ECONOMIC AND ENVIRONMENTAL IMPACT OF PEANUT PRODUCTION: A WATERSHED LEVEL APPLICATION OF A BIO-ECONOMIC MODEL

Sènakpon. E. H. Kokoye

Department of Agricultural Economics and Rural Sociology, College of Agriculture, Auburn University, 310 Comer Hall, Auburn, AL 36849, USA;
sek0013@auburn.edu

Diane Hite

Department of Agricultural Economics and Rural Sociology, College of Agriculture, Auburn University, 208 Comer Hall, Auburn, AL 36849, USA;
hitedia@auburn.edu

Norbert Wilson

Department of Agricultural Economics and Rural Sociology, College of Agriculture, Auburn University, 205 Comer Hall, Auburn, AL 36849, USA;
wilsonl@auburn.edu

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ECONOMIC AND ENVIRONMENTAL IMPACT OF PEANUT PRODUCTION: A WATERSHED LEVEL APPLICATION OF A BIO-ECONOMIC MODEL

AUBURN UNIVERSITY

SÈNAKPON. E. HAROLL. KOKOYE*, DIANE HITE, NORBERT WILSON

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY, COLLEGE OF AGRICULTURE, AUBURN UNIVERSITY, 310 COMER HALL, AUBURN, AL 36830, USA;

*: Corresponding author: sek0013@auburn.edu

INTRODUCTION

Nonpoint source pollution (NPP) threatens many water bodies in the United States and remains an environmental concern (Bhattarai et al., 2008).

The agricultural sector remains the main contributor to NPP through runoff of nutrients, sediment, pesticides, and other contaminants (USEPA, 1998; Bhattarai et al., 2008).

With the growing concern on water body pollution, we hypothesize that the cultivation of peanuts provides a benefit from nitrogen fixing in rotation with nitrogen for subsequent crops – in this case cotton—and thus limiting the quantities of chemical fertilizer used on the field.

Therefore the runoff into water bodies might be reduced by increasing peanut cultivation.

The main objective of the study is to quantify the economic and environmental benefits of cultivating legumes such as peanuts.

