

BROOKINGS

QUALITY. INDEPENDENCE. IMPACT.

# Agent-Based Modeling: New Methodologies in Impact Analysis

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# Outline

- Understanding Impact Analysis
- Agent Based Modeling
- ABM: How can it help you
- Methods for Impact Evaluation
- Conclusions: Future Directions

# What is Impact Analysis?

- The design, implementation, and evaluation of a social or technological **innovation** in a **real-world setting** that improves the **well-being** of individuals or communities.
- Examples:
  - Introduction of a regulation
  - Creation of a new social program
  - Dissemination of a new technology
- Outcomes of Interest:
  - Health indicators (life expectancy, nutritional status)
  - Economic indicators (GDP, household income)

# Stages of Impact Analysis

- Part 1: Before Roll Out
- Designing Roll-out Process
- Modeling Potential Impact
- Part 2: During/After Roll-Out
- Piloting
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# Designing Roll-Out

- How can we disseminate the innovation so as maximize the potential benefits?
- Considerations:
  - » Decision makers/ Decision Process
  - » Education
  - » Community Leaders/ Politicization
  - » Dissemination Channels

# Modeling Potential Impact

- Given the options of how to roll-out or disseminate the innovation, what will the potential impact be on individuals and communities?
  - Will the new innovation be adopted?
  - How fast will it spread?
  - Will the benefits be shared by all?
  - How will it interact with other programs?

# Agent-Based Modeling (ABM)

- A general tool to allow researchers and policy makers to simulate social or scientific phenomena in a computerized laboratory setting, in order to better understand how these phenomena will unfold in real-world settings.

# ABM: Building Blocks

- Components
- Agents
- Behaviors
- Landscape
- Key Concepts
- Bounded Rationality
- Heterogeneity
- Emergence/Bottom-Up Approach

# What is ABM Used For?

- Diffusion/ Contagion processes
- Social Networking applications
- Population Dynamics
- Spatial Analysis
- Most useful for understanding large-scale (macro) implications of individual-level (micro) processes

