GOVERNMENT OF NEPAL
AIRCRAFT ACCIDENT INVESTIGATION COMMISSION 2013

FINAL REPORT ON THE ACCIDENT INVESTIGATION OF 9N-ABO TWIN OTTER (DHC6/300) AIRCRAFT OWNED AND OPERATED BY NEPAL AIRLINES CORPORATION AT JOMSOM AIRPORT, MUSTANG DISTRICT, NEPAL ON 16 MAY 2013

[FINAL REPORT]

SUBMITTED BY

THE COMMISSION FOR THE ACCIDENT INVESTIGATION

TO

THE GOVERNMENT OF NEPAL

MINISTRY OF CULTURE, TOURISM AND CIVIL AVIATION

18/2/2014 (6/11/ 2070 BS)

FOREWORD

This Final Report on the accident of the Chartered Flight of Nepal Airlines Corporation 9N-ABO, Twin Otter (DHC6/300) aircraft has been prepared by the Aircraft Accident Investigation Commission constituted by the Government of Nepal, Ministry of Culture, Tourism and Civil Aviation, in accordance with Annex 13 to the Convention on International Civil Aviation and Civil Aviation (Accident Investigation) Rules, 2024 B.S. to identify the probable cause of the accident and suggest remedial measures so as to prevent the recurrence of such accidents in future.

The Commission carried out thorough investigation and extensive analysis of the available information and evidences, statements and interviews with concerned persons, study of reports, records and documents etc.

The Commission had submitted some interim safety recommendations as immediate remedial measures. The Commission in its final report presented safety recommendations to be implemented by the Ministry of Culture, Tourism and Civil Aviation, Civil Aviation Authority of Nepal and Nepal Airlines Corporation respectively.

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Date: 2014/2/18 (2070/11/06)

Abbreviations used in this report are as follows:

AFIS	: Aerodrome Flight Information Service
AIP	: Aeronautical Information Publication
AMSL	: Above Mean Sea Level
ARP	: Aerodrome Reference Point
ATC	: Air Traffic Controller
ATSO	: Air Traffic Service Officer
CAAN	: Civil Aviation Authority of Nepal
C of A	: Certificate of Airworthiness
COM	: Communication
CRM	: Crew Resource Management
CVR	: Cockpit Voice Recorder
DME	: Distance Measuring Equipment
DHC-6/300	: De Havilland Twin Otter 300 Series
ENR	: En-route
ETA	: Estimated Time of Arrival
ETD	: Estimated Time of Departure
F/O	: First Officer
FOR	: Flight Operation Requirements
HF	: High Frequency
ICAO	: International Civil Aviation Organization
IFR	: Instrument Flight Rules
KM	: Kilometer
LH	: Left Hand
LMC	: Last Minute Change
LT	: Local Time
NM	: Nautical Mile
PIC	: Pilot-in-Command
PIREP	: Pilot Report
PROP	: Propeller
QNH	: Pressure Setting to Indicate Elevation above Mean Sea Level
RH	: Right Hand
RWY	: Runway
SOP	: Standard Operating Procedures
STOL	: Short Take Off and Landing
UTC	: Universal Coordinated Time
VFR	: Visual Flight Rules
VHF	: Very High Frequency
VMC	: Visual Meteorological Conditions
VNPK/PKR	: Pokhara Airport
VNJS/JMO	: Jomsom Airport
VOR	: Very High Frequency Omni directional Radio Range

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FINAL REPORT ON THE ACCIDENT OF NEPAL AIRLINES CORPORATION'S 9N-ABO, (DHC6/300) TWIN OTTER AIRCRAFT AT JOMSOM AIRPORT ON 16 May 2013

Synopsis

The Twin Otter aircraft (DHC-6/300), 9N-ABO, owned and operated by Nepal Airlines Corporation (NAC) was on a second chartered flight departed Pokhara Airport at 0225 UTC (08:10LT) for destination Jomsom Airport.

In its first contact, Jomsom Tower advised the crew of 9N-ABO, the runway in use 24 considering wind south westerly 08-12 KTS (which provides tail wind effect to the aircraft on R/W 06). The pilot-in-command (PIC) of 9N-ABO requested to change the runway to be used from 24 to runway 06 and landed with the prevailing tail wind of 08-12 KTS.

The aircraft touched down runway of Jomsom airport at 0245 UTC (08:30LT) at a distance of approximately 776ft. far from the threshold of runway 06. After rolling 194ft in runway, the aircraft left runway and reached the grass area in the right side. The aircraft continued rolling for around 705ft. at the grass area and entered runway with added power, kept on rolling, hit the perimeter fence with an initial impact and finally fell down into the edge of Kali Gandaki River resulting into this accident.

There was no fatality. One passenger was seriously injured, ten passengers had minor injury and rest of the passengers appeared to be in normal condition. The PIC and co-pilot were seriously injured. The Airhostess was in normal condition after initial first aid service. The rescue and evacuation was carried out properly within a short period of time. All the 19 passengers and 3 crew members on board survived. The aircraft was substantially damaged.

The Government of Nepal, Ministry of Culture, Tourism and Civil Aviation formed a four-member aircraft accident investigation Commission on 16 May 2013 to probe into the circumstances and probable cause of the accident for the purpose of preventing reoccurrence of similar accident in future and enhancing flight safety.

The Commission carried out thorough investigation and extensive analysis, with the methodologies of site visits, interviews with concerned persons, study of reports, records and documents etc.

After detail investigation and thorough analysis of the evidences, the Commission has determined that the most probable cause of the accident as ***the inappropriate conduct of STOL procedure and landing technique carried out by the PIC, during the landing-phase and an endeavor to carry out take off again with no sufficient airspeed, no required lifting force and non availability of required runway length to roll.***

Contributory factors to the occurrence is the absence of proper CRM in terms of communication, coordination and briefing in between crew members on intention and action being taken by PIC during pre and post landing phase encountering runway excursion.

The presence of pebbles and uneven surface at the right side grass area of runway 06 was unfavorable to PIC in maneuvering the aircraft after landing roll.

The Commission had submitted some interim safety recommendations as immediate remedial measures limiting tail-wind operation at Jomsom airport and advised CAAN to strengthen its surveillance and monitoring function. The Commission in its draft final report presented safety recommendations to be implemented by the Ministry of Culture, Tourism and Civil Aviation, Civil Aviation Authority of Nepal and Nepal Airlines Corporation respectively.

The Commission was assisted by Mr. John Britten, the accredited representative for Canada as State of Manufacturer for the aircraft and the Engine, according to ICAO Annex 13, Section 5.2.4 Technical advisor to the TSB accredited representative.

1 Factual Information

1.1 History of the flight

1.1.1 History of the flight

The Twin Otter (DHC6/300) aircraft with registration number 9N-ABO, owned and operated by Nepal Airlines Corporation (NAC), departed Kathmandu to Pokhara for night stop on 15 May 2013 in order to accomplish up to 5 (five) Pokhara-Jomsom-Pokhara charter flights planned for the subsequent day on 16 May 2013. As per the programme, the aircraft completed first charter flight from Pokhara to Jomsom sector on 16 May 2013 morning after one and half hour waiting on ground due weather.

