

PROFIT - Productive Rotations On Farms In Texas

ANNUAL REPORT - FY 2000

Title: Economic and Environmental Impacts of Technology to Enhance PROFIT

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Contribution to Goals of PROFIT: Expected results from this project is an assessment of the economic, environmental and societal impacts of changes in crop mix or land use, tillage systems, plant/row spacing, variety/planting date selections, insect/weed/disease management and other production practices for sorghum used in rotations with other crops in Texas. Impacts at the farm/household level, sub-state regional level, state level and nationally will be assessed for technology changes in the major sorghum producing areas of Texas. At the farm level, the analysis will establish the response to the sorghum PROFIT technologies in terms of changes in net cash farm income, net worth, net present value (net cash farm income plus changes in real net worth), probability of financial survival, and other measures of farm level or household economic benefits from adoption of the technologies. At the sub-state regional, state and national level, analysis of commodity price, production, consumption and foreign trade responses to the technologies, and the economic benefits to producers as a group and consumers as a group will be assessed. At the watershed, river basin and statewide levels, impacts on runoff, erosion, sediment, nutrients (nitrogen, phosphorus, potassium) from the technologies and resulting land use changes will be assessed. Farm level impacts and changes in producers economic benefits will be particularly useful to producers. Sub-state regional, state and national impacts will be particularly useful to policy makers and state legislators who fund and/or support the PROFIT initiative.

Accomplishments: Three workshops were held in FY 2000 to acquaint PROFIT researchers and extension specialists on the information needs from their research and technology transfer projects for the impact assessment study. The first was held with all personnel funded under PROFIT in attendance at the Ag Program Conference in January, 2000. The second and third were held with personnel at the Lubbock and Amarillo Research and Extension Centers for the

High Plains and Southern Plains regions on August 7 – 8, 2000. Multiple interactions have occurred at the Corpus Christi Center with personnel working in the PROFIT initiative for the Coastal Bend and South Texas Region. Templates for scientists' collection of information were provided to participants in the workshops and included details on crop yields, input requirements and application rates, costs of production, and adoption rates for the various technologies being pursued.

Design: The project is regional in scope and primarily economic in disciplinary approach with additional orientation to environmental indicators.

Project Objectives are:

1. Estimate the economic and environmental impacts from adoption of sorghum PROFIT technologies
2. Extrapolate results from locations where experimental data are developed to geographically similar regions within the state and in adjacent states and/or substate regions.
3. Demonstrate to producers and state level policy makers and legislators the economic and environmental consequences of changed agronomic practices in producing crops.

Methodology: Baseline analysis for major crops and livestock enterprises have been conducted using the U.S. Ag Sector Model (ASM). In the baseline analysis, Texas is partitioned into 8 types of farming regions representing differences in commodities produced, yields, production inputs, costs of production, and regional land, labor and water resource constraints. The baseline analysis represents the current production technologies, resource allocations and commodity mixes.

Results from the PROFIT initiative in each sorghum producing region will be used to modify yields, input requirements and costs of production for the sorghum and related enterprises in the farm level system of rotation. Then ASM solutions will be developed using the PROFIT results and contrasted with the baseline solution.

In ASM, economic welfare (sum of producer economic surplus and consumer economic surplus) is maximized when supply and demand are in equilibrium. Solution of the model generates estimates of prices and quantities of agricultural commodities, input use, crop mixes, and consumer and producer economic surpluses. Comparison of current practices and adoption of the new sorghum production technology provides an estimate of the economic impact of the new technology at substate regional, state, and national levels. Prices and quantities from the ASM solutions are used in farm level models such as FLIPSIM to evaluate the same sorghum production system technology. Farm models provide more specific estimates of new technology

by modeling households and estimating the future impacts of new technology on the economic health of the farm enterprise.

Changes in crop mixes, acreages of crops and quantities of inputs used (e.g. fertilizer, pesticides, water, etc.) from the ASM solutions for new technology are used in the Soil and Water Assessment Tool (SWAT) to estimate the environmental impacts of adopting the new sorghum technology. SWAT provides estimates of water-shed level flows, a key factor in which is regional crop mix and management. SWAT simulates the effects of agricultural and other watershed management in water flows and quality. The SWAT input data, part of which comes from the ASM solutions, include historical weather, natural vegetation, political boundaries, reservoir management, crop mix, agricultural practices, land use, soils, watershed boundaries, stream networks, soil properties, stream flows, and crop budgets.

During FY 2000 we developed a procedure to reconcile spatial scales of models used for environmental analysis and economic analysis and applied it to the U.S. and Texas. We showed how the differing spatial scales can be reconciled in a national analysis involving an agricultural model (ASM) with state- and county-level-based geographical boundaries and a watershed model (SWAT) involving watershed boundaries. This type of modeling system integration has been done in analysis of single or multiple watershed-level issues, but our effort was the first to show a method for a national-level analysis involving state- and substate-level economic results and small watershed environmental results. The procedures and results were shown for a national cropland erosion control policy and for the release by TAES of improved crop varieties. The significance of these results for PROFIT is that we have now available methodology and proof of concept to evaluate both the economic and environmental impacts of new technology and management practices stemming from the PROFIT initiatives in Texas.

This project is accomplishing its objectives and it is awaiting results from the PROFIT agronomic research and technology transfer efforts in each of the state's sorghum producing regions. During FY 2001 additional interaction with PROFIT researchers and extension specialists through follow-up workshops will be held in each region to assure the information needed for the economic and environmental impact assessment of the new sorghum technology will be forthcoming from their PROFIT projects. The major effort to assess these impacts will be made in FY 2002 after two years of research and technology transfer results from the PROFIT initiative are available.

Publications:

J.D. Atwood, B. McCarl, Chi-Chung Chen, B.R. Eddleman, B. Nayda, and R. Srinivasan. 2000. Assessing regional impacts of change: linking economic and environmental models. Elsevier Science, Ltd. Agricultural Systems 63 (2000), 147-159