2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

THE ECONOMICS OF ADOPTION OF PRECISION FARMING

David Zilberman and Teresa Serra
University of California Berkeley
Berkeley, CA
Jeanne M. Reeves and Edward M. Barnes
Cotton Incorporated
Cary, NC

Abstract

A simple economic decision aid that will allow producers to enter the level of yield variation in their field and then determine if they will benefit from variable rate application of their inputs has been developed. The only inputs needed are information on production cost, lint prices, and the yield variability present in the field. Given this set of data, we developed an algorithm that will provide farmers with a prediction of the potential profitability of precision farming technologies.

Introduction

Precision farm technologies (e.g., variable rate application systems, yield monitors, imaging systems) are increasing in dependability and ease of use. The question for the producer still remains, "Will these technologies pay on my farm?" To answer this question, a simple decision aid was developed that requires a minimal amount of input information. Details on how this decision aid works is provided in the following discussion.

Materials and Methods

Our algorithm is now working for von Liebig production function cases, where we assume a fixed ratio between input and output until output reaches it limit. In addition, we develop the option to use the model for neoclassical production functions, where the marginal productivity is declining, for example, for the cases where the production function of water, fertilizers, or other inputs is quadratic. A key feature of our framework is that it is user friendly. It is written in Excel, and the user only needs to insert six pieces of information (e.g., upper, average, and lower levels of yield per acre, output price, variable input cost, and acreage). With this minimal amount of information, we assume normality of yield distribution, but the algorithm can be modified to assume more detailed and skewed yield distributions. We have experimented with a large number of simulations, and the results suggest that the potential benefits of precision farming in cotton vary significantly according to farmers' conditions and economic situations.

Results and Discussion

We found that farmers with yields between 500 and 1,100 lbs. per acre, and variable costs of $350 per acre and above, are likely to benefit from precision farming, especially when lint prices are lower than 65 cents per lb. Farmers with yield distributions between 1,100 and 1,500 lbs. per acre and similar variable costs will benefit from precision farming only under extremely low cotton lint prices. An increase in the range of yield will increase the variance and gains of adoption of precision farming practices. On the other hand, high output prices, above 80 cents per lb., reduce the gain from precision farming under the fixed-proportion specification where precision farming has a minimal impact on yield and primarily reduce cost. The fixed-proportion assumption primarily recommends precision practices to farmers with high levels of field variability, relatively low yield, and high production cost.

When we move to a quadratic specification, which allows significant yield effects, then the gains from adoption of precision farming may become possible in cases with high cotton prices. When traditional systems do not maximize yield, then precision practices can be beneficial both in terms of yield increase and cost reduction, and the benefits may occur with high output price and high input cost. The key factor in this case is variability. High variability will make adoption of precision profitable under a high range of circumstances. This analysis suggests the importance of understanding the exact specification of production functions at the farm level and recognizes to what extent there is potential of yield increase by enhancing input use.