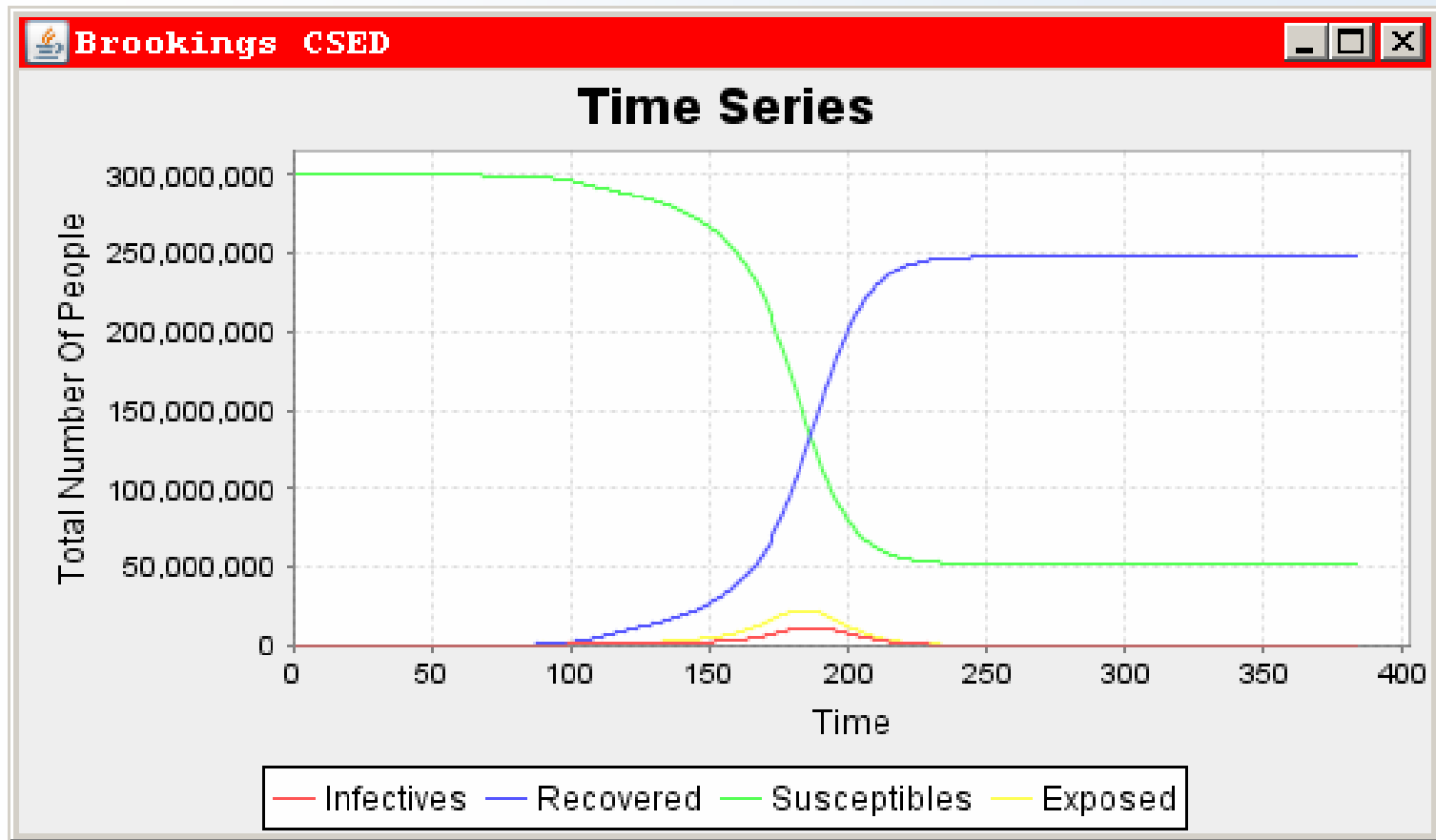
# How to Build an Agent-Based Model

- Domain Experts and Modelers Meet
- Story-Boarding
- First-pass model with basic behaviors
- Iterations to add more complexity

