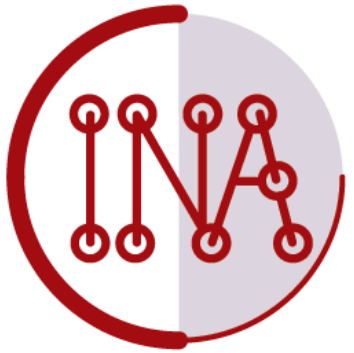
TOOL BOX FOR WORKING WITH ROOT, TUBER AND BANANA SEED SYSTEMS

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

Executive summary:

Impact network analysis (INA)



KAREN A. GARRETT

Alliance

LED BY CIP INTERNATIONAL POTATO CENTER · Bioversity International · CIAT International Center for Tropical Agriculture · cirad Agricultural Research for Development · IITA Transforming African Agriculture · WAGENINGEN UNIVERSITY & RESEARCH · UF IFAS UNIVERSITY of FLORIDA

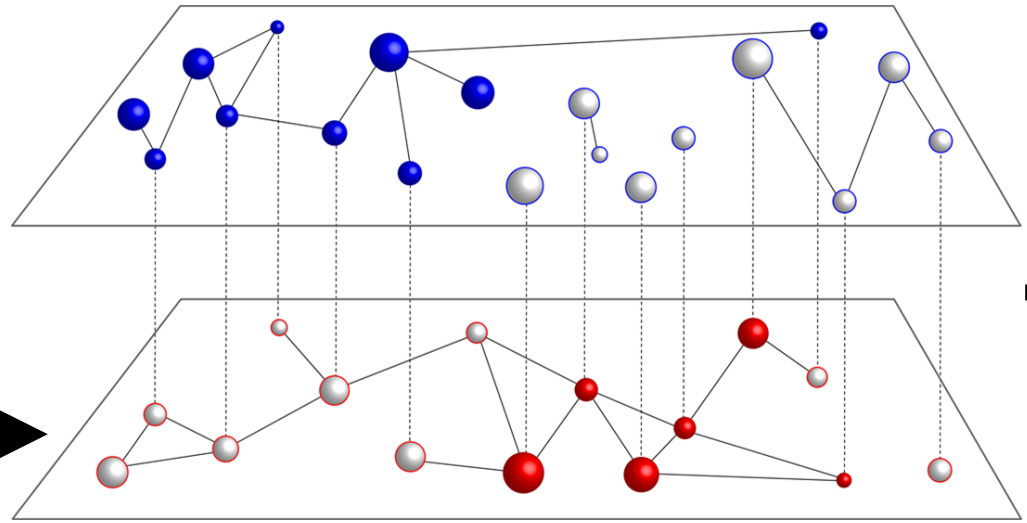
What impact network analysis (INA) provides

A framework for synthesizing what is known about a seed system

A program (in R) for scenario analysis to evaluate the implications of the system structure, and of potential changes to the system – to support decision making

Impact network analysis (INA) framework

Socioeconomic network
Exchange of information among decision makers,
affecting variety/management adoption



Varieties and management technologies available for adoption

Outcomes
Productivity, profitability,
adoption rates,
sustainability, resilience

Biophysical network
Dispersal of a variety or pathogen/pest,
with establishment influenced by management adoption

Garrett et al. 2018, Garrett 2021

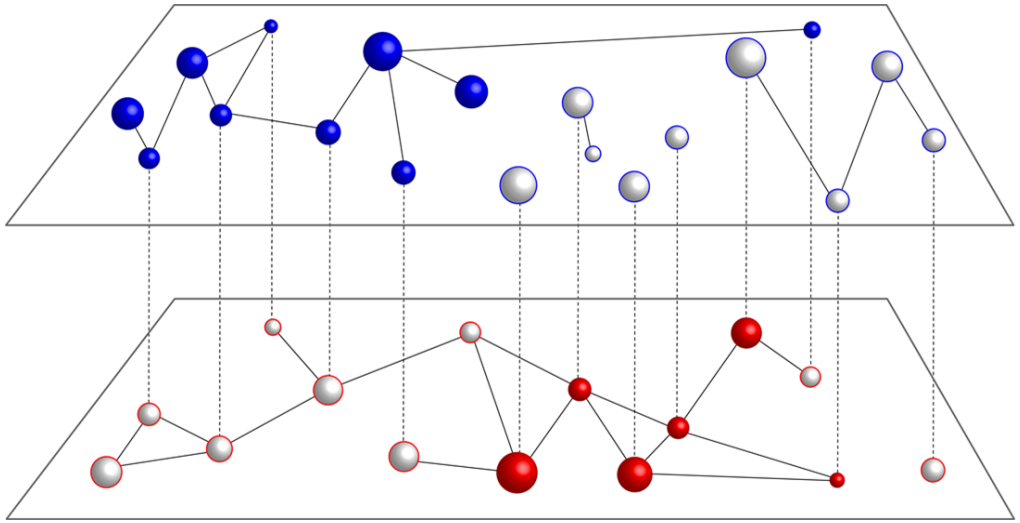
Key types of questions in INA scenario analysis

- 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?

What locations are particularly important for system management?

Specific locations (or individual people) may be key for enhancing the spread of varieties and/or managing the spread of pathogens and pests

Socioeconomic network
Exchange of information among decision makers, affecting variety/management adoption

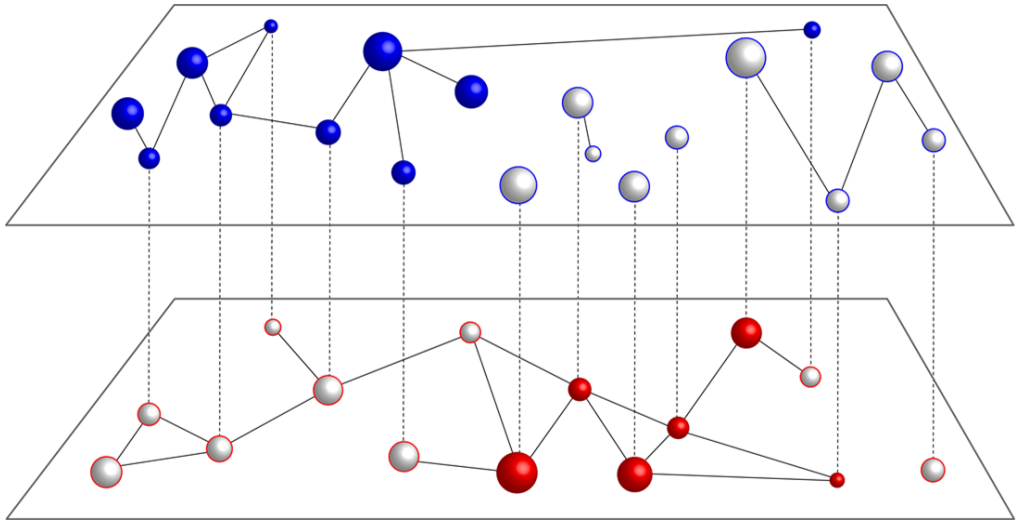


Biophysical network
Dispersal of a variety or pathogen/pest, with establishment influenced by management adoption

How are the benefits of the system distributed by gender and age?

Gender or age may be associated with access to higher quality seed, and changes to the system may target particular stakeholders

Socioeconomic network
Exchange of information among decision makers, affecting variety/management adoption

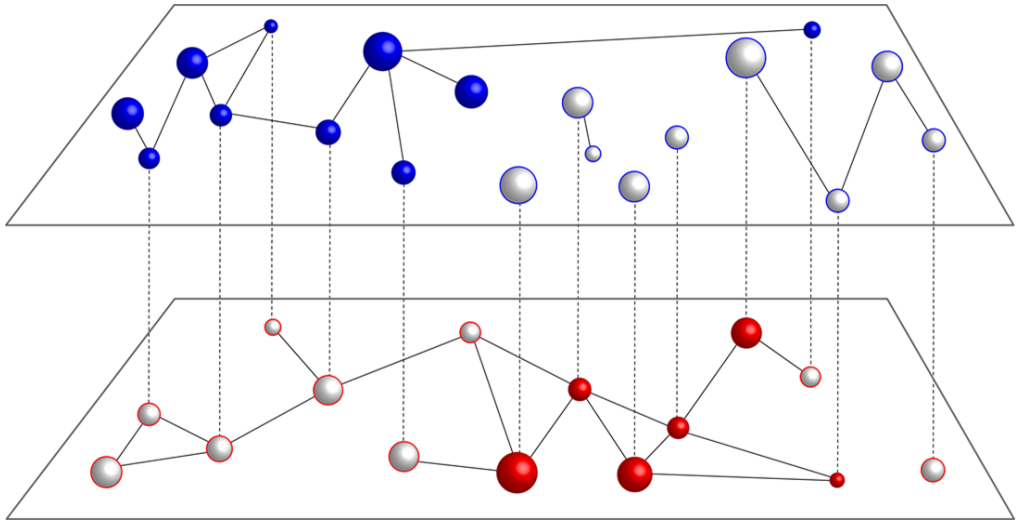


Biophysical network
Dispersal of a variety or pathogen/pest, with establishment influenced by management adoption

How could subsidies and policies influence system outcomes?