For this second flight, the aircraft departed at 0225 UTC (08:10LT) from Pokhara to Jomsom in the command of Capt. Dipendra Pradhan and Mr. Suresh K.C. as co-pilot. There were 19 passengers including one infant and 3 crew members on board. The aircraft was operating under Visual Flight Rules (VFR). As per the CVR readout there was no reported difficulties and all the pre and post departure procedure and en-route portion of the flight were completed in normal manner. There was no indication of lacking of information and advice from Jomsom Tower.

At first contact the co-pilot called Jomsom Tower and reported its position at PLATO (a compulsory reporting point) at 9 miles from Jomsom airport at 12500ft. AMSL. The Jomsom Tower advised runway 24 wind south westerly 08-12 KTS, QNH 1020, Temp 13 degree and advised to report downwind for runway 24.The co-pilot accepted by replying to join downwind for runway 24. There was no briefing and discussion between the two pilots regarding the tail wind at the airport.

The PIC, then, took over the communication function from co-pilot and called Jomsom Tower, requesting to use runway 06 instead of runway 24, despite the advice of tower to use runway 24 to avoid tail wind effect in runway 06.

Jomsom Tower repeated the wind speed to be 08-12 KTS for the runway 06, to which the PIC read back the wind and answered to have ”no problem”. As per the PIC request the Jomsom Tower designated runway 06 for landing and advised to report on final runway 06. The PIC did read back the same. The pre landing checklist was used, flaps with full fine in propeller rpm were taken and full flaps was also taken before touchdown. In the briefing of “missed approach” the PIC had answered to be “standard”.

The aircraft touched down runway of Jomsom airport at 0245 UTC (08:30LT) at a distance of approximately 776 ft, far from the threshold of runway 06. After rolling 194 ft. in the runway, the aircraft left runway and entered grass area in the right side. The aircraft rolled around 705 ft in the grass area and entered the runway again. The maximum deviation from the runway edge was 19 ft.

The Commission has observed that when aircraft touched down the runway, it was not heading in parallel to the runway centreline. After touchdown the aircraft rolled around 194ft on the runway, left the paved area and started rolling in the grass area in the right side.

During the landing roll, when the aircraft was decelerating, the co-pilot had raised the flaps as per the existing practice of carrying out “after the landing “checks". As per the observation of passenger seated just behind the cockpit, after touchdown of the aircraft there was no communication between pilot and co-pilot. It seemed that pilot was busy in cockpit and facing problem. It was obvious that PIC was in dilemma in controlling aircraft. He added power to bring aircraft into the runway with an intention to lift up the aircraft. He did not brief anything to co-pilot about his intention and action. He started adding power with the intention of lifting up, but the aircraft was already losing its speed, due to extension of flaps by co-pilot without briefing to PIC and use of brakes (light or heavy, knowingly and unknowingly) simultaneously by the PIC.

The accelerating aircraft with insufficient speed and lift to take off ran out of the runway 24 end, continued towards the river, hit the barbed fence and gabion wall with an initial impact and finally fell down into the edge of river. The left wing was rested in the mid of the river preventing the aircraft submerged into the river

1.2 Injuries to persons

There was no fatality. The PIC, co-pilot and one lady passenger were seriously injured. The Air Hostess and ten passengers had minor injury and rest of the passengers were in normal condition. The rescue and evacuation was carried out properly within a short period of time. It can be believed that the prompt rescue and evacuation operation helped a lot to rush the injured persons for necessary treatment.

Injuries	Crew	Passenger	Total
Fatal	0	0	0
Serious	2	1	3
Minor	1	6	7
None	0	11	11

Crew: 3 (2 Pilot + 1 Air Hostess)
Total number of passengers: adult 18 (8 Japanese, 10 Nepalese citizen + 1infant).

1.3 Damage to Aircraft

The aircraft was substantially damaged. As per the observation of the wreckage site by the Commission, the details of the damage are given below.

- Right hand (RH) wing totally sheared off and extensively damaged from the fuselage and right hand propeller severely damaged.
- Left Hand (LH) wing out board section partially submersed on the river and supported the aircraft. LH engine propeller tips slightly bent and some person teared out.
- Nose Oleo was detached from its structure and found at the river bank.
- RH and LH main landing gear wheels deflated and herbs damaged and the wheels were detached from the wheel hubs.
- Empennage and Rudder intact with minor damages. Fuselage top forward area buckled. Right elevator was partly damaged.
- ELT was activated.
- Fuel was leaking from the aircraft.
- Cockpit section smashed and detached i.e. the front structure of the aircraft from station -21 to station 111 was entirely damaged.

- Pilot stations (seats) and doors sheared off.
- Both engines were found externally physically intact.
- Instrument panel of cockpit was hanging on lower side of station 111 just above the water surface.
- Control column of aircraft was hanging on the back side of instrument panel.
- Oxygen bottle was found outside of the aircraft on the river embankment wall.

1.4 Other damage

A portion of the runway 24 end fence (barbed wire) has been damaged. No burn marks were visible at/around the crash site since there was no fire during impact.

1.5 Personnel information

1.5.1 Pilot-in Command (PIC)

Name	:	Mr. Dipendra Pradhan		
Age	:	39 years		
Date of Birth	:	18/11/1973		
Nationality	:	Napali		
Licence Issued by	:	CAAN		
Commercial Pilot Licence	:	Airline Transport Pilot License Number 210		
Aircraft Rating	:	DHC-6/300		
Licence Proficiency Check	:	29 Oct 2012 valid to June 2013		
Instrument Rating	:	N/A valid to Oct 2013		
Operator's Line Check	:	15 August 2012 valid to Aug. 2013		
Medical Certificate	:	30/10/2012 valid to Oct. 2013		
Flying Experience	:	Total all types	8451	Hours
		On Type:	8131	hours (Till April 15, 2013)
		Last 90 days:	251	Hours
		Last 30 days:	75	Hours

Last 24 hours: 0.50 Minutes

Previous rest period : 10 hours during Pokhara night stop/ 52 hrs before KTM-PKR FLT.

Marital Status : Married

Children : one Son, 6 Years old

Parents : Father and mother alive

1.5.1.1 Pilot in Commands' background

The PIC had been flying DHC-6/300 Twin Otter aircraft since 15 February. 2000, having joined NAC as a co-pilot and became commander in 08 June 2005. He held an appropriate and current medical category.

As per the NAC record, the PIC was held responsible in the following two incidents in the past.

i) Incident of 9N-ABX, DHC-6/300 at Kangeldanda Airport on 19 April 2010 which was investigated by NAC in-house investigation committee.

