Government of Nepal
Aircraft Accident Investigation Commission, 2022

Final Report

Accident Investigation of 9N-AET, DHC-6/300
Owned and Operated by Tara Air Pvt. Ltd.
At Sanusare, Mustang on 29th May 2022

FOREWORD

This report on the accident of 9N-AET, DHC-6/300 aircraft (flight number TRA197) owned and operated by Tara Air Pvt. Ltd is based on the investigation carried out by the Accident Investigation Commission duly constituted by the Government of Nepal on 30th May 2022 as per the provisions of the Civil Aviation (Investigation of Accident) Regulation 2014 (2071 B.S.) and following the guidelines of Procedure Manual of Aircraft Accident/Incident Investigation 2022, Nepal.

The sole objective of the investigation is to identify the cause of the accident and suggest recommendations to prevent the recurrence of such kinds of accident in the future. It is not the purpose of this investigation to apportion blame or determine civil or criminal liability. The Commission acknowledges the support provided by the safety regulator CAAN, operator Tara Air, Nepal Police, the Central Police Forensic Laboratory and NTSB, USA among others.

…… ……...

Ratish Chandra Lal Suman (Former DG CAAN)
Chairman

Mani Ratana Shakya
Member

…… ……

Er. Upendra Lal Shrestha
Member

Capt. Deepu Raj Jwarchan
Member

……..

Joint Secretary Buddhi Sagar Lamichhane
Member Secretary

Experts to the Commission:

1. Major General Er. Dipak Prasad Bastola, PhD (Retd.):	Human Factor Analysis
2. Major Er. Shishir Shrestha:	Flight Simulation
3. Er. Vishal Paudel:	Load and Trim Analysis

Note:

1. This report contains the facts which have been determined up to the date of publication. This information is published to inform the aviation industry and the public of the general circumstances of accidents and serious accidents.

2. The extracts may be published without specific permission provided that the source is duly acknowledged, the material is reproduced accurately and it is not used in a derogatory manner or in a misleading context.

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Abbreviations and Definitions

AD	Airworthiness Directive
ADC	Air Data Computer
AFIS	Aerodrome Flight Information Services
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
AID	Airworthiness Inspection Division
AIP	Aeronautical Information Publications
AMSL	Above Mean Sea Level
AOCR	Air Operator Certificate Requirement
ATPL	Airline Transport Pilot License
B. S.	Bikram Sambat
C of A	Certificate of Airworthiness
CAAN	Civil Aviation Authority of Nepal
CAA Nepal	Civil Aviation Authority of Nepal
CAT	Category
CBA	Correct Barometric Altitude
CFIT	Controlled Flight Into Terrain
CG	Center of Gravity
CPL	Commercial Pilot License
CRM	Crew Resource Management
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
DCP	Designated Check Pilot
DG	Director General
DI	Daily Inspection
DME	Distance Measuring Equipment
EGPWS	Enhanced Ground Proximity Warning Systems
ELT	Emergency Locator Transmitter
ETA	Estimated Time of Arrival
FDR	Flight Data Recorder
F/O	First Officer
FOD	Flight Operations Division
FOR	Flight Operation Requirements
FSSD	Flight Safety Standards Department
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
HF	High Frequency
ICAO	International Civil Aviation Organization

IFR	Instrument Flight Rules
IMC	Instrument Metrological Condition
IP	Instructor Pilot
IR	Instrument Rating
ITI	Imminent Terrain Impact
JOM	Jomsom
KTM	Kathmandu
LH	Left Hand
LMC	Last Minute Change
LW	Landing Weight
METAR	Meteorological Report
MHz	Mega Hertz
MLG	Main Landing Gear
MTOW	Maximum Take Off Weight
NCAR	Nepalese Civil Airworthiness Requirements
NST	Nepali Standard Time
NTSB	National Transportation Safety Board
OM	Operations Manual
Pax	Passengers
PDA	Premature Descent Alert
PELR	Personnel Licensing Requirements
PF	Pilot Flying
PM	Pilot Monitoring
P/N	Part Number
PIC	Pilot in Command
PIREP	Pilot Reported
PKR	Pokhara
PPC	Pilot Proficiency Check
PSI	Pound per square inch
RH	Right Hand
RMI	Radio Magnetic Indicator
RRTC	Reduced Required Terrain Clearance
R/W	Runway
SB	Service Bulletin
SLL	Service Life Limit
S/N	Serial Number
SOP	Standard Operating Procedure
SRA	Safety Risk Assessment
STA	Station
STOL	Short Take Off and Landing
TAWS	Terrain Avoidance and Warning Systems

TCAS	Traffic Collision Avoidance System
TCH	Type Certificate Holder
TOW	Take Off Weight
TWR	Tower
UTC	Universal Co-ordinated Time
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Metrological Conditions
Z	Zulu time [UTC]
ZFW	Zero Fuel Weight

Synopsis

Operator	Tara Air Pvt. Ltd
Aircraft Type and Model	DHC-6
Registration	9N-AET
Type of Flight	Scheduled Commercial
Location of Accident	Sanusare, Mustang
Person on Board	Flight Crew-2; Cabin Crew-1; Passengers-19
Date of Accident	29th May 2022
All time in this report is in UTC Local Time- UTC+5:45	

On 29th of May, 2022, De Havilland's DHC-6/300, registration 9N-AET, owned and operated by Tara Air Pvt. Ltd. met with CFIT at Sanusare, Mustang while en-route from Pokhara to Jomsom Airport.

The aircraft encountered unwelcomed en-route weather. Inadvertently entering into IMC with its Terrain Avoidance and Warning System [TAWS] inhibited and the PIC's decision to move out from the clouds; ultimately ended in a CFIT, resulting in the death of all onboard. The accident was notified to the concerned authorities as provisioned on Chapter 4, Section 4.1 of ICAO Annex 13. The Government of Nepal constituted a five membered Aircraft Accident Investigation Commission on 30th May 2022 to determine the cause and circumstances of the accidents as per the provision of the Civil Aviation (Accident Investigation) Regulation 2014. The Aircraft Accident Investigation Commission determines that the probable cause of the accident was *the* ***flight crew's failure to monitor and maintain the proper course while inadvertently flying in IMC conditions with the aircraft Terrain Avoidance and Warning System [TAWS] inhibited which resulted into a CFIT accident.***

After thorough and extensive investigation, the commission has issued 10 recommendations; 2 for all operators within AOC of CAAN, 4 for Tara Air and 4 addressed to CAAN for further improvement of flight safety.

FACTUAL INFORMATION

1.1 History of Flight

On 29 May 2022, Tara Air's 9N-AET, Twin Otter (DHC-6/300) aircraft was scheduled for three flights on Pokhara-Jomsom-Pokhara sector. Tara Air had also filed flight plans for two additional Charter flights on the same sector. Among those five flights, four flights were to be conducted by a set of crews already positioned at Pokhara while the last flight was scheduled to be commanded by the PIC who had reached Pokhara from Kathmandu that very morning. Since Jomsom Airport was closed for operations due to bad weather, the PIC went to Tara Air crew camp and waited for the updates of weather improvement of Jomsom.

After Jomsom Airport was open for operations at 0321 UTC, Tara Air operation decided to operate the first scheduled flight. However suspecting the next flight operation to Jomsom could not be operated, the original PIC assigned to the flight seated on board as a passenger to Jomsom for his scheduled business trip and the PIC assigned for the last flight took command. The Flight Plan was amended accordingly. At 0342 UTC, Summit Air's 9N-AKZ, LET-410 took-off from Pokhara to Jomsom. At 0405 UTC, it reported an altitude of 12,500 ft and patches of cloud over Tatopani. At 0409 UTC, Summit Air's second aircraft 9N-AMG, LET-410, took-off for Jomsom and subsequently, at 0410 UTC, 9N-AET of Tara Air (TRA197) took-off with 19 passengers and three crews on board. The Copilot had initially reported 3 crew and 18 passengers onboard to Pokhara Tower but later, revised the passenger figure was 19 prior to takeoff.

9N-AET was supposed to take-off before SMT 601 but the PIC seemed hesitant to commence the flight due to weather PIREP from 9N-AKZ that, the en-route weather was not favorable for VFR flights and critical around LETE and TATOPANI.

All the crew members of TRA 197 and SMT 601 were in their respective cockpits and communicating with the preceding flight 9N-AKZ as well as with Pokhara tower for the updated information of en-route and destination weather. No flights had been conducted since morning and most of the passengers of Tara air and Summit Air were already at airport. In this situation it can be assumed that there was pressure to conduct flight from each angle. While listening to the CVR of TRA 197, it was observed that someone, either ground staff or some intimate passenger to the crew, advising strongly to the PIC to conduct the flight. Following the PIREP from 9N-AKZ, both TRA197 and SMT 601 subsequently started their engines to commence the flights.

The PIC of TRA 197 was still hesitant to conduct the flight for Jomsom even after the engine start and delayed the taxi as he was not yet convinced about the weather report received from preceding 9N-AKZ aircraft. In the meantime, SMT 601 lined up for departure to Jomsom. That was one of the most important pressure points to the PIC of TRA 197 to initiate departure. TRA 197 finally lined up and took off from Pokhara at 0410 UTC following the SMT 601 based on the en-route weather information (VMC) from 9N-AKZ, through Pokhara Tower.

The en-route weather provided by Summit Air's 9N-AKZ to Pokhara Tower and the crew-members of TRA 197 and SMT 601 was not the same.

Aircraft took off from Pokhara from runway 04 heading North. Tower instructed "report 5 DME northwest RW 04". Then after departure at 90 climb power aircraft turned left to maintain a heading of 345 and planned to join heading 305 degree towards Ghodepani. After four minutes, TRA 197 reported, "Now on course…. 6000 climbing and ETA Jomsom 32" (0432 UTC). At 04:21 TRA 197 reported to Pokhara Tower as position approaching Ghodepani 12000 climbing for 12500. After 6 Seconds ATC Pokhara asked TRA 197, "confirm would like to change level and TRA 197 replied, "No Ma'am we have crossed Ghodepani and like to be on". Pokhara Tower instructed, "Tara 197 contact Jomsom Tower 122.5"

CVR recordings show that after TRA 197 crossed Ghodepani, the PIC was not comfortable with the en-route weather. However, the flight was continued following the advice of SMT 601. At 0426 UTC, TRA 197made the first contact with Jomsom AFS and reported its position to which Jomsom Tower conveyed the prevailing weather as "Wind South Westerly up to 30 kts, QNH 1019, Temp 18º". The PIC of TRA 197 reconfirmed twice if the wind was maximum, up to 30 Kts and currently South Westerly-25kts. The crew was discussing about the bad weather being encountered and the PIC himself voiced his dissatisfaction about the behavior of other pilots who conduct VFR flights in such unfavorable weather. The CVR recordings reveal that the aircraft was encountering clouds and the PIC was trying his best to remain clear of the clouds. During the course of flight, TRA 197 hadn't reported any abnormalities encountered and neither any technical defect on aircraft either to Jomsom tower or Pokhara Tower. As per CVR, PIC was searching for light and brighter areas and adamantly heading towards it. As per CVR and V2 tracker data, the aircraft was maintaining 12000 ft and was in a climbing attitude.

During the continuous attempts of crew to avoid the clouds with Terrain Avoidance and Warning System [TAWS] inhibited, the aircraft met with an unfortunate CFIT accident into the rocky terrain at an altitude of 4050 meter AMSL at Sanusare Mountain, Thasang Rural Municipality, Mustang. As per V2 tracker, last position of 9N-AET was 7.7 nm SW of Jomsom Airport. The aircraft was completely destroyed by the impact and there were no survivors.

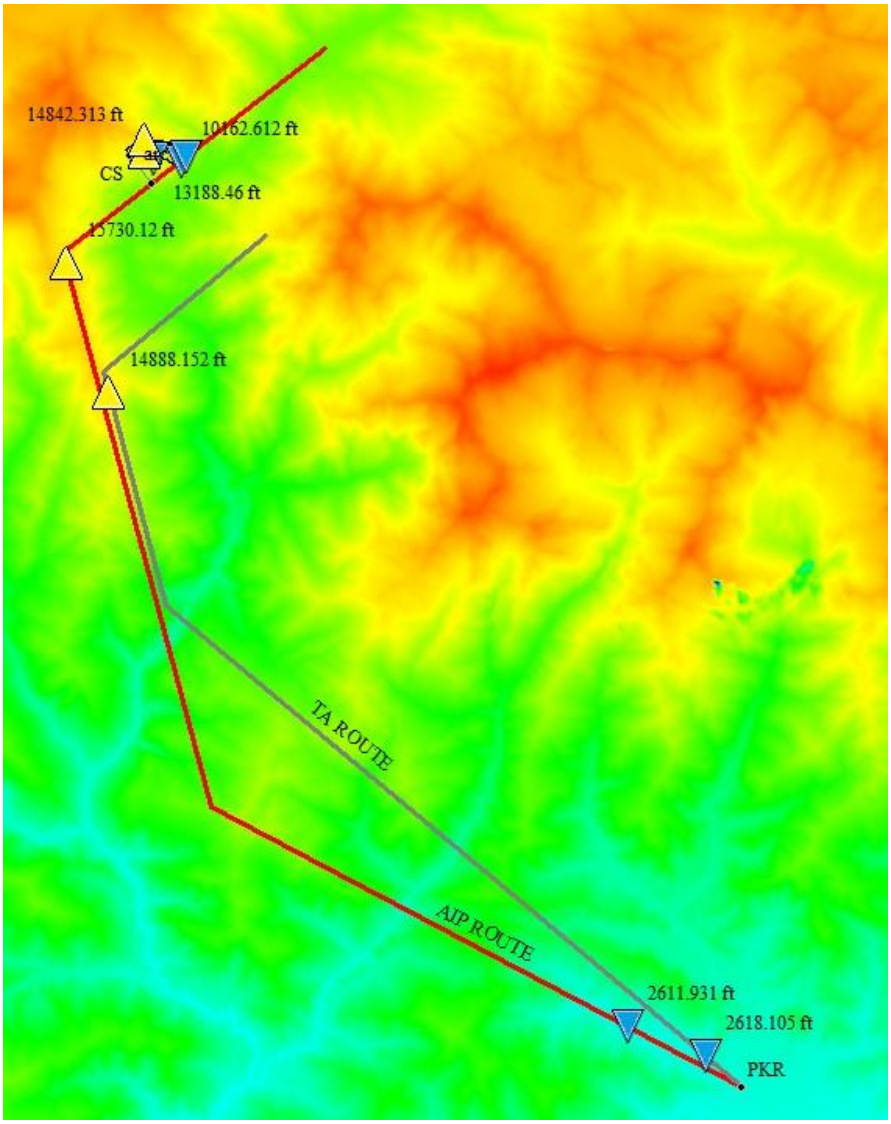

Figure 1 AIP route vs TRA 197's route from PKR to JOMSOM

1.2 Injuries to persons

9N-AET				
Injuries	**Crew**	**Passengers**	**Persons on the Ground**	**Total**
Fatal	3	19	-	22
Serious	-	-	-	-
Minor	-	-	-	-

1.3 Damage to aircraft

The aircraft was completely destroyed due to the impact with terrain.

