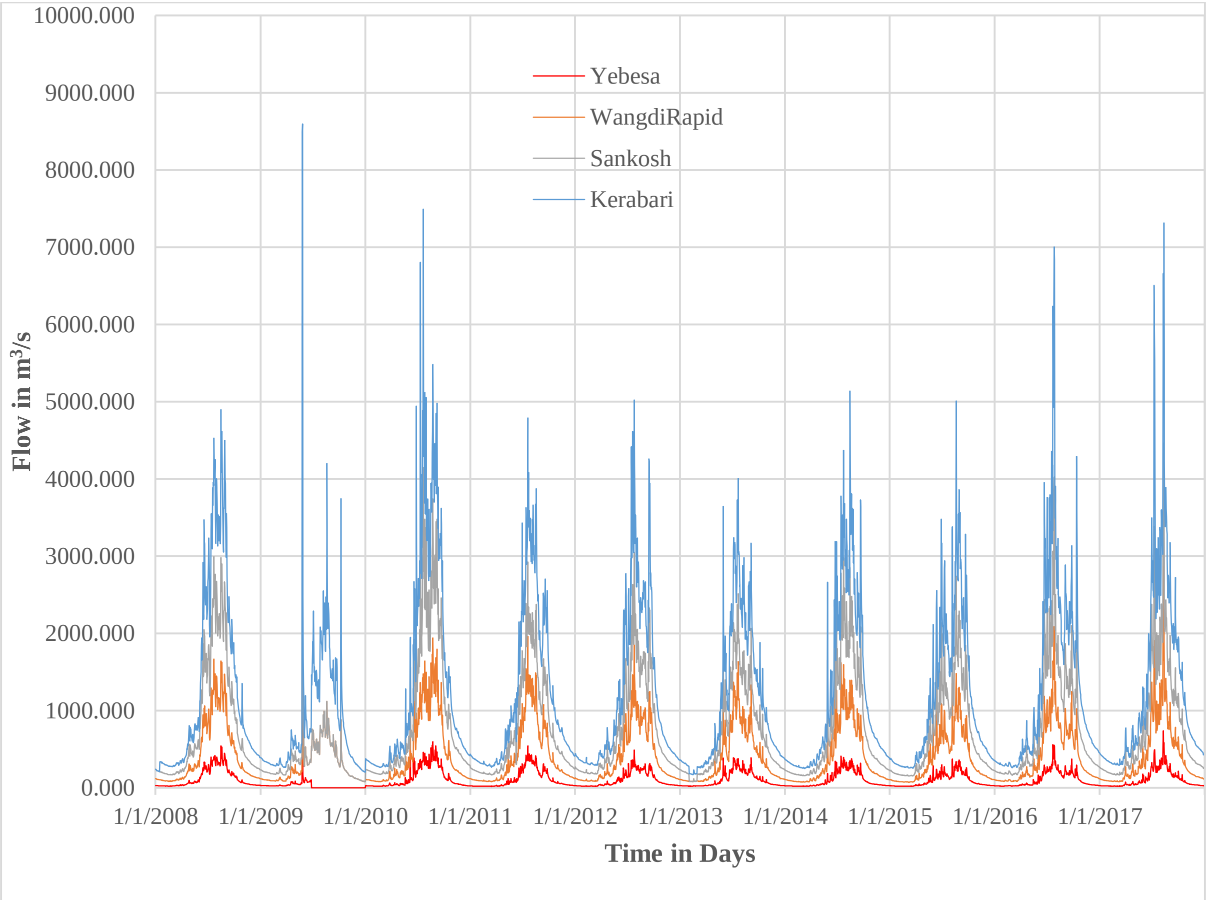
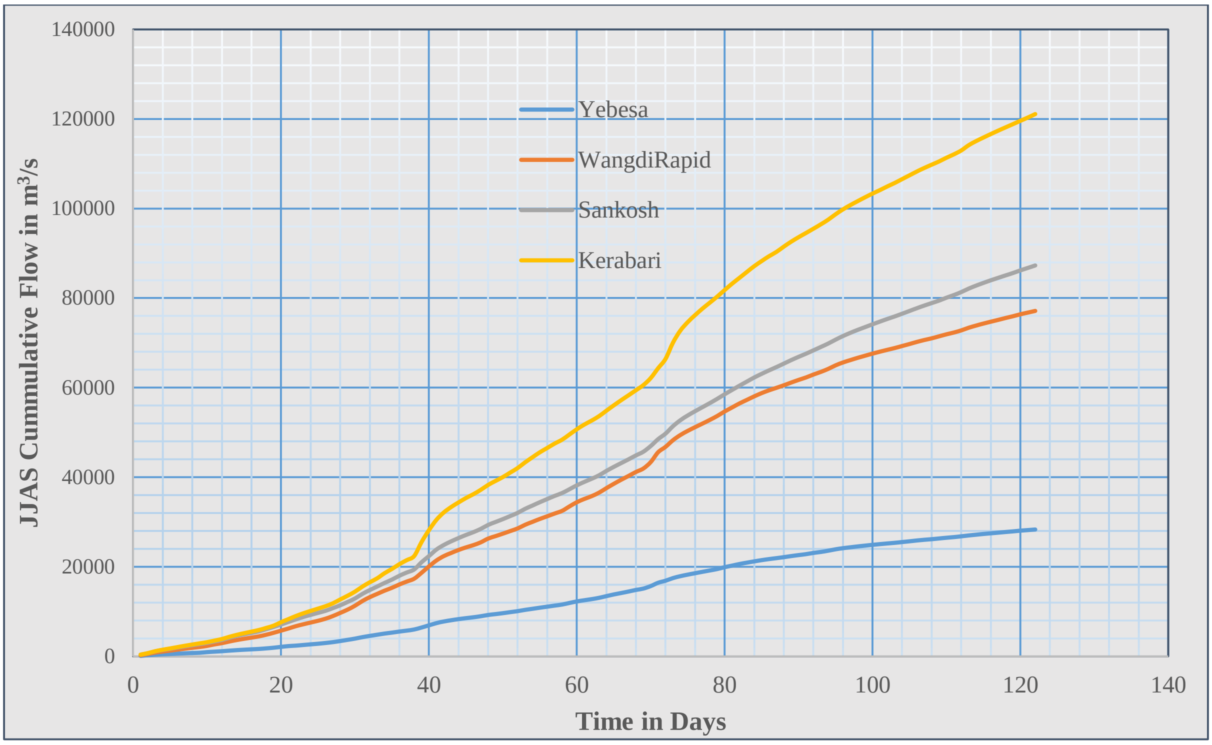
Hydrology and Water Resources Services Division
National Center for Hydrology and Meteorology
Royal Government of Bhutan,
Thimphu: Bhutan

River Flow Status of Bhutan



JUNE 2018

River Flow Monitoring Report of Bhutan



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About this Report

The river flow report is a summary of observations of the country's river. As the first of this series, this maiden issue contains a summary of 2017 river flow status. All computations contained in this report are based on Principle Station (manual) owned and operated by National Centre for Hydrology and Meteorology, Royal Government of Bhutan.

Contents

MAJOR FACTORS INCLUECNING RIVER FLOW VARIABILITIES IN BHUTAN

River Regimes

The river regime is the direct consequence of the climatic factors influencing the catchment runoff, which is derived or estimated from the climate knowledge of the region. The expected pattern of river flow during a year is known as the river regime. A flow records of 20-30 years are generally required to represent a pattern since there may be considerable variation in the seasonal discharge from year to year. The averages of the monthly mean discharges over the years of record calculated for each month, January to December, give the general or expected pattern: the regime of the river.

Temperature-dependent Regimes

Rivers with a dominant single source of supply, initially in the solid state (snow or ice), produce a simple maximum and minimum in the pattern of monthly mean discharges according to the seasonal temperatures.

- Glacial. When the catchment area is over 25-30 per cent covered by ice, the river flow is dominated by the melting conditions. Such rivers are found in the high mountain areas of the temperate regions. There is little variation in the pattern from year to year, but in the main melting season, July and August, there are great diurnal variations in the melt water flows.
- Mountain snowmelt. The seasonal peak from snowmelt is lower and earlier than in a glacial stream, but the pattern is also regular each year providing there has been adequate winter snowfall. The low winter flows are caused by freezing conditions.

Rainfall-dependent Regimes

In the equatorial and tropical regions of the world with no high mountains, the seasonal rainfall variations are the direct cause of the river regimes. Temperature effects in these areas are mostly related to evaporation losses, but with these being dependent on rainfall, the overall effect of evaporation is of secondary importance in influencing the river flow pattern.

- Equatorial. Drainage basins wholly within the equatorial belt experience two rainfall seasons with the annual migration of the intertropical convergence zone, and these are reflected directly in the river regime.

WHAT HAPPENED IN 2017?

Average Annual Flow

The annual average flow from recorded data as early as 1992 till 2016 is compared to the average flow of 2017 for five stations located at the downstream of other stations. Each station is located in different basins but does not serves as the representative flow of the whole basin. It shows that the annual average flow in Punatsangchu, Chamkharchu and manas in 2017 is slightly above the average flow till 2016 while in Wangchu and Mangdechu, the annual average flow is below the average flow till 2016

Sl. No	Station Name	Basin/Sub Basin	Average Flow (till 2016)	Average Flow 2017
1	Tamchu on Wangchu	Wangchu	61.45	51.95
2	Kerabari on Punatsangchu	Punatsangchu	449.19	490.68
3	Tingtibi on Mangdechu	Mangdechu	134.97	117.76
4	Bemethang on Chamkharchu	Chamkharchu	87.98	117.41
5	Panbang on Drangmechu	Manas	746.59	866.99

Table 1 : Comparative Flow in each Basin

EXPLAINATORY NOTES

Discharge- Catchment Map:

The existing network of stations does not portray a total volume of water flowing through the basin. A realistic flow pattern is difficult as the location of station is not at the end point of the river or at the point where it exits Bhutan boundary. The discharge shown in the map is the average discharge of the station from available recorded data till 2016 and the annual average flow of 2017. The value is the average discharge at the station and the catchment is delineated base on the location of the stations.

