

Exploring the effects of morbidity and mortality from HIV/AIDS on household agricultural productivity in Southeastern Uganda using a multi-agent systems modeling approach



Dawn Parker, Maction Komwa, Kathryn Jacobsen, George Mason University, USA;

Thomas Berger and Pepjin Schreinemachers, University of Hohenheim, Germany

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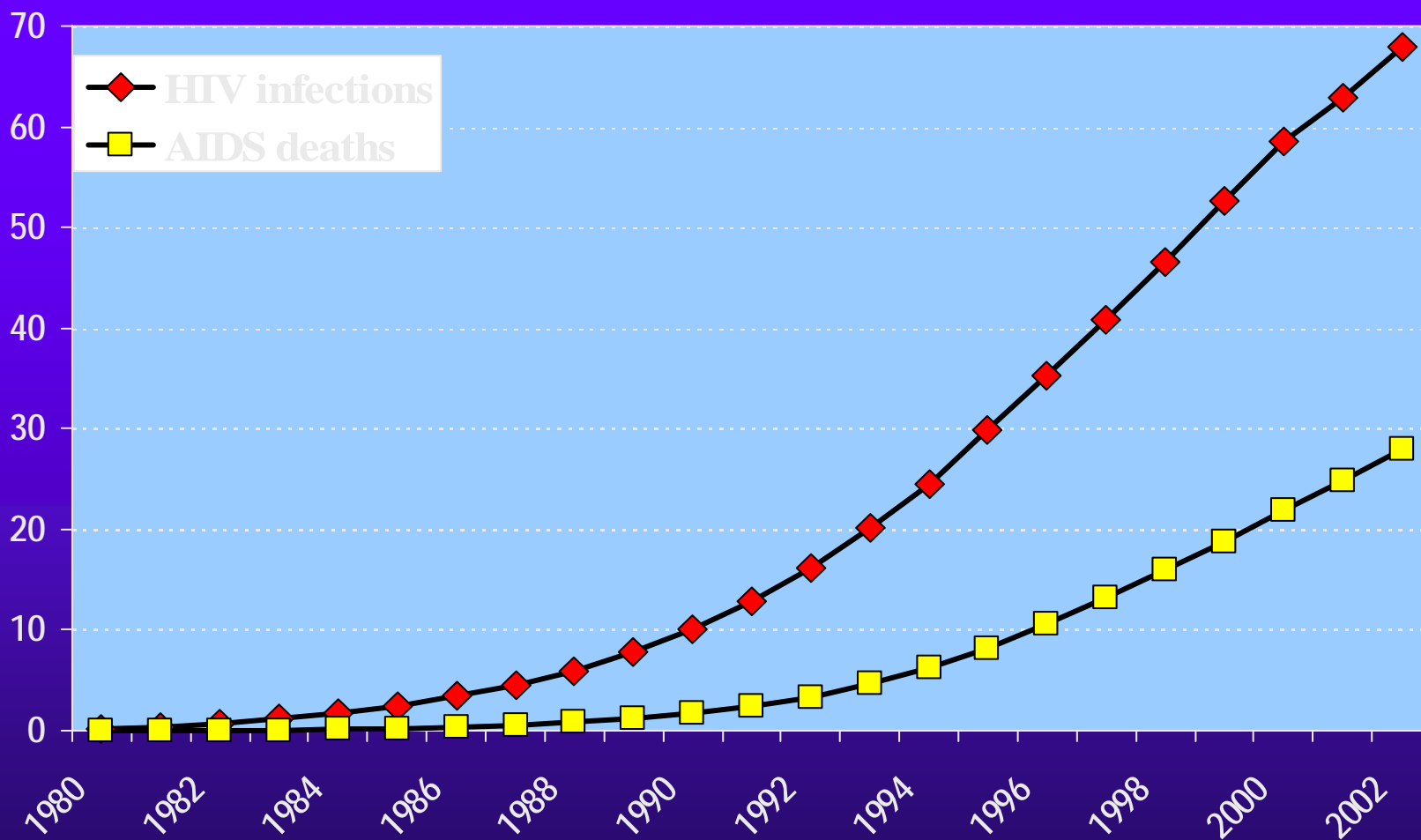
Outline

- ◆ Brief introduction and desc. of study area
- ◆ Research Objectives, questions and hypothesis
- ◆ MAS model 1: assumptions on HIV mortality and labor losses based on aggregate data
- ◆ MAS model 2 (in progress): modified rules based on local semi-structured interviews
- ◆ MAS model 3 (in progress): endogenizing links to food consumption and nutrition; household surveys