The investigation committee determined that the probable cause of the incident was flight crew continuing the flight to Phaplu with an intention to divert to Kangel (airfield with a time restriction) resulting control difficulties in maintaining the desired flight path during landing where exacerbated by illusion, unstable wind condition and improper loading. These contributing factors may have caused the aircraft to bounce three times, resulting this incident.

ii) Incident of Cabin crew occupying Co-pilot's seat on Lukla-Kathmandu flight on 12 October 2008 was also investigated by NAC investigation Committee.

The investigation committee found that on flight from Lukla to Kathmandu on date 12 October, cabin crew was let to occupy the co-pilot's seat.

The probable cause behind the occurrence of the event was pointed out that the incident appears to have occurred due to human factors. The PIC

failed to follow the Operations Manual, CAA-N FOR and other aviation regulation. It showed ignorance about the safety. The First Officer and Cabin crew were also unable to resist PIC's decision.

1.5.2. Co-pilot

Name	:	Mr. Suresh K.C.		
Age	:	29 years		
Date of Birth	:	12/03/1984		
Nationality	:	Napali		
Licence Issued by	:	CAAN		
Commercial Pilot Licence	:	343		
Validity Rating at Type	:	DHC-6/300		
Licence Proficiency Check	:	18/12/2012 valid to Aug 2013		
Instrument Rating	:	Valid to 30/06/2013		
Operator's Line Check	:	20/06/ 2012 valid to June. 2013		
Medical Certificate	:	10/06/212 valid to 30/06/2013		
Flying Experience	:	Total all types	1396	Hours
		On Type:	1202	hours
		Last 90 days:	102	Hours
		Last 30 days:	38	Hours
		Last 24 hours:	0.50	Minutes
Previous rest period	:	10 hours curing Pokhara night stop/ 27 hrs before KTM-PKR FLT.		
Marital Status	:	Unmarried		
Parents	:	Father and mother alive		

1.5.2.1 Co-pilots' background

The co-pilot joined NAC in 21 September 2008. He was in the first flight for Pokhara-Jomsom sector which was completed successfully prior to the second flight which met the accident on 16 May 2013. While in Pokhara, he was together with the crew team and prepared to fly Jomsom. There were no previous incidents reported for the co-pilot.

1.5.3. Air Hostess

Name	: Ms Santa Maya Tamang
Nationality	: Nepali
Age	: 25 years

Date of Birth	: 12/09/1988
Training	: DGR valid till September 2014
	Refresher valid till July 2014
	CRM valid till Feb. 2014
	Emergency evacuation valid till May 2014
	First aid valid till December 2013

1.6 Aircraft information

1.6.1 General Description

1.6.1.1 General

The Twin Otter (DHC-6 series 300) 9N-ABO aircraft is an all metal, high wing monoplane semi-monocoque aircraft which has two wing mounted turbo shaft free turbines, each driving a three bladed, Hartzell HC-B3TN-3D metal reversible pitch, fully feathering propeller.

The aircraft carries a pilot, co-pilot and up to 20 passengers depending upon the seat configuration. It has installed crew oxygen system.

1.6.1.2 Airframe system

The flight controls are conventionally operated through pulley and cable systems and mechanical linkage by a control column, control wheel and rudder pedals. The ailerons lower with the wing flaps and their degree of movement increases proportionately with flap deflection. The ailerons move deferentially at any flap position. The left elevator, rudder and left aileron are equipped with flight adjustable trim tabs, and the right elevator with a trim tab that is interconnected with the flaps. A geared tab is installed on each aileron and on the rudder.

Wing flaps consists of inboard and outboard fore flaps and an inboard trailing flap on each wing. Wing flaps are operated hydraulically by an actuator in the cabin roof through a system of push pull rods, levers and belleranks within a range of $0\text{-}37.5^{O}$.

The landing gear is a non-retractable type and comprises two main landing gear units and a nose landing gear.

The nose wheel is steerable by a steering lever over a range of 60^{O} to the left and right of center position.

The main landing gear wheels are equipped with hydraulically operated disc brakes which are applied independently by brake pedals integral with rudder pedals. A parking brake handle retains the brakes in the on condition when the pedals are depressed.

Hydraulic system operates wing flaps, nose wheel steering, wheel brakes. This system has an electric motor driven pump, emergency hand pump, reservoir, accumulators etc.

Its fuel system is contained in a forward and aft fuselage tank located in the lower fuselage beneath the cabin floor. The fuel is delivered by booster pumps to the engine. Each tank contains two booster pumps. A fuel quantity indicating system of the capacitance type provides an accurate indication of the fuel level in each tank. It has stand by booster pumps for emergency operation. It has low level caution light system at 75 lb fuel remaining for forward tank and 110 lb fuel remaining for the aft tank.

1.6.1.3 Power Plant System

The power plant consists of two PT6A-27 engines, each mounted in a wing nacelle. Each engine has two independent turbines, one driving the engine compressor, fuel pump and accessory gearbox, and the other driving the propeller through a reduction gearing. A starter generator and a gas generator tachometer are mounted on the accessory gear box, Retractable intake deflectors for ice and snow protection are installed in the engine air inlet ducts.

The engine/propeller/fuel controls are mounted in the overhead console in the flight compartment and comprise power levers, propeller levers and engine fuel levers. Friction control knubs for the power and propeller levers are also located immediately aft of their respective levers.

Each engine fuel control system mainly comprises: (a) an engine driven fuel pump; (b) a fuel control unit which determines the proper fuel schedule for engine steady state operation and acceleration in response to power lever selection; (c) fourteen fuel nozzles through which fuel is delivered to the combustion chamber, (d) a fuel shut off valve which controls fuel delivering to the fuel manifold and is operated by the fuel lever. Control of the fuel control system is affected by pulley and cable systems which connect the power lever and fuel lever to the fuel control unit and fuel shut off valve respectively.

The starting system for each engine consists of a starter generator, a start switch (common to both engines) and two starter relays. When the dc master switch is on and the start switch is selected for the required engine, power is supplied to the

starter generator, which rotates the gas generator turbine at sufficient speed to provide engine light up. When light up occurs and the engine has accelerated to idle speed and the switch is released, the starter relays de-energise the starter circuit.

Engine instruments are located on the engine instrument panel to the right of pilot's flight instrument panel. Each set comprises: (a) oil pressure indicator (b) torque indicator (c) oil temperature indicator (d) propeller rpm indicator (e) turbine temperature indicator (f) gas generator indicator and (g) fuel flow indicator.

Propeller has a pitch range of -15^0 (reverse) to $+ 87^0$ (feather) and a low pitch setting of $+17^0$. Beta range which is from $+17^0$ in the forward thrust range to -15^0 in the reverse thrust range is controllable by power lever. At idle the propeller blade angles are at approximately $+11^0$ at a gas generator speed of 51% rpm and propeller speed of 44% rpm when the power lever is retarded, beta control commences at approximately 75% rpm gas generator speed.

A propeller lever/power lever interlock mechanism is installed to prevent movement of the power levers beyond the idle stop if both propeller levers are positioned at less than 91% propeller rpm. Individual operation of either propeller lever above 91% rpm disengages the interlock lever.

