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Innovative Methods and Metrics for Agriculture and Nutrition Actions

Exploring the links between animal health and child nutrition in Tanzania: *is system dynamics a useful tool?*

23rd June 2016

ANH Academy Week, Addis Ababa

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Funded by:

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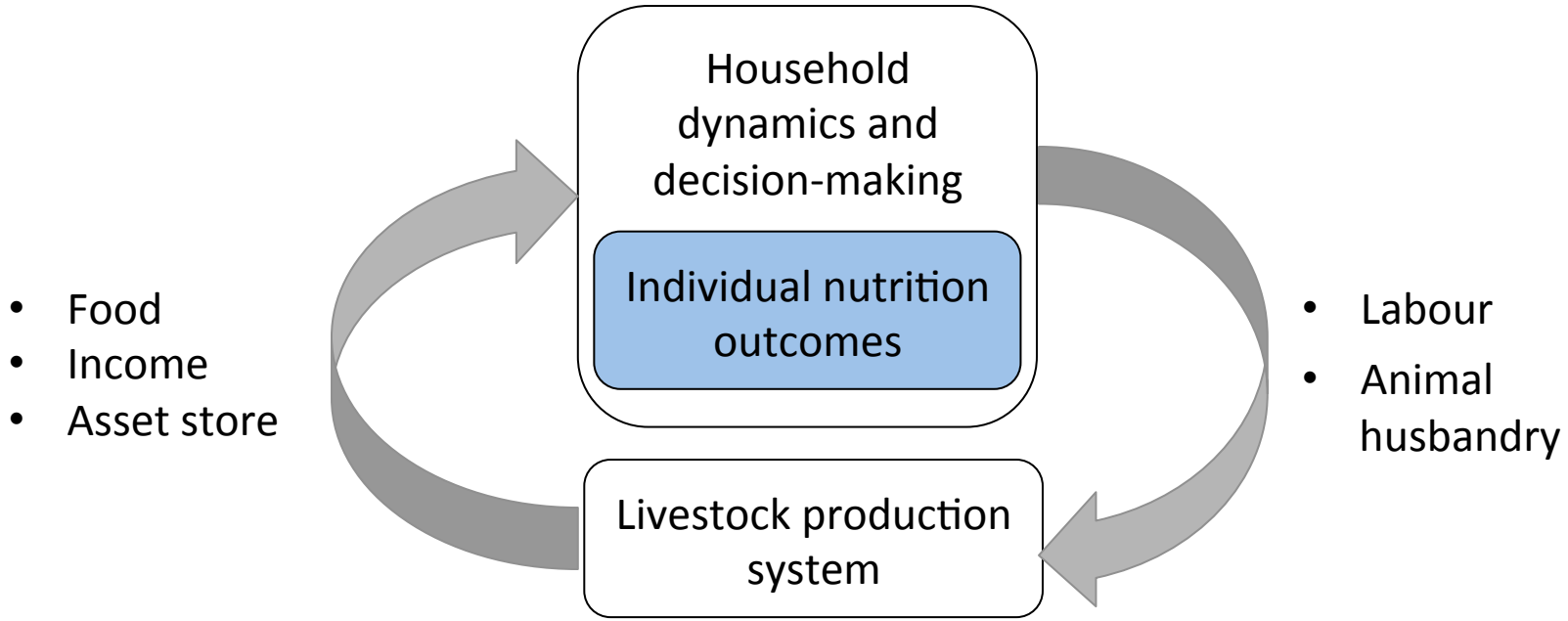
System Dynamics

a methodology and mathematical modelling technique for framing, understanding, and discussing complex issues and problems



System Dynamics process

Iterative phases of System Dynamics methodology

1. PROBLEM IDENTIFICATION: identifying and articulating the issue to be addressed
2. MODEL CONCEPTUALIZATION: developing a causal theory about the issue
3. MODEL FORMULATION: quantifying the model
4. MODEL SIMULATION and ANALYSIS: testing the model to assess whether it is fit for purpose and scenario simulation
5. MODEL USE: communication of results to (hopefully) design better nutrition-sensitive food system programmes and policies