The AIDS Epidemic: Global context

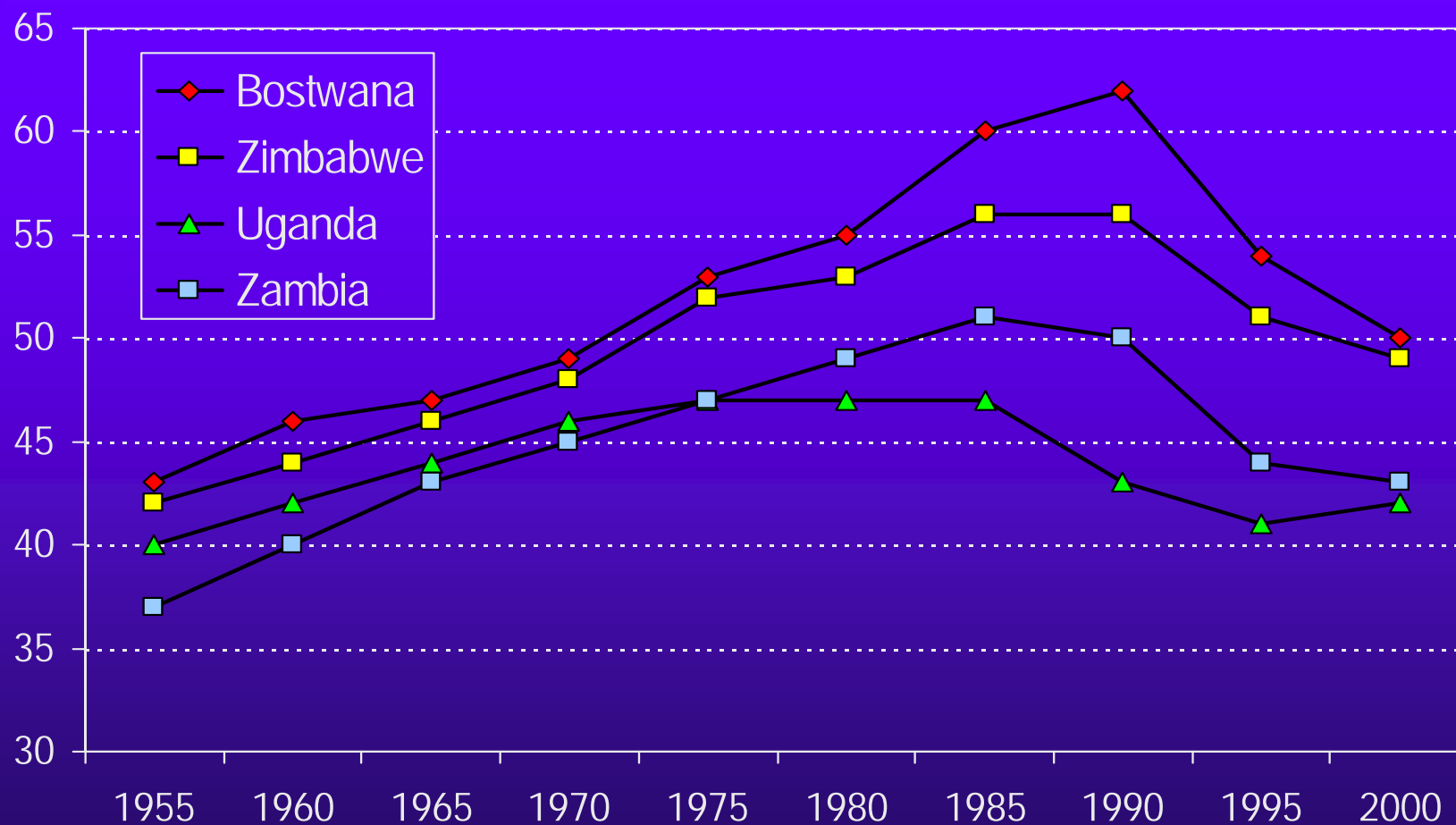
- ◆ More than 40 million people were HIV positive in 2000
- ◆ By the end of 2002, 27 million people have died of AIDS
- ◆ About 5 million contracted the virus in 2001; 95% in developing countries

Global Estimates of Cumulative HIV/AIDS Infections and Deaths Worldwide, 1980-2002 (in millions)