An automatic propeller feathering system is incorporated which automatically feathers the propeller of an under powered engine when a decrease in torque to 13-11psi is detected.

1.6.1.4 Airframe Information

Operator	: Nepal Airlines Corporation
Owner	: Nepal Airlines Corporation
Manufacturer	: De Havilland Canada
Model/Type	: DHC6-300
Type of flight	: VFR/IFR
A/C MSN	: 638
Year of manufacture	: 1979
Number and type of engines	: 2 (Two)
Total Times Since New	: 32291 :
Total Cycles Since New	: 54267 :

Initial Issue of Certificate of Registration (C of R) : 23/09/1979

Validity Date of Certificate of Airworthiness (C of A) : 15/07/2013

Validity Date or Radio Mobile Licence (RML): 15/07/2013

Validity of Maintenance Release Certificate: 32362 FH or 08/07/2013, whichever is earlier.

1.6.1.5 Engine Information

Manufacturer : Pratt and Whitney, Canada
Model/Type : PT6A-27
Number of Engine : 2(Two)
Engine Serial Number :
Port : PC-E40672
Stbd : PC-E42400
Engine Total hours/cycles since New :
Port : 33032/55594
Stbd : 23519/40236
Engine Hours/Cycle since Overhaul :
Port : 3841/6640
Stbd : 315/595

1.6.1.6 Propeller Information

Manufacturer : Hartzell
Model/Type : HC-B3TN-3D/T10282
Propeller Serial Number :
Port : BUA 27817
Stbd : BUA 25534
Time Since Overhaul :
Port : 2227
Stbd : 2858

1.6.1.7 Maintenance History

This aircraft has undergone standard maintenance as per maintenance programme approved by CAAN.

The aircraft flight log page and aircraft, engine, propeller log books reveal that the maintenance has been carried out at scheduled intervals.

A review of the past two months snag history before the accident revealed that among prominent snags, the following relevant snags were found recorded in the aircraft flight log page.

(1) On 18th April 2013, on approach, the right swing problem was reported by the pilot and the snag was rectified by the maintenance staff by adjusting port engine max NP.

(2) On 19th April 2013, on approach, the right swing problem was reported by the pilot and the snag was rectified by the maintenance staff by replacing port engine reverse linkage clevis pin.

(3) On 23rd April 2013 on approach, right swing problem was reported and the snag was rectified by adjustment of prime blade angles of both engines.

(4) On 27th April 2013 nose wheel steering did not work properly while taxying. The snag was rectified by changing nose wheel steering actuator.

(5) On 2nd May 2013, on approach, the right swing problem again reported by the pilot and the snag was rectified by the maintenance staff by replacing Pcu on left engine.

(6) Since then the problem of right swing on approach and nose wheel steering was not found reported.

1.7 Meteorological information

The weather information initially given was wind south westerly 08-12KTS, visibility 10 km, weather fair. At the time of first contact, it was given as wind SW 08-12KTS, QNH 1020, and Temp. 12^0.

1.8 Aids to navigation

The departure airport Pokhara is equipped with a DME navigation facility. However, the destination airport Jomsom is not equipped with any navigation facility. Jomsom is an AFIS airport. There is no navigation equipment installed till and hence no instrument procedure has been set up so far for this airport.

1.9 Communications

Since Jomsom airport is uncontrolled aerodrome, it provides Aerodrome Flight Information Service (flight information and alerting service) to air traffic. The airport Tower is equipped with the communication facilities which include VHF, HF and telephone. There was no reported or known communication difficulties.

1.10 Airport information

1.10.1 Origin Airport Information

Airport	: Pokhara Airport (VNPK)
ARP	: E083^{0}58' N028^{0}12'
Elevation	: 2696ft. AMSl
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 (Asphalft)

1.10.2 Destination Airport

Airport	: Jomsom Airport
Address	: Marfa VDC,Ward No. 5, Puthang, Jomsom Mustang District, Gandaki Zone
Aerodrome Reference Point	: $E93^0$43' 21" $N28^0$46'53"
Elevation	: 8976ft. (2736m) AMSL
Runway Designation	: 06/24
Runway Dimension	: 2424ft. X66ft. (739X20m)
Wind Sock	: Available at o6
Landing/take off	: Bitumin (Asphalt)
Operation Hours	: 0600 to 1800 LT

The official runway length declared was 2424ft. The runway contains down slope of 1.75% up to about 418ft from the threshold of runway 06.The down slope runway portion is not mentioned officially in AIP Nepal.

The right side area adjacent and parallel to the runway is grassy and covered with scattered pebbles.

1.11 Flight Recorder

Cockpit Voice Recorder (CVR)

The aircraft was equipped with Fairchild Cockpit Voice Recorder (CVR), part number 93A100-33 and serial number 3089; which was installed on 09 May 2013 in aircraft 9N-ABO. The CVR recovered with its case intact without any significant damage to the content of its tape quality. The CVR recorded 30 minutes of audio on separate channel for each pilot and the cockpit area microphone (CAM).

Review of the recording of CVR revealed that: ***the crew coordination in major decision making phases and handling the aircraft in critical situation was lagging behind.***

1. The communication between pilot and co-pilot was not appropriate in the pre-landing phase.

2. Similarly, the communication between pilot and co-pilot on intention and action being taken by PIC, in post landing phase (during critical situation) was missing.

1.12 Medical and Pathological Information

As per medical fitness report issued by the aviation medical assessor, both the pilot and co-pilot were in normal health condition and were certified as fit to fly.

The blood samples of PIC (T1) and co-pilot (T2) were taken to the National Forensic Science Laboratory, Khumaltar, Lalitpur and the samples were analysed by using Gas Chromatography/Mass Spectrometry (GC/MS) for Narcotic Drugs (Heroin, 6-MAN, codeine, morphine, methadone), Benzodiazepines (Nitrazepam, Loraxepam, Diazepam, Alprazolam) Barbiturates (Phenobarbital, pentobarbital, barbital) and Other drugs (Chlorpromazine, impramine)

The above mentioned drugs were not detected in sample T1 and T2.

Samples (T1 and T2) were analyzed by Headspace Gas Chromatography (HS-GC) for ethyl alcohol. Ethyl alcohol was not detected in sample T1 and T2.

As per the report it is found that both the pilot and co-pilot were out of influence of any kind of narcotic drugs and alcohol.

1.13 Fire

There was no evidence of fire upon impact. There was no external or internal burn injuries on any of the crew or passenger.

1.14 Survival Aspects

The accident was survival. All the passengers, the pilot, co-pilot and air hostess were fastening seat belts which might have prevented fatal injury even though they sustained minor to major injury.

1.15 Tests and Research

After the detail investigation of accident scenario along with the interview with the pilot, co-pilot, airhostess, passengers and eye witness, related personnel of NAC, examination of all the technical logs and documents, the Commission had concluded that the pre impact mechanical failure is not a contributing factor behind the accident. So, the Commission did not test any of the aircraft component, material or engine. However, the Commission was in regular contact with the Transportation Safety Board (TSB) of Canada regarding the possible technical support and information.