1. PROBLEM IDENTIFICATION

- Child stunting in Tanzania 42% (NBS, 2011)
- Agricultural interventions - potential to improve nutrition of farming households
- BUT farm-level link (or HH-level link) is hard to document
- Review of the evidence found that impact of agricultural programmes on child anthropometry or micronutrient status is inconclusive (Ruel and Alderman, 2013)
- AIM Investigate the utility of system dynamics in evaluating livestock interventions for improved child nutrition

2. MODEL CONCEPTUALTISATION

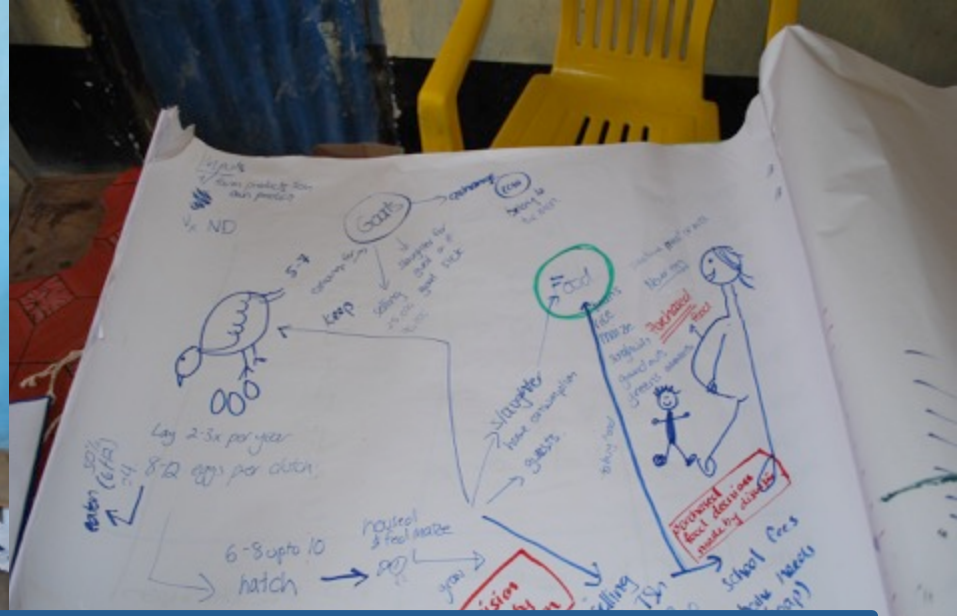
How is own production associated with farm household food access, diet quality and nutrition outcomes?

Four broad pathways:

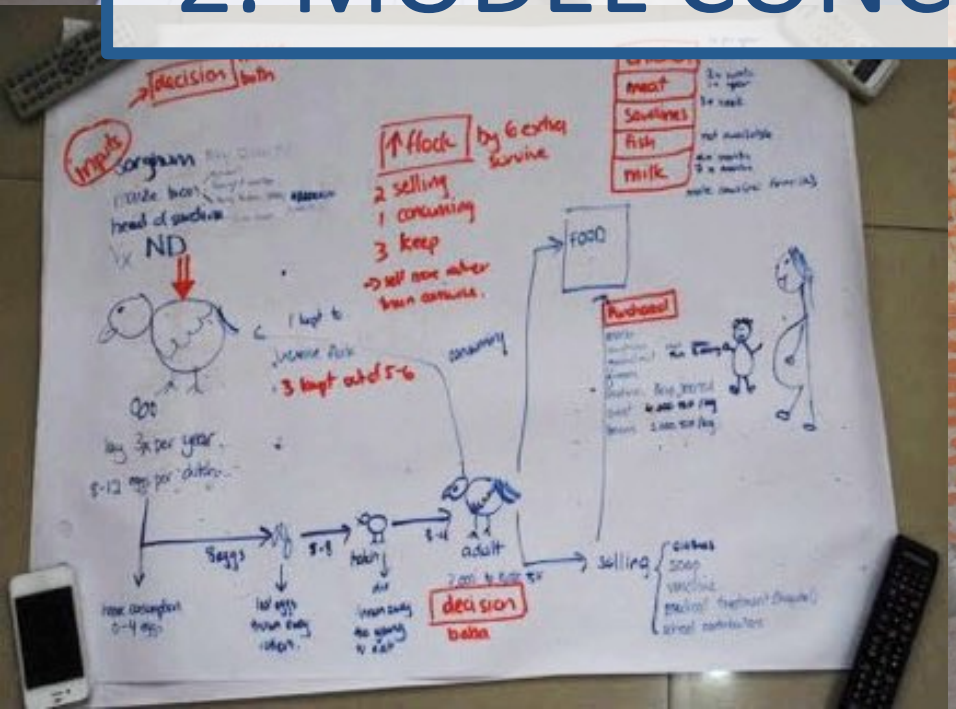
1. Food prices
2. Income from agriculture
3. Consumption of own production
4. Socio-cultural factors including gender