Figure 2 Aerial shot of the wreckage

1.4 Other damages

The crash site was very remotely located and not easily accessible due to the sloppy and rocky terrain. There was no damage caused to the private property, persons or third party on ground. There was no noticeable environmental effect caused by the accident.

1.5 Personnel Information

1.5.1 Pilot-in Command (PIC)

Date of Birth	: 27 October, 1960
Gender	: Male
Type of License and Number	: ATPL No. 147
License Issuing Authority	: CAAN
Issued On	: 01 January 2001
License Validity	: 31 December 2022
Aircraft Rating	: DHC-6/300, DHC-6/400
	: SAAB340B, J-41(No more valid/Latent)
Instructor Ratings	: DHC-6/300; DHC-6/400.

1.5.1.1 Flight Experience:

Total hours flown	: 17500 Hours
Total hours on DHC type	: 13500 Hours
Flight hours in last 12 months	: 580 Hours
Flight hours in last 3 months	: 166 Hours
Flight hours in last 30 days	: 50 Hours
Flight hours in last 7 days	: 05 Hours
Previous rest period	: Not in Flight Duty on 27 and 28 May

1.5.1.2 Others

Medical Certificate Type	: Class I
Medical Validity	: 30 June, 2022
Aviation Language Proficiency	: Level 5
Language Proficiency validity	: 02 February 2025
Limitation/ Restriction	: Shall wear correcting lens and carry a spare set of spectacles while exercising privilege of license. (+ 1.50 DS both eye)
Marital Status	: Married
Previous Accident/ Incident	: As documents submitted to Commission, No Record found

1.5.1.3 Enforcement (If Any)

Enforcement	: As documents submitted to Commission, Flight Duties with expired English language proficiency (January, 2019)

1.5.1.4 In-service training/courses:

Emergency evacuation training	: On DHC-6/300, 20 June 2021
Simulator Training	: 12-15 August 2019 *
Dangerous Goods Regulation	: 12 August 2020
Route Check	: 21 October 2021(KTM/ Lukla VFR)
PPC with Instrument, IP/DCP	: 27 January, 2022 (Done on Aircraft)
Ground Refresher on DHC-6/300	: 18-20 June 2021
DHC-6/400 difference flight	: 23 July 2015 (familiarization)
Crew Resource Management	: 10 June 2021 (Refresher

•FOR requires biannual simulator for DHC6 Instructor Pilots. However, due to Covid-19 pandemic, the 2021 plan was rescheduled for June, 2022.

Background of PIC

The PIC started his career as an Air Traffic Controller in Civil Aviation Department, and was selected as a pilot trainee and received the training through Government scholarship. After returning from the training, he continued his service in Civil Aviation Department as a pilot and flight safety inspector in Flight Safety Division. Later on, he switched his career to Necon Air (HS-748) a private company and subsequently Skyline Airways (DHC- 6/300), Yeti Airlines and finally in Tara Air (a subsidiary of Yeti Airlines). Since the beginning of his flying career, he was very sensitive to flight safety and never tried to violate rules of the flight. Similarly, he seldom operated in deteriorating or challenging weather and used to teach other colleagues and students regarding flight safety during various situations. He always encouraged others to follow rules without any question. He was in person and also regarded as a strong advocate of safety and compliance.

1.5.2 Co-pilot

Date of Birth	: 28 April, 1997
Gender	: Male
Type of License and Number	: CPL No 605
License Issuing Authority	: CAAN
Issued on	: 13/04/2021
License Validity	: 31 March 2026
Aircraft Rating	: DHC-6 *
IR Validity	: 30 June 2022

**PELR-- Appendix now refers DHC-6 for either 300 or 400 series and does not segregate the individual Type ratings in the License.*

1.5.2.1 Flight Experience:

Total hours flown	: 520 Hours
Total Hours on DHC Type	: 315 Hours
Flight hours in 12 months	: 308 Hours
Flight hours in 3 months	: 112 Hours
Flight hours in 30 days	: 012 Hours
Flight hours in 7 days	: 03:20 Hours

1.5.2.2 Others

Medical Certificate Type	: Class I
Medical Certificate Validity	: 30 March 2023
Aviation Language Proficiency	: Level 4
Language Proficiency validity	: 19 March 2023
Limitation/ Restriction	: Correcting eye glass
Marital Status	: Unmarried
Previous accident/incident	: Nil

1.5.2.3Enforcement (If Any) : Nil

1.5.2.4 In-service training/courses

Dangerous Goods Regulation Training	: 2-3 December 2021
Refresher ground training DHC -6/300	: 25-27 July 2021
Crew Resource Management Training	: 25 June 2021
Pilot Proficiency with Instrument check	: 23 March 2022
Simulator Training (Instrument Trainer)	: 27 August, 2021 (Check ride)
Emergency evacuation training (DHC-6/300)	: 27 July 2021
Route Check	: 14 February, 2022
DHC-6/400 difference Training	: 27 May 2022
DHC-6/400 difference familiarization flight	: 9 March 2022

1.5.3 Cabin Crew

Date of Birth	: March 12, 1996
Gender	: Female
Cabin Crew Certificate Number & Issued by	: TA/CCC/014
Cabin Crew Certificate issuance date	: 11 January, 2018.
Cabin Crew Certificate valid till	: 31 January 2020.
Aircraft Rating	: DHC-6/300, DO-228.
Medical validity	: August, 2022

1.6 Aircraft Information

Tara Air's aircraft 9N-AET Twin Otter (DHC-6/300) had conducted its first flight 42 years and two months ago on April 21, 1979. It was first purchased by Air Botswana in 1979 and was later sold to Lesotho Airways in December 1983. The same plane encountered an accident after striking a tree on approach in 1984. The plane was then purchased by RRCS Air Services before it was purchased by Jetstream Aircraft Sales in 1997. The plane later entered Nepal in 1998 under

its new operator Lumbini Airways but was procured by Yeti Airlines in 1999. The plane had been operated by Tara Air since April 2010.

The Viking Twin-Otter DHC-6/300 is a twin-engine, turbo-prop, non-pressurized, non-retractable landing gear airplane. The structure is an all-metal, high-wing monoplane with a tail plane. The aircraft is equipped with two 620 SHP Pratt & Whitney PT6A-27 turbine engines with 3-bladed Hartzell HC-B3TN-3D Propellers. The standard fuselage fuel tanks installed under the cabin floor have tank capacity of total 2576 pounds Jet A1 and 99% of the fuel is available in flight.

The aircraft had basic engine instrumentation and navigation /communication equipment. Later on the aircraft was modified to have different avionics equipment like GPS, TAWS [EGPWS], TCAS, CVR, AHRS, and weather radar.

Figure 3 Cockpit layout of 9N-AET

Operator	: Tara Air
Owner	: Tara Air
Manufacturer	: De Havilland Canada
Present Manufacturer	: Viking Air Limited, Canada
Model/Type	: DHC6-300
Type Certificate Number	: A-82(Canada)
Type of flight	: VFR/IFR
A/C MSN	: 619
Year of manufacture	: 1979
Registration	: 9N-AET

Number of engines	: 2 (Two)
Classification Aircraft Category	: Transport (Passenger)
Total Times since New	: 41336:09Hours
Total Cycles since New	: 71338 Cycles
Issue of Certificate of Registration in Nepal	: 22/09/1998
Validity Date of Certificate of Airworthiness	: 15 July 2022
Validity Date of Radio Mobile License	: 15 July 2022
Validity of Certificate of Release to Service	: 41350: 14 Hours or 25 June 2022

1.6.1 Engine

Manufacturer	: Pratt and Whitney, Canada	
Model/Type	: PT6A-27	
Engine Position	Left Side	Right Side
Serial Number	: PCE-PG0025	PCE-50981
Total Time since New [TTSN]	: 23803:04	17693:47
Total Cycles since New [TCSN]	: 35228	22466
Time since Overhaul [TSO]	: 2386:45	3138:44
Cycle since Overhaul [CSO]	: 4207	5797
Last Overhaul Done Date	: 18 Sep 2020	19 Aug 2019

1.6.2 Propeller

Manufacturer	Hartzell Propellers	
Type	HC-B3TN-3D	
Propeller position	LH	RH
Serial No	BUA29350	BUA22078
Installed Date	24 Apr 2021	14 Apr 2022
Total Time Since New (TTSN)	5072:31Hrs	8083:20 Hrs.
Time Since Overhaul	1664:31 Hrs.	166:13 Hrs.
Cycle Since Overhaul	2865	323

1.6.3 Aircraft Maintenance History

The aircraft was being maintained as per CAA Nepal Approved Tara Air DHC6 Approved Maintenance Program [AMP Document No: TA/DHC-AMP/2013] Issue 03 Revision 02 by Yeti Airlines, a CAA Nepal Approved Maintenance Organization.

Other Scheduled Maintenance:

1. Last C of A Test Flight Carried out on 27th July 2020

2. Hot Section Inspection on LH Engine: 13th Dec 2021
3. Hot Section Inspection on RH Engine: 1st July 2021
4. Last Engine Ground Run [Performance] Check carried: 8th Apr 2022
5. Last 125 Hours Check [Check 21] carried out on 26th April 2022 with next due on 41350:14 hours or 25th Jun 2022.
6. Last NAV DATA update carried out on 19th May 2022 with next due on 16th Jun 2022
7. Last 7 Days [Weekly] Inspection carried out on 24th May 2022
8. Last DI Performed on 28th May 2022
9. Last Pre Flight-Inspection carried out on 29th May 2022 Other Scheduled Maintenance:

1.6.4 Modification Status

Life Extension Program: Replacement of the following structural parts

1. Wing Strut Assembly [SLL: 36000 Hours/ 72000 Cycles]
   - LH : 01 Aug 1998
   - RH : 14 Feb 2018
2. Wing Structure Box [SLL: 33000 Hours/ 66000 Cycles]
   - LH : 21 Jul 2014
   - RH : 18 Jul 2014
3. Link Strut Assembly [SLL: 36000 Hours/ 72000 Cycles]
   - LH & RH : 14 Feb 2018
4. Fuselage Frame Assembly [SLL: 39000 Hours/ 78000 Cycles]

Non TCH Modifications for Avionics Equipment/System

Date	Description
7 Jan 2013	Installation of V2 Tracker
12-Mar 2014	Removal of Existing CVR and Installation of digital CVR-120A
3 Jun 2014	Installation of single SANDEL ST3400 “CLASS A” TAWS/RMI Systems
3 Jun 2014	Installation of TCAS I system
3 Jun 2014	Installation of Air Data Computer SAC 7-35 ADC
3 Jun 2014	Installation of Free Flight RA4500 Radar Altimeter
21 Feb 2017	Installation of Dual GTN 750/650 GPS/NAV/COM System
21 Feb 2017	Installation of Garmin Weather Radar GWX70
21 Feb 2017	Installation of KR-87 ADF
21 Feb 2017	Installation of SG102 AHRS
21 Feb 2017	Installation of KN-63 DME
21 Feb 2017	Installation of KR-21Marker Beacon Receiver
21 Feb 2017	Installation of Pilot KI-525A HIS
21 Feb 2017	Installation of Copilot RDI-444 Radio Deviation Indicator
21 Feb 2017	Installation of Copilot KNI-582 RMI

1.6.5 ADs/SBs Status

All applicable Airworthiness Directives have been complied and the repetitive inspections required as per the applicable Airworthiness Directive are being carried out at the interval specified in the respective AD.

All applicable Mandatory Service Bulletin have been complied. With the review of Continuing Airworthiness Records, there are no due for accomplishment of applicable Airworthiness Directives and Mandatory Service Bulletin.

1.6.6 Flight and Navigation Instruments

The following Flight and Navigation Equipment were installed on the aircraft.

Description	Part No.	Model	Make
GPS	010-00813-50	GTN-650	Garmin
GPS	010-00820-50	GTN-750	Garmin
RMI	066-3060-00	KNI-582	King
HSI	066-3046-03	KI-525A	King
HSI	2592920-444	RD-444	Sperry
DME Transceiver	066-1070-01	KN-63	King
Directional gyro	2587193-43	C-14A	Sperry
Radar Altimeter	84560-12-300A	RA-4500RX	Free Flight
Attitude Gyro	4300-311	4300	Mid Continent
Flight Director	622-1352-001	FD-112V	Collins
TAWS/RMI	90131-N	ST3400	Sandel
TCAS I	805-11900-001	TRC899	L3 Communication
Weather Radar	010-00793-00	GWX 70 R/T	Garmin
AHRS	90222-C	SG102	Sandel
Marker Beacon	066-1021-01	KR-21	King

1.6.7Aircraft Weight and Balance

Last Aircraft Weighing was carried out on 4th March 2018

Basic Empty Weight : 7473 lbs.
Center of Gravity : 214.30 inch

Weight and Balance Amendment #1 on 26th July 2020 for installation of Fuselage Frame Assembly at STA 218.82

Basic Empty Weight : 7473.029 lbs.
Center of Gravity : 213.20 inch

As per Load & Trim Sheet of 9N-AET Flight TR-197 PKR-JOM on 29th May 2022

Basic Empty Weight : 7473 lbs.
Crew : 473 lbs. [Two Male and One Female]

Extra Equipment : 22 lbs.

The final pax manifest is summarized in table below:

		Number	Weight(kg)	Weight(lbs)
Nepalese/Asian Male	**ADULT**	11	825	1818
Nepalese/Asian Female		6	390	860
Foreign Male		1	82	181
Foreign Female		1	75	165
Total		19	1372	3018
Include, LMC +1 NEP M PAX: 165 lbs.				