1.16 Organization and Management Information

1.16.1 Nepal Airlines Corporation (NAC)

The Nepal Airlines Corporation (NAC) is Government owned Company established on 1 July 1958 under Nepal Airlines Corporation Act. It is a national flag carrier which provides domestic as well as international air services using its aircraft fleet such as DHC-6 Twin Otter (2) and Boeing 757, 200 (2). The process of aircraft fleet expansion by Airbus 319 (2 narrow body) is in progress. Similarly, it is known that the aircraft fleet selection for domestic operation is also in progress. It has a total staff strength of around1400. The existing number of Twin Otter Captain is not adequate to meet the growing requirements.

1.16.2 NAC Agreement with M/S Satyam Tours and Travels, Pokhara

The Nepal Airlines Corporation has made a separate Air Charter Agreement with M/S Satyam Tours and Travels, Pokhara on 17 May 2013 with a view to provide DHC-6/300 Twin Otter aircraft to the charterer upon formal request to carry maximum permissible payload from Pokhara to Jomsom and vice versa. The charterer shall be responsible to assemble and keep ready all passengers baggage and cargo at the port of embarkation 60 minutes before the schedule time of charter departure.

1.17 Additional Information

1.17.1. Flight Operations environment at Jomsom

The flying time from Pokhara to Jomsom on DHC-6/300 aircraft type is approximately 20 minutes. Nepal Airlines and Tara Air are operating scheduled and charter services in this airport. Helicopter Charter operation is also prevailed. Agni Air ceased its operation as the airline itself is no longer in existence. It is a category B airfield which is reconsidered as demanding airfield, specially during the windy and rainy season when the approaches can be harsh and en route can be moderately to severely turbulent. Both the local passengers and foreign tourists (mostly Indian pilgrimage to pay tribute to Lord Muktinath) travel to and from Jomsom. It is the only nearest airport to this sacred religious site.

1.18. Rescue and emergency evacuation

The rescue operation and emergency evacuation was carried out properly and efficiently within a short period of time through the rapid mobilization of all agencies and individuals (Nepal Army, Nepal Police, Armed Police, Local Officials, Hospital, Civil Aviation Authority office Jomsom, Airlines Staff and general public, etc.). Everybody appreciated the outstanding and exemplary rescue operation extended to all the needy passengers and particularly the Captain who was flowing with the river current and the security guard of Jomsom CDO office, without any life-jacket, jumped into the river and grabbed up the Captain and did the life-saving job keeping himself in a high risk situation. Recognizing the commendable and exemplary rescue operation and contribution made by the various organizations at Jomsom, the Commission submitted its recommendation to the Government of Nepal, Ministry of Culture, Tourism and Civil Aviation to honor those organizations, agencies and individuals so that it will set an example and foster motivation to all concerned in such rescue operation in future.

Based on the recommendation of the Commission, the Government of Nepal, Ministry of Culture, Tourism and Civil Aviation, had granted Letter of Appreciation to the following person and organizations.

1. Lakshya Ram Chaudhary, Police Constable, Mustang District Police Office
2. Jomsom Civil Aviation Office, Jomsom, Mustang.
3. District Aministration Office, Jomsom, Mustang
4. Nepal Army, High Altitude Training Institute, Jomsom, Mustang
5. Kalidutta Gulma. Nepal Army, Jomsom, Mustang
6. District Hospital, Jomsom, Mustang
7. District Police Office, Jomsom, Mustang
8. Border Security, Armed Police Force, Jomsom, Mustang
9. Tara Air Private Limited, Tilganga, Kathmandu
10. Air Dynasty Private Limited, Sinamangal, Kathmandu

There was no fatality and all the 19 passengers and 3 crew members survived with minor to major injuries. The four local passengers were released after medical check-ups and primary health care at Mustang District Hospital. Some passengers were released after checkups at Gandaki Zonal Hospital, Pokhara. The crew member and the rest of the passenger (Nepali and foreigner) were air lifted to Pokhara and after detail medical checkup ultimately air lifted to Kathmandu by Nepal Airlines and Tara Air flight. The captain and co-pilot were rushed to TU Teaching Hospital for necessary in-depth investigation and treatment. The Chairman and member secretary of the Commission visited TU Teaching Hospital and obtained information about the health condition of both the pilots and expressed best wishes for their speedy recovery. Likewise the Chairman and the member secretary also visited the B & B Hospital to observe the health condition of the Japanese passengers who were admitted at that Hospital. Considering the health condition of patient the Doctor referred the Captain to the Siriraj Hospital at Bangkok, and subsequently few weeks later, the co-pilot was also referred to the Hospital in Delhi, India for further investigation and treatment.

The co-pilot had returned to Kathmandu after treatment at Medanta Medicity Hospital in India. The Commission has taken interview with the co-pilot at his residence on 11 July 2013 in normal environment.

The Commission member secretary and pilot member had visited and interviewed the PIC on 14 September 2013 at Siriraj Hospital, Bangkok in the presence of his

wife in peaceful environment. The health condition of pilot was found improving. His memory power was observed normal

2. Analysis

2.1 Introduction

The analysis of the events which led to the accident began with the careful scrutiny of the factors such as technical defects, unlawful interference, explosions, pilot incapacitation, lack of training/qualification/experience which could have contributed to the accident. These factors have been reviewed separately and ruled out accordingly.

The primary cause and contributory factors to this accident derived from the analysis of the facts and evidences gathered in this context are narrated hereunder.

2.2 Methodology

In order to determine the situation and probable cause of the accident of 9N-ABO, DHC-6/300 aircraft at Jomsom during landing the following methodology were employed.

(a)Accident Site Visit

The members of the Commission visited the accident site at Jomsom airport on the third day of accident and spent almost 5 days to collect the available evidence and information regarding the accident. The Commission had physically examined the touchdown point, deviation from the runway to grass area, marks and stress, tyre impression, aircraft external disintegrated structures and internal instruments. The location and position of the wreckage has also been observed and analysed.

(b) Interview and Statements

The interview and the statements of the pilot, co-pilot, air hostess and some of the passengers were collected. The local officials, the people with different walks of life, and the local eye witnesses were also asked to express their statement on the visual sequence of the accident. 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, Deputy Directors of Flight Safety and Quality Assurance were interviewed with questionnaires. The concerned officials of CAAN flight safety department have also been consulted and shared their views.

(c) Important Statements

Pilot in Command : Capt. Dipendra Pradhan

Technically, the 9N-ABO aircraft was in good condition. First flight was operated normally and this flight was second on that day. Weather at Jomsom airport as well as in en-route was good. Wind in the landing phase was S/W 10-12 KTS which was normal in Jomsom. Normally I used to land at runway 06 in that wind condition. The relation with co-pilot and Air Hostess was good. Wind was within tolerable limit and so, I requested Tower runway 06 even runway 24 was advised by the Tower. Approach was normal and everything was under control before landing on runway 06. After landing the aircraft turned to right and reached the grass area. Speed of aircraft was higher than normal and it was difficult to control aircraft. I had applied brakes to stop aircraft but the gravel and pebbles in the grass area did not help aircraft to reduce speed rather help to skid aircraft and made aircraft unbalanced.

