

Strategic Applications of Crop Growth and Biotic Constraint Modeling for Key Staple Crops in Sub-Saharan Africa

Date October 15 (Monday) – 18 (Thursday), 2007
Place World Agroforestry Centre (ICRAF) Board Room, Nairobi, Kenya
Sponsors HarvestChoice, ICRISAT

Background

Recent studies suggested that key causes for the stagnation in agricultural productivity in many parts of sub-Saharan Africa and South Asia include insufficient and erratic investment in agricultural research, rural infrastructure, and human capacity development. The HarvestChoice project, funded by the Bill and Melinda Gates Foundation, aims to undertake strategic assessments of investment options targeted to improving the productivity of crop production systems in ways that might reduce poverty and hunger most effectively. ICRISAT has been involved in developing and disseminating productivity-enhancing technologies for the crops of the arid and semi-arid tropics since 1972. Furthermore, ICRISAT has extensive experience in the application of crop growth models at plot and farm scale in several regions of Africa and Asia. This workshop will examine experiences gained at a micro-scale, as well as data and method options for linking these experiences to less-commonly practiced landscape, national and regional-scale applications. Such strategic-scale analyses are expected to provide improved information for investment targeting and priority setting decisions, particularly for funders and implementers of agricultural development in a multi-country context. .

A broad range of factors conditions both the biophysically-potential and the economic yield of a crop at any given location. HarvestChoice is using crop and pest models to examine and help decompose the likely differences in yields under a broad range of biophysical, input use and management conditions. When linked in subsequent analysis with market and adoption data, such information provides a basis for characterizing the scale and nature of potential payoffs to productivity interventions (which might then be compared with the likely costs involved). Juxtaposing analysis of yield differences with regional assessments of biotic (e.g., pathogen and weed) and abiotic (e.g., drought and low soil fertility) constraints will provide new, highly-relevant information to help guide investment choices. However, the best analytical strategy for

the technical implementation of this approach requires further elaboration and refinement.

In June 2007, HarvestChoice organized a similar 5-day workshop at CIMMYT to identify major biotic constraints in maize and wheat production systems and to model their current and potential spatial distributions using new spatial modeling approaches (in this case the CLIMEX software - <http://www.hearne.com.au/climex>). With on-site specialist help, participating crop specialists (entomologists, pathologists) were able to generate and validate assessment of the potential regional distribution and prevalence of plant diseases and pest damage risks for maize and wheat, as well as for whitefly (in this case linked to the incidence of cassava mosaic virus).

This workshop will bring together a small number of experts on crop modeling for, and on biotic and abiotic constraints of, some key crop production systems in sub-Saharan Africa. These specialists will shape the most feasible scope and specification of prototype yield and pest simulation experiments at a regional scale. Specifically, workshop participants will review and make proposals for 1) the characterization of major crop production systems and their major biotic and abiotic crop constraints, as well as 2) the appropriate representation of such systems and constraints in a modeling framework, given the databases and modeling tools at our disposal. This review will include hands-on evaluation of crop growth and biotic constraints models, in order to arrive at a relevant and tractable set of modeling scenarios, and will also propose an analytical implementation plan by sub-region, crop, and constraint.

During this process, we expect to address important research issues with regard to undertaking strategic assessments of crop productivity potential, such as: 1) improving the available options for representing soils and climate variability in regionally-focused crop growth simulation, 2) highlighting the major abiotic and/or biotic constraints in staple crop production systems and their geographical extents, and 3) identifying research partners willing to collaborate in undertaking, validating and making use of the results of this work.

Provisional Agenda

Day 1: Monday, October 15, 2007	
8:00 am – 8:30 am	Registration and Introductions
8:30 am – 8:40 am	Opening and Welcome Richard Jones (Co-Convenor and Session Chair)
8:40 am – 09:15 am	Introduction to HarvestChoice and the Goals of the Workshop Stan Wood <ul style="list-style-type: none"> - Increase awareness of HarvestChoice to audience, including special invitees. - Introduction to the proposed regional yield and pest modeling approach and its data and analytical challenges.
09:15 am – 10:00 am	Open Discussion
10:00 am – 10:15 am	Coffee
10:15 am – 12:30 pm	Characterizing Production Systems <ul style="list-style-type: none"> - Farming systems at a regional scale John Dimes - Crop modeling at a field scale KPC Rao - Crop modeling at a regional scale Jawoo Koo
12:30 pm – 1:30 pm	Lunch
1:30 pm – 2:30 pm	Climate Data at a Regional Scale Robert Hijmans
2:30 pm – 3:30 pm	Climate-induced Risk Analysis Peter Cooper (Presented by KPC Rao)
3:30 pm – 3:45pm	Coffee
3:40 pm – 4:45 pm	Soils Data at a Regional Scale Gerrit Hoogenboom
4:45 pm – 6:00 pm	Roundtable Discussion – Workshop Planning for Days 2-4 Stan Wood