Changes in the probability of spread of a variety or a pathogen can be propagated through the system

Socioeconomic network
Exchange of information among decision makers, affecting variety/management adoption

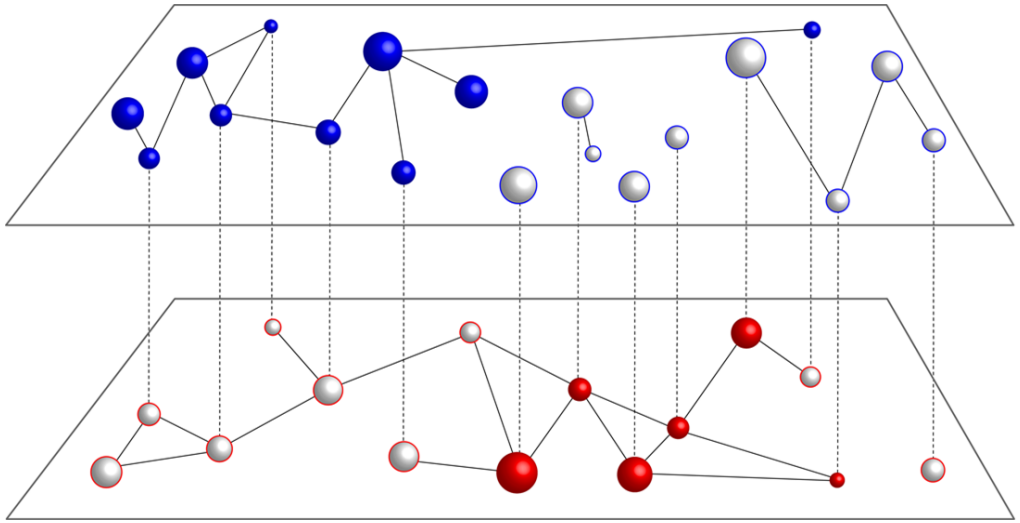


Biophysical network
Dispersal of a variety or pathogen/pest, with establishment influenced by management adoption

Are observations over time in line with goals for project monitoring and evaluation?

Observed system changes can be extrapolated to see whether project goals are likely to be met

Socioeconomic network
Exchange of information among decision makers, affecting variety/management adoption



Biophysical network
Dispersal of a variety or pathogen/pest, with establishment influenced by management adoption

Ongoing development of new features, and a community of practice for studying and analyzing these types of multilayer systems

"Off the shelf" analyses, as well as new custom analyses

Next: examples of applications in several countries

TOOL BOX FOR WORKING WITH ROOT, TUBER AND BANANA SEED SYSTEMS

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

Impact network analysis (INA)

Discussion and examples

KELSEY ANDERSEN ONOFRE, ERIK DELAQUIS, BEREA ETHERTON, SOSPETER GACHAMBA, KAREN A. GARRETT, JOHN F. HERNANDEZ NOPSA, AMAN BONAVENTURE OMONDI

Alliance

Team representing projects globally

Kelsey Andersen Onofre

Berea Etherton

Aman Bonaventure Omondi

Sospeter Gachamba

John Hernandez Nopsa

Erik Delaquis

Overview of examples

Seed systems in Africa, South America, and Asia

In many areas of these countries, informal seed systems are particularly important for vegetatively-propagated crops

Epidemic network analysis for mitigation of invasive pathogens in seed systems: Potato in Ecuador

Phytopathology 2017

C. E. Buddenhagen*, J. F. Hernandez Nopsa*, K. F. Andersen, J. Andrade-Piedra, G. A. Forbes, P. Kromann, S. Thomas-Sharma, P. Useche, K. A. Garrett

[open access link]

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

CENTRO INTERNACIONAL DE LA PAPA CIP

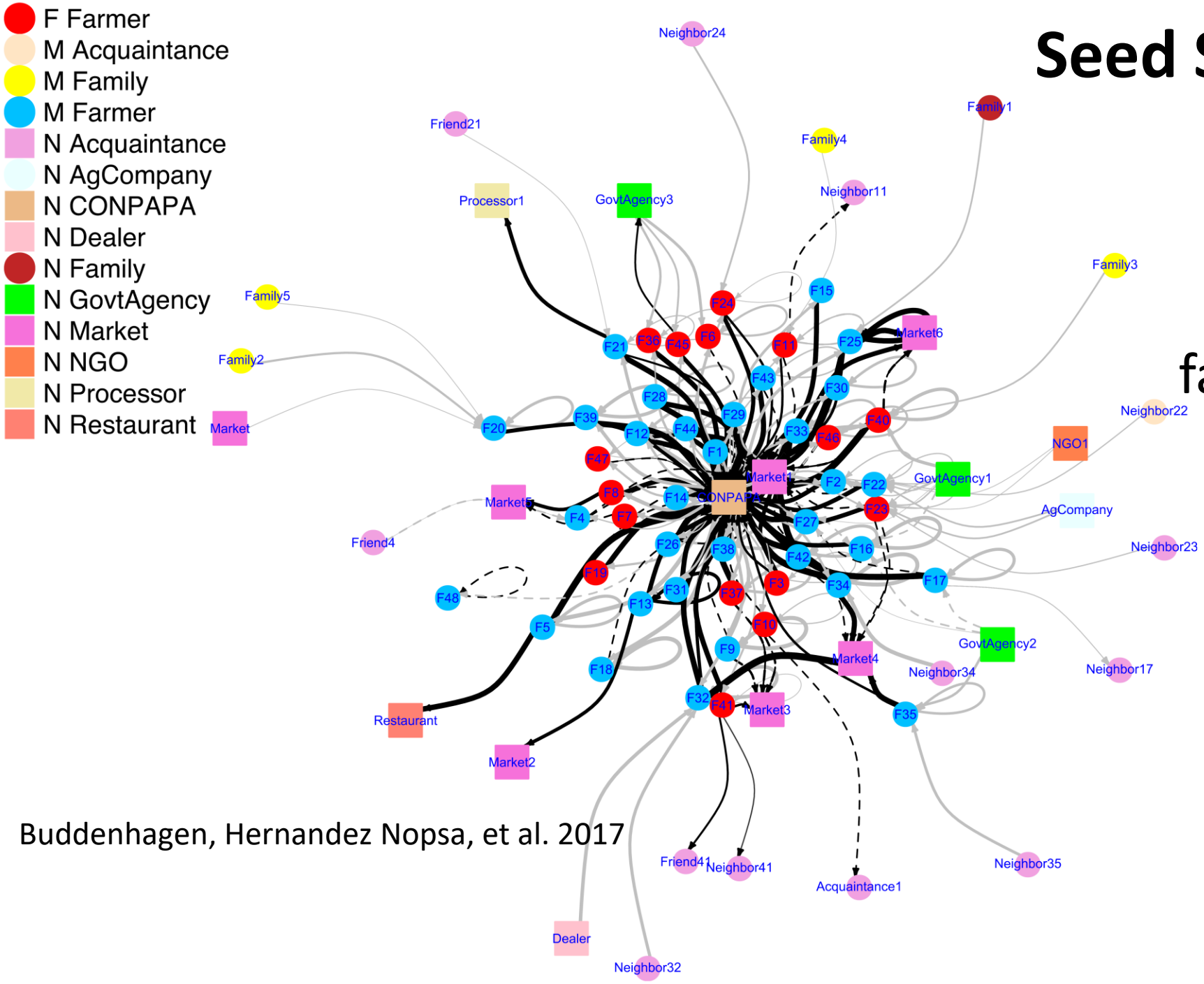
UF IFAS UNIVERSITY of FLORIDA

Potato production in Tungurahua Province, Ecuador

Photos: J. Hernandez Nopsa

In this analysis, we have survey data for both potato transactions and sources of information for IPM

