such as business and commute travel, tend to be less price sensitive than lower value travel.
- Wealthy people tend to be less sensitive to pricing and more sensitive to service quality than lower-income people.
- Travel tends to be more prices sensitive if travelers have better travel options.
- Motorists tend to be particularly sensitive to road tolls and parking fees.

The cost of transportation adds to the cost of the goods so it should always be kept in mind. Rail transport is comparatively a cheaper mode of transport for carrying heavy and bulky traffic over long distances. Motor transport saves packing and handling costs. Motor transport is suitable for carrying small consignments over short distances. Air transport is suited to light and precious articles which are to be delivered quickly.

Those who travel a lot by airplane may be more likely to drive a comfortable or expensive car (luxury category) because both characteristics are indicative of a high-income lifestyle, or because frequent flyers may place a higher value on comfort and time while traveling. One could also speculate that vehicle type affects objective mobility as well. Those who dislike travel may be more likely to use a larger and more comfortable car (large and luxury categories) to make the unpleasantness of travel more palatable, whereas those who like their travel may prefer similar kinds of cars, to make their travel even more enjoyable (Choo & Mokhtarian, 2004).

Choo and Mokgtarina (2004) indicate that choosing a vehicle often pays extra for features such as in-vehicle navigation systems, better sound systems and optional safety devices. They sometimes pay extra for more convenient parking or even for better roads (such as a toll road). Similarly, commercial airline passengers are often paid significantly more for first class service that offers increased convenience, comfort and prestige (airport waiting areas, larger seats, personal service) although it does not significantly increase travel speed or reduce delay.

For older adolescents, choosing between transport modes for travelling short distances to various destinations is not influenced by one factor, but by a combination of factors which influence each other. Since driving a car is not yet an option, cycling has the most advantages for older adolescents. It is a fast transport mode, it offers a lot of freedom to go to many places at all times and they can easily cycle together with friends. No bicycle storage at the destination and snow and ice on cycling paths are barriers for cycling. On the other hand, walking is only practical for very short distances. Driving a moped also offers advantages such as a fast travel time, autonomy and the social aspect, but the financial costs are a serious barrier. Furthermore, public transport has a lot of disadvantages such as a long travel time and little freedom and flexibility. Health benefits and the ecological aspects are not essenNepalgunjl factors in choosing between transport modes for older adolescents. If quantitative studies in a representative sample of older adolescents can confirm these findings, researchers should take these factors into account when developing interventions to enhance active transport over short distances to various destinations in older adolescents (Clarys et al., 2013).

Ashlatha (2013) had modeled the mode choice behavior of commuters in trip-makers in Thiruvananthapuram (Trivandrum) city using the multinomial logistic approach (multinomial logit model) with help of the SPSS software (Statistical Package of Social Sciences). The Cochran formula was used to estimate the number of sample to be collected, by which they had decided to collect the 739 samples. The questionnaire was designed for home interview of the commuters. The socio-economic variables, transport system variables, and attitudinal variables were considered in the model. Three categories of transport, viz. Two-wheeler, Bus, and Car were considered in MNL model for mode choice, in which the bus was considered as reference category.

According to Davies (2015), compared to a train, tram or bus, cars offer a lot of privacy and control: they're available on-demand, go directly to the driver's destination, are in most cases considerably faster, and are only shared by invitation. Car ownership usually costs more in terms of cash outlays than public transport, but people with a high standard of living are prepared to pay the price. But public transport can't ever be made as private as a car.

Thomas (2016) has also modeled the mode choice of the commuters in Tiruchirapalli city. 10500 people were interviewed with the designed questionnaire by home interview method, in which, the questions related to household characteristics, personal information of individual, information of trips of individual in weekdays as well as weekends, trip frequency, and preference of mode. MNL model was used to model the mode choice. The NLOGIT software was used for modeling the mode choice behavior of commuters. The data was analyzed and the model was formed by the data. The model was found fairly accurate, and maximum use of two-wheeler was there.

Karli (2017) has modeled the work trips in wards in the West zone of Ahmedabad city. Three wards of west zone, namely Navrangpura, Vasna and Paldi were selected as study area. The income groups (LIG, MIG, and HIG) were considered, and the main focus in the study was on workers and students. The MNL model was used for modeling of the trips, which was formed by SPSS. The model was found to be fair accurate, as there was not much difference in percentage use of modes before and after development of model.

Tushara (2013) has modeled the mode choice for the work trips in the Calicut city in Kerala. The study was done to identify the various variables affecting the mode choice of employees and to develop a model for mode choice in work trips. The model was formed for three types of modes: Car, Bus, and Two-wheeler, where the two-wheeler was taken as a reference category. By this, the main factors affecting the work trips in the study area were age, gender, income, time, two-wheeler ownership, trip time and cost. Maximum employees, who possessed the driver license, and aged in between 18-35, and included in middle income group, were using the two-wheeler.

Ram Chandra (2016) has modeled the mode choice of regular commuters on a stretch between Park Circus and Garia, situated in Kolkata city. Mode choice was modeled for three modes - Public transit, Intermediate Para transit, and Private transport.. The travel time, travel cost and waiting time were taken for utility function. The MNL model was formed, which was showing that 82% of the trip-makers in the study area were using bus (public transport), whereas, the usage of private vehicle was only 1%.

Adhikari, M.P. (2015) has completed masters thesis from Pokhara University, Nepal Engineering College, aboutthe effect of road on number of air passenger from Sankhuwasabha to Kathmandu.This study follows the analytical and descriptive approach in which the view of concerned key personal and primary and secondary data analysis has been incorporated.Most of the people reach Kathmandu for the education. Most of the people think that they choose plane, giving consideration to comfort. The major factors are cost, time, health, comfort and safety while choosing transport modes. Study has concluded that there is no effect of road operation on air traffic from Sankhuwasabha to Kathmandu as the growth rate of air traffic is nearly equal before and after operation of road.

## 2.12 Sampling and Data Collection

**Travel Survey Types**

The estimation of mode choice models requires collecting of travel and trip related (including the actual mode choice of the traveler). These data are generally obtained by surveying a sample of travelers from the population of interest. The most common types of surveying methods are household, workplace and intercept surveys (Koppelman, 2006).

**Sampling Methods**

Sample generation is regarded as a vital step in travel demand modeling since the modal split models are generally estimated using the data collected by surveying a sample of respondents from the targeted population. Therefore, it is essential that the sample generated for the research is representative of the characteristics of the population of the study area. Inappropriate sample generation can lead to erroneous modeling results involving biased estimated coefficients and non-representative travel behavior forecasts**.** Sampling may be simple random sampling, Stratified random sampling, Cluster Sampling, and systematic Sampling..

## 2.13 Utility equation for mode choice model

The logit model is based on the utility or disutility of any mode. The utility equation can be explained as: (Nisarg Desai et. al 2018)

$U_i = V_{ij} + \varepsilon_{ij}$ …………………………(1)

In this, the Uij means "Utility which a trip-maker in zone "i" gets by using the mode "j", Vij means the utility or disutility of the average trip maker, and εij is the uncertain factors/unobserved part of utility function. The utility equation (equation (2)) can be explained as:

$$U = a0 + a1x1 + a2x2 + \ldots + an.xn \ldots\ldots\ldots\ldots\ldots(2)$$

Where, a0 = mode specific attribute,

x1, x2,…xn = criterion considered for mode choice

a1, a2, ….an = weight factors for the criteria

The utility based model is used for estimation of the modal share or probability of choosing a particular mode. The probability of choosing any mode for travel by a particular trip maker can be calculated by the equation (3):

$$Pi = eUi / \sum_{i=1}^{n} e^{Ui} \ldots\ldots\ldots\ldots\ldots(3)$$

Where,

Pi = Probability of choosing "i" th mode from "n" number of modes for travelling.

Ui = Utility of $i^{th}$ mode

# CHAPTER THREE: METHODOLOGY

## 3.1 Study Area

The area for this study is Jumla, a part of Karnali province, is one out of ten districts of Karnali. The district, with Jumla as its district headquarters, covers an area of 2,531 square kilometres and had a population of 1,08,921 in 2011 Nepal census.

## 3.2 Jumla District

Jumla is a mountainous district of Karnali province . The district is located in the belt of Tila River. It is bordered with Dolpa districts in the east, Kalikot district in the west, Jajarkot district in the south and Mugu district in the north. The literacy rate is about 54.7% of the total population (CBS, 2011). The demographic situation of the district is shown in Table 3.1.

The topographical setting of the district constitutes small hill, valley plain, river basin, rivers, high hill and mountain. Geographically the district is divided into three distinct regions from north to south, viz higher Himalayan region, Higher Mountain and Mid Mountains. The district headquarter is Khalnga located at mid-hill valley of the district at an elevation of 1000 m from mean sea level. The district is divided into one municipality and seven rural municipality.

The district is endowed with historical base, tourism potential, mountainous topography and natural resources. The Rara National park in the north part and Shey-Phoksundo National park in the east part has enhanced the potential of tourism development. The study area is shown in Figure 3.1 below.

Table 3. 1: Demography of Jumla district

| Population in 1991(Number) | 75,964 |
|---|---|
| Population in 2001(Number) | 89,427 |
| Total population in 2011(Number) | 1,08,921 |
| Total household in 2011(Number) | 18,328 |
| Population density(per sq.km) | 43 per sq.km |
| Literacy Rate (Percentage) | 54.7 % |

(Source: CBS, 2011)
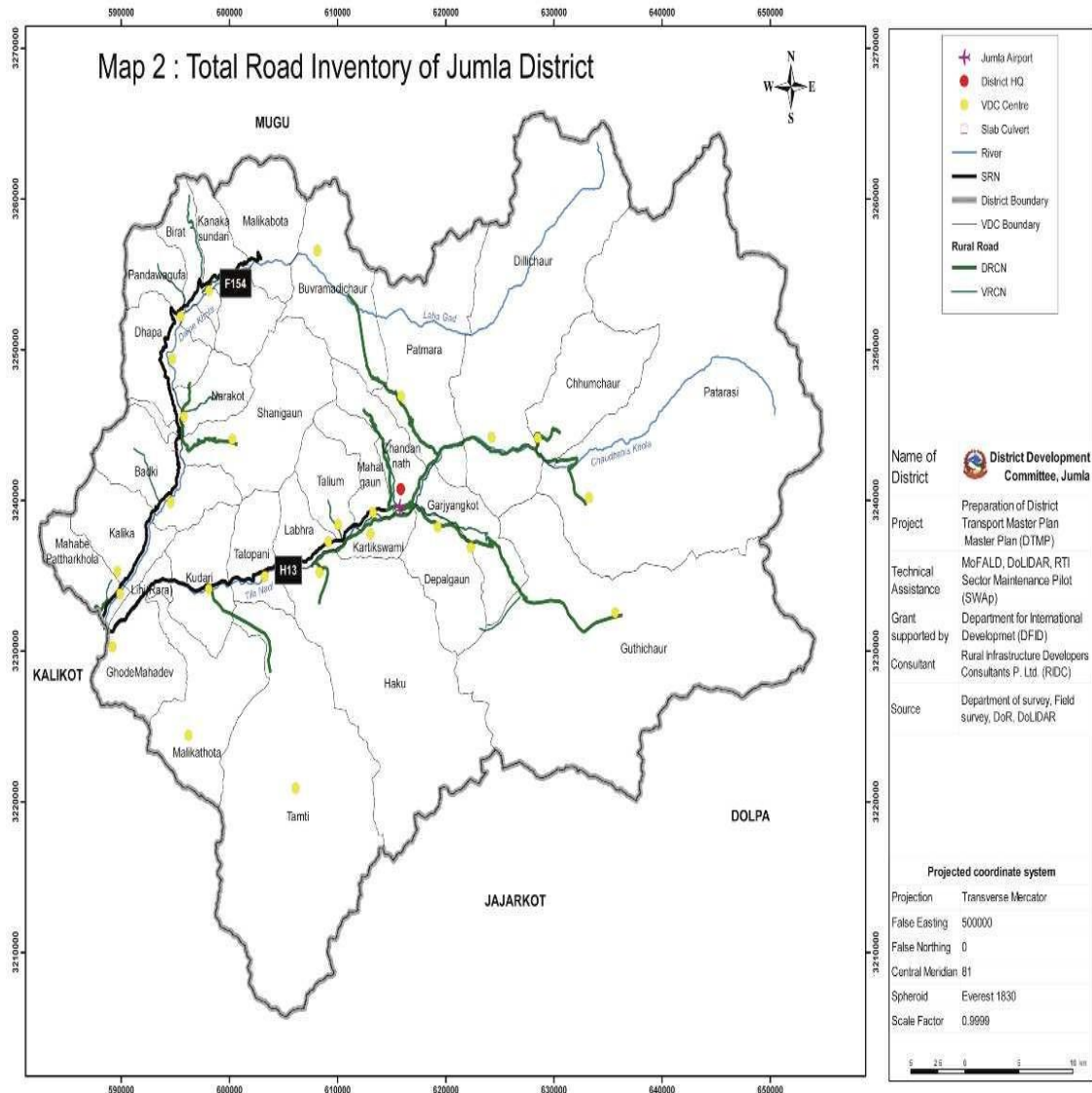
(Source: DTMP, Jumla, 2013)

**Figure 3.1: Study area**

## Jumla Airport

Jumla Airport is located in the Karnali province at an altitude of 7700 ft above mean sea level in Jumla district (DDC,Jumla, 2013). It is the gateway to Jumla Khalanga (valley), Rara Lake, Rara national park, a famous tourist destination of Nepal, lies in the Jumla district. The Rara National Park and Other historical places are famous for its natural beauty and bio-diversity. This airport plays a vital role for trade and tourism development as well as positive contribution to socio-economic development of the entire region. Air sservice is still main transportation mean for this district with regular glights to Nepalgunj available at all seasons.

22

## 3.3 Strategic road network in Jumla

Karnali highway having length 233 km commences from Birendranagar, surkhet and connected to NPJ by Ratna Highway (113km) .The Karnali Highway lies in the Karnali Region, north-west of Kathmandu. The highway is the link between the towns of Surkhet and Jumla, and goes on as a dirt road from Nagma to Talcha. The Karnali Region is the most remote and least developed zone in Nepal.

Karnali Highway also referred to as H13 is a highway, and is a vital transport link between two regions in Nepal.The Karnali Highway is already considered to be one of the most dangerous roads in the world by many. For us it was the most dangerous road we have ever encountered.

Table 3. 2: Strategic road network in Jumla

| Code | Name of Road | Total Length (KM) | Erthen (KM) |
|------|--------------|-------------------|-------------|
| H | Surkhet-Jumla Road (Nagmaghat – Khalanga Sector) | 32 | 32 |
| F | Nagmaghat – Mugu Road (Nagmaghat – Malika bota Daaba Sector) | 51 | 51 |
| Total | | 83 | 83 |

## 3.4 Research Design

The nature of research methodology is a combination of exploratory and descriptive. A quantitative technique is also applied for further explanations. This study is designed to explore existing transportation situation of study area, traffic trend from Jumla to Nepalgunj, trip characteristics and factors affecting mode choice.