BIO-ECONOMIC MODELING

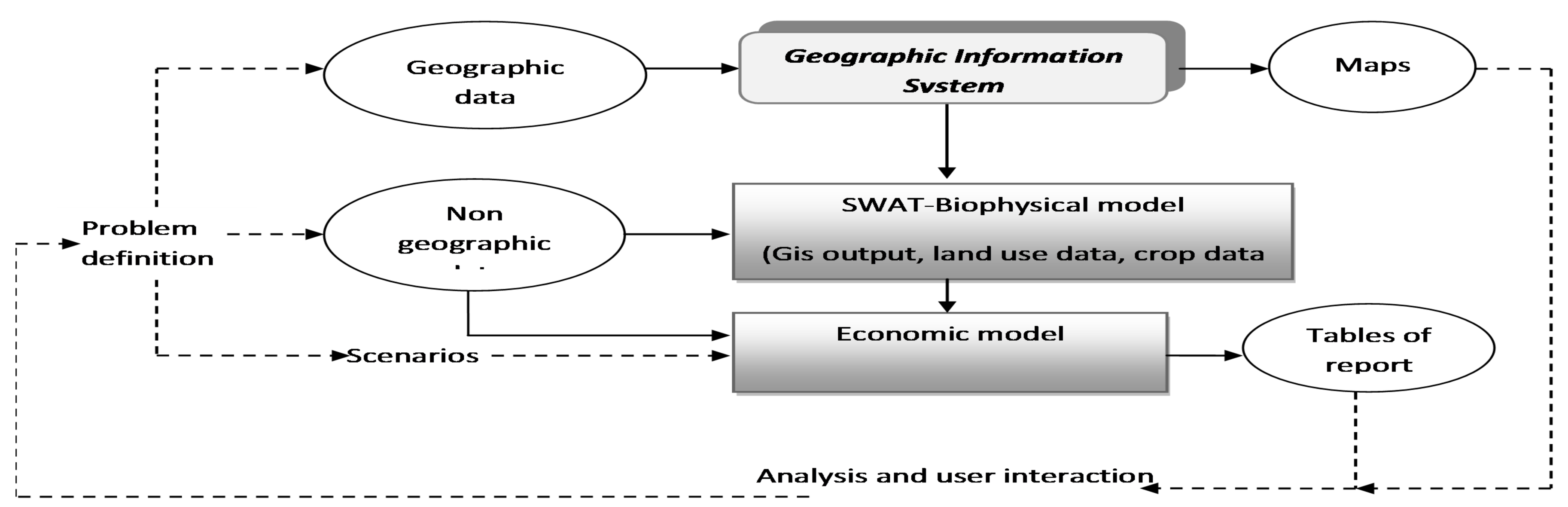


Figure 1. Structure of a Bio-economic model. Grey boxes are models: tools; ovals are data; blank names are activities; drawn lines are flow of data; dotted lines are flow of information. (Adapted from Bouman et al., 1998)

RESULTS

The results indicate that:

- cotton yields are higher in the peanut-cotton scheme than in continuous cotton farming system;
- the Nitrogen runoff is slightly smaller in the peanut-cotton scheme than the continuous cotton cultivation;
- peanut-cotton rotation yields a total annual profit of $18,248.083 compared to continuous cotton, which gives a profit of $15,345.567 for the watershed as a whole;
- By imposing an environmental constraint of 20% reduction of nitrogen the model results in a total profit of $14,598.472 and 12,458.654 for peanut-cotton and continuous cotton cultivation respectively.

METHODOLOGY

The Soil and Water Assessment Tool (SWAT) was used to run the biophysical model. SWAT divides the watershed into multiple subwatersheds. Each subwatershed is subdivided into hydrologic response units (HRUs) based on homogenous land use, management, topographical, and soil characteristics.

GAMS (General Algebraic Modeling Systems) is then used to optimize the profit of the farmer subject to constraints like land area in each watershed. The result of the GAMS output allocates the watershed to the cultivation of cotton and peanut due to its' profitability.

$$Max\ \pi_r \left[p_i \mathbf{Y}_{f,i,j,r} - C_{f,i,j,r} \mathbf{X}_{f,i,j,r} \right]$$

$$\sum_{i,j} X_{r,i,j} \leq A_r$$

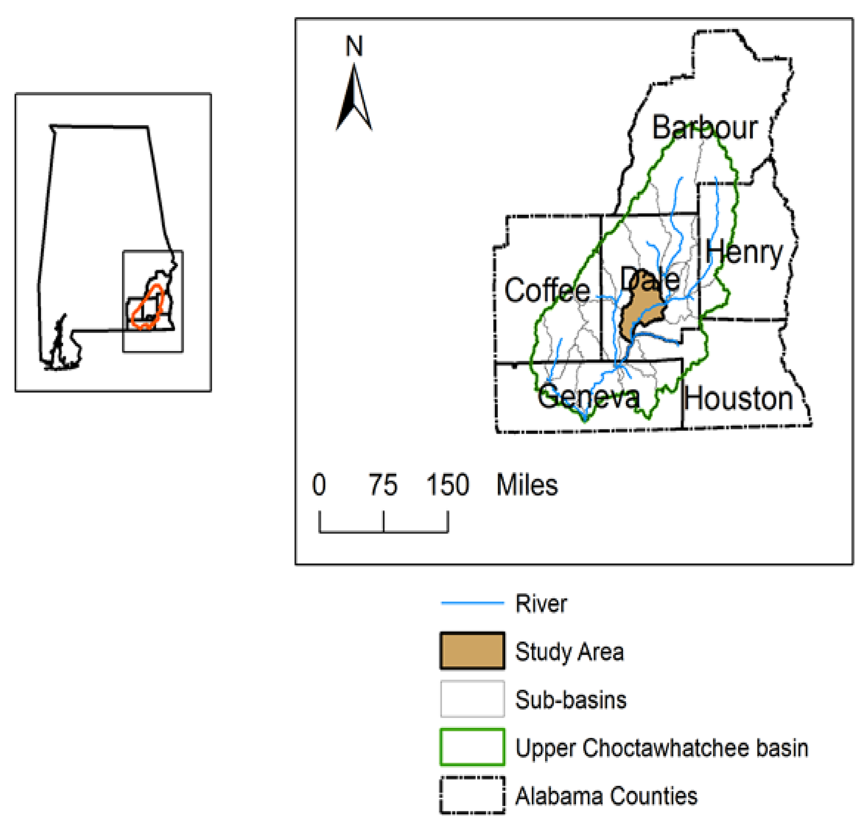
$$\sum_{f,j} n_{f,j,r} X_{f,j,r} \leq \overline{N}_r$$