Assuming difficulty to stop I tried aircraft to bring in the runway and added power to airlift the aircraft to avoid the possible overrun in the runway. My calculation did not match with the reality. Aircraft did not produce enough lift and ultimately fell down in the bank of Kaligandaki River. Because of critical state of aircraft and very little time I could not communicate with co-pilot about the intention and actions to be taken.

It is my recommendation to the authority to make weather (Wind and visibility) limitation for operation in the STOL airports and implement strictly.

Co-pilot: Suresh K.C.

We had waited for about one and half hour for departure due to pokhara weather. That day we have to complete five shuttles between Pokhara- Jomsom. Because of delay in flight we were in time pressure to complete flight. There was no communication between us except normal flight procedure function. En-route weather and Jomsom weather was good. First flight and second flight before landing was smooth. No any problem faced. The aircraft was under control of PIC all the time and I was conducting radio telephony most of the time. Before initiating approach while Tower advised R/W 24, wind S/W 10-12KTS and I had acknowledged, and then PIC had taken control of RT also. PIC requested tower for R/W 06. Approach was stable and landing was normal. Attitude of the aircraft on the runway seemed normal's after landing**.** While aircraft landed the Ground speed was around 118 KTS. During landing in normal condition the GS should be around 90-95 KTs. The landing speed was higher than normal. Initially PIC applied reverse but aircraft did not control rather diverted to grass area and become unbalanced. As usual practice when pilot applied reverse and brake I had raised flaps up and neutral without consent of pilot**.** It was difficult to control aircraft even PIC applied full rudder and nose wheel. Immediately after aircraft entered grass area, PIC applied power. After a little time aircraft again entered runway and accelerated. Before applying power the speed of aircraft was around 30-40 KTS. As PIC did not communicate with me about his intention and action to be taken, I did nothing. I was wondering what PIC is doing in such critical situation without informing me. There was no problem in aircraft tire.

There was no enough speed of aircraft and no enough runway to carry out take off. I think PIC did not notice the condition of flaps. Pilot should be in stress and he may have applied conflicting powers (power, brake etc) simultaneously with the sub-conscious state of mind. If R/W 24 was used the accident never would have happened.

Suggestion

1. Tower should have power to restrict operation of flight in abnormal situation
2. There should have wind and visibility limitation in airports and implemented strictly

Air Hostess: Santa Maya Tamang

Each phases of flight from take off till landing was observed normal. Weather was good. Approach and Landing was normal. I had observed the landing sound which was as usual. After landing I feel that aircraft was moving with higher speed. I did not notice the application of reverse and brake after landing. Once aircraft landed it became unbalanced.

All passengers had fastened seat belt. It may be the cause behind no fatality of passengers. I had checked time and again the condition of passengers. All were happy and enjoying flight. I wondered why pilots take risk in flight. Why pilots fly in bad weather? Marketing staffs of NAC should be controlled specifically regarding load management. However, there was no excessive load in the flight.

Pilots should be more responsible and accountable for safety of flight. We do not have any idea of prevailing weather, airport, operation attitude of aircraft etc.
I feel that sometime pilot Dipendra try to ignore weather and fly in his own discretion. PIC Dipendra is frequent flyer in this route, so he may have taken s/w 10-12 KTS wind as normal for R/W 06.

Since I was in rear part of aircraft I did not observe the aircraft situation completely and I did not notice the movement of aircraft in grass area. Once aircraft became unbalanced I closed my eyes and also cried. After 5-7 minute of accident I opened my eyes, I saw few passengers' onboard aircraft and they were crying. People were actively engaged in rescue of passengers and crew.

Summary of Statement of Eye-witness of Jomsom Area

Many people in the Jomsom area had seen the aircraft landing and movement in airfield and ultimately the accident. The view and version of most of the eyewitness is more or less the same. The version of eyewitness is as follows:
The landing of aircraft was seen normal as usual. After touchdown the aircraft directed towards grass area of runway i.e. right side of runway. After the sircraft entered in runway it was seen that it will stop but after few seconds the speed of aircraft increases and accelerated. Once the aircraft entered the runway the speed of aircraft increases and the sound was heard like aircraft started to take off.

Summary of Statement of Passengers

As per the passengers, the en-route flight, approach and landing was smooth. After landing the aircraft was unbalanced. The speed of aircraft was not under control rather it was increasing. Then they felt that aircraft will take off again due to some reason. Most of the passengers did not notice the movement of aircraft in grass area. One of the Japanese passengers seating near the PIC seat has observed the panic condition of PIC. The passengers were not aware of any other things of aircraft.

(d) CVR Read out

The CVR read out was recorded using the facility available in Kathmandu. Maximum effort was made to listen the conversation of the crew and record it as far as possible. The record using single channel facility in noisy condition was a little bit problematic, however, the Commission had successfully copied the conversation and analyzed from different angle. The CVR record was found very helpful in analyzing the cockpit scenario before and during the last phase of accident.

(e) Log Books, Records, Documents and Manuals

Airframe, engine and aircraft technical log books were reviewed and examined to assess any discrepancy and malfunctioning of the aircraft wheel and brake system. Operations Manual, Flight Safety Manual, Aircraft Flight Manual, Standard Operating Procedure, Pilot records were checked and reviewed. CAAN approved FOR, NCAR, AOCR, AIP, AIFS manual were also reviewed. Similarly, the relevant documents were reviewed and discussed with concerned personnel.

2.3. Observation and Analysis of the aircraft, company procedure for Jomsom Airport and the pilot

(i) Aircraft: DHC-6/300

The aircraft DHC-6/300 Twin Otter is capable and certified to carry out STOL operations as per the existing regulations. In this accident, theexamination of aircraft wreckage and results of analysis on facts and figures conforms that there was no evidence of any pre-impact failures or aircraft malfunction that could have contributed to the occurrence. The aircraft was conducting landing with STOL techniques as the runway length of Jomsom is 2424ft.

The co-pilots' explanation has revealed that the indicated air speed during landing was more than 100 KTS, meanwhile the required speed for landing in STOL operation is 70+_ 5KTS.

(ii) Company Procedure for Jomsom Airport

The Standard Operating Procedure (SOP) for DHC-6/300 Twin Otter aircraft of NAC explains the procedure where captain would carry out missed approach and co-pilot was to adjust flaps 10, propeller full fine and watch speed 80KTS indicated till the aircraft reach safer height.

In the present pre-landing checklist reading process, the PIC has responded by answering missed approach procedure to be standard. In fact, because of tail wind situation and with possibility of missed approach a full briefing on PIC's intention and action ought to have been pre-landing checklist.

