Economic implications of disease and pest losses – data, modelling and analytical approaches

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Themes

• DPL: An economic and policy perspective

• Some insights from the AgMIP Next Gen project

• Economic perspective on modeling issues

• Towards a new approach to private-public data
Issues and Challenges

• Crop loss and its management: a complex, challenging and unquestionably important problem

• What are objectives? Scientist vs stakeholder perspectives
  o Industrialized ag: food production & quality; consequences of high intensity of chemical use (disease & pest resistance to chemicals; farm worker health & safety; consumer health risk; environmental risk).
  o Developing ag: food production & quality (consequences of limited pest management); emerging: farm worker and family health and safety; environmental risk
  o Private sector role: ag R&D, chemical production, distribution, management advisory services
  o Public sector: farm worker safety, food safety, environmental regulation (local, regional and global externalities)

• We know there are huge gaps in science, data and models
• How to improve data, modeling capability, and provision of information to decision makers?
The problem (?): with available data, we can’t say what role diseases and pests play in explaining the huge variation in Kenyan maize yields across low and high productivity agro-ecozones, or in adoption of technologies such as hybrid seed and fertilizer.

*Econometric production models explain 30-50% of variation in data from a statistically representative sample of 1100 households over 5 years using observable covariates. Crop model simulations (DSSAT, APSIM) do worse. Covariates do not include any pest occurrence or pest management information.*

Source: Tegmeo Inst Rural Household Surveys, 1997-2010
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Some Insights from AgMIP’s Next Gen Project

- Use cases: insights from scientists and stakeholders
  - The need for a stakeholder-driven “computational ag science”
    - To accelerate and generalize traditional experimentation
    - To anticipate emergent challenges, e.g., climate change, pests & diseases
  - But...many needed model improvements
  - Better data may be the greatest challenge
Economic Modeling Challenges

• Challenges within and across scales: in principle can use models for “simulation experiments” to assess DPL:
  o Farm/household/impact assessment/technology adoption
  o Regional land use/market/food system
  o Global market/food system/IAM

• Model improvement hampered by:
  o Diversity of model types, purposes, data requirements (how to inter-compare?)
  o Lack of documentation & transparency
  o Lack of public investment!

• Critical role of risk management in farm decision making
  o Damage function models
  o Econometric production risk models
  o Behavioral dimensions: managing downside loss, upside gains
  o How to use crop models to characterize production risk, link to economic decision models?
Econometric Approach to Production Risk Modeling & Decisions

Production risk models are combined with risk management behavior to evaluate \textit{ex ante} decisions.

Farmer use chemicals to manage production risk

Potato yield distributions, Ecuador

Economic Modeling Challenges (cont.)

• Spatial heterogeneity and dynamics
  o Bio-physical (soils, climate)
  o Economic (farm size, location, ...)
  o Production system dynamics critical to disease & pest management
  o Difficult to model together!
Data Challenges

• Conventional approaches and limitations
  o Experimental
  o Farmer-collected/reported
  o Farm surveys - research
  o Farm surveys – government

• Most data lack key information
  o Disease and pest occurrence
  o Type, quantity and timing of chemical use
  o Prices paid (price is not equal to cost!)
  o Information based on inaccurate records or recall
  o Multiple observations over time, space (panel data)

• Need for an essential/minium data ontology
Towards a private-public data system for farm management, research and policy decision making...

Capalbo, Antle and Seavert, *Ag Systems* 2017