## Agricultural transformation in the drylandsrole of Data & Disruptive technologies

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## Fertile Crescent & Domestication of Crops and Ruminants



## Food insecurity and civil unrest

#### Figure 6 - Correlation of food price index to social unrest, 2004 to 2012



Red dashed lines correspond to the beginning dates of "food riots" and protests in North Africa and the Middle East between 2004 and 2011. The overall death toll is indicated in parentheses next to each country.

Source: Lagi, Bertand, Bar-Yam 2011.

Farming: the lowest intensity of IT in any economic sector



An agricultural transformation / revolution in the drylands – is possible!

- Data revolution and other disruptive technologies to improve resilience and productivity (crops and livestock)
  Large scale recording – data analysis for predictions of traits, ...
  - Real time/ongoing support to farmers for decision making on individual animals
- Data revolution and other disruptive technologies for assets management and market access
  - Farmers-led identification of animals, stock management, linkages with buyers/sellers
- Participatory approach strong community engagements
  - Community-based schemes (community-based livestock breeding programmes)
  - Introduction of tools to support genetic improvement, support interventions in animal health, ...

## Decoupling selection from phenotyping



genetics

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

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The rate of annual yield increases for major staple crops must more than double relative to current levels in order to feed a predicted global population of 9 billion by 2050. Controlled hybridization and selective breeding have been used for centuries to adapt plant and animal species for human use. However, achieving higher, sustainable rates of improvement in yields in various species will require renewed genetic interventions and dramatic improvement of agricultural practices. Genomic prediction of breeding values has the potential to improve selection, reduce costs and provide a platform that unifies breeding approaches, biological discovery, and tools and methods. Here we compare and contrast some animal and plant breeding approaches to make a case for bringing the two together through the application of genomic selection. We propose a strategy for the use of genomic selection as a unifying approach to deliver innovative 'step changes' in the rate of genetic gain at scale.

for the past century. Access at unprecedented levels to large scale sequence and phenotypic information will bring opportunities to unify breeding methods, tools and technologies across several plant and animal species, which in turn will catalyze the modernization of breeding programs. Furthermore, we postulate that the adoption of these new technologies and approaches at scale will enable breeding programs to be platforms for both the delivery of new products and biological discovery based on genome-wide association studies (GWAS) with field validation of new alleles.

PERSPECTIVE

#### A brief history of plant and animal breeding

Breeding of livestock and crops is as old as agriculture itself. At the heart of all breeding remain such traditional pursuits as designing and analyzing performance trials to rank selection candidates in order of merit, with the aim of maximizing selection gain per unit of resources expended<sup>5</sup>. The history and development of scientific animal and plant breeding can be traced back to the contributions of many individuals, but there are a few outstanding additions—at least from our current

### Origin Specific Genomic Selection: A Simple Process To Optimise the Favourable Contribution of Parents to Progeny

(b) Chin Jian Yang, (b) Rajiv Sharma, (b) Gregor Gorjanc, (b) Sarah Hearne, (b) Wayne Powell and (b) Ian Mackay

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### From Farmer Centric to Animal (Cattle, Camels, Small ruminants etc.) Centric: The next revolution in Livestock Industry



### An example of pedometers and detection of oestrus





### CBBPs offer infrastructure for the application of genomics in LMICs

#### **CBBP Structures**

1) Open-centralized nucleus



2) Closed-centralized nucleus



3) Open-dispersed nucleus



**Recorded traits** 

Prolificacy/production



#### Adaptation/resilience



#### Disease/parasite resistance





#### Precision breeding (Genomic selection)





# **Centre for Data Driven Breeding**

### **Research, Translation, Training**





DFID Department for International Development



Centre for Tropical Livestock Genetics and Health



## **The CDDB Development Agency for Drylands**

- A network broker
  - Connect the public and private sector
  - Into non traditional areas of science from the academic community
  - Our focus is on impactful research, translation and training
- Training
  - MSc, PhD and CPD program to underpin LMIC breeding programs
- Research
  - To underpin LMIC breeding programs
  - To optimise donor investments in breeding
- Translation
  - We aim to be the quantitative genetics back office to for public good breeding programs in LMICs

