Integrated Decision Support System

manage natural resources, increase agricultural production, and improve family nutrition and livelihoods

Purpose

SWAT, APEX, FARMSIM, NUTBAL, and PHYGROW are validated models that have been extensively applied in both U.S. and international settings. These previously validated spatially explicit models will be incorporated into an Integrated Decision Support System. This system will provide an integrated approach that links production, economic, and environmental consequences of the introduction of new technology, policy, and training for decision makers in agriculture at multiple temporal and spatial scales. This collection of models facilitate ex ante strategic decisions for investments that concurrently lead to sustainable increases in agricultural productivity, improved management of soil and water resources, and improved family nutrition and livelihoods. The component models are highly interactive, providing the ex ante ability to evaluate and select promising options for production systems at specific sites, regions, and watersheds. Using the same suit of models, the results of subsequent results of research or policy options derived from development or demonstrations can be modeled to predict quantitative outcomes for consideration by government or private sector investors.
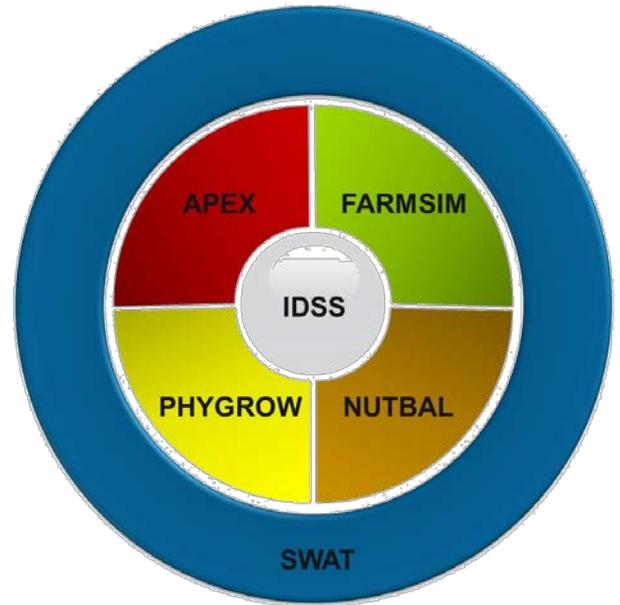
IDSS Component Models

FARMSIM – Economic and Nutritional Impacts Assessment Model

A farm level simulation model for analysis of family economics and nutrition. This model simulates a representative farm for five years using stochastic market prices, crop yields, and livestock production values.
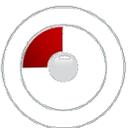
APEX – Crop and Land Management Simulation Model

A biophysical simulation model used to evaluate crop management technologies and decisions that affect agricultural production and environmental sustainability at the scales of individual fields, whole farms, or small watersheds.

NUTBAL– Animal Performance Report

Assesses crude protein and net energy status of livestock based on nutrient profile of animal's diet relative to requirements determined by genetic potential for maintenance, growth, fertility and lactation, and local environmental conditions to generate least cost feeding solutions for meeting performance goals.

PHYGROW – Grazing and Range Land Assessment Model

A phytomass growth model used to determine the effects of variations in landscapes, animal populations (conditions, demand, timing), and weather and their impacts on carrying capacity, hydrology, and stability of forage production.

SWAT – Soil and Water Assessment Tool

A biophysical simulation model that operates on a daily time step used to quantify the impacts of land management practices on stream flows and water quality in large complex watersheds or river basins. It uses geographic information systems to manage input and output data and is sensitive to weather, topography, soils, land use/land cover, and agricultural management practices.

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IDSS Inputs

- Special needs using biophysical and socioeconomic inputs available from international databases
  - *climate, weather, stream networks, soil types and fertility, ground cover, topography, etc.*
- Official documents, surveys and expert opinion
  - *local tillage and conservation practices, crop and livestock management and production statistics, input/output market prices, farm household characteristics, etc.*
- Inputs generated by well-validated expert systems built into the models

IDSS Outputs

IDSS outputs address a broad range of environmental and socioeconomic issues including:

Farm Economics

- *annual net cash farm income, ending cash reserves, net worth, probabilities of positive cash flows and economic sustainability, etc.*

Crop Production

- *grains, tubers, fruits, forage, residues*

Livestock Production

- *milk, meat, eggs*

Hydrology

- *runoff, subsurface return flow, stream flows, aquifer recharge/depletion, pond and reservoir water balances*

Crop Requirements

- *fertilizer, pesticides, irrigation*

Livestock Requirements

- *forage and feed crops consumed*

Family Nutrition

- *annual consumption of energy, protein, iron, calcium, fat, and vitamin A relative to minimum requirements*

Projected IDSS Application

- Provide common modeling environment for *ex ante* analyses to inform investment decisions, evaluate progress during project implementation, and forecast integrated impact from interventions.

- Identify optimum outcomes for situations which require trade-offs among production, environmental and economic benefits and costs.

- Hydrologists can anticipate how water harvesting for irrigation will affect stream flows and water quality indicators (e.g., suspended solids, ortho-phosphate, biological oxygen demand).

- Soil scientists can anticipate how alternative cropping systems affect indicators of soil fertility (e.g., topsoil pH, organic matter contents, extractable phosphorus).

- Agronomists can anticipate additional nitrogen fertilizer required to take advantage of irrigation or the increased yield potential of an improved variety.

- Human nutritionists can anticipate the impacts of interventions (such as small-scale irrigation to grow green and yellow vegetables) during the dry season on family nutrition.

- Economists can anticipate impacts of increased investments in additional land, fertilizer, seed, and/or irrigation on the probability of farm solvency over the next five years.

- Government officials concerned about floods and sedimentation of rivers, lakes, and irrigation canals can anticipate impacts of check dams on tributaries supporting small scale irrigation projects.

- Government policy makers can anticipate impacts from subsidizing costs of fertilizers, seeds, and other inputs on family nutrition and income from sales of agricultural products.