Next Generation Agricultural Systems: Data, Models and Knowledge Products

John M. Antle
Professor of Applied Economics
Oregon State University

tradeoffs.oregonstate.edu

AgMIP — The Agricultural Model Intercomparison and Improvement Project

Oregon State University

Themes

- Agricultural Model Inter-comparison and Improvement Project (AgMIP)

- NextGen Data, Models and Knowledge Products
  - Motivation
  - State of Ag Systems Science
  - Implications

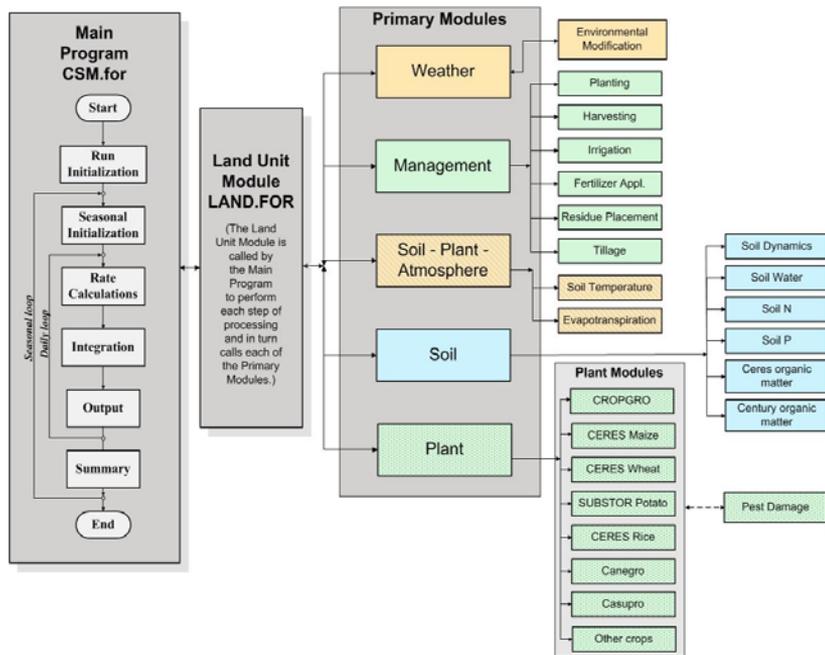- NextGen Data Systems and Analytics for Science and Decision Making

Agricultural Model Inter-comparison and Improvement Project (AgMIP.org)

A new global community of science: climate, energy, water, soils, crops & livestock, economics, pests & diseases

◦ More than 800 scientists

◦ Collaborating & supporting institutions include:
  ◦ USDA Agricultural Research Service
  ◦ UKAID (DFID)
  ◦ NASA
  ◦ USAID
  ◦ Bill and Melinda Gates Foundation
  ◦ National and international agricultural research centers and programs
  ◦ Universities

