

Weather Event Probabilities Used to Forecast Damages in an Agricultural Investment Model

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Recent risky events including crop diseases, weather events, and non-agricultural development have negatively impacted grapefruit production in Florida. A crop diversification strategy for culturing shrimp in low-salinity ponds in addition to citrus production was considered by producers to be a potential risk-management strategy. Probabilistic financial implications of various management strategies and hurricane events were estimated via a stochastic simulation model.

Stochastic computer simulation models have been used to analyze capital expenditures and agricultural management scenarios under conditions of uncertainty. A programmed financial accounting spreadsheet reflects deterministic financial accounting equations for point estimates of financial performance. A sensitivity analysis of deterministic results is examined via management scenarios that potentially influence production yields.

The stochastic component of the accounting model incorporates user-defined probability distributions for each input variable that may introduce risk into the investment scenario. Risky variables for Florida producers include random or uncertain input costs, market prices, and hurricane events. The economic success of this investment is determined by the positive probability of net present value (NPV) of net cash income over a 15-year planning horizon. Scenario output is represented by a Cumulative Probability Density Function (CDF) of the discounted net present value of cash flows for the proposed investment.

Hurricane event probabilities were estimated from storm event data available from NOAA Satellite and Information Service database and Unisys Weather System database (NOAA, 2007; Unisys, 2006). Wind speed data was recorded for counties directly within the storm path as well as significant wind speeds recorded in adjacent counties. Damage estimates to the shrimp production system were derived from actual events surrounding the 2003-04 hurricane season at the University of Florida Indian River Research and Education Center aquaculture site in St. Lucie County, Florida.

Model results indicate some small (<1%) probabilities of extremely negative NPV values ranging from -\$1,136,000 to -\$882,000 for the shrimp enterprise at all discount rate levels used to calculate NPV. These losses reflect the implications of multiple hurricane events occurring over the 15-year production horizon. Significant financial losses are associated with the capital-intensive infrastructure assumptions of the production model. Only a 50% probability of 0 NPV using a 3% return on the investment was indicated.

The model's probabilistic forecasts for the low-salinity shrimp aquaculture investment in Florida require a considerable degree of risk acceptance by investors. However, the development of stochastic spreadsheet models may provide interdisciplinary researchers with a tool aimed at optimizing the investment performance based on quantifiable input parameters. Spreadsheet accounting models can be used to analyze cost efficiencies associated with wind-resistant production designs, as losses to capital intensive production facilities heavily influence the probability of economic success of this type of agricultural investment. Using computer modeling and stochastic analysis as a farm or extension tool to quantify investment risks associated with aquaculture investments may promote cost-efficient investment alternatives for Florida agricultural producers.

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