The fact and figure mentioned in the SOP are outdated and has not reviewed and updated the existing runway length, limitation and recommended practices for the guidance of pilots.

Similarly, CRM of command action and response as mentioned in the SOP has not been used in the process of change of the flaps, in post landing phase where PIC has to order flaps retraction and only after PIC command for flaps to be retracted. The explanation given by co-pilot and observation of the flaps position has revealed that the aircraft was not in position to get sufficient lift for continuation of landing roll for takeoff.

(iii) The Pilot

(a) In this occurrence pilot has chosen runway 06 to land in spite of the prevailing tail wind 08 to 12KTS. He had landed leaving 776ft. far from runway 06, went out of the runway, added power and again brought the aircraft back into the runway and kept on rolling, which might indicate his intention to lift up again. The lack of risk analysing factors of safety and correct decision making within a short period of time has been obviously displayed here in this occurrence because there was no sufficient speed, sufficient lift and distance to roll for takeoff. The PIC has not bothered to call out his intention and action to the co-pilot.

(b) It seems that the co-pilot has been groomed to be less knowledgeable in area of risk analysis.

(c) The appropriate briefing during pre-landing phase of flight on change of course of action from runway 24 to runway 06, would have given the PIC an identified and confirmed action if something went wrong.

Similarly, during the post landing roll, the PIC ought to call out (or at least shout) on his intention and action required. If that was carried out then the PIC could have some help from the co-pilot. (like use of breaking by both pilots, hands on power by both pilots or some advice from co-pilot about consequence and force to stop and so on)

As such the vital ingredient of CRM among both pilots in the form of the inappropriate briefing during pre-landing phase of flight and absence of timely and proper briefing on intention and action of PIC during post landing phase has been considered to be the contributory factors to this occurrence.

2.4 Review Analysis

The mechanical, external and human factors which could have contributed to the accident were reviewed and analysed. Each of them is explained categorically.

(a) Bad Weather

The weather of Jomsom airport at the time of accident was:

Wind -- South Westerly 08-12KTS,
Visibility -- 10 km, WX fair
QNH -- 1020
Temp. -- 13^0 C

The prevailing weather condition at Jomsom airport could not be considered as the contributing factor for the accident.

(b) Approach and Landing Aids

The approach and landing aids help the pilot to approach and land during restricted visibility condition especially on IFR approach. At Jomsom there are no approach and landing aids, hence the flight was on VFR and the weather was VMC. As such, the unavailability of these aids is also not a contributing factor for the accident.

(c) Condition of Runway Adjacent Area

As per the PIC statement, the gravel and pebbles scattered at the adjacent side of runway i.e right hand side grassy area of R/W/06 did not help the braking action of aircraft. So, the presence of pebbles and uneven surface in the right side grass area adjacent and parallel to the runway 06 unfavourable in case of runway incursion and excursion during landing and take-off.

(d) Aircraft Weight

The regulated landing weight of DHC 6/300 Twin Otter aircraft is 12300 pounds. In the context of the present accident when the load sheet/trim sheet checked it was found out to be less than the maximum regulated landing weight. This indicates that aircraft was operated within the regulated landing weight limitation. So, the reason of weight factor could not be the cause of this accident.

(e) Pilot Incapacitation and Pilot Cross Control

The statement of pilots, CVR read out and statement from the passengers and eyewitnesses revealed that the pilots were capable and there was no indication of cross control activities till the impact.

As per the laboratory test of the toxicological specimens of both the crew conducted at national forensic science laboratory revealed that both the crew were not found under influence of, or imposed by, any drugs or alcohol at the time of the accident. As such the pilot incapacitation and pilot cross control is no longer an issue in relation to this accident.

(f) Experience of PIC

The pilot is experienced to fly in Nepal. He has accumulated more than 7000 flying hours in Nepalese topography. The instructor pilot have cleared Captain Dipendra Pradhan gradually in each STOL airfield in accordance with NAC Manual and FOR of CAAN. In this case, insufficient experience of PIC may be ruled out.

However, the STOL landing procedure undertaken by PIC and the final decision taken in this flight were inappropriate.

(g) Technical Problem of the Aircraft

The technical problem of aircraft swing has been reported and noted through the technical log. However, the problem of aircraft swing has been mentioned only in the air on approach while setting the propeller to full fine. The rectification of those snags has been carried out in time. There was no mention about the aircraft swing problem reported on the ground. The earlier flights of the day of occurrence, interview with the crew and marking of the wheel/tyre on runway revealed that there was no problem of swing and deflation of wheels/tyre. Hence, the failure due to technical problem has been ruled out.

(h) Procedure Adopted for Pre-landing, Landing and Post Landing Phases

The PIC adopted inappropriate conduct of STOL procedure and landing technique, during landing-phase and an endeavour to carry out take off again with no sufficient airspeed, no required lifting force and non availability of required runway length to roll during post landing phase. Hence, the wrong procedure adopted for pre-landing, landing and post landing phases cannot be ruled out. In this regard the following points are more illustrative:

i. In STOL approach to land, the approach speed should be strictly followed to land on desired point of touch down. In this landing the speed has not been maintained and ground speed has increased to such extent that landing at particular point was difficult.

ii. Similarly, there was no proper briefing for landing and missed approach in case of something goes wrong and the proper missed carriage also has not been carried out. The proper steps of briefing and coordination on intention and action of pilot in command have also not been carried out.

iii. As per aircraft manual of DHC-6/300, the tailwind limitation is 10 knots, but the aircraft landed when wind was S/W 10-12Knots.

(i) Unlawful Interference and Explosives

The information provided by the FO and the eye witness indicated that both the engines of the aircraft were running well and no fire was observed. During the crash

site visit, it was observed that both the power lever and speed levers were in maximum position. Both the engines were operating and producing full power till the last impact. So, it had no contributory role to this accident.

(j) Tower Information

The ATS officer on duty at Jomsom Tower provided information on surface wind and advised R/W 24 as runway-in-use referring wind south-westerly 08-12KTS. However, the PIC opted to land through R/W 06 and landed accordingly. The AIP Nepal (fifth edition, 2010) Chapter ENR 1.1.15. para 19.7 has made a provision where AFIS personnel on duty may declare runway closure in case of tail wind exceeds 10KTS at STOL aerodromes.

3. Conclusion

3.1 Findings

1. The pilots were fastening seat belts and wearing shoulder harness and the airhostesses as well as all passengers were fastening seat belts.

2. The pilots were certified and qualified in accordance with the existing Nepalese aviation regulations. Both the pilot and co-pilot were in normal health condition and were certified as fit to fly.

3. The crew had adequate rest and the duty times within the accepted guidelines.

4. The pilots were out of influence of any kind of narcotic drugs and alcohol.

5. There was no evidence of any pre impact failures, any mechanical failures of wheel assembly, and any other aircraft malfunction that could have contributed to the occurrence.

6. Initially the Tower advised runway in use 24 considering the prevailing wind S/W 08-12 KTS which may produce tail wind effect to aircraft while landing at R/W06, and the co-pilot replied back complying the advice of Tower.

