

SPATIAL AND TEMPORAL DISTRIBUTION OF PRECIPITATION IN UPPER KABUL RIVER BASIN, AFGHANISTAN

Tokai University Student Member ○Ahmad Milad Nasery
Tokai University Student Member Shohei Matsumura
Tokai University Regular Member Kazumi Terada

1. INTRODUCTION

Water resource is the vital natural asset in Afghanistan hence water management is crucial for this country ¹⁾. Afghanistan is located among central Asia, South Asia and Middle East, and referred as the heart of Asia. Due to decades of war, Afghanistan is a highly underdeveloped country and, in the meantime, it has suffered from destroyed infrastructure and poor economy ²⁾. During 1978-2004 the agricultural production reduced 3.5% annually and food shortage increased to 45% in household including urban areas ³⁾. Approximately 58% of the GDP is generated by agricultural and allied activities, and around 80% of the population live in rural areas ⁴⁾. As a result of poor irrigation insufficient water management and erratic water supply approximately one-third of the land stays fallow ⁵⁾.

Afghanistan is ranked as the most vulnerable country to climate change by Global Adaption Index ⁵⁾. Afghanistan has faced many challenges due to climate change such as flood and drought occasions ³⁾. These occasions seriously affected various sectors in Afghanistan such as agriculture, infrastructures, susceptibility of communities and ecosystem ³⁾. As a developing country Afghanistan will be greatly threatened by extreme precipitation occasions which will lead to serious effect on it's GDP ⁶⁾.

Historically, climate pattern and water resources around Afghanistan at a various scale and periods were investigated by few studies ⁷⁾. A considerable decline is reported about water availability ⁷⁾. Some studies have analysed the precipitation of Afghanistan in provincial scale which include upper Kabul River Basin ⁴⁾. However, those reports mostly relied on the estimated precipitation data using satellite data ⁷⁾.

This study was conducted for detecting the precipitation trend in Afghanistan, using the observed precipitation data taken by Ministry of Energy and Water of Afghanistan. The daily precipitation data were recorded in 9 stations in Upper Kabul River Basin. As a result of the study the precipitation trend was found during 2010 to 2020 period.

2. STUDY AREA AND METHODOLOGY

Afghanistan consists of main five river basins: the Amu Darya River Basin, the Northern River Basin, the Harirod-Murghab River Basin, the Helmand River Basin and the Kabul River Basin. Due to existence of high mountains Afghanistan is covered by a very dense network of rivers (Fig-1).

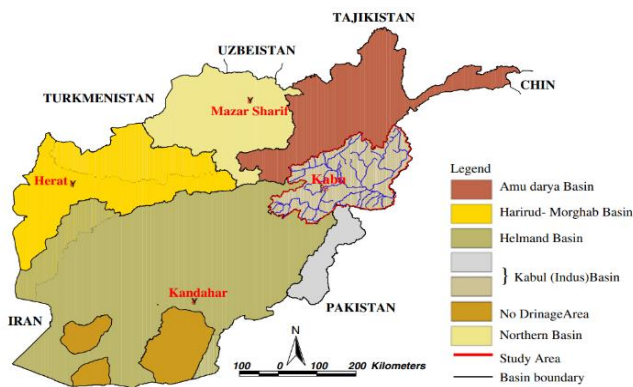


Fig-1: Afghanistan River Basins ¹⁾.

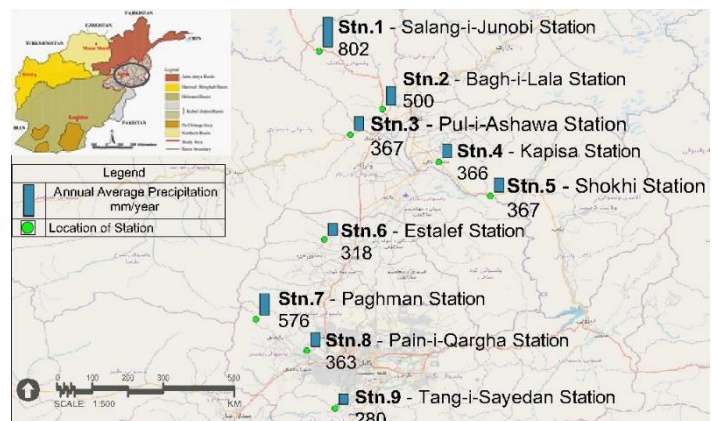


Fig-2: Spatial distribution of annual average precipitation in each station, during 2010 –2020.