## 3.5 Research Methodology

The approach of study is carried out by literature reviews, development of survey tools and study framework, primary and secondary data collection, data compilation, analysis, discussion, conclusion and recommendations. The process of research is presented in Figure 3.2.

```
                                    ┌──────────────────────────┐
                                    │ Problem Identification   │
                                    └──────────────────────────┘
                                                │
                                    ┌──────────────────────────┐
                                    │ Objectives Formulation   │
                                    └──────────────────────────┘
                                                │
                                    ┌──────────────────────────┐
                                    │  Study area Selection    │
                                    └──────────────────────────┘
                                                │
    ┌──────────────┐                ┌──────────────────────────┐
    │ Literature   │                │  Theoretical Framework   │
    │ Review       │                └──────────────────────────┘
    └──────────────┘                            │
                                    ┌──────────────────────────┐
                                    │    Data Collection       │
                                    └──────────────────────────┘
                                                │
                                    ┌──────────────────────────┐
                                    │ Data Checking, Compilation and │
                                    │          Entry           │
                                    └──────────────────────────┘
                                                │
                                    ┌──────────────────────────┐
                                    │     Data Analysis        │
                                    └──────────────────────────┘
                                                │
                                    ┌──────────────────────────┐
                                    │  Results and Discussion  │
                                    └──────────────────────────┘
                                                │
                                    ┌──────────────────────────┐
                                    │     Conclusions and      │
                                    │    Recommendations       │
                                    └──────────────────────────┘
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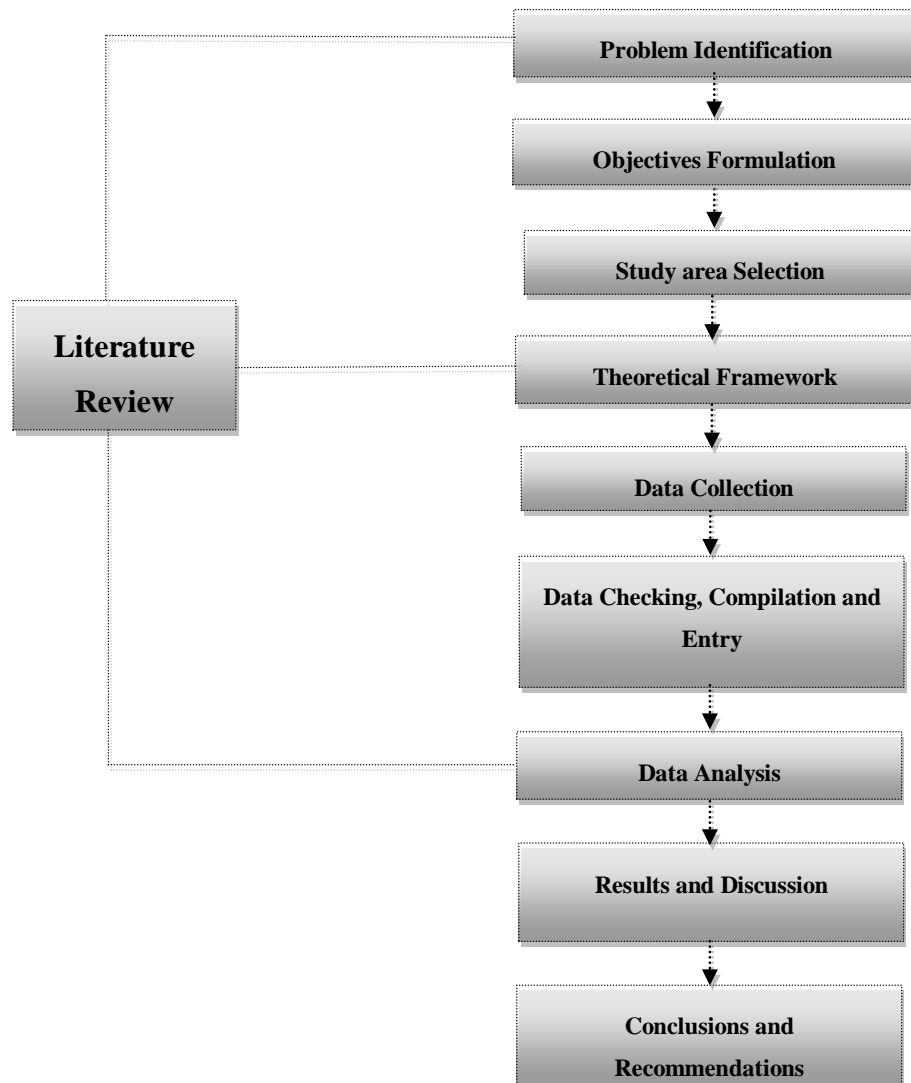
**Figure 3.2: Research Process**

## 3.6 Sample Size Determination

Survey is intended to estimate the true value of one or more population characteristics. In order to draw inference from a sample, that will accurately reflect the population careful attention must be given to determine the needed sample size. Several efforts were made and implemented to determine the minimum sample size that accurately reflects the population characteristics. The central limit theorem is on the heart of these efforts. The minimum sample size was calculated using the following equation (Kish, 1965).

ꞨȠ = n÷ [1+ (ñ÷N)]………………………………………………………..(4)

Where,

N is a total number of populations

Ƞ is a sample size from finite population

n is a sample size from infinite population

The Sample size from infinite population can be calculated using the following equation

n = $S^2$/ se $(\bar{x})^2$………………………………………………….........(5)

Where,

$S^2$ is the variance of the population element.

se $(\bar{x})$ is the standard error of sampling population.

For 95% confidence level and 10% error the sample size can be calculated as a function of coefficient of variation *CV*.

Se $(\bar{x}) = 0.1\mu/1.96 = 0.051\mu$

$\bar{n} = \left(\frac{S}{.051}\mu\right)^2 = 384 \ CV^2$…..…………………………………………(6)

As the value of n is very small comparing with N thus the ratio of (n÷N) is very small. So the sample size of finite population Ƞ can be taken as the same value of n . For *CV* = 1 the minimum sample size is 384.

About 420 numbers of questionnaires were distributed to the field. Among these questionnaire only 401 number s were responded by people which is more than the minimum sample size obtain from the Kish formula. The random sample method was adopted in this study.

Key informants were selected from Transport entrepreneur of Jumla, Office of District Development Committee and Trekking agencies.

### 3.7 Data Collection

Information was collected both from primary and secondary sources.

**Primary Data**

The primary data were collected through different methods and techniques such as survey and observations. Quantitative and qualitative data were collected. The survey included questionnaire survey with the people of study area and key informant interviews with the relevant agencies.

The questionnaire survey was carried out with 401 people in Khandabari, Jumla and Chainpur of Jumla district. All these places are accompanied with the major settlement of Jumla district.

The questionnaire had divided into three parts:

> ➢ Demographics, the questioner item correspondent to village they live, age, gender, job, family size and income.
> ➢ Trip characteristics covered the travel behavior of individual for his/her daily trips such as (the mode usually used, annual frequency, and travel cost and travel time from study zone to Nepalgunj.
> ➢ This focuses on the factors that affect the mode choice. The respondents were asked to indicate their perception on the importance of well organized factors that affect the choice of transportation mode for trips from study zone to Nepalgunj. These variables are: travel cost, travel time, comfort, health status, security and trip privacy.

The major information from the key informant survey includes the existing transportation situation of Jumla district, travel trend before and after the operation of highway, status of existing road condition as well as the views and opinions for the future of the airline and road transport service in Jumla.

The questionnaires and checklists used for the data collection are presented in Appendix A. The Key informant survey was carried out with 4 people from different agencies. Check list of key informants' survey is presented in Appendix B.

**Secondary Data**

Air traffic data between Jumla Airport and Nepalgunj Airport was collected directly from section of Nepalgunj Airport civil aviation office. The domestic air traffic flow data was obtained from CAAN annual report which is presented in Appendix D. Road

transport data was collected from the transport entrepreneurs of the Jumla district and these data are Shown in Appendix E . Remaining data were collected through DoR, DDC Jumla, various websites, documents/reports, journals and Published and unpublished reports.

## 3.8 Data Analysis

Primary and secondary data from various sources were processed and analyzed. Microsoft excel was used for data processing and analyzing. The Binary logit model was developed by SPSS software. Microsoft excel was used for model validation.

## 3.9 Model Analysis

Data was analysed and model developed by SPSS software, after entering the data in software. The mode used was considered as the dependent variables and independent variables

1. Dependent variable:
    - Plane
    - Bus
2. Independent variables:
    - Gender: Male and Female
    - Age
    - Income
    - Education: Slc, Inter, Bachelor, Master and No study
    - Profession: Agriculture, Student, Business and Service
    - Trip frequency: Once a year and More than one time in a year
    - Easiness to get plane ticket: Easy and Difficult
    - Convenient season: winter and any time
    - Trip purpose: Study, Business, Visiting doctors/clinic and Visiting friends/relatives

The utility equation of the model was as following:

U = a0 + a1[Gender] + a2[Age] + a3[Income] + a4[Education] + a5[Profession] + a6 [Trip_frequency] + a7[Easiness_to_get_plane_ticket] + a8[Trip_Purpose] + a9 [Convenient_Season]………..……………...………(7)

# CHAPTER FOUR: RESULTS AND DISCUSSION

## 4.1 Transportation Situation in the Influence Area of the Jumla Airport

This chapter gives an overview of the transportation situation in the influenced area by Jumla Airport in Jumla district. One municipality and Seven Rural munucipality in Jumla district are taken as the influence area by Jumla Airport was found out by the respondents participated in the questionnaire survey that either used the Jumla Airport or highway to reach Nepalgunj. These influenced area had verified by the interview with key informants.

### 4.1.1 Jumla Airport

Jumla is located in the lap of Chandannath Municipality in Jumla district. It is the deepest valley and biggest Tar of Nepal. Many newly constructed district roads join to these strategic road networks have improved the accessibility of remote areas of Jumla.

According to the questionnaire survey 69.3% of the respondents go to Jumla by vehicles and 30.7% by walking. Most of the villages are connected to Jumla Airport by rural roads so that more people use vehicles to reach Jumla Airport. According to the key informants, before the construction of road, it was very difficult to walk for old people, woman and children. Now availability of jeep and motor cycle has made people to feel comfort to reach Jumla Airport.

### 4.1.2 Road Transportation in Jumla District

Jumla district has an estimated road network of 337.28 kilometres, including 83 km of strategic roads managed by DOR and 281 km of rural roads managed by Jumla DDC and the VDCs. Most of the strategic roads and all of the rural roads have an earthen surface.

Jumla district has one major feeder highway starts from Basantapur and ends at Num having 136 km total in length, which is aimed to connect Basantapur with Kimathanka on north part of district. 82.7 km of road section is black top and remaining 9.3 km and 44 km are gravel and earthen respectively.

The description of National highway and feeder road has shown in Table 4.1.

Table 4. 1: National Highways and Feeder Roads in Jumla district (km)

| Code | Description | Total length | Earthen |
