



R2M: Rapid risk assessment to support mitigation of plant diseases and pests



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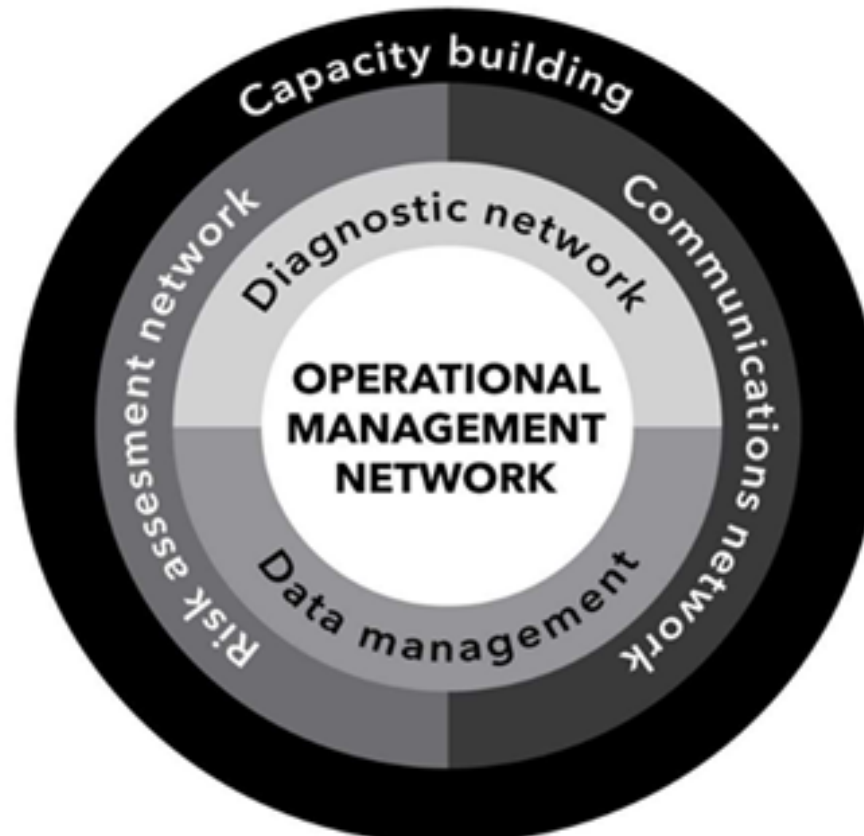
**GLOBAL FOOD
SYSTEMS INSTITUTE**