Baggage Weight : 330 lbs.
Fuel : 1300 lbs.
Take Off Weight : 12451 lbs. [MTOW: 12500 lbs.]
Actual Take-off Weight for the flight : 12616 lbs. [Excess of 116 lbs.]
Actual Landing weight : 12300 lbs. [The flight exceeds the LandingWeight]
The weight category is as per Flight Operations Directive-08 published by CAAN.

It is observed from the Load and Trim Sheet that one adult Nepalese male was included at the last minute. To accommodate the LMC, equivalent weight of baggage (1 Nepalese male pax) was shown reduced, keeping the TOW and LW unchanged. However, since there are no evidences to justify the LMC, it can be concluded that the LMC was made hastily in the Trim Sheet, thus, resulting in an inappropriate actual aircraft loading with possible MTOW exceedance and assumably MLW exceedance.

It is also observed that although the standard weight calculation for each category is calculated correctly (before LMC) but the Load and Trim Sheet has different values for standard weights. The trim sheet also lacks fuel information.

1.6.8 Crew Oxygen

A portable Oxygen Cylinder 22 cubic feet, 1800psi (Zodiac AVOX P/N: 25200-22, S/N: 5047) was installed in the cockpit.

1.6.9 Limitation of Privileges Regarding Age of Pilots

1.6.9.1 ICAO Standard

A Contracting state having issued pilot licenses, shall not permit the holders thereof to act as pilot of an aircraft engaged in international commercial air transport operation if the license holders have attained their 60th birthday or in the case of operations with more than one pilot, their 65th birthday. *(Appendix 1: Annex 1 Personnel Licensing 2.1.10)*

1.6.9.2 CAAN Requirements: The 60-65 Years Rule

1. Pilots holding Nepalese licenses shall not act as pilot of an aircraft engaged in commercial air transport operations if the license holders have attained their 60th birthday or, in the case of operations with more than one pilot, their 65th birthday.

2. Holder of pilot license having attained their 65thBirthday shall not be permitted to exercise the privilege of license in commercial air transport operations.

3. Prescribed medical and licensing restrictions shall apply. (*Appendix 2: PELR 5th Edition, 1.17, Part 1-11)*

1.6.9.3 CAMR 1.26.3 THE 60-65 YEARS RULE

The provision regarding the age of crew is provided in Civil Aviation Medical Requirement of CAAN is as follows: Permission to act as flight crew is also dependent on the age provisions set out in Personnel Licensing Requirements. Prescribed medical and licensing restrictions shall apply.

1.7. Meteorological Information

1.7.1 Prevailing weather situation in Nepal:

The weather situation prevailing in Nepal and surrounding areas in South Asia on 29 May 2022 have an effect of:

•Weak Westerly wind and

•Low pressure system over head Bay of Bengal

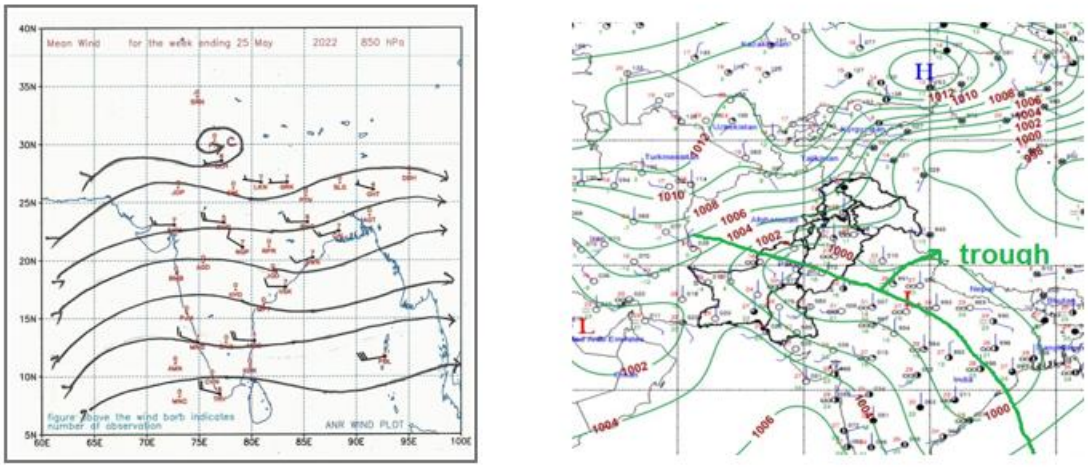

Figure 4 a) Westerly wind and b) weak trough extending from Bay of Bengal

On 29 May 2022, monsoon onset took place in Kerala, India resulting change in weather condition in Nepal and adjoining South Asia. The onset of monsoon is however 3 days ahead of normal date which is 01 June.

Weather at Pokhara Airport

Pokhara Airport observed a light rain and drizzle in the morning till 06:35 NST with horizontal visibility of 3000 m as observed in METAR from Pokhara. However, visibility increased to 6000 m starting from 07:35 AM with no rain. And, the weather improved to partly cloudy with dominance of dense cloud at some parts of the valley as seen in satellite image given below.

Weather at Jomsom Airport:

The weather situation in Jomsom airport in the early morning was cloudy with light rain. However, the weather improved to partly cloudy at the accident time with some blue sky. A wind of SW 26 knot surface wind at 10:05 AM, 29 knot at 10:15 AM and 31 knot at 10:25 AM prevailed at Jomsom Airport.

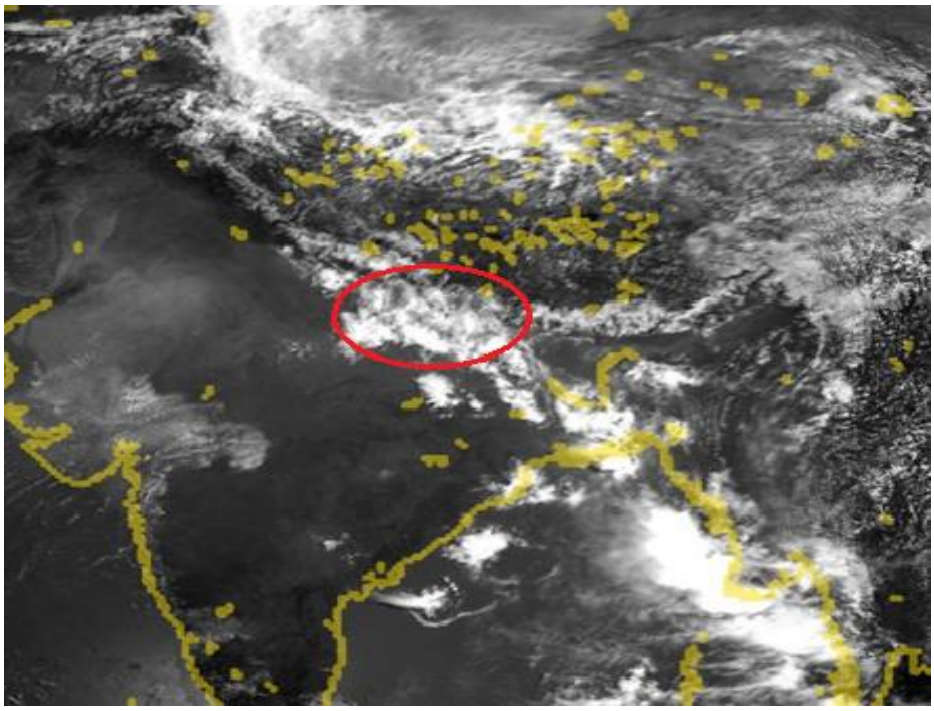

Figure 5 Visible image at 04 Z, 29 May 2022 (Source : Weather News, Japan)

1.7.2 Enroute weather condition along Pokhara - Jomsom route

Surface winds along the flight route from Pokhara to Jomsom show a south-westerly wind prevailing over the Gandaki province of Nepal. 20 to 25 knot wind speed in Marpha and surrounding area noted from synopsis of Meteorological Forecasting Division, Nepal.

High altitude wind showed predominance of south-westerly wind as of high-level wind forecast of Meteorological Forecasting Division. Further, Meteorological Forecasting Division, under Department of Hydrology and Meteorology showed north westerly winds dominating with speeds ranging from 15 – 30 Knots at different flight levels. At the same time, Pokhara Airport's automatic weather system (AWS) shows an average wind having speed of around 5 to 7 knots in Pokhara.

Investigation on meteorological report shows an availability of weather observatory installed by Department of Hydrology and Meteorology near by the accident site is a Climate Station in Lete. As per report made by observer from Lete climate station, upon inquiry, found that the weather on 29 May 2022 beginning from early morning in Lete and surrounding areas till the aircraft crash time was covered by dense fog and cloud. And light drizzle was noted. As per the information received from the locals since early in the morning the Lete and Tatopani area was covered by dense fog.

As reported by the PIC of Summit Air's 9NAKZ, the en-route weather condition during the flight was cloudy with light drizzle at one or two places till it reaches to the Jomsom valley entry point. Inside the Jomsom Valley the weather was a partly cloudy with lot of blue sky.

Figure 6 Live camera image of Jomsom Airport, at 04Z, 29 May 2022(Source: Weather News, Japan)

As per the CVR data it is proved that the en-route weather at the time of accident was cloudy and weather was IMC. There was no possibility of VFR flight. It is noticed that the nearer weather observatory installed by Department of Hydrology and Meteorology was stationed near by the accident site Lete and as per weather report obtained from Lete climate station, it is found that the

weather on 29 May 2022 in Lete and surrounding areas beginning from early morning till the aircraft was covered by dense fog and cloud and some light drizzle.

1.8 Aids to Navigation

1.8.1 Pokhara

Pokhara Airport is equipped with a Radio Navigation and Landing Aid VOR/DME.

1.8.2 Jomsom

Jomsom is an Aerodrome Flight Information Service (AFIS) airport. Jomsom Airport is not equipped with any navigation facility.

1.9 Communication

1.9.1 Pokhara Airport

Pokhara Airport is one of the busiest domestic aerodromes. Because of the airport layout and terrain around there is no possibility of IFR flight. However the tower is providing positive control to the VFR traffic.

Type of Service	: ATS Communication Facilities Service
Pokhara Tower Frequency	: 118.475 MHz/123.8 MHZ

1.9.2 Jomsom Airport

Jomsom airport is an uncontrolled STOL aerodrome that provides Aerodrome Flight Information service (flight information and alerting service) only. The airport Tower is equipped with the communication facilities which include VHF, HF and telephone. There were no reported or known communication difficulties. Tower frequency: 122.5 MHZ

1.10 Aerodrome Information

1.10.1 Pokhara (Origin) Airport Information

Airport	: Pokhara Airport (VNPK)
Aerodrome Reference Point	: $028^0$12' N 083^0 58' E
Elevation	: 2684ft. (818m) AMSL
Reference Temperature	: 35^0 C (June)
Runway Designation	: 04/22
Runway Dimension	: 4700ft.X98ft.
Wind Sock	: Available on both sides of the runway
Landing/take off	: Both way
Runway Surface	: Bitumin (Asphalt)
Types of Traffic Permitted	: VFR
MET Briefing	: Half Hourly METAR, during ATS Operation Hours

1.10.2 Jomsom (Destination) Airport

Airport	: Jomsom Airport
Aerodrome Reference Point	: $93^0$43' 21" E $28^0$46'53" N
Elevation	: 8976ft. (2736m) AMSL
Runway Designation	: 06/24
Runway Dimension	: 2424ft. X66ft. (739X20m)
Wind Sock	: Available at 06
Landing/take off	: Bitumin (Asphalt)
Operation Hours	: 0600 to 1800 LT
Serviceability	: All Weather
Re-fueling facility	: Not Available
Type of Service	: AFIS
Type of Traffic Permitted	: Visual Flight Rules (VFR)
Type of Aircraft (Suitable)	: D228, DHC6, L410, Y12 etc.

Jomsom Airport is a domestic airport Situated at Gharpajhong Rural Municipal in Jomsom serving Mustang District, of Gandaki Province in Nepal. It serves as the gateway to Mustang District that includes Jomsom, Kagbeni, Muktinath temple, Tangbe, Damodarkund, Lo Manthang and, Annapurna trekking circuit, which are popular tourist and pilgrimage destinations for Nepalese and foreigners. The airport is situated at the bank of Kali Gandaki River lying in between majestic mountains Dhaulagiri, Annapurna, Nilgiri and other towering peaks. Jomsom valley is one of the major tourist's destinations of Nepal, so the airport remains busy during the tourist and holy festival season.

1.10.3 Categorization of STOL Airfields (FOR CAAN, Rev. 03/21-06-2021, CHAP 14-6)

Jomsom Airport is categorized as follows as described in CAAN Flight Operation Requirement as follows:

Category A STOL Airfield: Those STOL airfields located below 5500 feet AMSL and where missed approach is possible.

Category B STOL Airfield: Those STOL airfields which are below 7000 feet above mean sea level and where missed approach is critical.

Category C STOL Airfield: Those STOL airfields which are at or above 7000feet above mean sea level, approach is difficult due to local weather conditions and where missed approach is not advisable or possible after a certain point during the approach and landing phase.

Provision regarding PIC clearance is as follows (CH 14-6)

CAT B Airfield- Jomsom Airfield is CAT B airfield for multiengine aircraft operation.

- A Pilot must have accomplished at least 100 STOL missions and 12 months experience to any Cat B or Cat C airfield after acquiring CAAN ATPL and every STOL field of this Category should be cleared after completing at least five missions with an Instructor Pilot in each airfield and checked by another Instructor Pilot in the sixth mission.
- Clearance to Cat A and B airfields may not be commenced until 12 calendar months have passed since the pilot was upgraded to P1 status and the experience requirements of Section 2 have been satisfied.

CAT C Airfield- Jomsom Airfield is CAT C airfield for Single engine aircraft operation.

A Pilot must have accomplished additional 150 missions, in Cat C airfields. For multi-engine aeroplane, having accumulated at least 2500 hours and after being upgraded to P1 status, 18 months must have been completed prior to beginning the clearance of CAT C airfields; and for single-engine aeroplane, a minimum of three years for multi-pilot operations and four years for single-pilot operations after receiving the CPL license. Cat C airfields may not be cleared until a pilot has completed the experience requirements of Section 2. Each airfield of this category should be cleared after accomplishing ten missions in each airfield and checked by an Instructor Pilot in the eleventh mission.

