CropBASE:

Decision Support Knowledge Platform for Underutilised Crops

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with
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Malaysia

3rd International Bambara Groundnut Workshop Accra 24 September, 2013
CropBASE:  
*Decision Support Knowledge Platform for Underutilised Crops*

- **Web-based**  
  First ‘port-of-call’ for information on underutilised crops

- **Decision Support**  
  Multi-stakeholder options on underutilised crops and end-uses

- **Knowledge Platform**  
  Cross-cutting all CFFRC Programmes and Themes & research value chain

- **Comparative**  
  Productivity and resource-use-efficiency of underutilised and major crops and cropping systems under current and future climates

- **Interactive**  
  Tools to integrate data on underutilised and major crops with geo-referenced information and databases
CropBASE: Decision Support Knowledge Platform

`provides a service to potential end-users interested in underutilised crops and products that can contribute to livelihoods’

Four Clusters:
CropBASE: *Decision Support Knowledge Platform*

“Agile” Development
- Lightweight framework
- Iterative development
- Close links between development team & client
- Frequent communication
CropBASE: Decision Support Knowledge Platform

Set of Solution Components or Software Subsystems

1. User interface
   Interactive data capture and retrieval

2. IT and information storage system
   Data storage and management
   Conventional and alternative data sources

3. Analysis engine
   Data manipulation and modelling for end-use applications
CropBASE: Decision Support Knowledge Platform

1. User Interface

- Social networking style `accessibility`
- Self-regulating community of experts ‘legitimacy’
- Quality control via editorial panel ‘filtering’
- Scientific data from recognised sources `credible’
- Geo-referenced information `comparative’
- Crowd sourcing data input `novel data’
CropBASE: Decision Support Knowledge Platform

CropBASE outputs

Various formats depending on user/audience requirements

- Graphical,
- Diagrammatic,
- Tabular,
- Spatial maps via GIS tools,
- etc

1980-2010 Yield Data for UN landrace at all Namibia Sites
CropBASE: Decision Support Knowledge Platform

2. IT and Information Storage System

- Evidence-based research and
- Local knowledge & information
CropBASE: Decision Support Knowledge Platform

Current databases provide input for crop models within GIS framework

- Existing geospatial natural resource databases
  - e.g. FAO for soils, crop statistics, food and water indices;
  - e.g. WMO, NASA, NOAA for past, current and future climate scenarios.

CFFRC working with crop modelling community
- e.g. AgMIP www.agmip.org

Comparative testing of models for range of crops

- CFFRC to spearhead underutilised crops in crop models
  - e.g. APSIM, AquaCrop, DSSAT
  - African Bambara groundnut (Azam-Ali & colleagues)
  - Ethiopian Teff (Raes & colleagues)
  - Peruvian Quinoa (Raes & colleagues)

- Calibrated for AquaCrop (FAO Irrigation and Drainage #66)
  - Other leafy vegetables and root crops are in the pipeline.
CropBASE: Decision Support Knowledge Platform

Community information

- Local preferences via participatory community interactions

- Regional & global demand as driver to expand specific crops & niche markets

- Economic assessment of crops & cropping systems beyond current locations and centres of diversity.
CropBASE: Decision Support Knowledge Platform

3. Analysis engine

- **Climate**  agroecological suitability

- **Quality**  nutritional, food security and livelihood potentials of crops and products at field, farm and regional scales

- **Economic**  socio-economic, trade and regulatory potential

Crop-climate modelling is most advanced stage: link available databases as input for crop models in GIS framework.
Crop-Climate Modelling

**input**

- Climatic conditions
- Climate scenarios
- Soil conditions
- Environ Data: Soil, Climate
- Primary Data Base
- Underpinning Data Base
- Crop Data: Agronomy, Physiology, Genetics
- Market data
- Genotypic characters
- Meta data: Farmer, Knowledge

