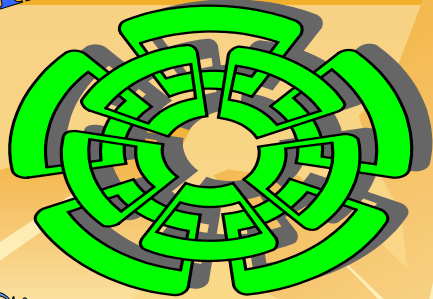


Human Ecology



Cinvestav Mérida Unit



**W.K. KELLOGG
FOUNDATION**

To help people help themselves

A systemic model of development against poverty

Heriberto E. Cuanalo de la Cerda

Cinvestav – Merida Unit.

Problem

- We are about 6 billion people in the world. 2.8 billion live with less than \$2.0 Dlls./day (WB)
- Székely (2005) estimates that 47% of Mexican households are poor
- Bolvinik (2002) estimates that more than 70% of Mexican households are poor
- There is also inequality/ intense poverty amidst the presence of wealth

Definitions

- Poverty a social syndrome with multiple symptoms, results from the effect of several causes and their interaction
- Development is a process that goes from poverty to wellbeing or the opposite
- Development process can be seen as a system with memory, conditioned by variables and their interactions in time cycles (dynamic)

The dynamic system

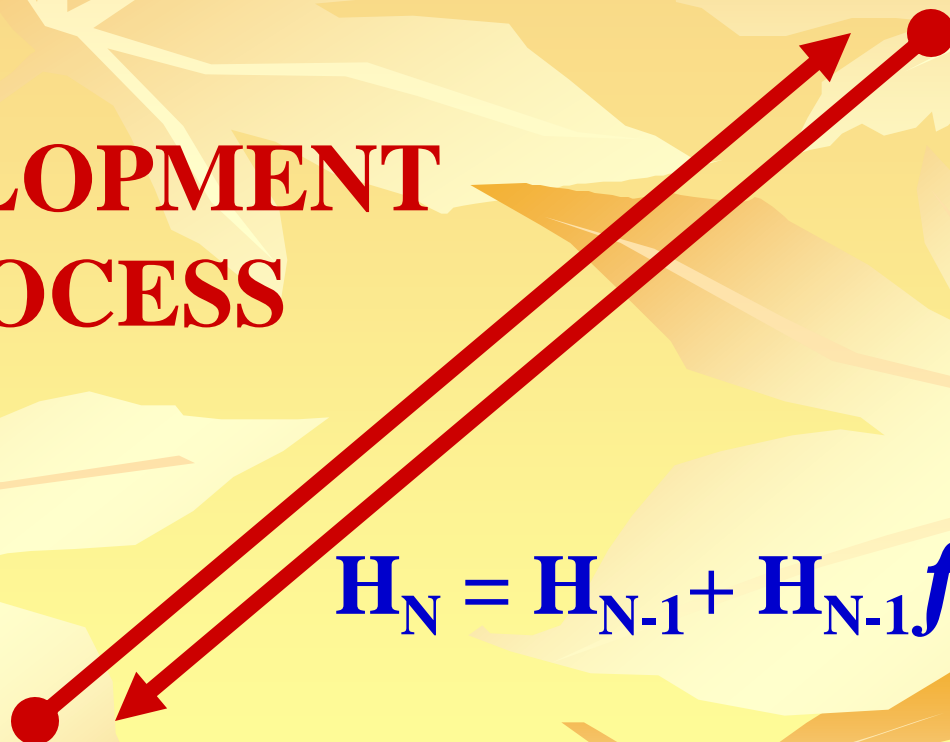
AIM: WELLBEING

DEVELOPMENT
PROCESS

$$H_N = H_{N-1} + H_{N-1}f(x, y, \dots, z)$$

FAILURE: POVERTY

TIME



The conceptual model

Poverty definitions

- Dictionary: people lacking the means to live comfortably
- **Some economists : low income**
- Poverty in Yaxcabá:
 - Low self-esteem and lack of leadership
 - Malnourishment and illness
 - Low production and productivity
 - Deficient access to subsidies, savings,
and loans

Aims: Household wellbeing

- Education: Self esteem and Leadership
- Health: Physical and Mental
- Production & productivity: For their auto- consumption and market; Jobs
- Economic security: Capital, loans, and subsidies

PROCESS: DEVELOPMENT

Households are the basic units

- Households consist mainly of families
- Households are the basic unit of human reproduction, both biological and cultural
- Households organize themselves internally via bonds of both authority and love
- Households obtain energy from the environment, food, education, health, and other commodities

Households develop in an environment

Development as a dynamic system

- Households and its environment form nets and they function as a whole
- Changes in part of the system affect the whole
- Households and environment show causality in cycles (births, deaths, days, seasons, years)
- Crisis occurs when there are changes in the system (household or environment)
- Calibrated to present => Oriented to goals
- Households show stable dynamic states in equilibrium, auto-regulatory interactions; example poverty

