ANALYSIS OF DROUGHT USING TRIVARIATE COPULAS IN HAMBANTOTA DISTRICT

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Sri Lanka is an island found near the equator and inclined to warm climate conditions, annual occurrences of droughts can be seen and Hambantota region is the most noticeably affected. Therefore aim of this study is to identify drought characteristics to minimize drought risk.

Drought Duration (DD), Drought Severity (DS) and Drought Intensity (DI) are taken as drought characteristics and they were defined using 3-month Standard Precipitation Index (SPI). 52 drought events were identified from 1951 to 2013 in Hambantota district using the calculated SPI values. The Kendall's rank correlation coefficient for each of the two variables were calculated and they are significant (p-value < 0.05). So there exist dependencies between the variables. Thus the copula method was used to derive the trivariate joint distribution. Gamma, Weibull, Normal, Lognormal, Exponential and Logistic distributions were used to fit the marginal distributions. The best marginal distribution was identified as the Lognormal distribution for all three characteristics using AIC, BIC and kolmogrov-Smirnov tests. Normal copula was identified as best fitted copula based on AIC and BIC values using Gumbel-Hougaard, Clayton, Frank, Normal and Student copulas. By combining the identified best marginal distributions using the Normal copula the trivariate joint distribution was obtained and return periods were calculated. The best fitted copula was applied to derive the trivariate cumulative joint distribution and the univariate and the trivaraite joint return periods (T_{DSI} and T'_{DSI}) were calculated using Lognormal univariate marginals and using Normal copula. By using fitted trivariate joint distribution any drought with above mention three specific characteristics can be predicted. A drought event occurred in 2001 was identified as a significant drought event using SPI. This kind of drought can be expected if DD $\geq$ 12.00 months or DS $\geq$ 15.16 or DI $\geq$ 2.84 in once in 26.25 years. Similarly a drought can be expected if DD $\geq$ 12.00 and DS $\geq$ 15.16 and DI $\geq$ 2.84 in once in 503.42 years. Based on these return periods, we can minimize the drought risks by pre-planning and make decision against conflicting affects of droughts.