Evaluating Different Drought Products for Assessing Drought and Implications on Agriculture in Nepal

Shishir Chaulagain [a], Manoj Lamichhane [b], Urusha Chaulagain [a, †], Sushant Gyawali [a, †], Sadina Shrestha [a, †], Vishnu Prasad Pandey [c, d]

[a] *Department of Civil Engineering, Advanced College of Engineering and Management, Kathmandu, Nepal.*

[c] *Department of Civil Engineering, Pulchowk Campus, Institute of Engineering, Nepal*

[d] *Center for Water Resources Studies, Institute of Engineering, Tribhuvan University, Nepal*

[b] *Department of Agricultural and Biosystems Engineering, South Dakota State University, Brookings, SD 57007, USA*

†These authors contributed equally to this work.

** Corresponding author. E-mail address: vishnu.pandey@pcampus.edu.np (Vishnu Prasad Pandey)*

Abstract

Drought impacts adversely the agriculture sector by reducing soil moisture (SM) levels, leading to decreased crop yields and increased water scarcity, thereby threatening food security and the livelihoods of a population predominantly reliant on farming. Unlike previous studies on this region, this study uses multiple SM products to evaluate agricultural drought with the aim of identifying the area that is more vulnerable to drought. Using satellite-based and model-based SM observations Soil Moisture Active Passive (SMAP), Soil Moisture and Ocean Salinity (SMOS), Global Land Data Assimilation System (GLDAS-2.1), Famine Early Warning Systems Network Land Data Assimilation System (FLDAS)) along with climatology and discharge measurements, we examine the spatial and temporal drought patterns. By utilizing Soil Water Deficit Index (SWDI) alongside Standardized Precipitation Evapotranspiration Index (SPEI) and Standardized Flow Index (SFI), this research highlights the complex progression from meteorological to agricultural and hydrological droughts. The findings reveal a strong relationship between SWDI-GLDAS (SWDIgl) and the Atmospheric Water Deficit (AWD), confirming SWDIgl's reliability for identifying agricultural drought. Notably, SPEI's impact in SWDI is more evident with the three-month lag, and SPEI correlates moderately with SFI at a 12-month lag. Significant correlations were found for winter wheat during their sowing and growing period. These findings suggest that further monitoring and forecasting of agricultural drought should incorporate SWDIgl

due to its strong correlation with AWD. These insights can inform targeted interventions for winter wheat during their critical growth periods to mitigate drought effects in agriculture.

Keywords: Agriculture, crop yields, drought, food security, soil moisture