ANH 101
Core Disciplines in Agriculture-Nutrition-Health Research

20th June 2016

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Session 1: Economics

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What is Economics?

Adam Smith “an inquiry into the nature and causes of the wealth of nations,"

Alfred Marshall (1890) “examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing.”

Lionel Robbins (1932): Allocation of scarce resources to alternative uses

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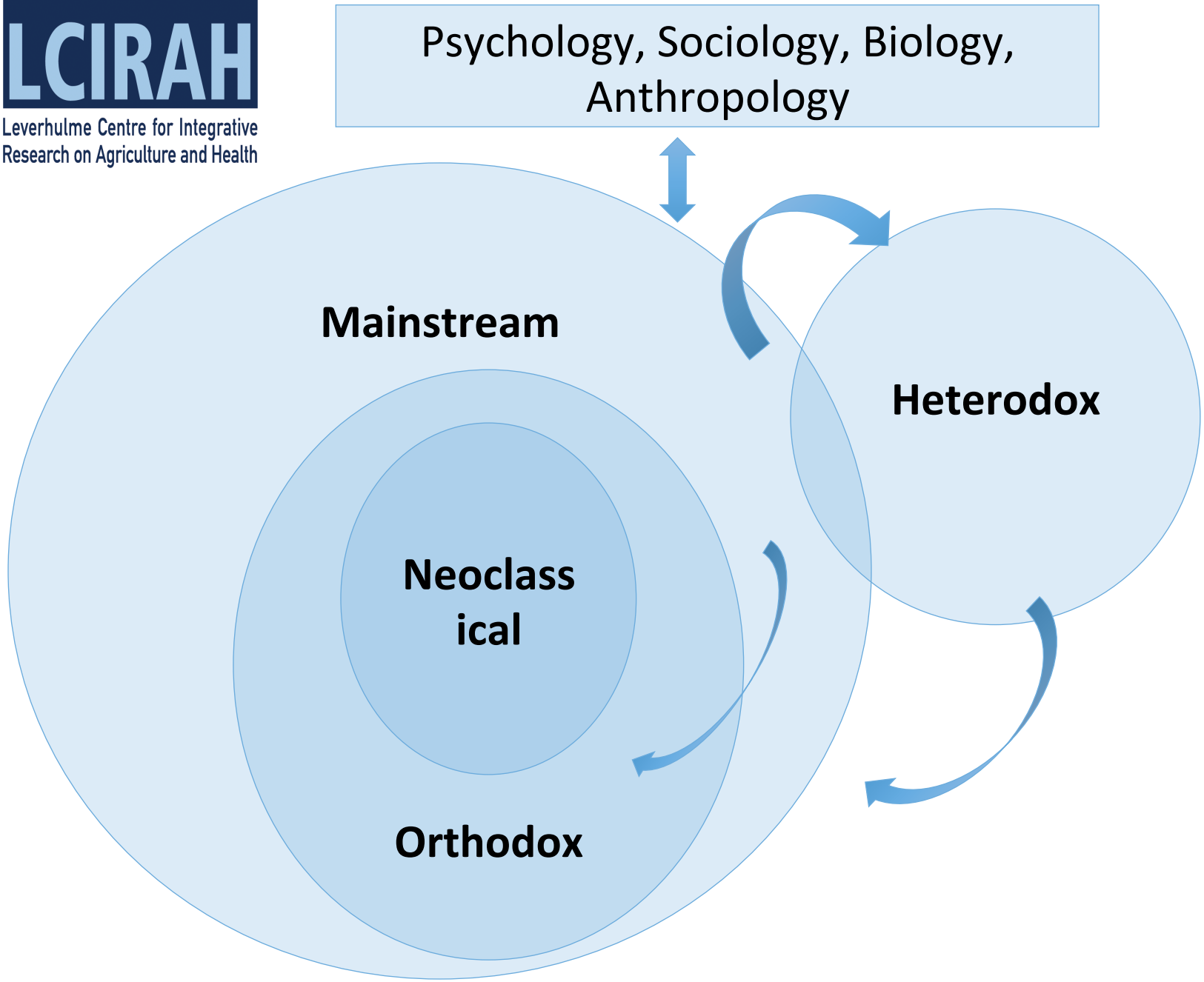

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Positive and Normative Economics

Is there a real difference?

Positive → Statements about associations, cause and effect.

Are meant to be objective and verifiable.

