Quantitative value chain approaches for animal health and food safety

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Outline

• Motivation: why value chains, why quantitative methods?

• Method: role of system dynamics

• Example: food safety in Viet Nam

• Next steps – areas for future research
Context: what role for economics?

- Economic impact assessments – increasingly important in animal health/food safety
- Increased risk (globalization, trade, perceptions)
- Greater demands on scarce resources ("how to get greatest return for money?")
- How to prioritize control efforts?
Context: what role for economics?

• Focus of economic impact studies (and policy) generally at farm level.

• But impacts (and risks) exist downstream: think about roles played by traders, processors, retailers, etc.
Perceptions of risk at farm level, but...
... animal health and food safety risks exist downstream too.
Motivation

Context: why value chains?

• Systems context – actions taken by one affect all

• “Weak links” in the chain may accentuate disease risk

• But need to understand who these stakeholders are, how they interact with others, and why they behave as they do.
A generic livestock value chain

Where are the risks and why do they occur?
Motivation

Context: why value chains in impact assessment?

• Assess impacts on different actors and feedbacks (economic, behavioral)

• Assess constraints to uptake (behavioral, socio-economic, institutional, cultural)

• Identify critical control points: links to risk analysis
Motivation

Gaps with value chain analysis

• Most applications descriptive/qualitative

• How to assess tradeoffs and returns to different options?

• Research need – quantitative approaches with interfaces to epidemiology and risk analysis

• A role for system dynamics
Method

- System dynamics – a computer aided simulation approach to model development and policy analysis

- A method for studying complex dynamic systems that include nonlinearities, delays, and feedback loops.

- Multidisciplinary, holistic, ability to link across disciplines (economics, epidemiology, biology, food science, etc.)
Key concepts

- Stocks (accumulation)
- Flows (change overtime – rate/time unit)
- Feedback loops (circular causality)
- Delays
Modular approach

- Animal disease dynamics
- Investment dynamics
- Market dynamics
- Biosecurity
- Trade
- Sales
- Resource constraints
- Environmental impact

Animal production
Why system dynamics?

• Understanding the impact of VC investments
  – The general performance of a chain
  – The ability to evaluate ex-ante between different options

• Conventional value chain analysis: good at stories and description, less good on measurement.
System dynamics applied to food safety and animal health in Viet Nam

- **Food safety and animal health**: important constraints to smallholder pig production in Viet Nam
- High prevalence of animal disease and food-borne pathogens within the Vietnamese pig sector
- Important **negative livelihoods effects** on smallholder pig producers and other value chain actors, as well as important **public health impacts**

**Question**: where to intervene in the chain to maximize pro-poor returns?
PigRISK project (2012-2017)

Funded by ACIAR, implemented by ILRI, VNUA, VSPH

Aim: To assess impacts of pork-borne diseases on human health and the livestock sector and identify control points for risk management.

Focus on risk based approaches
Qualitative/quantitative risk assessments

Multi-disciplinary team: Vets, public health, economists, environmental specialists

Data collected: Value chain survey, biological sampling, questionnaires, participatory epidemiological tools

Use of SD to look at “best-bet” interventions
Value chain modules

The structure of the value chain

- Farm revenues and costs
  - Press for information on farm-level revenues and costs

- Production by region and system
  - Press for information on production

- Processing and retail
  - Press for information on processing and demand

- Farm investment and innovation
  - Press for information on investment dynamics
Production module

Age cohorts, separated by region and production system
Production module

Sales channels for pigs

Interventions to reduce death rate at farm level (these add costs also – not shown here)
What are the tradeoffs between the benefits of interventions and their costs over time, taking into account market adjustments?

Productivity effect from healthier pigs

Income effects on consumers: healthier consumers spend more on all goods, including pork

But interventions come at higher compliance costs at slaughterhouse – higher prices
Use of modeling interfaces

Policy scenarios

1. Animal health intervention
   - % increase in income
   - Death rate reduction
   - Weeks for intervention
   - % increase in pig weight
   - Additional weekly costs at farm level

2. Public health intervention (Hung Yen only)
   - % increase in slaughterhouse margin
   - % increase in income from better health

Simulation results

For illustration, we highlight two types of interventions:
1. Interventions in disease control that both reduce mortality and increase liveweight;
2. Interventions in pathogen reduction that increase food safety and thus increase income.

For simplicity, we allow these parameters to be adjusted by different percentages to reflect the expected change in benefits and costs.
Application

Four scenarios

1. An animal health scenario to reflect the adoption of GAHP as a means of promoting better animal health. Assumes an increase of costs of 10%, against an increase in productivity of 20% and a reduction of animal mortality of 50%;

2. Scenario (1) under a scenario in which costs rise by 5% instead of 10%

3. Impacts of a 20% rise in slaughterhouse margins against a 20% in increase in income associated with public health.

4. Scenario (3) under a scenario in which incomes rise 10% instead of 20%

Scenarios run over 20 years, with interventions taking place in year 3.
Consumer prices under GAHP scenarios

Meat sales under GAHP scenarios
Consumer prices under food safety scenarios

Meat sales under food safety scenarios
Extensions

Next steps

• Mainstreaming systems approaches and systems thinking

• Improved modeling platforms and community of practice

• Improved data collection platforms – the role of participatory processes and group model building
Extensions

Group model building (GMB)

• A participatory process aimed at:
  – Identifying and prioritizing the key problems in the system
  – The causes of these problems
  – The consequences of these problems

• SD principles and language (stocks/flows/feedbacks) are used to facilitate this discussion

• Model development and construction based on this process

• New extensions (spatial GMB): see Rich, Rich, and Dizyee (2016)
1. Descripción de la situación actual
2. Gestión de producción sostenible
3. Mejora de la infraestructura y el manejo del agua
4. Mejora de la calidad del suelo
5. Mejora del rendimiento de la productividad
6. Mejora del manejo de la eficiencia
7. Mejora de la eficiencia energética
8. Mejora de la gestión de la calidad del producto
9. Mejora de la gestión del riesgo
10. Mejora de la gestión del cumplimiento
11. Mejora de la gestión del cumplimiento de los estándares de calidad
12. Mejora de la gestión del cumplimiento de los estándares de seguridad
13. Mejora de la gestión del cumplimiento de los estándares de salud
14. Mejora de la gestión del cumplimiento de los estándares de ambiente
15. Mejora de la gestión del cumplimiento de los estándares de ética
16. Mejora de la gestión del cumplimiento de los estándares de gobierno
17. Mejora de la gestión del cumplimiento de los estándares de innovación
18. Mejora de la gestión del cumplimiento de los estándares de innovación tecnológica
19. Mejora de la gestión del cumplimiento de los estándares de innovación de productos
20. Mejora de la gestión del cumplimiento de los estándares de innovación de servicios
21. Mejora de la gestión del cumplimiento de los estándares de innovación de procesos
22. Mejora de la gestión del cumplimiento de los estándares de innovación de estrategias
Definición sistema de alimentación animal

Consecuencias

- Baja producción animal
- Inseguridad alimentaria
- Afectación de las medidas de vida de la familia
- Pérdida de la calidad y peso
- Efecto negativo al medio ambiente
- Problemas con la población
- Enfermedades zoonóticas
- Valor de la finca es diferente

Falta de incentivos para aumentar la calidad de leche
Conclusions

Added value from systems approaches to animal health and food safety

• Improved information on the chain to improve the effectiveness of interventions and their sustainability

• A planning tool for future policy development

• A way to develop shared solutions in a participatory manner and a platform for joint learning

• A means to communicate chain-level needs to government, donors, etc. more effectively.