A global surveillance system for crop diseases

Global preparedness minimizes the risk to food supplies

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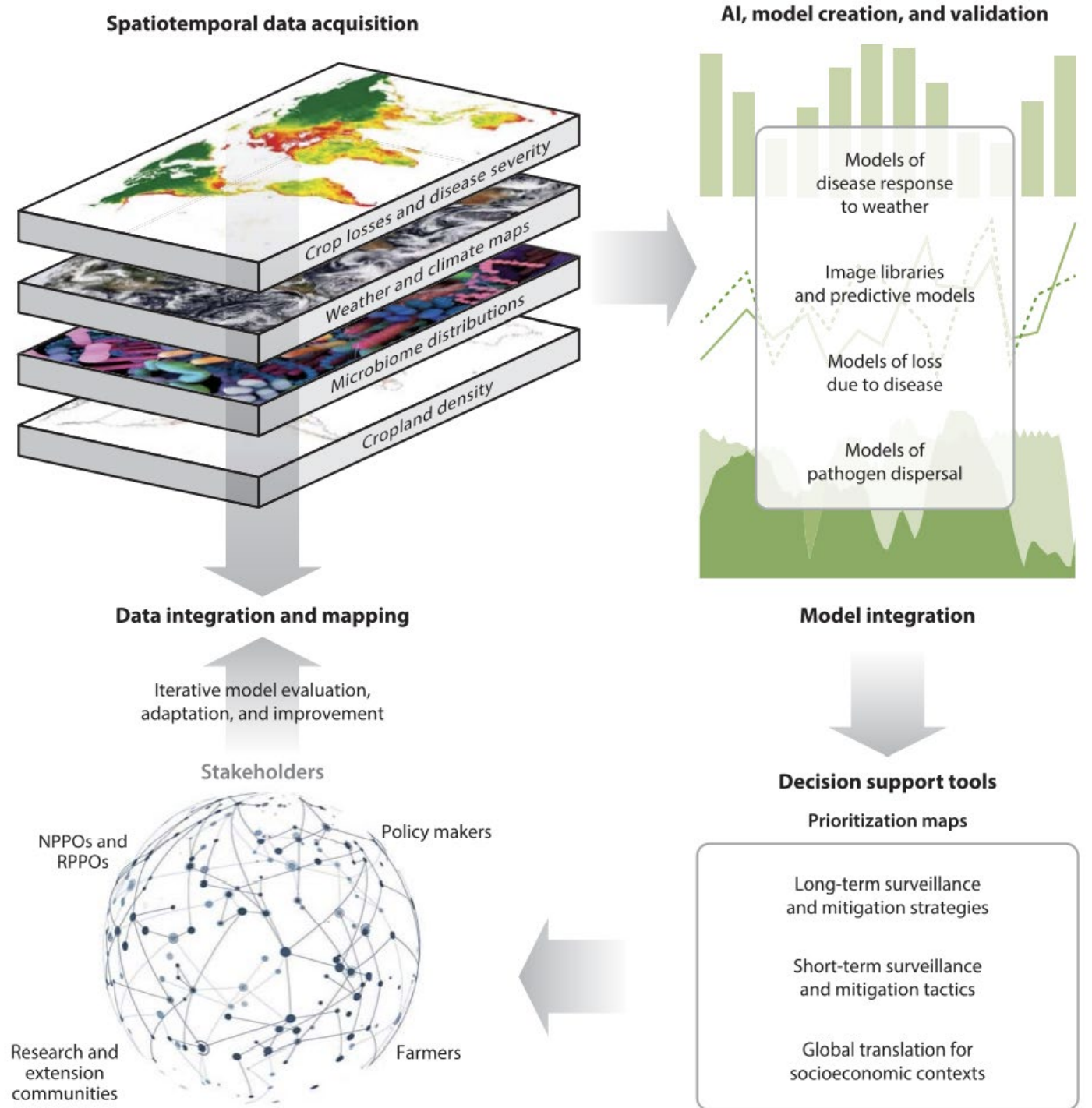


Annual Review of Phytopathology

Climate Change Effects on
Pathogen Emergence: Artificial
Intelligence to Translate Big
Data for Mitigation

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Data and model integration can improve global responses to emerging pathogens



Overview

- R2M rapid risk assessment to support mitigation
- Meta-tool for expert knowledge elicitation
- Cropland connectivity
- Scenario analysis for regional management
- Next steps

Scaling up rapid analysis with R2M



Rapid risk assessment to support
mitigation of crop diseases and pests

**Making the most of existing data and
knowledge for rapid assessment**

R2M components

- Expert knowledge elicitation
- Cropland connectivity analysis
- Scenario analysis for regional health management
- Trade network analysis
- Next options include climate-based risk



As ubiquitous as
a literature
review?

We're designing the
R2M tools to be quick
and easy to use, so
that anyone studying
a plant disease or pest
problem could apply it



R2M: integration

Potential users

- Extensionists
- Scientists
- Policy makers
- Funders
- National Plant Protection Organizations (NPPOs)
- Risk analysts such as insurers
- Private sector
- ...



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Pondering AI language models like ChatGPT

ChatGPT rapidly synthesizes huge amounts of existing information into a useable format, but doesn't 'think about it critically'

How can we design tools that rapidly synthesize knowledge AND add critical thinking?

