Crop forecasting: Its importance, current approaches, ongoing evolution and organizational aspects

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Why AMIS? - creation

• Lack of reliable and up-to-date information on supply, demand, stocks and export availability

• Weaknesses at national level to produce consistent, accurate and timely agricultural market data and forecasts

• Inadequate information on stocks, domestic prices, and linkages between international and domestic markets

• Inappropriate and/or uncoordinated policy responses to market crisis
Why AMIS? - creation

IGC Grains and Oilseeds Index and sub-Indices (Daily)
Jan-00 = 100

Zoom 1m 1y YTD 5y All From Jan 3, 2000 To Feb 5, 2016

Grains and Oilseeds Index, Wheat, Maize, Rice, Soybeans

Source: International Grains Council (IGC)
What is AMIS?

• **A G20 initiative** to increase food market transparency and reduce food price volatility
  
  • Crops: wheat, maize, rice, and soybeans
  
  • Focus: production, utilization, stocks, trade
  
  • Participants: G20 Members plus Spain and 7 invited countries

• **Bodies and governance:**
  
  • Secretariat of International Organizations, hosted by FAO
  
  • The Global Food Market Information Group (countries, technical)
  
  • The Rapid Response Forum (countries, policy)
  
  • + steering committee, etc.
What is AMIS? - coverage

G20 Members & Spain  Other EU Members*  Invited Countries

* Not participating in AMIS as individual countries, but collectively represented by the European Union
What is AMIS? - activities
Why crop production forecast

• Reduction of the risk associated with local or national food systems

• Food System includes all those activities involving the production, processing, transport and consumption of food

• The risk reduction should contribute to improved outcomes in terms of:
  • The environment
    • Better flows and access
  • Socio economic aspect
    • Increased wealth
    • Increased income
    • Increased employment
    • Economic growth
  • Health and nutrition
    • Reduced diseases
    • Reduce morbidity
    • Reduce mortality
Why crop production forecast

• The chosen scale in terms of space and time affects the interest of the actors in the food system:

• In terms of Space

  • In field yields modeling: to improve management techniques and boost actual yields
    • Monsanto, Du pont Pioneer, and Land O’lakes in USA
  • Number of crops selected for the forecast: to address policy needs
    • The Mahalanbois National Crop Forecast Center (India) issues crop production forecasts for the country’s eight major crops

• In terms of time: Long term or current

  • AGMIP seeks to improve agricultural models in light of the medium- and long term effects of climate change on crop yields
  • GEOGLAM monitors current year conditions and contributes to national crop production forecasts on a monthly basis
Why crop production forecast
Considerations for good crop production forecast model

- The evaluation criteria should be based on the forecasting system’s capacity to induce changes in the relevant agents’ behavior, resulting from their perception of risk reduction.

- The ideal properties of the good crop production forecast model:
  - Reliability
  - Objectivity
  - Consistency with scientific knowledge
  - Adequacy to scales
  - Minimum cost
  - Simplicity
  - Timeliness
  - Sensitivity to extreme events
The current two core modeling approaches:

1. **Statistical models**
   - Regression models: link the variable of interest (yield) to the predictors known for the current season
   - Predictors: chosen from the meteorology and/or the remote sensing domains
   - Statistical crop models are simple and entail low costs
   - Limitations: Smallest prediction interval around the average
2. Process-based models

• Impressed mechanistic models by replacing the theoretical relations with empirical functions

• There are a number of such models that differ by their level of approximation, the choice of process modeled and the datasets retained

• Most models require information on:
  • Crop management
  • Nutrient availability
  • Water availability
  • Energy received

• Most models make use of remote sensing information

• Most models perform crop yield assessments not on biomass production of pasture land
• International initiatives are helping for the evolution of crop yield models

• Academia, public administration and the private industry working jointly to boost:
  • Models integration
  • Foster interaction
  • Knowledge sharing
  • Model comparison

• Great forces are undergoing to secure access to validated datasets
  • ~300 data sources for meteorological information alone
  • The problem lies more in choosing which data source to use than how to access

• Availability of new remote sensing products: SMAP for soil moisture

• Availability of innovative working environments: NOAA’s Data Alliance with Amazone WS, Google CP, IBM, Microsoft and OCC
Ongoing evolution

- Models expected to evolve from biomass production forecasts to the estimation of associated externalities
- Models to provide outputs:
  - Crop water use (in competition with drinking water under shortage scenarios)
  - Nitrogen/phosphorus soil pollution
  - Greenhouse gas emission
- Adding new crops in the list – peri-urban production of vegetables is a component of food security resilience
- Moving from forecasting potential yield to forecasting actual yield
  - Integrating the aspects linked to weeds, pests, diseases, pollutants, or adaptation
- The Future of crop yield modeling will entail:
  - Multi-disciplinary inter-institutional frameworks
  - Modular open source code
  - Free access reference datasets
Organizational aspects

Crop forecasting is a complex multi-disciplinary exercise and it requires competence in:

- Crop management
- Plant physiology
- Meteorology
- Soil science
- Remote sensing
- IT
- Statistics

It also requires adequate budget and human resources for:

- Hardware and software
- Data and model access
Organizational aspects

• Examples at continental level:
  • The Indian Mahalanobi National Crop Forecasting Centre: 20 staff members, 1.5 million USD annual budget
  • The European MARS AGRI4CAST: 23 persons, 1.5 million USD annual budget

• National example: CNT-CGMS in Morocco relies on a team of 23 staff members

• Costs are lower than agricultural survey but the modeling approach more rely on close collaborations with national space centers research programs
Remaining challenges

• The effects of climate change
  • Particularly, the extent and rapidity of these changes
• Real time estimation of crops
  • More significant if crop optimal location, management techniques, or disease progresses at greater speed
    1. Double or triple season cropping has moved 100 KM to north in the last 15 years in China
  • Models based on past observations will become less relevant
  • The effects of climate variability and extreme events on the output of the model
• The role of the private sector in developing the models
  • The quest for profit maximization
  • The public sector will have to finance the developments corresponding to the applications at national level
  • The private sector is likely to boost the research at the local level
• The reconciliation and bi-directionality of information flows will require particular attention
Crop production forecast is important to minimize risk in the food system.

Various models/approaches and data are available for crop production forecast, therefore:

- Identify the proper model that fits the context.
- Build institutional capacity.

Crop production forecast is a multi-disciplinary exercise:

- Better coordination and cooperation is critical.
THANK YOU