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FARMSIM: a dynamic livelihood model for analyzing management strategies in African smallholder farms

Mark T. van Wijk[1*], Pablo Tittonell[1,3], Mariana C. Rufino[1], Mario Herrero[2], Nico de Ridder[1] and Ken E. Giller[1]

Introduction

African smallholder farming systems are complex, dynamic systems with many interacting biophysical components along a wide range of soil, climatic and socio-economic conditions. Modeling tools for understanding the constraints of smallholder farming and identifying options for improved strategic management must have:

1. Limited complexity.
2. A balanced description of the socio-economic and biophysical components of the system,

Here we describe a new tool, called FARMSIM, which fulfills these requirements and can be used to analyse strategic decision-making in African farms.

The model

The following components of the farm (see also Figure 1) are dynamically simulated (between parentheses the name of the module):

- Crop and Soil ('FIELD')
- Livestock ('LIVSIM')
- Feed for livestock ('FEEDSIM')
- Manure handling and storage ('HEAPSIM')
- Cash availability ('CASHSIM')
- Family development ('FAMSIM')
- Food availability ('FOODSIM')
- Labour availability ('LABSIM')

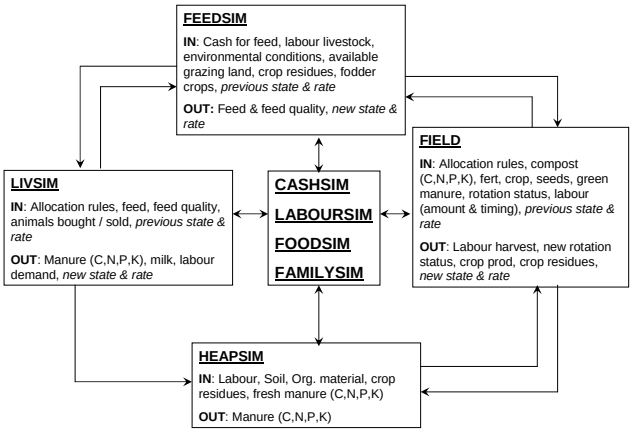

Figure 1: FARMSIM modules together with their interactions

An important aspect of the model is the role of labour. The labour available is allocated to different activities on the farm. If not enough is available at the right moment, the module that needs this input will calculate the consequences of sub-optimal labour availability (Figure 2).

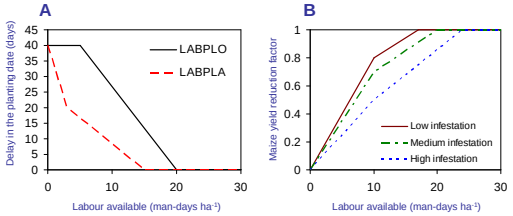

Figure 2: Consequences of labour investment and crop yield determining factors.
A) Delay in planting depending on how much labour is invested in planting (LABPLA) and ploughing (LABPLO)
B) Reduction in yield depending on how much labour is invested in weeding

Testing of modules

Both LIVSIM and FIELD have been tested for several locations (Figs. 3 & 4). Individual modules show satisfactory performance.

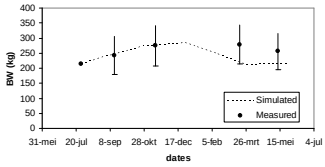

Figure 3: LIVSIM output compared to measured bodyweights of a feeding trial of zebu cattle in Niger (data from Ayantunde, 1998)

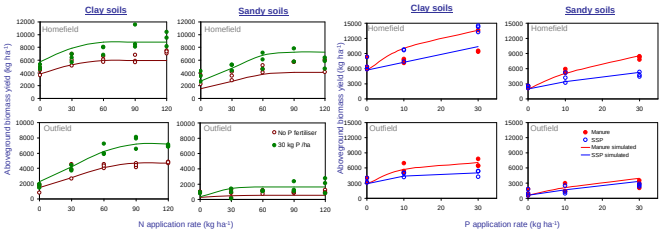

Figure 4: Performance of FIELD on maize experiments in Zimbabwe (Zingore et al 2006)

Decision making and FARMSIM

In FARMSIM the decision module is outside of the core model, and supplies the input necessary run the modules interactively (e.g. allocation of available labour over activities, etc.). The core of FARMSIM calculates the consequences of these decisions using also all other specified inputs. This allows a flexible and user-friendly setup of the FARMSIM model.

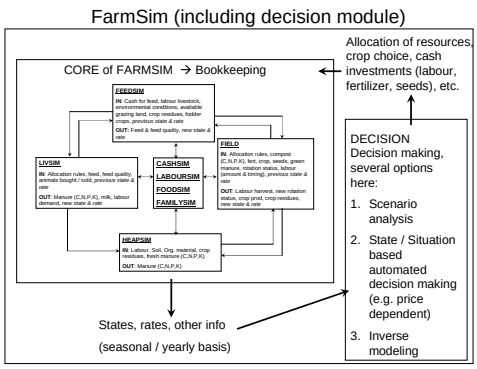

Figure 5 Setup of FARMSIM including the decision module

Conclusions and way forward

The different components of FARMSIM perform well. The tools have low data- demand and can be applied relatively easy across different types of farming systems. The FARMSIM model is now being set up for application in several sites in sub-Saharan Africa (Western and Central Kenya, Zimbabwe). The aim of the model is to combine ease of use and applicability with the ability to address fundamental and applied questions related to strategic management of smallholder farming systems in sub-Saharan Africa.

[1] **Plant Sciences, Plant Production Systems, Wageningen University and Research Centre**
[2] **ILRI, Nairobi, Kenya**
[3] **TSBF-CIAT, Nairobi Kenya**
[*] **Corresponding author; *email:* mark.vanwijk@wur.nl**

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