One approach: systematic **expert knowledge elicitation (EKE)**

Expert knowledge elicitation

R2M expert knowledge elicitation can be used to establish a baseline of disease and pest risk

- RTB seed degeneration
 - Thomas-Sharma et al 2017
- Potato seed systems in Republic of Georgia
 - Andersen Onofre et al 2021
- Wheat health in Pakistan 2022
 - Afzal, Plex Sula et al, in preparation
- RTB crop health in Cameroon and Ethiopia
 - Mouafo Tchinda et al, in preparation



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Meta-tool:
tool for
building
tools

This meta-tool

- Suggests questions that organizers might be interested in
- Generates a survey instrument for expert knowledge elicitation
- Provides some standard analyses of the results

It draws on a curated set of questions that have proven useful

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Artificial
intelligence
and 'natural
intelligence'

Experts have huge
knowledge bases we
can draw on

There will be biases
and missing data in
expert knowledge, too

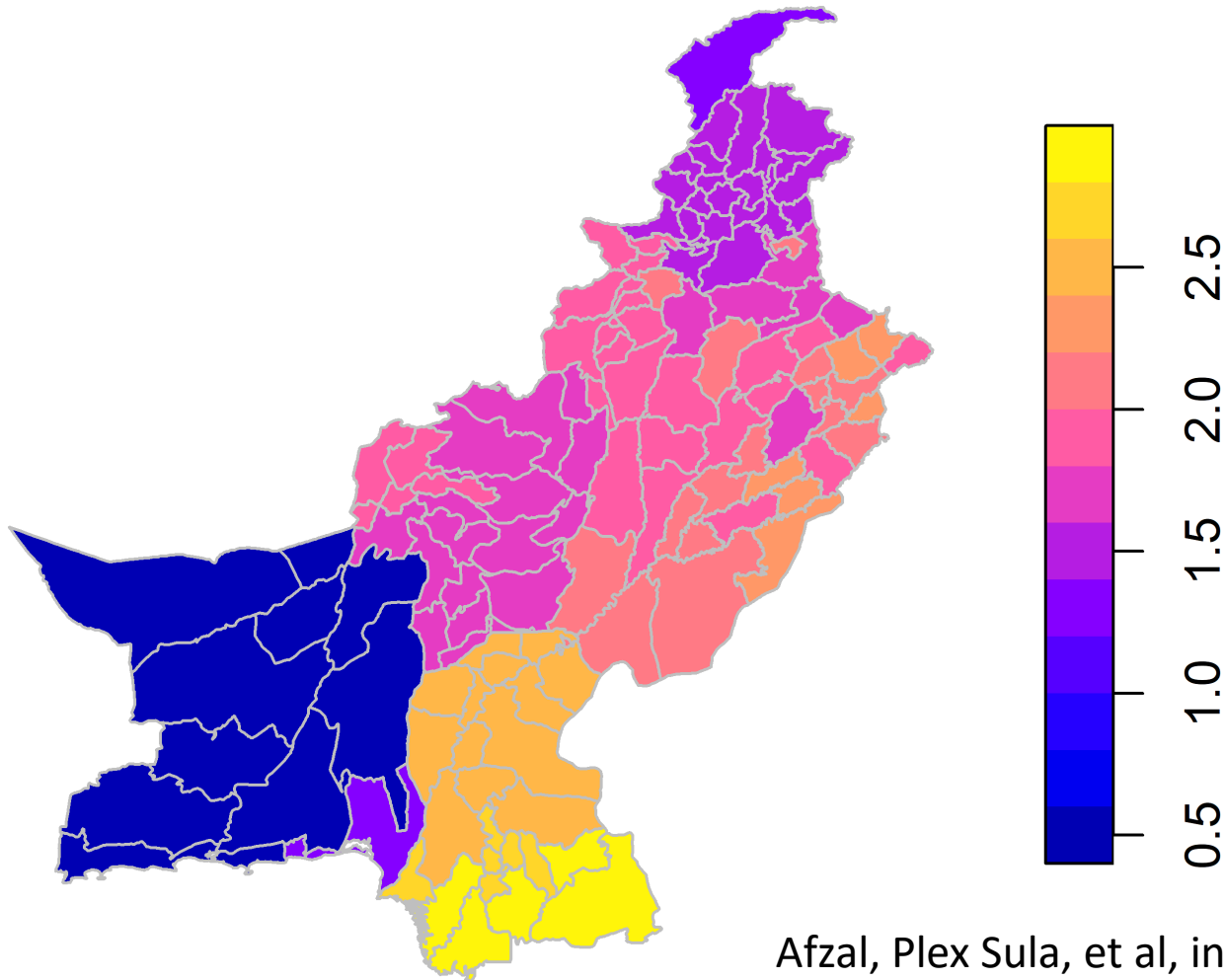
Bayesian framework

Expert knowledge may be thought of as the 'prior' knowledge about a parameter (like infection rates)