◦ North American initiative
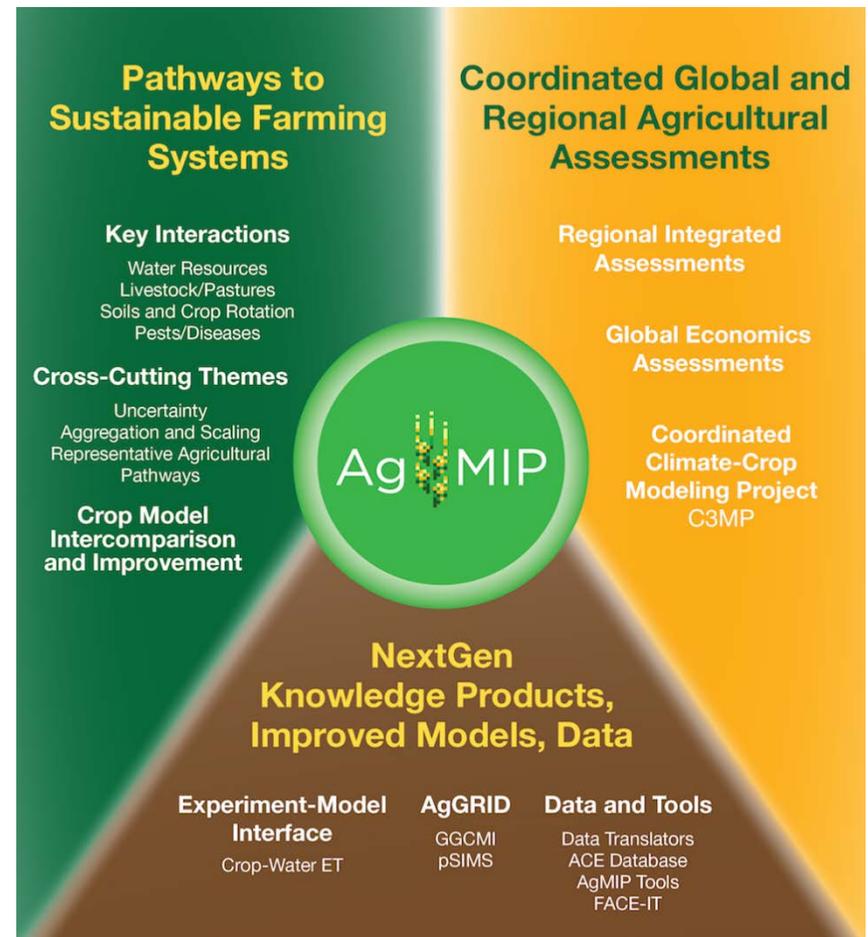
Land, soil, crop, climate, and management components
in the DSSAT Cropping System Model
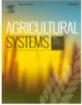(Jones et al. *Ag Systems* 2017)

Data and analytics for farm- and landscape-scale decisions
(Capalbo, Antle and Seavert *Ag Systems* 2017
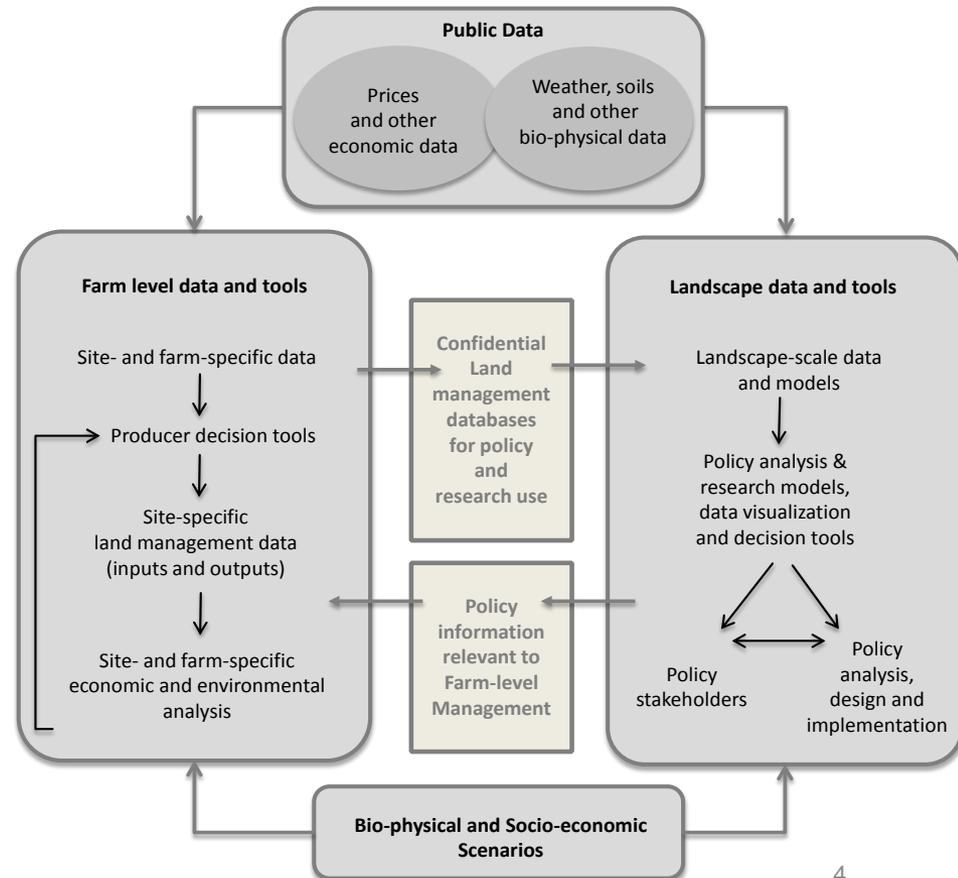
AgMIP NextGen Project