Poverty, a dynamic state in equilibrium

- Education: low self-esteem and leadership
insufficient knowledge to better themselves
- Health: malnourished, bad housing, septic
environment, often ill
- Income: insufficient to cover basic needs, low
production & productivity, poorly paid jobs
- Capital: low levels, highly vulnerable, small
contingencies, bring crisis to households

Household internal changes

- Household structure changes by birth, death or absence of its members
- Household functioning changes by education, health, and income levels

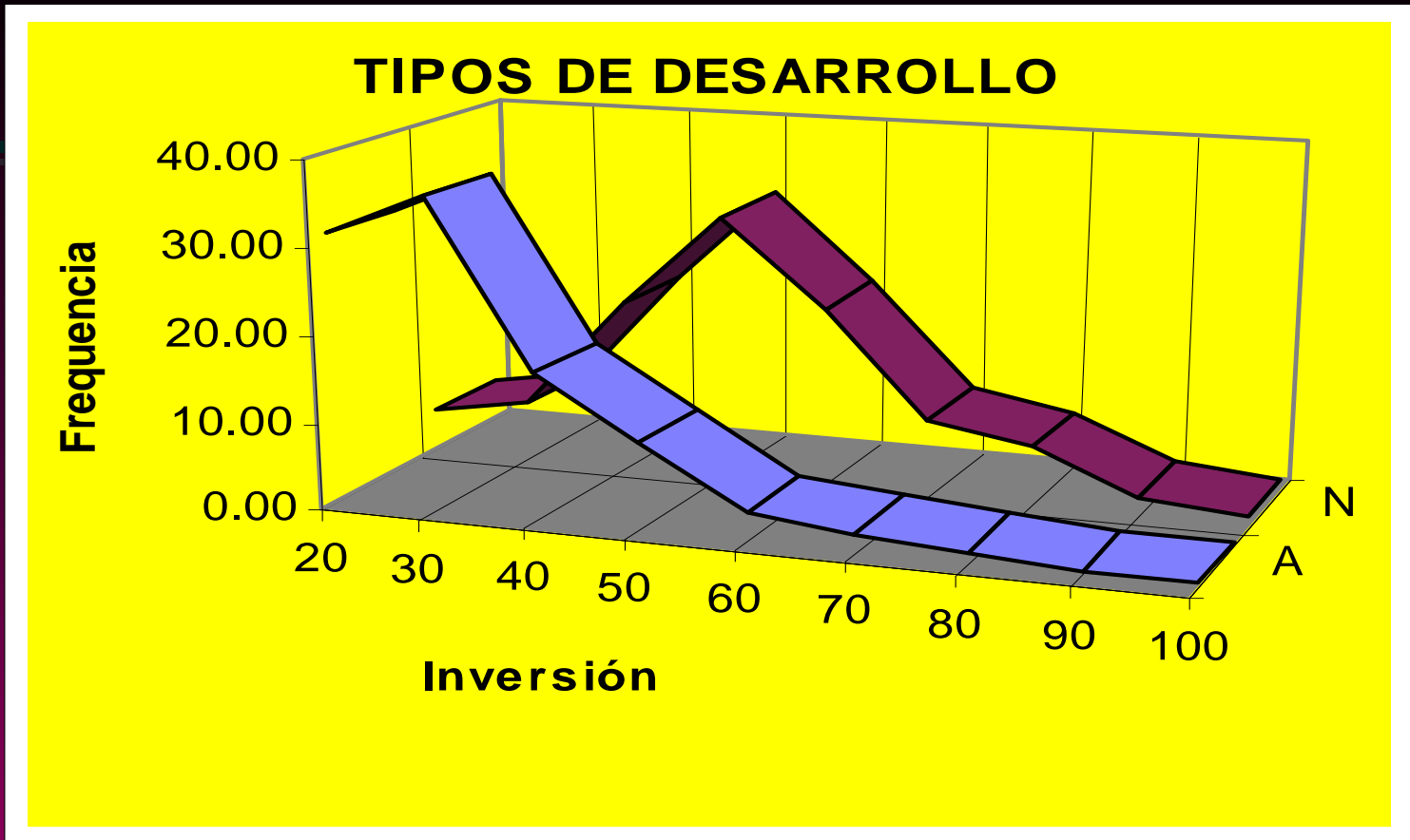
Affects only a few household at a time

Changes in Household's environment

- Change from welfare state (Keynesian) to Neo-liberal (Market), economic model
- Change in exchange terms among agricultural and industrial products, e.g. NAFTA. High increase in oil prices
- Physical and biological changes, e.g. hurricanes, droughts, epidemics

Fast changes. Many households are affected

Development types



Methodology

- **Participative approach, science is social construct based on values interpretation**
- **Participatory research. What is the problem? What do we know? What can we do? What will we do about it? How will we do it? What did we learn? And the process starts ageing**
- **We began with 31 households, but results presented came from 62 households**

