Flood Probability Evaluation in Liberian Agriculture

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Liberia is located on the West Coast of Africa with a long (579 km) coastline of the North Atlantic Ocean on its south-western side, bordered on the northwest by Sierra Leone, the north by Guinea (Conakry), and the east by Cote d'Ivoire. The country consists of 96,320 km^2 of land and 15,049 km^2 of sea. Liberian agriculture is based in two types of crops: cash crops and food crops. The former are mainly palm oil, rubber, cocoa and coffee, and the later cassava and rice.

The most frequent weather disasters are floods (40% of the events) according to EM-DAT 2017. Flooding has a direct consequence on land slides, soil erosion, crop production and deforestation, as well as important indirect impacts on water quality, pest and diseases and transportation, among others. In this study, we have done a detailed analysis of Liberian precipitation patterns based on available data from NOAA/FEWS NET datasets. Using Liberian counties as spatial unit, we have analyzed monthly precipitation on crop land from 1996-2012. Even if precipitation patterns are relatively similar among counties, there are perceivable differences. For example, we can distinguish a group of counties that do not exceed a maximum precipitation of 450 mm and have two marked rain peaks, and another group that achieve a maximum of 800 mm and presents a single rain peak. Observing these differences among counties, we estimated the probability of exceeding a certain amount of precipitation on the crop land based on the function of density precipitation probability for each county and its consequences on different crops.

In order to do so, each monthly precipitation was adjusted to a Weibull function (Johnson et al., 1994) by maximum likelihood (Li et al., 2014) as the frequency of the events is not symmetric. Then, we calculated the probability that the rain would exceed a certain value in each month (threshold) based on the studied crops. Finally, all monthly probabilities were added obtaining annual probability estimation of flood by county and crop.

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