1.10.3.1 Tara Air SOP for STOL Operations

Policy

The company will operate within the regulated weight and other operating limitations as approved by CAAN.
a. All take-offs from STOL airfields will be made with the flaps at 20 degrees.
b. If a tail wind or head wind is encountered, the aircraft flight manual shall be consulted, and the maximum permitted take-off weight adjusted accordingly.
c. The maximum permitted take-off weight is calculated without the intake deflector extended, with either a soft earth, or firm dry sod runway, and a runway gradient correction.
d. All the maximum take-off and landing weights are calculated based on 70 % of the runway length being available for the ground run, using the graph for the DHC-6 Twin Otter 300/400 series.
e. All the calculations are based on an outside air temperature in degrees centigrade, and all weights are given in lbs. (conversion 2.2 lbs =1kg).
f. The pilot-in-command is responsible for calculating the maximum take-off weights for airports other than those listed in the templates. *(Appendix 3: Tara Air SOP for STOL operations)*

1.10.3.2 Take-Off and Landing Limitations

a. Take-off and Landing weight: As approved by CAAN.
b. Visibility: Not less than 5 KM.
c. Maximum Wind Vectors: 10 kts Tail wind / 15 kts crosswind
d. Variable wind: up to 8 kts
e. Ceiling: 1500 feet AGL

8.5 JOMSOM

IDENT	GPS Coordinates:	CATEGORY	VHF
VNJS	28°46′52″N 083°43′20″E	B	122.50
Length/Width	**Elevation**	**Surface / Slope**	
810 x 20 m (2657 x 65 ft.)	8976 ft./2736m	PAVED / N/A	
QNH: LOCAL	**TAKEOFF RWY 06/24**	**LANDING RWY 06/24**	
RFFS	Ultra-high pressurize system fire vehicle available Complementary extinguishing agents and fire extinguisher available.		

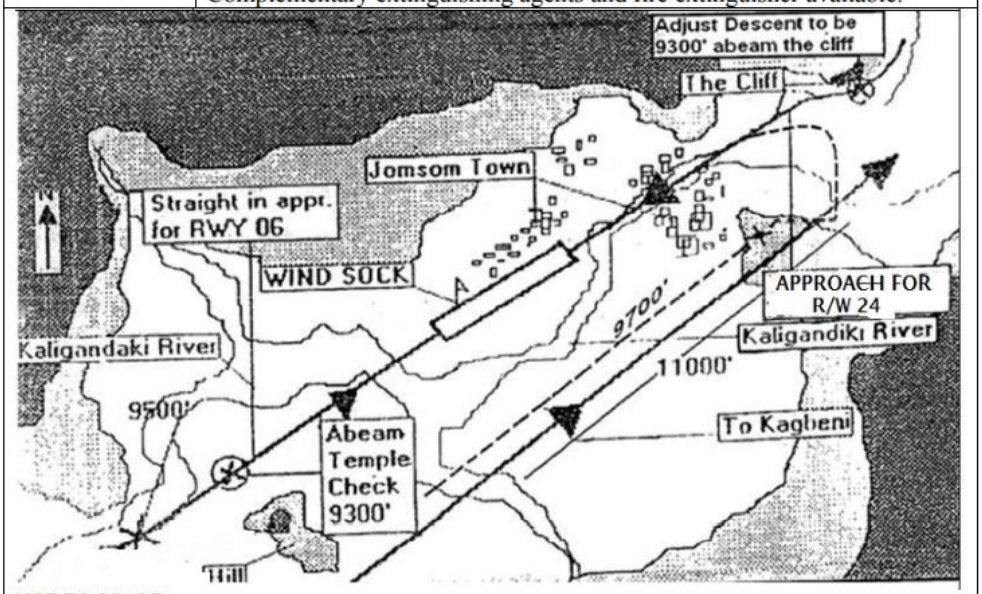

Figure 7 Jomsom Airport Information

1.10.3.3 Safety Recommendation as per SOP of Tara Air for Jomsom Airport

a) Use local QNH. If unavailable use latest KTM QNH.
b) At a position abeam the temple, check 9300ft. for a R/W 06 approach.
c) Left hands circuit for runway 24, at 11000 ft, if planning to turn at Kagbeni.

d) Every morning, the wind blows from the north. Winds exceeding 10kts from the north can cause considerable turbulence in the valley. After 1000 hours, the wind changes direction, and blows from south. Wind speeds can go up as high as 60 to 70knots.
e) Avoid operation in the afternoon as far as possible.
f) The direct sun glare on final approach for runway 06 can cause difficulties with landing in the early morning.
g) During winter, avoid flying with winds above northerly 5kts, if winds of more than 20 knots blew continuously throughout the previous night.
h) It is not recommended to operate if wind exceeding southwesterly 30 kts and early morning wind Northerly / North Easterly 10 kts.
i) It is recommended to avoid making close circuit inside the main valley to make an approach for runway 24 during turbulence.

1.10.3.4 Tara Air Operation Manual General Instruction

A. Take-off

a) Flight shall not be dispatched unless the mass and balance of the aircraft at the time of take-off are within the maximum take-off weight as specified in the aircraft flight manual under the prevailing conditions:

1. The regulated or restricted take-off mass.
2. The forecasted landing mass.
3. The zero fuel weight as applicable.

b) The center of gravity of the aircraft during the flight lies within the range specified in the specific flight manual.

c) The performance requirements, calculated from the data scheduled in the aircraft flight manual for the conditions obtain at the time shall be met. The significant parameters are scheduled in the aircraft flight manual.

d) The aircraft shall not take-off if the mass of the aircraft at the commencement of take-off run exceeds the limiting mass which is specified as the maximum for take-off at the altitude of the aerodrome, for the ambient temperature at the time of takeoff, the slope and condition of the runway the reported wind component and obstruction on take-off path.

e) The aeroplane shall be able in the event of a power unit failing at any point in the take-off either to discontinue the take-off and stop within the accelerate stop distance available or to continue the take-off and clear all obstacles along the flight path by an adequate margin until the aircraft is in a position to comply with the requirements.

B. Landing

Expect in emergency, an aircraft shall not land, if the mass of the aircraft at touch down exceeds the maximum landing mass corrected for altitude of the aerodrome, temperature, slope and condition of landing runway, wind component and obstruction of approach.

C. Last Minute Change (LMC)

Last Minute Change means any change concerning traffic load: passengers, baggage, cargo, fuel occurring after the issuance of the Load and Trim sheet. A Last-Minute Change is permitted only if the changes of the load are within prescribed limits or operational envelope. In case of Last-Minute Change, it is mandatory to check that:

1. None of the maximum operational limiting weight are exceeded (ZFW, TOW, LW)
2. No loading limitation is exceeded
3. ZFW CG, TOW CG and LW CG remain within allowed limits.

In case of Last-Minute Change loading, the dispatcher or load control personnel shall correct the previous Load and Trim sheet. *(Appendix 4: Operation Manual 8.5.2.1 Part A)*

1.10.3.5 Crew Rostering and Pairing

Tara Air (OM-A, General, Chapter-5, Crew Composition) Provides:

The Company shall take care when scheduling flight crew members that any pairing shall include an experienced pilot for 2 crew operations. Pairing inexperienced pilots shall be avoided at all times. The company shall use the following requirements to avoid such inexperienced pilot pairing.

a) After obtaining P1 or P2 rating a pilot shall fly a minimum of 50 hours with DCP/Instructor Pilot under supervision, and shall complete the clearance requirements as mentioned in this manual to ensure sufficient experience before scheduling with a line captain.
b) A newly licensed co-pilot shall be scheduled to fly a minimum of three flights with company DCP/IP, and one other experienced first officer shall be scheduled as supernumerary (S/N) crew on board. After a release report has been signed by DCP/IP that co-pilot may be scheduled as a F/O under supervision flying with DCP/IP without another S/N co-pilot on board.

1.11 Flight Recorders

A. Cockpit Voice Recorder (CVR)

The aircraft 9N-AET was equipped with Universal Avionics, Combined Cockpit Voice Recorder (CVFDR), part number 1606-00-01 and serial number 858; The CVR was recovered with its case intact and without any significant damage. The CVR-120A is capable of Recording 120 minutes of cockpit voice and ambient audio. However, the CVR Four Channel Audio was downloaded for 120 minutes.

B. Flight Data Recorder (FDR)

9N-AET was equipped with CVFDR with 25 hours of flight data (minimum) recording capability. However, since the aircraft was not equipped with the required sensors and flight data acquisition system for flight data recording, no flight data were recorded in the recovered CVFDR.

1.12 Wreckage and Impact information

During the crash site visit, the location of the first impact of the aircraft as recorded in the portable GPS is as follows:

28^0 42' 57" N and 83^0 35' 39" E
Elevation: 4050 m AMSL

It was observed that 9N-AET, Viking DHC-6/300 aircraft was completely destroyed due to the hard impact on the cliff at an altitude of 4050 meter AMSL. Most of the body parts of the aircraft are found disintegrated from the main body. The aircraft's main fuselage including the cabin section and flight deck was severely damaged due to impact and was lying at the right side of the ridge.

The main wreckage consisted of wings and damaged portions of cabin & cockpit. The left main landing gear, with its wheel assembly intact, was found near the main wreckage.

The LH Wing was found lying upside down at right side of the ridge with its tip severely damaged near the main fuselage wreckage. The left engine with its propeller assembly was found in the gorge, left side of the ridge. The right wing was found lying on top of the ridge along with a part of fuselage attached.

RH propeller assembly was found stuck in the ground with its blades in relatively FINE position detached from the engine in the flight path direction with reference of simultaneous first impact of RH MLG Wheel Assembly.

The main wreckage was found around 20 meters ahead of the first impact position at LH side of its flight path. The RH Wing assembly was found on the top of the ridge with RH Engine lying beside. The tail section of the fuselage was found LH side of the ridge.

The Rudder with horizontal stabilizer was located into the gorge downhill of the main wreckage area. CVR and ELT were located intact at their installed position along with a section of empennage which was over the ridge left side of the main wreckage.

The right engine was found at the area of right-wing assembly. The instrument panels and engine control were completely damaged by the impact force all the cowlings and fairings were in a damaged condition. Based on the data collected during the crash site visit by the commission members; the following observations were made:

The airplane initially impacted with its right main landing gear wheel and right propeller. The point of first impact was approximately 30 meters right side downstream from the main wreckage.

The measurements of the main subsequent impact area were 30 meters long by 20 meters wide, with the wreckage aligned slight LH side on a heading of flight. After the first impact with the RH MLG Wheel and the RH Propeller, the aircraft moved ahead with left hand roll and the aircraft's main fuselage impacted on the ridge at LH side of the flight path. Both the wings were found around the main wreckage. The RH Propeller found detached from the engine at the impact and stuck in the ground with its propeller blade in fine pitch. The LH engine and the stabilizer along with the rudder were found in the gorge downstream RH side of the main wreckage area. The RH engine was found along with the RH wing. There was no evidence of any fire after the impact of the aircraft on the ground. CVR/ELT were located along with aft fuselage area at the main wreckage area on the other side.