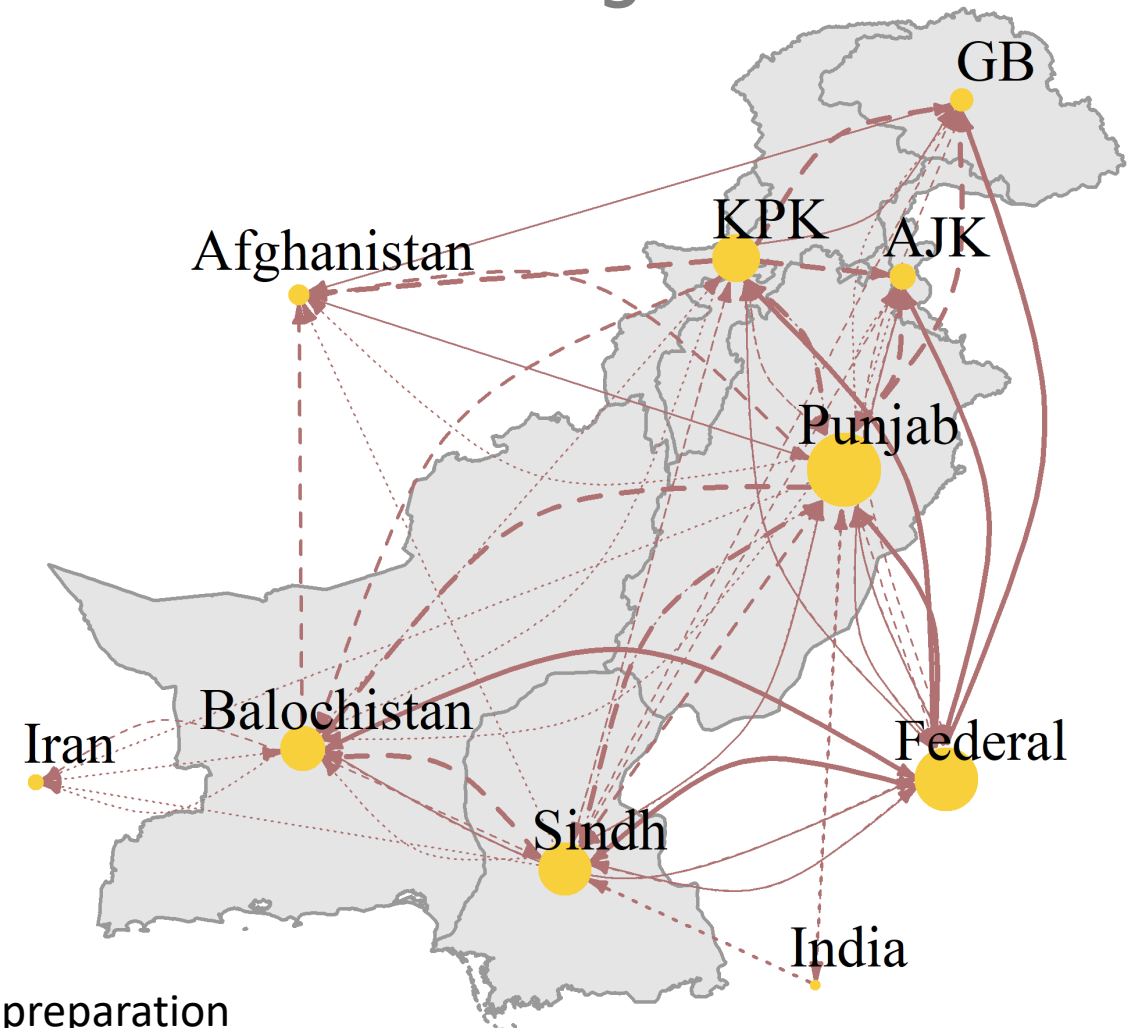
New experiments can build on this knowledge to summarize 'posterior' knowledge about a parameter