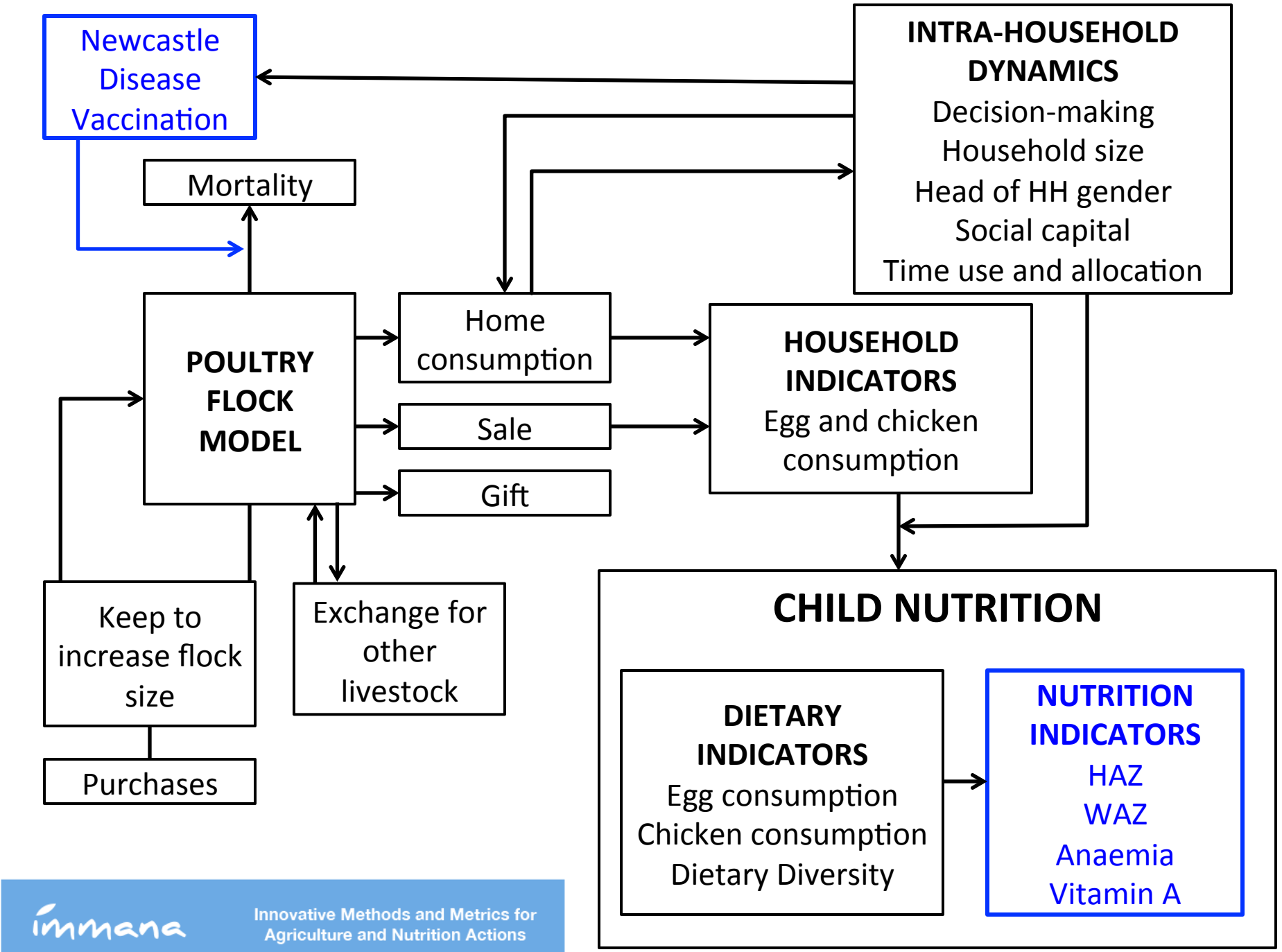
Pathways are interlinked!