Seed System Transaction Network

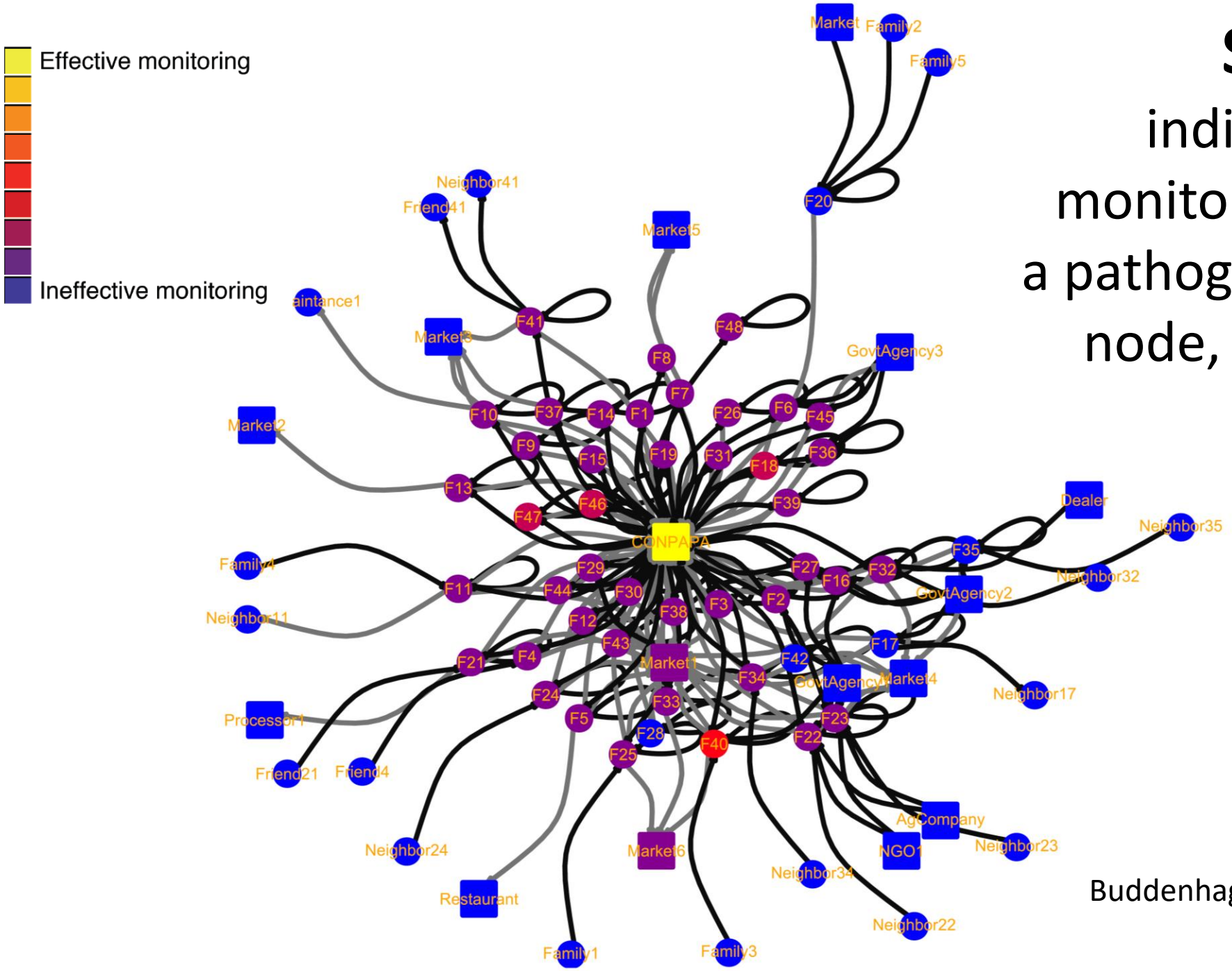


Buddenhagen, Hernandez Nopsa, et al. 2017

Nodes represent 48 farmers associated with CONPAPA in Tungurahua, Ecuador, and institutions and individuals linked with them

Black lines: seed

Gray lines: potato for food consumption



Scenario analysis

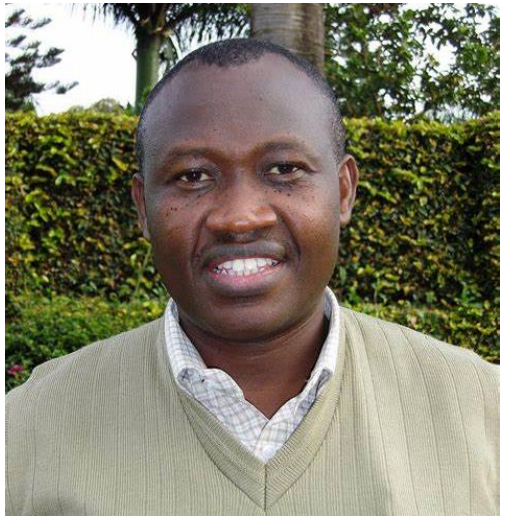
indicating how effective monitoring of the spread of a pathogen would be at each node, based on location in network and IPM information sources

Buddenhagen, Hernandez Nopsa, et al. 2017

Healthy banana seed systems

Innocent Nduwimana, Ir. Ag.

Omondi Aman
Crops



Celestin Niyongere
ISABU - Burundi

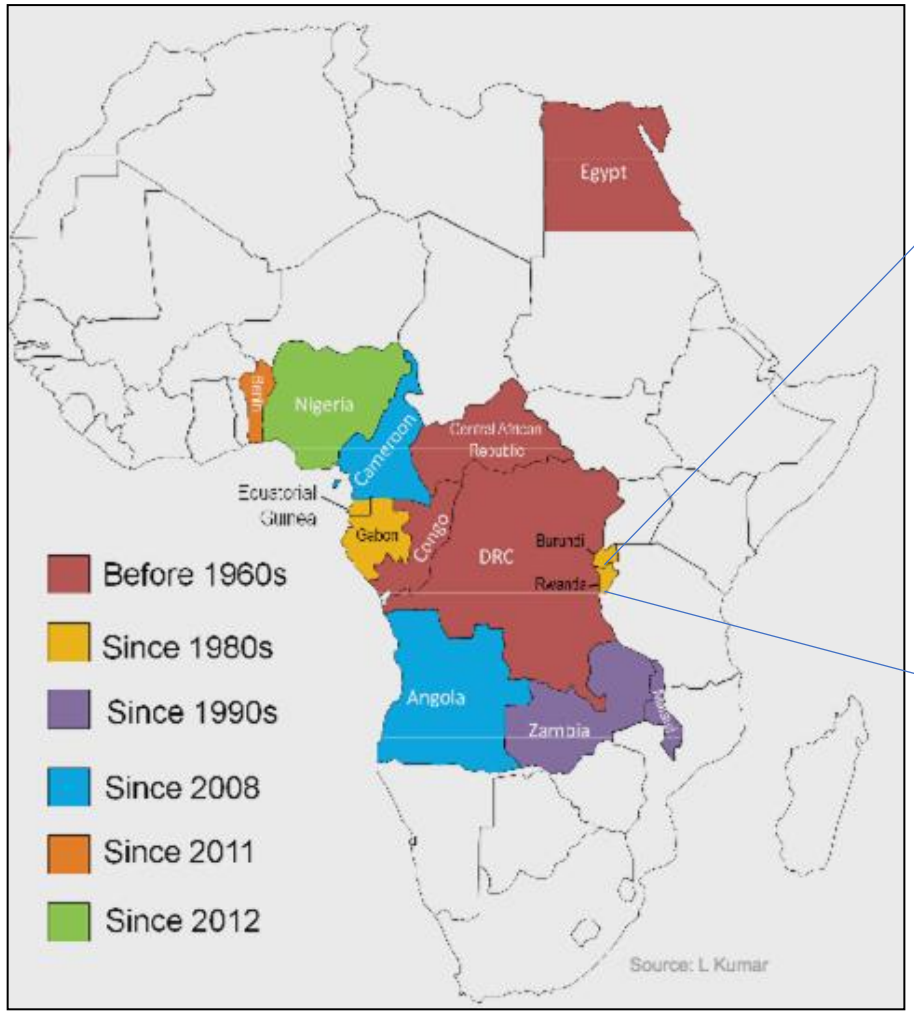
Healthy banana seed systems

- Banana seed systems in the Banana Bunchy top disease endemic regions are key aspect of disease control
- BBTD has exerts the need for clean seed but also forces low availability of seed.
- These effect on Banana diversity especially of farmer landraces (Simbare et al., 2020).
- Banana seed takes several forms (eg suckers or plantlets) and varieties that farmers must accept through different assessment processes.
- We used INA to assess farmer seed sharing and potentially assess seed security scenarios among different players.
- **Questions linked to:**
  - What are the most important players in a seed distribution system serving, say women or small holders?
  - Who are the key components to deliver new varieties?
  - What are the most risky nodes for disease surveillance?