"The cost of controlling disease in livestock is smaller than the benefit obtained" "Increased public investment in disease control increases early detection rates"

Normative → Statements that can incorporate value judgements, explicitly stem from a specific philosophical perspective or opinion

"The government should be responsible for pathogen control in livestock", "everyone should have access to a healthy and affordable diet" "each person should be considered the best judge of their own preferences"

Agricultural Economics

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Content

- Economics for Agriculture
  - Agriculture sector and economic growth relation
  - Agriculture for poverty reduction and improved nutrition

- Methods
  - Impact assessment and programme evaluation
  - Counterfactual approach
  - Selection Bias
  - Finding a counterfactual

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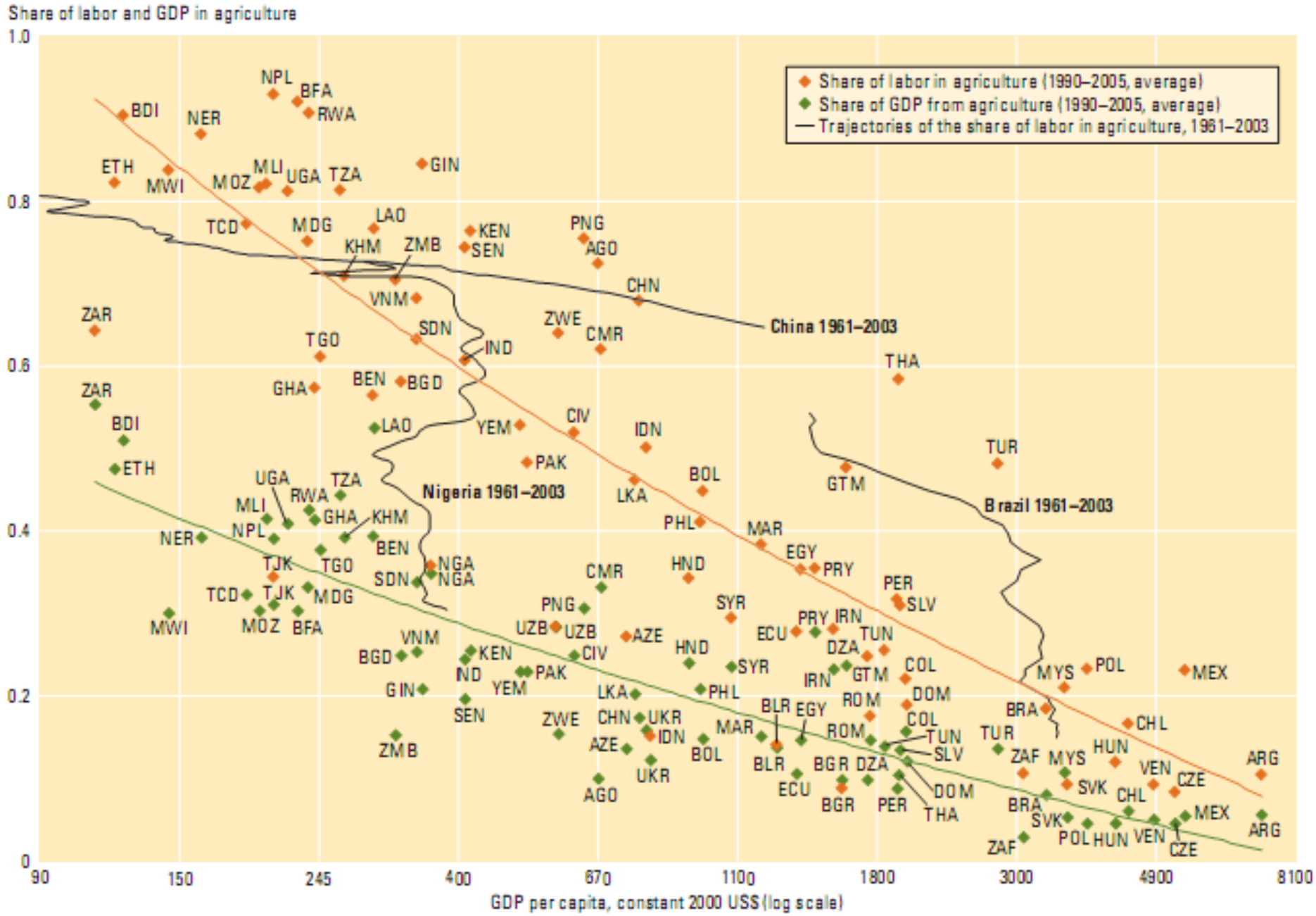
- “Most of the people in the world are poor, so if we knew the economics of being poor we would know much of the economics that really matters. Most of the world's poor people earn their living from agriculture, so if we knew the economics of agriculture we would know much of the economics of being poor.”