(Ruel and Alderman, 2013; Carletto et al., 2015)



2. MODEL CONCEPTUALTISATION




Newcastle Disease Vaccination
INTRA-HOUSEHOLD DYNAMICS
Decision-making
Household size
Head of HH gender
Social capital
Time use and allocation
Mortality
POULTRY FLOCK MODEL
Home consumption
Sale
Gift
HOUSEHOLD INDICATORS
Egg and chicken consumption
Keep to increase flock size
Exchange for other livestock
Purchases
CHILD NUTRITION
DIETARY INDICATORS
Egg consumption
Chicken consumption
Dietary Diversity
NUTRITION INDICATORS
HAZ
WAZ
Anaemia
Vitamin A

3. MODEL FORMULATION

"Strengthening food and nutrition security through family poultry and crop integration in Tanzania and Zambia"

- Subset of larger study – two villages
- Random selection of households with at least one child <24 months of age
- Interview-based data collection
  - Mother and Child Health and Nutrition (2x per year)
  - Livelihood Questionnaire (1x per year)
  - 2 weekly data on poultry flock population and child health
  - Visual diary (3x per year) flock population dynamics consumption of poultry products
- Child anthropometry WAZ, HAZ, WHZ, MUAC, vitamin A

Model

- Time step 1 week – changes calculated every week, simulated over 10 years
- Households stratified on size
- Maximum poultry flock size (range for different simulations)
- Newcastle disease vaccination 3x per year at village level – changes in mortality
- Delay in link to child nutrition outcomes – data x2 year

4. MODEL SIMULATION AND ANALYSIS

Baseline model

- Positive link between number of chickens, home consumption and sales rates and HH food security indicators
- Positive link between HH food security indicators and child dietary indicators (in small household size <6 people)
- Weak link between offtake rates and child nutrition indicators

Newcastle disease vaccination simulation

- Reducing poultry mortality should increase home consumption and sales - BUT Newcastle disease vaccination had varied effect on mortality rates

5. MODEL USE??

- Allows time delay between ND vaccine and effect on child nutrition
- Pulse vaccination and effect on poultry population – poultry mortality rates not static
- Intermediary indicators can be assessed (own consumption versus income effects)
- Simulate “what if” scenarios (change frequency and timing of vaccination)
- Can be extended

PROOF-OF-CONCEPT

Limitations

- Data limitations - ND status of individual chickens or flocks not well documented, model at village level – may dilute effects
- Model limitations - Omitted variables affected differences in intervention groups - **DROUGHT (climate should be exogenous)**
- Model limitations - Model independent of HH dynamics and farming systems
- Model limitations - Notable absence of proximal cause of undernutrition – DISEASE STATUS

Therefore more integrated models required!

Thank you for listening!

ACKNOWLEDGEMENTS

Jonathan Rushton – *RVC, UK*

Furaha Mramba – *TVLA, Tanzania*

Robyn Alders – *University of Sydney, Australia*

Wende Maulaga – *Nkuku4U, Tanzania*

Julia de Bruyn - *University of Sydney, Australia*

Elpidius Rukambile - *Nkuku4U, Tanzania*

Msafiri Kalloka - *Nkuku4U, Tanzania*

Nkuku4U team and staff at TVLA

Australian Government

Australian Centre for International Agricultural Research

Australian AID

REFERENCES

Alders, R.G., Bagnol, B. and Young, M.P. (2010): Technically sound and sustainable Newcastle disease control in village chickens: lessons learnt over fifteen years. World's Poultry Science Journal 66(03), 433-440.

Carletto G., Ruel M., Winters P. & Zezza A. (2015). – Farm-Level Pathways to Improved Nutritional Status: Introduction to the Special Issue. *Journal of Development Studies,* **51** (8), 945-957. doi: 10.1080/00220388.2015.1018908.

NBS and ICF Macro. (2011): Tanzania Demographic and Health Survey 2010. National Bureau of Statistics, Dar es Salaam, Tanzania, and ICF Macro, Maryland, USA.

Ruel, M., and H. Alderman. 2013. "Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition?" The Lancet 382 (9891): 536–551.