The Integrated Farm System Model: Software for Evaluating the Performance, Environmental Impact and Economics of Farming Systems

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Definition:

The Integrated Farm System Model (IFSM) is a process level simulation of the performance of crop, beef and dairy farming systems that estimates major environmental impacts, production costs, and farm profitability.

Purpose:

With tighter profit margins and increasing environmental constraints, strategic planning of farm production systems is becoming both more important and more difficult. This is especially true for dairy and beef production. Livestock production is complex with a number of interacting processes that include crop and pasture production, crop harvest, feed storage, grazing, feeding, and manure handling. Computer simulation provides a useful tool for integrating these processes to predict the long-term performance, environmental impact, and economics of production systems.

How Does This Software Work:

The IFSM simulates all major farm components on a process level. This enables the integration of components in a manner that represents the major interactions among the many biological and physical processes on the farm. The IFSM provides a robust research and teaching tool for exploring the whole farm impact of changes in management and technology. Crop production, feed use, and the return of manure nutrients back to the land are simulated on a daily time step over many years of weather. Nutrient flows through the farm are tracked to predict potential nutrient accumulation in the soil and loss to the environment. Environmental impacts include erosion of sediment, soluble and sediment-bound phosphorus runoff, nitrate leaching, ammonia and hydrogen sulfide volatile loss, all greenhouse gas emissions, and the farm gate water, reactive nitrogen, energy, and carbon footprints of the production system.

Simulated farm performance is used to determine production costs, incomes, and economic return for each year of weather. A whole-farm budget is used where annual fixed costs for equipment and structures are summed with predicted annual expenditures for labor, fuel, and other resources to obtain a total production cost. Production costs are subtracted from the income received for milk, animal, and crop sales to determine a net return to management.

Where This Software Applies and Its Limitations:

IFSM was primarily developed for use in the temperate climate regions of the United States, but with suitable climate data and appropriate assumptions, it has been adapted to other regions of the world. Weather files provided with the software are limited to the United States. Although the model contains many options for crop, feed, animal, and manure management, these options are limited to the major strategies used in the United States.

The software is not intended for use in evaluating farms for regulatory or similar purposes, but rather for determining and comparing relative differences obtained through changes in farm management and technology. The model and documentation are distributed "as is", with no warranty expressed or implied. Because of the many variables involved and the judgments that must be made in choosing inputs, interpreting outputs, and general use of this software, the USDA's Agricultural Research Service is not responsible for any problems, damages, or losses caused either directly or indirectly by use of the model.

Effectiveness:

The IFSM software was developed and is primarily used as a research tool for evaluating and comparing production systems. The software is also used as an educational aid for individual, workshop, and classroom use to illustrate the complexity and interrelationship of farm components. Most model options have been verified to provide reasonable predictions, and evaluation of the model continues as model changes and additions are made.

Cost of Software:

The IFSM is available at no cost through Internet download. The software and further information can be obtained at http://www.ars.usda.gov/Main/docs.htm?docid=8519. The software is easily installed and used on computers using a Windows® operating system.

Operation:

Input information is supplied to the program through three parameter files. The farm file contains data such as crop areas, soil type, equipment and structures used, animal and herd characteristics, harvest, tillage, and manure handling strategies, and prices for various farm inputs and outputs. The machinery file includes parameters for each machine available for use on a simulated farm. Most farm and machinery parameters are modified quickly and conveniently through dialogs in the user interface of the program. Many of these files can be created to store parameters for different farms and machinery sets for later use in other simulations. The weather file contains historical daily weather data for many years at a specified location. The software includes files describing typical farms over a range of sizes and weather files for all of the United States.
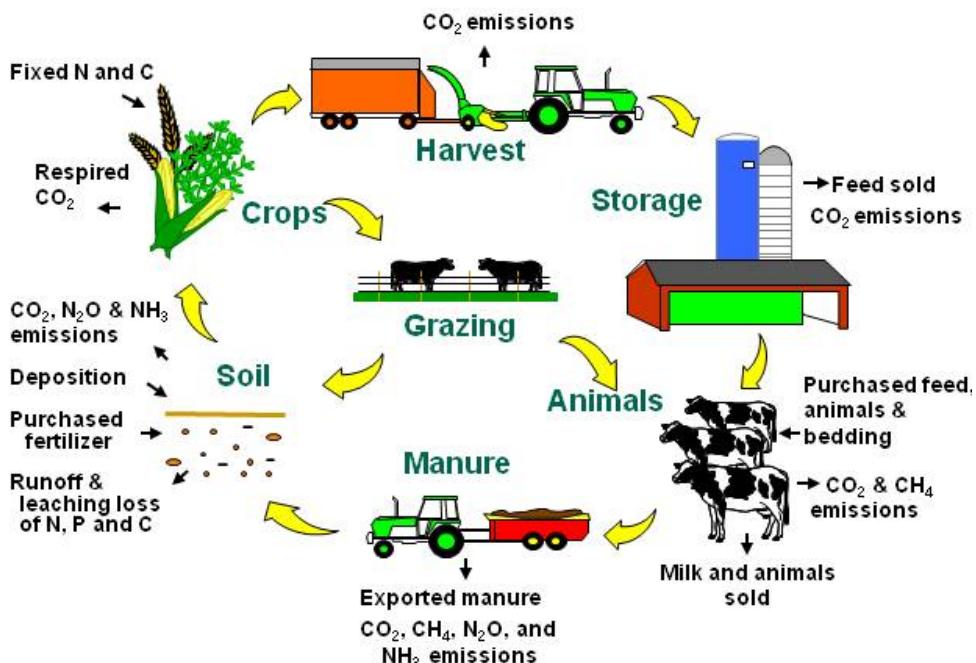
Simulation output is available in four files, which contain summary tables, report tables, optional tables, and parameter tables. The summary tables provide average performance, environmental impact, costs, and returns for the years simulated. These values consist of crop yields, feeds produced, feeds bought and sold, manure produced, nutrient losses and gaseous emissions to the environment, production costs, income from products sold, and the net return or profitability of the farm. In the more extensive report tables, output values are given for each simulated year as well as the mean and variance over the years. Optional tables are available for a closer inspection of how the components of the simulation are functioning, which include daily crop growth and harvest, suitable days for field work, machinery operations, animal rations, and feed use. Parameter tables summarize the input parameters specified for a given simulation, providing a convenient method of documenting the settings for specific simulations.

References:

Rotz, C.A., M.S. Corson, D.S. Chianese, F. Montes, S.D. Hafner, R. Jarvis, and C.U. Coiner. 2011. Integrated Farm System Model: Reference Manual. USDA Agricultural Research Service. Available at: http://www.ars.usda.gov/SP2UserFiles/Place/19020000/ifsmreference.pdf.

For Further Information:

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IFSM

Process level simulation of the major farm components is used to evaluate performance, environmental impact, and economics of the production system.