- Theodore Shultz in his acceptance speech for the 1979 Nobel Prize in Economics



Source: World Bank - World Development Report 2008

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Agriculture and Economic Growth

- There is an inverse relationship between per capita GDP and the percentage of labour force in agriculture
- In 2003

Country	Labour Force	GDP
UK/USA	3%	2%
South Korea	12.5%	6%
Brazil	20%	9%
China	54%	20%
India	67%	28%

Source: Bhaduri (2003)

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Agriculture and Poverty Reduction

- Three main links between agriculture and poverty reduction (Thirtle et al, 2001)
  - Income from farms
  - Income from wage labour (not all farm workers are farmers)
  - Lower food prices
- GDP growth in agriculture is twice as effective as in other sectors at reducing poverty – World Bank 2008
- Various studies find a yield increase of one-third might reduce poverty by 25%
  - Irz et al (also in Ashley & Maxwell)

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Agriculture and Nutrition

- Links
  - Own production pathway
  - Income pathway
  - Food prices
  - Market pathway (purchase via income)
  - Gender pathway

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Agriculture and Nutrition

- But these are changing as structure of food systems change
  - Food market globalisation
    - Global food markets influence local diets
  - Modernisation of food value chains in developing countries
    - Inclusion of smallholders? – poverty linkages
  - Climate change
    - Will it force us to make new production decisions and how this will change our food habits?

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Methods

- Impact assessment and programme evaluation
  - Examples include new rice irrigation technology
  - Or impact of food price rise on farmers and consumers
- Objective
  - Extent of adoption
  - Average effect of adoption
    - Increase in rice yields due to irrigation scheme
    - Changes in calorie intake

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Methods

- Challenges
  - Adoption rate
    - Fairly simple to estimate using survey data
  - Impact on outcomes of interests
    - Estimating effect on correct population
      - A sub-population may be more likely to adopt over others
    - Establishing causality
      - Differences between observed versus unobserved characteristics
    - Spillover effect of intervention

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Methods

- Counterfactual approach

$$D_i = \begin{cases} 1 \text{ if individual } i \text{ participated in the programme} \\ 0 \text{ otherwise} \end{cases}$$

  - Di =1 is treatment group or adopters
  - Di =0 is control group or non-adopters

  – 'What if' question

$$y_i = y_{i0} + D_i \left(y_{i1} - y_{i0} \right) \tag{1}$$

That is, for individual i we observe EITHER y_{i0} OR y_{i1}, BUT NOT BOTH!

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Methods

- Selection bias
- Randomisation
- Finding a true counterfactual
  - Selection on observables
    - Propensity Score Matching (PSM)
  - Difference –in-difference (DID)

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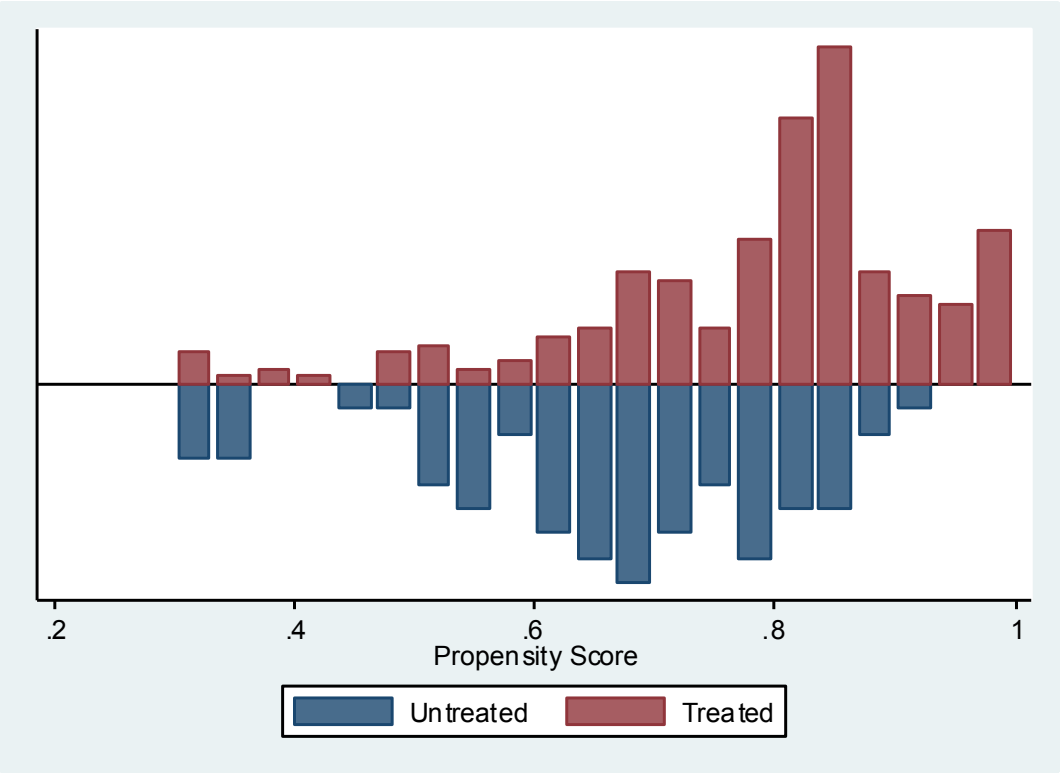
Methods