- Supported by BMGF

- Motivation: gap between data, models and users (scientists as well as farm & policy decision makers)

- Background papers

- Stakeholder workshop

- *Agricultural Systems*
        special issue 2017
                open access

NextGen Project Approach: Use Cases

|	Use Cases				
	1	**2**	**3**	**4**	**5**
	Farm extension in Africa	Developing and evaluating technologies for sustainable intensification.	Investing in agricultural development projects that support sustainable intensification.	Management support for precision agriculture.	Supplying food products that meet corporate sustainability goals.
Farming System	small-holder	small-holder	small-holder	commercial crop	commercial crop
Information User	Farm adviser	Agricultural research team/program	Analyst/adviser	Management consultant	Corporate analyst
Beneficiaries	Farm family	Research institution/farm population	NGO & clients	Farm business	Agri-business firm
Outcomes	Improved livelihood (income, nutrition, food security)	Improved technology	Sustainable technology	Income, soil conservation & water quality	Profit, risk management, sustainbility objectives

NextGen Use Cases and Papers

- Vision: **computational agricultural science** can accelerate innovation & improve decision making

- Many needs for **science-based model improvements**
  - Biological and physical factors, management options, and socioeconomic and environmental conditions, at farm and landscape scales

- **Data** the most important limitation to model improvement & use
  - Ontologies for interoperability, AI & ML
  - Ownership, institutional & legal issues

- **Knowledge products** to connect end-users (in science and in decision making) with data and models

- **Private-public partnerships** to support **pre-competitive** and **competitive** spaces for science, data, model, KP development
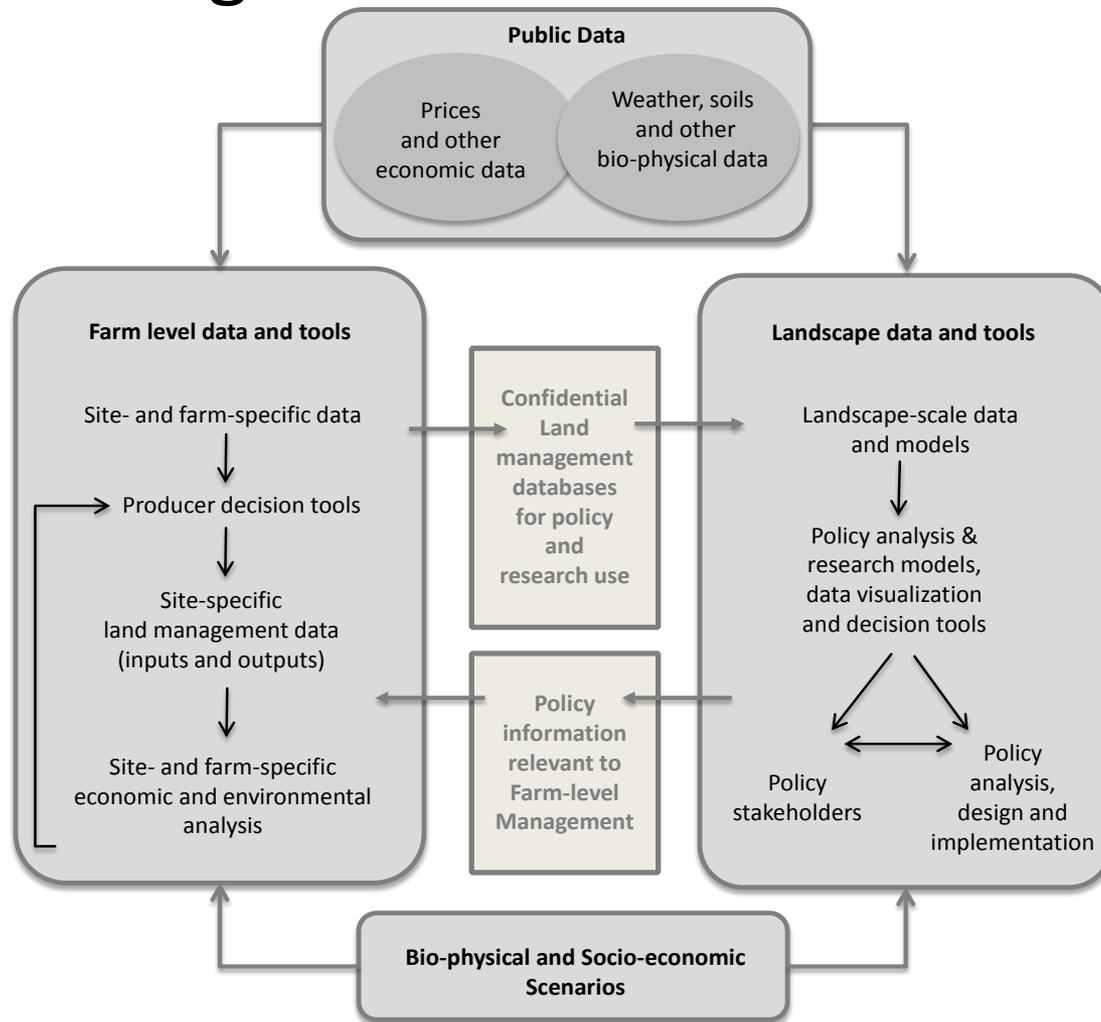
Example: precision nutrient management