**output**

- Climate Forecast
- Species genotype Suitability
- Yield forecast
- Yield potentials
- Fertilizer responses
- Pest disease tolerance
- Market potentials
- Decision Support & Knowledgebase
- Maps
- Inferences
AquaCrop Flow-Chart

I Irrigation
Tn Min air temperature
Tx Max air temperature
ET0 Reference evapotranspiration
E Soil evaporation
Tr Canopy transpiration
gs Stomatal conductance
WP Water productivity coefficient
HI Harvest Index
CO2 Atmospheric carbon dioxide concentration

stress (1), (2), (3), (4), (5): different water stress response functions and feedbacks
AquaCrop Conceptual Framework
Water Productivity

\[ WP = \frac{\text{Biomass}}{\sum T_C} \quad (g \text{ m}^{-2} \text{ mm}^{-1}) \]

\[ WP^* = \frac{\text{Biomass}}{\sum \left( \frac{T_C}{ET_o} \right)} \quad (g \text{ m}^{-2}) \]

Sorghum
Sunflower
Chickpea
Wheat

\[ \sum T_C : (\text{mm} \times 1000) \]

\[ \sum (T_C / ET_o) \]
AquaCrop Conceptual Framework
Canopy Cover

Canopy Cover (CC) and exponential growth during early development and exponential decay during late development.

\[ CC = CC_o e^{CGC \cdot t} \]  (1)

\[ CC = CC_x - (CC_x - CC_o) \cdot e^{-CGC \cdot t} \]  (2)
### CropBASE
### CFFRCPLUS Studentships

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<th>Proposal No.</th>
<th>Title</th>
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<td>Interviews</td>
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CropBASE
Crop-Climate model challenges

- To simulate crop productivity at country to global scales under variable climates
- To capture crop-climate interactions for underutilised crops and trait identification across geographical boundaries
CropBASE Crop-Climate Model Example

Simulation Example

AquaCrop

crop predictions under water deficit

Bambara groundnut - Model evaluation

\[ y = 0.8329x + 0.1021 \]

\[ R^2 = 0.72 \]

\[ \text{RMSE} = 0.36 \text{ t/ha} \]

\[ Vigna subterranea \ L. \ Verdc \]

CropBASE Crop-Climate Model Example

Approach

- Select crops and genotypes (bambara groundnut and pearl millet)
- Select locations (districts in South Africa, Botswana & Namibia)
- CropBASE retrieves relevant Geospatial input data
- Select AquaCrop
- Geospatial database information into AquaCrop format
- Select geospatial data (1990-2010) and climate data from GCMs
- Compare AquaCrop output: dry matter & yield for 20-years for each genotype and location for historical & climate change scenario.
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<th>WP ET Yield (kg/m³)</th>
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CropBASE Crop-Climate Model Example
Bambara groundnut vs Pearl Millet: Baseline and A2-CSIRO

**Botswana**

**South Africa**

- Baseline-Bambara(UN)
- A2-CSIRO-Bambara(UN)
- Baseline-Bambara(S19)
- A2-CSIRO-Bambara(S19)
- Baseline-PearlM(Mon)
- A2-CSIRO-PearlM(Mon)
CropBASE Crop-Climate Model Example

Namibia: Bambara groundnut landraces yield predictions

Simulated Yield trend at NA58

Simulated Yield trend at NA42

Simulated Yield trend at NA32

Simulated Yield trend at NA47

Simulated Yield trend at NA63

Simulated Yield trend at NA61
CropBASE:
Decision Support Knowledge Platform for Underutilised Crops

- A Web-based 1st `port-of-call’ for info on underutilised crops
- with Decision Support for multi-stakeholders on underutilised crops and end-uses,
- as a Knowledge Platform cutting across the research value chain,
- for Comparative Analysis of productivity & resource-use-efficiency of underutilised vs major crops and range of cropping systems under current & future climates,
- as Interactive Tools to integrate data on underutilised & major crops with geo-referenced information & databases.