|------|-------------|--------------|---------|
| H | Surkhet-Jumla (NagmaghatKhalang) | 32.00 | 32.00 |
| F | Nagmaghat-Mugu (Nagmaghat-Malika) | 51.00 | 51.00 |
| | Total | 83.00 | 83.00 |

(Source: DTMP, 2013)

As part of the preparation of this DTMP, the District Road Core Network (DRCN) was identified together with the DTICC and DDC. This DRCN is the minimum network that allows all VDC headquarters to be connected with the strategic road network and the district headquarters, either directly or through other VDCs. In the selection of the DRCN roads, account was taken of the road conditions and the existing traffic levels.

Table 4. 2: Road length in Jumla District (km)

| Road Class | Earthen Road (km) | Total (km) |
|------------|-------------------|------------|
| **Strategic Road Network** | 83.00 | 83.00 |
| Highways | 32.00 | 32.00 |
| Feeder Roads | 51.00 | 51.00 |
| Dristict Road Core Network | 116.38 | 116.38 |
| Village Roads | 67.30 | 67.30 |
| Total | 266.68 | 266.68 |

(Source: DTMP, 2013)

## 4.2 General Analysis of Data

IniNepalgunjlly frequency tables were obtained on a whole datasets to determine the distribution of travelers for various travel and socioeconomic characteristics. The results of this analysis are summarized in the form of frequency tables.

### 4.2.1 Gender of Respondents

The distribution of travelers for theirgender can be seen in Figure 4.1. As can be seen in the figure about 72.82% of the respondents are male and 27.18% are female. It indicates that male is the active trip maker than female.
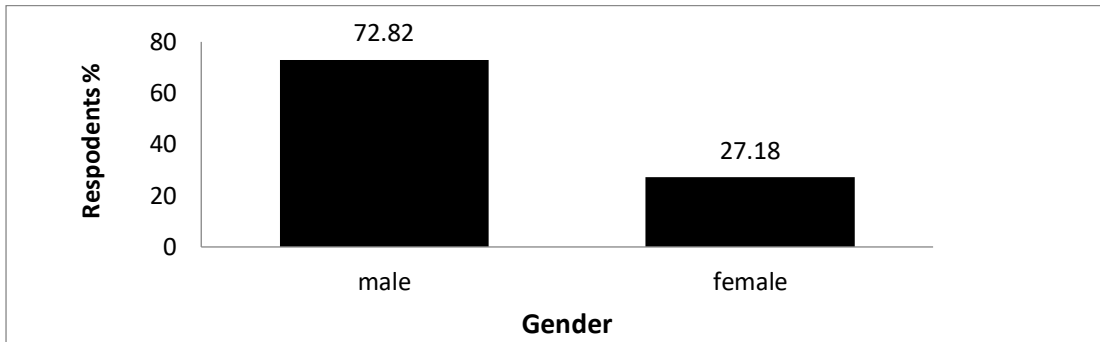
**Figure 4.1: Respondent's gender**

Majority of respondents are male because of the social belief that female should not leave home and male should leave home to manage his family. Male are comparitively educated, creative and skilllfull than female.

### 4.2.2 Age of Respondents

The distribution of respondents' age is presented in Figure 4.2. As it can be seen in the figure 26-35 years represents about 38.90% of the whole sample. A small percent of respondents lies more than 56 years old which represents about 2.65% of the total samples.
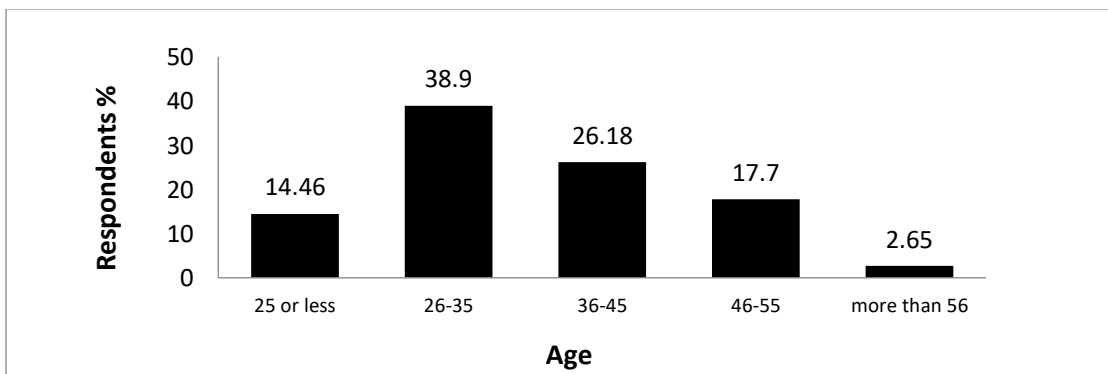
**Figure 4.2: Respondent's age**

The large percent of respondents lies in the age of category of 26-35 because of higher education, visiting doctors/clinic, visiting friends/relatives and business.

### 4.2.3 Job of Respondents

The distribution of respondents' job can be seen in Figure 4.3. The results reported in the figure shows that more respondents are students which are about 42.39% of the whole respondents.
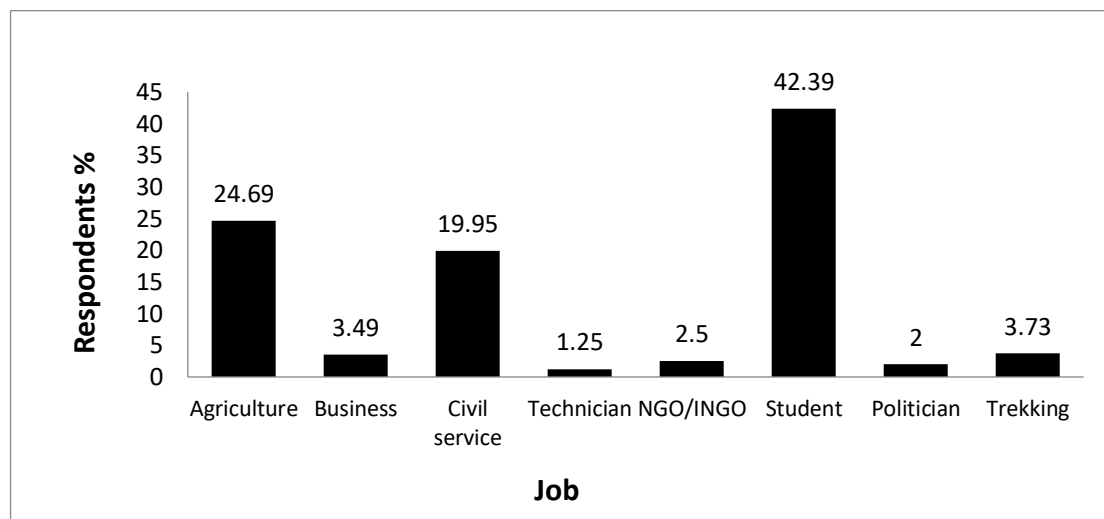


(Source: Travel Preference Survey, 2018)

**Figure 4.3: Respondent's job**

More respondents are studentsbecause of higher education, business and other service. Jumla district has not hgher level of educational organzation and other job oppurtinity.

### 4.2.4 Permanent Address of Respondents

Most of the respondents are from the Chandannath Municipality of Jumla where the Jumla Airport is situated. The distribution of respondents' permanent address can be seen in appendix C. About 14.96% of respondents live in Chandannath Municipality. All the respondents cover 7 Rural Municipality having 50 wards of Jumla districts

### 4.2.5 Average Monthly Income of Respondents

The distribution of respondents' average family monthly income can be seen in Figure 4.4. No income is about 54.36% of the whole sample. Similarly 9.5% respondents have NRS 10,000.00-20,000.00 and 10.22% people have monthly income less than NRS 10,000.00.
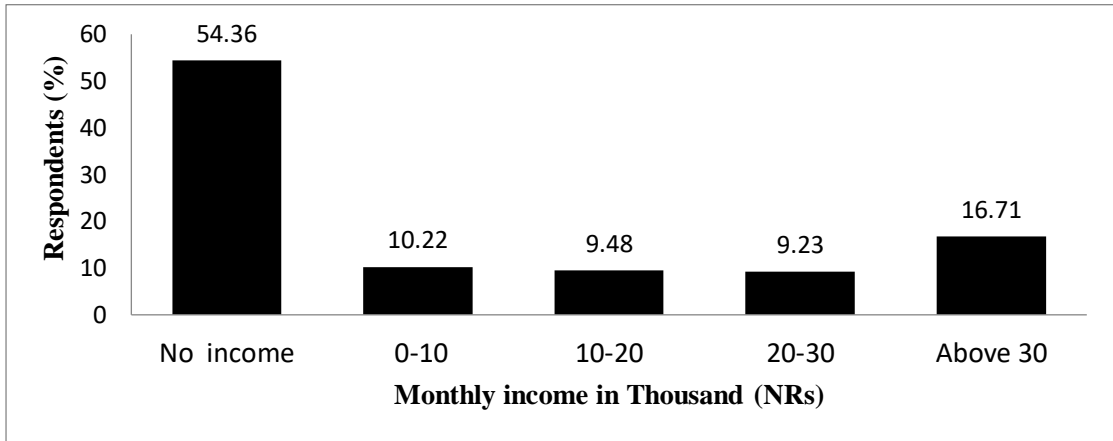
**Figure 4.4: Respondent's monthly income**

The results shows the majority of respondents are student and other some repondents so they have not monthly income and they are depend on their family income for their trip.

### 4.2.6 Level of Education

The distribution of respondents' level of education was presented in Figure 4.5. As can be seen in the figure 38.9% of the respondents are from slc, it means that majority of responedents are SLC level. 36.2 % are from Intermediate level and 0.7% respondents are from above the masters level.
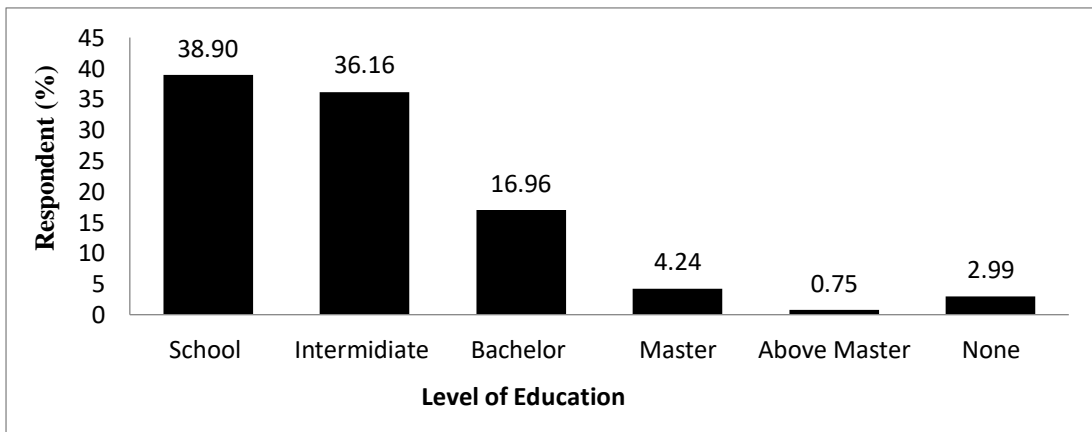
**Figure 4.5: Respondent's level of education**

Most of the people of Jumla district have Slc level of education. So majority of respondents is Slc, because of pepole are lacking of higher education.

### 4.2.7 Family Size of Respondents

The distribution of respondents' family size is presented in Figure 4.6. The collected data is categorized into three categories. The result shows that the majority of people have a family size between 4-6 members which represents about 57.1% of the whole sample. While the people with a family size bigger than 7 members represents about 36.5 % of the sample. The average family size of the respondents is about 6.04 as shown in Figure 4.6.
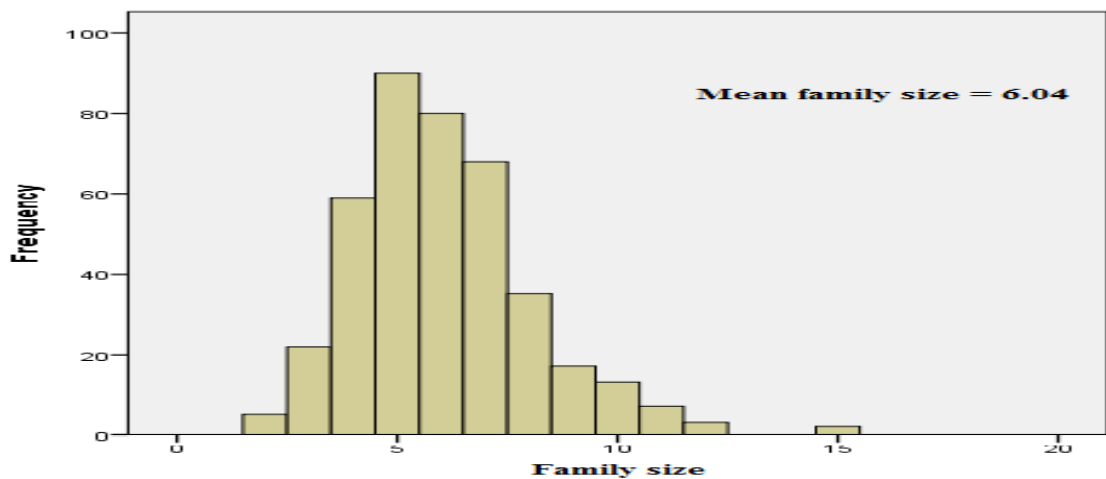


(Source: Travel Preference Survey, 2018)

**Figure 4. 6: Respondent's family size**

Most of the people in Jumla district have joint family of large size. The majority of people have a family size between 4-6 members because people have low education and lack of awareness and knowledge.

### 4.3 Travel Characteristics in Influence Area

Travel characteristics suggest how individual and household may affect travel pattern on the basis of questionnaire survey. This describes the annual family trips to Nepalgunj, purpose of trip to Nepalgunj, mode of transport use, ticket availability and willingness to pay for bus and airlines fair charge and travel trend before and after operation of highway.

### 4.3.1 Number of Family Trips to Nepalgunj

One fifth of the respondents in the sample never go to Nepalgunj. The distributions of respondents' family trips are presented in Figure 4.7. About 12.95% respondents make more than three trips to Nepalgunj in a year and 3.75% of the respondents visit Nepalgunj every month.
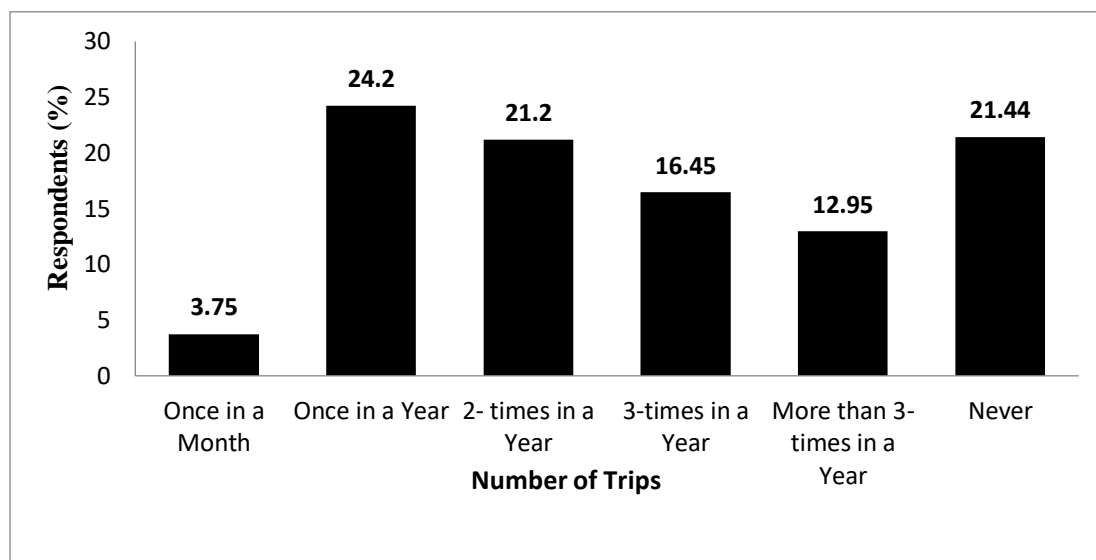


(Source: Travel Preference Survey, 2018)

**Figure 4.7: Number of family trips to Nepalgunj**

The Figure 4.7 shows that the majority of the people go to Nepalgunj for once in a year which represents about 24.2% of the whole sample. Similarly people make trip two times in a year is about 21.2% and three times in a year is about 16.45%.

Because of the difficult, more expensive, unsafe and time expenses journey, most of the people travel once a year. According to the key informants, more people go to Nepalgunj one or two times in a year as the people respond in this question.

### 4.3.2 Purpose of Trip to Nepalgunj

The distribution of respondents' purpose of trip to Nepalgunj is presented in Figure 4.8. 25.43% of the respondents go to Nepalgunj for higher study.
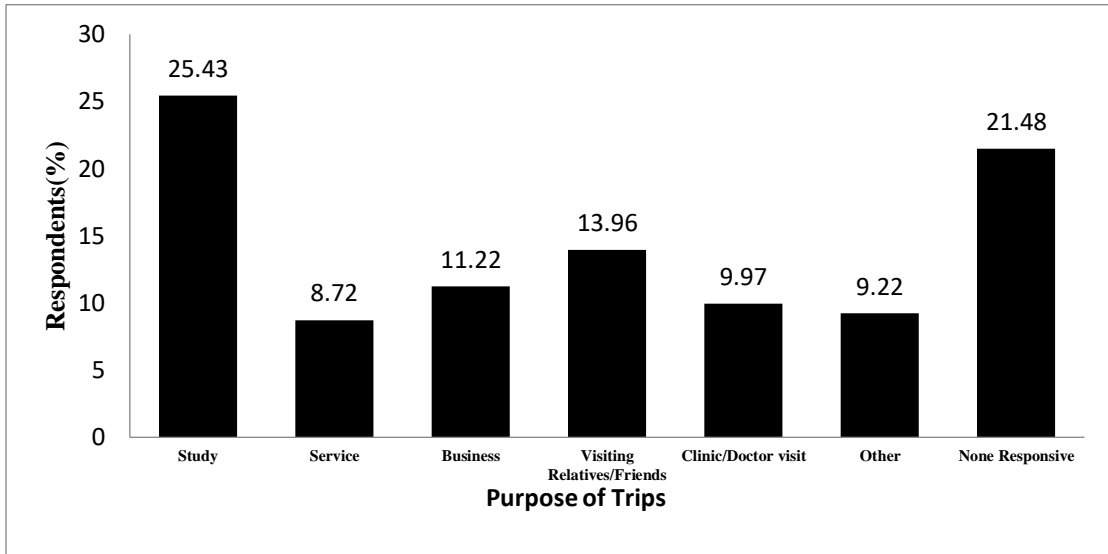
(Source: Travel Preference Survey, 2018)

**Figure 4.8: Purpose of trip to Nepalgunj**

Most of the respondents are student for higher education due to lack of higher educational organization.

### 4.3.3 The Mode of Transport usually used by the Respondents

The distribution of the various modes that are normally used by the respondents was reported in Figure 4.9. About 24.97% people don't respond the questions. Most of them who don't respond this question are not visiting to Nepalgunj as in Figure 4.9.in which 21.44% people said that they never go to Nepalgunj. As can be seen from the table below the large percent of the respondents (50.12%) mostly used both modes of transport according to situation.
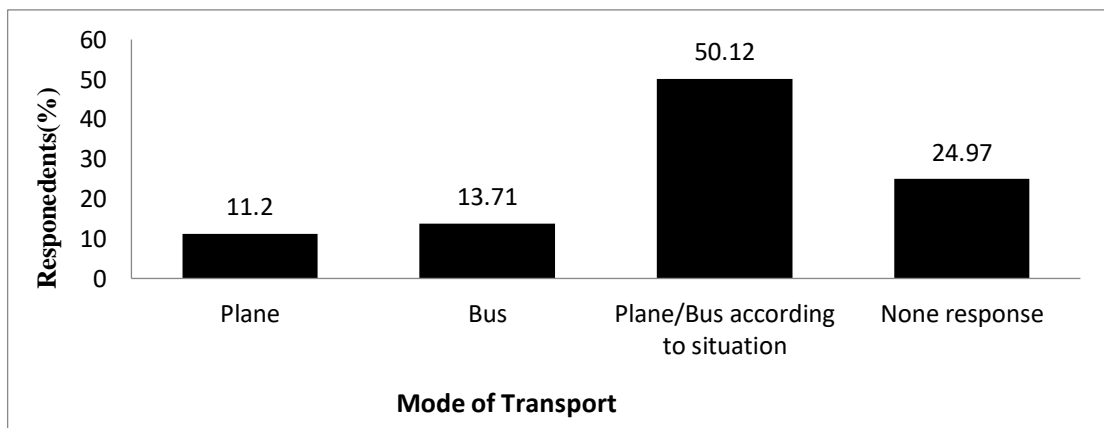


(Source: Travel Preference Survey, 2018)

**Figure 4.9: Modes of transport that usually used by people**

35

Road transport is unsafe and dangerous and air transport has not fixed sheduled. So most of the respondents travel according to their situation. One of the key informants had also expressed that people normally use plane or bus according to the situation.

**Relation between the Mode of Transport and Gender**

The distribution of the transport modes that are usually used by the respondents versus the gender of the respondents can be seen in Figure 4.12. The data obtained from the travel preference survey indicates that 68.44% are the male traveler where as only 31.56% are female traveler among 298 respondents. That means the female trips to Nepalgunj is lesser than male trips which shows the Nepali social structure still rooted deeply even in study area. The Figure further shows that the males and females are likely to use the bus or plane according to the situation.
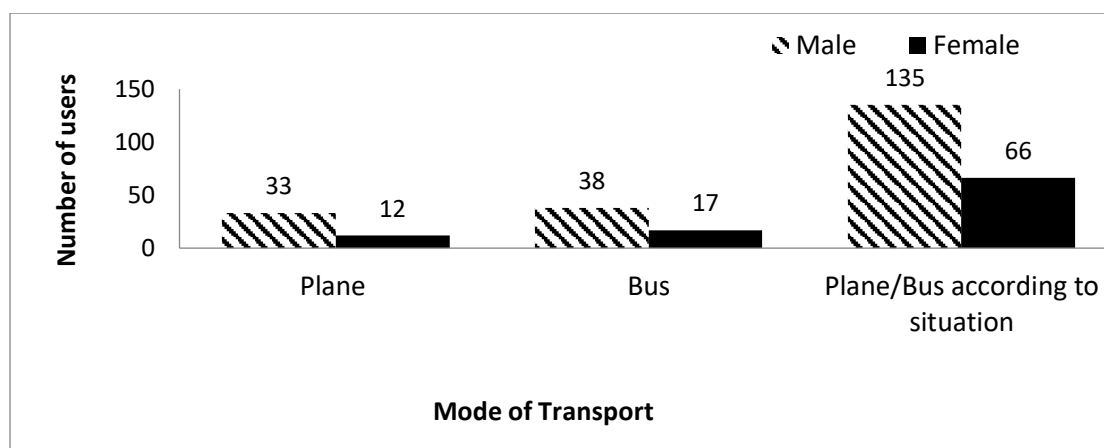


(Source: Travel Preference Survey, 2018)

**Figure 4.10: Relation between the mode of transport and gender.**

Air transport has not fixed shedule. So its not easy to get plane ticket.

**Relation between the Mode of Transport and Age**

The distribution of the transport modes that is usually used by the respondents over the age of the respondents can be seen in Figure 4.11. As can be seen from the Figure, bus users decreases as the age increases because the old people prefer to have privacy and comfort in transport modes which are not available in a road transport.
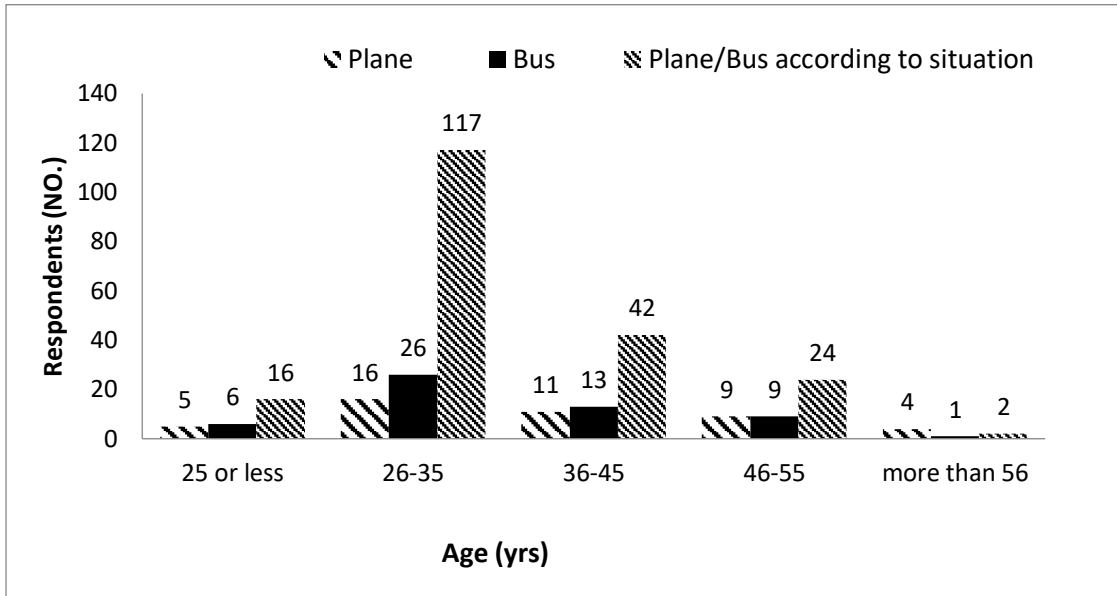
**Figure 4.11: Relation between the mode of transport and age**

**Relation between the Mode of Transport and the Monthly Income**

The distribution of transport modes that are usually be used by the respondents over the average family monthly income of the respondents is presented in Figure 4.14. As can be seen from the chart the percent of traveler's trips increases as the monthly income increases and the percent of riders using plane users' increases as the monthly income increases. But most of the respondents with no income have significantly higher trips than others. Most of the people choose both types of transport mode according to situation. The respondent's income does not reflect their modes of choice.

About 84 numbers of people among 301 respondents who do not have any income source use either road transport or air transport. 21 numbers of bus users and 10 numbers of plane users do not have income source. That means most of the respondents depend on their family for travel expenses.
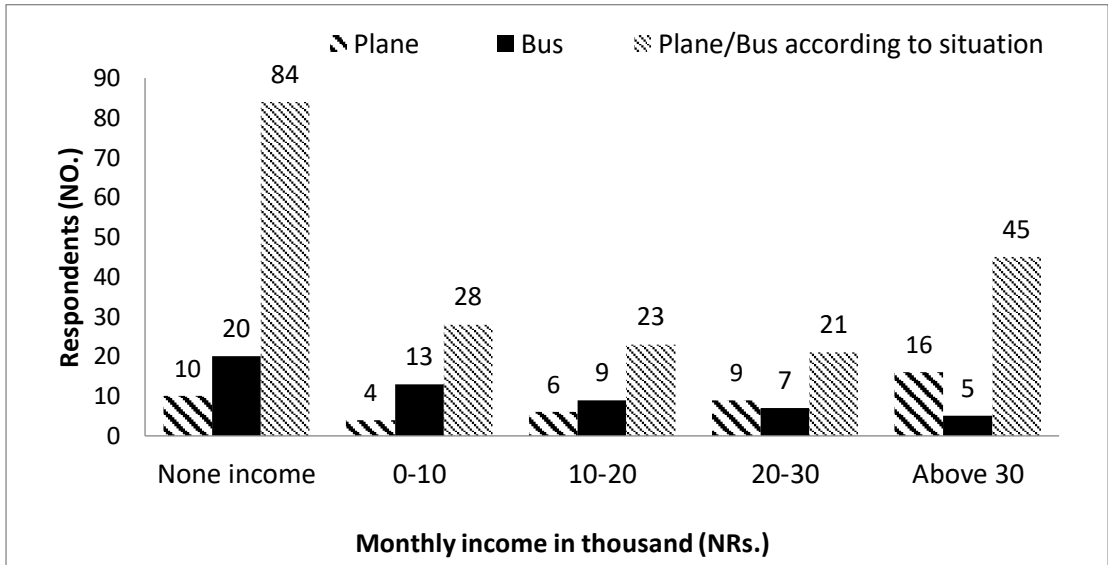