- Matching
  - Method compares outcomes of treated group with similar observations from the control group based on observed characteristics



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Methods

- Difference-in-difference (DID)
  - Take the difference pre and post programme data for both treated and control groups
  - Panel data
  - Controls for the time-invariant characteristics of farmers when comparing treated group with control
- Cross-sectional approaches require that, after controlling for observable characteristics, the 2 groups would have same expected outcomes in the absence of treatment
- While DID approach instead requires that after controlling for observables, the change in expected outcomes between pre and post-adoption surveys would be the same in the absence of adoption.

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Methods

- Measures of impact
  - ATE: average treatment effect
    - Average impact of intervention on outcome variable
    - Estimated by taking the average y_{i1} of treatment group and y_{i0} of untreated group
  - ATT: average treatment on the treated
  - ATU: average treatment on the untreated
  - LATE: local average treatment effect
    - estimation of the average treatment effect to the subpopulation of "compliers", that is the potential participants of intervention

$$ATE = pATT + (1 - p)ATU$$

    - Where p is the proportion of population in the treatment group

Health economics in agri-health research

Soledad Cuevas and Laura Cornelsen

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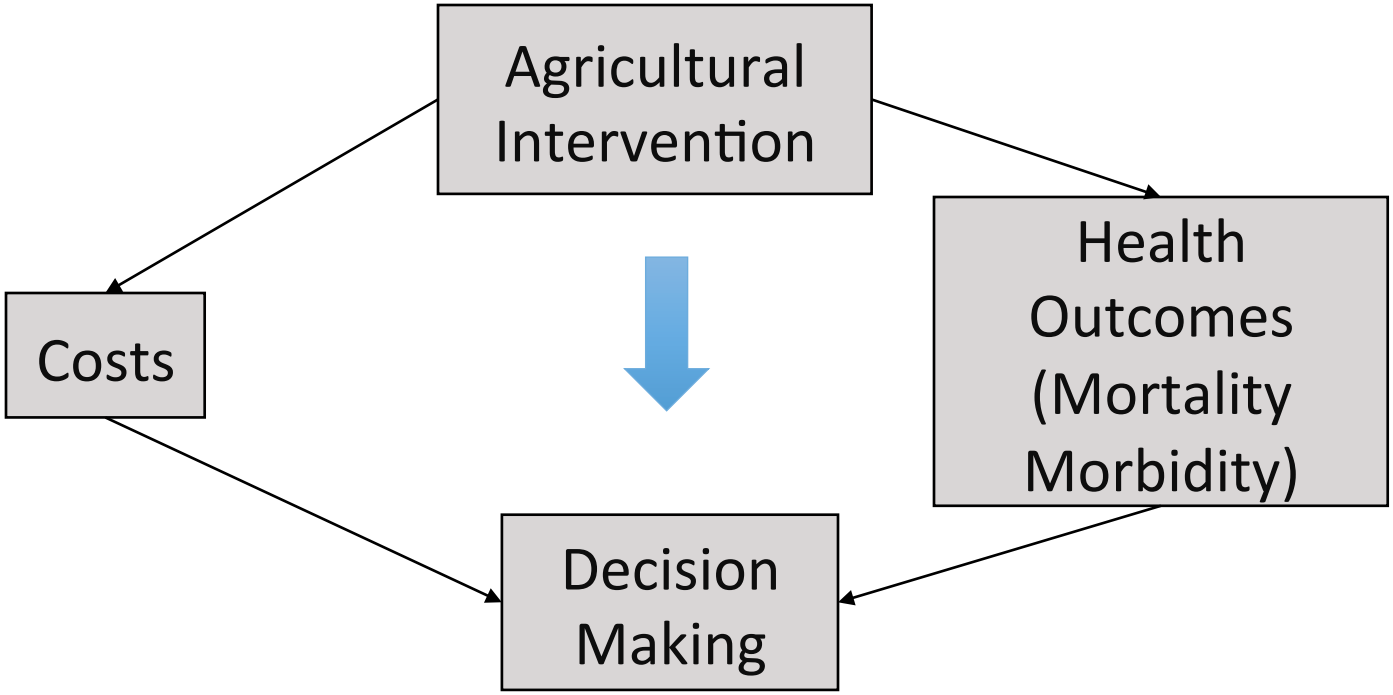
Evaluation of agricultural interventions. Cost-effectiveness, cost-utility and cost-benefit