In this study Logar-Upper Kabul Sub-basin and Panjshir Sub-basin are investigated which are the main parts of Upper Kabul River Basin ¹⁾. The weather stations were installed in Stn.1 Salang-i-Junobi Station, Stn.2 Bagh-i-Lala Station, Stn.3 Pul-i-Ashawa Station, Stn.4 Kapisa Station, Stn.5 Shokhi Station, Stn.6 Estalef Station, Stn.7 Paghman Station, Stn.8 Pain-i-Qargha Station, and Stn.9 Tang-i-Sayedan Station (Fig-2).

3. RESULTS

The data was recorded daily and consists of the minimum, maximum and total precipitation in the mentioned area from 2010-2020. The data of some months and years was missing, and those data have been filled using the satellite data from USGS ⁸⁾. The observed and complementary data are shown in Fig-3. The blue bars show the complete observed precipitation data (no missing in the data). Secondly, the yellow bars show that the data of a few months or days in a month are missing. Finally, the red bars show that the data of the whole year is missing and filled with the satellite data. The missing data was filled with a Dekadal Rainfall Estimate (RFE) ⁸⁾ and the maximum precipitation of each categorized were used for filling.

Key words: Precipitation Data, Weather Station, Data Filling, Upper Kabul Sub-basin, Panjshir Sub-basin.

Contact address: 4-1-1 Kitakaname, Hiratsuka-shi, Kanagawa 259-1292, Japan, Tel: +81-80-7854-2351 Email: m.nasery9886@gmail.com

