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TEMPORAL RAINFALL VARIABILITY IN DISTRICT ZHOB OF BALOCHISTAN FROM 1999 to 2009

ZAIBUNISA[1] and ROMANA AMBREEN[2]*

[1,2]Department of Geography and Regional Planning, University of Balochistan, Quetta, Pakistan.
*Corresponding E-mail: ambgeog@gmailcom

Abstract

Rainfall Variability and its impacts on different sectors of the economy and ecosystem are getting more and more importance and attention from researchers worldwide. This study is based on rainfall variability of the District Zhob of Balochistan for 11 years from 1999 to 2009. The results show that this small district of semiarid climate has high variability in precipitation. Zhob falls in the extremely high rainfall variable area. Its highest coefficient of variation is 170% in the year 2000. Autumn is the season with extreme rainfall variability. October has high rainfall variability of 274%. The highest rainfall variability has adverse effects on agriculture, fruit production, and livelihoods of the local people.

Key words: Rainfall Variability, Precipitation, Semiarid, Ecosystem, Agriculture**.**

Introduction

Rainfall variability hits many areas of the ecosystem such as underground water, cropping pattern, and surface water resources, especially in rainfall-dependent areas (Kundu, 2019). Unreliable rainfall is associated with semiarid areas, which affects water resources and food security (Barbe, et.al, 2002). Complete data on rainfall variations is needed for better planning and management of drought and floods (Hussain & Lee, 2016). In the near times, climate variability will affect poor Asian countries very badly (IPPC, 2007). Water in the form of rainfall is one of the important factors in the Earth's climate, many agro-based countries are highly dependent on rainwater for food safety (Basharat, et al., 2011; Haghtalab, et al., 2019). Rainfall data is fundamental in developing an understanding of fluctuations at regional and global climatic patterns (Ahmed et al., 2017). Variation in precipitation affects multiple components of the ecological system namely, Surface water resources, Cultivation, Irrigation, and soil fertility (Ali et al., 2021). Pakistan is a sub-tropical country with a variety of topography and climate. Social and natural environments are highly affected by climate variability and change (Naheed & Rasool, 2011). Two-thirds of Pakistan is located in semi-arid to arid climatic zones by Pakistan's agro-climatic classification (Chaudhry et al., 2004). The rise in global surface temperatures over the years has caused rainfall schedules to disrupt, and increased evapotranspiration and cropping practices made it difficult (Dars et al., 2017). Pakistan has received its share of severe global climatic variation in the past two decades (Rodo, 2003). Fluctuation in rainfall directly induces an impact on water, cultivation, and disaster management. According to the report of the Task Force on Climate Change (2010) in Pakistan, the nation is vulnerable to vast numbers of natural disasters, for instance, floods, droughts, storms, and intense rainfalls (Hussain et al., 2010).

