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

Yakob M.Seid
Statistician AMIS Project
FAO Statistics Division
Yakob.Seid@fao.org

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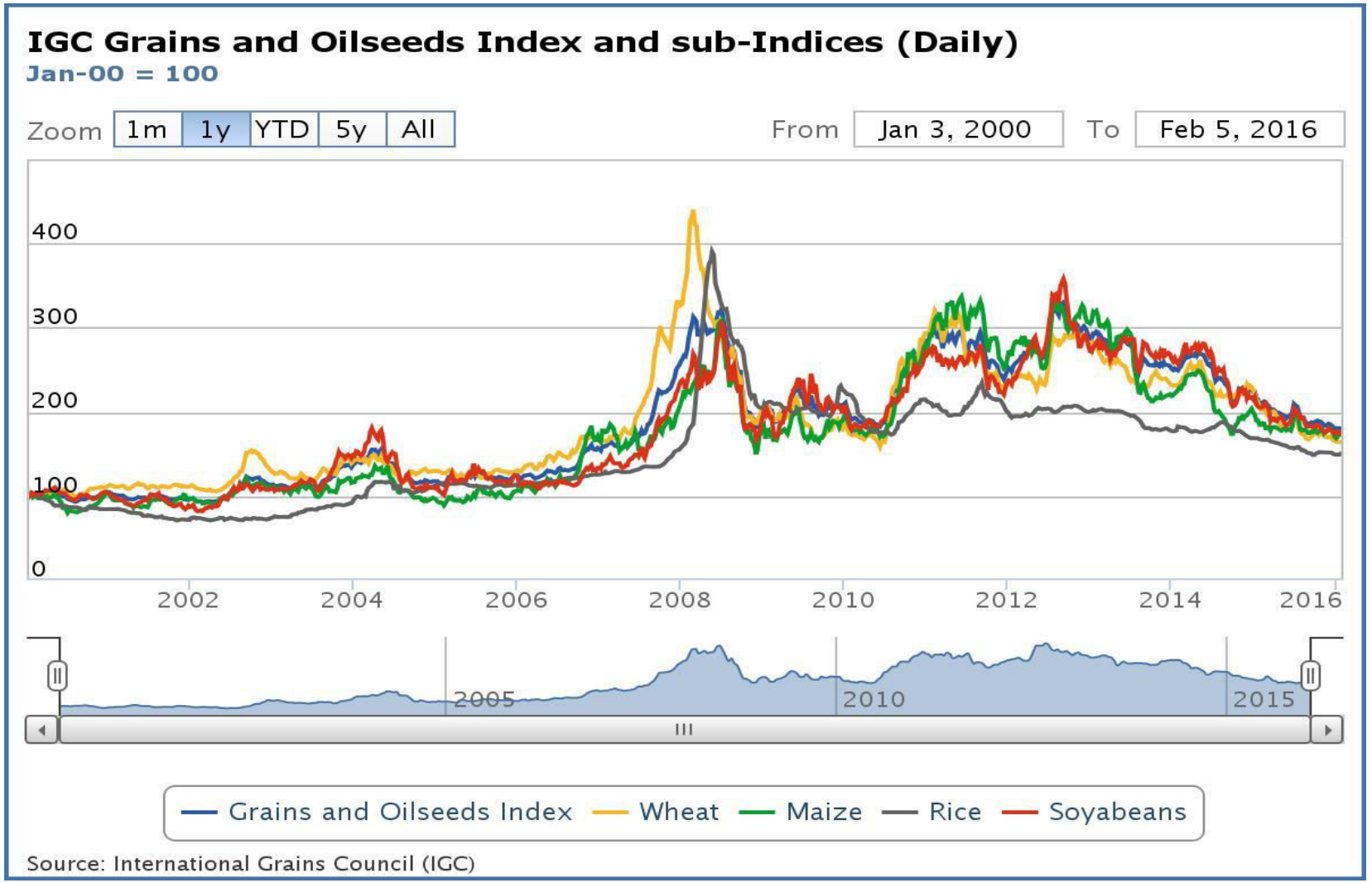
- Background AMIS
- Why crop production forecast
- Considerations for good crop production forecast
- Current approaches
- Ongoing evolution
- Organizational aspects
- Remaining challenges