Source: UNAIDS/WHO. 2004

Life Expectancy in Selected African Countries, 1955-2000

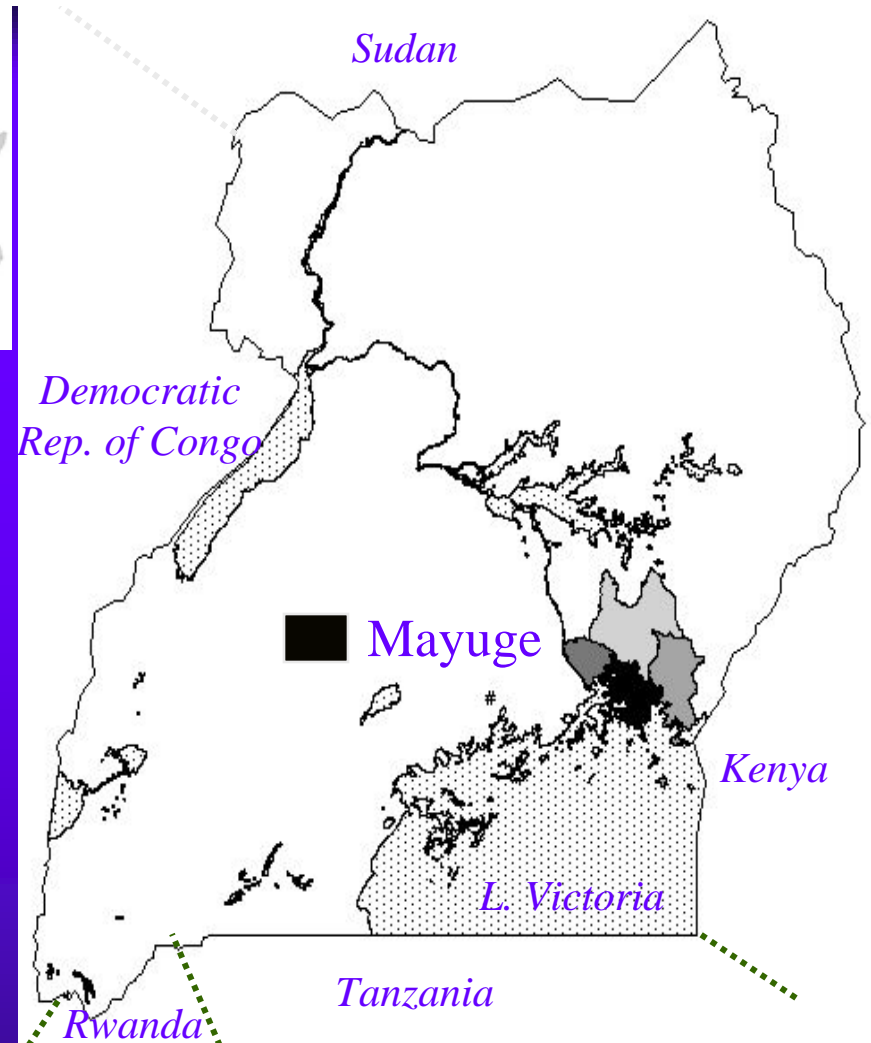


Source: UNAIDS/WHO. 2004

AIDS in Uganda

- ◆ Adult HIV prevalence in Uganda has decreased from above 20 percent to below 5 percent.
- ◆ Unique example of success in a continent facing a severe AIDS crisis
- ◆ Still, more young adults between the ages of 13 and 44 in Uganda were dying from HIV/AIDS infection than from any other diseases.
- ◆ Result is a huge loss of human capital, both labor and knowledge

Study Area



- The Mayuge district is located in southeastern Uganda near the shores of Lake Victoria.
- The district's economy relies heavily on subsistence agriculture and fishing.