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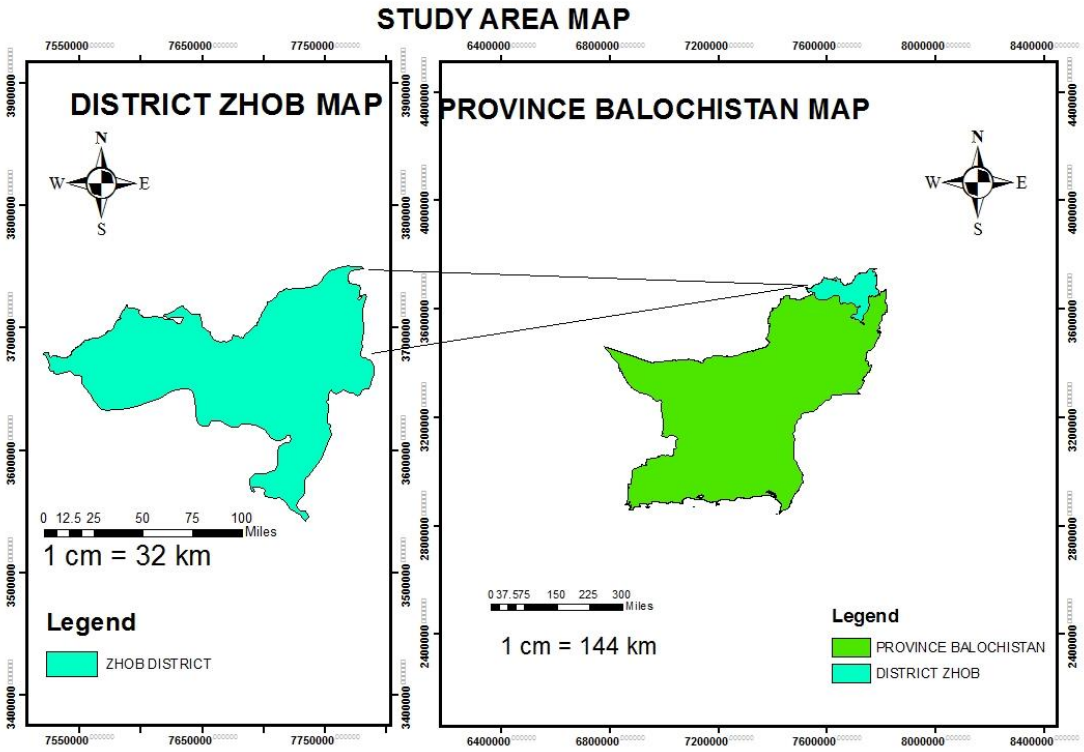
Balochistan, the relatively barren province of Pakistan is highly susceptible to Natural disasters. Therefore, calendaring seasonal rainfall and its abundance can significantly aid in water resource management, Selection of suitable crops in accord with water availability, and basis for planning and infrastructural development in the region (Ahmed et al., 2017).



Study Area

Zhob is situated North-East of Balochistan. Zhob district lies between 69°44'43" east longitudes and 31°57'32" at north latitudes, and spreads over an area of 12,400 square kilometers. Zhob has a semi-arid climate, and its precipitation is sufficient to avoid arid climate listing found at lower altitudes. Zhob rarely receives rainfall from the monsoon system. Zhob district resides in east of the river Zhob. The water of the Zhob river is used for irrigation. This area is famous for vegetables and fruits.

Data & Methods

This research examines the annual, monthly, and seasonal rainfall variability from (1999-to 2009) in district Zhob. Secondary data were collected from the Pakistan Meteorological Department, Quetta. The monthly, and seasonal average, deviation from mean, variance, standard deviation, and Coefficient of variance were calculated in Zhob district, Balochistan province. EXCELSTATS is used for calculation, tabulation, and graphs.

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Results & Discussions

This work identifies annual, seasonal and monthly temporal Rainfall variability from 1999 to 2009 in the Zhob district of Balochistan.

Annual rainfall variation

Mean, standard deviation, and coefficient of variance were calculated from 1999 to 2009 for 11 years for only the Zhob district (Figure 1). Mean rainfall with standard deviation is tabulated. Some of the years like 2001 show the least deviation from mean rainfall. The years 2005 and 2007 show high variation. In the year 2005 standard deviation was 37 while the mean was 29. Almost similar pattern is showed in 2008 where the standard deviation is 36 while the mean is 25.