Is this intervention worthwhile, compared to a specific alternative?



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Health economic impacts and cost-effectiveness of aflatoxin-reduction strategies in Africa: case studies in biocontrol and post-harvest interventions

F. Wu* and P. Khlangwiset

Department of Environmental and Occupational Health, University of Pittsburgh, 100 Technology Drive, Pittsburgh PA 15219, USA

(*Received 12 June 2009; final version received 23 October 2009*)

Advances in health economics have proven useful in evaluating the cost-effectiveness of interventions, where the benefit usually takes the form of improved health outcomes rather than market outcomes. The paper performs health-based cost-effectiveness analyses of two potential aflatoxin control strategies in Africa: (1) pre-harvest

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How cost-effective is biofortification in combating micronutrient malnutrition? An *ex-ante* assessment

J.V. Meenakshi, Nancy Johnson, Victor M. Manyong, Hugo De Groote, Josyline Javelosa, David Yanggen, Firdousi Naher, Carolina Gonzalez. James Garcia and Erika Meng

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Costs

Programme implementation

- Fixed (infrastructure, equipment)
- Variable (salaries, energy use)
- Set-up costs (organization, administrative)

Health related costs or cost-savings

- Productivity
- Labour supply
- Health Care costs
- Indirect and intangible costs

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Evaluation of agricultural interventions: Cost benefit

	Cost / Effectiveness	Cost / Utility	Cost / Benefit
Measures	YLG Cases detected Etc.	QALYS DALYS	Value of a statistical life WTP per QALY

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Cost effectiveness

	Aflatoxin Reduction in Maize	Aflatoxin reduction in Groundnut, post-harvest
Cost	1 million$	20 million $
Outcome	10000 cases prevented	40000 cases prevented
Ratio (ICER)	100$/case prevented	50$/case prevented
Comparison	????	????

*Hypothetical figures, the case of aflatoxin is only used as illustrative of the concepts

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Cost utility

	Aflatoxin Reduction in Maize	Aflatoxin reduction in Groundnut, post-harvest
Cost	60 million	80 million $
Outcome	200, 000 DALYs	400,000 DALYs
Ratio (ICER)	30$/DALY	20$/ DALY
Comparison Ranking	2(?)	1(?)

*Hypothetical figures, the case of aflatoxin is only used as illustrative of the concepts

Budget

Thresholds

Giving a monetary value to health outcomes

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Evaluation of agricultural interventions: Cost benefit

	Cost / Effectiveness	Cost / Utility	Cost / Benefit
Measures	YLG Cases detected Etc.	QALYS DALYS	Value of a statistical life WTP per QALY

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Methodological approaches and policy making

Inequality?

Political power?

Changing preferences and cultural norms?

Is reductionism always a problem?

Economics of Animal Health and One Health

Mieghan Bruce, Pablo Alarcon, Barbara Häsler, and Jonathan Rushton

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Key concepts

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Animal Health

- The "physical, mental and spiritual well being of an individual animal"

AND

- A "state of maximum economic production" (Martin, 1987)

One Health

- The health of people, animals and the environment are inextricably linked.
- Requires "the integration of relevant sciences at the systems level"

(Häsler et al, 2014)

Disease transmission and impact?