**Figure 4.12: Relation between modes of transport and monthly income**

**Relation between the Mode of Transport and the Job**

The distribution of transport modes that are usually used by the respondents over the job of the respondents can be seen in Figure 4.13. As can be seen from the Figure, the large numbers of mode users are students who have low income but usually go Nepalgunj than other professionals. Most of the respondents use plane or bus according to situation.
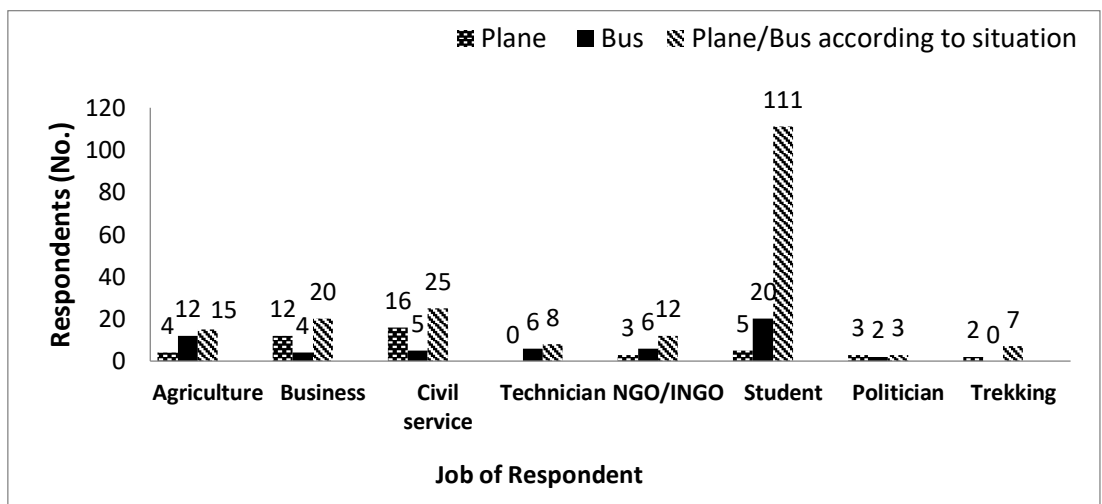
**Figure 4.13: Relation between the mode of transport and job**

### 4.3.4 Easiness to get Plane Ticket

The distribution of the easiness to get plane ticket by the respondents is presented in Figure 4.14. About 6.0 % people don't respond the questions. As the key informants, the ticket availability is neither easy nor difficult as majority of respondents think which corresponds to 49.88% of the whole sample.
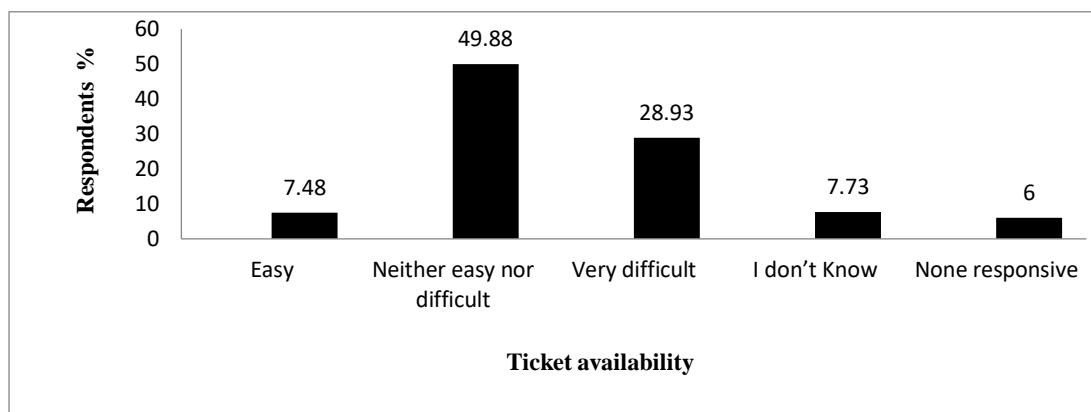


(Source: Travel Preference Survey, 2018)

**Figure 4.14: Easiness to get plane ticket**

### 4.3.9 Convenient Season to Reach Nepalgunj by Bus

Figure 4.15 shows the people (74.31%) expressed that the convenient time to travel by bus is winter season. Majority of passenger seem to prefer to travel in winter season by bus due to the bad condition of road in rainy season.
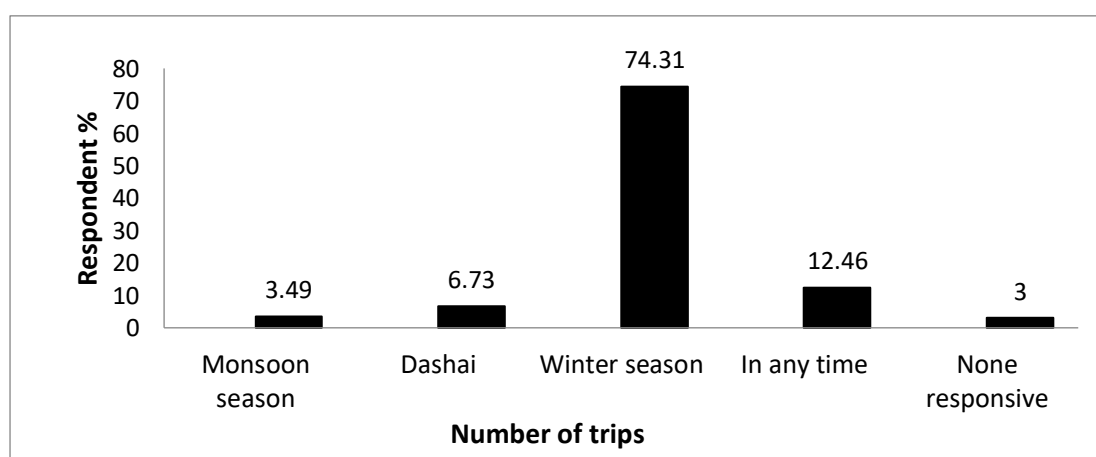


(Source: Travel Preference Survey, 2018)

**Figure 4.15: Convenient time to reach Nepalgunj by bus**

In winter season people have free time so they visit their friends/relative and visit doctors/clinic.

**4.4 Important Factors Choosing Transportation Modes**

Along with varying attitudes towards transport modes were varying motivational factors in mode choice. Firstly, respondents stated that comfort, health status and safety were the most important when choosing a plane as shown in Figure 4.22. Half of the people think that comfort (56.2%), Health status (52.8%) and safety (51.9%) are the major factors for preferring plane. This is particularly relevant in highway when travelers have to go through rough pavement for continues day and night travel without having sound sleep.

Obviously, travel cost influences choice, however, only 39.5% respondents think that it is high importance for plane while only 21.2% people think travel cost is highly important for bus. Around half of the respondents had expressed that the cost factor is important for bus mode (53.2%) and plane (45.1%). One of the key informants said that the people having high economic status usually go to Nepalgunj by plane. The actual travel cost from Jumla to Nepalgunj by airlines was about NRS 5500.00 (Source: Yeti airlines rate, 2018 AD) and NRS 1800.00 for bus transport (Jumla to Surkhet = NRS 1500.00 and Surkhet to Nepalgunj = NRS 300.00). It indicates that the travel cost for plane is more than the travel cost of road users.

Each respondent was asked to express his/her importance of travel time for each mode. They could choose from the three options, less importance, importance and high importance. The travelling times for plane is high importance expressed by 47.6% compared with the bus mode expressed by 25.4%. Similarly 26.8% people have given less important to travel time for Bus and 14.0% for plane. People have to travel continuously for 24 hours from Jumla to Nepalgunj.

Table 4.3: Important Factors Choosing Transportation Modes

| Factors | Less Importance (%) | | Importance (%) | | High Importance (%) | |
|---------|------|-------|------|-------|------|-------|
| | **Bus** | **Plane** | **Bus** | **Plane** | **Bus** | **Plane** |
| Travel cost | 25.6 | 18.0 | 53.2 | 45.1 | 21.2 | 39.5 |

| Factors | Less Importance (%) | | Importance (%) | | High Importance (%) | |
|---|---|---|---|---|---|---|
| | **Bus** | **Plane** | **Bus** | **Plane** | **Bus** | **Plane** |
| Travel time | 26.8 | 14.0 | 47.8 | 38.4 | 25.4 | 47.6 |
| Comfort | 30.5 | 3.7 | 40.8 | 40.1 | 28.7 | 56.2 |
| Health status | 28 | 3.6 | 50.5 | 44.1 | 21.5 | 52.8 |
| Safety | 32.4 | 8.2 | 42.9 | 39.9 | 24.7 | 51.9 |
| Privacy | 40.1 | 36.5 | 36.2 | 37.1 | 23.4 | 26.4 |

(Source: Travel Preference Survey, 2018)

As per the Table 4.3, acceptance of high importance of comfort factors in plane is more than bus. 56.2% of respondents think that comfort factor is high importance for choosing plane while only 28.7% respondents feel high importance for bus. More people (30.5%) choose comfort is less importance for bus compare to 3.7% chooses it for plane. There was another question about comfort in which two third people (71.3%) prefer plane, giving consideration to the convenience.

Another major factor affecting mode choice is health status. Health status is high importance (52.8%) for choosing plane while 21.5% people think it is high important for choosing bus mode. As in comfort factors, more people have choose health status as less importance for choosing bus mode compared to plane (3.6%). Key informants had also said that people usually go to Nepalgunj by plane for health check up.

As per the Table 4.3, 51.9% people thought that safety factor is the high importance and 8.2% people thought that it is less importance for choosing plane. About 24.7% people considered that it is high importance and 32.4% felts that it is less importance for choosing the bus mode. There was another question regarding safety concern in which two third people (75.3%) considered that the plane is safe mode.

Privacy factor is less importance than other factors for choosing modes. Only 26.4% people (for plane) and 23.4% people (for bus) thought that privacy is high importance for choosing modes. More people considered (36.5% for plane and 40.1% for bus) this factor is less importance for choosing modes.

## 4.5 Travel Trend

Sound growth has been recorded in the past with the number of people visiting the Nepalgunj growing from 6,513 to 7,206from 2010 AD to 2018 AD. Number of visitors to Nepalgunj by plane has been increasing every year since 2010 AD, except in the years 2016 AD. Similarly number of people travelling to Nepalgunj by bus has been growing from 1,278 to 7,731 from 2010 AD to 2018 AD. The historical travel trend is discussed below.

### 4.5.1 Travel Trend from Study Area to Nepalgunj
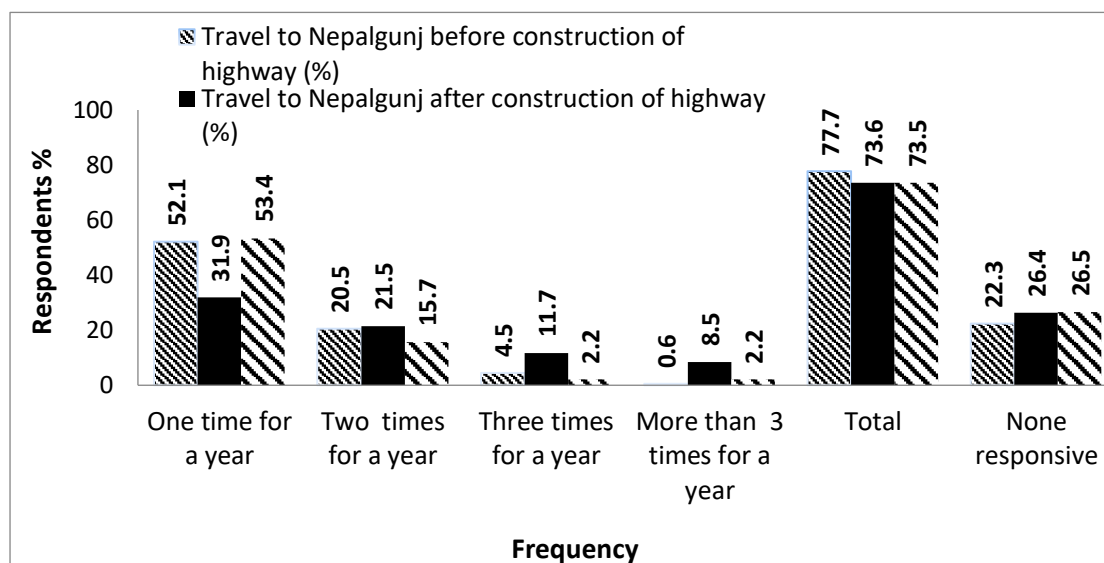


(Source: Travel Preference Survey, 2018)

**Figure 4.16: Travel trend from study area to Nepalgunj**

The distribution of travel trend before operation of highway by the respondents is reported in Figure 4.16. As can be seen from the figure below the large percent of the respondents used to go once in a year before operation of highway. More than fifty percent of the passengers (52.1%) used to go Nepalgunj once in a year before operation of highway followed by twice a year (20.5%), thrice a year (0.6%) and 22.3% of the respondents did not respond the question.

Figure 4.16 shows that there is nearly equal to the trip trend between one time travel in a year by 52.1% and one time travel in a year by plane (53.4%) before the operation of highway and after the operation of vehicles through the highway. Percentage of the trip in a year is decreased from 52.1% to 31.9% after operation of

highway. Three times and more than three times travel trip have been increased from 4.5% to 11.7% and 0.6% to 8.5% respectively. According to the key informants the frequencies of trips to Nepalgunj have been increased after using highway.

### 4.5.2 Passengers Travel Trend from Jumla to Nepalgunj
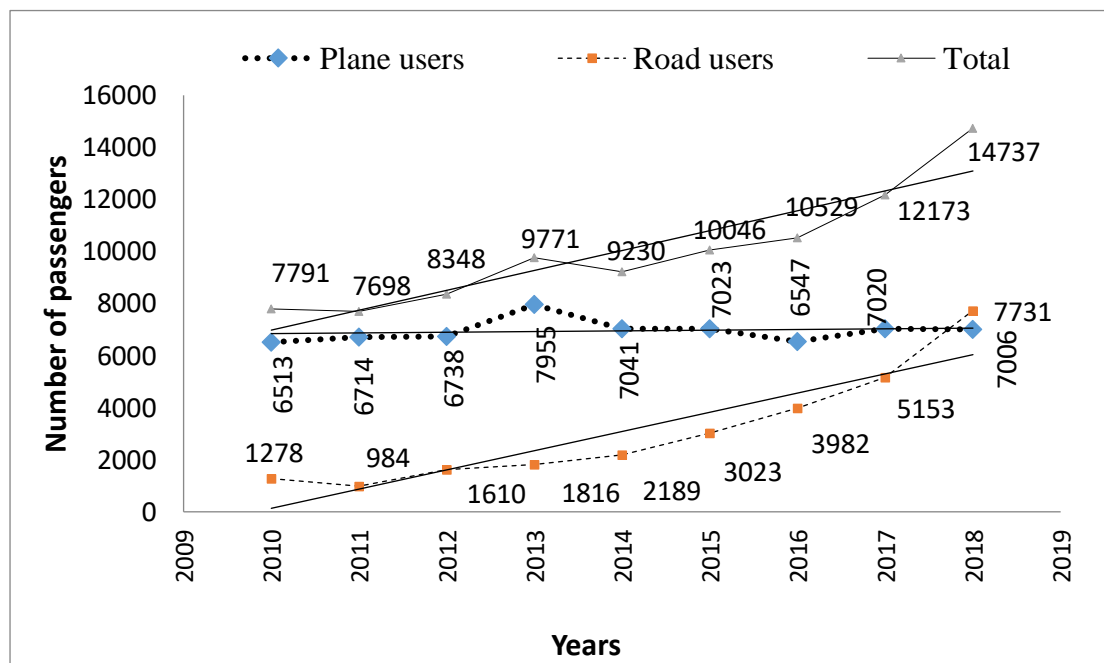


(Source: Revenue office of Nepalgunj Airport, 2018 and District transport entrepreneur of Jumla, 2018).

**Figure 4.17:  Passenger trend from Jumla to Nepalgunj**

Passengers' arrival to Nepalgunj from Jumla shows unstable growth trend as shown in Figure 4.17. For example, the number of passengers arrival decreased by 11.5% in 2014 AD, due to the Nepalese constituent assembly election and political crisis

Passengers' arrival to Nepalgunj was declined in the year 2015 AD and 2016 AD due to heavy decrease in passenger flow from Jumla be due to various reasons such as security, weather.

The available transport service, whether it may be air or land has a crucial factor to increase passengers from Jumla to Nepalgunj. Before 2010AD most of the people used air service while visiting Nepalgunj. Some people used to walk to Surkhet for 5-7 days and took a bus from Surkhet to reach Nepalgunj. However, the mode of transport of People visiting from Jumla to Nepalgunj changed since 2010 AD. Since 2010 AD, district headquarter Khalanga had been connected by highway.

43

Air passengers increase from 6,512 to 7,006 at the rate of 1.31% from 2010 AD to 2018 AD. In 2013 AD, The arrival of passenger in Nepalgunj from the study area was increased by 18.06% than previous year and slows down by 11.5% in 2014 AD.

In 2013 AD, the data of air passengers achieved highest peak for 4 years and decreased sharply by 11.5% in 2014 AD. The air passenger growth is at the rate of 1.31% from 2010 AD to 2018 AD as shown in Figure 4.17. The growth of population in the study area which is about 1.97% (according to Table 3.1) annually is more than growth of air passengers. That means the growth of air passengers is directly affected by the population of study area.

The number of road users increased from 1,278 to 7,731 from 2010 AD to 2018 AD at the rate of 25.23% annually. In 2011 AD, the arrivals of people using bus in Nepalgunj from Jumla was decreased by 23% than previous year and increased by 63.61% in 2012 AD than 2011 AD.

### 4.5.3 Coefficient of Determination for Different Mode users

It is the percentage of the response variables variation that is explained by a linear model. The R-Squared value for different data was obtained as following:

The trend line is plotted for number of total traveler (y-axis) against number of years in x-axis. Table 4.4 shows that polynomial line is a best fitted line for total traveler from Jumla to Nepalgunj. The total traveler is the summation of road users and plane users. The $R^2$ is about 0.938 which is reasonable value for the given historical data which is shown in Figure 4.17.

Table 4. 4: Fitted line for total traveler from Jumla to Nepalgunj

| S.N. | Trend line | R² Value |
|------|------------|----------|
| 1 | Linear | 0.854 |
