Precision agriculture, a strategy for food and feed challenges for the 21st century

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CIMMYT’s Mission

To sustainably increase the productivity of maize and wheat systems to ensure global food security and reduce poverty.
CIMMYT’s Background: Key Facts

- Headquartered in Mexico, CIMMYT is an international organization with 22 offices worldwide.
- CIMMYT employs nearly 200 scientific staff.
- CIMMYT’s genebank holds 27,000 accessions of maize and 150,000 accessions of wheat.
Examples of CIMMYT’s Global Impact

- Over 75% of wheat varieties in South America are derived from CIMMYT germplasm.
- 55% of wheat varieties in China are sourced from CIMMYT.
- 90% of all spring wheat cultivars grown in India and Pakistan originate from CIMMYT.
- Over half of the maize varieties in the developing world have been developed using CIMMYT genetic materials.
Global Challenges: Increasing Demand

- Rice: +28%
- Cotton: +102%
- Soybeans: +125%
- Wheat: +40%
- Corn: +76%

Million Metric Tons
Converging Challenges of Global Food Security

“In the next 50 years we will need to produce as much food as has been consumed over our entire human history.”

Megan Clark, CEO of the Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia
Global Challenges: Heat

Up to 23% of South Asia’s maize crop will be lost due to higher temperatures by 2050.

Global Challenges: Wheat and Maize

- Water, nutrient & energy scarcity
- Diseases
- Climate change

Projected demand by 2050 (FAO)
Linear extrapolations of current trends
Potential effect of climate change-induced heat stress on today’s cultivars (intermediate CO2 emission scenario)

World-wide average yield (tons ha⁻¹)

Year

Percentage of Annual Income Used to Purchase Food + Malnutrition Rates
Science Offers Opportunities
Opportunities to Feed the Future
CIMMYT’s Strategic Initiatives

1. Integrated programs, i.e. MasAgro, CSISA, SIMLESAA
2. Seeds of Discovery
3. Precision nutrient management
4. Conservation Tillage
5. Marker assisted breeding
6. Hybrid wheat
7. Photosynthetic efficiency
8. Cellphone / internet decision support tools
9. Borlaug Institute for South Asia
Opportunity – The Yield Gap

- Simulated Potential yield (t/ha) (A)
- Max attainable Exper.yield (t/ha) (B)
- Average Yield (t/ha) (C)

Yield (t/ha)

- Rice
- Wheat
- Maize
- Rice
- Wheat
- Maize
- Rice
- Wheat
- Maize
- Rice (Boro)
- Rice (Aman)
- Wheat
- Maize
- Rice
- Maize

#2
Punjab

#3
Haryana

#5
EUP

#6
BIHAR

#8
Nepal

#10 & #12
Bangladesh

#14
Tamil Nadu
1. Opportunity: integrated programs like MasAgro Sustainable Modernization of Traditional Agriculture

- **General objectives:**
  - Boost corn and wheat productivity.*
  - Increase returns on grain harvested.
  - Reduce agriculture’s climate footprint.

- **Targets low-income farmers, small- and medium-sized seed companies, national researchers.**

* By 2020: Annual rainfed corn production increased by 5-9 million tons.
MasAgro research components

Take it to the Farmer (TTF) / Desarrollo Sustentable con el Productor to integrate agri-food chain actors, with emphasis on small scale farmers, extension agents, input suppliers and market agents, to promote solutions to sustainable maize and wheat production.

International Maize Improvement Consortium (IMIC) / Estrategia Internacional para Aumentar el Rendimiento de Maíz, to increase the competitiveness of the country’s seed industry in a PPP.

Seeds of Discovery (SeeD) / Descubriendo la Diversidad Genética de la Semilla to use cutting edge technologies to unlock the black box of genetic diversity in maize and wheat.
Precision Agriculture ongoing efforts & future plans
The MasAgro experience

April, 2013
Strengthening smart small scale farmers

- 500 million small farmers feed 1/3 of the world’s population, basically using their hands, with limited access to information and education for making decisions.
- MasAgro has tailor-made versions of technologies and farming systems to strengthen small farmers
- These are conducive to a **favorable context for change** in the areas of machinery, information-communications and agricultural marketing.
Precision Agriculture and public – private partnerships for increasing crop productivity and enabling sustainable farming systems.

Smart Nutrition
Smart Mechanization
Smart Resource Management
Smart Communication
**Smart NUTRITION**

- Lack of access to credit blocks access to fertilizers.
- Imbalanced doses of fertilizers destabilize production and harm soils.
- CIMMYT aims is to offer farmers a service that provides them with personalized, tailor-made recommendations in a timely manner to optimize nutrient use.

**Smart MECHANIZATION**

- Lack of access to machinery and inefficient use of land results in **low yields and income**.
- CIMMYT works with partners in Mexico and Asia to improve 2WT tractors, and to **develop 4WT multi-functional machines** that are ideal for CA.
- The aim is to facilitate access for small farmers to affordable machinery especially designed for local needs.
**Smart Resource MANAGEMENT**

- **Climate change** has a strong impact in rainfed agriculture; smart resource management and optimal use of water mitigates this impact.
- CIMMYT and its partners promote an efficient and improved resource management system based on: the adoption of **irrigation systems**, **productivity planning** and monitoring, and precise **weather information**.

**Smart COMMUNICATION**

- Communications is the key for promoting the productivity of small scale smart farmers. We combine sensors and cellphones with more traditional tools (T.V., radio, comics, plays, etc.)
- Innovative business models using ICTs facilitates **fair access to information, technology, networks and finance**.
- CIMMYT adapts its messages and tools to the needs of the different users of its **learning and support platforms**.
Global Technological Platform

REMOTE SENSORS → MOBILE TELEPHONES

SUPPORT FOR DECISION MAKING → N&P FERTILIZATION

PRODUCTION ESTIMATIONS
A system for the electronic recording of field data developed in collaboration with Impulsora Agrícola, PROMAF, PESA, Chapingo and INIFAP

Launched 11th March
Last update 27th March
Modules 2,229
Extension plots 7,611
Women 2,205
Men 7,465

In collaboration with INCA and SAGARPA
Link with GIS and Conservation Earth (under construction)

- Geographic coordinates
- Crop management data
- Inputs from field logbook
Electronic Information - e-MasAgro

- **A system for the electronic recording of field data** developed in collaboration with Impulsora Agrícola, PROMAF, PESA, Chapingo and INIFAP

- **Conservation Earth**

- **A platform of interactive digital maps** from SAGARPA’s center for geo-spatial control

- **GreenSeeker remote sensing**

- **MasAgro GreenSat => SIAP and AOASS**
CIMMYT scientists make the difference
Food security faces tremendous challenges
But science offers amazing opportunities

However leaders must act – You must act