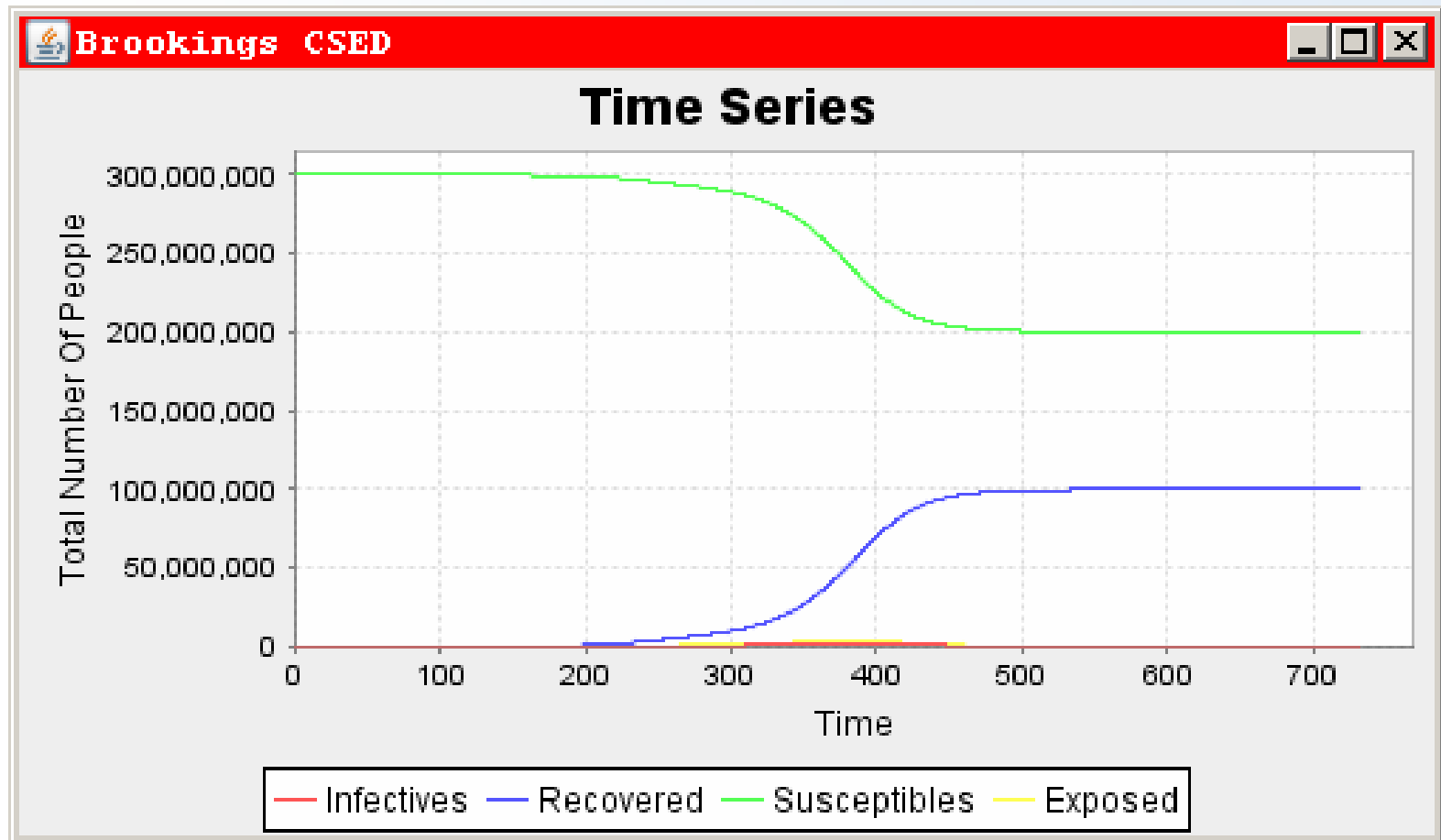
# ABM: Examples

- Technology Diffusion
- Agricultural Practices
- Teenage Smoking
- Kayenta Anasazi
- Epidemics

# ABM: Examples (2)



# ABM: Examples (3)



# ABM: How it can Help YOU

- Delivery and Dissemination of Bio-Fortified Staple Crop Species
- How are new crop species adopted, marketed, and consumed?
- How are the benefits of new crop species distributed across society?
- How will the dissemination unfold under different scenarios?

# ABM: How Can it Help You To... Design Roll-Out

- What are the best dissemination channels?
- Who should provide extension?
- When should the new varieties be introduced?
- To whom should the new foods be piloted?