Results

Participative village diagnostic

- Insufficient food production for self-sufficiency
- Insufficient jobs and low wages
- Shortage of medicines for ill people, specially for infants and children
- Poor housing conditions

PROBLEMS OF MANY MEXICANS

Innovations

- Participatory research on production and productivity of milpa, honeybees, home gardens and poultry
- Health, workshops on child nutrition, and hygiene
- Participatory organization of a community bank to provide savings and loans services
- Participatory organization to obtain subsidies from the state

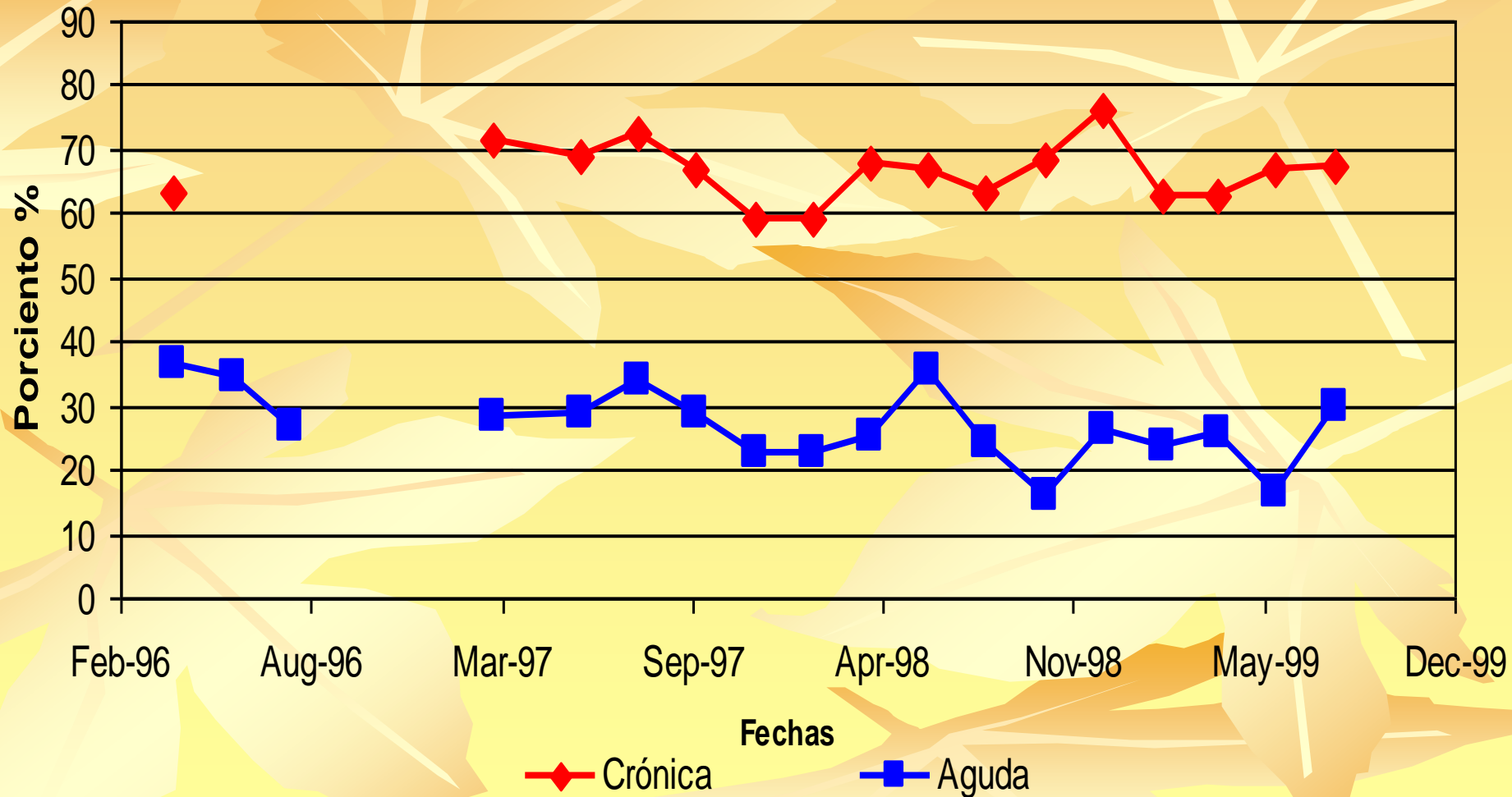
Mulch milpa. Expectations vs. Reality



Malnourished 9 years old



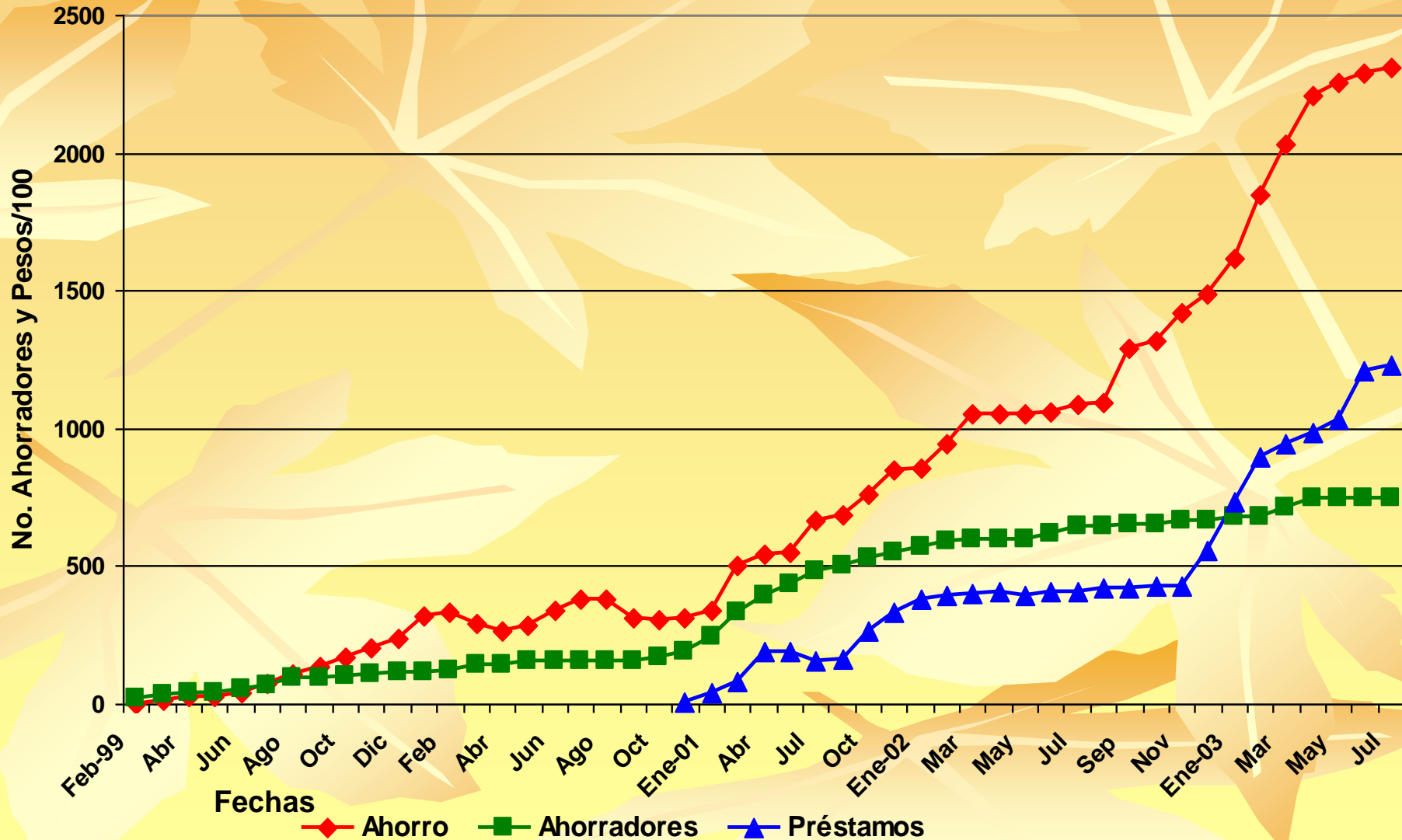
Malnourished children: HAZ and WAZ less than 1 Z



Community bank's monthly meeting



Savers, savings, and loans



Households investment levels, %

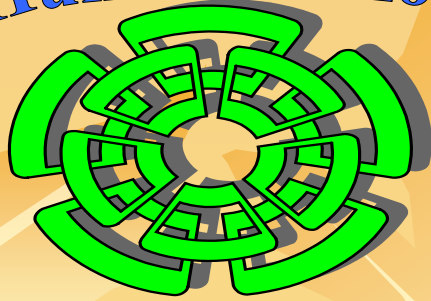
Mexican Pesos 1997

| Range /Year | 5,000–10,000 | 10,000-15,000 | 15,000-20,000 | 20,000-25,000 | 25,000-30,000 | >30,000 |
|-------------|--------------|---------------|---------------|---------------|---------------|---------|
| 1997 | 43.5% | 27.5% | 11.6% | 10.1% | 2.9% | 4.3% |
| 1998 | 23.8% | 17.5% | 23.8% | 14.3% | 4.8% | 15.9% |
| 1999 | 14.3% | 12.7% | 11.1% | 25.4% | 14.3% | 22.2% |

Results

- Poverty abatement to be effective needs a dynamic multiple strategy of improvement on the local limiting factors. In Yaxcabá, Yuc.: education, health, income, and banking
- Positive interactions between improvements on the limiting factors would have a much larger impact on poverty abatement than improvements on any single factor

Human Ecology



Cinvestav Mérida Unit



A mathematical dynamic model of development against poverty

Gabriel Murrieta Hernandez

Faculty of Mathematics. UADY

Heriberto E. Cuanalo de la Cerda

Cinvestav – Merida Unit.