LOCATION MAP OF PRINCIPLE HYDROLOGICAL SATTIONS

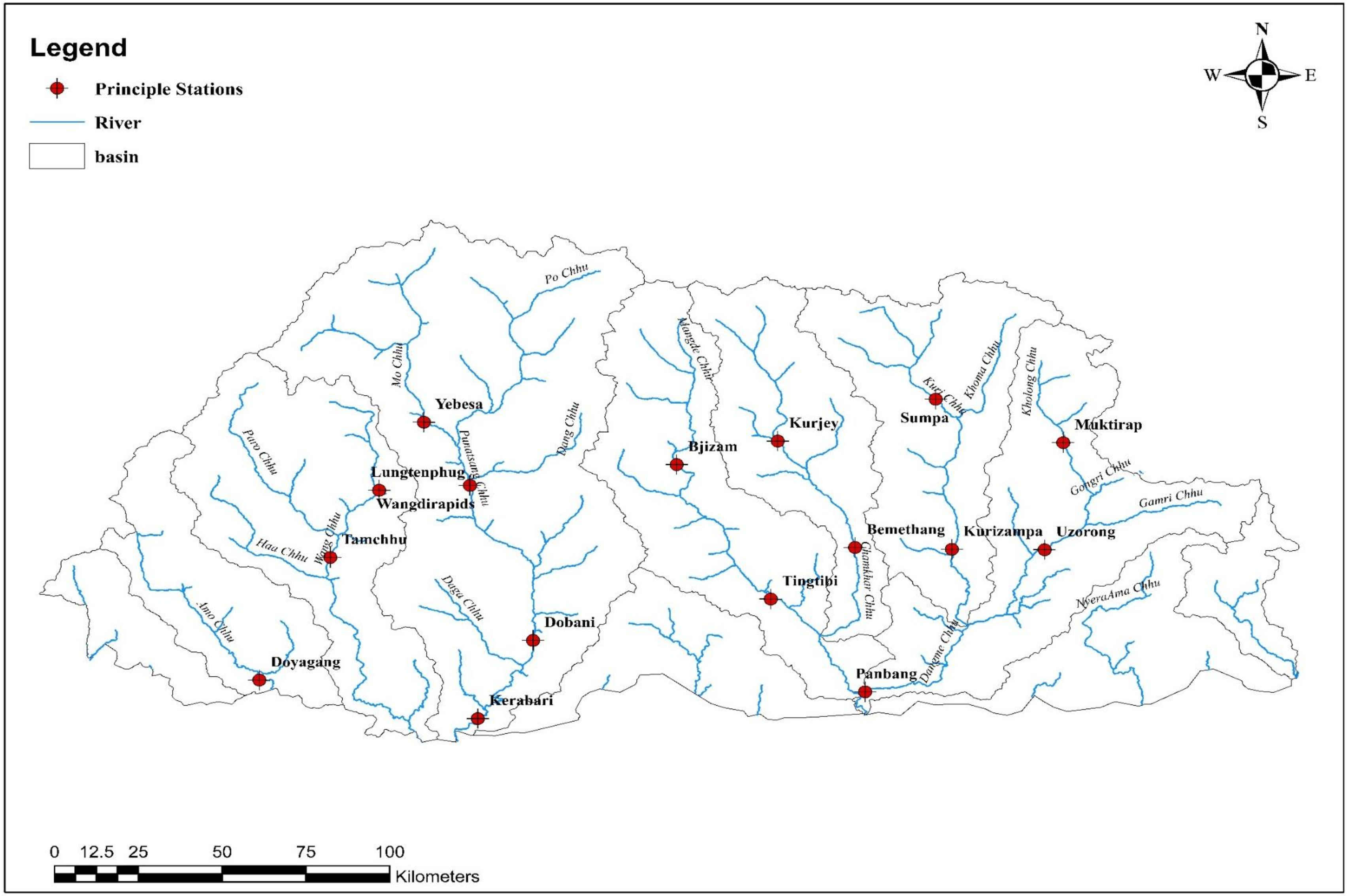


***Figure 1**: Location of Principle Stations*

1. WANGCHU BASIN

1.1 ANNUAL AVERAGE DISCHARGE MAP

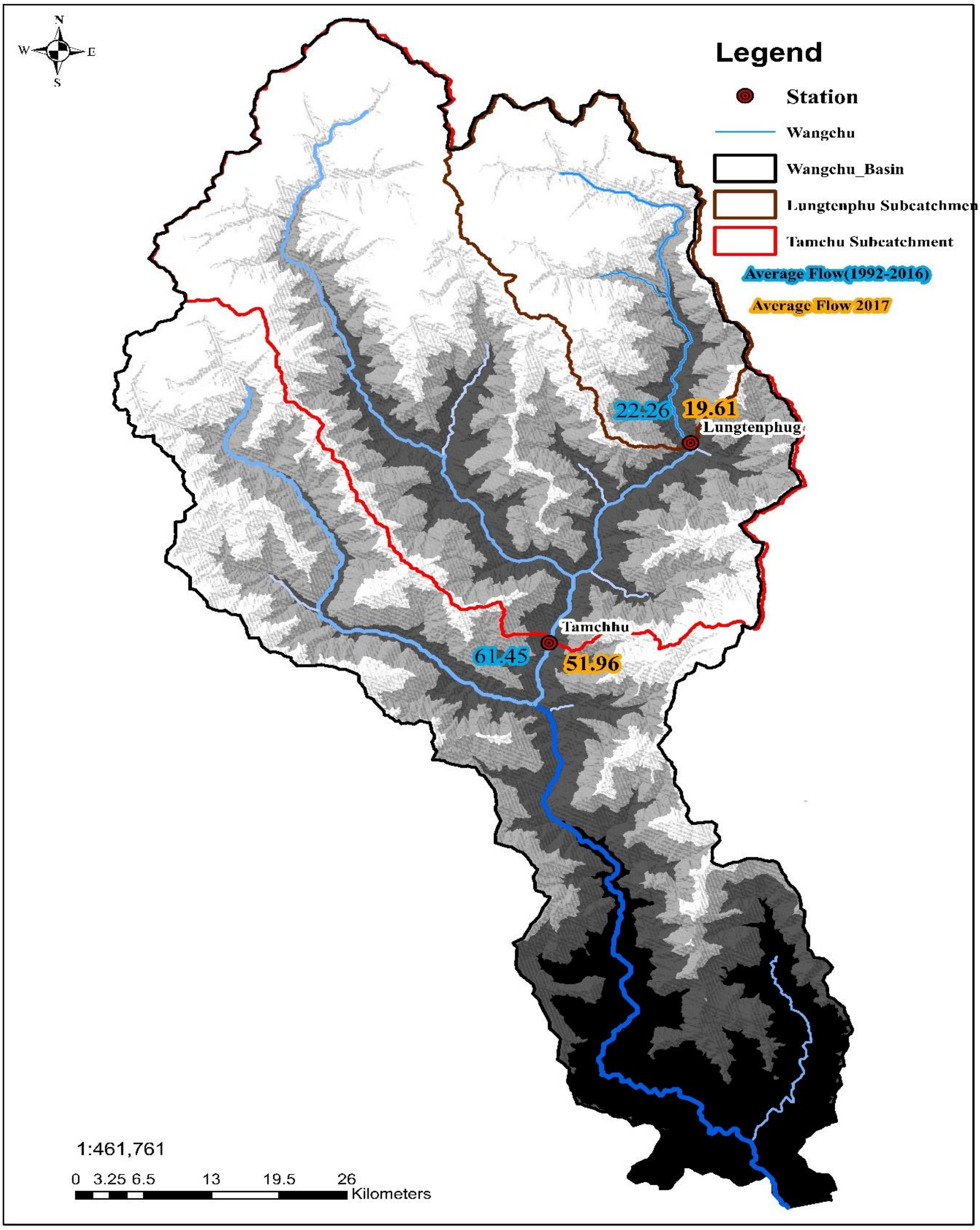
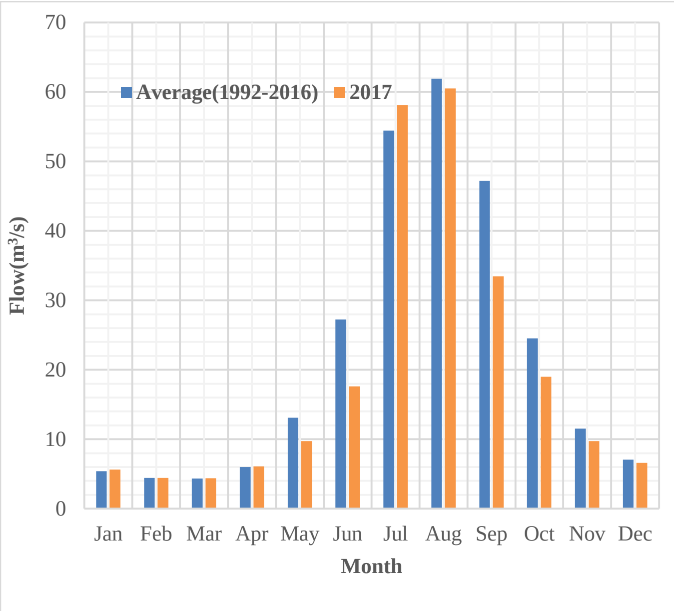
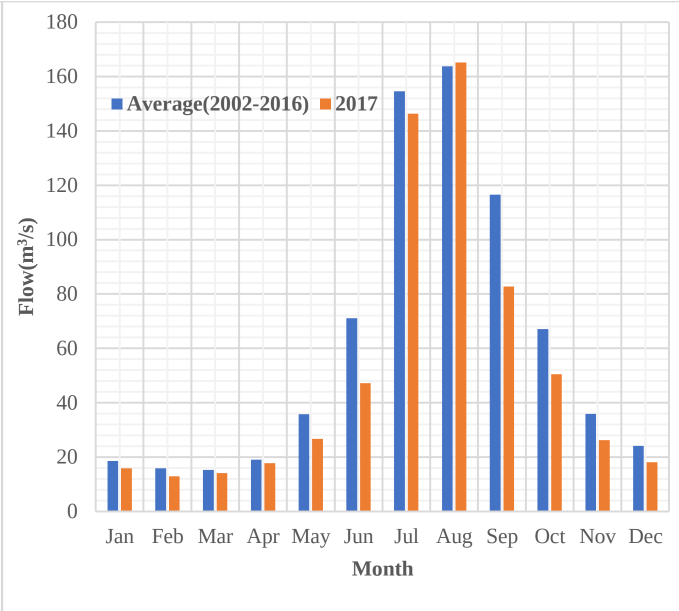


