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A parametric insurance framework based on remote-sensing observations to mitigate drought impacts through risk financing

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Agricultural production is highly sensitive to extreme weather events such as droughts, floods and storms. According to the Food and Agriculture Organization, between 2005 and 2015 natural disasters cost the agricultural sectors of developing country economies a staggering $96 billion in damaged or lost crop and livestock production. Drought was one of the leading culprits. Eighty-three percent of all drought-caused economic losses documented by FAO's study were absorbed by agriculture, with a price tag of $29 billion. Since extreme droughts are expected to increase worldwide both in number and severity, the development of appropriate strategies to reduce and mitigate drought impacts on agricultural production will be essential to enable farmers to quickly recover from the disaster. There is growing interest in insurance as an instrument for managing drought risk in agriculture. Insurance is a self-reliant mitigation measure that increases society's resilience, particularly in the financial sector. There are two main options of crop risk transfer solutions: indemnity-based programs, in which the basis for compensation is the actual loss; and weather index-based (or parametric) programs. Parametric programs are based on variables called indices, often retrieved from remote-sensing observations. Indices should be highly correlated with agricultural losses. A parametric policy for drought pays out if a specific value of the index is achieved in a specific period. Index-based insurance shows various attractive features: the value of the index cannot be influenced by farmers, indemnities are based on observable variables (the indices), on-farm inspections to assess the damages are no more necessary and finally funds to recover from the disaster are provided quickly.

The aim of this work is the design of a parametric insurance framework against drought to be applied in the Caribbean region as well as in other regions with similar conditions. Initially a new drought index, the Probabilistic Precipitation and Vegetation Index (PPVI) was developed to identify drought. PPVI was computed combining two consolidated drought indices, the Standardized Precipitation Index (SPI) and the Vegetation Health Index (VHI). SPI was calculated from precipitation retrieved from satellite (the Climate Hazard Group Infrared Precipitation dataset was used) and VHI is already a remote-sensing product. Then a framework allowing an objective identification of drought weeks was implemented. The framework was used in combination with PPVI and the model was calibrated in order to reproduce past drought events at specific locations. A relationship between drought and negative crop yield anomalies was established. Significant crop growth periods were taken into consideration: establishment,

vegetative, flowering and yield formation. The probability of having a negative crop yield anomaly when a significant growth period was in drought was computed. The sensitivity to drought of each crop growth period was evaluated based on this probability. In the end a loss index to relate drought with yield reduction suffered by farmers was developed. The entire framework was tested in the Dominican Republic and cereals losses (maize and sorghum) were evaluated. Results were promising.