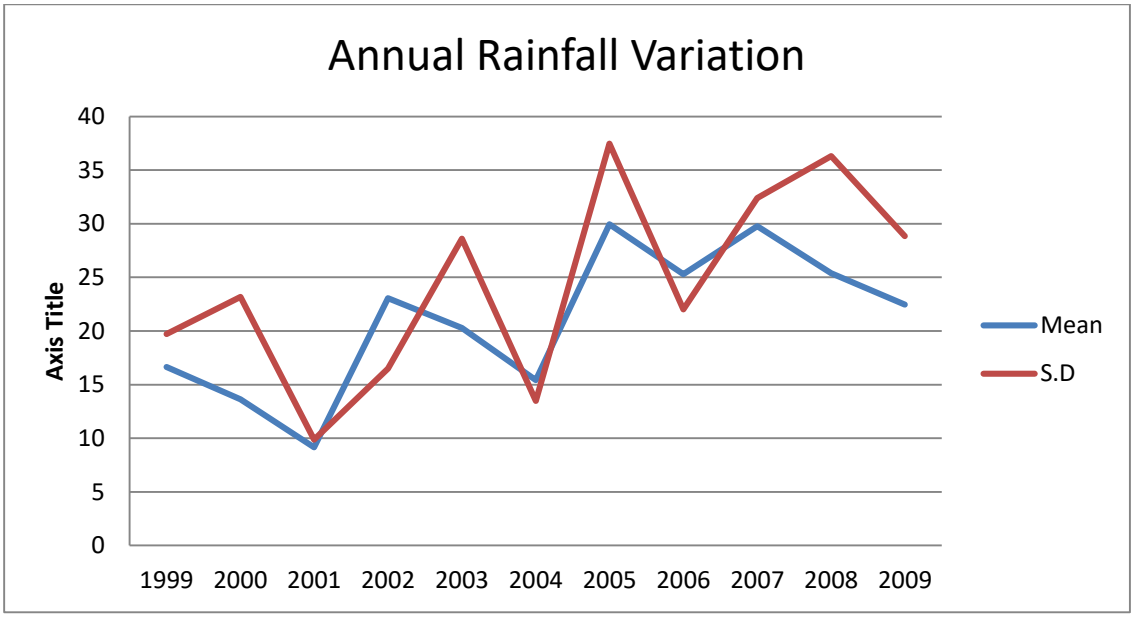

Figure 1: Annual rainfall variation in Zhob

The coefficient of variation (CV) quantifies the degree of variability, with lower values (CV 20%), moderate values (20 CV 30%), high values (CV > 30%), very high values (CV > 40%), and extremely high values (CV > 70%) indicating exceptionally high inter-annual variability of rainfall. (Ashraf & Routray 2015). Figure 2, shows that high rainfall variability is in the year 2000, it is 170 % while in 2002 it is lowest i.e., 71%. Other years have different trends some show high while others are in low percentage. But one point is obvious that all years fall in more than 70% which means extremely high variability.

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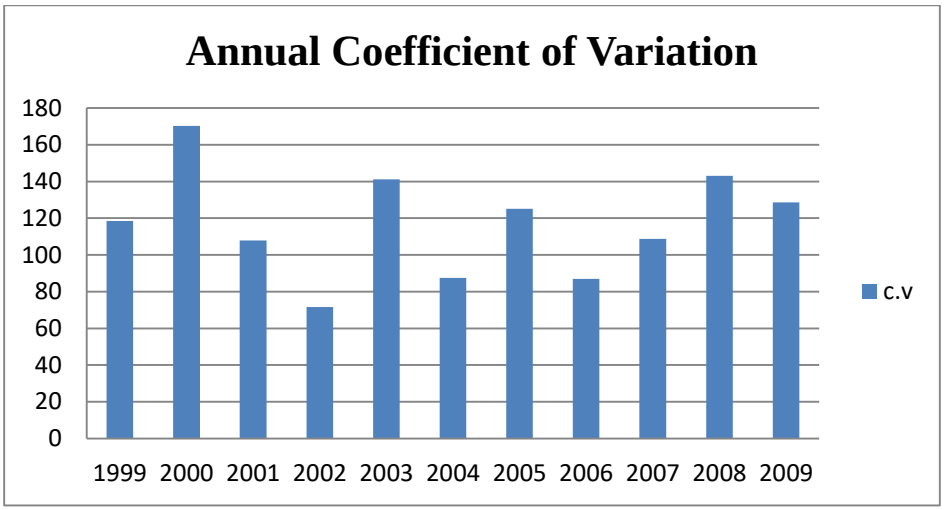

Figure 2: Coefficient variation of Annual rainfall

Seasonal Rainfall Variation

For Seasonal rainfall variation analysis data were distributed in four quarters every year. Data for December, January, and February were included in the winter season. March, April, and May were in spring. June, July, and August were in summer while September, October, and November in were in autumn. Three months' data for each quarter for the 11 years from 1999 to 2009 were analyzed. For four seasons mean, standard deviation, variance, and coefficient of variance were calculated. The figure 3 shows that rainfall is less deviated from the mean in the winter season, the standard deviation is 30mm and the Mean is 47mm while summer season highly deviates from the mean. The standard deviation of summer is 117mm while the mean is 52mm.