Figure 2 (a). *Annual average flow Stations in Wangchu Basin*

1.2 STATIONWISE AVERAGE MONTHLY FLOW



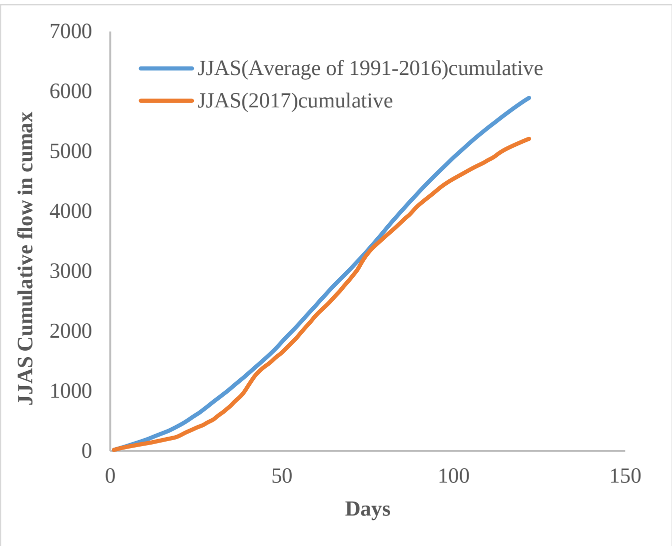
Station: Lungtenphu on Wangchu



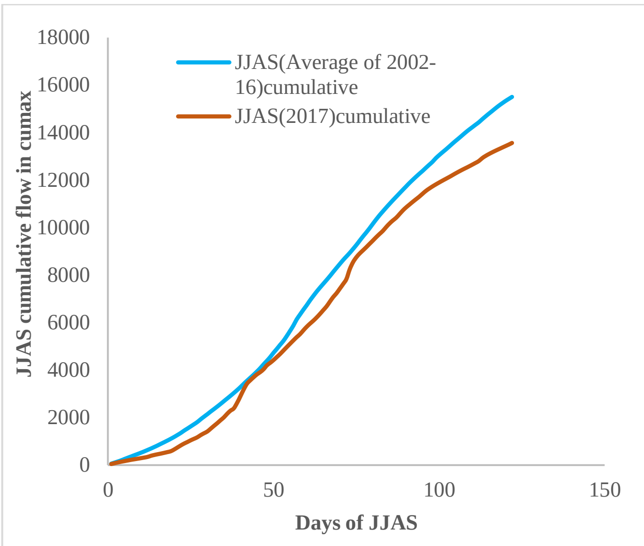
Station: Tamchu on Wangchu

Figure 2(b): *Station wise Average Flow of Wangchu Basin*

1.3 STATIONWISE JJAS CUMMULATIVE FLOW



Station: Lungtenphu on Wangchu



Station: Tamchu on Wangchu

Figure 2(c): *Station wise JJAS Cumulative Wangchu Basin*

2. PUNATSANGCHU BASIN

2.1 ANNUAL AVERAGE DISCHARGE MAP

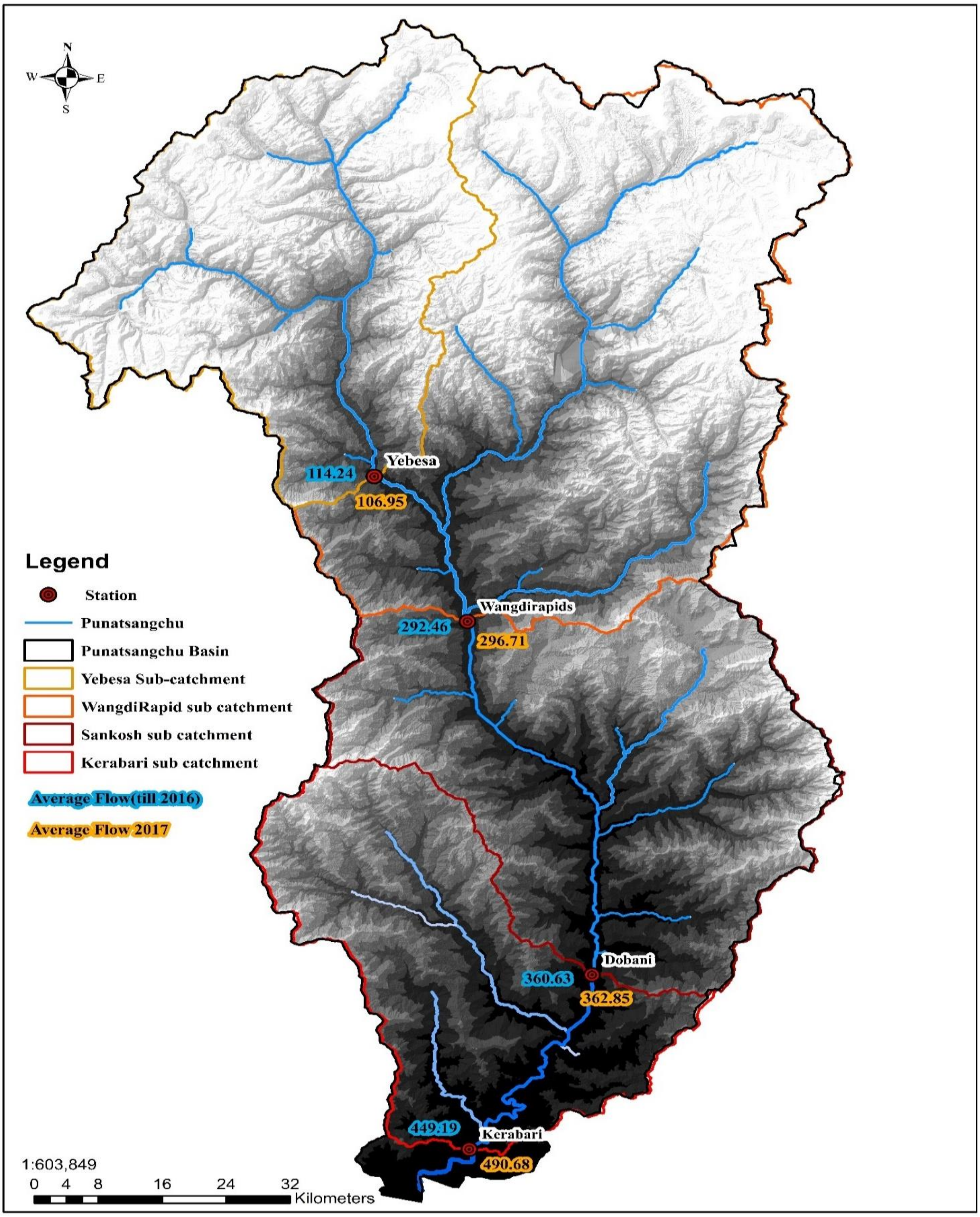
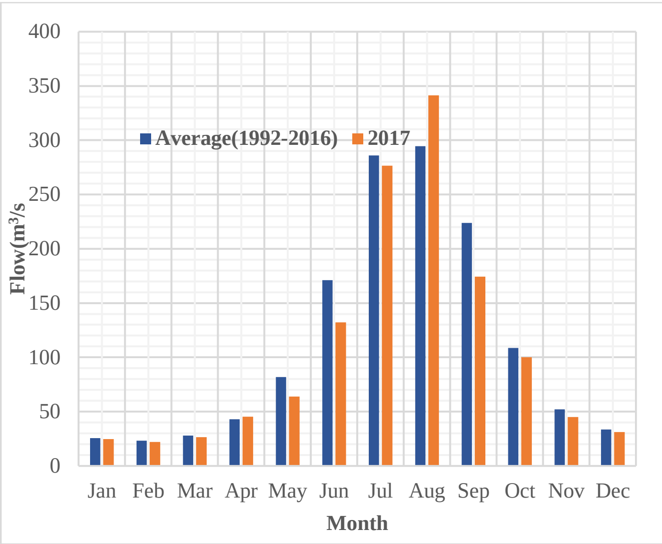
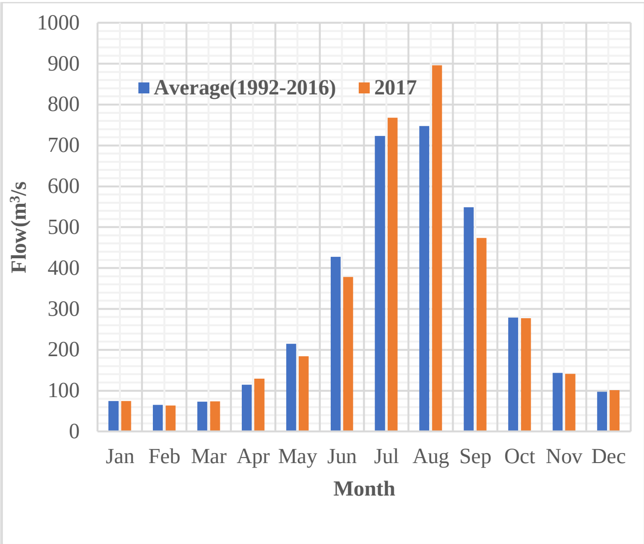