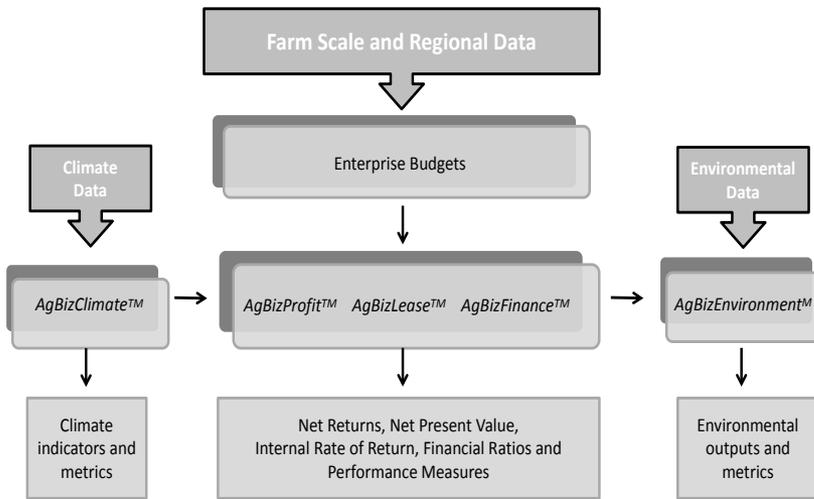Farmer's objectives: Yield or profit max? Risk management?