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

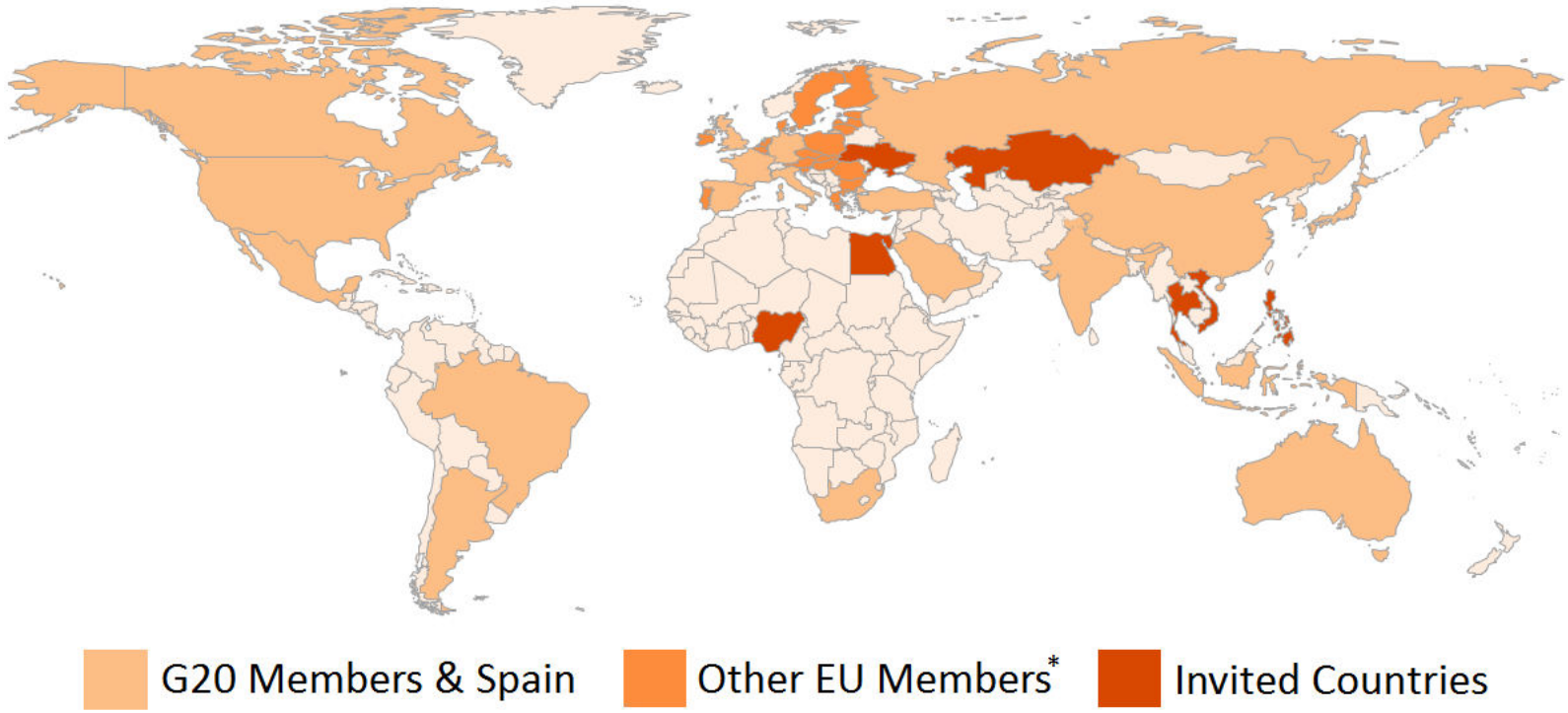
Why AMIS ? - creation



What is AMIS?

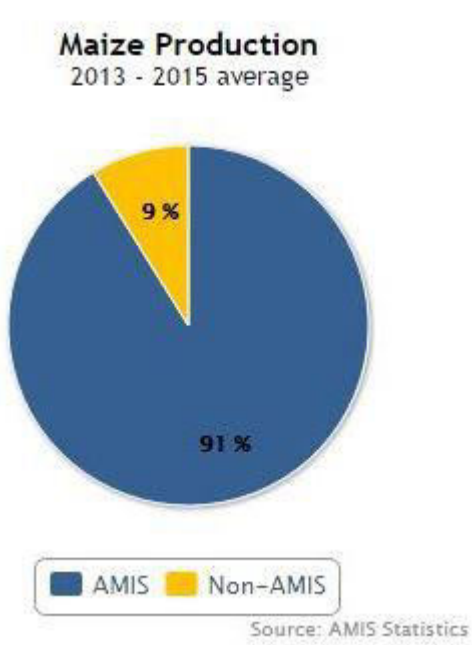
- **A G20 initiative** to increase food market transparency and reduce food price volatility
  - Crops: wheat, maize, rice, and soybeans
  - Focus: production, utilization, stocks, trade
- Participants: G20 Members plus Spain and 7 invited countries
- **Bodies and governance**:
  - Secretariat of International Organizations, hosted by FAO
  - The Global Food Market Information Group (countries, technical)
  - The Rapid Response Forum (countries, policy)
  - + steering committee, etc.