Figure 3 (a). Annual average flow Stations in Punatsangchu Basin

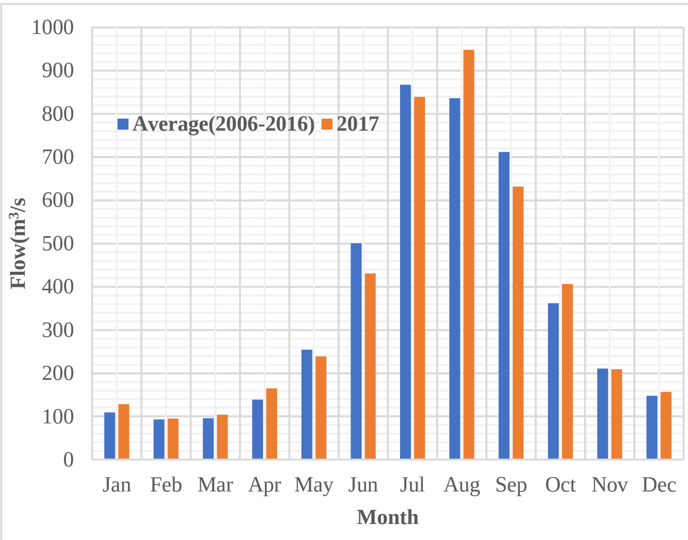
2.2 STATIONWISE AVERAGE MONTHLY FLOW



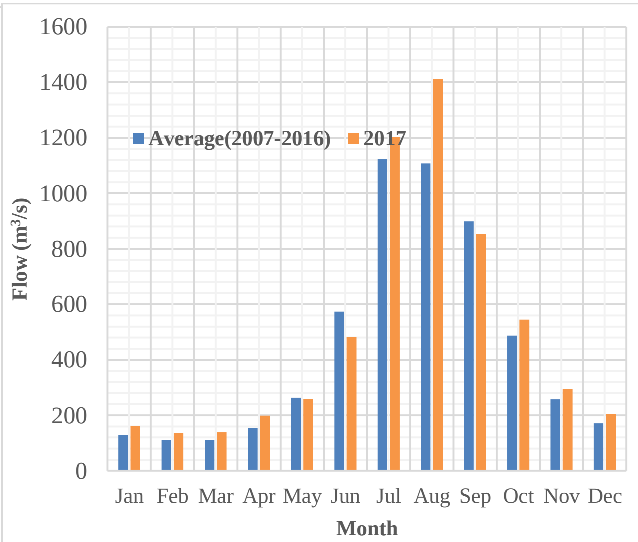
Station: Yebesa on Mochu



Station: WangdiRapids on Punatsangchu



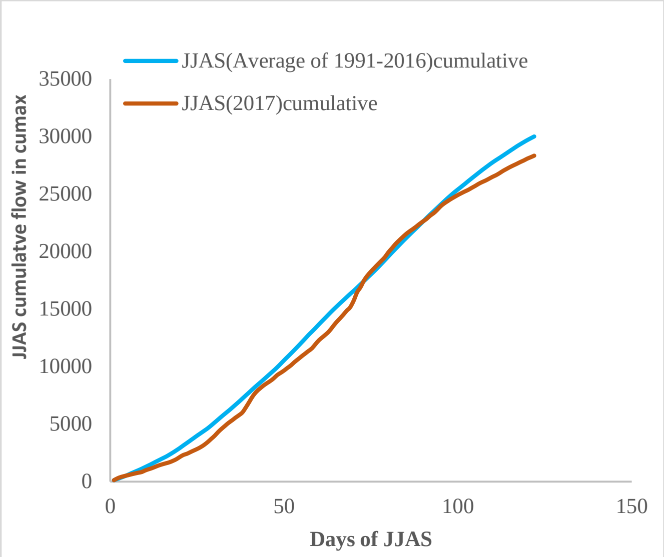
Station: Sankosh on Punatsangchu



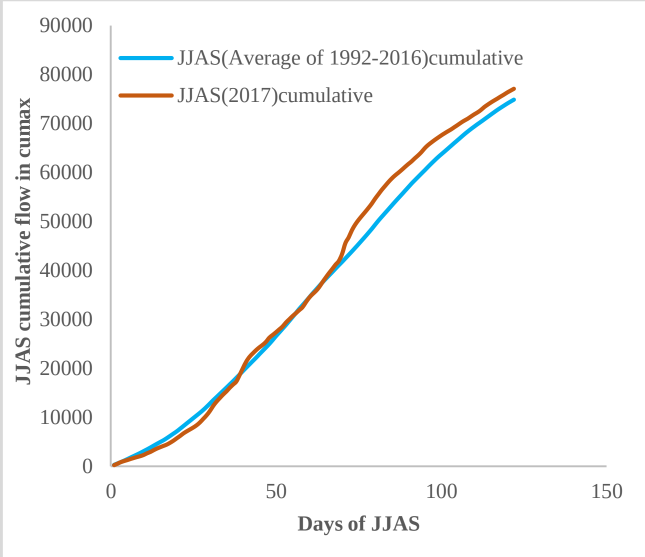
Station: Kerabari on Punatsangchu

Figure 3(b): *Station wise Average Flow of Punatsangchu Basin*

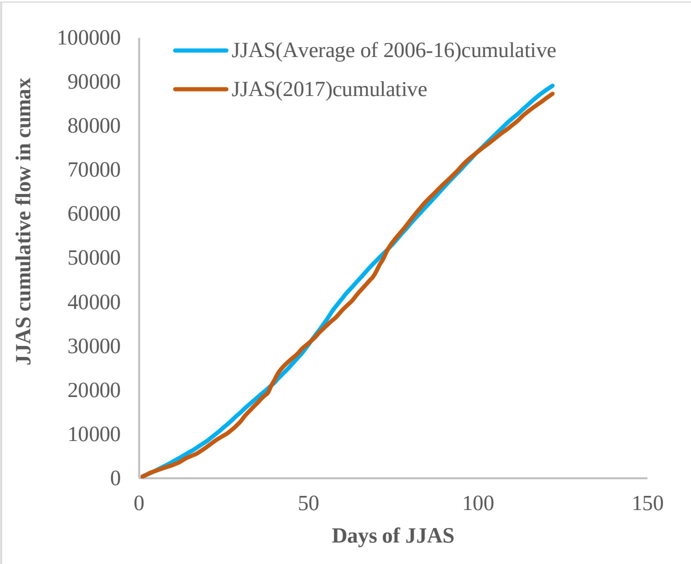
2.3 STATIONWISE JJAS CUMMULATIVE FLOW



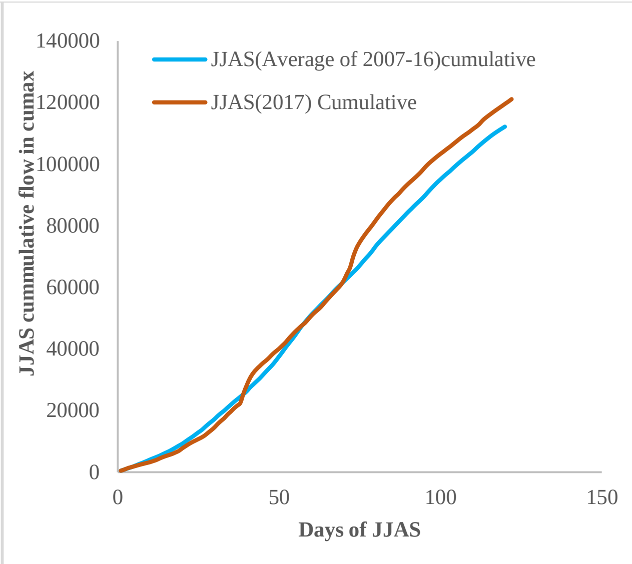
Station: Yebesa on Mochu



Station: WangdiRapids on Punatsangchu



Station: Sankosh on Punatsangchu



Station: Kerabari on Punatsangchu

Figure 3(c): *Station wise JJAS Cummulative Punatsangchu Basin*

3. MANAS BASIN

3.1 ANNUAL AVERAGE DISCHARGE MAP

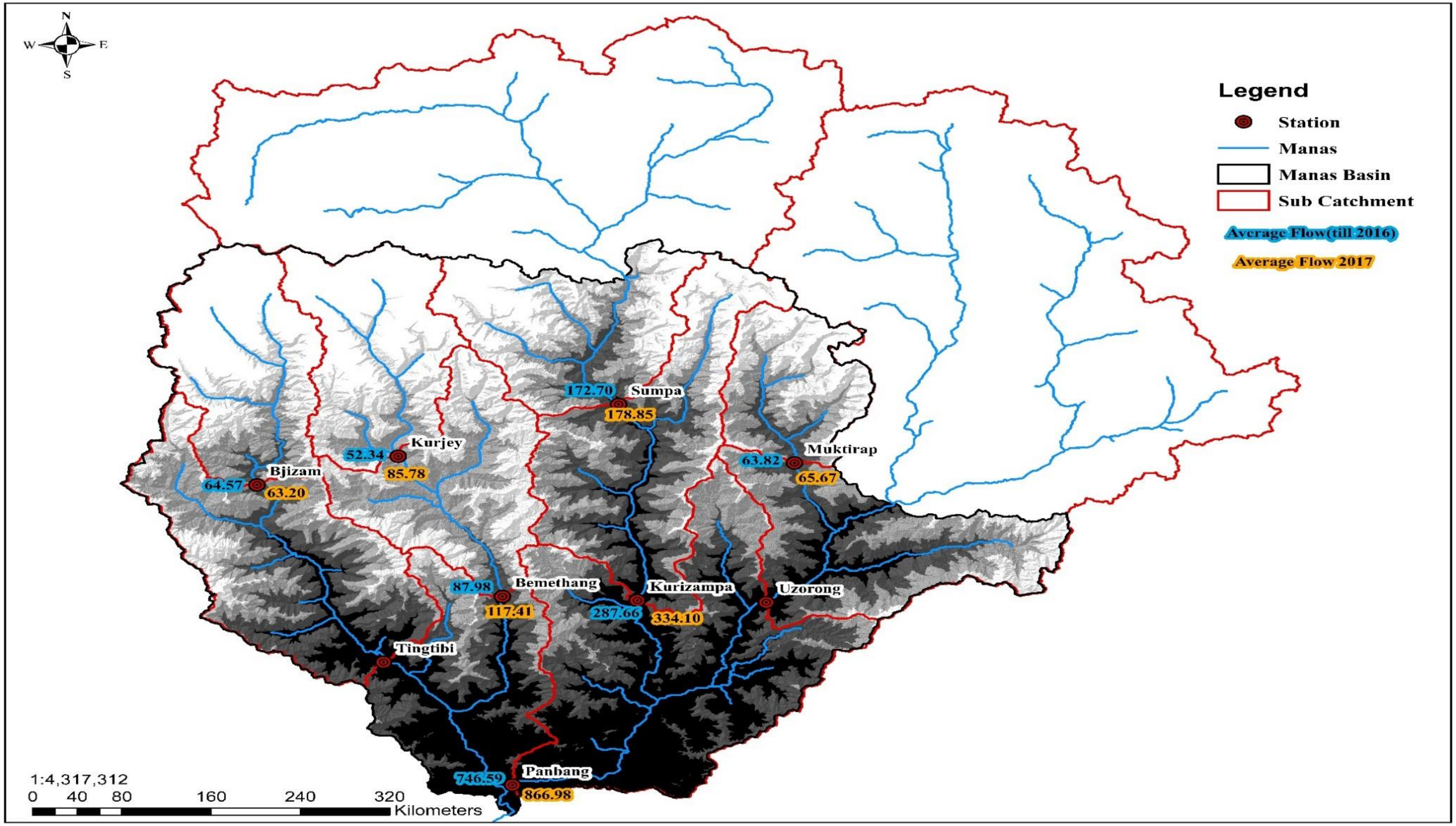
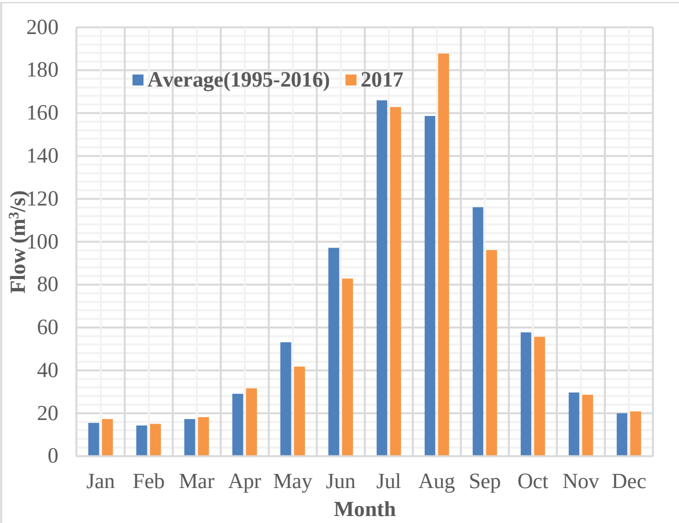
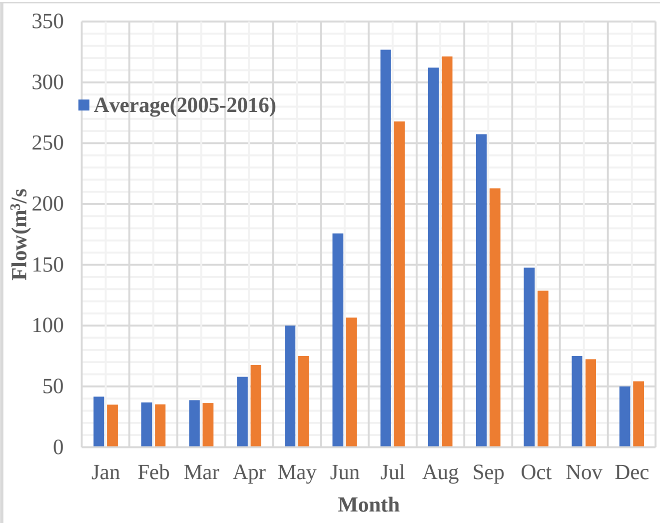


