

Using modelling and mapping for digital insights into diseases in the rice field

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“All models are wrong; some models are useful”

“Essentially, all models are wrong, but some are useful.”

“Since all models are wrong the scientist cannot obtain a "correct" one by excessive elaboration.”

"Is the model illuminating and useful?"

Two Tools

From breeders' plots to farmers' fields



Tool # 1 - Models for rice diseases

(No equations were harmed during the making of this presentation)

RICEPEST

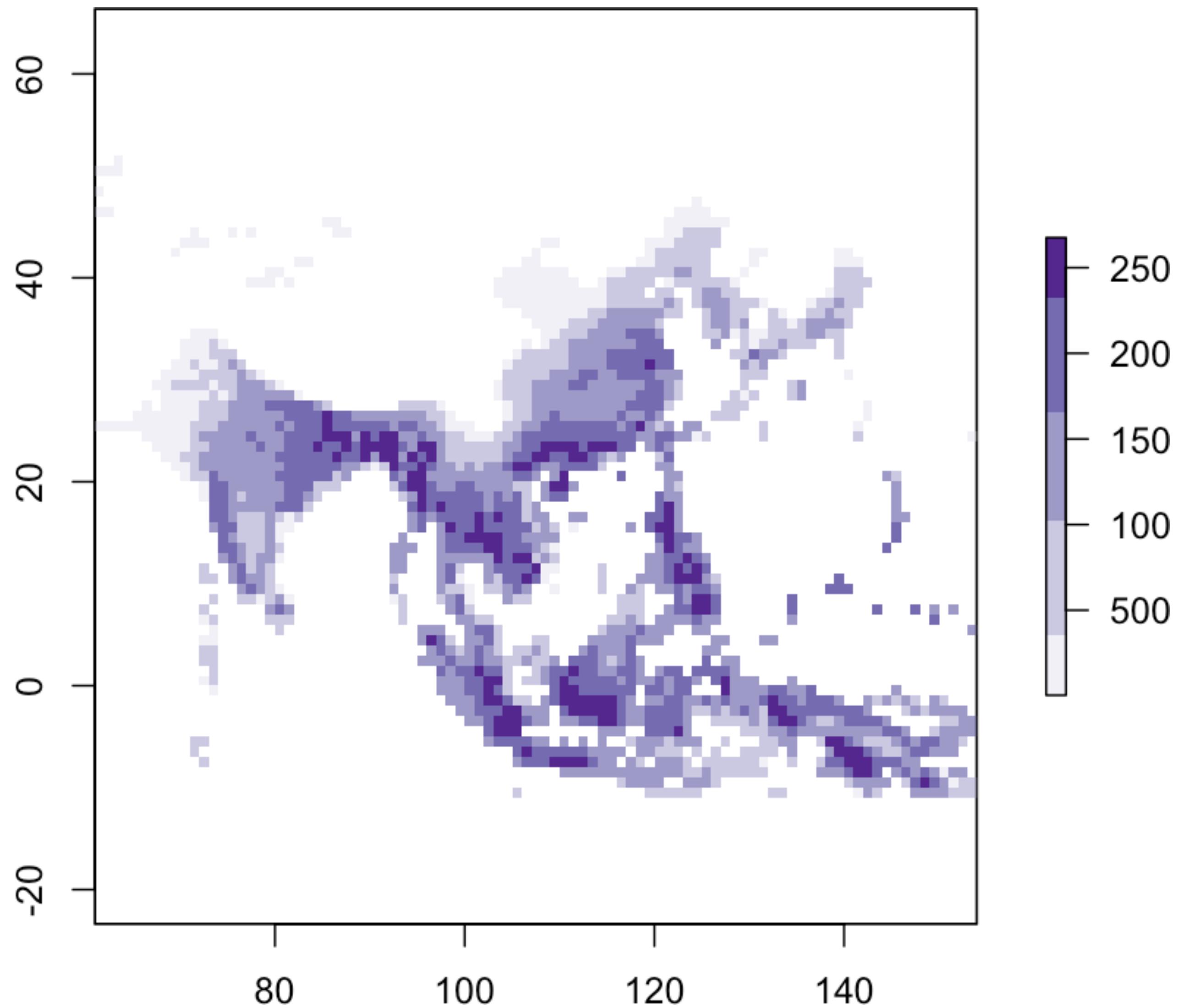


Production-Situation
Driven Crop Growth
Model
(Attainable Yield)