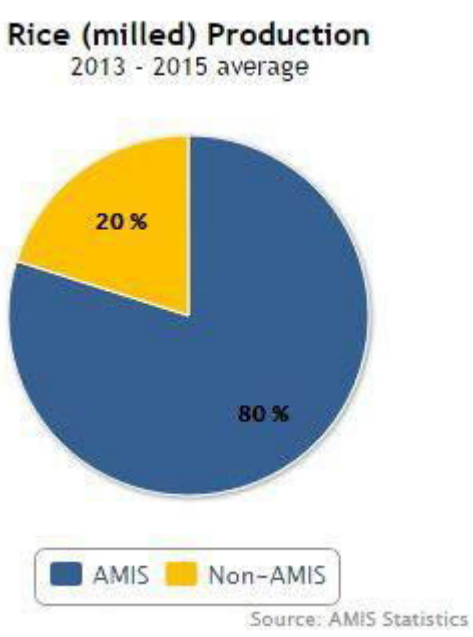
What is AMIS? - coverage

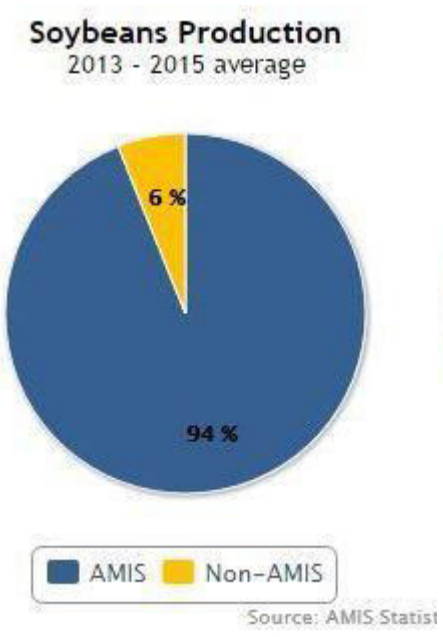


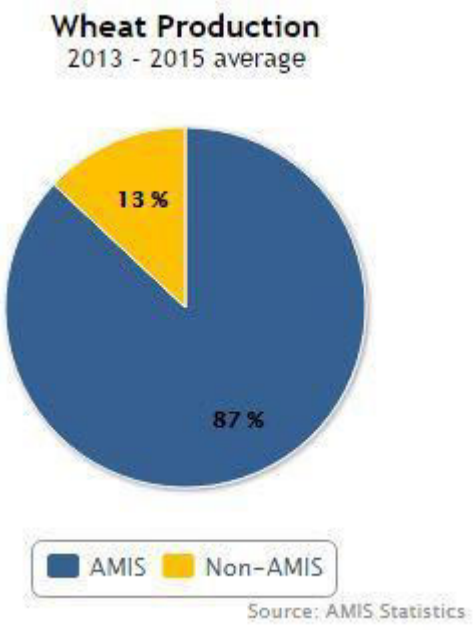
* Not participating in AMIS as individual countries, but collectively represented by the European Union

