INNOVATE  
CATALYZE  
TRANSFORM  

ASEAN +3 Rice Breeding & Genetics Initiative  
CORRA Presentation  
By George Kotch (Head of Rice Breeding Platform)
ASEAN +3 is a South-South Cooperation initiative that enables ASEAN-wide co-development and co-generation and access to international public goods for germplasm, traits breeding methods and technologies, ASEAN +3 also provides a framework for the development of bilateral and national programs.
• By 2040, mankind will need an additional **112 million tons of milled rice per year**

• Future rice production will be challenges with climate change, less labor, water and other inputs

• Greater economic value will need to be brought to the rice production chain

• To satisfy the UN Sustainable Development Goal targets for Zero Hunger (Goal 2), an End to Poverty (Goal 1), and Good Health and Wellbeing (3)
Our Objectives...

- To address the challenges while creating market opportunity for ASEAN countries

- Specifically, to increase **Genetic Gains** of the national breeding programs by developing and releasing improved varieties with an annual yield increases between 1.5-2.0% annually

- The proposal is for a long-term call for investment and collaboration

- ASEAN+3 is about providing NARES Rice Breeders better tools to build a stronger economic engine and reduce economic and environmental risks through the development of superior rice varieties, traits or know-how

- IRRI will be a partner in co-creation and co-development
Three Types of ASEAN +3 Project Support

1) A core program of pre-competitive research developing international public goods.

2) Bilateral projects initiatives that generate national public goods that are made available internationally in accordance with the laws and policies of the participating ASEAN nations.

3) National agriculture research and extension systems (NARES) will determine the extent to which germplasm, information or customized enabling technologies flow back into the core program.
ASEAN+3 Modules

- Breeding Program Management
  For Directors or Managers
- INGER-MERiT Trialing Program
- B4R (Breeding For Rice)
  Breeding Program Software
- Biotic Resistance (Disease)
  Management
- Abiotic Tolerance (Stress)
  Management
- Quantitative Genetics &
  Biometrics
- Technology Uplift
- Healthier Rice
- Hybrid Rice

All Modules are part of IRRI’s Transformative Rice Breeding (TRB) Way of Working. Additional modules are also available.
Management processes and principles based on how high-performing breeding programs work.

- **Expected Results**: Greater economic return on investments, increased speed to market of breeding releases, program efficiencies and transparencies
- **Activities**: Implementation of best management practices to accelerate variety impact, management of resources and improve transparency within the NARES organization. This module is part of a continuous improvement review process by managers.
Rice Variety Replacement Strategy Process

- A Variety Replacement Strategy is created so breeding program resources are dedicated to replace a “Mega Variety” and to increase variety turnover.
- A Variety Replacement Strategy must also incorporate market trends captured by product profiles to develop new product concepts.
- The Variety Replacement Strategy is supported by Product Profile designed by a cross-functional team.
- Product profile assessments will also dictate future trait investments by assessing gaps within the breeding program.

### IRRI Rice Variety Replacement Strategy (Product Profile)

<table>
<thead>
<tr>
<th>Country or Region: Tanzania</th>
<th>Market Leading Variety To Be Replaced: Saro 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Slot or Ecology: Rainfed Rice (Indica Type)</td>
<td>Other Varieties of Importance: Varieties Imported From S. Asia (not Grown in Tanzania)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trait Family</th>
<th>Key Economic Traits</th>
<th>Trait Value</th>
<th>Bench Mark Variety Comparison</th>
<th>Trait Benchmarking Details</th>
<th>Trait Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (Paddy)</td>
<td>Yield</td>
<td>2-Must Have Trait</td>
<td>Saro 5</td>
<td>=&gt; Saro 5</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Drought Tolerance (Abiotic Stress)</td>
<td>Drought tolerance</td>
<td>2-Must Have Trait</td>
<td>Komboka</td>
<td>=&gt; Komboka</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Resistance (Virus)</td>
<td>BYMV Resistance (Partial)</td>
<td>3-Game Changer</td>
<td>Mwangaoro or Gigante</td>
<td>Standard Evaluation Scale =&lt; 3</td>
<td>Trait Limited or NOT available</td>
</tr>
<tr>
<td>Resistance (Fungal)</td>
<td>Blight</td>
<td>2-Must Have Trait</td>
<td>K2 &amp; PR</td>
<td>Standard Evaluation Scale =&lt; 3</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Yield (Economic)-Head Rice Recovery</td>
<td>Head Rice Recovery</td>
<td>2-Must Have Trait</td>
<td>Komboka</td>
<td>=&gt; Komboka</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Consumer Traits</td>
<td>Aroma</td>
<td>1-Nice to Have</td>
<td>Saro 5</td>
<td>=&gt; Saro 5; Supa is ultimate goal</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Consumer Traits</td>
<td>Amylose Content</td>
<td>2-Must Have Trait</td>
<td>Komboka</td>
<td>=&gt; Komboka</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Plant Characteristics</td>
<td>Plant Height</td>
<td>2-Must Have Trait</td>
<td>Komboka</td>
<td>&lt;= 120 cm</td>
<td>Program is actively working with trait</td>
</tr>
<tr>
<td>Maturity</td>
<td>Early to Intermediate Range</td>
<td>2-Must Have Trait</td>
<td>Komboka</td>
<td>=&gt; Benchmark</td>
<td>Trait Limited or NOT available</td>
</tr>
</tbody>
</table>