EPIRICE

Bacterial Leaf Blight - Asia

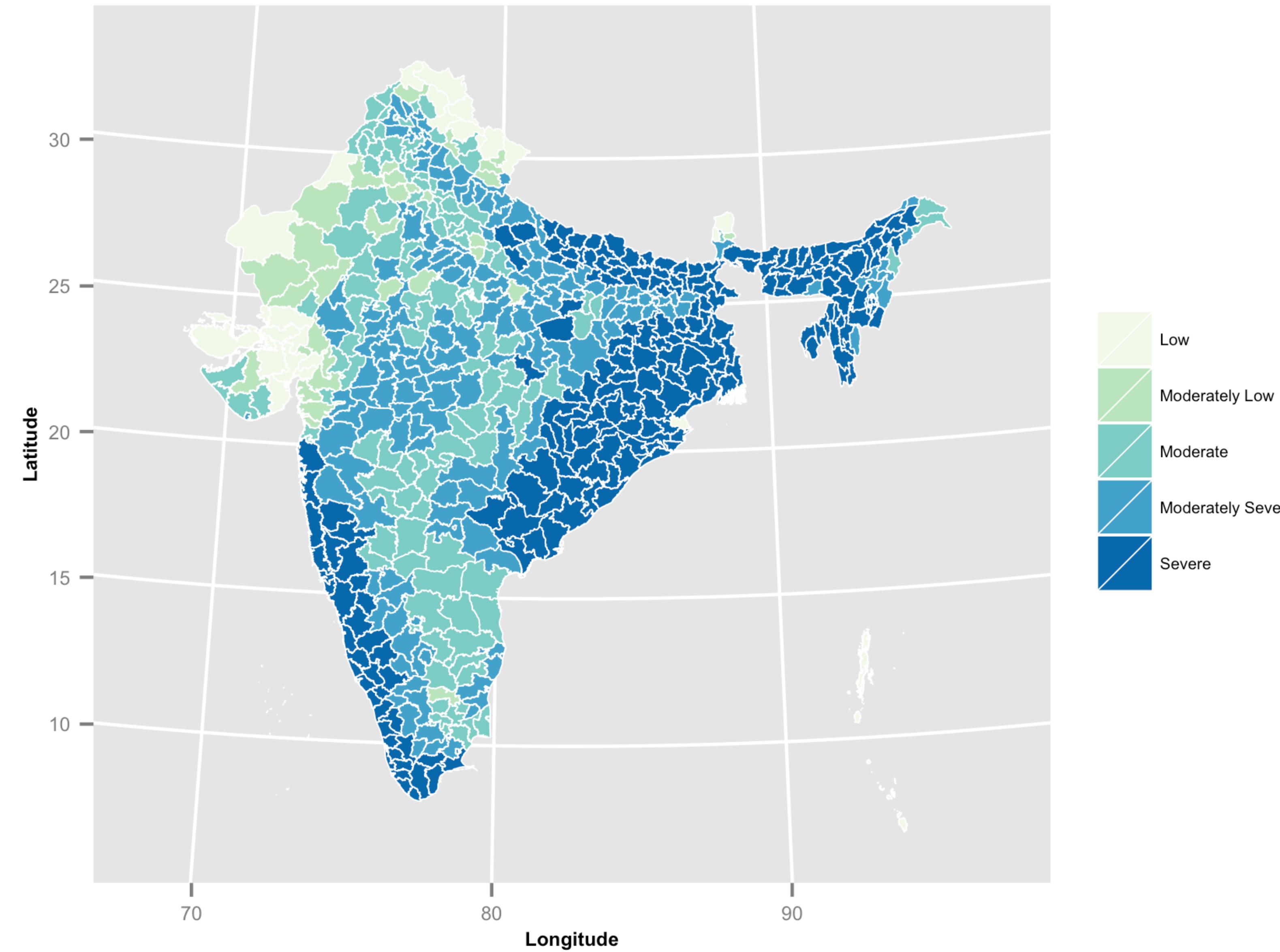
Average AUDPC
1983-1998



Biotic Stresses in India as a part of STRASA