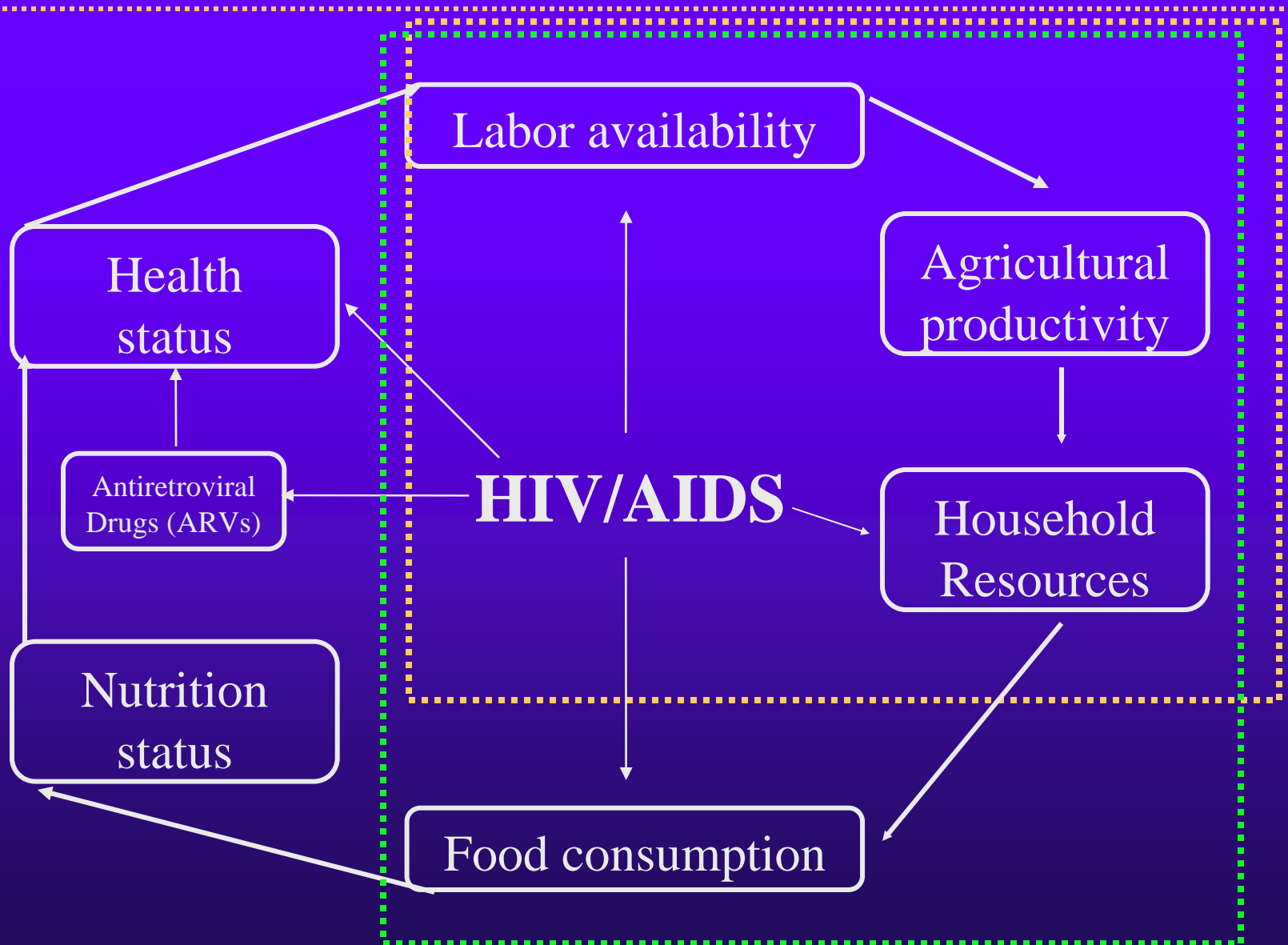
Objectives

- ◆ To evaluate the impact of HIV/AIDS on agriculture households, including household labor availability, cropping choices, and household livelihoods.
- ◆ To explore the relationship between HIV/AIDS, food production, and nutrition in the affected households.
- ◆ To build a dynamic simulation model that integrates the following factors:
 - HIV/AIDS prevalence in a household;
 - household nutrition and health status;
 - labor availability;
 - agricultural production

Research questions

- ◆ What effects does the presence in the household of a person living with HIV/AIDS (PWA) have on both farming and non-farm activities?
- ◆ What are the effects of an individual living with HIV/AIDS on the health and nutritional status of the person with AIDS and other members of HIV/AIDS affected rural households?
- ◆ How do land tenure patterns and land ownership dynamics associated with HIV/AIDS affect the welfare of individual households and the distribution of wealth between households?
- ◆ Under what circumstances can the presence in the household of a PWA lead to a downward spiral of degradation of household welfare?
- ◆ What policy interventions would be most effective in reversing this spiral?

Conceptual Framework-Household



Methodology

- ◆ Develop a series of multi-agent systems simulation models to explore research questions/hypotheses
- ◆ Model development supported by fieldwork to gather qualitative and quantitative data:
 - IFPRI household surveys
 - Household cropping survey (Schreinemachers, 2005)
 - Semi-structured interviews (Komwa, summer 2006)
 - Household surveys (Komwa, summer 2007)