Figure4 (a). *Annual average flow of Stations in Manas Basin*

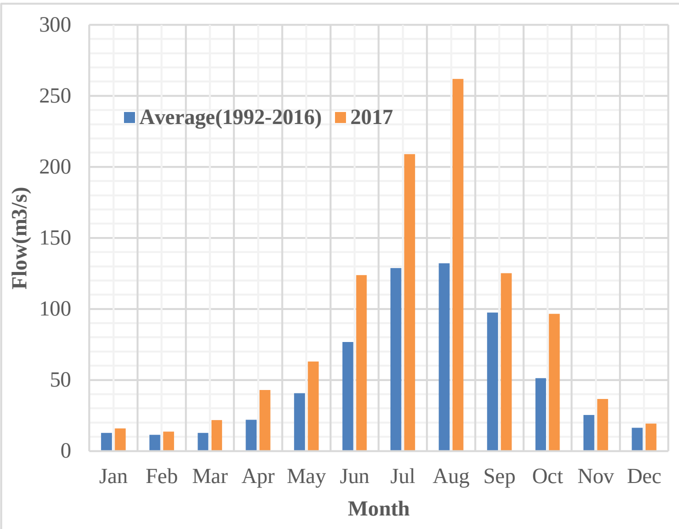
3.2 STATIONWISE AVERAGE MONTHLY FLOW



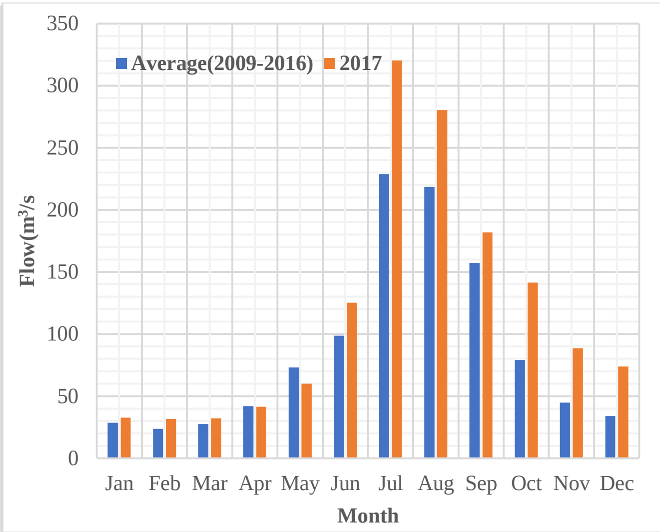
Station: Bjizam on Mangdechu



Station: Tingtibi on Mangdechu

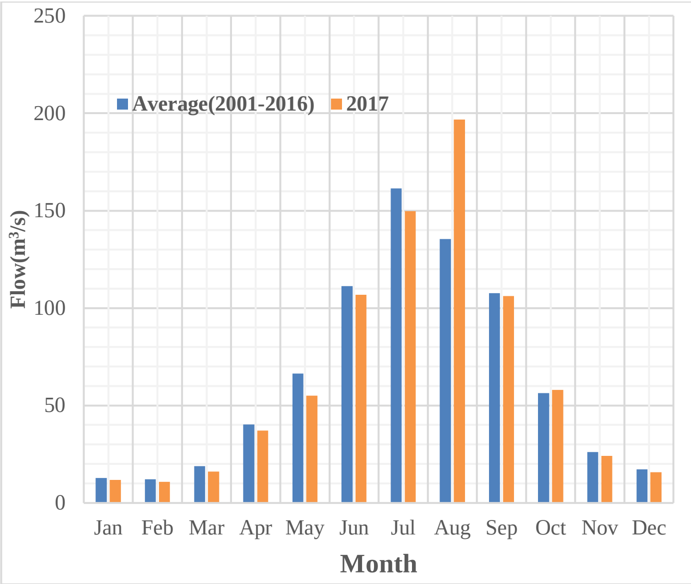


Station: Kurjey on Chamkharchu

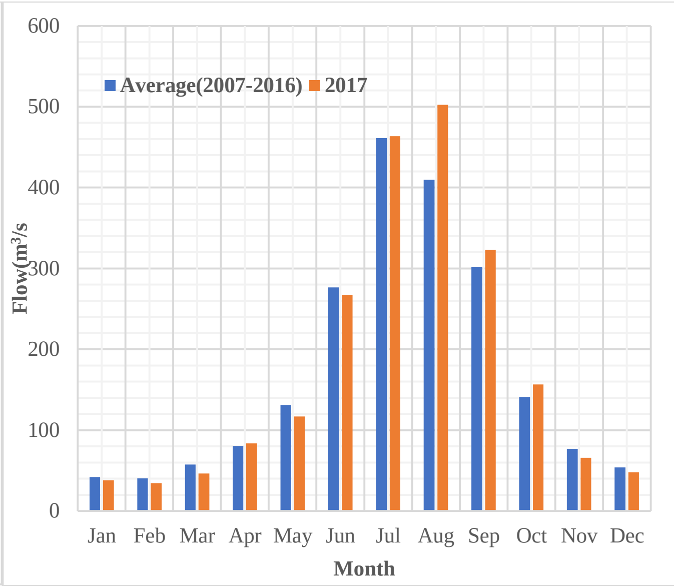


Station: Bemethang on Chamkharchu

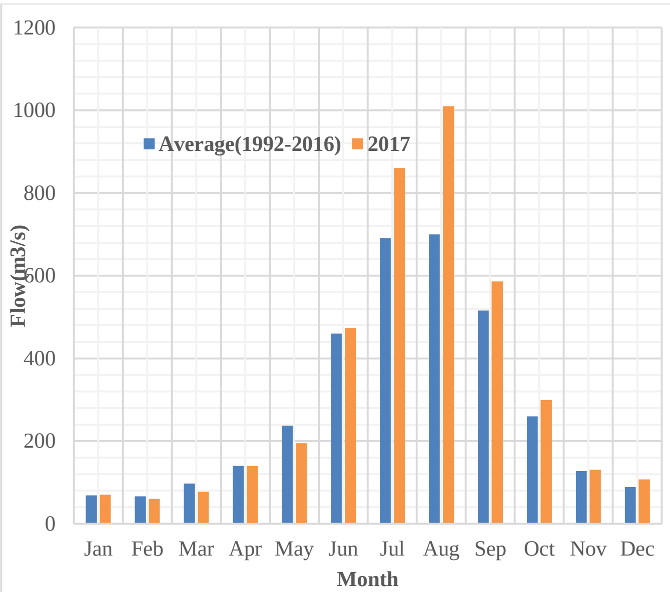
Figure 4(b): *Station wise Average Flow of Manas Basin*