Tissue culture plantlets in nursery

Banana suckers shared informally

BBTD endemic areas of Africa and Burundi



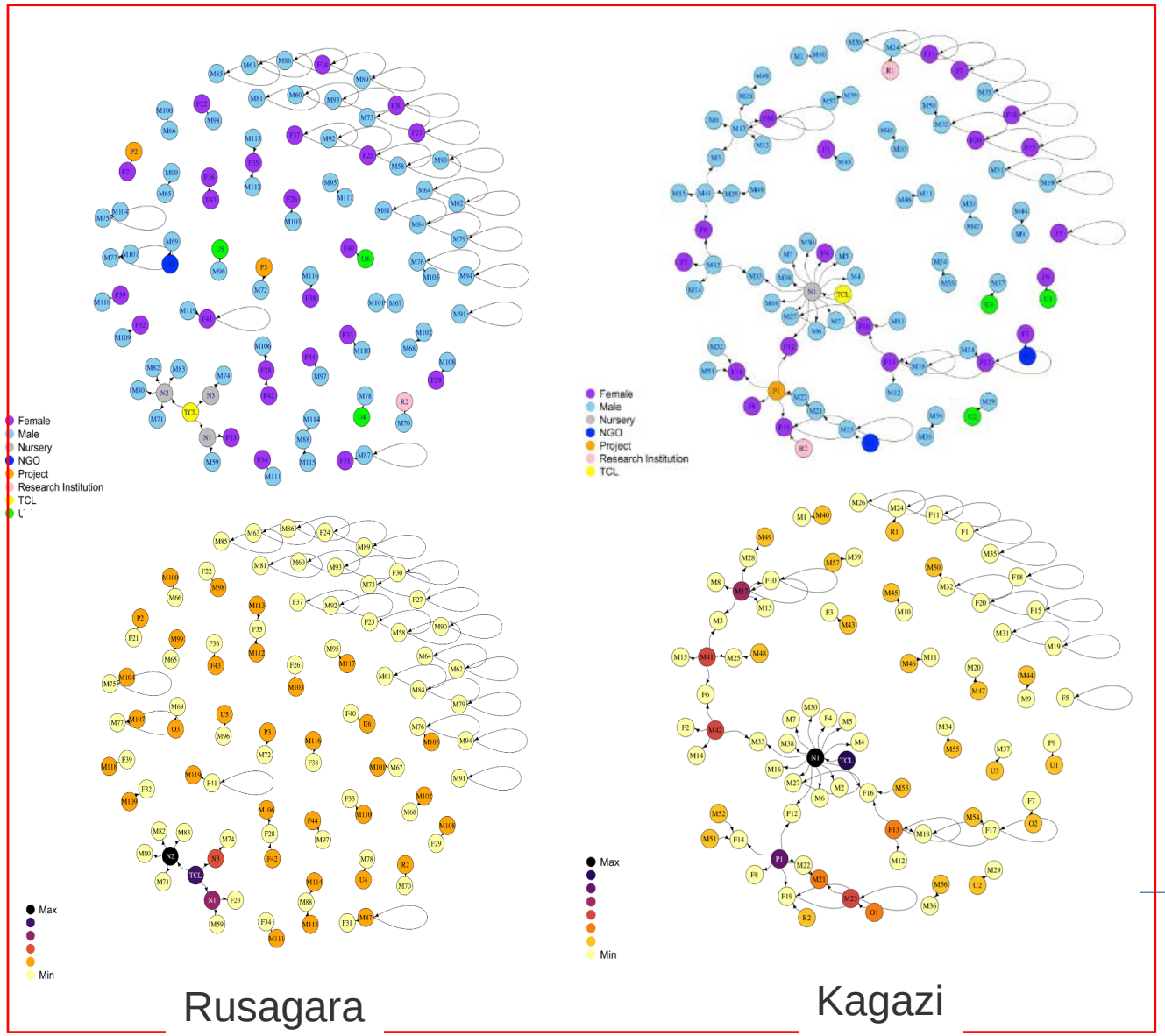
Website: www.bbtdalliance.org

- BBTD has been reported in 17 countries in Africa
- It is endemic in five provinces of Burundi

Comparative structure of banana seed sharing in three villages

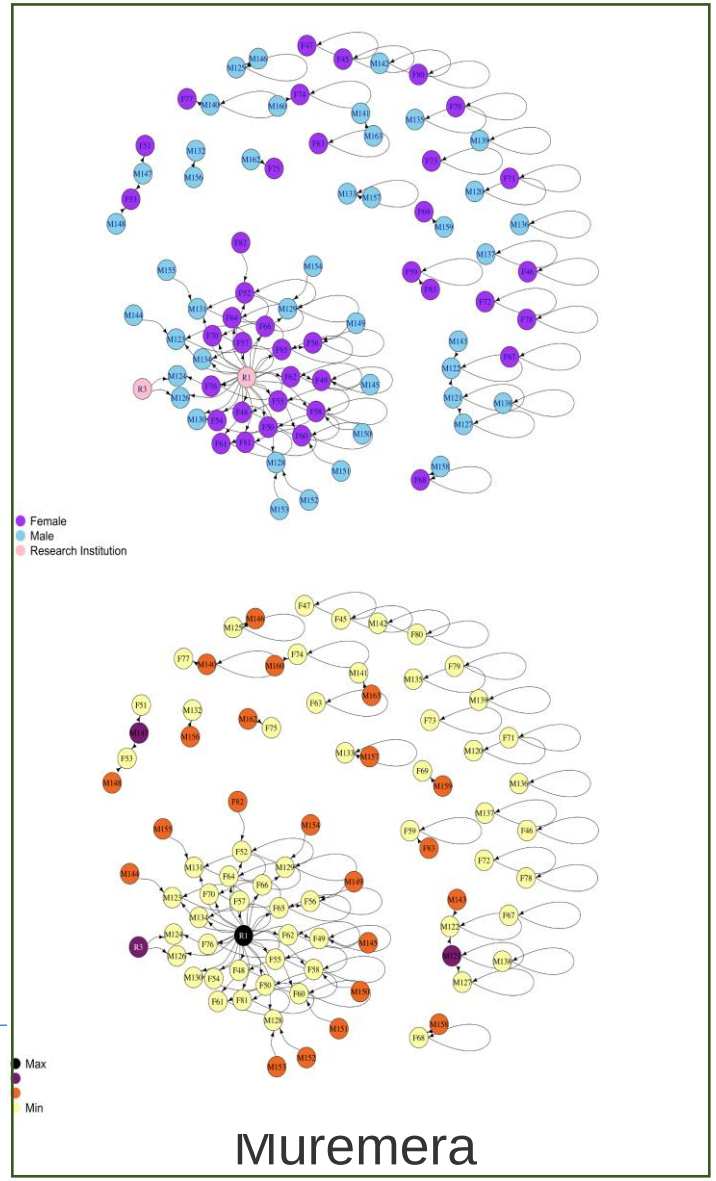
Players

Surveillance priority



Rusagara

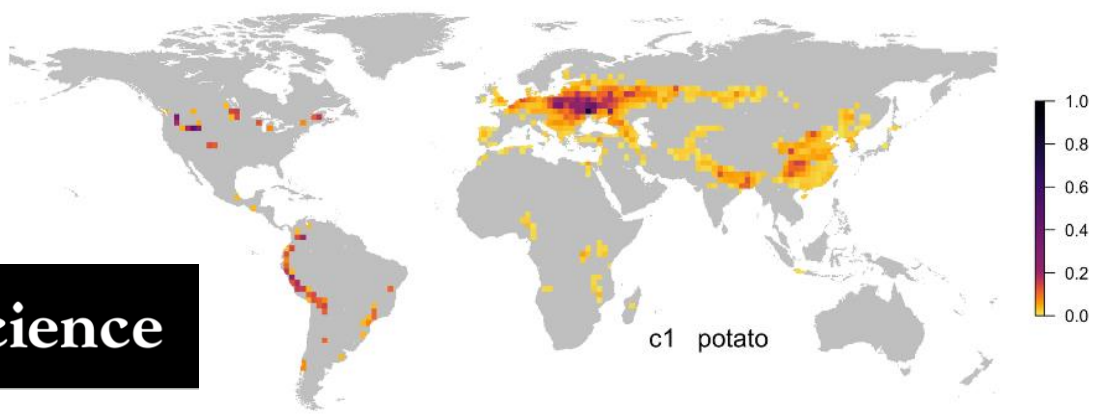
Kagazi

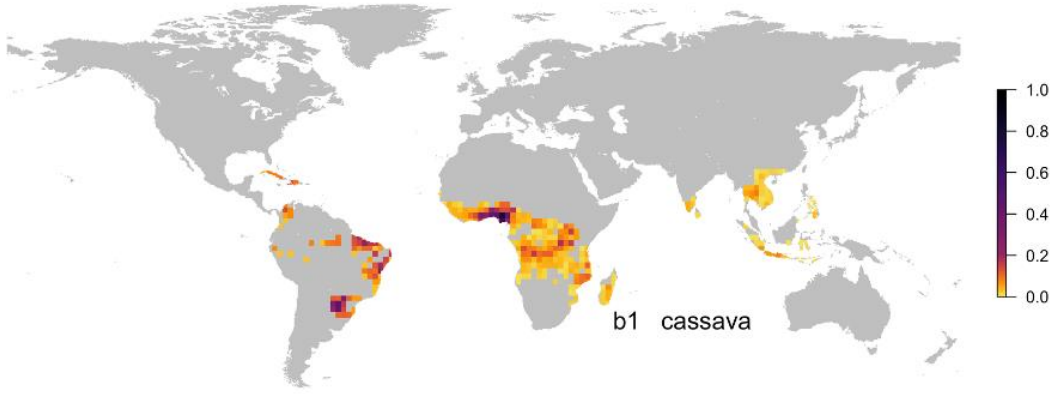


Muremera

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 KROSCHEL, P. LAVA KUMAR, JAMES P. LEGG, MONICA PARKER, ELMAR SCHULTE-GELDERMANN, KALPANA SHARMA, AND KAREN A. GARRETT





