Analysis of Agricultural Drought and Investigation of Bivariate Return Periods using Copula

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Drought is a natural climatic disaster causing a severe impact on agriculture and its allied sectors. Investigation of mutually correlated agricultural drought characteristics (severity, duration, and frequency) plays a crucial role in building drought resilience environment. The present study aims to develop the copula-based joint probabilities to examine bivariate return periods of agricultural drought in the Ghataprabha river basin, India. The major portion of the basin is semiarid, and rainfall is the major sources of water for agriculture. The Vegetation Condition Index (VCI) was employed to assess agricultural drought using MODIS-NDVI products from the year 2000-2013. Further, drought characteristics (duration and severity) as defined by VCI are derived to model the joint probabilities of drought severity and duration. Three copulas (Clayton, Gumbel, Frank) from Archimedean family were evaluated, and suitable copula was selected based on the goodness of fit tests. Results of VCI indicates severe agricultural drought over basin during 2001-2003 and in 2012. However, severe droughts are frequent in the eastern portion of the basin. The P values of the goodness of fit tests (K-S and CVM) suggests the Frank copula as the most appropriate copula to construct the joint probability distributions. The developed joint distributions were used to compute joint return periods, conditional probabilities and respective return periods. This study facilitates to formulate proactive drought mitigation and preparedness strategies.