Outcomes of the Wheat Futures Convening: Envisioning possibilities for wheat improvement

Moderator: Kathy Kahn, Bill & Melinda Gates Foundation

Panelists: Iago Haie, University of New Hampshire, USA
          Jemanesh Haile, Ethiopian Institute of Agricultural Research, Ethiopia
          Jessica Rutkoski, Cornell University, USA
The participants

15 early-career wheat scientists
9 countries
14 institutions (public and private)
The challenges

9 billion people by 2050
Resource limitations
Extreme weather events
Urbanizing population
Growing demand for wheat

The opportunity

What will it take to achieve global wheat security?
What does the wheat world need globally?
How can we strengthen/improve wheat productivity?
Future headlines
Wheat success stories in 2025

Wheat Production
Doubled since 2013

Due to:
* Improvement of integrated crop management
* Mechanization
* Increased investment from National programs

"We never thought this was possible"
"Africa is exporting wheat"

"Rust has been put to sleep" - Bob McIntosh

Precision genetics and farming practices achieve stability in increasingly unstable environments.

Strong linkage among stakeholders

New tillering gene linked with heat tolerance and disease resistance
Anti-problems

What could *prevent progress* in wheat improvement and delivery to farmers?

- Centralized decision-making and research
- Restrictions on data sharing and germplasm exchange
- Exclusive focus on genetics as a solution
- Uncoordinated activities across sectors and stakeholders
- Lack of investment in extension and farmer training
- Disconnect between researchers and farmers
- Gluten intolerance becomes a communicable disease
Researcher empowerment
Support training and deployment 9
Facilities 7
New tool development 5
Shared data management platforms 4

Cultural practices
Integrated cropping systems 11
Soil fertility management 8
Small-scale mechanization 7
Management of problematic soils 3
Irrigation and water management 1

Genetic improvement
Integrate molecular breeding approaches 9
Strengthen phenotyping 9
Strategies for multi-disease durable resistance 8
Breeding for widely-adapted wheat 3
Strengthen genotyping 1

The Farmer Link
Integrate farmer input into research objectives and priorities
Align research activities with farmer needs
Effective systems of demonstration
Empower farmers to engage in research and dissemination
A Global Wheat Improvement Network to Empower Breeders and Scientists
Wheat breeders/scientists share common challenges

Phenotyping

Genotyping

Organize and store data

Analyze data

MASwheat

Crossa et al 2013

......with limited time and resources
Common facilities → improved efficiency

Germplasm Evaluation:
- Disease screening nurseries
- Biosafety Level 3 facilities
- Managed stress nurseries

Accelerated breeding cycles:
- Doubled haploid facilities
- Genotyping centers

Michael Gore

www.tecan.com
Community database and analysis tools → improved breeding decisions

**Database for:**
- Genotypes
- Pedigrees
- Phenotypes
- Climatic data

**Tools for:**
- Trial design
- Phenotypic data analysis
- Marker assisted selection
- Genomic selection
- Germplasm characterization
Training and within-community consultation → researcher/breeder empowerment

Group training courses
- Phenotyping
- Data management
- Data analysis
- Marker assisted and genomic selection

Individual consultation
Exchange of experts across breeding programs to:
- Understand specific needs
- Provide expert advice
- Learn from exposure to different programs

http://blog.cimmyt.org
Improving Wheat Productivity Through Integrated Crop Management Research and Extension for Local Conditions

(Ethiopia as a Case Study)
Agriculture in Ethiopia

- Mainstay of Ethiopian economy
  - 60% of the national income
  - 80% of the work force
  - 60% of the total export income
Agriculture in Ethiopia

- Characterized by low production and productivity
  - 15% of the arable land is currently utilized
  - 1% of the irrigable land is currently utilized
  - Low productivity
    - e.g. wheat ≤ 2 tons/ha
Major Agronomic Constraints to Wheat Production in Ethiopia

❖ Soil Fertility degradation

- Extremely low fertilizer use
- High price of fertilizer
- Lack of capacity for frequent soil analysis (Blanket recommendation)

✓ Proposed Solutions

- Identify/disseminate site-specific fertilizer rate and type
- Establish means for fertilizer affordability & access
  - Identify locally available alternative sources
- Upgrade the capacity of soil fertility analysis (human resources, mobile labs, equipments, reagents, etc.)
Major Agronomic Constraints to Wheat Production in Ethiopia

❖ Lack of agricultural implements
  ➢ Difficulty implementing row planting
  ➢ Non-optimal management practices
  ➢ High labor intensity
  ➢ Avoidable losses during harvest and postharvest

✓ Proposed Solutions
  ➢ Build local capacity (partnerships between small scale industry/manufacturing and research centers)
  ➢ Design, produce, and disseminate small farm implements that are easily available and affordable to farmers
Major Agronomic Constraints to Wheat Production in Ethiopia

❖ Problematic soils (vertisol, acidic and saline soils)
  - Large proportion of the arable land
  - Central highlands, Northern & South-Eastern parts of the country
  - Large acreage of wheat production in these areas

✓ Proposed solutions
  - Targeted agronomic and soil management practices
  - Drainage improvement
  - Proper farm implements

❖ Other constraints
  - Lack of irrigation (immense water resources)
  - Expansion of wheat into marginal (drought prone) areas
  - Climate change
The Approach: ICM for local conditions

- **Surveys (farmers & researchers) – EIAR / Stakeholders**
  - Assessments of local wheat production constraints
  - Technology/capacity/vision/challenge inventories

- **Workshops**

- **Project implementation (pilot) areas**
  - Central Highlands
  - South-Eastern (Awash basin)
  - Northern parts of Ethiopia

- **Objective:** To improve wheat productivity in Ethiopia through Integrated Crop Management
Smallholder wheat yield gap in sub-Saharan Africa:
2,120 kg/ha
What should the future of wheat improvement look like?
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<thead>
<tr>
<th>Phase</th>
<th>Activity</th>
<th>Time frame</th>
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<tbody>
<tr>
<td>I</td>
<td>Engaging Central, Northern &amp; South-Eastern parts in developing and carrying out surveys</td>
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<td>Soil samples collected and analyzed from pilot areas (existing facilities)</td>
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<td>Expanding soil analysis capacity and expertise (Mobile labs)</td>
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<td>Building and upgrading of weather stations in selected pilot areas</td>
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<td>Prioritization of production constraints</td>
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<td>Identification of model farmers</td>
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<td>Workshop (s) to determine future experiments and demonstrations</td>
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<td>(Extension agents, researchers, model farmers, other stakeholders - \wheat industry)</td>
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<tr>
<td>II</td>
<td>Design and conduct experiments &amp; demonstrations</td>
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<td>Results/Training/Communication/Evaluation of adoption</td>
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<td>Outreach: initiation of field days - short videos!</td>
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