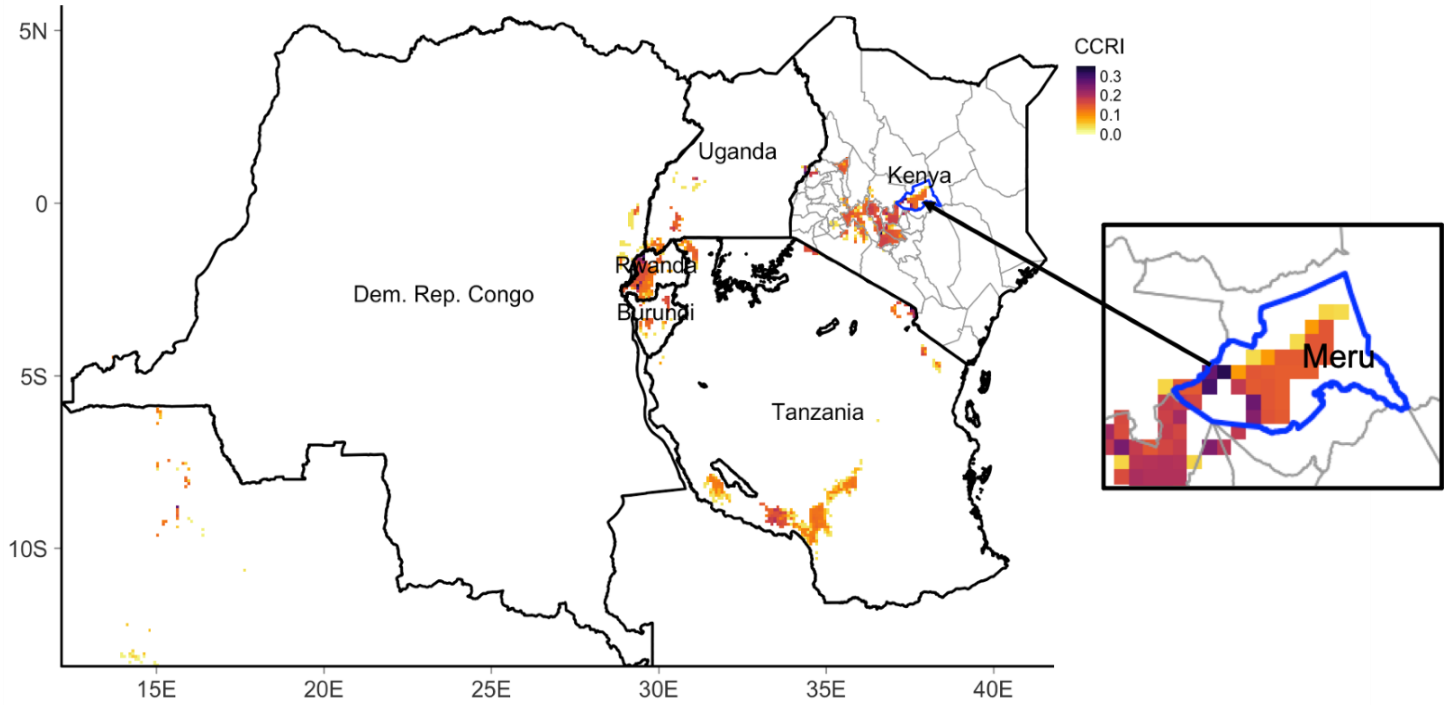
BioScience

2020

Healthy potato seed systems in Kenya

- Potato seed system in Kenya is largely informal (96%), about 3% semiformal and 1% formal. Lack of adequate and certified potato seed has increased the seed and soilborne disease problem in Kenya

- ***Project:*** Improved Diagnostics and Genotypic/ Epidemiological Mapping of Potato Bacterial Wilt Disease to Enhance Food Security of Smallholder Farmers, funded by BMZ



- Objective is to characterize and identify potential sources of bacterial wilt infection in a potato seed network in Kenya and evaluate the risk of disease spread through trade and the potential role of cropland connectivity in disease risk

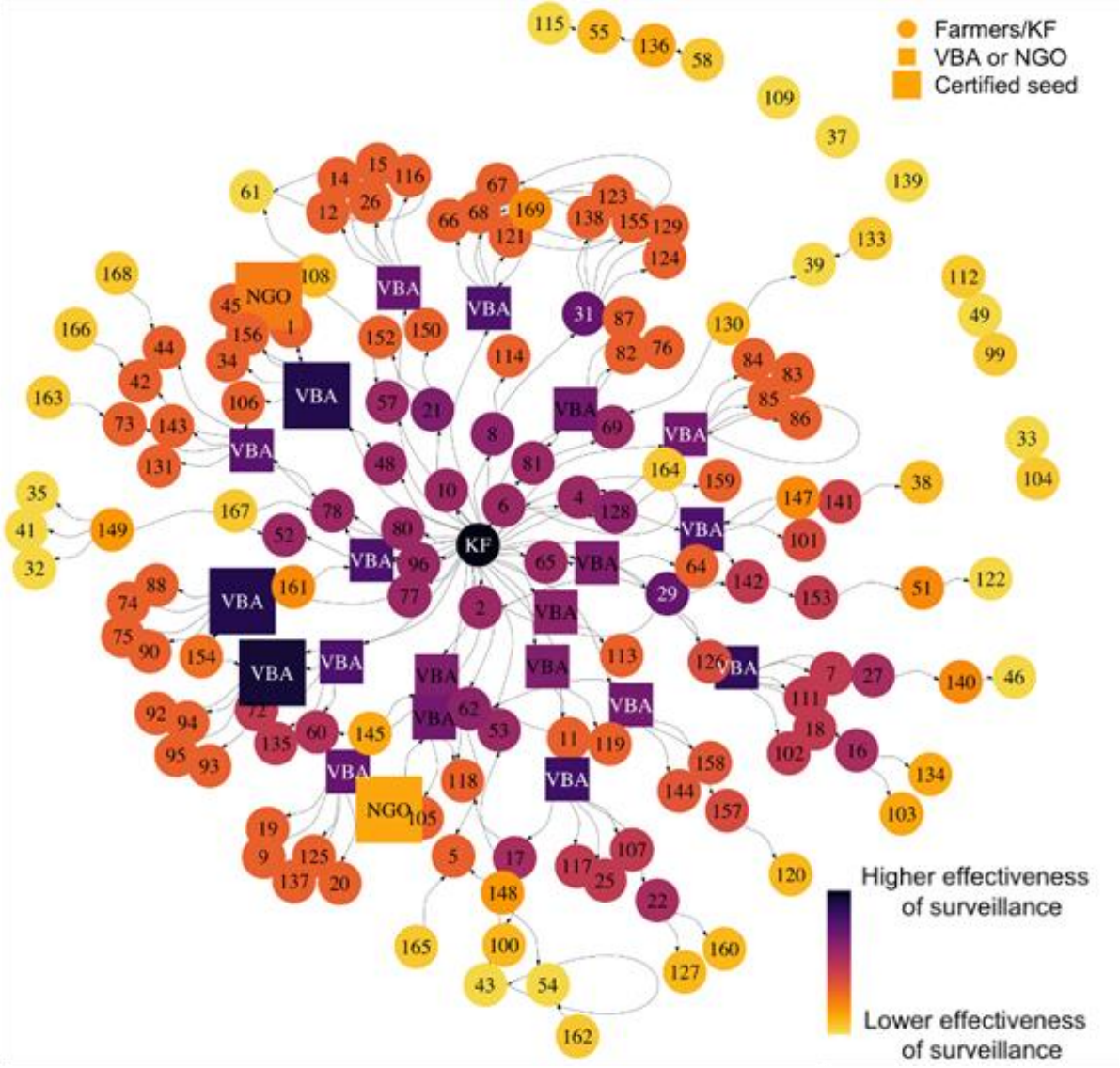
Sospeter Gachamba*, Yanru Xing*, Kelsey F. Andersen, Karen A. Garrett, Kalpana Sharma