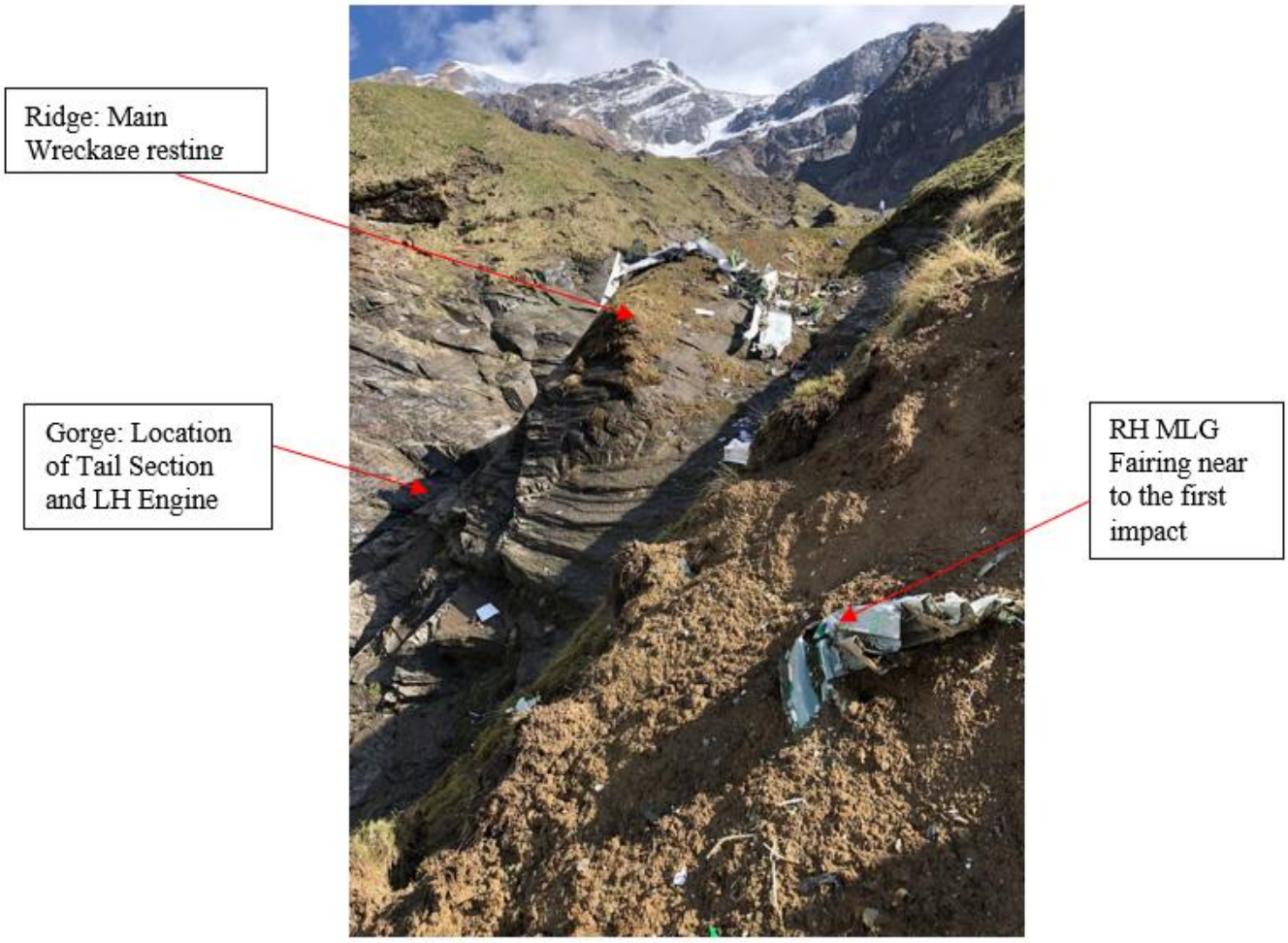

Figure 8 Wreckage Distribution

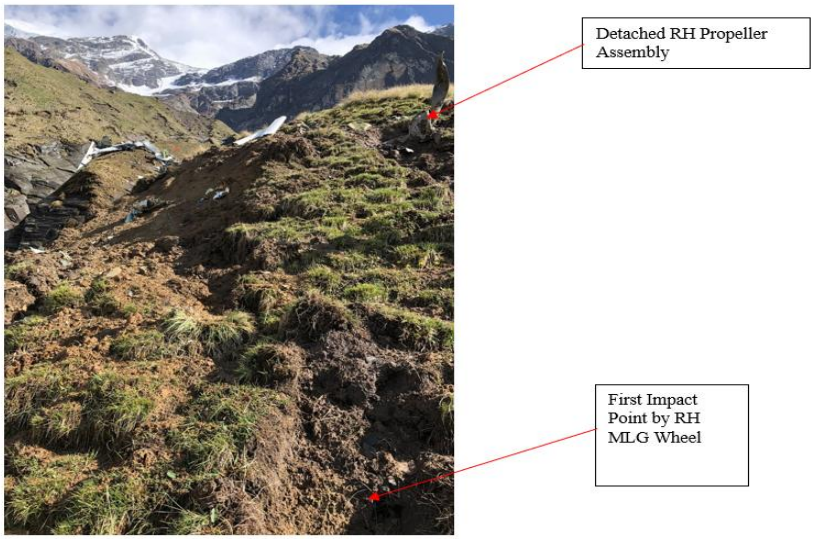

Figure 9 First Impact position

Figure 10 GPS reference of the Crash SIte

1.13 Medical and Pathological Information

1.13.1 Medical Information

A. The Pilot in Command (PIC)

The latest medical examinations took place according to the Civil Aviation Authority of Nepal's requirement according to the CAAN approved Civil Aviation Medical Requirement.

Decisions on fitness to fly were taken on the basis examination by CAAN approved medical examiner.

As per the medical record,

1. The PIC was medically and psychologically found fit.
2. The only relevant medical finding is the PIC shall wear correcting lens and carry a spare set of spectacles while exercising privilege of license. (+ 1.50 DS both eye) corrected satisfactorily with spectacles
3. No health defect existed prior to or to the time of the accident.
4. Previous medical history and findings of examinations, as well as interviews with family members and acquaintances, give no indications of abuse of alcohol, medicines or drugs.

B. The Co-Pilot (F/O)

The F/O was medically and psychologically found fit.

1. No significant health defect existed prior to or to the time of the accident.
2. Previous medical history and findings of examinations, as well as interviews with acquaintances, give no indications of abuse of alcohol, medicines or drugs.

1.13.2 Pathological (Forensic) Findings (Nepal police forensic laboratory)

As a result of the very high impact energy, all occupants of the aircraft suffered very serious injuries to all vital organs. Because of the massive destruction, the cause of the death as reported by the report is due to multiple blunt trauma all over the body. The result of pathological examination showed negative test for common pesticides, common narcotic drugs, and common phosphine for all three crew.

1.14 Fire

There were no evidences of fire before or after impact. There were no external or internal burn injuries to any crew's or passenger's body.

1.15 Survival Aspects

The accident was fatal with no survivors.

1.16 Test and Research

With the analysis of CVR and V2 Tracker Flight Simulation, it is considered as a typical case of CFIT Accident. During the CVR Read out Analysis, it is observed that there was no warning of TAWS [Forward Looking Terrain Alert] annunciated except the GPWS Warning annunciated and recorded in the CVR at the last moment with aural warning of Pull Up.

Hence, the commission has decided to send the TAWS unit to NTSB to find out whether the unit was inhibited for the flight and status of any warnings/alerts latched during the flight.

The Flash memory chips from ST3400 serial number 6-7379 were provided for insertion into a bench AST3400B loaner board for subsequent data extraction and data analysis. The donor board was placed onto a SN3500A chassis for power connection and USB access to offload the recorded data.

The ST3400 configuration parameter and data record files were obtained from the flash memory from the ST3400 TAWS/RMI unit S/N 6-7379.

1.17 Organizational and Management information

1.17.1 Tara Air

Tara Air Pvt. Ltd., a subsidiary of Yeti Airlines, is an airline headquartered in Kathmandu, Nepal. Tara Air was formed in 2009, is based at Tribhuvan International Airport with a secondary hub at Nepalgunj Airport and is the biggest domestic air service provider in the Nepalese STOL airfields. Tara Air, before the accident operated a fleet of four STOL aircraft, comprising of three Twin Otter DHC-6/300 aircraft.

Tara Air was established by the owner of Yeti airlines to dedicate its service at STOL airports with the DHC6-300 and Dornier DO228 aircraft fleet.

As per FSSD, CAAN, AID had audited the airline on 23rd and 24th March of 2021. The audit area was CAMO only, because of Maintenance contracted out to Yeti Airlines. The status of findings of the audits was 5 in CAMO Conformity and 9 are in Conformity with Requirements of NCAR Part M. All are level 2 findings. Current status of audit loop is closed.

FOD had also audited Tara Air on 22nd and 23rd March 2021. The Audit area was compliance with Flight Operation Regulation. As per Audit report, there were 10 Corrective actions Notice given to Tara Air, which excluded the Aircraft and Ramp inspection. All findings are of level 2. A Corrective Action Plan (CAP) was submitted by the Director of Operations on 25th April 2021 and was accepted by FOD on 28th April. On 29th July 2021 FOD conducted Follow-Up Audit regarding Findings of FOD. Current status of Audit loop is closed.

1.17.2 Flight Monitoring

Tara Air has implemented Safety Management System (SMS) and Voluntary Reporting System (VRS) and has a safety and quality office dedicated for the monitoring of flight operations.

The airline has introduced V2 track in all its fleet to monitor the progress of each flight from the back-end office. Although this has no capability of two-way communication to exchange the necessary information, it is useful for the assurance of the position of all aircrafts in flight.

1.17.3 TAWS Warning

The CVR Readout Analysis reveals that the aural warning of GPWS, a part function of TAWS, was triggered approximately just 3 seconds prior to the impact. However, there was no aural warning of enhanced Forward Looking Terrain Alert [FLTA], Premature Descent Alert [PDA], and Imminent Terrain Impact [ITI] Alert/Warning function of TAWS annunciated and recorded in the CVR.

Through sophisticated look-ahead algorithms, Alerts are generated if terrain or an obstacle conflict with the flight path angle of the aircraft. This potential conflict area projects forward and to the side of the aircraft. If any terrain alert occurs, the TAWS Alert Text is shown at the bottom of the screen and an audible alert message will occur on the cockpit audio system. The REL [Relative Altitude] terrain display screen is automatically selected at appropriate range to put the alerting terrain onscreen. This action occurs on any alert including GPWS.
During enroute operations, a caution typically occurs approximately 60 seconds ahead of the terrain conflict. A caution will turn into warning if evasive action is not taken.

As the pilot had selected TAWS INHIBIT for the accident flight, there were no TAWS FLTA [Forward Looking Terrain Alert] Premature Descent Alert [PDA], and Imminent Terrain Impact [ITI] Alert/Warning shown in the TAWS and no relevant TAWS Warnings annunciated and recorded in the CVR. However, there was GPWS warning annunciated and recorded in the CVR just before the impact and recorded in the CVR.

2. ANALYSIS

2.1 Introduction

The analysis of the events which led to the accident began with the careful scrutiny of the evidences/factors such as technical logs, relevant documents, manuals, SOP, weather reports, CVR data, interview and statements of the witnesses, experts' advice, medical and pathological reports, human factor analysis report etc. which could have contributed to the accident. These factors have been reviewed and analyzed separately.

The analysis is carried out based on the available evidences and information, ICAO guidance, AIG procedure manual, discussion with experts and among investigators and witness accounts.

2.2 Methodology

The following methodologies were adopted by the Commission during the investigation to reach the conclusion on the probable causes of the accident.

a) Visual examination and assessment of wreckage at Crash site
b) Weather Study and analysis
c) Inspection and Study of Technical Documents
d) Study and Analysis of Cockpit avionics and advanced equipment
e) Crew Training and Company Procedure
f) Study and Analysis of Load and Balance
g) Information received from Interview and written statements taken from all concerned,
h) Study and analysis of personal files and other related information about the crew Member,
i) Review of the CAAN regulations/requirements regarding aircraft operations,

a) Visit to the Crash Site and examination of wreckage

After the accident a team of experienced Investigators visited the crash site to collect the relevant data and information regarding the accident. The investigators gathered the initial information, examined the wreckage, drew out the wreckage distribution and collected the wreckage that may be useful, established flight profile and interviewed relevant people and witnesses.

Photographs and videos were collected for detailed study and analysis.

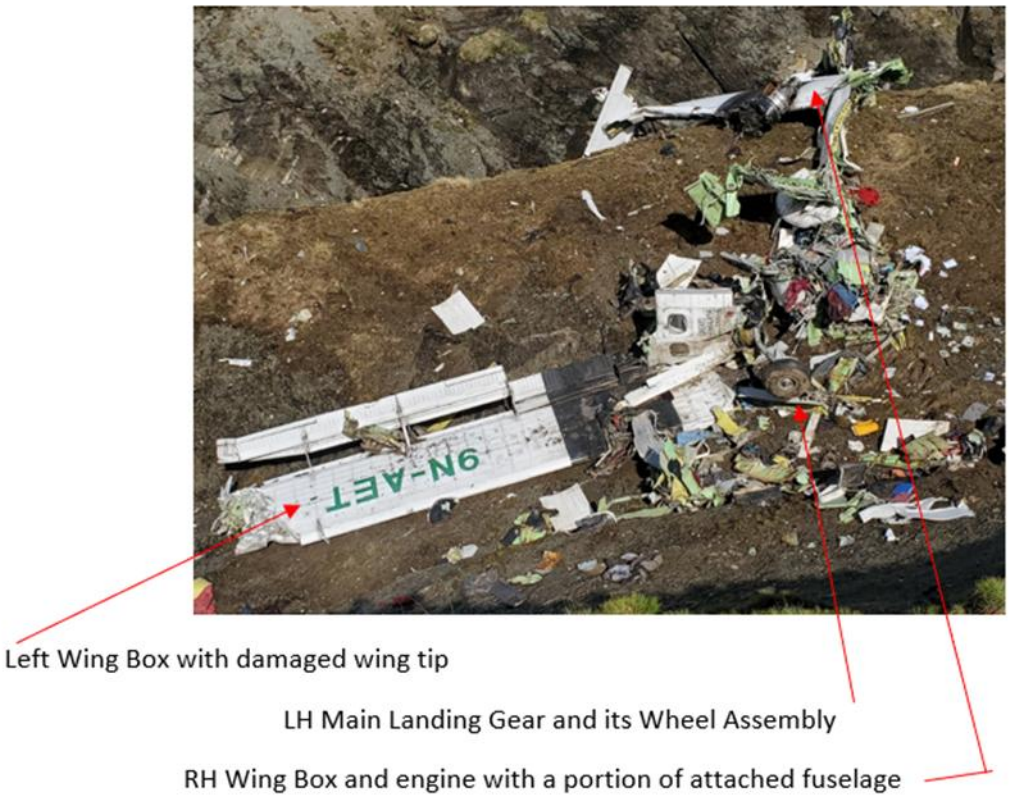

Figure 11 Wreckage Distribution

Figure 12 Right hand Wing and Engine

Figure 13 Tail Section lying left side of the ridge

Figure 14 Figure 14 Tail Section in gorge

Figure 15 Left Hand Engine with Propeller Assembly

Figure 16 RH Engine with sheared propeller shaft

Figure 17 Main Fuselage wreckage

There were no indications of pre and post impact fire. So, fire is excluded to be a cause of accident. There weren't any pre-existing technical defects which could have caused or contributed to the accident.

b) Weather Study and Analysis

Based on the available weather data and CVR transcript analysis, although it is found that the Weather at Pokhara and Jomsom airport during the time of departure was VMC, cloudy weather, in and out dense fog since the early morning and somewhere drizzle in the en-route, indicates the risky weather phenomena for the visual flights at that altitude and narrow gorge of high mountain terrain. Based on the CVR data it could be established that the weather in critical area of en-route was unlikely for visual flight.

As per the locals of Lete, Tatopani area and accounts of a PIC of a helicopter operating at that area, the weather was continually worsening since early morning in that area with all around covered up and very risky to operate the VFR flight.

Tara Air (TRA 197/ 9N-AET) started engine prior to Summit Air flight (SMT 601/9N-AMG) and both were waiting at PKR airport for the better weather information from the preceding aircraft of Summit Air (9N-AKZ).