What is AMIS? - main market players

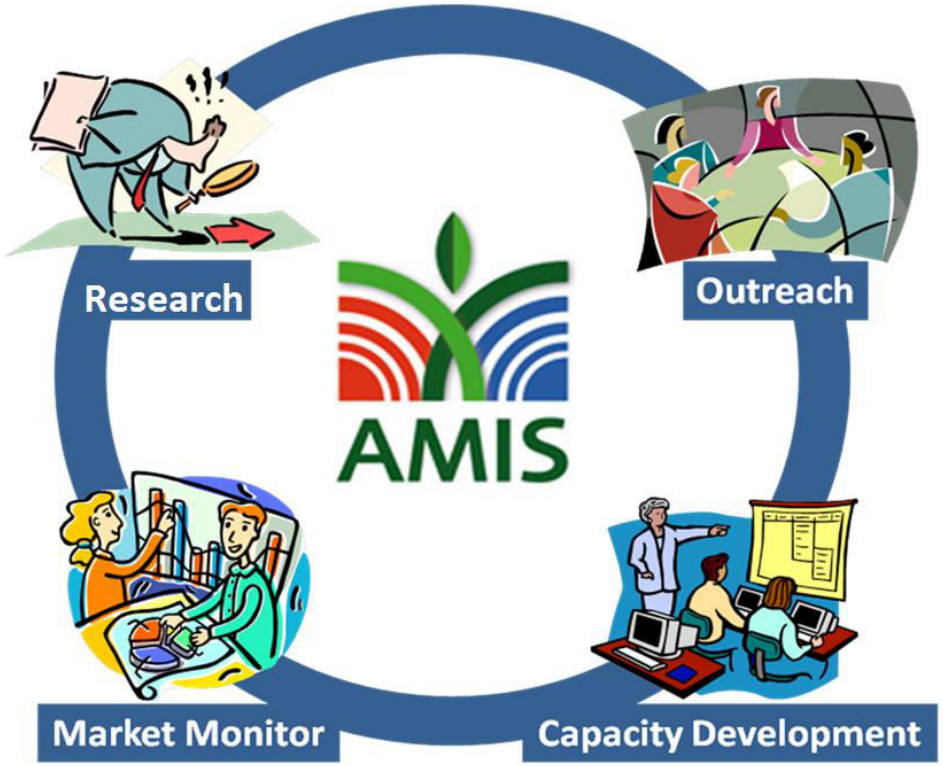








What is AMIS? - activities



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:

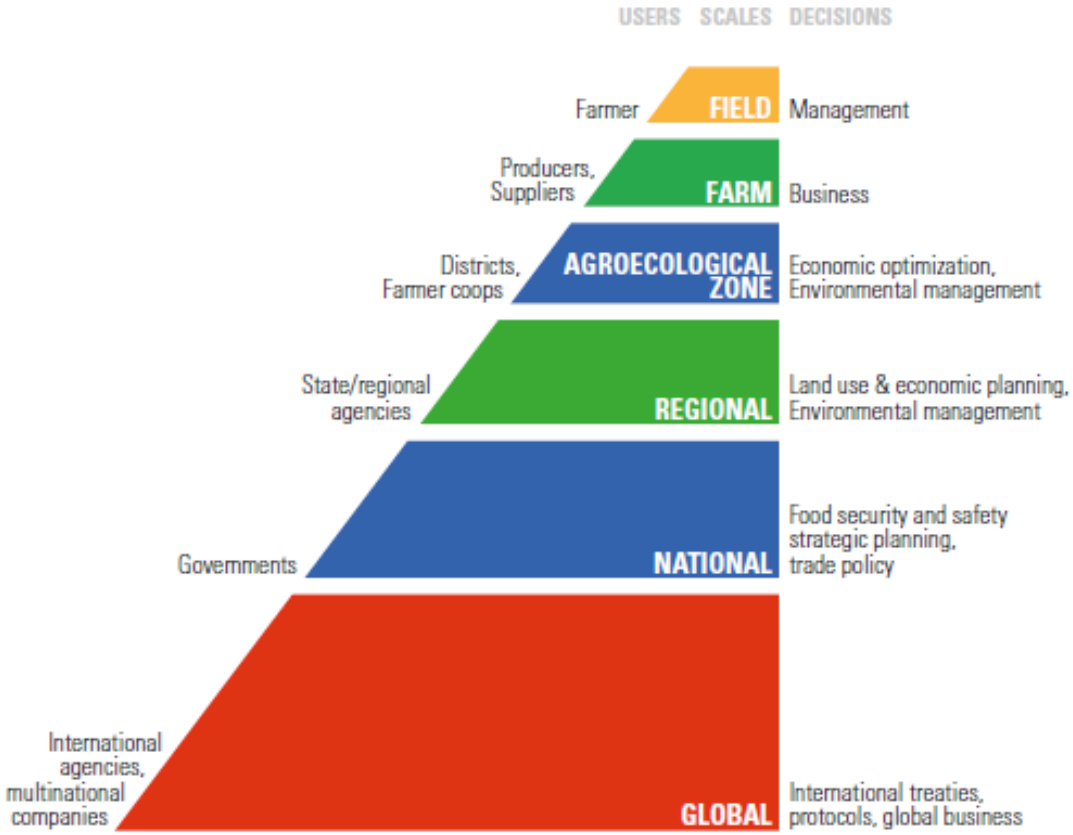
- In terms of Space

    - 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



[2] http://www.amis-outlook.org/fileadmin/user_upload/amis/docs/AMIS_brochure.

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

Current approaches

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

Current approaches

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

Ongoing evolution

- 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 Allience 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
        - 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

Key messages

- 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