Examples of epidemic risks in Pakistan based on expert knowledge elicitation

Mean crop loss (%) by leaf rust



Seed exchange network



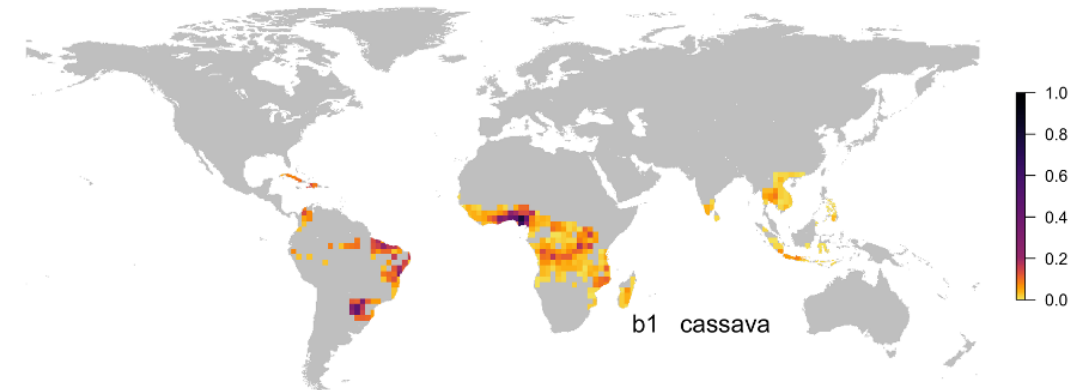
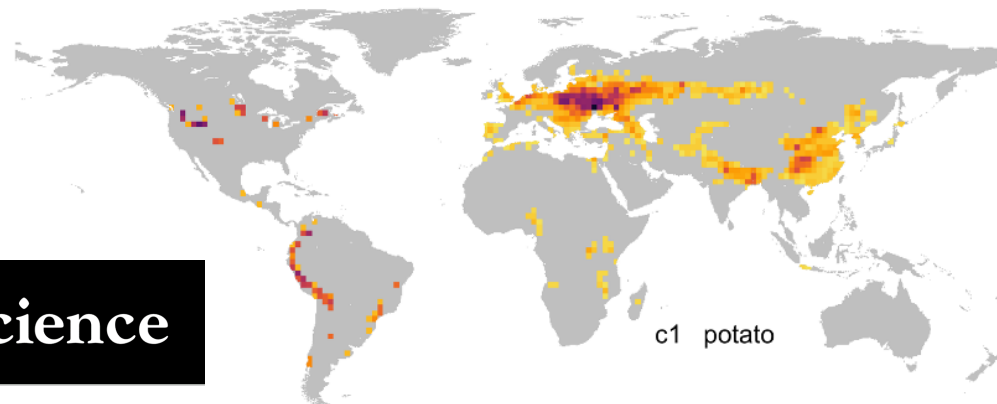
Afzal, Plex Sula, et al, in preparation

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Global Cropland Connectivity: A Risk Factor for Invasion and Saturation by Emerging Pathogens and Pests