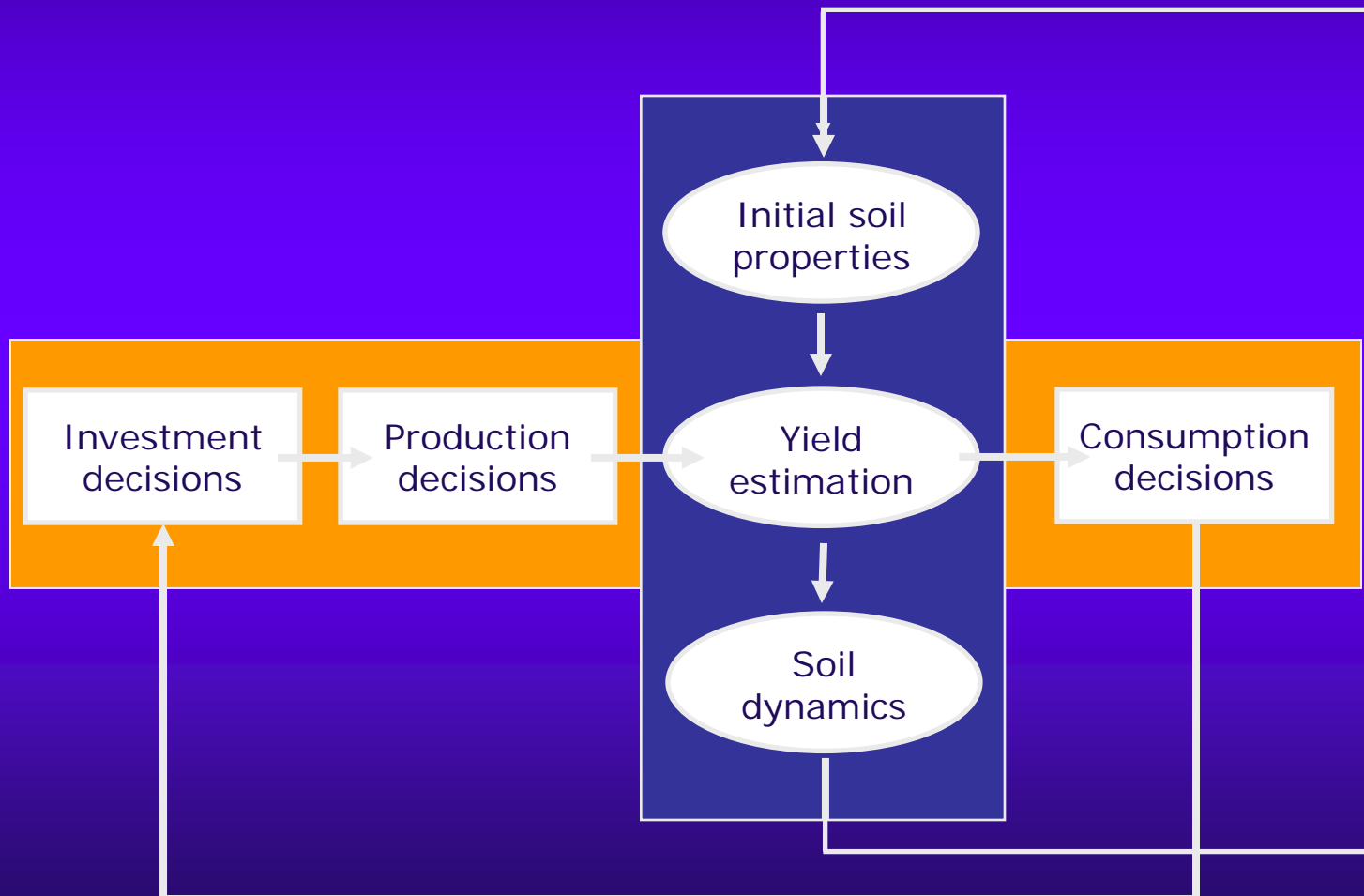
Multi-agent system (MAS) models:

- ◆ Are micro-level simulation models that directly represent decision-making entities and their interactions with their social and physical environment.
- ◆ Qualitative and quantitative information can be used to develop several sets of decisions rules
- ◆ Focus on modeling
 - agent heterogeneity based on differential household expenses and labor losses related to HIV
 - and on agent interactions, in terms of HIV-induced land transfers and land inheritance