Model diagram

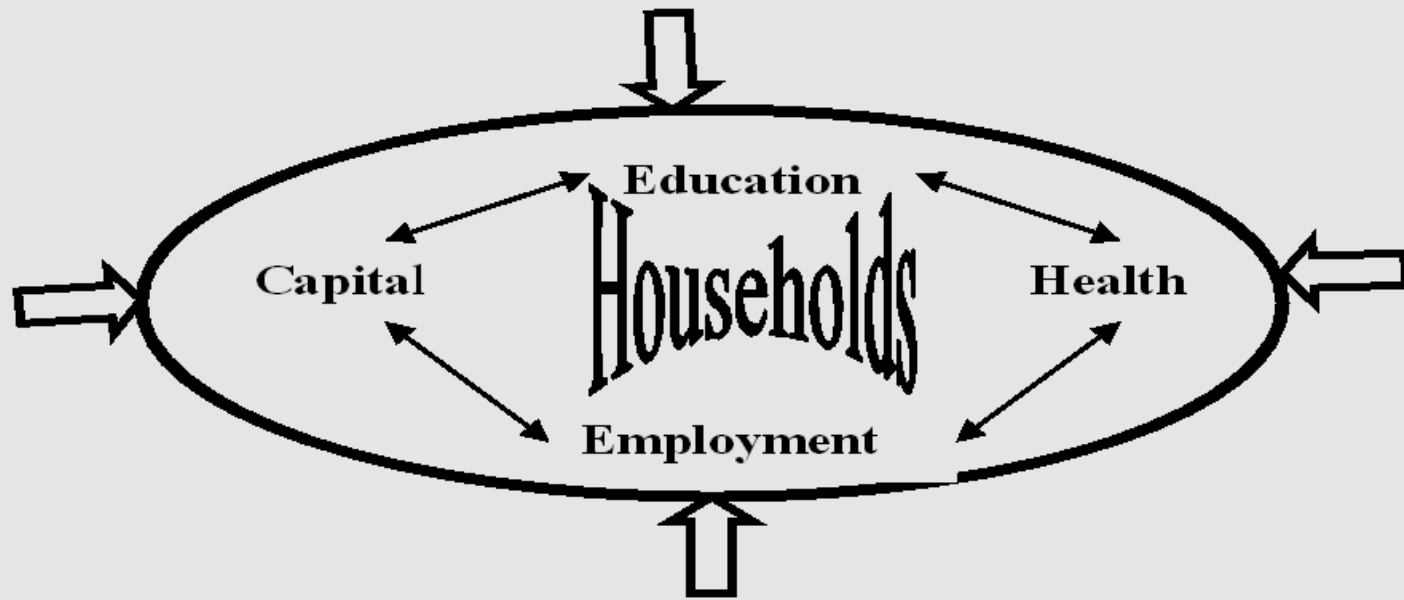
ENVIRONMENT

Schools

P
u
b
l
i
c

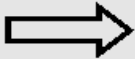
H
e
a
l
t
h


B
a
n
k
s



Production Infrastructure

Legend


Parameters' Effect


Interacting variables

The mathematical model

Household variables

- 1) Capital: refers to household levels of investment, loans and subsidies
- 2) Education in terms of adults' number of school years
- 3) Health: physical and emotional; it includes nutrition, illness, self esteem, etc
- 4) Employment: proportion of household members with an income; production skills, training, productivity, capabilities, etc

Environment parameters

- 1) Access to capital, given by the ratio of savings interests, to loans interests
- 2) Production infrastructure, which includes communications, access to markets, values 0 to 1
- 3) Access to health services, values 0 to 1
- 4) Employment availability (self employment and job opportunities) with values 0 to 1

Functions

- Household are randomly assign capital (C), school years (E) and health (S).
- Agent's capital (C) is obtained from log-normal distribution
- Agent's education is obtained from normal distribution
- Agent's health is obtained from a uniform distribution, between zero and one

Functions

- Each agent has **Agent Production Potential (M)** as a function of their capital, education and health, the higher their values, the higher M
- Environment is defined by quality of public health care (Cs), productive infrastructure (DM), and access to capital (iap), which is the ratio between interests on loans and savings
- Environment variables remain constant on each simulation and are called parameters

Functions

- Environment Access Potential (A) is define by a function of the environment parameter
- Net Income Probability (P_I), each agent searches to increase their income given by probability function
- Agent Income Potential (N) is the product of Agent Production Potential (M) and the Environment Access Potential (A)

Rules that affect household capital (C)