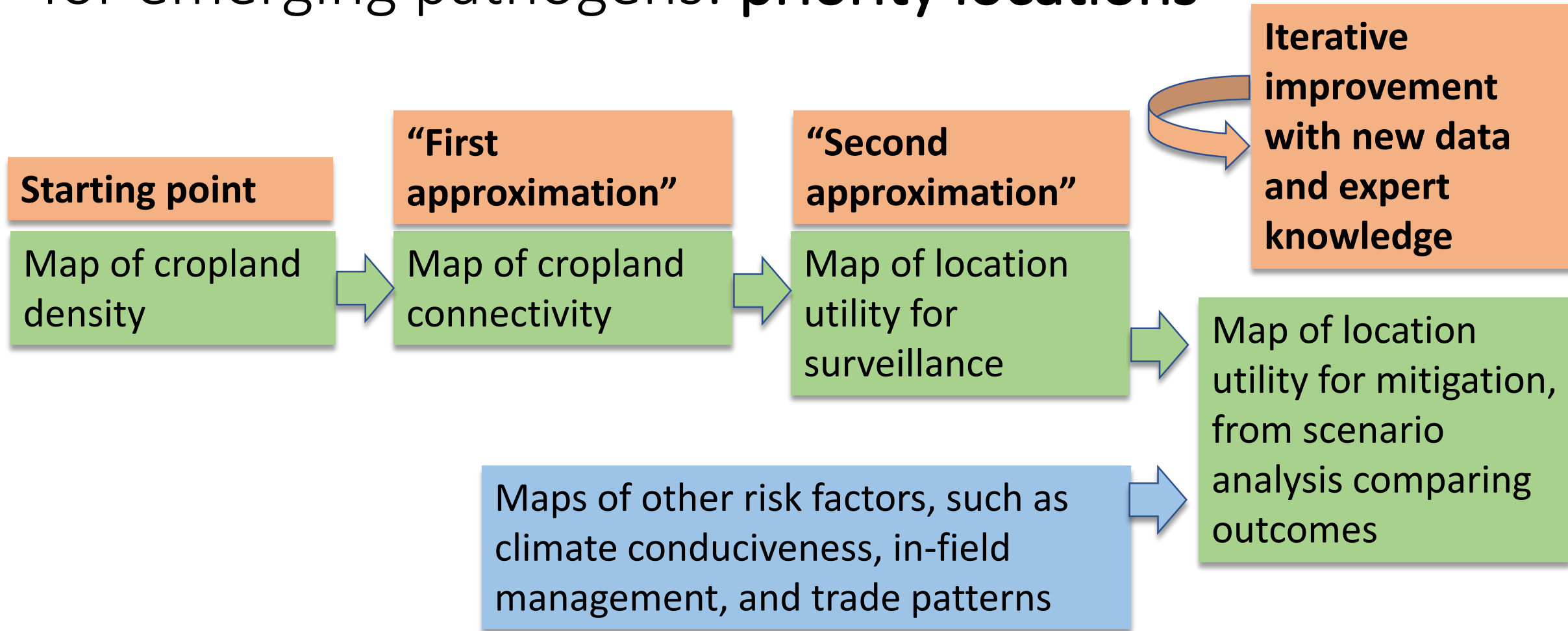
YANRU XING, JOHN F. HERNANDEZ NOPSA, KELSEY F. ANDERSEN, JORGE L. ANDRADE-PIEDRA, FENTON D. BEED, GUY BLOMME, MÓNICA CARVAJAL-YEPES, DANNY L. COYNE, WILMER J. CUELLAR, GREGORY A. FORBES, JAN F. KREUZE, JÜRGEN KROSCHER, P. LAVA KUMAR, JAMES P. LEGG, MONICA PARKER, ELMAR SCHULTE-GELDERMANN, KALPANA SHARMA, AND KAREN A. GARRETT



BioScience

2020

Building blocks for national mitigation strategies for emerging pathogens: **priority locations**