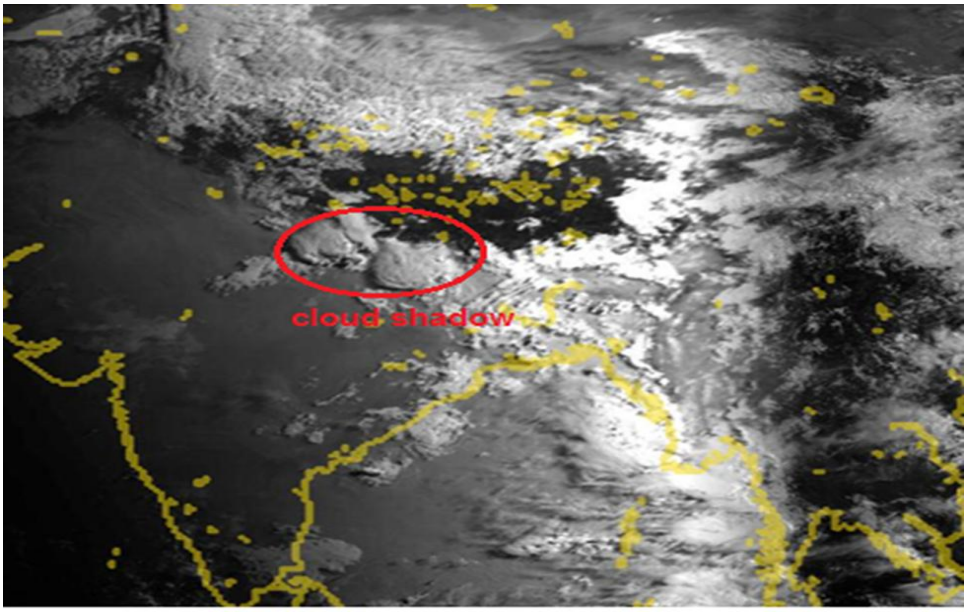

Figure 18 Weather in South Asia Region-I

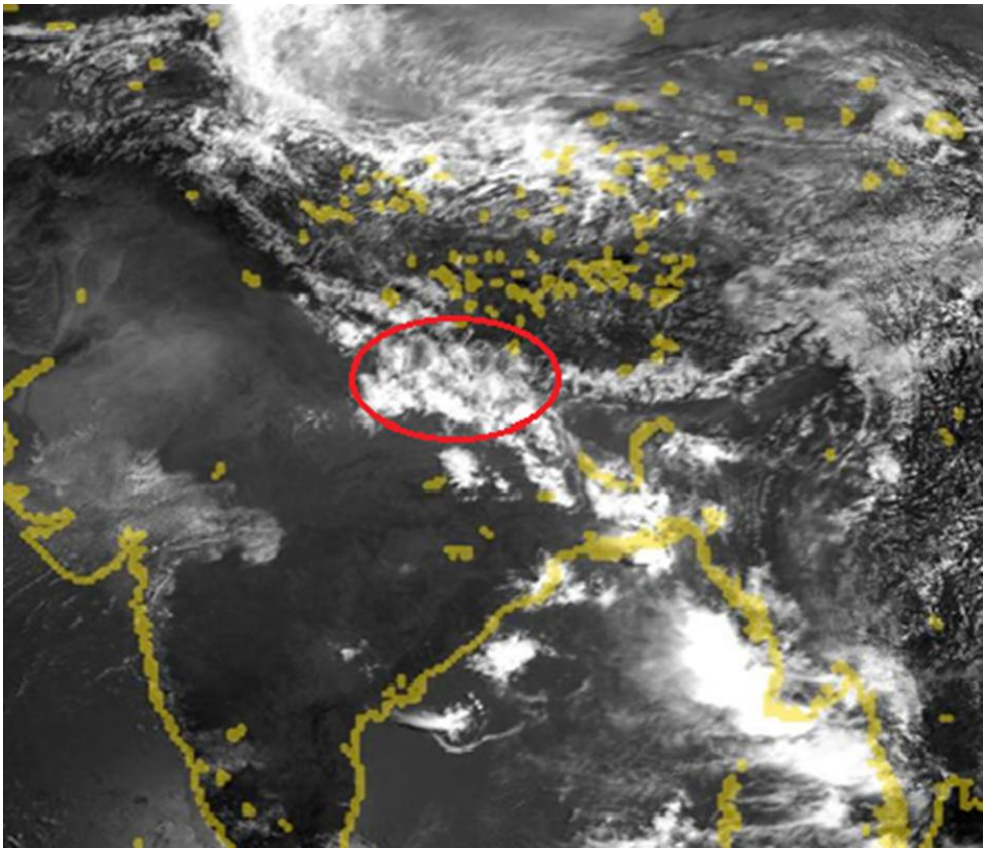

Figure 19 Weather in South Asia Region II

The PIREP received from 9N-AKZ was not encouraging TRA 197's PIC for the flight. But the PKR TWR, and Jomsom tower relaying the en-route weather received from 9N AKZ decided that the weather was fit to fly in. In the meantime, the SMT 601 requested line up for Jomsom, which undeniably created additional pressure to the PIC of TRA 197. Upon analyzing the CVR and evidences, it is clearly observed that the weather communicated by 9N-AKZ to the PKR and Jomsom towers and succeeding aircrafts SMT 601 and TRA 197 was not the same.

It is observed that the PIC was worried about the prevailing weather since it was different than the weather as reported by the preceding flights. Furthermore, the copilot was a junior copilot and relatively new in that sector. It was clearly observed that the PIC panicked while encountering the unexpected IMC en-route and was struggling to escape from that weather. PIC even spoke to himself stating "they used to fly in such dangerous weather!!!"

There was no operational weather monitoring facility along the route to acquire the present weather updates. Hence, the report of the preceding aircraft was the only source of en-route weather report for the succeeding aircraft, which leads to the discovery that flights in PKR-JMO-PKR sector always operated on the assumption of en-route weather.

However, despite weather not being the main causal factor of the accident; it can be considered that en-route weather was one of the main contributing factors of the accident.

The evidences prove that the weather was adverse for visual flight; the performance of the aircraft was not impaired by any weather phenomena such as wind shear, severe turbulence, up or down drafts, thunderstorm and/or icing conditions. Till the last moment aircraft was flying with full control of PIC.

c) Inspection and Study of Technical Documents

Airframe, engine and aircraft technical log books were reviewed and examined to assess any discrepancy and malfunctioning of the aircraft system. Operations Manual, Flight Safety Manual, Aircraft Flight Manual, Standard Operating Procedure, Pilot records were checked and reviewed. CAAN updated FOR, NCAR, AOCR, AIP, AFIS manual were also reviewed. It was found that the technical log books, records, Documents, Manuals were maintained as per CAAN regulations.

The aircraft DHC-6/300 Twin Otter is proven and certified aircraft to carry out STOL operations in Nepal since last more than four decades.

There were no indications of any pre-existing technical defects which would have caused or contributed to the accident. The following can be summarized regarding the technical aspect of the aircraft during the accident:

i. Up until the end, the aircraft was under full control of the PIC. The engine sounds captured in the CVR shows the normal operation of engines. From the wreckage investigation and the ground markings, as well as deformed propeller blades, it was

evident that the engines were operating prior to the impact. Hence the possibility of engine failure is ruled out.

ii. There was no evidence of any system or primary flight controls failure during the flight. Hence, the failure of the aircraft systems such as hydraulics, flight controls, and other major components can be ruled out. The probability that the power-plant system, or structural failures or any other mechanical malfunction contributed to the accident can be ruled out.

iii. The Commission examined the maintenance history of the aircraft and found that all the applicable airworthiness directives and mandatory service bulletins had been complied with as per the maintenance requirements within the prescribed time frame. The technical logs and log books show that the maintenance works, major inspection works and modifications were carried out as per the approved maintenance program and approved maintenance data. No technical defects were reported in the technical logbook prior to the flight. The CVR data also proves that there were no technical or system problems rose during flight by the Pilots.

iv. Analysis of the recorded data retrieved from the TAWS shows some issues that need to be considered as they indicate that the installation, GPS output configuration settings, and crew operation of the ST3400 TAWS/RMI unit in this aircraft were not optimal, thus preventing the TAWS system from effectively performing its intended function.

d) Study and Analysis of Cockpit avionics and advanced equipment

i. **<u>GPS Altitude configured but not received</u>.**

The recorded parameter data for the aircraft DHC-6 Twin Otter 300, 9N-AET shows that the GPS1 was configured to as "GARMIN GNS5XX (429_232)". However the recorded data in all of the flight showed that the data items from the RS_232 interface was always 'Timed-Out'. This is a preferred source for Altitude into the TAWS. The reason for not receiving the GPS Altitude by the TAWS unit could be various but is likely caused by the misconfiguration of the RS-232 output format from the Garmin GPS receiver.

Note: the installed GPS receivers will provide GPS altitude when properly configured.

Figure 20 GPS/FMS 1 Data

ii. Corrected Barometric Setting irregularities

The recorded parameter data for this aircraft shows that the ADC1 was configured to as "429H" for all of its inputs items.

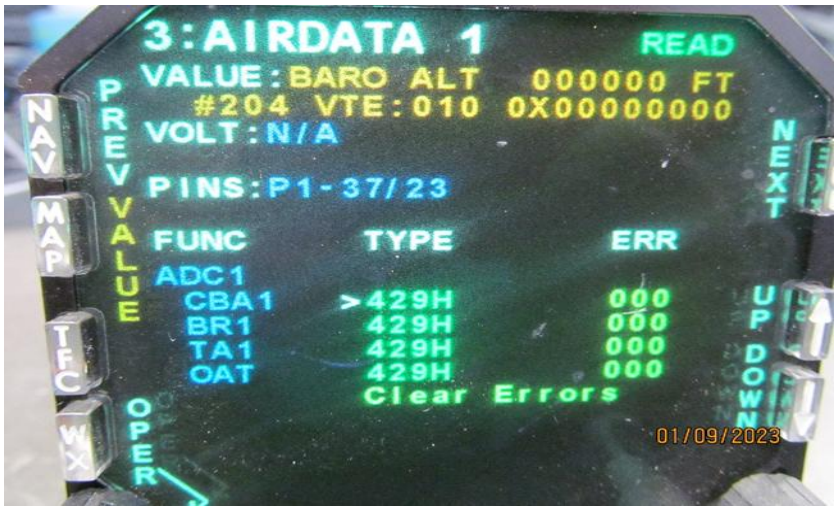

Figure 21 AIRDATA 1 Data

The Air Data Computer [ADC] did not have any inputs from Altimetry System other than OAT and Pitot Static Air. To properly compute Corrected Barometric Altitude (CBA), a regional barometric pressure setting must be available to the ADC, and the pilots must enter the current regional barometric pressure value. Without this input, the ADC in this aircraft was unable to provide an accurate CBA value. Moreover, the Initial Post Installation Test Records for these systems show the test items for Correct Barometric Altitude as NOT APPLICABLE.

This would be the reason for the recorded data of the Correct Barometric Altitude [CBA] when compared to the posted Airport Elevations are off by in some cases a rather large value. Here are the delta values for take offs and landings at the two visited airports in these recorded flights.

Since the GPS Altitude was not available for this ST3400 unit, then made the Correct Barometric Altitude [CBA] into this unit was then the Primary Altitude source. In the cases where the CBA is miss-set too low by a large amount, that would most likely generate unwanted Nuisance Alerts.

VNPK Elev = 2,713’ VNJS Elev = 8,976’

fdr_01: VNJS→VNPK	
VNJS=8976 ft	VNPK=2713 ft
CBA =8110 ft	CBA =2220 ft
866 ft	493 ft

fdr_03:VNPK→VNJS→VNPK		
VNPK=2713 ft	VNJS=8976 ft	VNPK=2713 ft
CBA=2150 ft	CBA=8440 ft	CB=2,330 ft
563 ft	536 ft	383 ft

fdr_04: VNPK → VNJS	
VNPK=2713 ft	VNJS=8976 ft
CBA=2220 ft	CBA=8630 ft
493	346

fdr_06: VNJS→VNPK→VNJS→VNPK			
VNJS=8976 ft	VNPK=2713 ft	VNJS=8976 ft	VNPK=2713 ft
CBA=8580 ft	CBA=2420 ft	CBA=8880 ft	CBA=2740 ft
396 ft	293 ft	96 ft	-73 ft

fdr_00: VNPK→VNJS (Incident Flt)		
VNPK=2713 ft		
CBA=1990 ft		
823 ft		

iii. Flight Crew selection of TAWS INHIBIT

The above listed issues of missing GPS Altitude causing the Correct Barometric Altitude to be the Primary Altitude source and then having CBA settings that induced nuisance alerts introduced a lack of trust in the proper alerting of the ST3400 TAWS unit.

This ST3400 TAWS should not be operated when it is producing an overabundance of nuisance alerts. The system needs to be examined by the proper Technical Support personnel to determine why these alerts are occurring.

The recorded data shows indications where the TAWS INHIBIT feature had been selected by the Flight Crew during the entire recorded flight [fdr_00 VNPK-VNJS which was the incident flight that crashed.

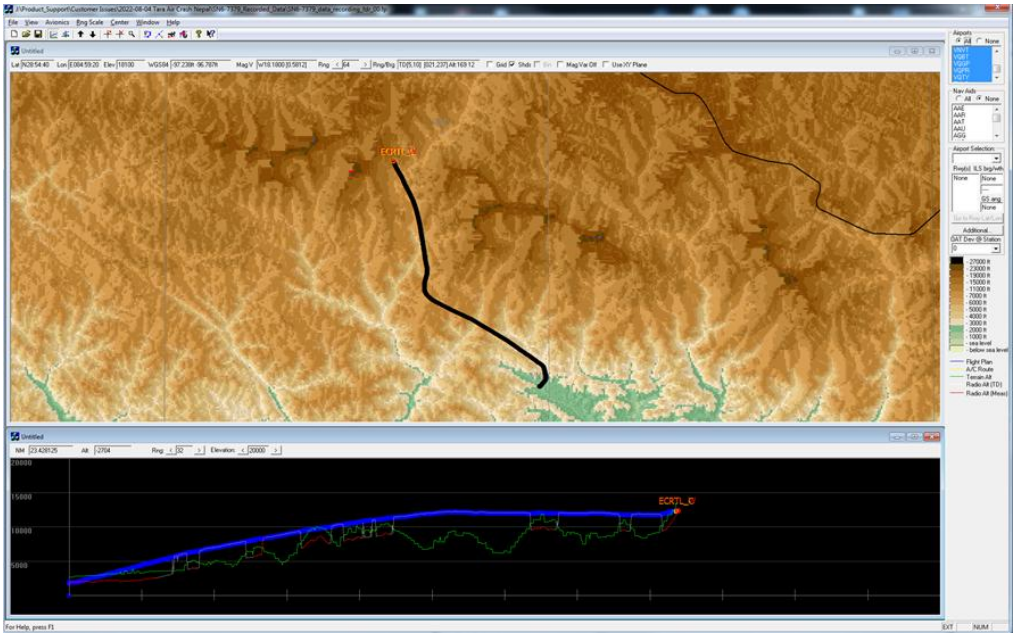

Figure 22 Plot of TAWS recorded data _00: Flight from VNPK to VNJS with TAWS Inhibit Active

iv. Actual Flight Profile with TAWS Inhibit ACTIVE

When the 'TAWS Inhibit' is active, the predictive FLTA [Forward Looking Terrain Alert], ITI [Imminent Terrain Impact] and PDA [Premature Descent Alert] Alerting are disabled. Only GPWS Alerts are still active, which was annunciated approximately 3 seconds just before the impact and recorded in the CVR for that flight.