- I-If the Agent Income Potential (N) is $>$ than (C/C_{tot}) , then agent increases income, by a random number (g), from a uniform distribution with values 0 to 1. This value is compared with the value obtained from the Net Income Probability (P_I)
- II-If g is $<$ than P_I then the agent increasing capital by (uC), product of its capital (C) and a random number (u), from a uniform distribution (0, Umax). Umax is the product of public production infrastructure (DM) and access to capital (iap)
- III-If (g) is $>$ than Net Income Probability (P_I), then the agent has an expense given by (uC), product of agent's capital (C) and (u)
- IV- If the Agent Income Potential (N) is $<$ than agent's capital (C), standardized 0 to 1 (C/C_{tot}), then agent has an expense given by the product of the capital of the agent (C) and (u)

Rules that affect household's health (S)

- A number (r) is drawn from uniform distribution between 0 and 1
- I- If the number (r) is < than household's health, ($r < S$), then household remains healthy. A healthy household remains healthy for several loops
- II- If the number (r) is > than household's health, ($r > S$) then household changes its health by a Beta function, with parameters C_s and B_s . Here the Beta function average EX is

$$EX = \frac{C_s}{C_s + B_s}$$

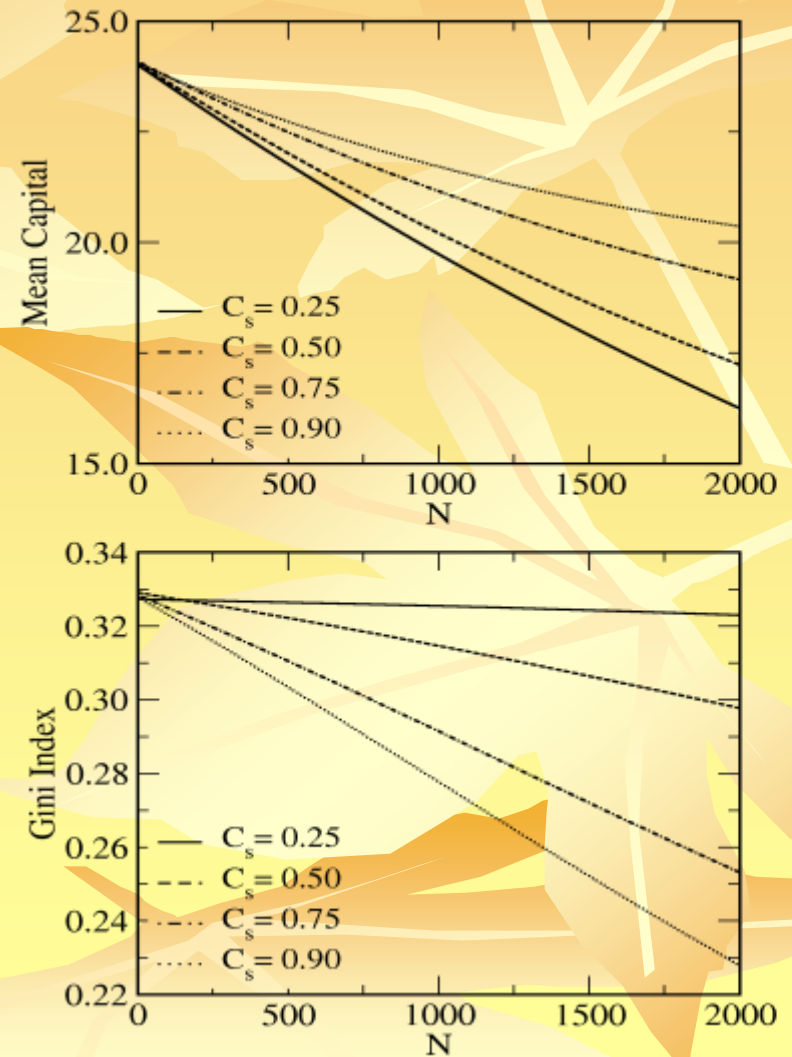
where C_s is quality of public health and B_s is a number so that when C_s is near 1, B_s approaches 0 and when C_s is nearly 0, B_s approaches infinitum. For B_s to behave like this, values are obtained by the Pareto's function (C_s is Pareto's function parameter).