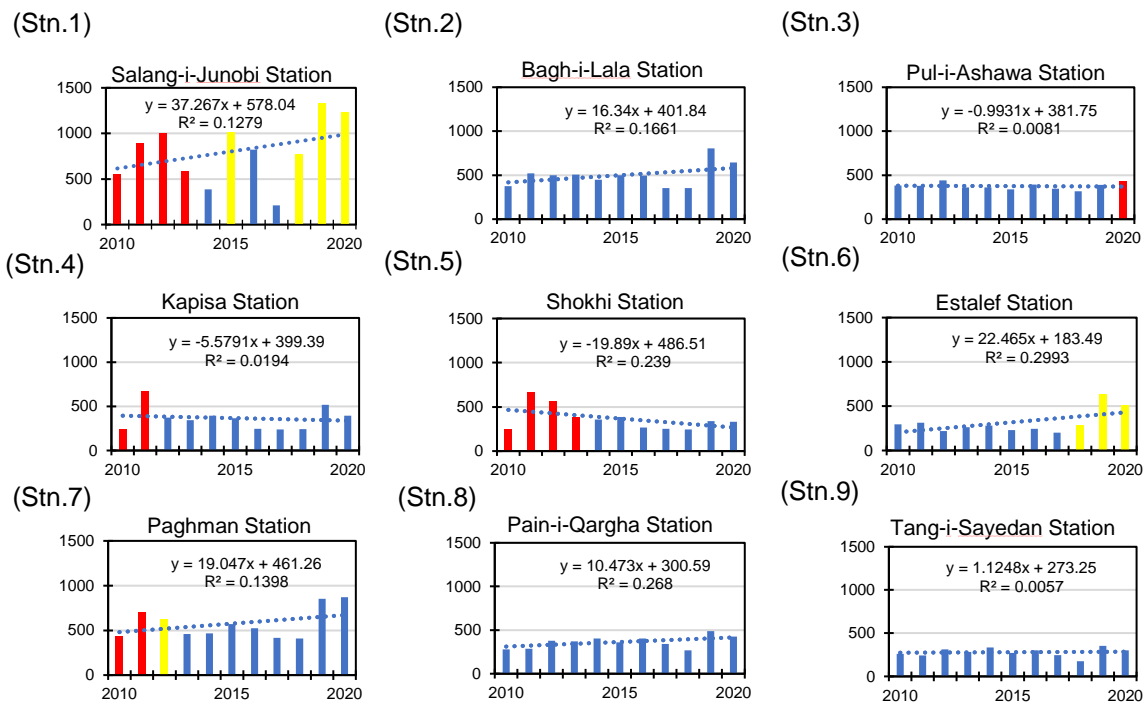


Fig-3: Temporal distribution of annual precipitation recorded in Stn.1 – 9, during 2010 – 2020.

Figure-3 showed that the minimum precipitation in Upper Kabul River Basin occurred in Stn.9 Tang-i-Sayedan Station, located in Kabul Province, which was 173 mm year^{-1} in 2018. The maximum recorded precipitation was $1336 \text{ mm year}^{-1}$ in 2019, in Stn.1 Slang-i-Junobi station located in Salang District of Parwan Province.

According to Figure-2 the heaviest and lowest rain stations were Stn.1 Salang-i-Junobi station, with the mean precipitation of 802 mm year^{-1} and Stn.9 Tang-i-Sayedan Station with the mean precipitation of 280 mm year^{-1} .

In addition, it was also found that the average precipitation in the Upper Kabul River Basin in 2010 to 2020 period was 438 mm year^{-1} .

Observing the trend line in the bar charts, only three stations showed decreasing trend which are Stn.3 Pul-i-Ashawa Station, Stn.4 Kapisa Station, and Stn.5 Shokhi station, while the other six stations showed an increasing trend.

Suryavanshi et al. (2022, in print) reported that the mean precipitation in upper Kabul River Basin was 389 mm year^{-1} at provincial scale, which is close to results of this study which show 438 mm year^{-1} of mean precipitation. Suryavanshi et al. (2022, in print) also reported an increasing trend in upper Kabul River Basin at provincial scale except Kapisa province which is close to the results of this study which also shows an increasing trend.

4. CONCLUSION

In this study the precipitation data during 2010 to 2020 in Upper Kabul River Basin, Afghanistan was analysed, where the precipitation distribution, average precipitation and the heaviest and lowest rain station were found. As the precipitation data and researches are scant in Afghanistan conducting this research is important for water management and preventing drought and flood events.

5. REFERENCE

- 1) G. R. Lashkaripour & S. A. Hussaini. Water resource management in Kabul River basin, eastern Afghanistan. Springer Science+Business Media, LLC 2007.
- 2) Qureshi, A.S., 2002. Water resources management in Afghanistan. International Water Management institute, 2002
- 3) Kakar, K., Xuan, T.D., Haqani, M.I., Rayee, R., Wafa, I.K., Abdiani, S. and Tran, H.D., 2019. 637 Current Situation and Sustainable Development of Rice Cultivation and Production in 638 Afghanistan., Agriculture, 9(3)
- 4) Shakti Suryavanshi. 2022. Understanding Precipitation Characteristics of Afghanistan at Provincial Scale. Research square (Article in press)
- 5) Maletta, H., and Favre, R. Agriculture and food production in post-war Afghanistan: A report on the winter agricultural survey 2002-2003. FAO, 2003
- 6) Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M. and Chawla, N., 2015. University of Notre Dame. Global adaptation index country index technical report.
- 7) Shokory, J.A.N., Tsutsumi, J.I.G., Yamada, H. and Kløve, B., 2017. Intra-seasonal Variation of Rainfall and Climate Characteristics in Kabul River Basin. Central Asian Journal of Water Research.
- 8) USGS 2010-2020, Daily NOAA RFE and GFS Forecast, 20 March 2022, <<https://earlywarning.usgs.gov/fews/product/39/>>