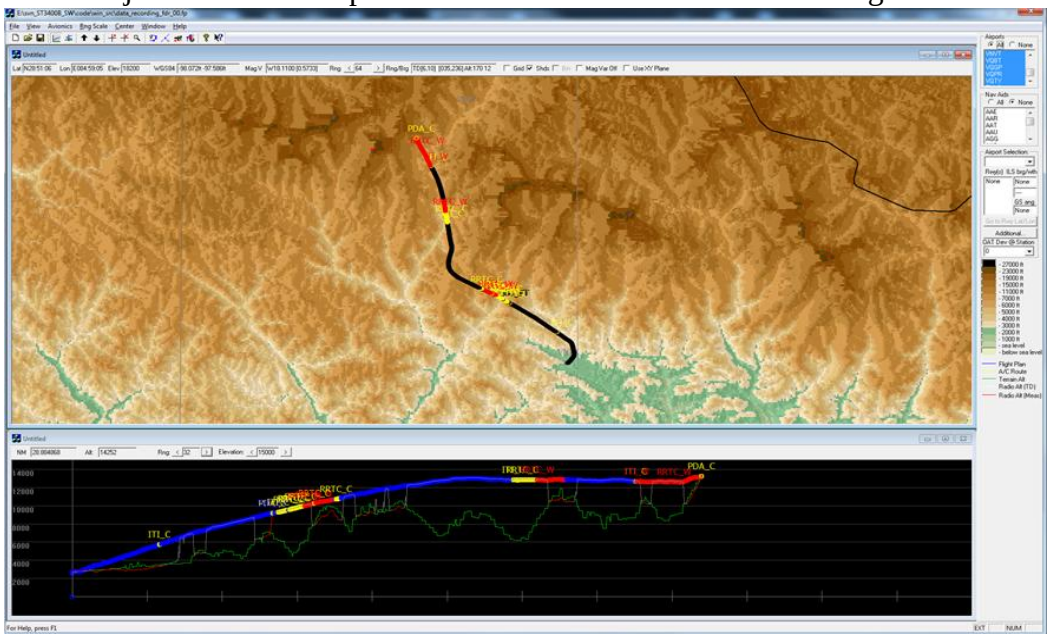

Figure 23 Plot of TAWS recorded data _00: Flight from VNPK to VNJS with corrected CBA and TAWS Inhibit OFF

v. **Simulated Flight Profile with Correct CBA and TAWS Inhibit OFF**

If the TAWS was not inhibited with the proper configuration of TAWS and/or GPS1 Altitude being received by the TAWS, there would have various TAWS Alerts/Warnings at three occasions during that flight.

There would have series of last Alerts started with an Imminent Terrain Impact [ITI] Caution that became an ITI Warning and last for almost 60 seconds and then a Reduced Required Terrain Clearance [RRTC] Warning was issued and that lasted for an additional approximate 60 seconds.

In that situation, the flight crew would definitely have ample of time for comprehending the existing situation after the first TAWS Caution/Warning and taking the required corrective maneuver in order to avoid CFIT.

vi. In addition to the normal required equipment for VFR operation, the aircraft was equipped with latest avionics equipment like GPS, TAWS, Weather Radar, etc. which suggests that the aircraft could fly in IMC. It is a debatable matter that CAAN has mandated to install such advanced equipment and the operators have installed them, while spending a large sum of money such that the aircraft is capable to fly in IMC and the crews are also trained on the operations of these equipment. However, the CAAN procedures do not allow PIC to fly in IMC for normal VFR operations legally, even in critical phases of flight. It is inevitable for the PICs who fly in STOL airfields in Nepalese terrain to encounter IMC (usually unexpected and unplanned) but they refrain from reporting such encounters due to the existing procedures. Nepal's STOL operation en-route weather is so critical that PIC might have to deviate from the VFR rules to complete the flight safely. So as a regulator, CAAN should discuss with the concerned operators and experts and develop a procedure on how to fly safely with the usage of the onboard installed sophisticated equipment on occasions where the aircraft encounters with unexpected IMC, somewhere en-route.

In this accident it is found that once the aircraft inadvertently encountered IMC, the PIC did not choose to take support of its onboard equipment. He tried to maintain VFR and escape from the suddenly encountered deteriorated weather surrounding him. Unlike this ill-fated flight, it was assumed that the two successful preceding flights were conducted using the IFR techniques. There seems to be a clear gap between the standards set forth by CAAN on the installation of high-end equipment and the procedures mandated on pilots on VFR flight. It should be solved amicably and practically that should be customized to best suit our operational environment and standards.

The CVR reveals that the GPWS aural warning was triggered just 3 seconds prior to impact. Had the flight crew received a TAWS caution alert in advance with regards to the forward looking

terrain avoidance function of the TAWS equipment, the Crew could have maneuvered the aircraft so that a collision with the terrain might have been avoided.

e) Crew Training and Company Procedure

Pilots Proficiency Checks (PPC) are conducted twice a year and Route checks are conducted once a year in addition to other mandatory trainings. Flight Simulator training of all flight crew of DHC-6 aircrafts for IFR Currency are conducted in Frasca International Inc. Flight Simulator Training Device at Thai Airways, Bangkok, Thailand annually for validation of instrument flying procedures. Captains of DHC-6 fleet are sent to Flight Safety International, Toronto, Canada once every two years for Twin otter Recurrent Pilot Course that includes ground training and flight training in DHC-6 type simulator. Due to COVID-19 it was not possible to send the Captains to Flight Safety International's flight simulator and as per Tara Air's request, regarding exemption on FOR-A, clause 14.5, permission has been granted to conduct IP (Instructor-Pilot) PPC, on DHC-6 aircraft instead of type simulator in line with submitted Safety Risk Assessment by CAAN. However, in this PPC, emergency exercises were only briefed. During the course of investigation, it was noted that though pilots were trained in escape maneuvers of WIND SHEAR, no proper training were done for TAWS (GPWS/EGPWS) escape maneuvers considering similarity in the corrective action.

Operation Manual of Tara Air Part-A on ―new equipment Training Planning states:

- New equipment training for new equipment installation shall be carried out as per Training manual.
- Company training program chapter 10(a, b) includes classroom training on TCAS, EGPWS/GPWS, and Weather Radar every 12 months for 1 hour, utilizing materials from aircraft Manual, SOP, Manufacturer 's booklets, ICAO/COSCAP documents and related publications. Chapter 11(a, b) includes refresher/training on CFIT, ALAR and Runway incursion/excursion. The commission concludes that this duration is not sufficient as per course content.

f) Study and Analysis of Load and Balance

As per SOP and Operation Manual of Tara Air, the regulated takeoff weight of 9N-AET, DHC-6/300 is 12500 and landing weight of this aircraft at Jomsom aerodrome is 12300 pounds. While reviewing the Load and Trim Sheet it was found that one adult Nepalese male was included at the last minute. To accommodate the LMC, equivalent weight of baggage (1 Nepalese male pax) was shown reduced, keeping the TOW and LW unchanged. However, since there are no evidences to justify the LMC, it can be concluded that the LMC was made hastily in the Trim Sheet, thus, resulting in an inappropriate actual aircraft loading with possible MTOW exceedance and assumably MLW exceedance.

As per the company SOP it is mandatory to develop new load and trim sheet if there is LMC but the airlines' Pokhara Operations failed to comply with the company policy.

It is also observed that although the standard weight calculation for each category is calculated correctly (before LMC), the Load and Trim Sheet itself was not updated for standard weights approved and circulated to all operators by CAAN The trim sheet also lacks fuel information.

Hence it is seen that there are discrepancies regarding values for standard weight in Flight Manual, Operation Manual, and as well as FOR Nepal.

2.3 Interview and Statements

The interview and the statements of the some collogue pilot, co-pilot, air hostess were collected. The local officials, the family member of crew Jomsom Tower duty officer, security personnel, ATC officer on duty at Pokhara Tower and the airline staff of Jomsom and Pokhara airports were also interviewed. From the organization side, the responsible key officials like: Managing Director, Engineering Director, Flight Safety/QA Director, Operations Director, questionnaires. The concerned officials of CAAN flight safety department have also been consulted and shared their views.

2.4 Company Procedure and Safety Review Meeting

The company procedure seems clear regarding the operation at Jomsom Airport. However, there is no instruction for en-route flying to deal with IMC-related contingencies among others. Since the en-route of the Pokhara-Jomsom sector is highly critical, it should be addressed specifically in the SOP of the operator for safe flight in different situations.

It is to be noted that there was an agenda for undue pressure to the Flight Crew for operations in the unfavorable weather condition in the Safety Review Meeting. However, the Accountable Manager had made note of this and ensured no such activity would be entertained.

2.5 Pilot

2.5.1 Crew Rostering and Pairing

Tara Air has specific provisions regarding crew pairing and rostering in Operation Manual-A, General, Chapter-5, Crew Composition which was approved by CAAN.

After thorough analysis it is found that in the crew rostering and pairing, the provision of SOP was followed by Tara Air. However, for the assurance of safety in such difficult airport the normal procedure does not work, it demands specific attention of rules, procedure and management oversight. So, for crew pairing in such a difficult sector, special provisions need to be included.

2.5.2 Crew Age and CAAN Requirement

The CAAN requirement regarding the crew age is same as ICAO standard and is applicable to all kinds of flight. There is no restriction for aging pilot at STOL airports as well as at difficult airports. Due to the flying environment of Nepal and variety of fleet as well as airport location,

the age, experience and training required of a crew may differ. So, CAAN should analyze and review such matter with the help of experts and taking reference of global best practices that may be applicable in our environment to help enhance the overall flight safety.

The PIC was an IP of Tara Air and the IP is designated to perform various specific duties including training the copilots, carrying out checks of other pilots etc. as per requirements. Despite the PIC having crossed 60 years of age, there were no restrictions or limitations to fly with inexperienced copilots in difficult routes. To prevent such overload to aging PICs, the Commission believes that limiting the upper age of IP for STOL airfields will enhance safety. The crew pairing and gradient play a vital role in decision making in critical phases of flight. When the crew gradient is high, there is a possibility of ineffective CRM in the cockpit and minimization of the co-pilot's role. So, considering Nepal's STOL aircraft flying environment, airport geographic location, take-off and landing criticalities, culture of blind following of senior by junior, it is important and critical to reassess the age limitation for IPs, especially for those operating in STOL airfields of Nepal in order to minimize the possibility of high cockpit gradient. It is also found that there was no provision of Safety risk assessment (SRA) either in CAAN Requirement or in operators Manual before allowing the aging PIC to fly in such difficult and high altitude sector. So it is seen imperative to conduct SRA before allowing aging pilots to fly in such sector either by CAAN or operator.

2.6 Human Factor Analysis

2.6.1 Crew Pairing, Pilot Incapacitation and relation of AGE

In this accident the PIC was 62 years old and he was flying in high altitude, difficult route in adverse weather conditions. At the same time, the Copilot was relatively junior and with very little experience. The flight was the second flight of the copilot in that sector. Since the copilot was new and un experienced in that sector, it added additional pressure to PIC while controlling and flying in that condition. The crew pairing was not satisfactory based on the nature of flight. So, in this case the issue of Pilot Incapacitation and age automatically raises and the analysis in this issue is pertinent.

Incapacitation of the crew increases with age. Skill and Performance of the pilot can be affected by the increasing age, as shown as below.

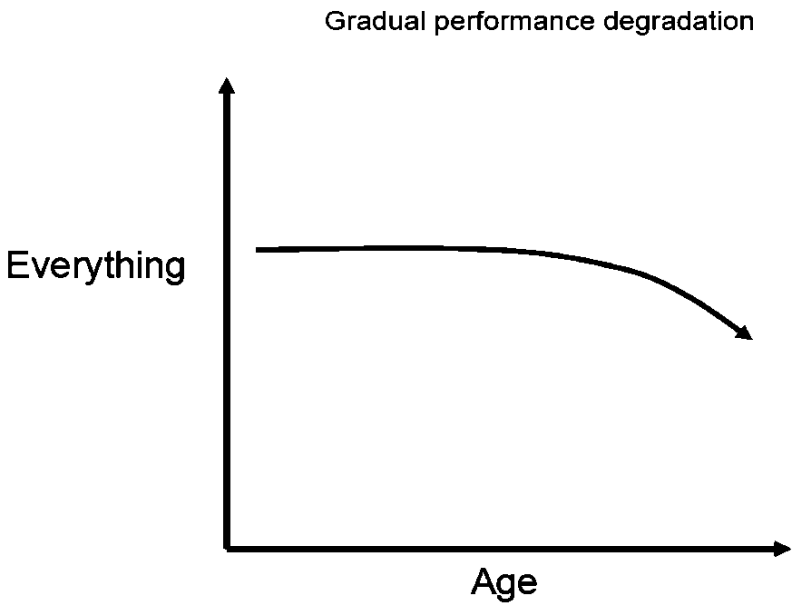

Figure 24 Performance degradation of the Crew with age

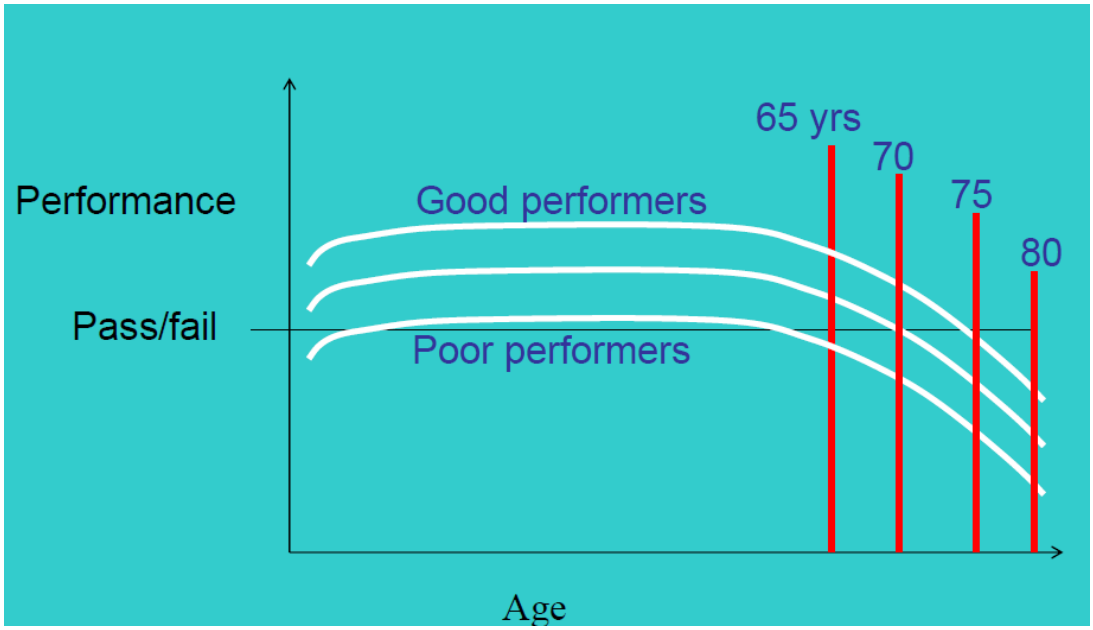

Figure 25 Performance of the Crew with age

The ICAO standard normally talks about international flight operation. PELR approved by CAAN has provision same as that of ICAO standard regarding the Age of Pilot. The PELR requires customization to Nepalese terrain and context, further study, analysis and common consensus regarding the age of Pilot while flying the difficult high altitude STOL Airport and critical routes.