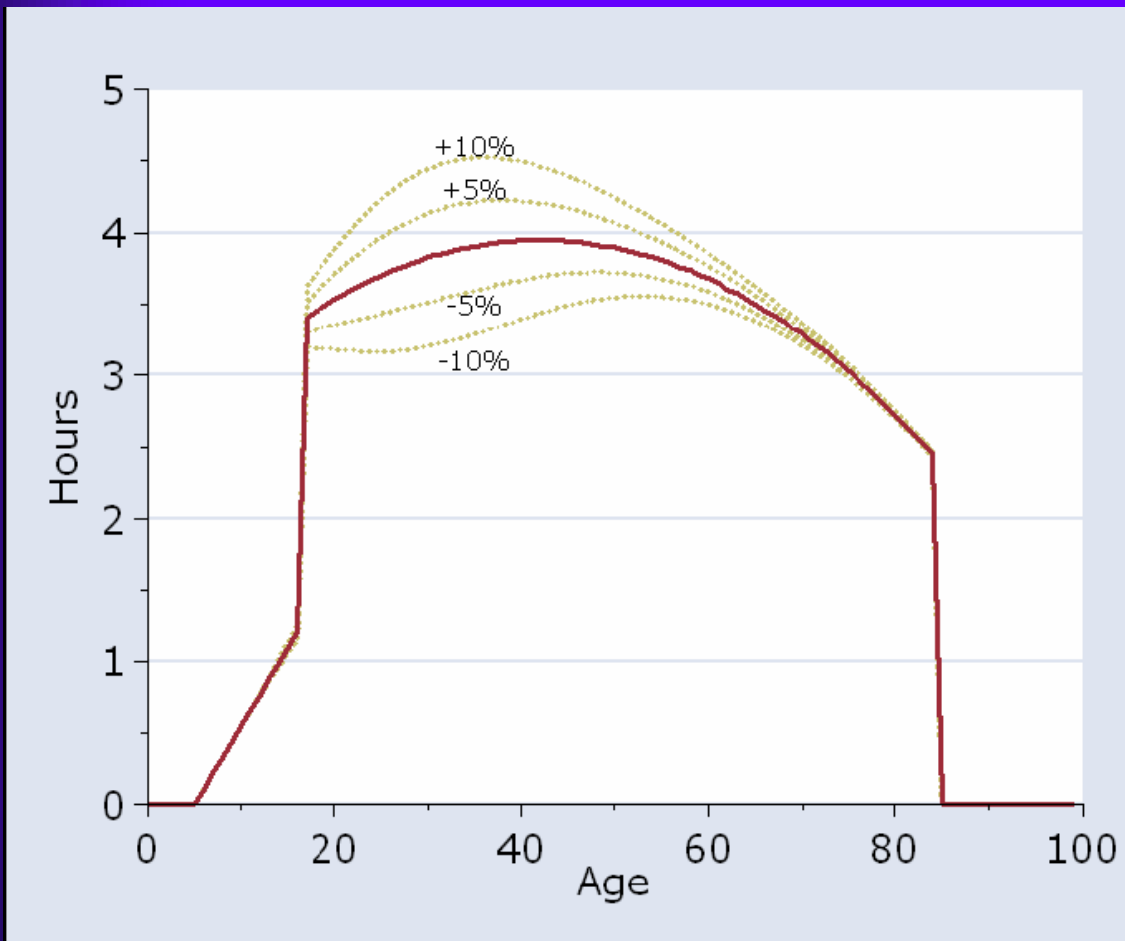
Research stage 1 (Schreinemachers, PhD thesis)

- ◆ Core model combines:
 - Mathematical programming model of household decision making, calibrated using survey data
 - Soil fertility and crop yield model based on locally calibrated Tropical Soil Fertility Calculator
- ◆ Simple assumptions regarding labor losses and mortality from aggregate statistics

Berger/Schreinemachers household decision model



Initial household labor loss scenarios



Solid red line is baseline (from household survey data); dashed lines are labor reduction scenarios adapted from FAO (2003) and age/sex specific mortality data from Feeney and Zaba (2001)