Rules and incentives?

FOOD SYSTEM

ENVIRONMENT

Risk perceptions?

Uncertainty?

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Disease impact

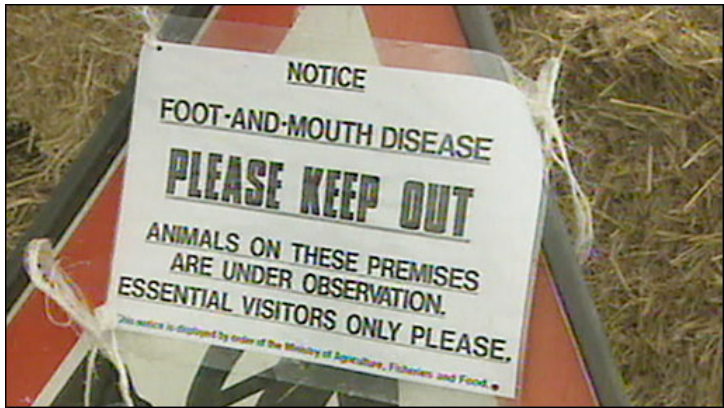
Example: Mitigation Strategies for Foot and mouth disease

1. Farmer does nothing

- **Farmer:** least cost option - affect on productivity is less than cost of control
- **Society:** loses international trade of livestock and livestock products

2. Government imposes depopulation of the farm

- **Society:** least cost option - avoid further disease spread and markets unaffected
- **Farmer:** loses all their stock



Economic methods and tools used in animal health and one health

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Economic methods

Assessing disease impact - orthodox

- Gross margin
- Partial budgeting
- Production function
- Cost-benefit analysis
- Cost-effectiveness analysis

Assessing risk and uncertainty – mixed methods

- Sensitivity analysis
- Break-even analysis
- Decision tree analysis

Assessing behaviour and risk perception – heterodox

- Agent-based modelling
- System dynamics
- Value-chain analysis

Application Of Value Chain Analysis To A Food System

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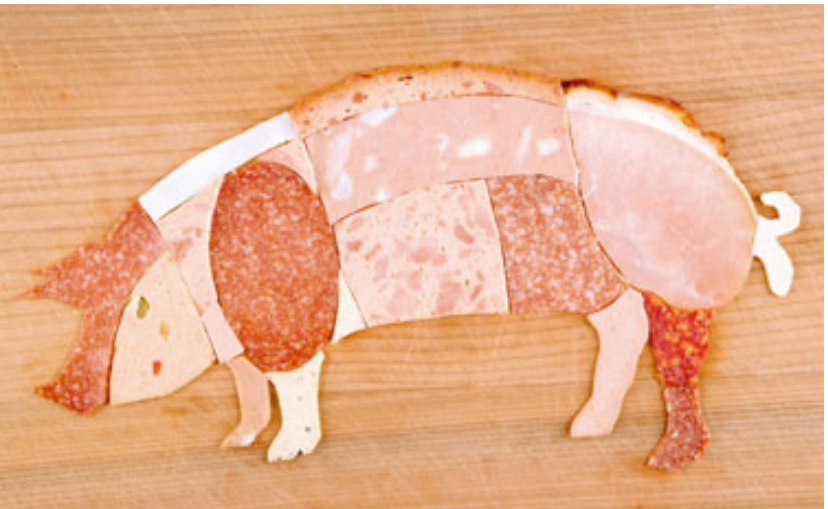
Salmonella in pig food systems

- Salmonella identified as a major food-borne pathogen
- Some food-borne salmonella comes from pig production system

WHERE TO INTERVENE?



- *Disease impact*
- *Risk and uncertainty*
- *Risk perception and behaviour*

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Moral hazard

- Actions of one party may lead to the detriment of another
- Occurs when a person takes risks because the cost that could incur will not be felt by them or will be borne primarily by others.