| 2 | Exponential | 0.904 |
| 3 | **Polynomial** | **0.938** |
| 4 | Logarithmic | 0.854 |
| 5 | Power | 0.904 |

(Source: Revenue office of Nepalgunj Airport, 2018 and District Transport Entrepreneur of Jumla, 2018)

The figure shows a polynomial trend line chart with y-axis labeled "Numbers of passenger" (0 to 20000) and x-axis labeled "Years" (2009 to 2019). The equation displayed is:

$$y = 105.39x^2 - 423728x + 4E+08$$
$$R^2 = 0.9382$$

Data points: 7791, 7698, 8348, 9771, 9230, 10046, 10529, 12173, 14737. Legend: Poly. (Total )
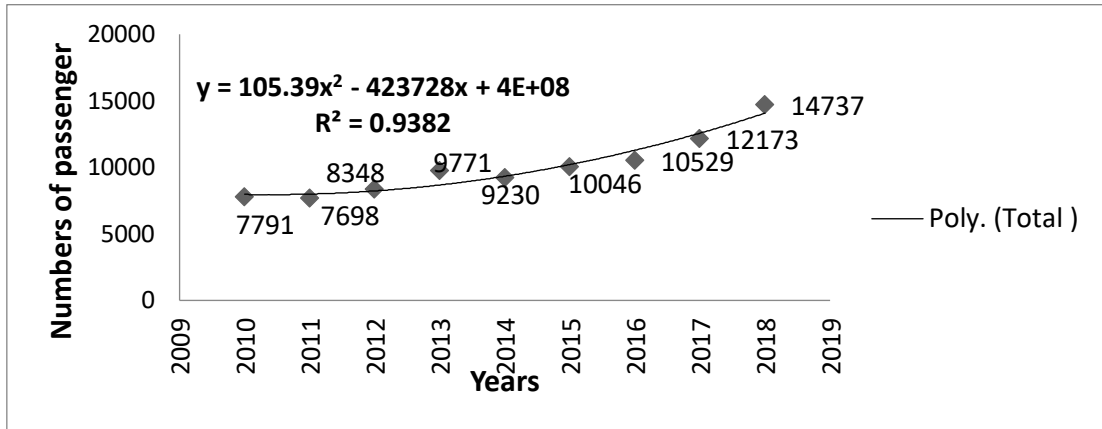
(Source: Revenue office of Nepalgunj Airport, 2018 and District Transport Entrepreneur of Jumla, 2018)

**Figure 4.18: Polynomial Trend Line for total traveler**

For the road users data R² is generally high (above 0.8 in all trend line) as shown in table 4.5. The best fitted line for historical trend data of road users is polynomial as in historical data of total traveler from Jumla to Nepalgunj.

Table 4. 5: Fitted line for road users from Jumla to Nepalgunj

| S.N. | Trend line | R² Value |
|------|-----------|----------|
| 1 | Linear | 0.838 |
| 2 | Exponetial | 0.949 |
| 3 | **Polynomial** | **0.982** |
| 4 | Logarithmic | 0.838 |
| 5 | Power | 0.949 |

(Source: District Transport Entrepreneur of Jumla, 2018)

The R² value for the road users accounts 0.982 which is highest for best fitted polynomial line among other lines. The road user data shows that its increment is uniformly from 2010 to 2018 as shown in Figure 4.19

The chart shows:

Road passenger (y-axis) vs Years (x-axis)

$y = 134.67x^2 - 541699x + 5E+08$

$R^2 = 0.9823$

Data points:
- 1278
- 984
- 1610
- 1816
- 2189
- 3023
- 3982
- 5153
- 7731

Legend: ◆ Road users; — Poly. (Road users)

**Figure 4.19: Polynomial Trend Line for road users from Jumla to Nepalgunj**

The Table 4.6 shows that the R- Squared value for plane users is less than 0.25 in all cases. Among these lines, polynomial line gives best fitted lines from these data. The low value of R- Squared for air travelers is due to the fluctuations on the historical data of plane users. The fluctuation on the data may be due to various reasons such as security, weather and rehabilitation works in the site.

In 2016 AD, airport had been operated only for some month. This may be due to the security problem in Nepal. Frequent strike and violence was common in those days due to political instability. So, the air passenger data had been decreased sharply in 2014 AD as compared in the year of 2013 AD. In 2015 AD and 2016 AD, the air traffic data had decreased by 0.3% and 6.77% respectively than previous year.

Table 4. 6: Fitted line for plane users from Jumla to Nepalgunj

| S.N. | Trend line | R² Value |
|------|-----------|----------|
| 1 | Linear | 0.027 |
| 2 | Exponential | 0.034 |
| 3 | **Polynomial** | **0.205** |
| 4 | Logarithmic | 0.027 |
| 5 | Power | 0.034 |

(Source: Revenue office of Nepalgunj Airport, 2018)

The R- Squared value for total passengers making trip from Jumla to Nepalgunj is about 0.938. In many cases people used to make trip by bus if the airport is not functioning. This shows that the plane users were diverted to road users due to lack of sufficient service provided by airlines companies.
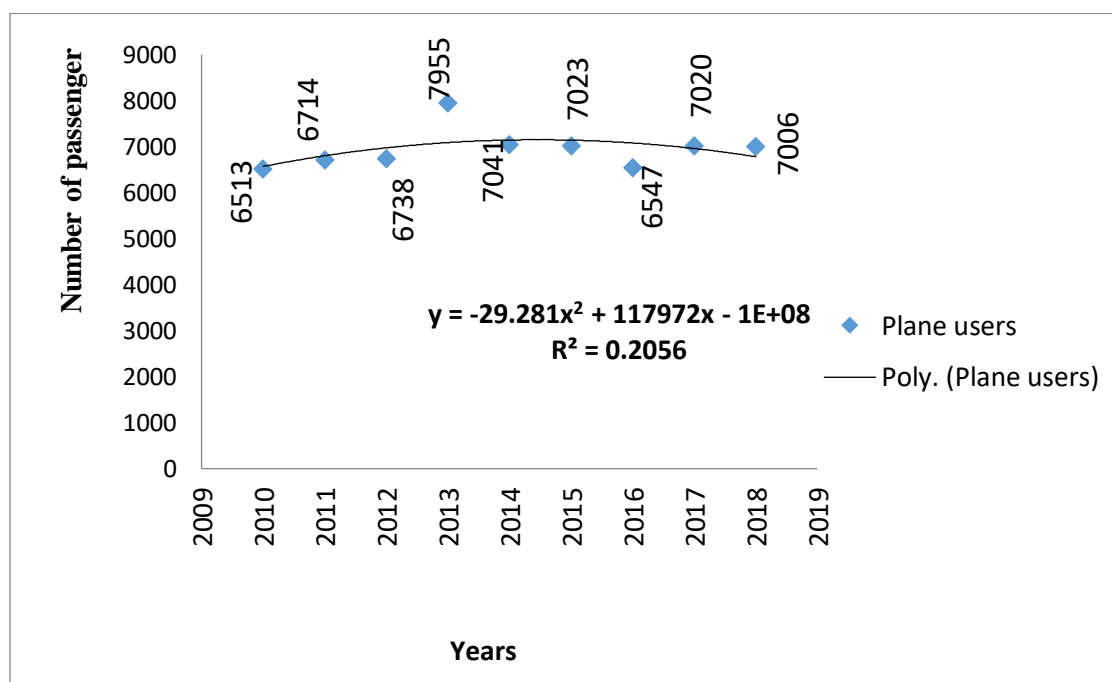


(Source: Revenue office of Nepalgunj Airport, 2018)

**Figure 4. 20: Polynomial Trend Line for plane users with considering fluctuation**

Table 4.7: Fitted line for plane users excluding fluctuation.

| S.N. | Trend line | R² Value | |
|------|-----------|----------|---|
| 1 | Linear | 0.756 | |

| S.N. | Trend line | R² Value | |
|------|-----------|----------|---|
| 2 | Exponential | 0.755 | |
| 3 | **Polynomial** | **0.962** | |
| 4 | Logarithmic | 0.757 | |
| 5 | Power | 0.755 | |

If these fluctuations do not consider, then R-squared value for plane user accounts 96.2% for best fitted line (polynomial) which is higher in value as shown in Figure 4.21. This indicates that the R-squared value explains all the variability of response data around its mean.

**Figure 4.21: Polynomial Trend Line for plane users without considering fluctuation**

# CHAPTER FIVE: MODEL DEVELOPMENT AND ITS RESULT

## 5.1 Model development

The models are shown in table 5.1 and the interpretations from values in the table 5.1 are given in below. In these values, the Exp(B) value, called as "odd ratio" is important for modelng, as this value indicates the ratio of independent variable of particular category to that of the reference category. The model should have the significant value equal to or less than 0.05 if the confidence interval of the model is 95%.

The significance and ability of explanations of variations can be checked by the pseudo R-square values. Two pseudo R2 values are obtained in the binary logit model, namely, Cox and Snell pseudo R2 and Nagerkelke pseudo R2. R2 (Co-efficient of Determination - gives an idea of how many data points fall within the results of the line formed by the regression equation).

So it is found to be reliable, and higher value of that indicates the higher fit of model. This value has a maximum limit of 1. The model has the pseudo R2 value of 0.684, and 0.931, which means the model can explain the 68.4% to 93.1% variation in the mode choice in the study area.

Table 5.1: Liklihood Ratio Test and R2 value Test for model

| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
|------|-------------------|----------------------|---------------------|
| 1 | 46.598 | 0.684 | 0.931 |

(Source Travelling preference survey, 2018)

**The utility equations of model for Plane users is:**

**Uplane** = -4.113-[0.839*Gender]+[0.076*Age]+[0.029*Income]-[2.638*Easiness_to _get_plane_ticket]-[2.659*Trip_frequency]-[1.778*Convenient_season]-[1.679*Purp ose(study)]+[1.046*Purpose(business)]+[0.494*Purpose(visiting_doctor/clinic)].....(8)

Table 5.2: Estimate of various parameters

| | B | S.E. | Wald | df | Sig. | Exp(B) | 95% C.I.for EXP(B) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| Gender(1) | -.839 | .742 | 1.277 | 1 | .025 | .332 | .101 | 1.852 |
| Age | .076 | .32 | 5.707 | 1 | .047 | 1.079 | 1.014 | 1.148 |
| Income | .029 | .058 | 15.014 | 1 | .045 | 1.023 | 1.000 | 1.000 |
| Trip_Purpose | | | 2.818 | 3 | .039 | | | |
| Trip_Purpose(1) | -1.679 | 1.473 | 1.299 | 1 | .044 | 0.039 | .299 | 96.117 |
| Trip_Purpose(2) | -1.046 | .946 | 1.225 | 1 | .038 | 0.848 | .446 | 18.171 |
| Trip_Purpose(3) | .494 | 1.038 | .227 | 1 | .034 | .610 | .080 | 4.664 |
| Easiness_to_Get_Plane_Ticket(1) | -2.638 | .798 | 10.942 | 1 | .001 | .071 | .015 | .341 |
| Convenient_Season(1) | -1.778 | .696 | 6.524 | 1 | .011 | .169 | .043 | .661 |
| Trip_Frequency(1) | -2.659 | .759 | 12.279 | 1 | .046 | .072 | .016 | .310 |
| Constant | -4.113 | 1.940 | 4.498 | 1 | .034 | .016 | | |

(Source: Travelling preference survey, 2018)

## 5.2 Validation of Model

The final model needs to be validated against the data that were not used to develop the model. Hence for the validation process, the data from travel preference survey (nearly 30%) is taken. The value of "p" in the above equation determines the probability of the using plane. A cut point of 0.5 is used to separate the plane users from the bus users. This means that the value of "p" below 0.5 is termed as a bus users and the value of "p" above 0.5 is termed as a plane users.

The validation process was done in the Excel by using equation (8). A total of 150users were used out of which 49 users failed which means that the accuracy of the model is 67.33%.

## 5.3 Result from Model

**Age Effect:**

The exponent of the coefficient of the variable "Age of users" is 1.079 which means that the ratio of the odd of the plane users to the odd of the bus users is 1.079.This means that for every unit increase in the age of the users, the odd of the plane

usersincreases by 7.9%. This can also be stated as for every 10 years increase in the age of the users, the odd of the plane users increases by 79%.

**Income Effect:**

The exponent of the coefficient of the variable "Age of users" is 1.023 which means that the ratio of the odd of the plane users to the odd of the bus users is 1.023.This means that for every unit increase in the income of the users, the odd of the plane users increases by 2.3%. This can also be stated as for every 10 years increase in the age of the users, the odd of the plane users increases by 23%.

**Effect of Easiness to get plane ticket:**

Since this is the categorical variable and it has 2 categories, one is used as a base category and another one is stated on the basis of this base category.In this case, the "difficult" is used as the base variable. The exponent of the coefficient of the dummy variable "easy" is **0.071** which means that the odd of the plane user is **92.9%**difficult.

**Effect of trip purpose:**

Since this is the categorical variable and it has 4 categories, one is used as a base category and others are stated on the basis of this base category.In this case, the "visiting friends/relatives" is used as the base variable.

The exponent of the coefficient of the dummy variable "study" is **0.039** which means that the odd of the plane usersfor the "study" is **96.1%** less than that of the plane users for "visiting frinds/relatives"

The exponent of the coefficient of the dummy variable "business" is **0.848** which means that the odd of the plane usersfor the "business" is **15.2%** more than that of the plane users for "visiting frinds/relatives"

The exponent of the coefficient of the dummy variable "visiting doctors/clinic" is **0.61** which means that the odd of the plane usersfor the "visiting doctors/clinic" is **39%** more than that of the plane users for "visiting frinds/relatives"

**Effect of trip_frequency:**

Since this is the categorical variable and it has 2 categories, one is used as a base category and another one is stated on the basis of this base category.In this case, the

"once a year" is used as the base variable. The exponent of the coefficient of the dummy variable "more than one time in a year" is **0.072,** which means that the odd of the plane user is "more than one time in a year" **92.8%**less than "once a year".