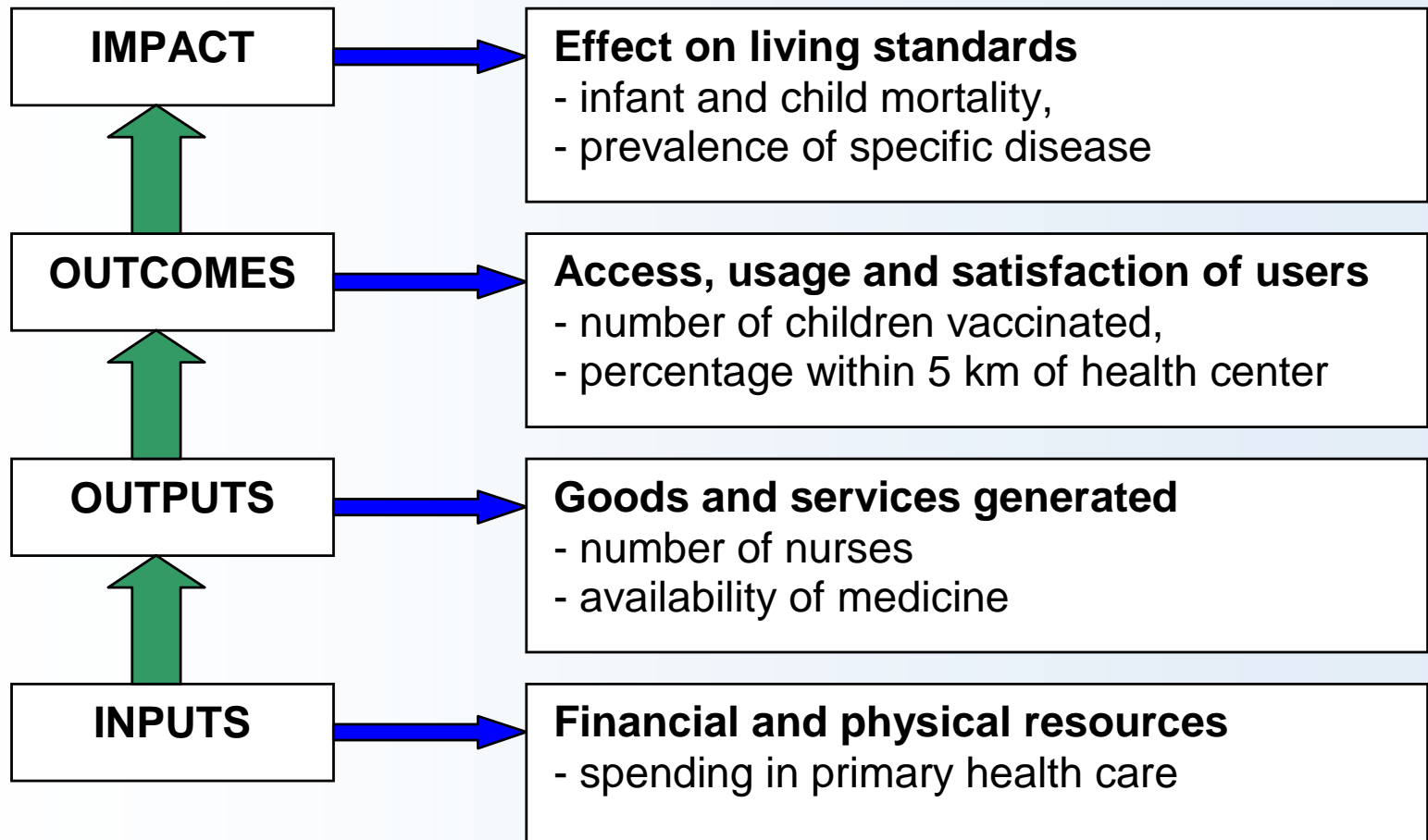
# ABM: How Can it Help You To... Model Potential Impact

- How will farmers and consumers benefit from new crop species?
- How will markets be affected by these new foods?
- Heterogeneous effects
- Static vs. Dynamic impacts

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# Impact Evaluation



# Impact Evaluation

- Experimental Methods
- Quasi-Experimental Methods
- Non-Experimental Methods
- Qualitative Methods

# Experimental/Quasi-Experimental Methods

- Need a comparison group that:
  - » Is as identical as possible in observable and unobservable dimensions to those receiving the program
  - » Will not receive spillover benefits
- How to construct a comparison group (building the counterfactual):
  - » Randomized Controlled Trials (RCT)
  - » Controlled Trials (Difference-in-Difference)
  - » Exploiting spatial and temporal differences in roll-out

# Non-Experimental/Qualitative Methods

- Comparing before-and-after measures
- Focus Group Discussions
- Key Informant Interviews

# Directions for Future Work

- Using ABM before roll-out to understand process and estimate potential impact
- Using Impact Evaluation after roll-out to identify benefits and beneficiaries

# Resources for More Information about ABM

- Liz Else. “Can We Model the Real World?”, *The New Scientist*. Vol. 194, Iss. 2603. May 12, 2007.
- Jonathan Rauch. “Seeing Around Corners”, *Atlantic Monthly*. April 2002.
- Joshua Epstein. *Generative Social Science: Studies in Agent-Based Computational Modeling*. Princeton University Press, 2007.

Thank you