An Explanation of Oscillating Cashflows Experienced by Ugandan Smallholder Farmers: The First Use of a Model to Simulate the Effects of Trader Business Strategies on Farmer Livelihoods

Katherine R. Picchione

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Extended Abstract

The agricultural sector is a staple of Uganda's economy, employing 75% of Ugandans and accounting for 85% of export earnings (USAID, 2017). However, many smallholder farmers, who typically cultivate two hectares or less, experience volatile cashflows around crop cycles. Before the growing season begins, farmers invest in seeds, agrochemicals, tools, and field preparation; farmers' returns on investment come at the harvest, though not without risk. Financial services are limited in rural Uganda, and crop insurance is essentially non-existent for smallholder farmers. Consequently, farmer livelihoods are vulnerable to uncertain growing conditions, market price fluctuations, and financial shocks such as hospital bills or school fees. Farmers have limited cash during the growing season and the most financial stability at harvest, a pattern of behavior offering a veritable reference mode for system dynamics models.

Agribusinesses—commodity traders in particular—are well positioned to help farmers access knowledge, goods, and services necessary for production. This paper contributes to a larger body work that explores the extent to which trader business strategies might be leveraged to mutually benefit agribusiness growth and farmer livelihoods (Picchione, 2018 (forthcoming)).

The dynamic hypothesis is that **oscillations in farmer and trader cash are caused by concentrated costs surrounding resource-constrained crop production and changing market prices.** To explore this hypothesis, I designed a system dynamics model to simulate fluctuations in farmer cash. The model is based on empirical evidence from interviews with Ugandan agribusinesses and subsequent qualitative analysis. The model is explanatory, elucidating the underlying causal structure of growth modalities in the process. It is also a platform that can be used to explore how business strategies affect farmer and trader cashflows. This paper describes the model structure, base model behavior, and modifications for testing two trader business strategies: (1) financing of agricultural inputs, and (2) increasing farmer yields.

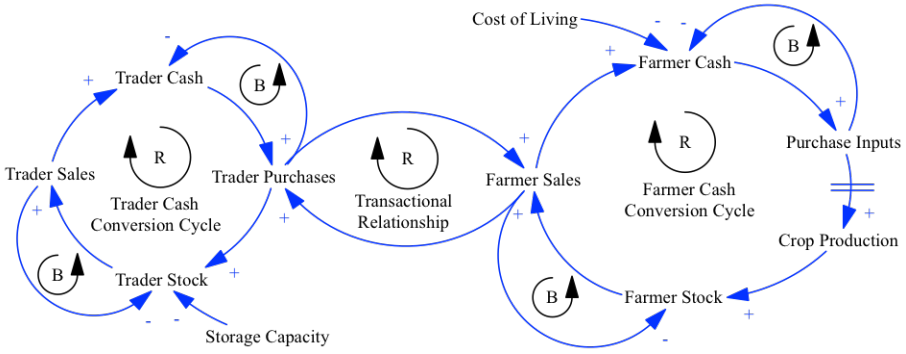

Figure 1: Causal loop diagram of the transactional relationship between farmers and traders.

The model has two main components: a structure simulating farmer production and sales, and a structure simulating trader purchases and sales. Stocks include Trader Cash, Trader Inventory, Farmer Cash, Farmer Crops in Fields, and Farmer Crops in Stock. Both structures are governed by a strong, second order positive feedback loop called the Cash Conversion Cycle, the main driver of business growth and farmer income.

The model emulates how farmers plant crops, grow crops, harvest them, and sell them to traders. Traders in turn are able to purchase, store, and sell crops at a profit. Additional variables impose costs (costs of production, living expenses), limits on crop production capacity (planting area), limits on crop storage capacity, growing season restrictions, and time constants (time to plant, time to grow crops, transaction time). The model also includes a construct for Indicated Month, which relies on the Get_Time_Value function of Vensim DDS and is used to dictate growing seasons and price seasonality. In the Base Case simulation (Figure 2), the model produces reference mode behavior: oscillating cash. The Base Case model and simulations are included as supplemental materials. Auxiliary variables were populated with real data or reasonable estimates based on fieldwork.

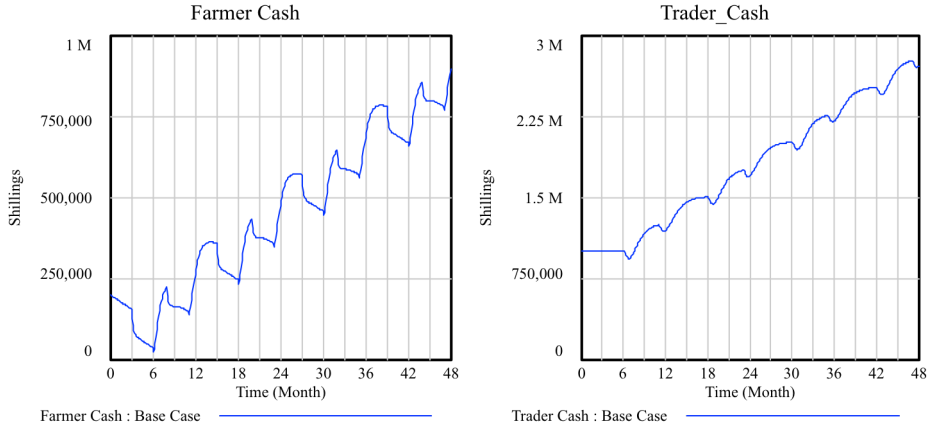

Figure 2: Farmer and Trader Cash under Base Case conditions

Sensitivity analysis reveals that, when paired with costs of production and living, crops maturation time is the major cause of fluctuations in farmer cash. Crops In Fields is the stock responsible for the main oscillations since Time to Grow Crops is the longest delay. Thus, analysis of the Base Case model confirms that farmer livelihoods are most vulnerable to financial shocks during the growing season because funds are tied up in production—and not without high risk.

The Base Case model was modified and used to test two trader business strategies: (1) financing of agricultural inputs, and (2) increasing farmer yields.

Inputs financing creates resilience by offsetting concentrated expenses. Several simulations were run to test the effects of an Inputs Financing business strategy. Where the cost of seed and input chemicals is offset by a trader, a farmer facing bankruptcy is able to plant and produce instead. By offering credit for inputs or, by extension, for other concentrated expenses, the trader builds resilience into the supply chain. At the same time, the farmer benefits from less volatile cashflow. When traders have lenient payback policies, farmers also benefit from inputs financing as a type of informal insurance against a bad season.

Production efficiency has a strong direct effect on trader and farmer cash. Traders use various methods to help farmers increase yields. To observe the effect of production efficiency on cash, Farmer Yield was set to 1%, 20%, 50%, and 100% of the theoretical maximum. Predictably, increased yield leads to increased income. Of all the causal links and feedback loops explored, the relationship between yields and cash is perhaps the least complex. As described by traders in interviews, more quantity leads to more income. When farmers have higher yields, both farmers and traders benefit. Thus, incentives are aligned for traders to help farmers increase yields.

However, the mechanisms by which traders influence farmer yields proved difficult to model. Several unsuccessful attempts were made to add structure for training, adoption of methods, and provision of quality inputs and services. While qualitative analysis of methods for increasing yields was quite extensive in previous work, constraints on data and time made it difficult to discern additional causal structures. Further empirical evidence is needed to model *how* traders provide these benefits to farmers—and how they then benefit in return. Herein lies a great opportunity for future work in applied system dynamics.

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