Dealing with businesses and people who need to make a profit for a living (profit thinking)

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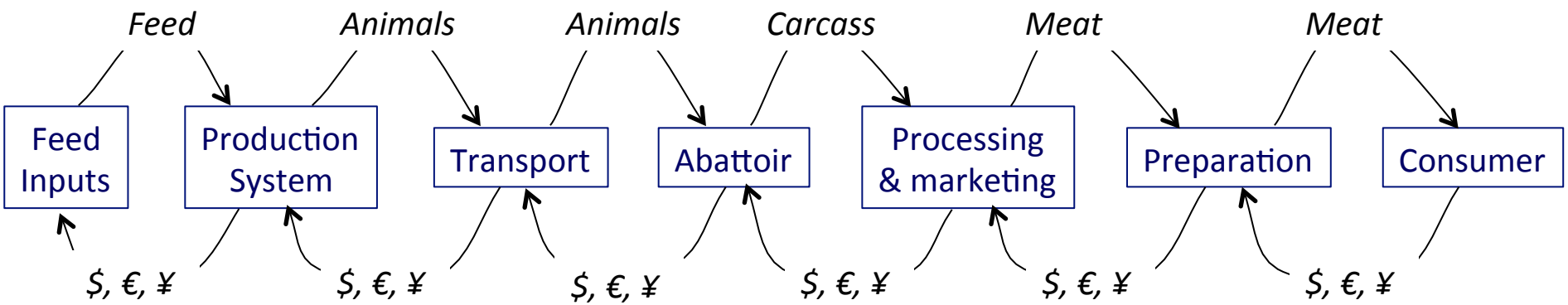
Basic pig food system



- Provides food for human consumption
- Moves money
- Generates employment
- People in the chains are **GEOGRAPHICALLY DISPERSED** great likelihood of ***moral hazard***

Acknowledgement: Jonathan Rushton

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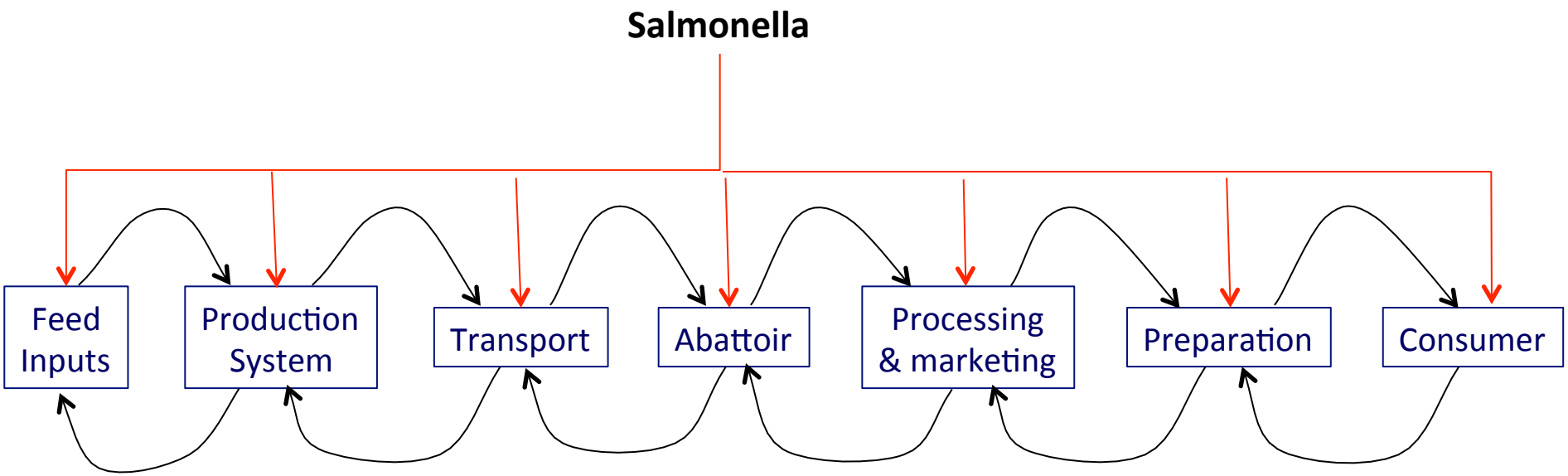
Pig food system and salmonella



In the pig food system salmonella pathogen:

- can be maintained
- spread in both directions
- be introduced from external sources

Acknowledgement: Jonathan Rushton

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How do we achieve sustainable, stable and safe supplies of food?

- **Epidemiology** of health – animals as sentinel beings and risk factors for pathogens
- Context in which diseases circulate – **food system**
- Rules by which people operate – **institutional environment**
- Response of the people concerned – **risk perception** and **behaviour**
- **Uncertainty** – the role of chance in disease events

Acknowledgement: Jonathan Rushton

Thank you for listening!

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