**Effect of Convenient_Season:**

Since this is the categorical variable and it has 2 categories, one is used as a base category and another one is stated on the basis of this base category.In this case, the "any time" is used as the base variable. The exponent of the coefficient of the dummy variable "winter" is **0.169** which means that the odd of the plane user in "winter"is **83.1%**less than in "any time".

**Gender effect:**

Since this is the categorical variable and it has 2 categories, one is used as a base category and another one is stated on the basis of this base category.In this case, the "female" is used as the base variable. The exponent of the coefficient of the dummy variable "male" is **0.332** which means that the odd of the plane user by "male"is **66.8%**less than "female".

# CHAPTER SIX: CONCLUSIONS AND RECOMMENDATION

## 6.1 Conclusion from General analysis:

During the period of collection of primary data and general analysis of primary and secondary data few findings have been made which is summarized as follows.

➢ Economic status has been significantly enhanced in this zone after the operation of highway. But the result from the studies shows that the present situation of road maintenance is very poor due to lack of adequate resources and weak management.

➢ They expressed that winter season is the preferred time than rainy season for bus users due to bad condition of road in monsoon period.

➢ Male are the active trip maker than female in this study area. Though students who have low income and sometimes no income, however they are the frequent trip maker than other professionals for better educationBus users' decrease as the age increases because old people prefer to have comfortable and safe modes of transport which is not possible in road transport.

➢ Travel cost for plane is more important factor so that rich people frequently use it. Study shows that low income people have less importance for time factor. Comfort is the major factor while choosing modes. Two third of the people think that they choose plane, giving consideration to comfort. Health is another major factor choosing transport modes. Usually old people and patients use plane for health checkup. Study has concluded that Privacy is minor factor comparing with other factors while choosing transport modes.

Number of air passengers has been increased as previous trends after the operation of road. Study has concluded that there is not effect of road transport service on air travel demand from Jumla to Nepalgunj as the growth rate of air traffic is nearly equal before and after operation of road.

## 6.2 Conclusion from Model analysis:

- ➢ Both the increasing ages of the passengers and that of the income is contributing towards the increasing number of the plane users.
- ➢ The chances of plane users are the highest by "business" followed by the "visting doctors/clinic", "visiting friends/relatives", and "study" respectively.
- ➢ Its difficult to get plane ticket.
- ➢ Most of people use plane once a year.
- ➢ "Winter" seasosn is best for bus users and the chances of plane users in "any time".
- ➢ The chances of plane user are relatively "Female".

## 6.3 Recommendation:

Roads should be maintained at all weather standards. Significant rehabilitation should be done to bring very poor road to the original surface. Suitable cross drainage structures should be placed with the aim of making the road all weather even during the rainy season. Priority should be given for maintenance of the constructed road to operate regularly.

Transport entrepreneurs should study the decision making behavior of people. Decision making behavior during selection of mode depends on trip characteristics of people. Personal characteristics include socio economic condition of people, values, personality and attitude. Before the investment in transport industry, basically entrepreneur should study as follows:

- ➢ Demographics: village they live, age, gender, job, family size and income.
- ➢ Trip characteristics: Information covered is relating to travel behavior of individual for his/her daily trips such as (the mode usually used, annual frequency of travel cost and Travel time).
- ➢ Factors affecting the mode choice.
- ➢ Binary logit model

Airlines should increase the number of flights to meet the demand and provide more efficient and convenient service for passengers. More competition will lead to increase service quality at lowest cost.

## 6.4 Suggestion for Further Studies:

This study can be extended to To improve the accuracy of the model between Jumla to Nepalgunj. In addition, this study can also be extended for other remote places of Nepal where both the road and air transports exist.

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# APPENDIX A: TRAVELLER PREFERENCE SURVEY

> Please (√) mark the appropriate field; wherever options are available

## Section I: Demographic Question:

1. Name:

2. Age:

3. Gender:

      a. Male                                  b. Female

4. Indicate your profession:………….

5. Where is your home?…………………

6. Indicate the level of education:

      a. School Level.                         d. Master

      b. Plus Two/Intermediate          e. None

          Level                             f. Above master level

      c. Bachelor/ Diploma

7. What is your Monthly Income:

      a. None.                                 c. 10,000-20,000

      b. 0-10,000                             d. 20,000-30,000

e. 30,000 and above

8. How many members do you have in your family:……………………………..


## Section II: Questionnaire For Assessing Demand and Willingness To Pay

9. Which mode of transport you prefer for Nepalgunj trip?

   a. Plane

   b. Bus

10. What is the purpose of your travel to Nepalgunj?

   a. Studying

   b. Services

   c. Business

   d. Visiting Friends/relatives

   e. Clinics/ doctors visit

   f. Others

11. Does your household frequently to go Nepalgunj?

   a. One time for a month

   b. One time for a year

   c. Two times in a year

   d. Three times in a year

   e. More than 3 times in a year

   f. Never

12. What is the mode of transport you usually use to go to Nepalgunj?

   a. By plane

   b. By bus

   c. Bus or Plane according to situation

   d. If others Please specify


13. Does your household can afford plane Ticket?

   a. Yes

   b. No

14. How you reach to Jumla airport?

   a. By walking

   b. By Public vehicle

15. How often do your family travel to Nepalgunj **before** operation of  highway for one year      ( Number of trip per year)

    a.  1 time for a year             c.  3 times for a year

    b.  2 times for a year           d.  More than 3 times for a year

16. How often do your family travel to Nepalgunj  **after** operation of  highway for one year      ( Number of trip per year)

    a.  1 time for a year             c.  3 times for a year

    b.  2 times for a year            d.  More than 3 times for a year

17. How often do your family travel to Nepalgunj by plane **before** operation of highway for one year (Number of trip per year)

    a.  1 time for a year             c.  3 times for a year

    b.  2 times for a year            d.  More than 3 times for a year

18. If you do not get plane ticket for Nepalgunj in timely:

    a.  I will wait for plane ticket        b.  I will use bus

19. How would you feel the ticket availability on Plane during your travel?

    a.  Easy             c.  Very difficult

    b.  Neither easy nor difficult        d.  I don't know

20. How do you consider the fare charge of the bus transport to Nepalgunj?

    a.  Expensive            c.  Low

    b.  Average

21. (For this question, present the list in a different order on a random basis to each respondent) "I would like to show you a list of possible problems that might be faced by your household (or establishment):

a. Difficult to get plane ticket

b. Poor service of Public transport

c. Lack of public transport

d. Unreliable plane service

22. Of these possible problems (question No 20), which do you consider the most serious problem and second most serious problem for you?

a. Most serious problem …(Write letter – a to d.)

b. Don't know

c. Second most serious problem ……..(Write letter – a to d.)

23. (If item (a) was not listed in question no 20) In your opinion, how serious is the problem of unreliable plane service?

a. Very serious

b. Somewhat serious

c. Not serious

d. Don't know

24. (If item (c) was not listed in question no 20) In your opinion, how serious is the problem of Poor service of Public transport?

a. Very serious

b. Somewhat serious

c. Not serious

d. Don't know

25. If you are going to Nepalgunj by Plane, how often you have not got a plane ticket?

a. One time in a year

b. 2 times in a year

c. 3 times in a year

d. More than 3 times in a year

26. If you have not get a plane ticket, how often go to Nepalgunj by Bus?

a.  One time in a year

b.  2 times in a year

c.  3 times in a year

d.  More than 3 times in a year

e.  Wait for next schedule from plane

27. What is your opinion of the service that you are receiving from airlines?

a.  Very satisfied

b.  Reasonably satisfied

c.  Not satisfied at all : Go to question No. 26

d.  Don't know

28. If you are not satisfied with service, would you state your primary reason?

e.  The service is not reliable

f.  Flight schedule is too long

g.  The staff of airlines are rude or impolite

h.  Other problems(please explain)

……………………………………...

……………………………………………………………………

………………...………………………………………………………

…………………………………………………………………………

………………………………………………………

29.  Are you concerned about whether the air transport is safe and acceptable?

a.  Yes

b.  No

c.  Don't know

30. Which of the transport mode options do you prefer, giving consideration to the convenience and the cost?

a.  By plane – Now go to Question 29.

b.  By Public Vehicles – Now go to Question 31 and 32

c.  Don't Know

31. If you prefer plane, how many times would you be willing to reach Nepalgunj from Jumla?

    a. One time a year                c. 3 times a year

    b. 2 times a year                d. More than 3 times a year

32. What is the maximum fare that your household would be prepared to pay for plane ticket?

    a. ……………………….per trip       b. Can't pay

                                    c. Don't know