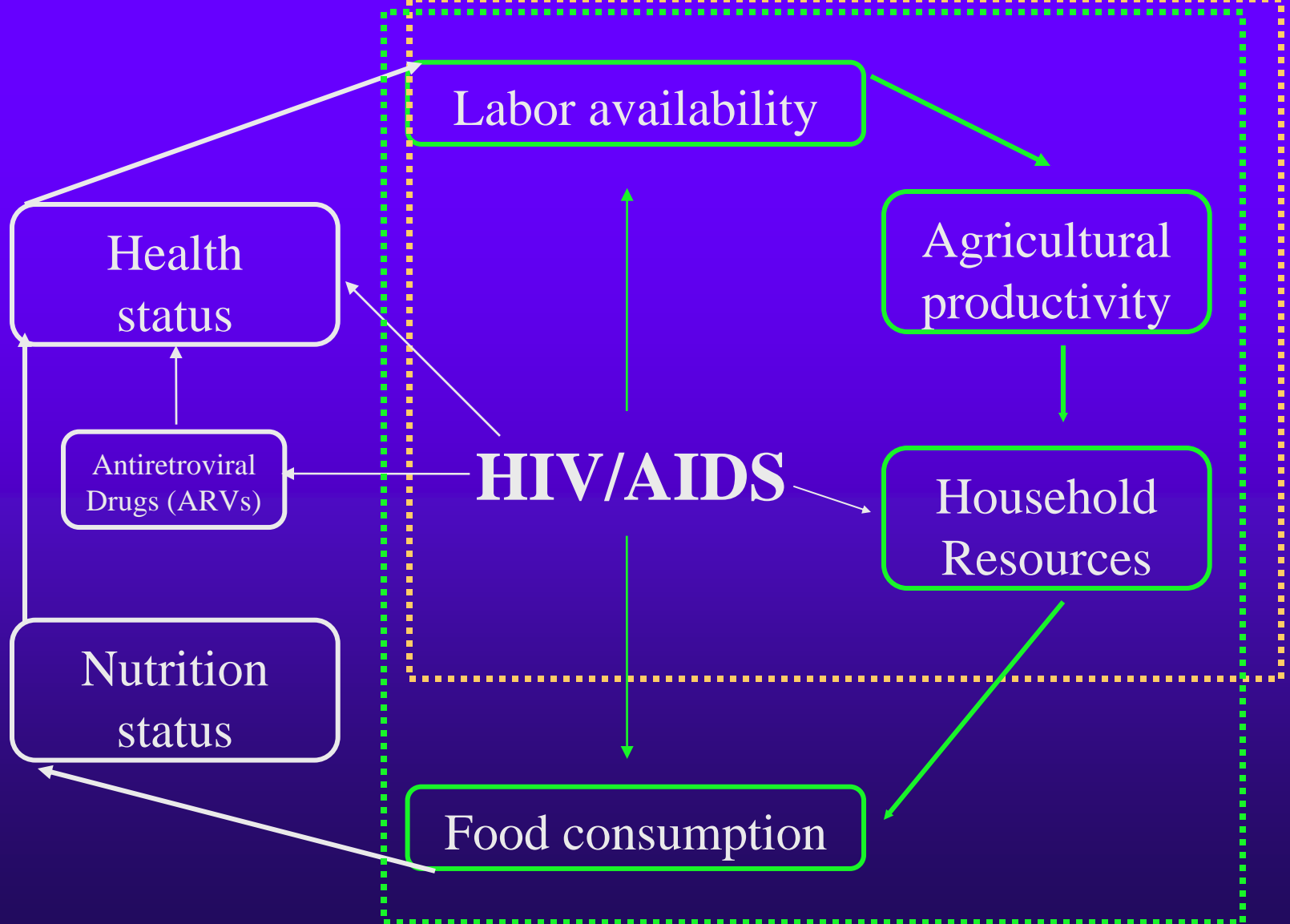
Berger/Schreinemachers Model 1 results (relative to pre-HIV):

- ◆ Reduced maize yields
- ◆ Lower rates of adoption of improved maize varieties
- ◆ Lower values of livestock assets

Research Stage 2 (Komwa, Parker, Berger, Schreinemachers)

- ◆ **Model 2** seeks location-specific data on changes in:
 - Household structure and composition
 - Labor losses throughout household
 - Fate of household assets (land, livestock, household members) following a death
 - HIV-related expenses
 - Crops grown
- ◆ Focus of 2006 semi-structured interviews
- ◆ Data used to modify rules from first MAS model

Stage 2: green box



Survey results: Household composition and structure

- ◆ General findings: Changes in household structure, with increases female or orphan-headed households and break up families (Cohen 2000, Deininger et al 2005, Mukiza-Gapere and Ntozi 1995)
- ◆ Our results the same
- ◆ We also find more independent families (outside clan network); traditional support structures breaking down
- ◆ Model will produce changes in household structure through mortality and inheritance rules created based on qualitative research