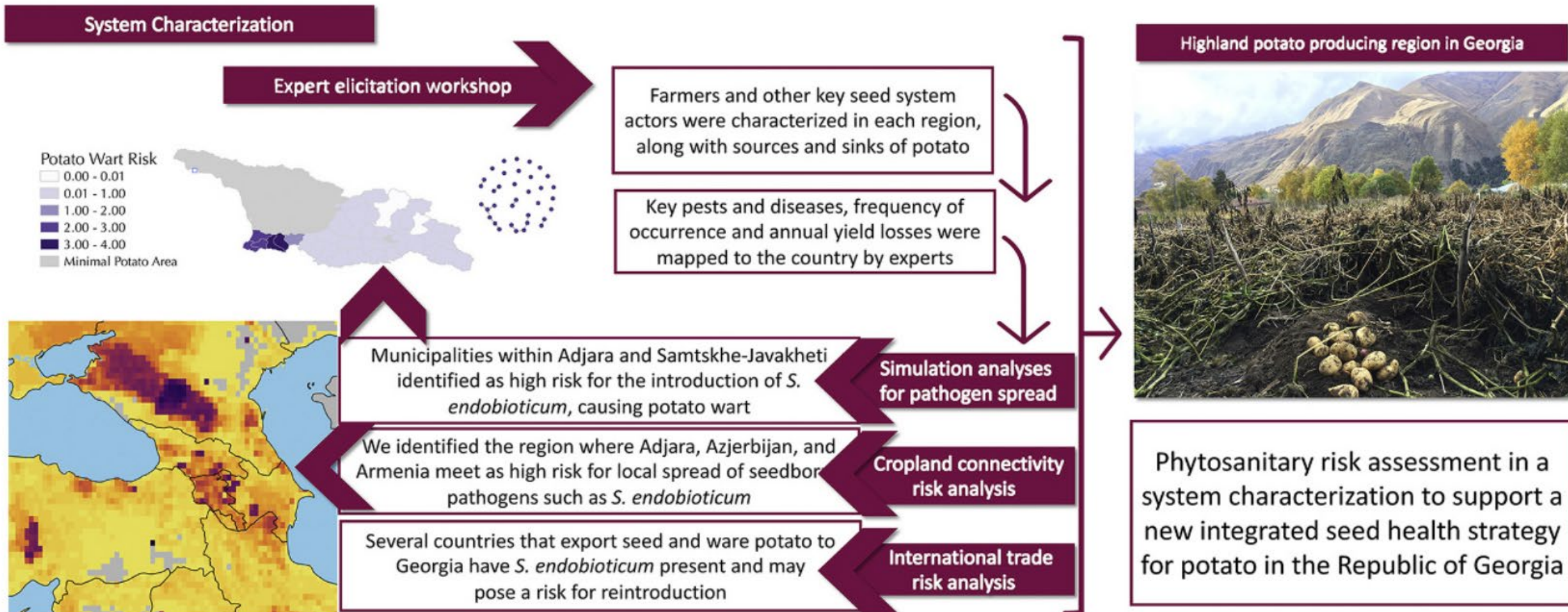


Impact network analysis (INA) provides tools for scenario analysis

An integrated seed health strategy and phytosanitary risk assessment: Potato in the Republic of Georgia