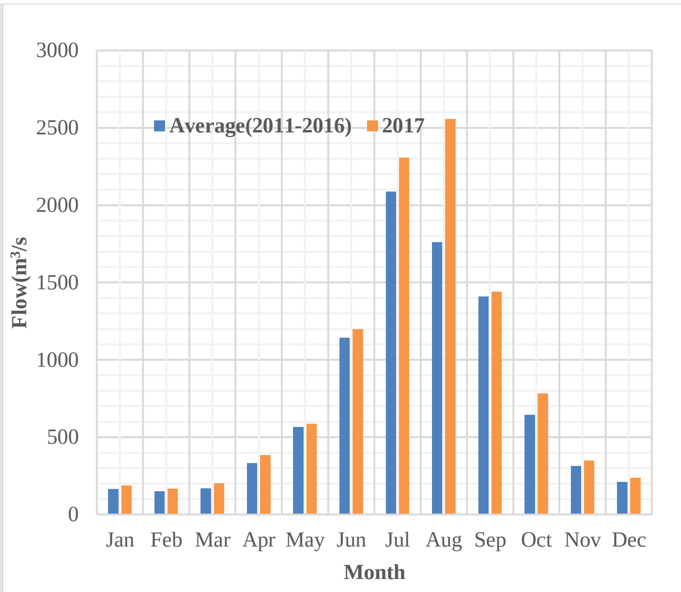
Station: Muktirap on Kholongchu



Station :Sumpa on Kurichu



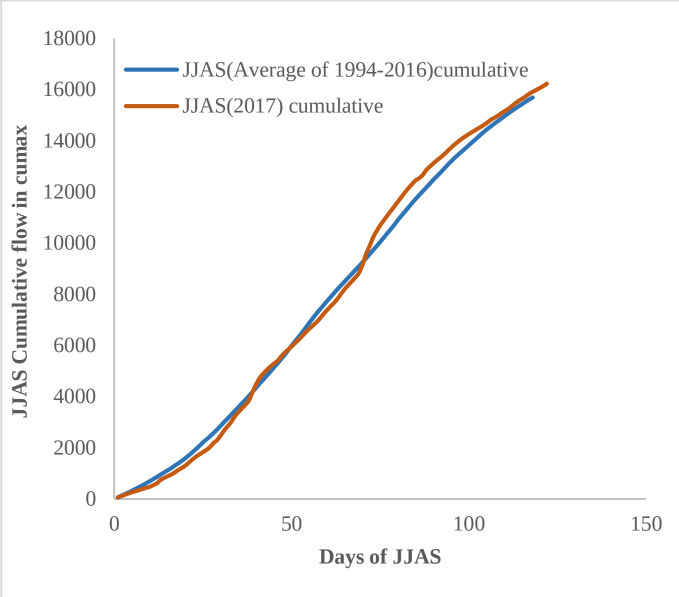
Station: Kurizampa on Kurichu



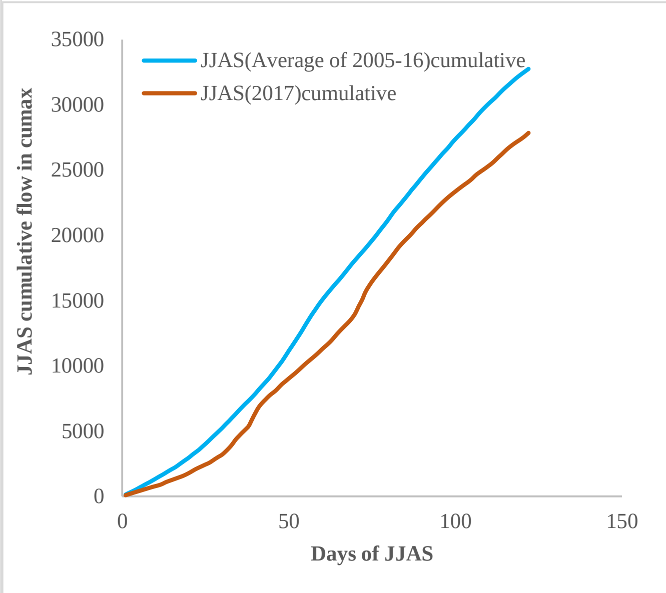
Station: Panbang on Drangmechu

Figure 4(c): *Station wise Average Flow of Manas Basin*

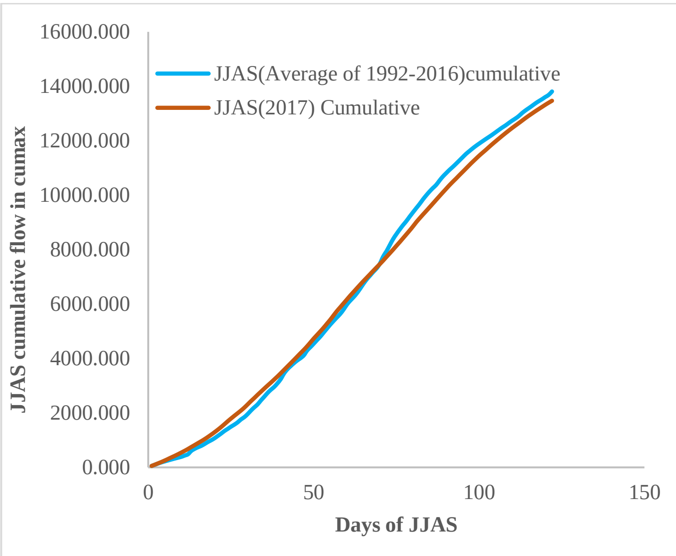
3.3 STATIONWISE JJAS CUMMULATIVE FLOW



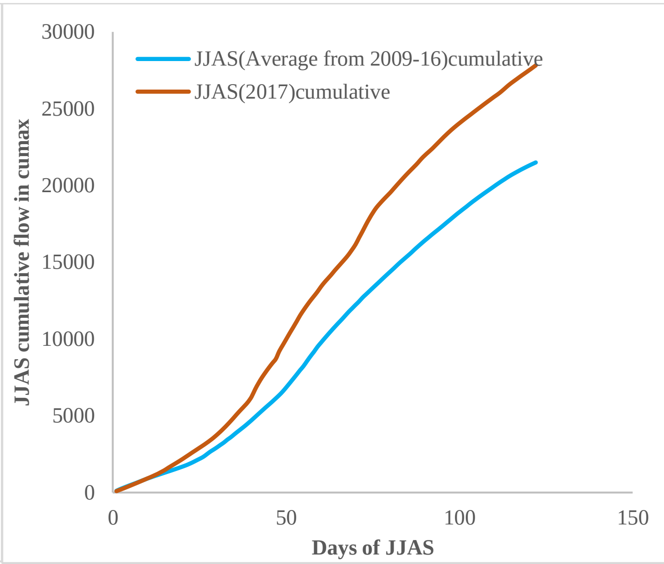
Station: Bjizam on Mangdechu



Station: Tingtibi on Mangdechu

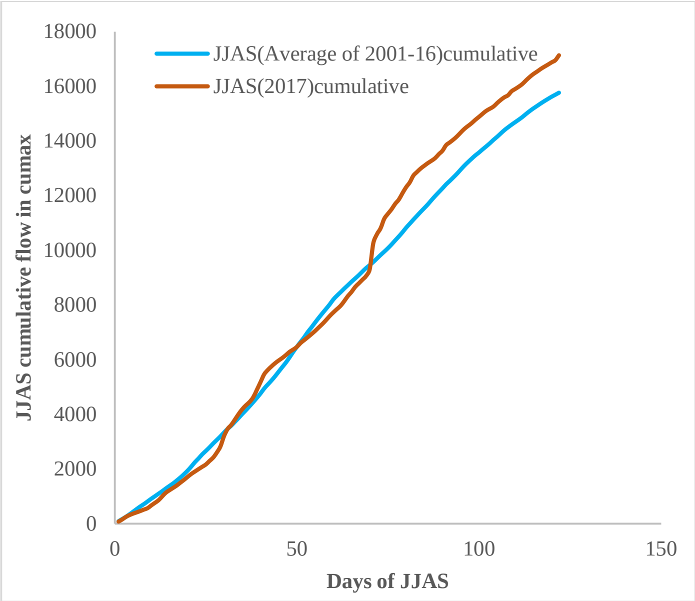


Station: Kurjey on Chamkharchu