33. If you prefer bus, how many times would you be willing to reach Nepalgunj from Jumla?

    a. One time a year                c. 3 times a year

    b. 2 times a year                d. More than 3 times a year

34. If you prefer bus travel, there are certain seasons you would find it most convenient to reach Nepalgunj from Jumla?

    a. In monsoon season

    b. In Dashain

    c. In Winter season

    d. In any time

## Section III. factors affecting  mode choice

To what extent do you think that the following Factors are important in choosing the transport mode from Jumla to Nepalgunj?

**For Bus**

| Attributes | Very Low Important | Important | Very high Important |
|---|---|---|---|
| Travel cost | | | |
| Travel time | | | |
| Comfort | | | |
| Health Status | | | |
| Safety | | | |
| Privacy | | | |

**For plane**

| Attributes | Very Low Important | Important | Very high Important |
|---|---|---|---|
| Travel cost | | | |
| Travel time | | | |
| Comfort | | | |
| Health Status | | | |
| Safety | | | |
| Privacy | | | |

# Appendix B: KEY INFORMANTS SURVEY

Name of Interviewer:                                                    Date:

Name of Institution:

Name of Respondent:                                                     Sex:

Position of Respondent:                                                 Age:

1. How often people go to Nepalgunj?

2. Please mention your opinions regarding the existing transportation system of this area.

3. From which places people come to obtain road and air facility?

4. What is the situation of road facilities in your District? Please mention in detail.

5. What is the impact upon the economic activity in district after the construction of road? Please mention in detail.

6. What is the current situation of air transportation in Jumla? Please suggest.

7. What was the travel trend before Construction of Karnali highway?

8. What is the density of passengers in airport after construction of Karnali Highway?

***Thanks for your cooperation!***

***The end***

**Matrix for KII**

| Questions | KII1 : Indra Bahadur Thapa, Karnali Trade Association, Jumla | KII2: Rajjat Ali Manihar, Industry Association, Jumla | KII3: Nisa Budha, Hotel and Tourism Business, Jumla | KII4: Karma Budha, District Co-operative Committee |
|---|---|---|---|---|
| What is the situation of transportation? | For Bus and Airways normal situation in all season except rainy season. . Difficult during rainy season. | Plane tickets are not available in time. The way(route) gets disturbed during rainy season.( It's difficult to operate vehicles during rainy season) | The situation of transportation satisfactory . The vechiles are running day by day but the situtation of road is not so much good. | Due to the wearther, the flight schedule is offer changed.Also bus fare is not fixed |
| What is the volume of passenger in airport after the operation of highway? | Due to unreliable Plane service, passenger are waiting 4/5 days when the flight schedule changed or cancelled, then passenger travel through Bus. | we see a lots of passenger in the airport because of the bad condition of Karnali Highway. | Volume of passenger has been reduce. | |

| | | | | |
|---|---|---|---|---|
| What was the travel trend before operation of highway ? | Most often people would go to Nepalgunj once in a year and some often would go two or three times Among them were plane users. | Oviously, the main route of travel trend before the operation of highway was the Airways. | People/we had to walk just to reach Surkhet/Nepalgunj before the operation of karnali highway. | Most of the people had to walk 5 to 7 days to reached Nepalgunj and passengers were waiting 5/7 days for flight. Also people were used donkey, horse for their transpotation. |
| What type of impact is seen on the economic activities of people after the road construction in district? | The road construction led to the emergence of new marketing opportunities for small enterprises along the road corridor. The number of enterprises increased significantly (doubling, and in one case greater than double). | Greater access by roads and the establishment of new or better-stocked retail shops within their communities has allowed people to shop nearer to their homes. They therefore do not have to travel regularly to the more distant traditional markets. | People living northern part benefited the most by the road construction. These people are taking advantage of new opportunities generated (eg, cash crop cultivation, establishing micro-enterprises). Many have agriculture surplus to sell and funds to invest in inputs and off-farm activities. | Families associated with Road Construction have received a range of complementary skills to help them improve their livelihoods and income generation. Most of the people use their income for better education and health. They send their children to Nepalgunj for higher education. |

68

| What is the situation of roads on district? | Vehicles can not be operated in the rainy season. Continued and regular maintenance of the roads at this area are very poor. | Continued and regular maintenance of the roads at this area are very poor. | Many roads frequently have been blocked by landslide during moonsoon for weeks. | Budgets are mostly used for emergency maintenance using heavy equipment in case of landslides or major damage to road sections. |
|---|---|---|---|---|
| From which places people come here for road transport and plane? | It covers almost all Rural Municipality/Municipality of Jumla. Negligible people from the border Dolpa. | 95% of the passers are covered by jumli people. | Most of the passenger for bus and plane are jumli. | |
| How often people visit to Kathmandu from here? | Most of the people visist to Nepalgunj for business, education, treatment so that, they visit one/two times in a year. | At, not many more but there are a lot of student who goes for their higher education. | . | Only few businessmen and employed go to Nepalgunj in each month otherwise only one /two times in a year. |

| What is the condition of air transport in Jumla district? | Ticket is not too expensive. Passengers prefer to go by plane as per the availability. | There is no vast difference in cost that's why according to the availability, people use plane than bus. | However, in some cases, they have to catch bus when plane tickets are not available. Yet, no matter how long they have to wait to get plane ticket, old, children and sick people go by plane. | As much as possible people prefer plane. Plane facility is favorable. |
|---|---|---|---|---|
| views and opinions for the future of the airline and road transport service in Jumla | Road and Runway should be extend so that the flow of passenger to travel through plane and bus may/can be increased. | The cost of airplane is costly so if the highway are properly maintain, most of the people may/can chhose the bus. | If the economic activity increases the number of passengers will be increased. | Runway should be extend and then Direct flight from Pokhara or Ktm to Jumla Definitely increased tourist. |

(Source: KII Survey, 2018)

**APPENDIX C: PERMANENT ADDRESS OF RESPONDENTS**

| Permanent Address | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Kanakasundari Rural municipality-1,jumla | 5 | 1.2 | 1.2 |
| Kanakasundari Rural municipality-2,jumla | 9 | 2.2 | 3.4 |
| Kanakasundari Rural municipality-3,jumla | 6 | 1.5 | 4.9 |
| Kanakasundari Rural municipality-4,jumla | 5 | 1.2 | 6.1 |
| Kanakasundari Rural municipality-5,jumla | 6 | 1.5 | 7.6 |
| Kanakasundari Rural municipality-6,jumla | 7 | 1.8 | 9.4 |
| Kanakasundari Rural municipality-7,jumla | 8 | 2.0 | 11.4 |
| Kanakasundari Rural municipality-8,jumla | 5 | 1.2 | 12.6 |
| Chandan nath municipality-1,jumla | 5 | 1.2 | 13.8 |
| Chandan nath municipality-2 ,jumla | 6 | 1.5 | 15.3 |
| Chandan nath municipality-3 ,jumla | 5 | 1.2 | 16.5 |
| Chandan nath municipality-4 ,jumla | 9 | 2.2 | 18.7 |
| Chandan nath municipality-5 ,jumla | 5 | 1.2 | 19.9 |
| Chandan nath municipality-6 ,jumla | 6 | 1.5 | 21.4 |
| Chandan nath municipality-7,jumla | 7 | 1.8 | 23.2 |

| Permanent Address | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Chandan nath municipality-8,jumla | 5 | 1.2 | 24.4 |
| Chandan nath municipality-9,jumla | 7 | 1.8 | 26.2 |
| Chandan nath municipality-10,jumla | 5 | 1.2 | 27.4 |
| Gothichaur Rural municipality-1,jumla | 8 | 2.0 | 29.4 |
| Gothichaur Rural municipality-2,jumla | 9 | 2.2 | 31.6 |
| Gothichaur Rural municipality-3,jumla | 9 | 2.2 | 33.8 |
| Gothichaur Rural municipality-4,jumla | 10 | 2.7 | 36.5 |
| Gothichaur Rural municipality-5,jumla | 8 | 2.0 | 38.5 |
| Sija Rural municipality-1,jumla | 9 | 2.2 | 40.7 |
| Sija Rural municipality-2,jumla | 7 | 1.8 | 42.5 |
| Sija Rural municipality-3,jumla | 5 | 1.2 | 43.7 |
| Sija Rural municipality-4,jumla | 6 | 1.5 | 45.2 |
| Sija Rural municipality-5,jumla | 8 | 2.0 | 47.2 |
| Sija Rural municipality-6,jumla | 9 | 2.2 | 49.4 |
| Tatopani Rural municipality-1,jumla | 7 | 1.8 | 51.2 |
| Tatopani Rural municipality-2,jumla | 5 | 1.2 | 52.4 |

| Permanent Address | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Tatopani Rural municipality-3,jumla | 6 | 1.5 | 53.9 |
| Tatopani Rural municipality-4,jumla | 5 | 1.2 | 55.1 |
| Tatopani Rural municipality-5,jumla | 9 | 2.2 | 57.3 |
| Tatopani Rural municipality-6,jumla | 5 | 1.2 | 58.5 |
| Tatopani Rural municipality-7,jumla | 7 | 1.8 | 60.3 |
| Tatopani Rural municipality-8,jumla | 9 | 2.2 | 62.5 |
| Tila Rural municipality-1,jumla | 5 | 1.2 | 63.7 |
| Tila Rural municipality-2,jumla | 6 | 1.5 | 65.2 |
| Tila Rural municipality-3,jumla | 9 | 2.2 | 67.4 |
| Tila Rural municipality-4,jumla | 6 | 1.5 | 68.9 |
| Tila Rural municipality-5,jumla | **5** | 1.2 | 70.1 |
| Tila Rural municipality-6,jumla | 7 | 1.8 | 71.9 |
| Tila Rural municipality-7,jumla | 5 | 1.2 | 73.1 |
| Tila Rural municipality-8,jumla | 8 | 2.0 | 75.1 |
| Tila Rural municipality-9,jumla | 6 | 1.5 | 76.6 |
| Hima Rural municipality-1,jumla | 5 | 1.5 | 78.1 |

| Permanent Address | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| Hima Rural municipality-2,jumla | 7 | 1.8 | 79.9 |
| Hima Rural municipality-3,jumla | 5 | 1.2 | 81.1 |