7. The PIC took over communication from co-pilot and opted to land through runway 06 despite the advice of the Tower to use runway 24 for landing without any briefing between the crew.

8. The decision of the pilot in selecting runway 06 in tail wind situation was against the STOL procedure and the company Standard Operating Procedure (SOP).

9. The Flight Manual of DHC-6/300, Twin Otter has limitation of 10 Knots Tail wind for operation.

10. The company's SOP is not updated incorporating the prevailing runway length, limitations and recommended practices for the guidance of the pilot.

11. The presence of pebbles and uneven surface in the right side grass area adjacent and parallel to the runway 06 is unfavorable in case of runway incursion and excursion during landing and takeoff.

12. The runway constitutes a down slope of 1.75% for up to about 418ft in length from the threshold of runway 06.

13. The aircraft touched down the runway at a distance of about 776ft. far from the threshold of runaway 06. The physical observation of the runway shows that while landed the aircraft nose was heading towards outside the runway. The aircraft initially rolled 194 ft at runway surface and entered the right side grass area where it rolled for about 705ft and again entered the runway. The maximum deviation of aircraft from runway end was found 19 ft.

14. After crossing around half of the runway distance, without realizing the facts of retracted flap, the speed of the aircraft, availability of remaining runway length, the PIC added power without briefing anything of his intention to co-pilot.

15. The evidence of piece of gravel with bitumen stuck up into the tyre and marks of breaking effect on the runway surface explains that the aircraft breaks were used even when aircraft was rolling with an intention of take off knowingly or unknowingly by the pilot.

15. With no airspeed sufficient to make aircraft air borne, and no further distance sufficient to roll for takeoff (for balked landing) and with retracting flap not sufficient to support lift, the aircraft was not in position to get airborne and hit the perimeter fence and plunged into the bank of Kaligandaki river.

16. The facts of the PIC taking control over communication from co-pilot without briefing, absence of required briefing prior to landing , and absence of briefing in between crew, on intention and action taken in

post landing phase, clearly shows that absence of proper CRM has greatly contributed to this accident.

17. The rescue operation and emergency evacuation was conducted in a well coordinated and efficient manner.

3.2 Causes

The Accident Investigation Commission has determined **the most probable cause** of the accident as the ***inappropriate conduct of STOL procedure and landing technique carried out by the PIC, during landing phase and an endeavor to carry out take off again with no sufficient airspeed, no required lifting force and non availability of required runway length to roll***.

Contributory factors to the occurrence is ***the absence of proper CRM in terms of communication, coordination and briefing in between crew members on intention and action being taken by PIC, during pre and post landing phase.***

4. Safety Recommendations

4.1. Interim Safety Recommendations

After return from the crash site visit and visualization of the operating environment of Jomsom airport and more or less similar condition of other STOL airport operation, the Commission along with the Operations and engineering officials of CAAN Flight Safety Standard Department, held extensive discussion with IPs and other operational pilots of NAC and other airlines having substantial STOL flying experience focussing on the problems and challenges being encountered in STOL operations and immediate remedial measures to be taken to further enhance flight safety. The issues and concerns raised during discussions and the practical suggestions were duly noted.

At this backdrop, the Commission as per the decision dated 2070/2/2 (24 May, 2013) submitted the following interim safety recommendations to the Government of Nepal, MoCTCA, in order to take immediate remedial action by the concerned agencies. The interim safety measures should be implemented with priority to further enhance safety at Jomsom airport taking into account the geographical situation and typical weather conditions of Jomsom airport.

1. Considering the typical geographical location and nature of wind, arrangement should be made to stop tail-wind landing and take off practices in case of the wind exceeding 5 KTS at Jomsom airport.

2. Arrangement should be made for necessary maintenance and keep intact the fencing that has been damaged in the east side of the end of the runway 24, as early as possible.

3. Special surveillance should be made to those pilots involved in at least in one serious incident or accident and the corresponding action taken thereon by the CAAN in the past.

4.2. Safety Recommendations

As a result of thorough investigation of the accident, the Commission has made the following safety recommendations directed to the concerned organizations.

A. Recommendations to the Government of Nepal, Ministry of Culture, Tourism and Civil Aviation (MoCTCA)

1. An independent and effective aircraft accident investigation mechanism with the provision of adequate resources and functional autonomy should be established under the Ministry of Culture, Tourism and Civil Aviation (MoCTCA) to effectively conduct accident investigations and continuously monitor the implementation and compliance-status of remedial safety measures.

2. The MoCTCA should encourage CAAN and airline operators to take initiatives towards promoting safety culture and best practices as well as producing credible outcomes in the formulation of rules, regulations, requirements and standards and their proper implementation.

B. Recommendations to the Civil Aviation Authority of Nepal (CAAN)

1. The CAAN should further strengthen its surveillance and monitoring function focusing on the critical safety areas including violation of SOP, proper application of CRM, CFIT, runway incursions/excursions, approach and landing accident reduction etc. and ensure effective enforcement mechanism.

2. In order to undertake proactive safety measures, the CAAN should constitute a dedicated committee of relevant professional experts to have in-depth review of the existing STOL field, taking into account the major factors particularly the runway length and slope, Runway layout, runway condition, Runway marking, regulated weight, approach, trends of wind

blowing and presence of obstruction etc and ensure corrective action against risk factors as necessary.

3. The CANN should encourage the professionals like pilots, engineers, ATC officer and general people to report the unsafe practices and establish a database of such activities of concerned personnel and the airline, to analyse the risk and take risk mitigation mechanism and remedial measures as necessary.

4. The ATS and AFIS personnel working at AFIS airports should have customized training including STOL airfields and aircrafts operating limitations and knowhow of relevant provisions of safety regulations applicable in the respective airports to strengthen the regulatory capacity of CAAN.

5. Considering the typical geographical location and nature of wind, arrangement should be made to stop tail-wind landing practices in case of the wind exceeding 5 KTS at Jomsom airport.

C. Recommendations to the Nepal Airlines Corporation (NAC)

1. The NAC should strengthen training on Crew Resource Management s (CRM) focusing attention on the critical phases of flight (take-off, landing and missed approach phases) as identified in the analysis and findings of this report.

2. The NAC should further strengthen its existing mechanism to monitor, investigate and mitigate the risk associated with the repetitive defects of particular aircraft at expert level to strengthen flight safety.

3. The NAC should develop and maintain the procedures in STOL operation (*Considering the specific points mentioned in the analysis and findings of this report*) enabling the pilot to know and apply the rules, regulations and standards and analyze the risk and enhance safety performance.

4. The NAC should review and update the SOP to make it compatible to the existing facilities and include recommended guidelines for the guidance

of pilots particularly during take-off, landing and missed approach phases.

5. The NAC should develop the qualified professionals to be the trainer on Safety Management System (SMS) and imparts the knowledge to all key personnel, pilots, engineers and related ground staffs and set a target to the full-fledged implementation of SMS with an applicable database.