Implementing genomic selection in CGIAR breeding in perspctive

Søren K. Rasmussen

Wayne Powell and the Implementing Genomic Selection in CGIAR Breeding Programs Workshop Participants 2016

UNIVERSITY OF COPENHAGEN

### Demand for innovation in agriculture because…

- Global food price crisis of 2008
- Changing climate and a growing population
- Increase CO2 AND temperature
- Food insecurity
- A 70–100% increase in food production next 35 year
- Biofuel food- feed dilemma
- Change in lifestyle
- Water supply
- Limiting resources P

# CGIAR: Consultative Group for International Agricultural Research



INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS









Transforming African Agriculture







Since 1967 ( Science in cultivate change







IRRI



#### Milestones in selective animal and plant breeding Domestication ~12,000 years ago Domestication ~12,000 years ago 1860 1860s Discovery of the rules of inheritance (Mendel) 1886 Concept of regression to describe relationship between offspring and parents (Galton) 1903 Pure-line breeding theory (Johannsen) 1908 Hardy-Weinberg law 1908 Exploitation of heterosis (Shull) 1908 Law of population genetics 1910 Modern pedigree selection (Nilsson-Ehle) 1910 (Hardy & Weinberg) 1918 Population genetics introduced as Bmr in maize 1920 Mutation breeding (Stadler) an extension of the laws of inheritance (Fisher, Wright & Haldane) 1939 Concept of single-seed-descent breeding method (Goulden) 1935 Improved breeding methods (Lush) 1945 Recurrent selection method of breeding (Hull) 1950 Estimation of breeding values as 1952 Methods for double-haploid lines (Chase) random effects (Henderson) 1953 Model for DNA structure (Watson & Crick) Game changer 1953 Model for DNA structure Rht wheat rice (Watson & Crick) 1960 1960 Quantitative genetics (Falconer) Statistical methods 1970 Nobel Prize for the Green Revolution (Borlaug) 1972 Genetic engingeering, first 1980s Biotechnology, from the early 1980s recombinant DNA molecules (Berg) 1983 Nobel Prize for discovery of mobile genetic 1975 Best linear unbiased prediction DNA sequencing elements (McClintock) (BLUP) (Henderson) 1990 Molecular markers used for improved selection 1980s Biotechnology, from the early 1980s (Lande & Thompson) 1990 Molecular markers used for improved PCR 1994 First approval of commercial GM variety selection (Lande & Thompson) 1998 Best linear unbiased prediction based on trait and marker data (TM-BLUP), a form of genomic selection, introduced (Bernardo) 2001 Introduction and application of 2001 Introduction of theoretical approaches to genomic genomic selection (Meuwissen 2010 selection (Meuwissen et al.) Site-directed mutagenesis et al.) 2010s Application of genomic prediction in plant breeding 2013 CRISPR-Cas9-based genome editing 2013 CRISPR-Cas9-based genome editing

### Breeding approaches



# Population improvement & product development



PYT, primary yield trials; AYT, advanced yield trials EYT, elite yield trials.



genomic estimated breeding value (GEBV) genetic diversity coordinated phenotyping across environments cost-effective sequencing genomic prediction and genome editing

#### PERSPECTIVE



### Genomic prediction unifies animal and plant breeding programs to form platforms for biological discovery

John M Hickey<sup>1</sup>, Tinashe Chiurugwi<sup>2</sup>, Ian Mackay<sup>2</sup>, Wayne Powell<sup>3</sup> & Implementing Genomic Selection in CGIAR Breeding Programs Workshop Participants<sup>4</sup>

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