### The Key Traits Required to Replace The Top Commercial Variety

- **Primary Trait(s) Needed to Replace the Market Leader:** Trait #1 (Please Designate), Trait #2 (Please Designate), Trait #3 (Please Designate)
- **OtherTrait(s) of Value to Replace the Market Leader:** Please mention other traits.

<table>
<thead>
<tr>
<th>Trait Importance (ESA Portfolio)</th>
<th>Index (Relative Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blight</td>
<td>24</td>
</tr>
<tr>
<td>Drought tolerance</td>
<td>16</td>
</tr>
<tr>
<td>Cold tolerance</td>
<td>7</td>
</tr>
<tr>
<td>BLB</td>
<td>2</td>
</tr>
<tr>
<td>Submergence</td>
<td>1</td>
</tr>
<tr>
<td>Sheath Rot complex</td>
<td>1</td>
</tr>
<tr>
<td>Fe Toxicity</td>
<td>1</td>
</tr>
</tbody>
</table>
INGER-MERiT Trials

• **Background:** New Genetic Variability is the Life Blood of Crop Improvement
  – INGER-ASEAN (INGER, International Network for Genetic Evaluation of Rice)
  – MERiT-ASEAN (MERiT, Multi Environment Rice Trials).

• **Expected Results:**
  – INGER-ASEAN Trials, targeting specific eco-systems, will allow the NARES programs to select 3-4 varieties/annually for commercial use and further variety development by the national breeding programs.
  – MERiT-ASEAN will allow the NARES collaborators to access IRRI’s elite breeding programs. The module expects at least 4-5 potential new varieties that can be used for market introduction or as parents for the next generation of NARES developed varieties.

• **Activities:**
  – The NARES programs co-design the module, they propose the number and type of trials.
  – By using Biometrics and Advanced Experimental design, the NARES programs will make data driven decisions on which lines will be advanced as part of the national variety replacement strategy.
B4R is a **software system** for all breeding activities across ASEAN. Information is critical and B4R has been demonstrated with the CGIAR as the global tool to manage the breeding programs.

**Expected Results:** A common software language across a the ASEAN breeding programs key to drive innovation and increase automation and standardization.

**Activities:** NARES programmer and data manager to introduce and further develop breeding information management as part of an open source system.
Breeding is a complex function much like engineering. Today’s modern breeding approaches require a more data intensive population improvement approach.

Expected Results: A modernization of the breeding process that will assure a more sustainable and repeatable variety pipeline.

Activities: Collaborations and trainings requiring a significant change in breeding philosophy and strategy.
• This module unlocks the understanding and deploys that understanding to develop healthy and nutritious rice.

• Expected Results: Improved health of the domestic rice market while adding value added traits to the export market.

• Activities: Collaboration in trait assessment. Introgression of the health and nutrition traits to replace the current varieties. The focus would be low GI rice with higher Zn content.
Plant Protection

Biotic monitoring
Resistance discovery

- Mitigation of economic and social risks caused by a constantly emerging insects and pests populations due to climate change
- Expected Results: Monitoring pest populations to reduce risks and developing new resistance genes to prevent the development of diseases/pests
- Activities: Monitoring network of disease/pest spread, pathology and entomology discovery support of resistance elucidation. In situ disease testing
Stress Resilient Rice
Drought, Salinity and Flood Tolerance

• The discovery and deployment of stress resilient germplasm and traits to mitigate the economic risks of a constantly changing climate

• Expected Results: Increased productivity, enhanced yield stability and diversity of ASEAN rice-based production systems in stress and non-stress environments

• Activities: Collaboration on developing and screening germplasm directly transferable to the NARES breeding programs
Technology and Molecular Marker Support

- The cost-effective deployment of IRRI developed technology to modernize plant breeding
- Expected Results: A greater level of precision breeding to overcome complex problems associated with today’s changing environment
- Activities: Technical collaboration leading to the assimilation of multiple levels of know-how and expertise in modernizing rice breeding
• Development of female and male parent genetic breeding pools using advanced genomic technology

• Expected Results: A more repeatable and sustainable hybrid breeding program for the NARES breeding programs designed for their specific market

• Activities: Co-designed and co-developed and tested by the Hybrid National Breeding program
Perceived Benefits to the NARS Partners

- The adoptions of best practices to improve genetic gains
- Capacity building by hands on module development and deployment
- New germplasm, traits and know-how to fuel a modern rice breeding program.
- Critical linkages between and among modules that will increase the impact of the individual modules.
Breeding Program Management