CIP INTERNATIONAL POTATO CENTER

UF UNIVERSITY of FLORIDA

KEPHIS Kenya Plant Health Inspectorate Service

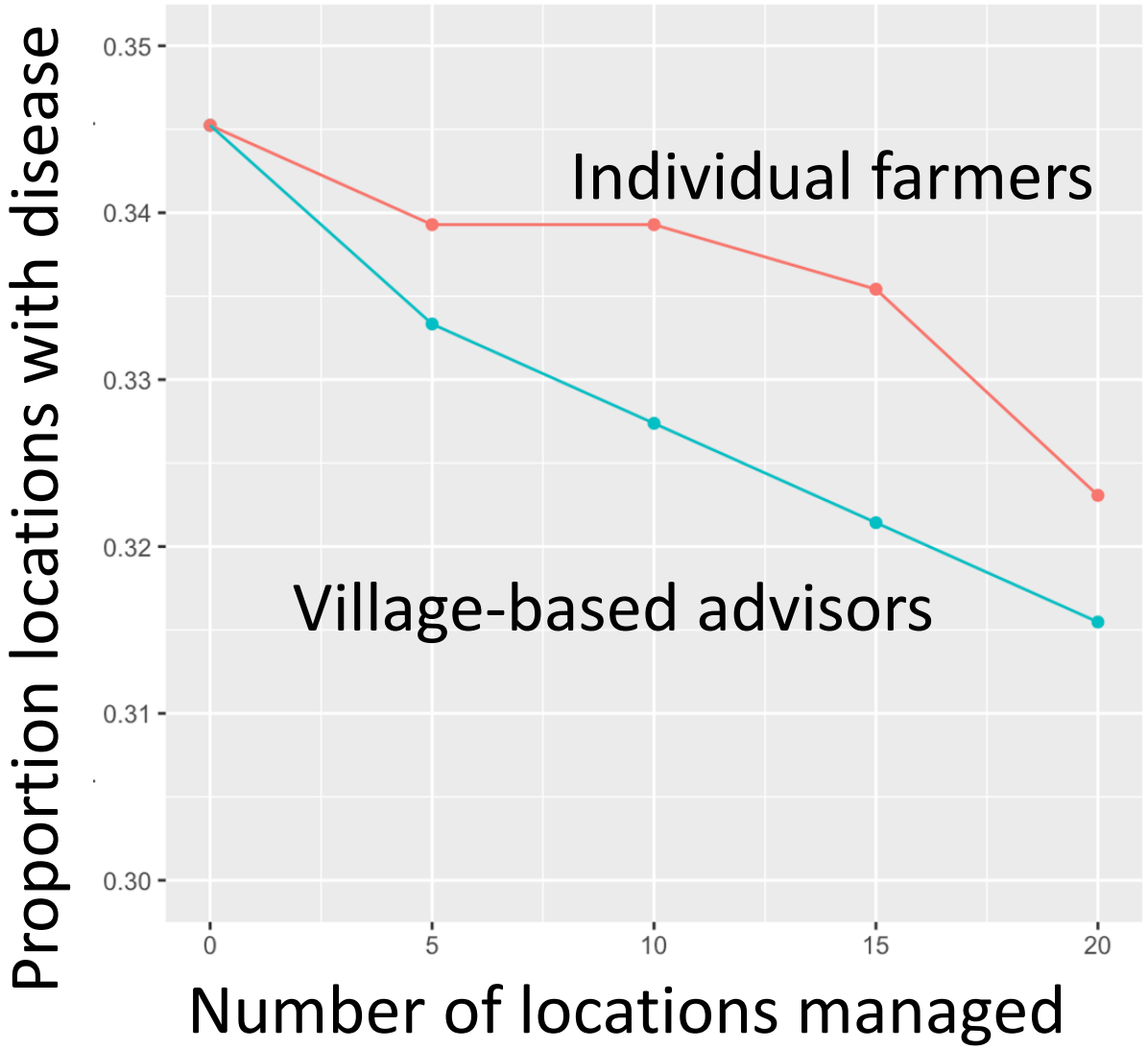
The potato seed system as reported in Meru



Important locations for disease surveillance are indicated in darker colors

In this system, men and women farming have generally the same distribution of roles in potential disease spread and surveillance

How much more efficient is improving management by village-based advisors versus farmers in general?



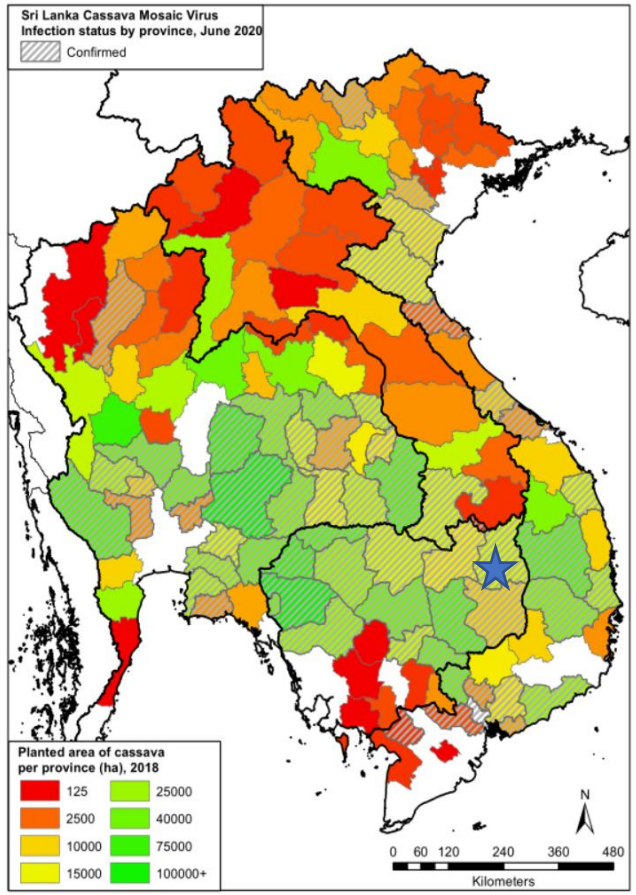
In scenario analyses, improved management for village-based advisors would give a somewhat bigger benefit than the same improvement for farmers in general

Kelsey Andersen Onofre recording

Sweetpotato in Uganda

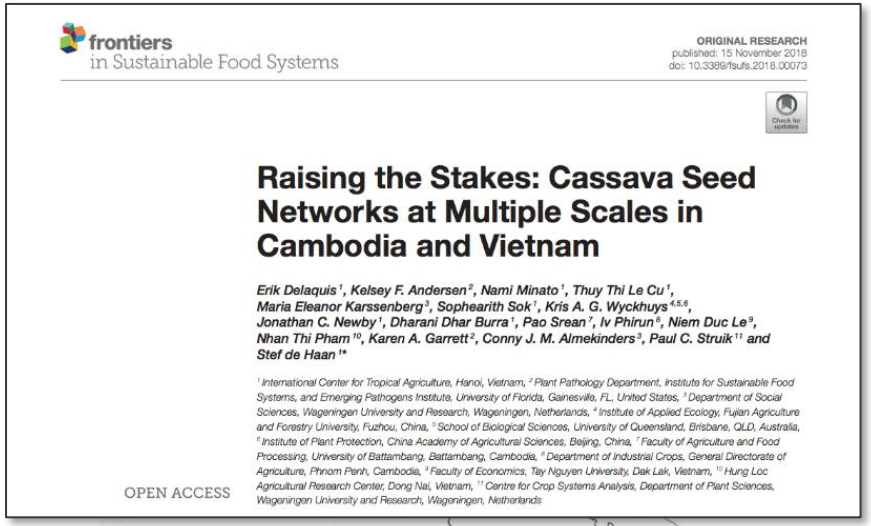
Potato in the Republic of Georgia

Cassava mosaic disease networks in Southeast Asia



Source: CIAT Asia cassava program; compilation of unpublished national data

2015: Cambodia - Rattanakiri (Wang et al. 2016)
2016: inter-province Cambodia (Minato et al. 2018)
2017: Vietnam (Uke et al. 2018)
2017: China (Wang et al. 2018)
2019: Thailand (Leiva et al. 2020)
2020: Lao PDR (Chittarath et al. 2021)



frontiers in Sustainable Food Systems

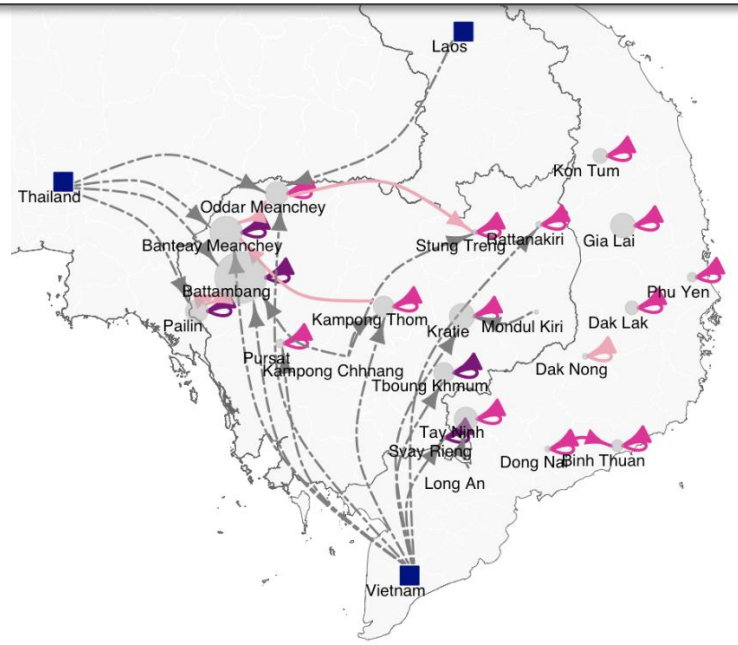
ORIGINAL RESEARCH
published: 15 November 2018
doi: 10.3389/fsufs.2018.00073