2.6.2 CRM and Workload

In the 1970s, investigators discovered that more than 70% of air crashes involved human error rather than failures of equipment or weather. Now this percentage reached up to 80 % as per the flight safety foundation. A NASA workshop examining the role of human error in air crashes found that the majority of crew errors consisted of failures in leadership, team coordination, and decision-making. Workload management is one of the vital jobs of the crew in CRM.

In this flight, it can be clearly observed that, pilot in command has taken almost total flight related duties including Flying, Monitoring and Communications.

He has not assigned any operational role to the copilot. As per CVR report, somewhere he did not respond to the copilot's input regarding the deviation from the track. Lack of CRM and workload management of the crew is also one of the major contributory factors in the accident.

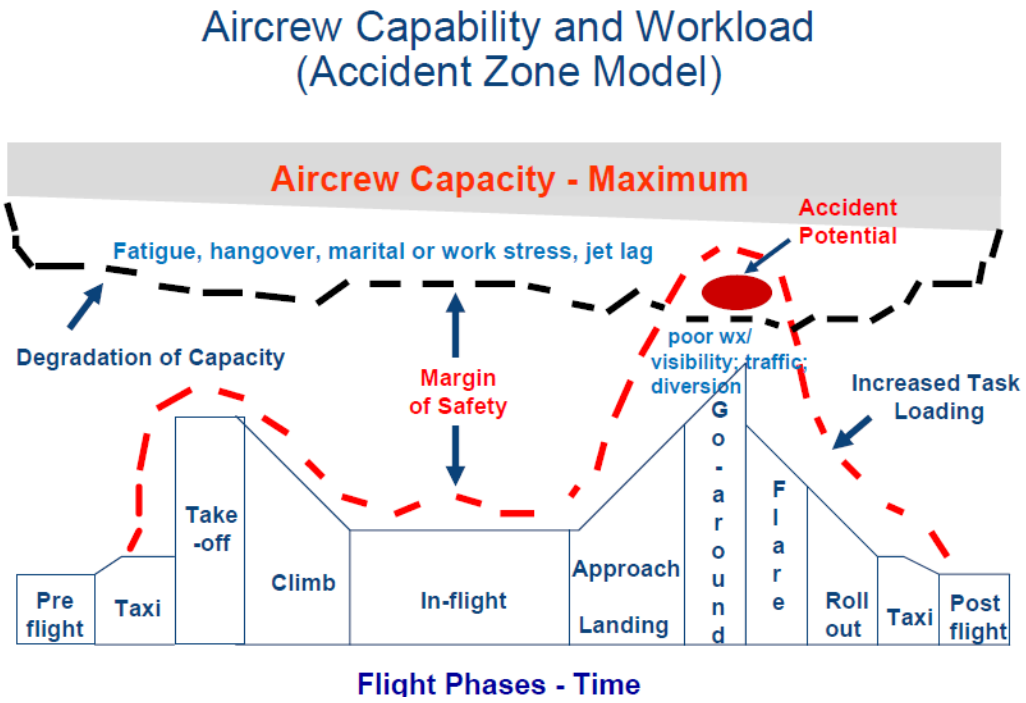

Figure 26 Accident potential at high workload condition

2.7 Some external factors influencing PIC to conduct flight were

Both the PIC of Summit Air (9N-AKZ & 9N-AMG) were junior than PIC of TRA197. 9N-AKZ already crossed Ghodepani and was providing PIREP regarding weather is not so good but encouraging PIC's to try for the flight. SMT601 also line up for flight before TRA197 even started later than TRA197.

Weather report from Pokhara and Jomsom ATS could also have encouraged PIC to conduct the flight along with the crowded passengers at airport terminal willing to fly to Jomsom and eagerness of onboard Passengers to fly as soon as possible.

So, the above external factors could have been the main influencers for the PIC to initiate the flight. Once he took off and while en-route, he was trapped in the deteriorated weather and ultimately encountered a CFIT accident.

There is a very thin line between the normal error in judgment by an experienced pilot and mild impairment of judgments induced by spatial disorientation. The latter may never be noticed because disorientation at no time leaves any significant signs other than its end results.

No other noticeable external factors have observed based on interview of various domain of the organization.

2.8. Human Factor Analysis and Classification System (HFACS)

The commission decided to carry out in-depth humanoid aspect examination of this accident. A Systematical analysis of the accident was carried out to determine the primary factor or casual factor of this accident. CVR data and interactions with concerned personnel of different professional life of Tara and Yeti Air, revealed some underlying problems of human factor associated with this accident as tabulated below:

PARAMETER	EVIDENCE	SOURCE	EFFECT	OTHER INFORMATION
1) Unsafe Acts				
Decision Error of Crew	Decision to continue even the weather was not VMC by entering into the cloud. Flight crew's selection of TAWS INHIBIT	CVR recording	Causal/ Contributory	Significant effect in this accident

Skill Based error of Crew	Lack of visual scan of the cockpit instruments	CVR recording	Circumstantial	
Perceptual error	Loss of situational awareness	CVR recording	Causal	Unable to determine ground position and not following the other cockpit navigational instruments
Error (mistake) of the crew	Entering into cloud	Interview with other crews/ CVR recordings	Contributory	Can be avoided
Lack of workload management	All cockpit function carried out by PIC	CVR recordings	Contributory	Can be avoided
2) Preconditions for Unsafe Acts				
Complacency	Continue into IMC and reassuring F/O, not visualizing the risk due to potential threat	CVR Recording	Contributory	Captain only
Fail to use all available resources (Lack of CRM)	Crew failed to be assertive and more interactive during critical phase of flight	CVR Recording	Contributory	High Cockpit gradient
External Pressure	Other aircraft flying in same sector	CVR record/Tower Log Books	Circumstantial	Passenger and Peer pressure (Other aircraft crew)
3) Unsafe Supervision				

Lack of effective oversight by Operator	Exceeding the structural limitation (takeoff and landing weight) Failure in monitoring SOP compliance by the crew	CVR recordings / Load and trim sheet	Circumstantial	The CG was within the prescribed Limit.
4) Organizational Influences				
Operational Tempo	Get-There-It is	CVR	Circumstantial	Not significant in this accident

Decision making process of the PIC was affected by number of human factors particularly, lack of CRM, over workload to PIC, age related performance deterioration, complacency of PIC and cockpit gradient are major factors which have significant contribution in this accident.

3. CONCLUSIONS

3.1 Findings

1. The Crew were certified in accordance with the rules and the regulations of the CAAN.
2. Proficiency checks of the crew were carried out according to CAAN requirement and the captain was also a DCP for Tara Air.
3. Rest period and duty time of crew were within the approved guidelines.
4. The aircraft was maintained as per approved maintenance programme. No maintenance work was overdue and all maintenance records were maintained properly.
5. There was no evidence of failure of the aircraft's flight controls, systems, structure, or power-plant prior to the impact.
6. The Take Off weight was not within the approved structural limit.
7. The weather PIREP of preceding aircraft to both the airport Towers and succeeding Aircrafts was not same.
8. There was no facility for en-route weather information in the Pokhara - Jomsom sector during the time of accident.
9. Despite the availability of modern sophisticated cockpit navigation equipment like TAWS, GPS, Weather Radar, etc. the PIC refrained from optimal usage of those equipment's input and tried to maintain VMC at any cost.
10. The flight was not conducted in compliance with the VFR.
11. After the flight encountered IMC, the PIC lost his situational awareness.
12. The TAWS was not receiving GPS Altitude as Primary Source for the altitude though it was configured to do so.
13. The TAWS was not properly configured to meet its design objectives.
14. The TAWS was inhibited for that flight which disabled its Forward-Looking Terrain Alerts [Cautions/Warnings] like Imminent Terrain Impact [ITI] Alert, Premature Descent Alert [PDA] and Reduced Required Terrain Clearance [RRTC].
15. If the TAWS was not inhibited with properly configured condition, there would have series of last Alerts started with an Imminent Terrain Impact [ITI] Caution that became an ITI Warning and last for almost 60 seconds and then a Reduced Required Terrain Clearance [RRTC] Warning was issued and that lasted for an additional ~60 seconds

16. In that situation, the flight crew would definitely have ample of time for comprehending the existing situation after the first TAWS Caution/Warning and taking the required corrective maneuver in order to avoid CFIT.

17. There were no PIREPs and communications for any nuisance alerts generated by the TAWS during the flights in the past.

18. The pilot in command had taken almost total flight related duties including Flying, Monitoring and Communications.

19. The copilot was not assertive enough during flight potentially because of high crew gradient and less route experience.

20. The PIC disregarded the input of F/O regarding the deviation of the aircraft to the left of track and was too late to regain the track while he noticed the fact.

21. The F/O failed to effectively monitor and/or challenge the captain's decision, which was causal to the accident.

22. Cockpit Crew gradient was high.

23. CRM was not effectively implemented.

24. The aircraft was completely destroyed due to the impact with terrain.

25. The company's Load and Trim Sheet was not updated to project the standard weights approved by CAAN and circulated to all the operators, similarly the trim sheet lacks fuel information.

26. CAAN requirement regarding the age of crew is same as ICAO standard which is applicable to all kind of flights.

27. The captain, mistakenly believed that the light he seen from cockpit is of safe visual area and he may be safe if proceed towards there.

28. The captain was overloaded by all the cockpit duties (both PF and PM) while dealing with the unexpected weather, which significantly degraded his performance and contributed to his failure to make proper decision on tackling with the abnormal situation.

29. There was no provision of SRA either in CAAN requirement or in operator's manual before allowing the ageing PIC to fly in the high-altitude difficult terrain.

30. Company record shows that, they are compromising in Training Syllabus and duration

31. Airline Operations personnel files are not retained and controlled properly

3.2 Probable Cause

The probable cause of this accident was the flight crew's failure to monitor and maintain the proper course while inadvertently flying in IMC conditions with the aircraft Terrain Avoidance and Warning System [TAWS] inhibited which resulted into a CFIT accident.

3.3 Contributing factors

The contributing factors for the accident are:

1. The flight crew's failure to follow the SOP of company
2. The aircraft flight operation with TAWS inhibited during deteriorating en-route weather condition.
3. Loss of situational awareness of crew
4. Deteriorating en-route weather
5. Less experienced copilot for that sector and high crew gradient
6. Poor CRM during the flight
7. The whole cockpit duties [both PF and PM] were undertaken by the PIC, which likely impaired his performance.
8. Underutilization of the available Navigation instruments.

4 Safety Recommendation(s)

All Operators

1. It is recommended to have an Independent Inspection for ensuring the correct configuration set up of TAWS and relevant interfaced system as well, and its proper functioning as per the approved data each time after any associated maintenance [modifications, parts replacement and wiring repairs, data upload, etc. on these systems which could affect the configuration set up and its proper functions.
2. Any nuisance Alerts generated by the TAWS shall mandatorily be reported for proper analyzing and troubleshooting by the authorized personnel in order to keep the TAWS functional reliability all the time as per the design criteria.

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3. An effective operational control of the flight should be maintained at all operation bases, including positioning of a qualified Flight Dispatcher.
4. Cockpit gradient in STOL operation should be maintained as low as possible.
5. The carrier establishes a policy and makes it clear to their pilots that there will be no negative repercussions for appropriate questioning in accordance with CRM techniques of another pilot's decision or action and to ensure that CRM programs provide pilots with training in recognizing the need for, and practice in presenting clear and unambiguous communications of flight-related concerns.
6. The operator should conduct safety risk assessment and medical before allowing the aging PIC to fly in high altitude difficult terrain.

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7. CAAN should devise mechanisms for en-route weather to ensure safe operation along the routes serving STOL remote airports.
8. It is recommended to have an immediate One Off inspection on all required aircraft in order to verify the correct configuration set up of TAWS and other interfaced system as well as Functional Test of the TAWS in accordance with the approved maintenance data.
9. It is recommended to have random/spot checks to ensure the aircraft operations with its TAWS functioning condition and the inhibit function is not inhibited.
10. CAAN should review the procedure in coordination with operators and comparing the best practices of similar countries to address the following issues:

    a. The age of PIC, especially Instructor Pilot for STOL operations, to be limited at or below 60th birthday, **if possible and/or practical based on his/her medical status (Physical**

and Mental), past accident/incidents records, human factor analysis etc. (based on Scientific study)

b. Policy to ensure that the crew gradient in STOL airfields operation is maintained to be as low as possible.

c. Review of Nepalese STOL Airfields categorization criteria based on enroute, geographical factors, aerodrome features, etc.

d. Provisions of phase-wise up-gradation policy of co-pilots operating in the STOL airfields categorically, referencing to PIC's upgradation provisions.

e. Requirement to establish best practices for conducting trainings for safe and effective management of emergency and abnormal situations, created by unexpected weather.

f. Requirement to ensure that simulator-based exercises or role-playing for the F/O to assertively raise their concerns and also train Captains to develop a leadership style that supports the F/O's assertiveness to be included as part of the already required crew resource management training.

g. CAAN should increase its safety oversight frequency in base stations of airlines other than Kathmandu.

h. CAAN should study and review the inadequacy in medical requirements of aging pilots.