| Hima Rural municipality-4,jumla | 5 | 1.2 | 82.3 |
| Hima Rural municipality-5,jumla | 6 | 1.5 | 83.8 |
| Hima Rural municipality-6,jumla | 8 | 2.0 | 85.8 |
| Hima Rural municipality-7,jumla | 9 | 2.2 | 88.0 |
| Patarasi Rural municipality-1,jumla | 6 | 1.5 | 89.5 |
| Patarasi Rural municipality-2,jumla | 7 | 1.8 | 91.3 |
| Patarasi Rural municipality-3,jumla | 5 | 1.2 | 92.5 |
| Patarasi Rural municipality-4,jumla | 6 | 1.5 | 94 |
| Patarasi Rural municipality-5,jumla | 8 | 2.0 | 96 |
| Patarasi Rural municipality-6,jumla | 9 | 2.2 | 98.2 |
| Patarasi Rural municipality-7,jumla | 7 | 1.8 | 100 |
| **Total** | 401 | 100 | |

(Source: Travel Preference Survey, 2018)

# APPENDIX D: AIR PASSENGERS DATA

Civil Aviation Authority of Nepal
**Nepalgunj Airport Civil Aviation Office**
**PASSENGER  & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2010-01-01 Date To : 2010-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 440 | 433 | 873 | 489 | 26050 | 26539 |
| 2 | FEBRUARY | 698 | 593 | 1291 | 0 | 4101 | 4101 |
| 3 | MARCH | 580 | 555 | 1135 | 0 | 3711 | 3711 |
| 4 | APRIL | 545 | 516 | 1061 | 301 | 1452 | 1753 |
| 5 | MAY | 530 | 726 | 1256 | 0 | 6460 | 6460 |
| 6 | JUNE | 400 | 393 | 793 | 0 | 5362 | 5362 |
| 7 | JULY | 350 | 490 | 840 | 0 | 8997 | 8997 |
| 8 | AUGUST | 430 | 745 | 1175 | 709 | 13087 | 13796 |
| 9 | SEPTEMBER | 380 | 550 | 930 | 731 | 20004 | 20735 |
| 10 | OCTOBER | 570 | 537 | 1107 | 0 | 41714 | 41714 |
| 11 | NOVEMBER | 740 | 416 | 1156 | 0 | 6570 | 6570 |
| 12 | DECEMBER | 850 | 398 | 1248 | 0 | 3129 | 3129 |
| | TOTAL | 6513 | 6352 | 12865 | 2230 | 140637 | 142867 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2011-01-01 Date To : 2011-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 660 | 738 | 1398 | 0 | 1249 | 1249 |
| 2 | FEBRUARY | 586 | 938 | 1524 | 0 | 1794 | 1794 |
| 3 | MARCH | 138 | 286 | 424 | 0 | 3420 | 3420 |
| 4 | APRIL | 316 | 444 | 760 | 0 | 8707 | 8707 |
| 5 | MAY | 274 | 298 | 572 | 0 | 715 | 715 |
| 6 | JUNE | 858 | 683 | 1541 | 0 | 6083 | 6083 |
| 7 | JULY | 770 | 625 | 1395 | | 6636 | 6636 |
| 8 | AUGUST | 854 | 684 | 1538 | 2078 | 20384 | 22462 |
| 9 | SEPTEMBER | 863 | 861 | 1724 | 0 | 6366 | 6366 |
| 10 | OCTOBER | 579 | 735 | 1314 | 1400 | 2384 | 3784 |
| 11 | NOVEMBER | 587 | 608 | 1195 | 0 | 2838 | 2838 |
| 12 | DECEMBER | 229 | 231 | 460 | 0 | 842 | 842 |
| | TOTAL | 6714 | 7131 | 13845 | 3478 | 61418 | 64896 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2012-01-01 Date To : 2012-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 662 | 590 | 1252 | 18 | 6864 | 6882 |
| 2 | FEBRUARY | 533 | 773 | 1306 | 41 | 3028 | 3069 |
| 3 | MARCH | 629 | 817 | 1446 | 14 | 5950 | 5964 |
| 4 | APRIL | 713 | 742 | 1455 | 7 | 7747 | 7754 |
| 5 | MAY | 737 | 903 | 1640 | 392 | 5958 | 6350 |
| 6 | JUNE | 797 | 763 | 1560 | 26 | 5960 | 5986 |
| 7 | JULY | 744 | 795 | 1539 | 737 | 9739 | 10476 |
| 8 | AUGUST | 1086 | 902 | 1988 | 2754 | 11135 | 13889 |
| 9 | SEPTEMBER | 823 | 830 | 1653 | 4351 | 6175 | 10526 |
| 10 | OCTOBER | 760 | 875 | 1635 | 213 | 7495 | 7708 |
| 11 | NOVEMBER | 645 | 634 | 1279 | 0 | 8512 | 8512 |
| 12 | DECEMBER | 609 | 467 | 1076 | 172 | 7823 | 7995 |
| | TOTAL | 8738 | 9091 | 17829 | 8725 | 86386 | 95111 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

## Nepalgunj Airport Civil Aviation Office
## PASSENGER & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT

Date From: 2013-01-01 Date To : 2013-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|------|--------|------|------|-------|------|--------|--------|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 610 | 503 | 1113 | 0 | 10970 | 10970 |
| 2 | FEBRUARY | 600 | 907 | 1507 | 592 | 4773 | 5365 |
| 3 | MARCH | 458 | 757 | 1215 | 20 | 8019 | 8039 |
| 4 | APRIL | 636 | 756 | 1392 | 0 | 9375 | 9375 |
| 5 | MAY | 687 | 859 | 1546 | 1879 | 10950 | 12829 |
| 6 | JUNE | 615 | 705 | 1320 | 13 | 5913 | 5926 |
| 7 | JULY | 800 | 784 | 1584 | 227 | 13762 | 13989 |
| 8 | AUGUST | 898 | 1114 | 2012 | 0 | 15940 | 15940 |
| 9 | SEPTEMBER | 765 | 982 | 1747 | 21 | 15449 | 15470 |
| 10 | OCTOBER | 1045 | 1109 | 2154 | 60 | 5981 | 6041 |
| 11 | NOVEMBER | 446 | 528 | 974 | 0 | 6058 | 6058 |
| 12 | DECEMBER | 395 | 466 | 861 | 0 | 7033 | 7033 |
| | TOTAL | 7955 | 9470 | 17425 | 2812 | 114223 | 117035 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER  & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2014-01-01 Date To : 2014-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 274 | 445 | 719 | 0 | 7010 | 7010 |
| 2 | FEBRUARY | 340 | 608 | 948 | 17 | 4315 | 4332 |
| 3 | MARCH | 527 | 798 | 1325 | 0 | 11868 | 11868 |
| 4 | APRIL | 444 | 697 | 1141 | 0 | 13351 | 13351 |
| 5 | MAY | 721 | 346 | 1067 | 193 | 23070 | 23263 |
| 6 | JUNE | 643 | 723 | 1366 | 0 | 11907 | 11907 |
| 7 | JULY | 610 | 549 | 1159 | 0 | 12770 | 12770 |
| 8 | AUGUST | 931 | 842 | 1773 | 0 | 16484 | 16484 |
| 9 | SEPTEMBER | 866 | 1017 | 1883 | 0 | 8655 | 8655 |
| 10 | OCTOBER | 637 | 617 | 1254 | 0 | 4965 | 4965 |
| 11 | NOVEMBER | 599 | 680 | 1279 | 0 | 7106 | 7106 |
| 12 | DECEMBER | 449 | 436 | 885 | 0 | 11720 | 11720 |
| | TOTAL | 7041 | 7758 | 14799 | 210 | 133221 | 133431 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2015-01-01 Date To : 2015-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|------|--------|------|------|-------|------|-------|-------|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 641 | 547 | 1188 | 0 | 3680 | 3680 |
| 2 | FEBRUARY | 747 | 820 | 1567 | 550 | 695 | 1245 |
| 3 | MARCH | 687 | 794 | 1481 | 0 | 4341 | 4341 |
| 4 | APRIL | 688 | 845 | 1533 | 0 | 4065 | 4065 |
| 5 | MAY | 643 | 814 | 1457 | 0 | 3905 | 3905 |
| 6 | JUNE | 490 | 633 | 1123 | 0 | 3787 | 3787 |
| 7 | JULY | 619 | 574 | 1193 | 0 | 10433 | 10433 |
| 8 | AUGUST | 386 | 489 | 875 | 0 | 4201 | 4201 |
| 9 | SEPTEMBER | 541 | 506 | 1047 | 0 | 5418 | 5418 |
| 10 | OCTOBER | 674 | 658 | 1332 | 0 | 2338 | 2338 |
| 11 | NOVEMBER | 614 | 499 | 1113 | 0 | 3072 | 3072 |
| 12 | DECEMBER | 293 | 321 | 614 | 369 | 2766 | 3135 |
| | TOTAL | 7023 | 7500 | 14523 | 919 | 48701 | 49620 |

(Nepalgunj Airport Civil Aviation office, 2018**)**

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER  & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2016-01-01 Date To : 2016-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 433 | 425 | 858 | 0 | 3408 | 3408 |
| 2 | FEBRUARY | 593 | 698 | 1291 | 0 | 5019 | 5019 |
| 3 | MARCH | 555 | 544 | 1099 | 0 | 3650 | 3650 |
| 4 | APRIL | 516 | 535 | 1051 | 0 | 1680 | 1680 |
| 5 | MAY | 826 | 517 | 1343 | 0 | 902 | 902 |
| 6 | JUNE | 393 | 496 | 889 | 0 | 3438 | 3438 |
| 7 | JULY | 490 | 511 | 1001 | 0 | 1070 | 1070 |
| 8 | AUGUST | 604 | 618 | 1222 | 0 | 2691 | 2691 |
| 9 | SEPTEMBER | 486 | 549 | 1035 | 0 | 1405 | 1405 |
| 10 | OCTOBER | 537 | 656 | 1193 | 0 | 370 | 370 |
| 11 | NOVEMBER | 516 | 484 | 1000 | 0 | 341 | 341 |
| 12 | DECEMBER | 598 | 387 | 985 | 787 | 2804 | 3591 |
| | TOTAL | 6547 | 6420 | 12967 | 787 | 26778 | 27565 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER  & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2017-01-01 Date To : 2017-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|------|--------|------|------|-------|------|------|-------|
|      |        | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 497 | 466 | 963 | 550 | 2209 | 2759 |
| 2 | FEBRUARY | 752 | 750 | 1502 | 868 | 1069 | 1937 |
| 3 | MARCH | 510 | 676 | 1186 | 73 | 867 | 940 |
| 4 | APRIL | 299 | 437 | 736 | 0 | 270 | 270 |
| 5 | MAY | 394 | 499 | 893 | 0 | 474 | 474 |
| 6 | JUNE | 371 | 470 | 841 | 0 | 405 | 405 |
| 7 | JULY | 491 | 445 | 936 | 0 | 1232 | 1232 |
| 8 | AUGUST | 853 | 856 | 1709 | 320 | 550 | 870 |
| 9 | SEPTEMBER | 862 | 1014 | 1876 | 1350 | 1529 | 2879 |
| 10 | OCTOBER | 683 | 648 | 1331 | 10 | 427 | 437 |
| 11 | NOVEMBER | 628 | 544 | 1172 | 35 | 1365 | 1400 |
| 12 | DECEMBER | 680 | 369 | 1049 | 100 | 1311 | 1411 |
|  | TOTAL | 7020 | 7174 | 14194 | 3306 | 11708 | 15014 |

(Nepalgunj Airport Civil Aviation office, 2018)

Civil Aviation Authority of Nepal

**Nepalgunj Airport Civil Aviation Office**

**PASSENGER & CARGO MOVEMENT RECORD BETWEEN JUMLA AND NEPALGUNJ AIRPORT**

Date From: 2018-01-01 Date To : 2018-12-31

| S.N. | MONTHS | PASSENGERS | | | CARGO (KG) | | |
|---|---|---|---|---|---|---|---|
| | | IN | OUT | TOTAL | IN | OUT | TOTAL |
| 1 | JANUARY | 336 | 390 | 726 | 100 | 533 | 633 |
| 2 | FEBRUARY | 525 | 660 | 1185 | 30 | 2240 | 2270 |
| 3 | MARCH | 687 | 684 | 1371 | 430 | 1655 | 2085 |
| 4 | APRIL | 493 | 459 | 952 | 40 | 292 | 332 |
| 5 | MAY | 753 | 709 | 1462 | 198 | 632 | 830 |
| 6 | JUNE | 604 | 610 | 1214 | 350 | 803 | 1153 |
| 7 | JULY | 621 | 591 | 1212 | 433 | 494 | 927 |
| 8 | AUGUST | 784 | 862 | 646 | 820 | 395 | 1215 |
| 9 | SEPTEMBER | 618 | 525 | 1143 | 50 | 880 | 930 |
| 10 | OCTOBER | 680 | 612 | 1292 | 200 | 350 | 550 |
| 11 | NOVEMBER | 625 | 604 | 1229 | 630 | 450 | 1080 |
| 12 | DECEMBER | 480 | 302 | 782 | 710 | 525 | 1235 |
| | TOTAL | 7206 | 7008 | 14214 | 3991 | 9249 | 13240 |

(Nepalgunj Airport Civil Aviation office, 2018)

**APPENDIX E: RAOD USERS DATA**

| S.N | Month | SKT/NPJ by bus | | | | | | | | |
|-----|-------|------|------|------|------|------|------|------|------|------|
| | | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
| 1 | Janaury | 115 | 120 | 130 | 146 | 179 | 222 | 350 | 476 | 615 |
| 2 | February | 134 | 112 | 128 | 149 | 182 | 254 | 356 | 487 | 678 |
| 3 | March | 150 | 102 | 138 | 155 | 188 | 267 | 370 | 490 | 656 |
| 4 | April | 140 | 115 | 135 | 152 | 192 | 255 | 354 | 500 | 702 |
| 5 | May | 124 | 116 | 132 | 160 | 185 | 270 | 398 | 515 | 756 |
| 6 | Jun | 116 | 50 | 120 | 162 | 195 | 215 | 212 | 320 | 615 |
| 7 | July | 90 | 44 | 121 | 150 | 160 | 215 | 205 | 300 | 500 |
| 8 | August | 85 | 49 | 125 | 144 | 162 | 200 | 218 | 285 | 450 |
| 9 | September | 95 | 46 | 142 | 140 | 162 | 218 | 356 | 389 | 600 |
| 10 | October | 80 | 55 | 150 | 132 | 189 | 285 | 402 | 402 | 670 |
| 11 | November | 72 | 80 | 144 | 156 | 195 | 300 | 413 | 487 | 700 |
| 12 | December | 77 | 95 | 145 | 170 | 200 | 322 | 348 | 502 | 789 |
| | Total | **1278** | **984** | **1610** | **1816** | **2189** | **3023** | **3982** | **5153** | **7731** |

(Source : Association of Transport Entrepreneurs, Jumla, 2018)