Day 2: Tuesday, October 16, 2007	
9:00 am – 11:00 am	<p>Issues in Regional Crop Modeling John Dimes, Robert Hijmans, KPC Rao, Jawoo Koo</p> <ul style="list-style-type: none"> - Summary of discussions from Day 1 (about 10 min. for each topic) - Practical issues in running models at a regional scale - Spatial datasets - Validation strategies for simulation results
10:00 am – 10:15 am	Coffee
11:00 am – 12:00 pm	<p>Biotic Constraints at a Regional Scale Jawoo Koo</p>
12:00 pm – 1:00 pm	Lunch
1:00 pm – 2:00 pm	<p>CLIMEX: Use of climate and biology data to predict the likely distribution and prevalence of pests, arthropods and weeds. Bob Sutherst</p>
2:00 pm – 4:00 pm	<p>Hands-On Exercise: Modeling Biotic Constraints using CLIMEX</p> <ul style="list-style-type: none"> Group 1) Groundnut – KPC Rao, John Dimes Group 2) Maize – Jawoo Koo Group 3) Rice – Robert Hijmans
4:00 pm – 4:15pm	Coffee
4:15 pm – 5:30 pm	<p>Wrap-up Discussion for Day 2 All Participants (Session Leader – TBD)</p>
Day 3: Wednesday, October 17, 2007	
9:00 am – 12:00 pm	<p>Hands-On Exercise: Yield-Gap Analysis using Crop Models</p> <ul style="list-style-type: none"> Group 1) Groundnut – KPC Rao, John Dimes Group 2) Maize – Jawoo Koo Group 3) Rice – Robert Hijmans
(10:00 am – 10:15 am)	Coffee
12:00 pm – 1:00 pm	Lunch
1:00 pm – 4:00 pm	Exercise, continued

4:00 pm – 4:15 pm	Coffee
4:15 pm – 5:30 pm	Wrap-up Discussion for Day 3 All Participants (Session Leader – TBD)
Day 4: Thursday, October 18, 2007	
9:00 am – 10:30 am	Presentation of Group Exercise Results: Production system characterization, Crop modeling, and CLIMEX Group 1) Groundnut – KPC Rao, John Dimes Group 2) Maize – Jawoo Koo Group 3) Rice – Robert Hijmans
10:30 am – 10:45 am	Coffee
10:45 am – 1:00 pm	Wrap-up Discussion for Overall Workshop All Participants (Session Leader – Stanley Wood) - Data: Production systems characterization, Climate, Soils, Trials & other validation data. - Model scenarios and methods: Crop simulation (DSSAT, APSIM, WOFOST/ORYZA) and CLIMEX. - Next Steps.
1:00 pm	Lunch

Presentations

** Please keep assigned time!*

Presenters and (Tentative) Titles	
Stan Wood	<ol style="list-style-type: none"> 1. Background and Status of HarvestChoice (30 min) <ul style="list-style-type: none"> - Increase awareness of HarvestChoice to audience, including special invitees 2. Introduction to Yield Analysis (30 min) <ul style="list-style-type: none"> - Introduction to yield analysis within HarvestChoice and its issues and challenges, including datasets and use of models. - Overall yield analysis schema. - Present crop model matrix of input, code availability, and output comparison.
Jawoo Koo	<ol style="list-style-type: none"> 1. Crop Modeling at a Regional Scale (30 min) <ul style="list-style-type: none"> - Literature reviews - Data aggregation - Validation strategy

	2. Biotic Constraints at a Regional Scale (30 min) <ul style="list-style-type: none"> - Strategy assessment (CLIMEX example) - Case study: Potato late blight (Robert Hijmans)
KPC Rao	Crop Modeling at a Field Scale (30 min)
John Dimes	Farming Systems at a Regional Scale (30 min)
Robert Hijmans	Climate Data at a Regional Scale (30 min) <ul style="list-style-type: none"> - Available data sources - Historical/stochastic - Temporal/spatial resolution
Peter Cooper	Climate-induced Risk Analysis (30 min)
Gerrit Hoogenboom	Soils Data at a Regional Scale (30 min) <ul style="list-style-type: none"> - Sources: WISE, DSMW, SOTER, etc - Spatial aggregations
Bob Sutherst	CLIMEX (1 hr) <ul style="list-style-type: none"> - Background - Limitation - Brief demonstration

Group Exercise Preparations

Dataset	
KPC Rao, John Dimes, Robert Hijmans, and Jawoo Koo	Baseline Regional Datasets for a Pilot Country/Region <ul style="list-style-type: none"> - Soil - Climate/Weather - Crop cultivar characteristics (local, improved)
Henri Tonnang	Major pest/disease biophysical information and global distribution
Patrick Kariuki	Catalogue of Crop Systems-related Spatial Datasets in East Africa

Software for the Hands-On Modeling Exercise	
KPC Rao, John Dimes, Robert Hijmans, and Jawoo Koo	Crop Model Software <ul style="list-style-type: none"> - DSSAT - APSIM - ORYZA

GIS

- DIVA
- ArcView

Biotic Constraints

- CLIMEX (temporary licenses for workshop)
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