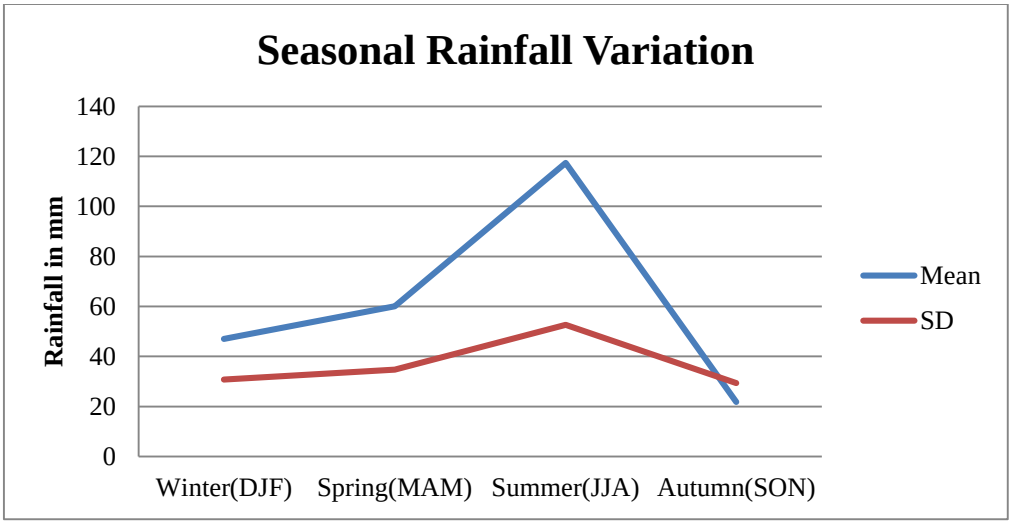

Figure 3: Seasonal Rainfall Variation

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Figure 4 shows the coefficient of variation in percentage for different seasons for different years. According to the graph above autumn have high rainfall variability of 134%, so, it falls in extremely high variability while winter, spring, and summer are included in a high coefficient of variation of 65%, 57% and 44%, respectively.

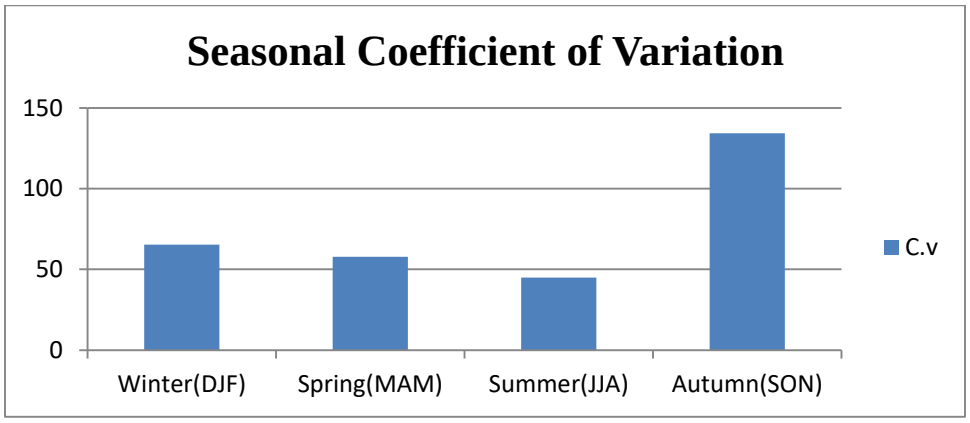

Figure 4: Seasonal coefficient of variation

Monthly Rainfall Variation

Monthly Rainfall variation is analyzed every month for eleven years from 1999 to 2009 (Figure 5). The figure depicts that a high standard deviation is in the months of summer, especially July. Less standard deviation is in the months of winter.