Raising the Stakes: Cassava Seed Networks at Multiple Scales in Cambodia and Vietnam

*Erik Delaquis[1], Kelsey F. Andersen[2], Nami Minato[1], Thuy Thi Le Cu[1], Maria Eleanor Karssenberg[3], Sophearith Sok[1], Kris A. G. Wyckhuys[4,5,6], Jonathan C. Newby[1], Dharani Dhar Burra[1], Pao Srean[7], Iv Phirun[8], Niem Duc Le[9], Nhan Thi Pham[10], Karen A. Garrett[2], Conny J. M. Almekinders[3], Paul C. Struik[11] and Stef de Haan[1]**

[1] International Center for Tropical Agriculture, Hanoi, Vietnam, [2] Plant Pathology Department, Institute for Sustainable Food Systems, and Emerging Pathogens Institute, University of Florida, Gainesville, FL, United States, [3] Department of Social Sciences, Wageningen University and Research, Wageningen, Netherlands, [4] Institute of Applied Ecology, Fujian Agriculture and Forestry University, Fuzhou, China, [5] School of Biological Sciences, University of Queensland, Brisbane, QLD, Australia, [6] Institute of Plant Protection, China Academy of Agricultural Sciences, Beijing, China, [7] Faculty of Agriculture and Food Processing, University of Battambang, Battambang, Cambodia, [8] Department of Industrial Crops, General Directorate of Agriculture, Phnom Penh, Cambodia, [9] Faculty of Economics, Tay Nguyen University, Dak Lak, Vietnam, [10] Hung Loc Agricultural Research Center, Dong Nai, Vietnam, [11] Centre for Crop Systems Analysis, Department of Plant Sciences, Wageningen University and Research, Wageningen, Netherlands*

OPEN ACCESS



All photos: Alliance of Bioversity International and CIAT/ E. Delaquis

Managing CMD and the case for INA

Complex system:

- Sophisticated seed exchange network
- *Bemisia tabaci* insect vector
- Variable environment / climate
- Huge scale: 5M ha at 10k cuttings / ha

Key management strategies:

- Seed/phytosanitary quarantines
- Clean seed production/deployment
- Resistant varieties

How to use what we've learned about the CMD epidemic network to generate evidence-based strategies for action?

Q1 - What impact would enforced seed quarantines have on disease progress?

Q2 - How much clean seed is needed to make an impact?

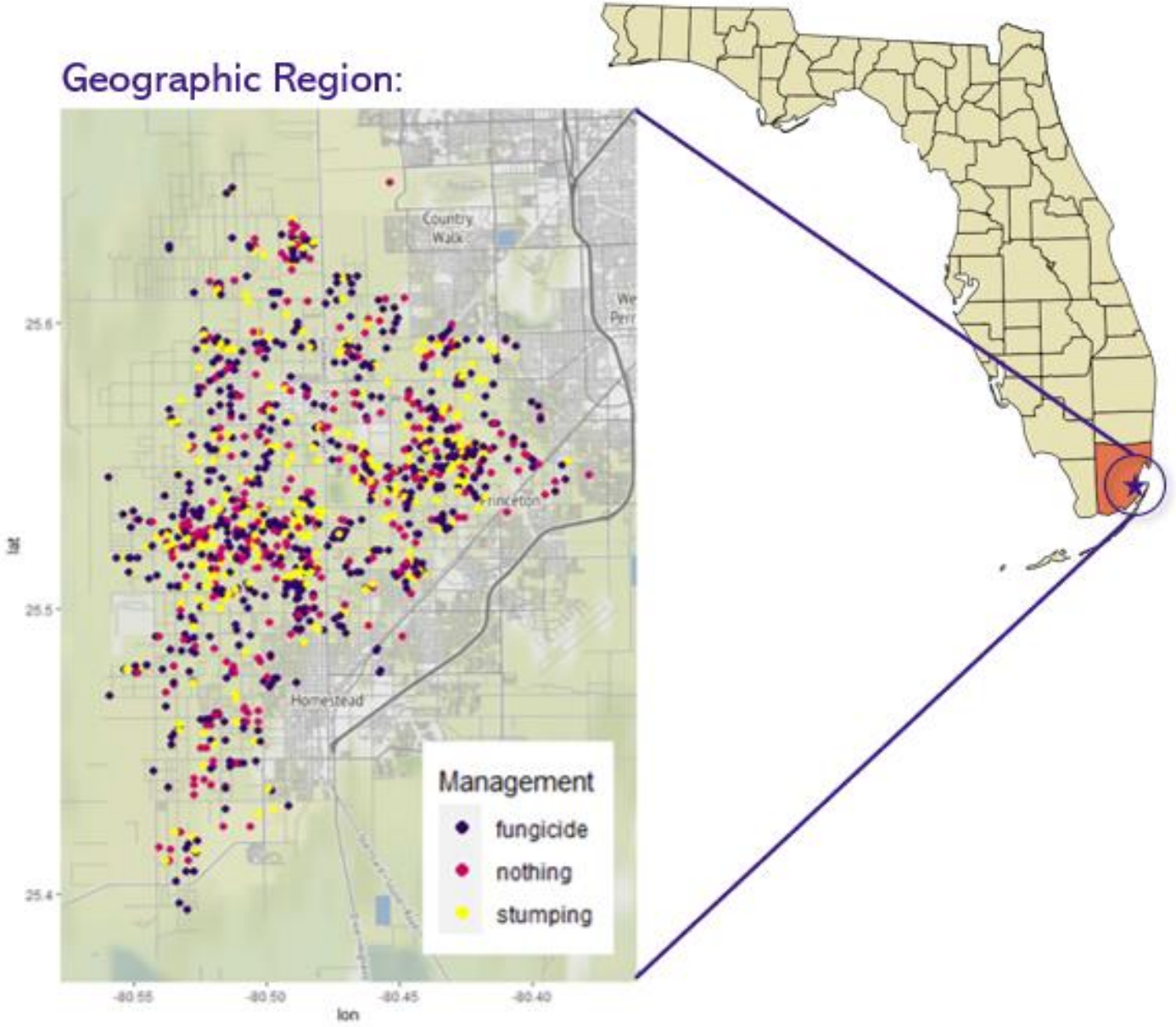
Q3 - Where & how should clean seed be distributed – focus on one area, or smaller amounts to more places?