Simulations

- The simulation construct 1000 agents by drawing values from the distributions of the capital (C) and a health level (S) variables
- The values of capital (C) and health (S) change after each iteration
- During each simulation school years (E) and household members with employment (O), remain constant
- Environmental parameters remain constant in each simulation, namely access to public health care (Cs), public productive infrastructure (DM), and access to capital (iap)
- Environmental parameters however may be changed in different simulations

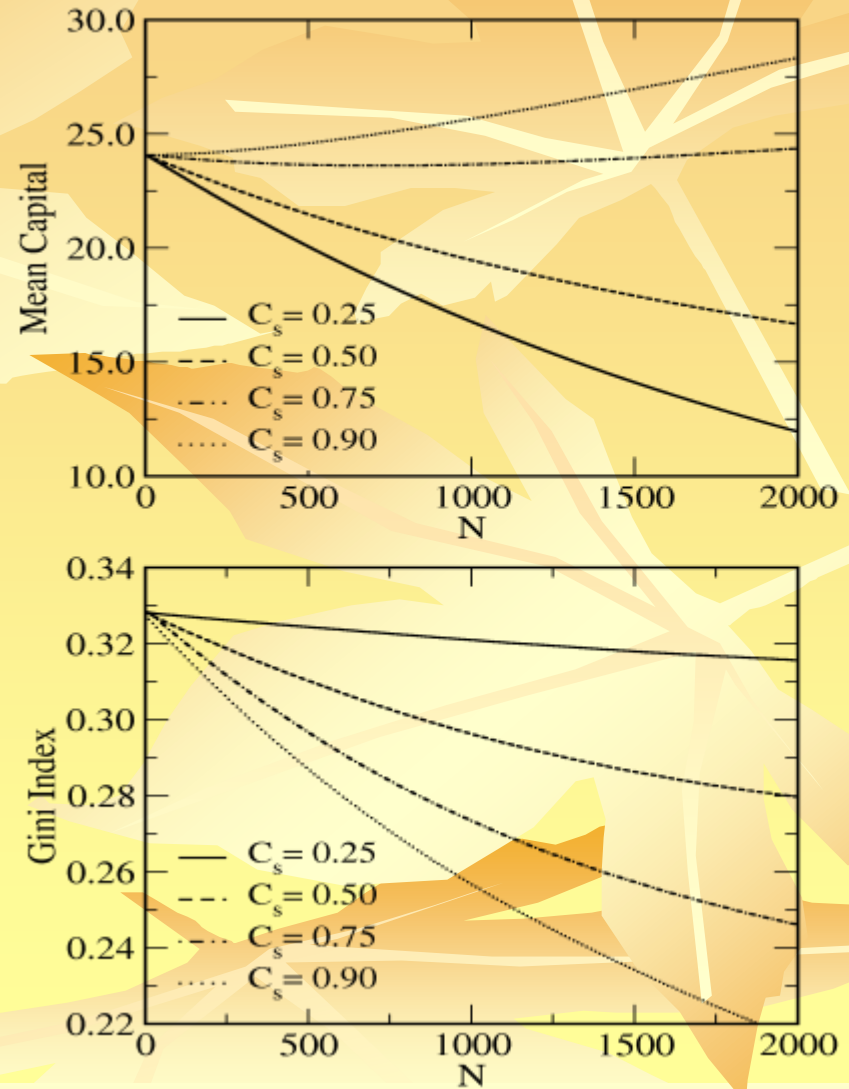
RESULTS

- Simulation results from a household group in an adverse environment. Changing one environmental parameter, health services (C_s), over 2000 iterations
- Fig 2. Mean capital slowly decreases and Gini index decreases, households lose capital but become more uniform. When health service values (C_s) increase, the community loses capital more slowly and becomes less variable at an increased rate.