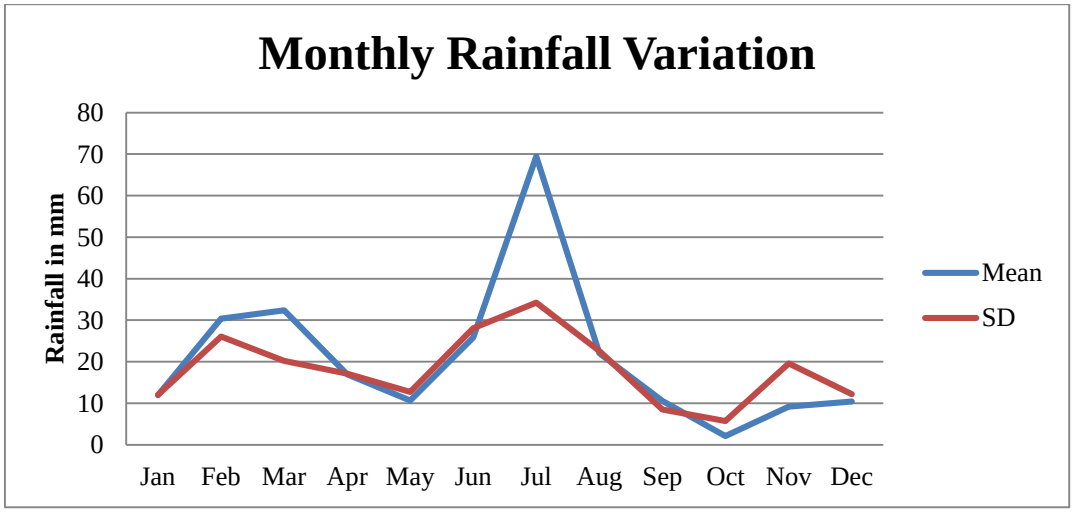

Figure 5: Monthly rainfall variation

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Figure 6 shows that if we observe from January coefficient of variation gradually decreases every month. Like in March it is the lowest. From April, it shows an increase which reaches the highest coefficient of variability in May which is 119%. Again, a gradual decrease can be noticed every month which reaches the lowest coefficient of variability in July. The highest coefficient of variation is shown in October which is 274%.

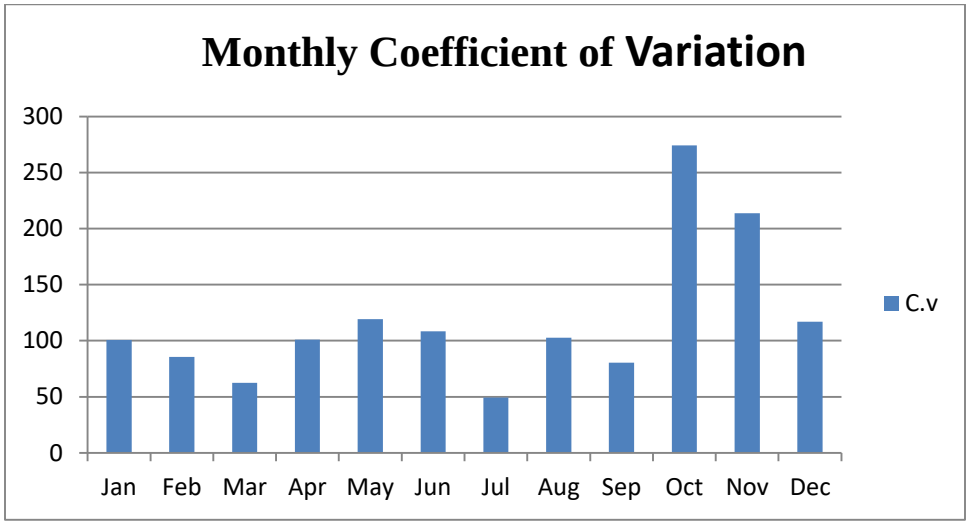

Figure 6: Monthly coefficient of variation

Conclusions:

This study is based on rainfall data for the period 1999 to 2009. The rainfall data were obtained from the Pakistan Meteorological Department. From the monthly series, seasonal and annual rainfall totals were obtained for the analyses of the temporal variability of rainfall as considered in this study is important for the management of agricultural practices and water management in the semiarid climate of District Zhob. Zhob district is famous for its fruits like Almonds, Grapes, Apricots, etc., and vegetables like tomatoes, onions, potatoes, etc. The annual coefficient of variation ranges from 71% to 170% which falls in the extreme category. While, on the other hand, 2005 and 2007 have a high standard deviation from the mean. By observing the Seasonal coefficient of variation, it is obvious that the autumn season has extreme values i.e. of 134% while summer has the lowest value of 44%. While winter rainfall has less deviated from the mean and summer is more deviated from the Mean. This shows that summer Monsoon doesn't reach Zhob every time. Already seasons provide the results of monthly rainfall variation quite clear that October which falls in autumn have high rainfall variability of 274% while the lowest is in the summer season in May. Standard deviation is also highest in the summer months, which means monsoons are not obligatory.

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References:

1. Ahmed K., Shahid S., Ali R., Harun S. (2017) Evaluation of the performance of gridded precipitation products over Balochistan Province, Pakistan, Desalination and Water Treatment.
2. Ali G., Sajjad M., Kanwal S., Xiao T., Khalid S., Shoaib F., NayabGuL H., (2021) Spatial-temporal characterization of rainfall in Pakistan during the past half-century (1961–2020), Scientific reports/nature.com.
3. Ashraf M., Routray J. K. (2015) Spatio-temporal characteristics of precipitation and drought in Balochistan Province, Pakistan, Natural Hazards. 77:229–254
4. Barbe L. L., Lebel T., Tapsoba D. (2002) Rainfall Variability in West Africa during the Years 1950–90, JOURNAL OF CLIMATE, 15:187-202
5. Basharat, M. (2011) Water management in the Indus basin in Pakistan: challenges and opportunities. Mt. Res. Dev. 31(3), 252–260
6. Dars, G.H.; Najafi, M.R.; Qureshi, A.L. (2017) Assessing the Impacts of Climate Change on Future Precipitation Trends Based on Downscaled CMIP5 Simulations Data. Mehran Univ. Res. J. Eng. Technol., 36, 385–394. [CrossRef]
7. Haghtalab, N., Moore, N. & Ngongondo, C. (2019) Spatio-temporal analysis of rainfall variability and seasonality in Malawi. Reg. Environ. Change 19(7), 2041–205.
8. Hussain, A., Zulqarnain, M., and Hussain, J., (2010) Catastrophes in the South Punjab Due to Climate Change and the Role of PIDEANS
9. Hussain M. S., Lee S. (2016). Investigation of summer monsoon rainfall variability in Pakistan Meteorology and Atmospheric Physics. 128: 465–475.
10. IPCC, 2007c: Asia in Climate Change 2007: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge. Cambridge University Press, 469 – 506.
11. Kundu, S. K. & Mondal, T. K. (2019) Analysis of long-term rainfall trends and change point in West Bengal, India. Teor. Appl. Climatol. 138(3–4), 1647–1666.
12. Naheed, G. & Rasul G., (2011). Investigation of Rainfall Variability for Pakistan. Journal of Meteorology, 7(14): 25-32.
13. Rodo, X., (2003) Global Climate Current Research and Uncertainties in the Climate System. University of Barcelona Climate Research Group Baldiri Rexac, 4-6, Torre D 08032 Barcelona Spain, 3-6
14. Zaman Q. C., Rasul G., (2004): Agroclimatic Classification of Pakistan, Science Vision. 9 (1-2 & 3-4), (July-Dec, 2003 & Jan-Jun, 2004), 59.