All photos: Alliance of Bioversity International and CIAT/ E. Delaquis

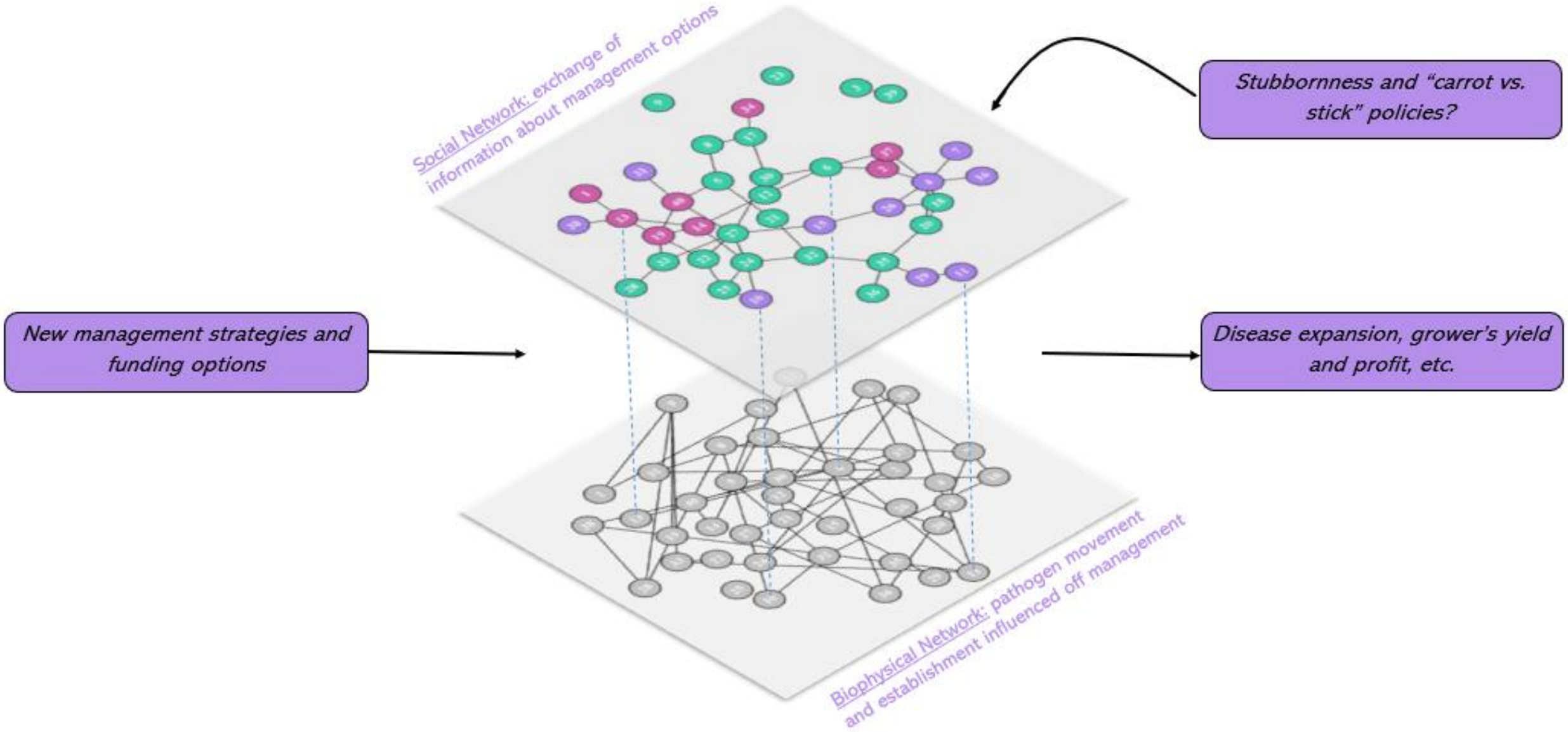
Kelsey Andersen Onofre recording

Cassava in Southeast Asia

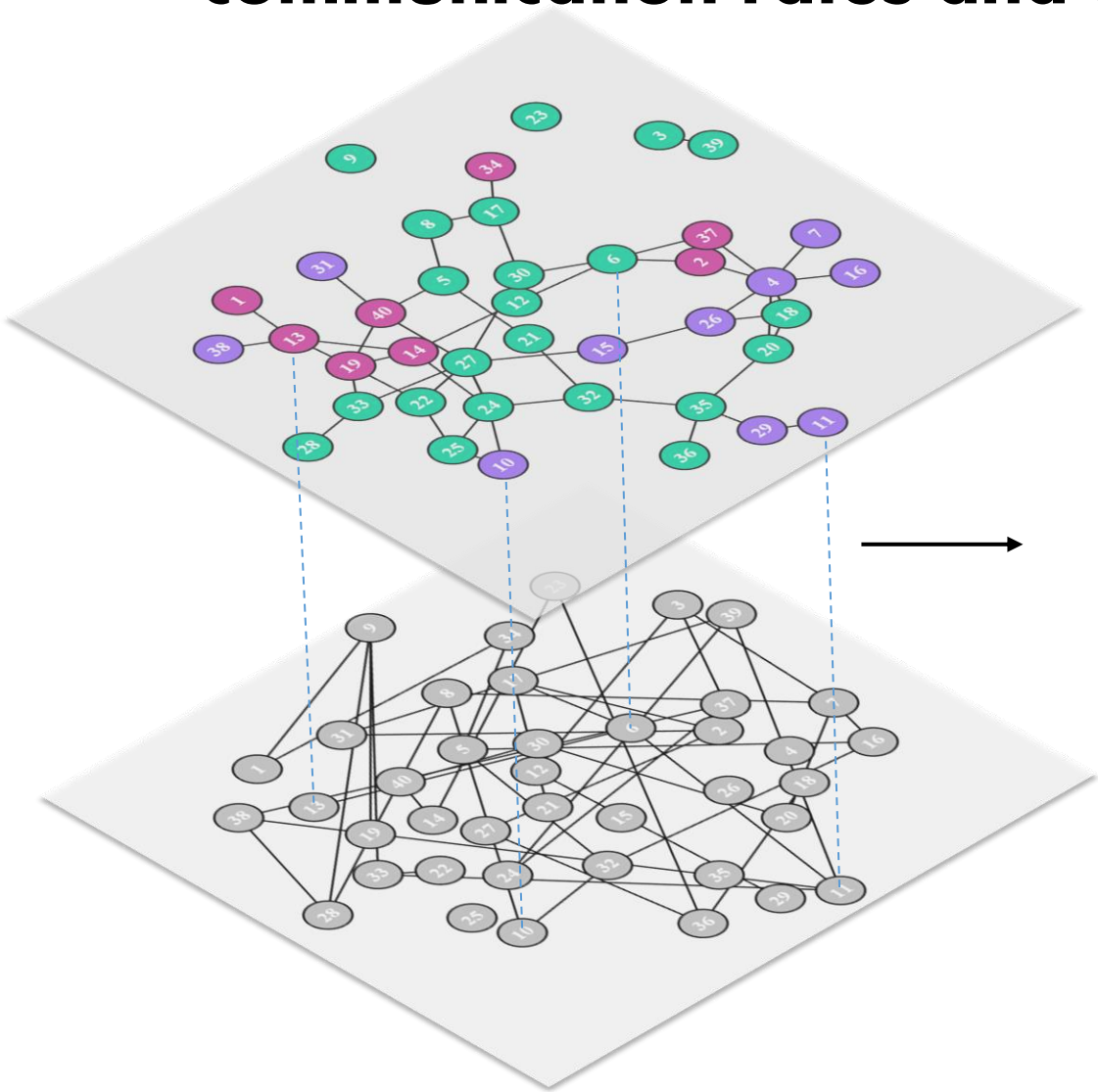
Regional network analysis to understand the effects of policy and farmer management decisions on an avocado laurel wilt epidemic

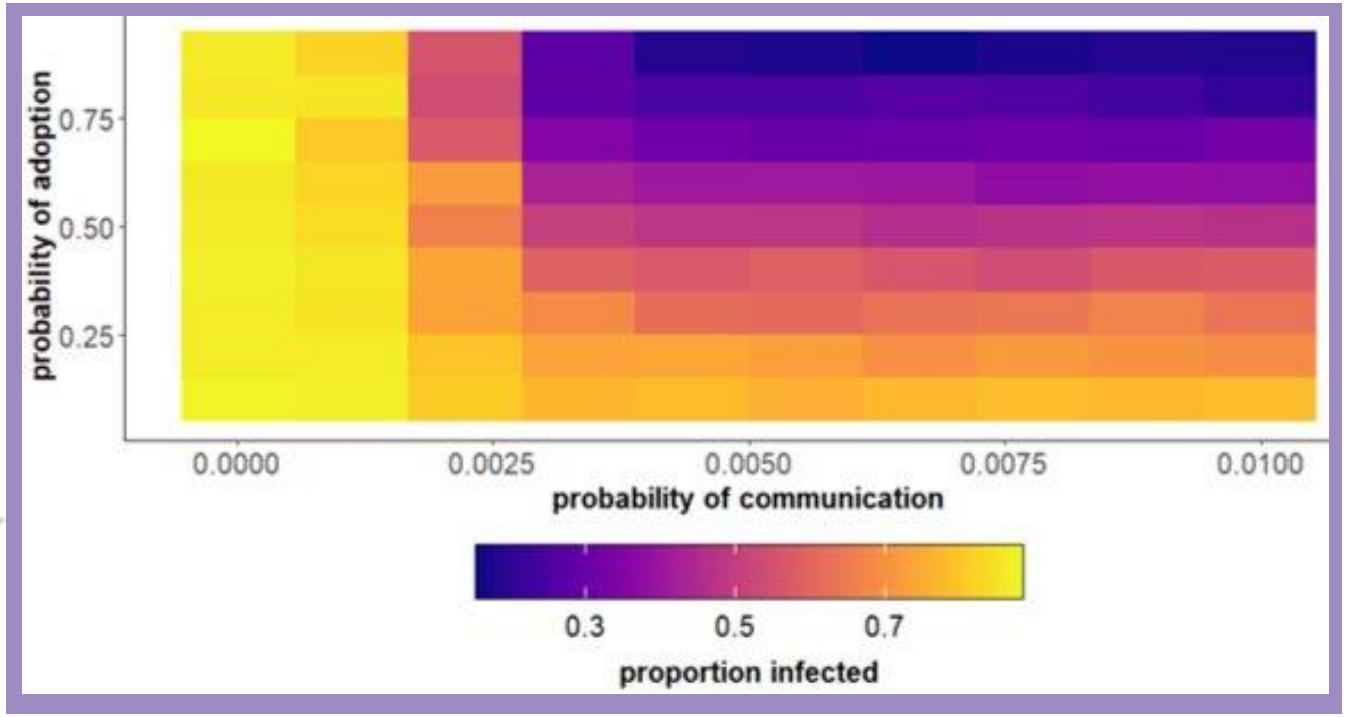


Incorporating policy options and their effects on adoption



One example of a scenario evaluating the effects of changing communication rates and adoption rates





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?

The Tool Box

https://tools4seedsystems.org/

TOOL BOX

FOR WORKING WITH ROOT, TUBER AND BANANA SEED SYSTEMS

Replicable,
open-source,
and backed by science.

- ✓Description sheet
- ✓User guide
- ✓Case study
- ✓Tool validation
- ✓Peer-reviewed publication
- ✓Technical support available