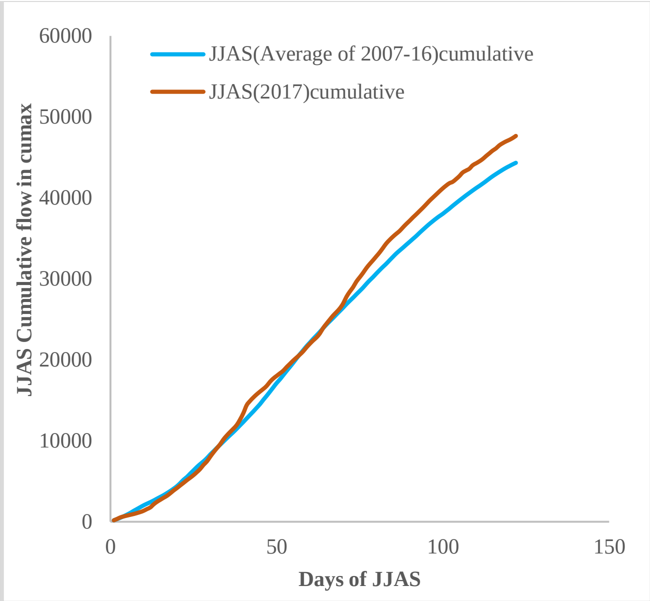


Station: Bemethang on Chamkharchu

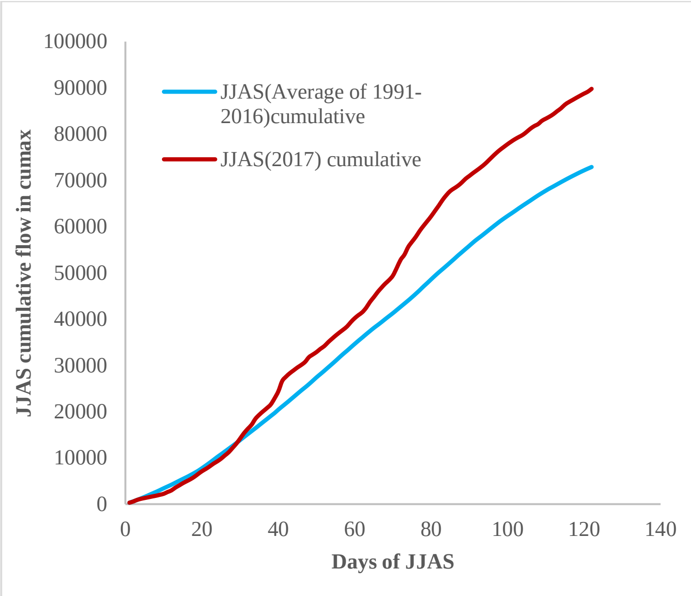
Figure 4(d): *Station wise JJAS Cummulative Manas Basin*



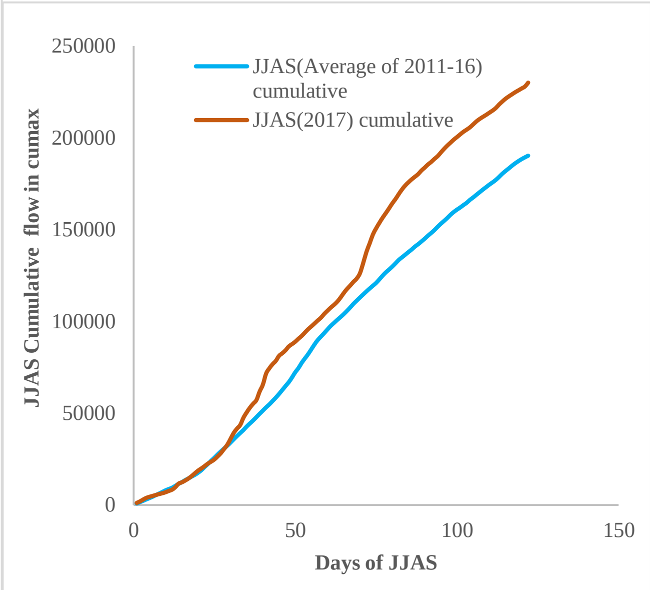
Station: Muktirap on Kholongchu



Station :Sumpa on Kurichu



Station: Kurizampa on Kurichu



Station: Panbang on Drangmechu

Figure 4(E): *Station wise JJAS Cummulative Manas Basin*

4. AMOCHU BASIN

4.1 ANNUAL AVERAGE DISCHARGE MAP

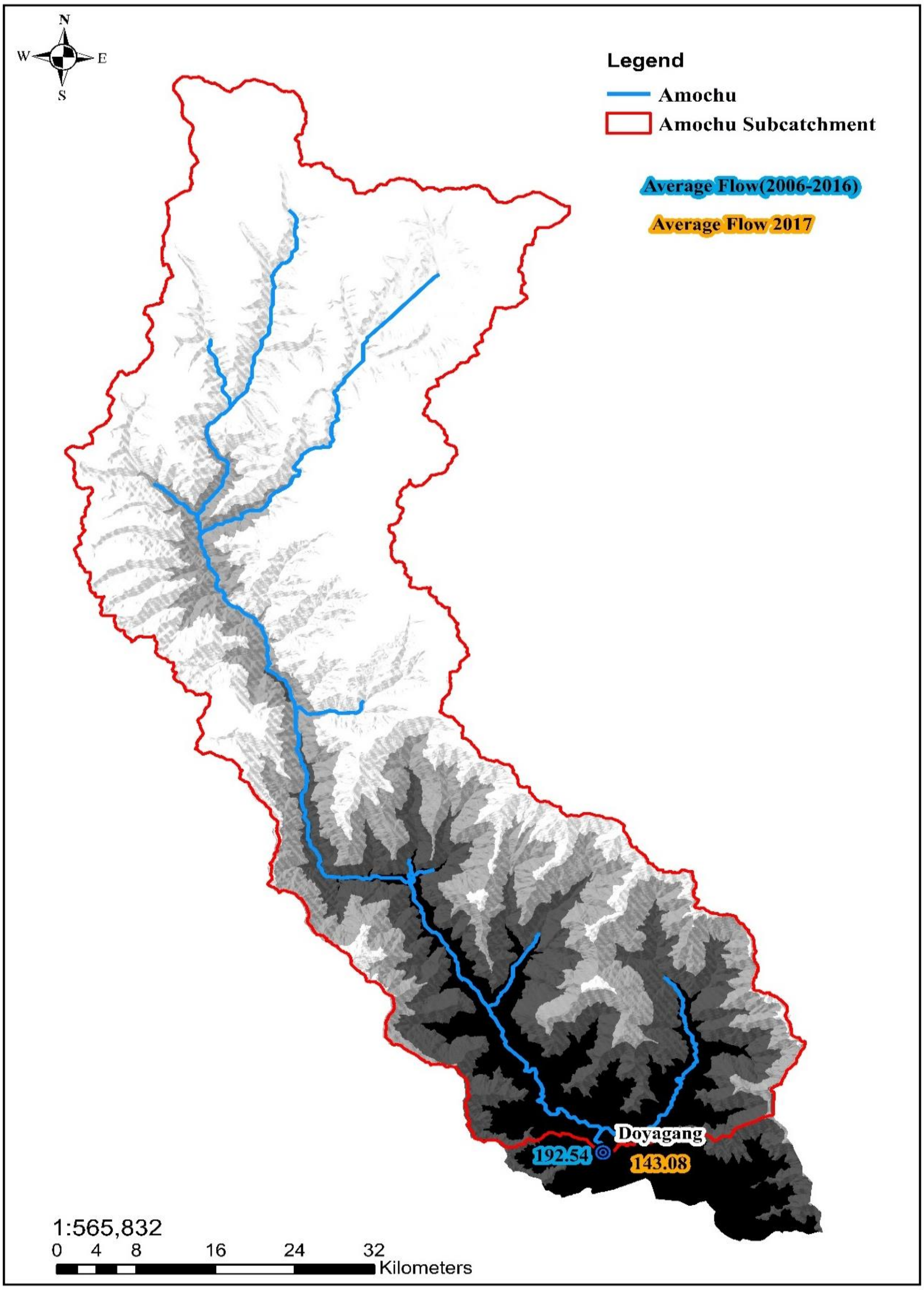
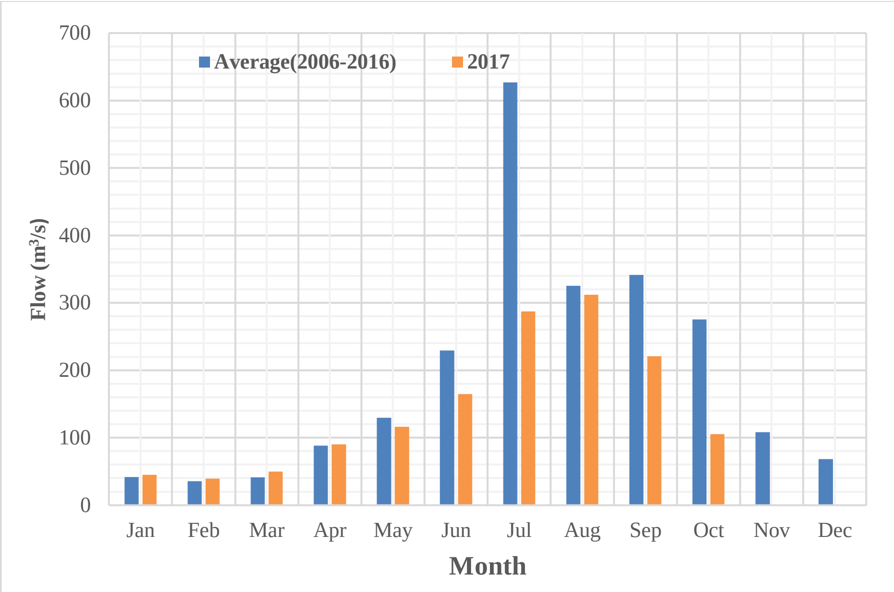