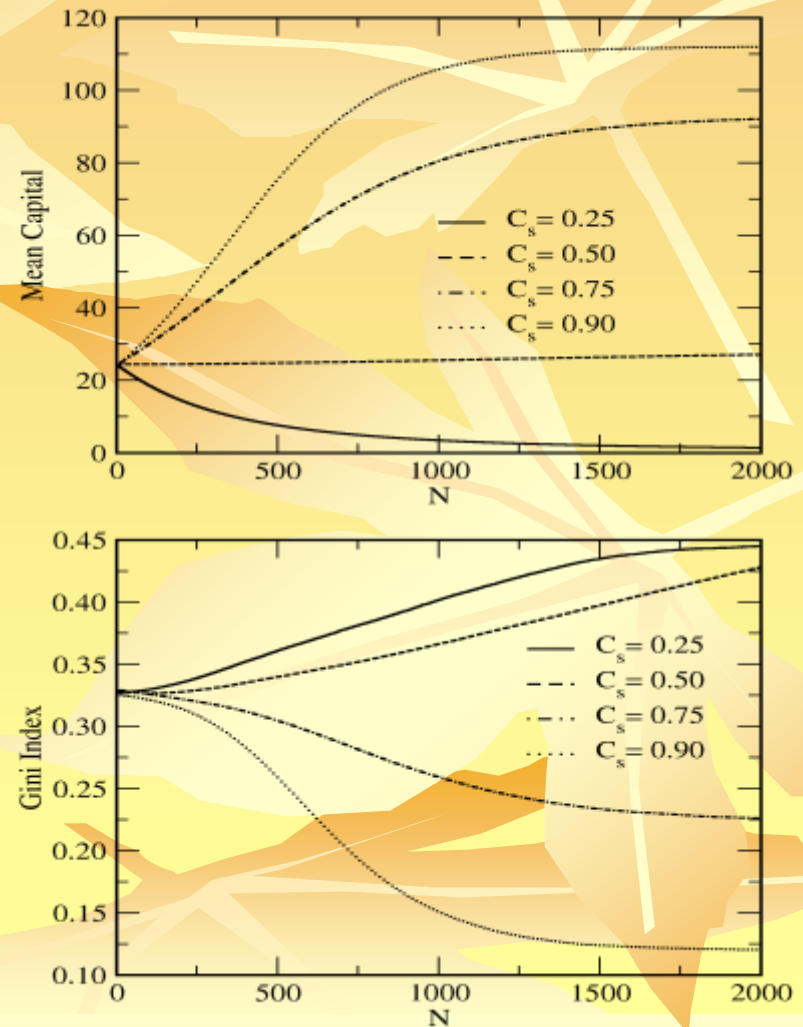
Simulation, improving 2 parameters

- Fig 3. If interest rates (iap), increase from 0.2 to 0.4, and health service (C_s) are varied, then households lose capital and the overall income variability decreases at a slower rate than in Fig 2
- At the highest health services value ($C_s = 0.9$), the mean capital increases and the variability decreases quickly



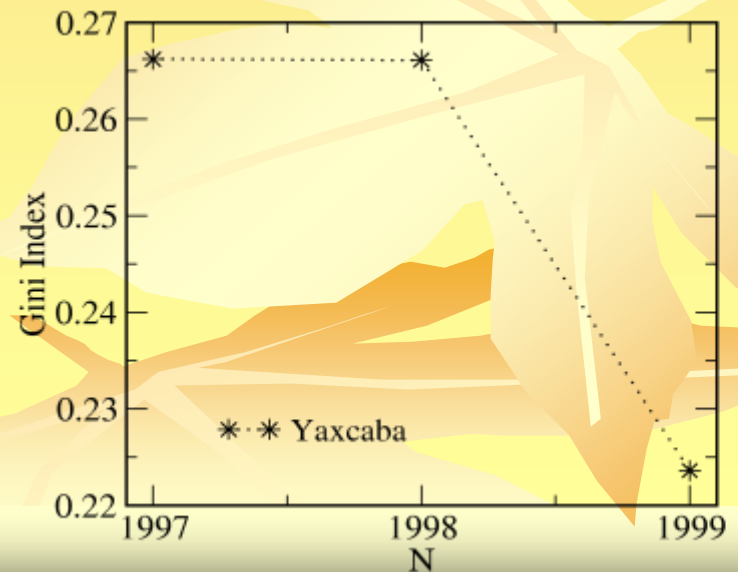
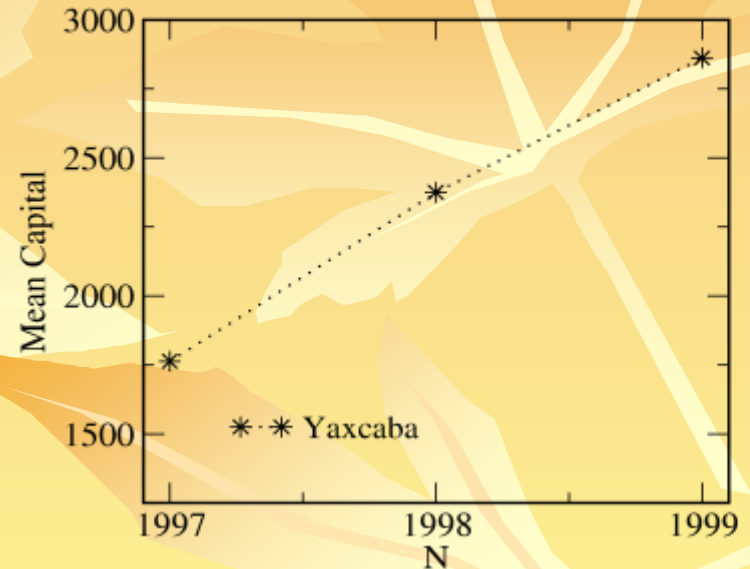
Simulation, improving 3 parameters

- Fig. 4. Results when employment ($O = 0.9$), production infrastructure ($DM = 0.9$), and access to capital ($iap = 0.9$) at different health services (C_s) values
- When health services are low ($C_s = 0.25$), households become poorer and more variable, many opportunities are lost due to illness



DISCUSSION

- The more environmental variables are improved the faster increase on households' average capital and the decrease in variability
- Improvements on production, heath, education and banking increased both the average households' capital and decreased its variability, Gini's index



CONCLUSIONS

- The simulation model is a plausible version of our understanding of the process
- The model shows reasonably good results with only four household variables and three environmental parameters
- The model enhanced our understanding of interactions among key household variables and key environmental parameters as, well as their role in the abatement of poverty

Community Center, Yaxcabá, Yuc.



Thank you!