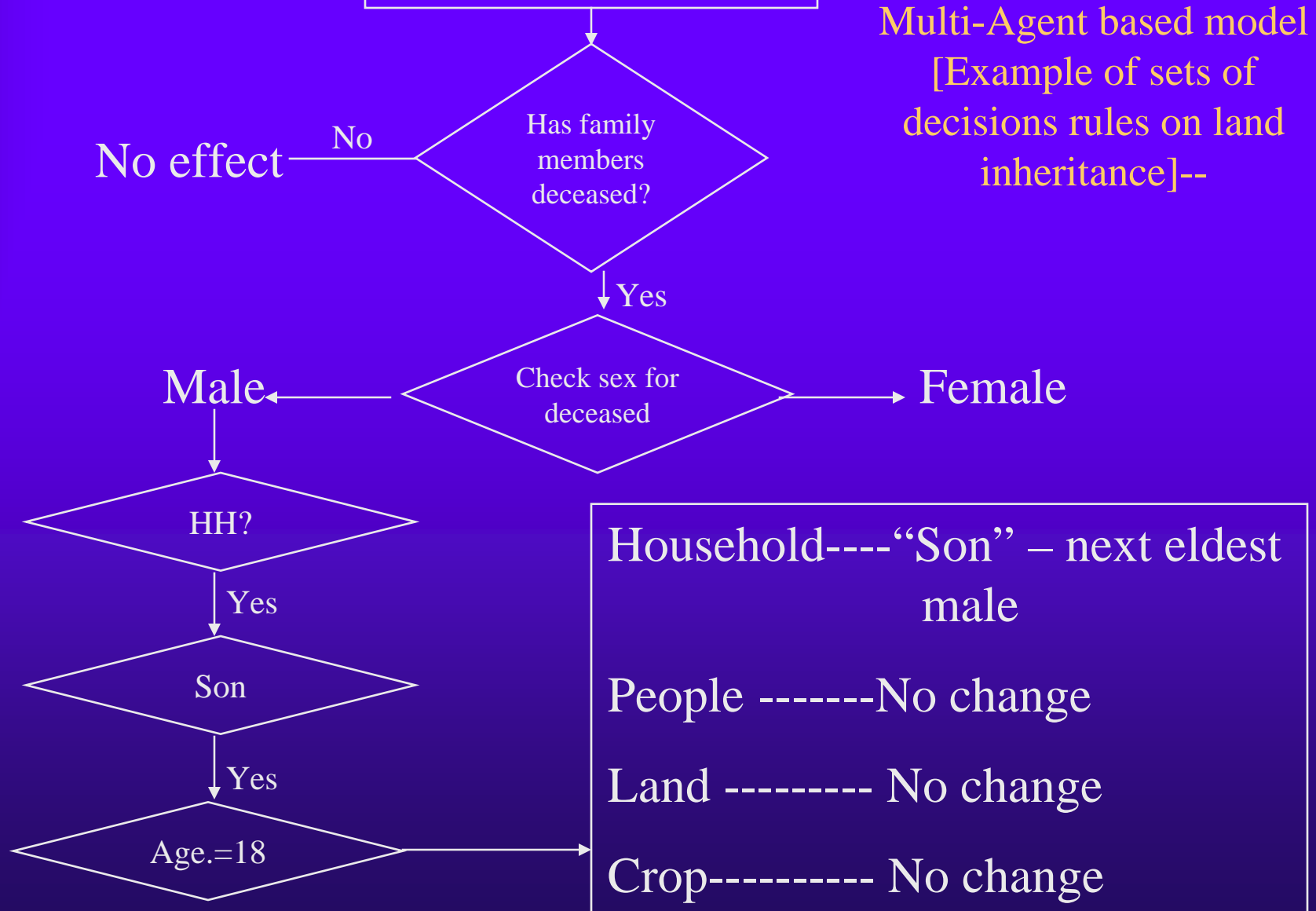
Survey results: loss of household labor

- ◆ General findings: loss of household labor from caretaking and from PWA (Drimie 2003, FAO 2003, Jayne et. al 2005, Donovan et al 2003, Williams 2003).
- ◆ Our results the same; used to produce quantitative model inputs of local labor losses by gender and status
- ◆ We also find self-reported labor reductions by PWAs to preserve health status

Survey results: Land tenure

- ◆ General findings: Widows and children denied the right to inherit land or property after death of husbands (Barnett 2004, Aliber and Walker 2006, Williams 2003)
- ◆ We find the same; traditional institutions preserve land holdings within clan (extended family network) through male-line inheritance
- ◆ Result is that widows and female orphans are very vulnerable to loss of land and assets
- ◆ New community organizations designed to defend inheritance rights for women
- ◆ New model rules created for land transfers; scenarios planned related to female land rights

Inheritance within family



Women's organizations



Survey results: Expenses

- ◆ General findings: increased expenses due to drugs, transport to medical care, funerals, etc.
- ◆ We find the same; new quantitative model inputs produced using survey data
- ◆ We also find that expenditures on high-nutrient foods are a high priority; produced estimates of these costs
- ◆ Local organizations provide these foods at reduced costs

Survey results: Crops grown

- ◆ General hypothesis: Reductions in ag output in HIV – affected households, also grow less intensive crops with lower nutritional values (Gillespie 1989, Guerny 199, Haslwimmer 1994, Deininger 2005)
- ◆ Our findings: Reported lower agricultural production; but not universal switch to subsistence crops
- ◆ Reports of production of higher valued, less intensive crops (vanilla, aloe vera, poultry), profit eroded by middlemen
- ◆ New models will estimate cropping changes and output reductions

Research stage 3: Nutrition and health

- ◆ **Model 3:** seeks to endogenize the effects of household nutrition on health status
- ◆ Collaboration with social epidemiologist from Mason (K. Jacobsen)
- ◆ Development to be supported by detailed household survey (expanded geographic area, 245 surveys); providing data on food consumption, health status (height/weight and self reports) as well as cropping decision, labor, and land tenure
- ◆ Will allow us to validate previous rules, estimate new rules, and simulate effects of a broader range of policy interventions

Stage 3: Endogenizing health and nutrition