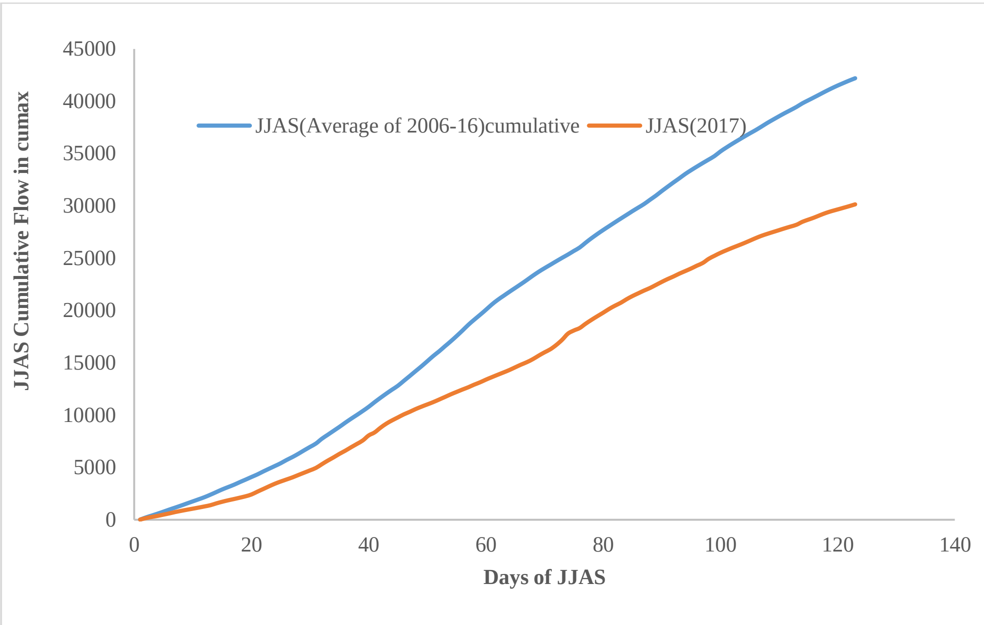
Figure 5(a). *Annual average flow of Amochu Basin*

4.1 STATIONWISE AVERAGE MONTHLY FLOW



Station: Doyagang on Amochu

4.2 STATIONWISE JJAS CUMMULATIVE FLOW



Station: Doyagang on Amochu

ANNUAL OBSERVED SPECIFIC RUNOFF MAP

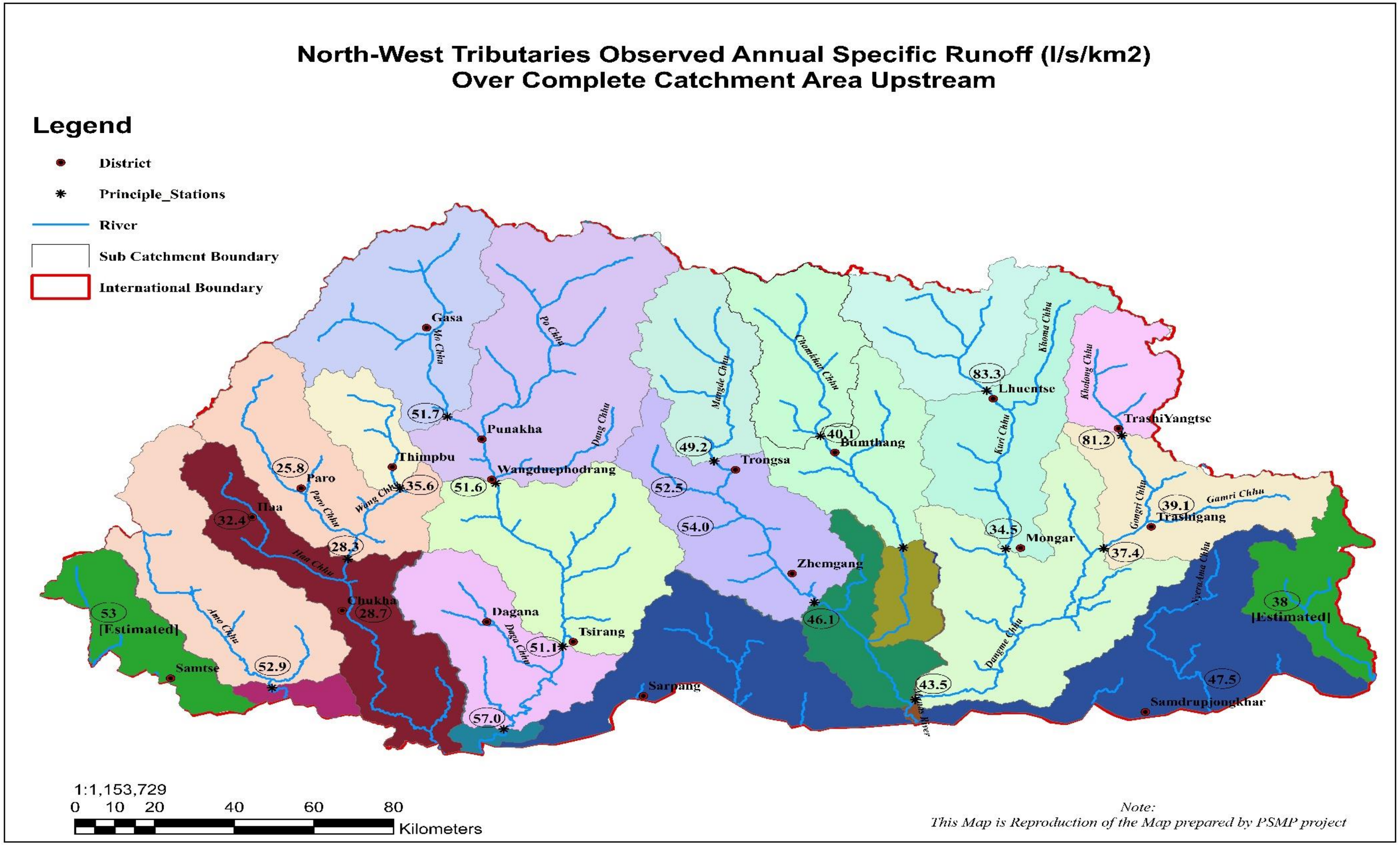


Figure 6. *Annual Observed Specific runoff*

STATIONWISE EXTREME DISCHARGE IN 2017

Sl. No	Station	Catchment Area (sq.km)	Maximum Discharge (m^3/s)	Date	Minimum Discharge (m^3/s)	Date
1	Lungtenphu on Wangchu	665.71	98.798	12/8/2017	3.744	9/3/2017
2	Tamchu on Wangchu	2529.17	409.221	12/8/2017	10.962	8/3/2017
3	Yebesa on Mochu	2223.30	737.011	10/8/2017	19.899	(7-8)/3/2017
4	WangdiRapids on Punatsangchu	5647.62	2195.295	10/8/2017	58.165	10/3/2017
5	Sankosh on Punatsangchu	8062.55	1648.049	12/8/2017	85.122	25/2/2017
6	Kerebari on Punatsangchu	9627.237	3609.528	12/8/2017	124.427	9/3/2017
7	Bjizam on Mangdechu	1390.33	419.472	10/8/2017	14.103	(15-17)/2/2017
8	Tingtibi on Mangdechu	3339.26	601.883	12/8/2017	23.450	(5-6)/1/2017
9	Kurjey on Chamkharchu	1354.97	261.852	10/8/2017	11.778	16/2/2017
10	Bemethang on Chamkharchu	2717.72	599.797	18/7/2017	30.122	20/2/2017 (8-9)/3/2017
11	Sumpa on Kurichu	7101.15	977.223	11/7/2017	31.073	(8-10)/3/2017
12	Kurizampa on Kurichu	8997.70	2205.712	11/7/2017	58.213	(18-23)/2/2017
13	Muktirap on Kholongchu	876.36	958.443	10/8/2017	9.591	16/2/2017
14	Uzorong on Drangmechu	8260.73	1194.245	11/7/2017	74.840	20/2/2017
15	Panbang on Drangmechu	21006.10	6070.874	11/8/2017	148.691	19/2/2017
16	Doyagang on Amochu	3710.06	592.698	12/8/2017	33.976	8/3/2017

Table 2: Discharge Extremes in 2017