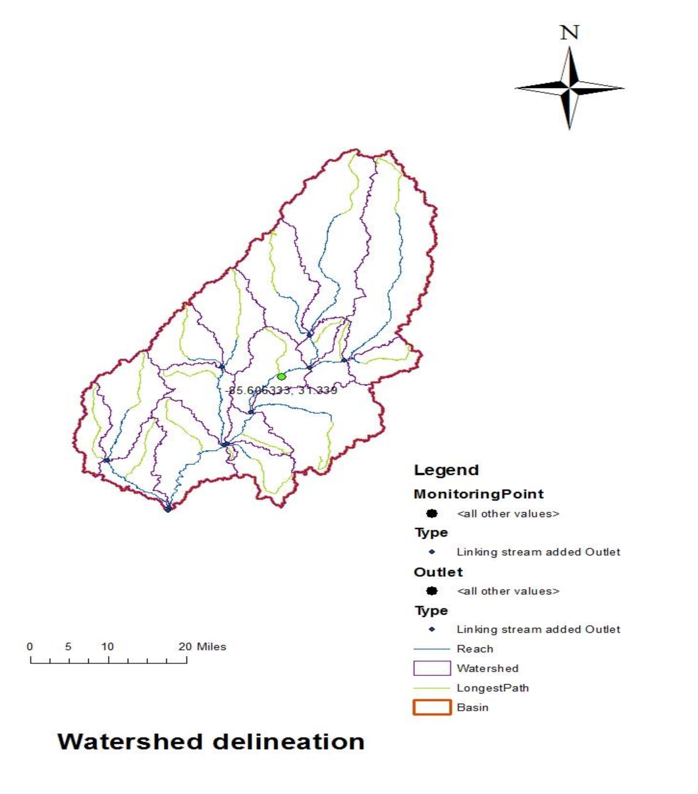
where pi, Y, X, and C are crop price, vectors of crop yield and cropping acreage, and costs of production, and f, I and j represent soil type, crop, and cropping practices; r indexes for HRUs. A is a land available for each practice in each sub-watershed within a single 8-digit HUC watershed.

where N represents constraint on per acre runoff of nitrogen within a watershed. Changes in the constraint allow estimation of a shadow cost of nitrogen runoff..

MAP OF UPPER CHOCTAWHATCHEE WATERSHED

Upper Choctawhatchee watershed in southern Alabama (HUC#03140201), also called Wiregrass region is located between several counties in Alabama including Barbour, Coffee, Dale, Geneva, Henry and Houston. The watershed covers roughly 399465 ha and is located in the Southerneast of Alabama.





CONCLUSION

- This study looks on the current trend of farm in term of profitability based on environmental constraint;
- Farming system that include peanut in the farming system gain an increase of cotton yields;
- Annual profit generated the cotton-peanut rotation system generates higher profit with a nitrogen runoff smaller than the continuous cotton;
- However the optimal runoff seems to be too small.

LITTERATURE

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