Policy objectives: Ecosystem services? Food & nutrition security?
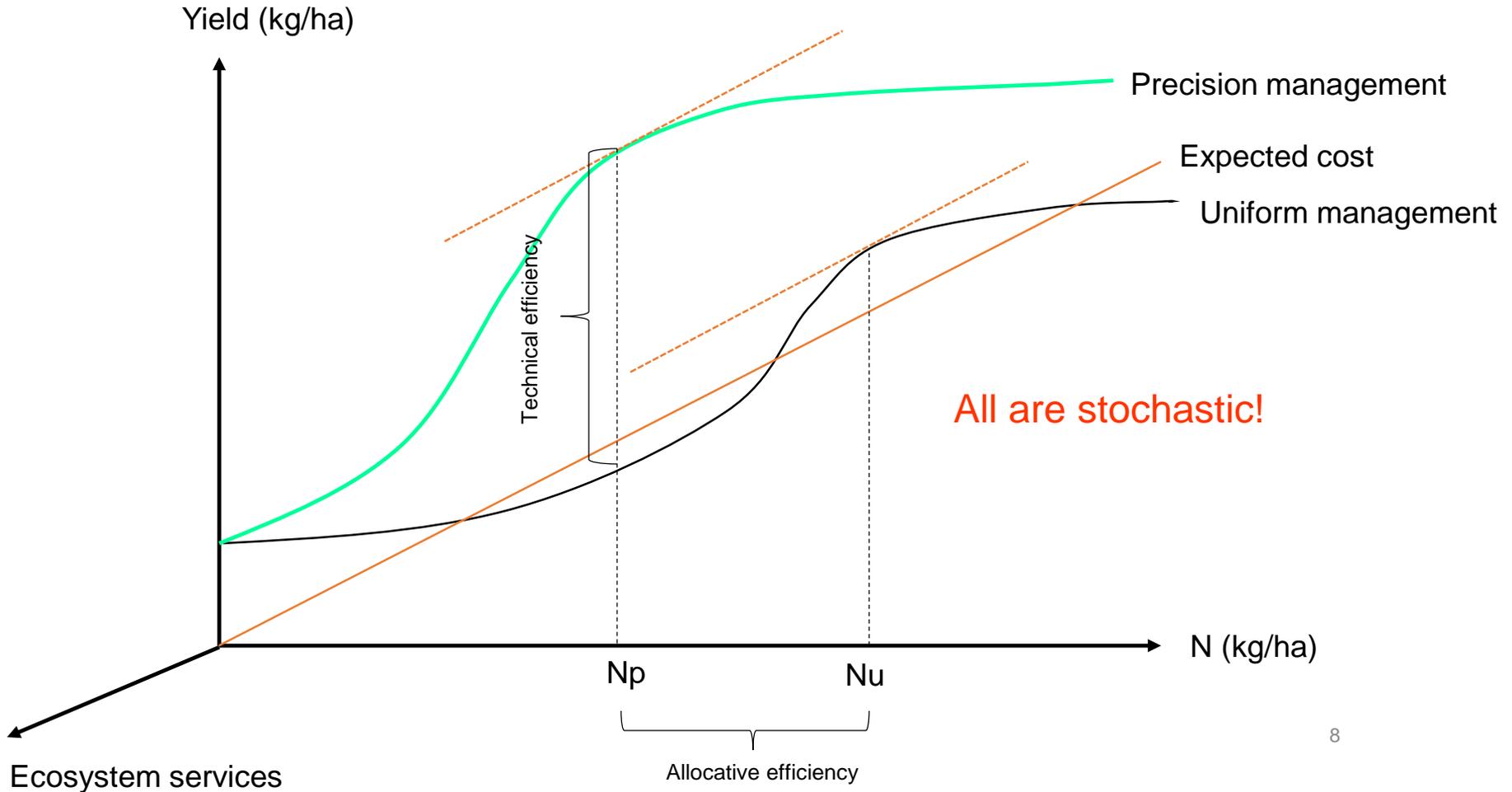
Data & analytics for farm & landscape-scale decision making

Data & analytics for farm & landscape-scale decision making

Tradeoff Analysis Model
(landscape-scale technology adoption & impact, ecosystem services)
tradeoffs.oregonstate.edu

Farm Scale and Regional Data

Enterprise Budgets

Climate Data

Environmental Data

AgBizClimate™

AgBizProfit™   AgBizLease™   AgBizFinance™

AgBizEnvironment™

Climate indicators and metrics

Net Returns, Net Present Value, Internal Rate of Return, Financial Ratios and Performance Measures

Environmental outputs and metrics

AgBizLogic
(farm-level data and analytics)
AgBizLogic.com

Bio-physical data and models (crop, livestock, environment)

Farm-level economic data (outputs, inputs, prices, land allocation, farm household characteristics)

Biophysical model outputs (crop & livestock yields, environmental outcomes)

Biophysical and socio-economic scenarios

Global and regional model projections (prices, incomes, employment, productivity)

TOA-MD Parameters (System 1, System 2

Social outcome data (gender, health, nutrition)

TOA-MD Model (adoption, impact)

TOA-MD outputs

Adopters (treatment effect on treated)

Non-Adopters (treatment effect on untreated

Aggregate (adoption rate, average treatment effect, threshold indictors)

Capalbo, Antle and Seavert *Ag Systems* 2017