2021

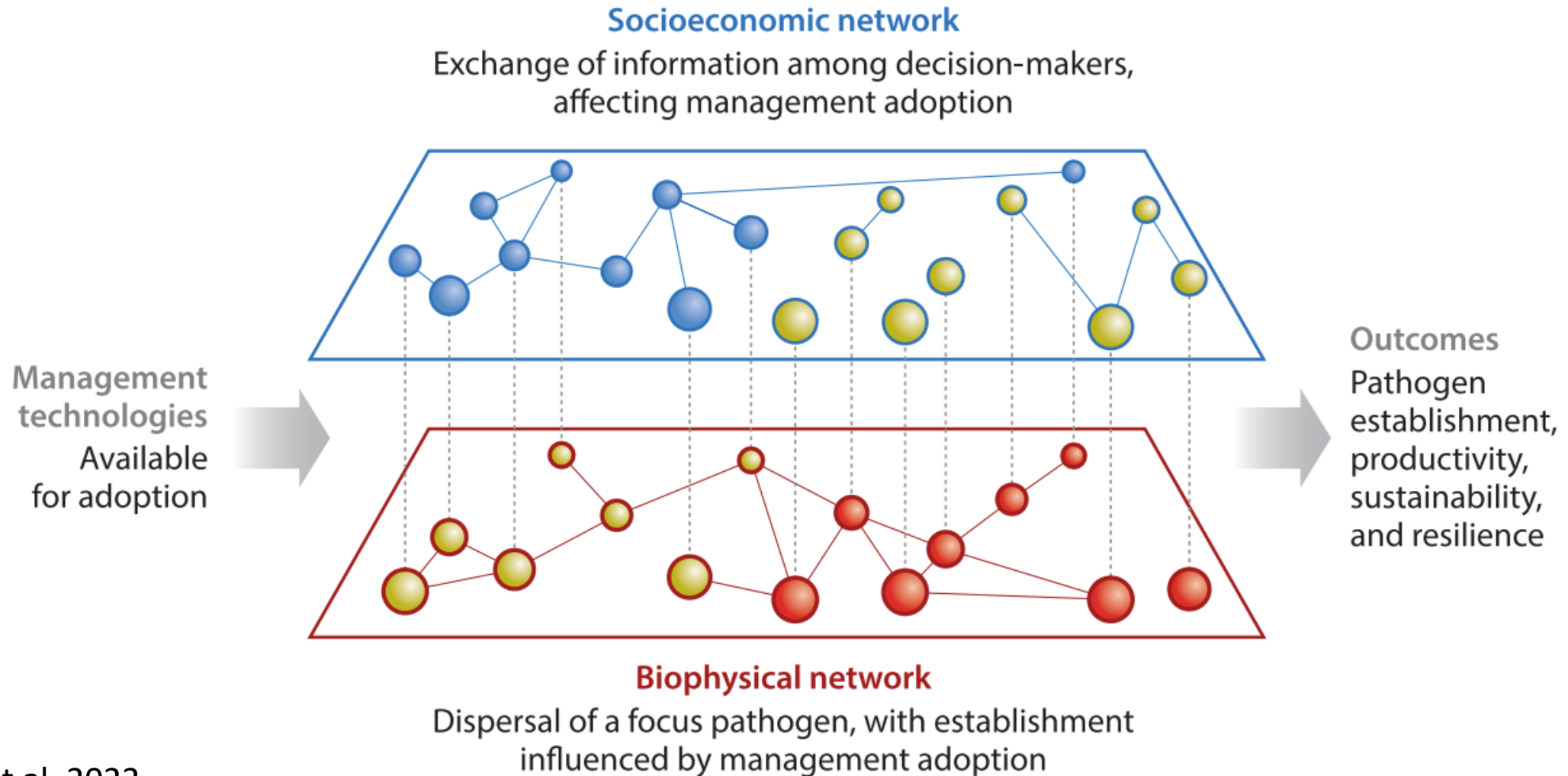
Kelsey F. Andersen Onofre^{a,b,c,d,*}, Gregory A. Forbes^e, Jorge L. Andrade-Piedra^e,
Chris E. Buddenhagen^{a,b,c,f}, James C. Fulton^{a,b,c}, Marcel Gatto^g, Zurab Khidsheli^h,
Rusudan Mdivaniⁱ, Yanru Xing^{a,b,c}, Karen A. Garrett^{a,b,c,*}



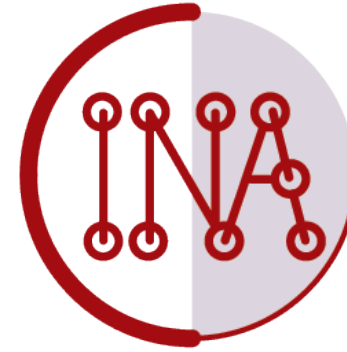
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Impact network analysis (INA)



Key types of questions in INA scenario analysis



- What locations are particularly important for system management?
- How are the benefits of the system distributed by gender and age?
- How could subsidies and policies influence system outcomes?
- Are observations over time in line with goals for project monitoring and evaluation?



Impact network analysis and the INA R package: Decision support for regional management interventions

Karen A. Garrett 

- This R package is available for R&D teams that include an R user
- We are developing an online app for non-R users

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Building a global community of practice using R2M



Scaling up R2M tool applications



Scaling up translation for effective mitigation



Capacity building



Developing shared databases and code: **open source ecosystem**



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Thanks for your attention!
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 Thanks to our funders