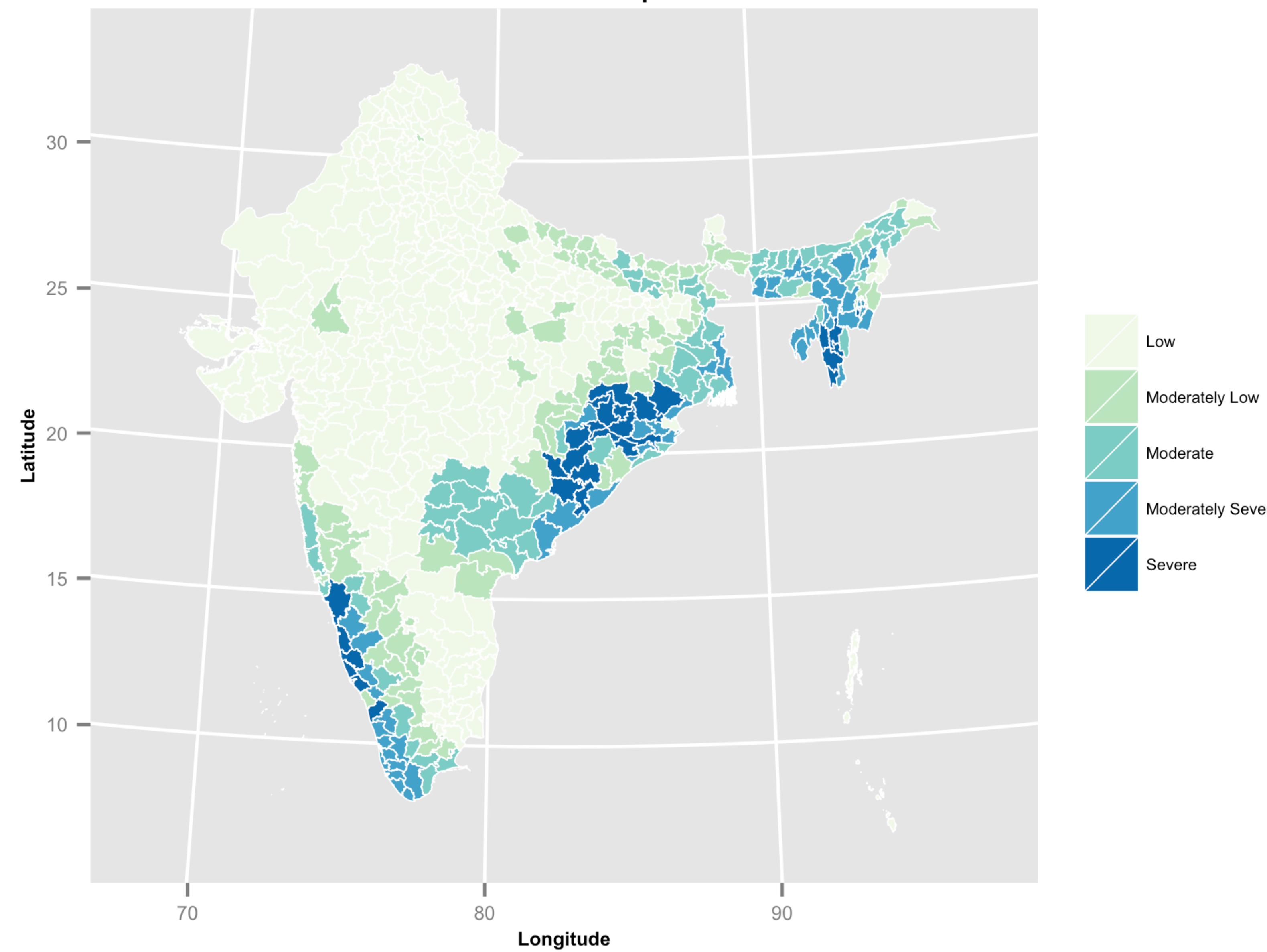
An EPIRICE example

Relative Risk of Bacterial Blight for India



The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by IRRI.

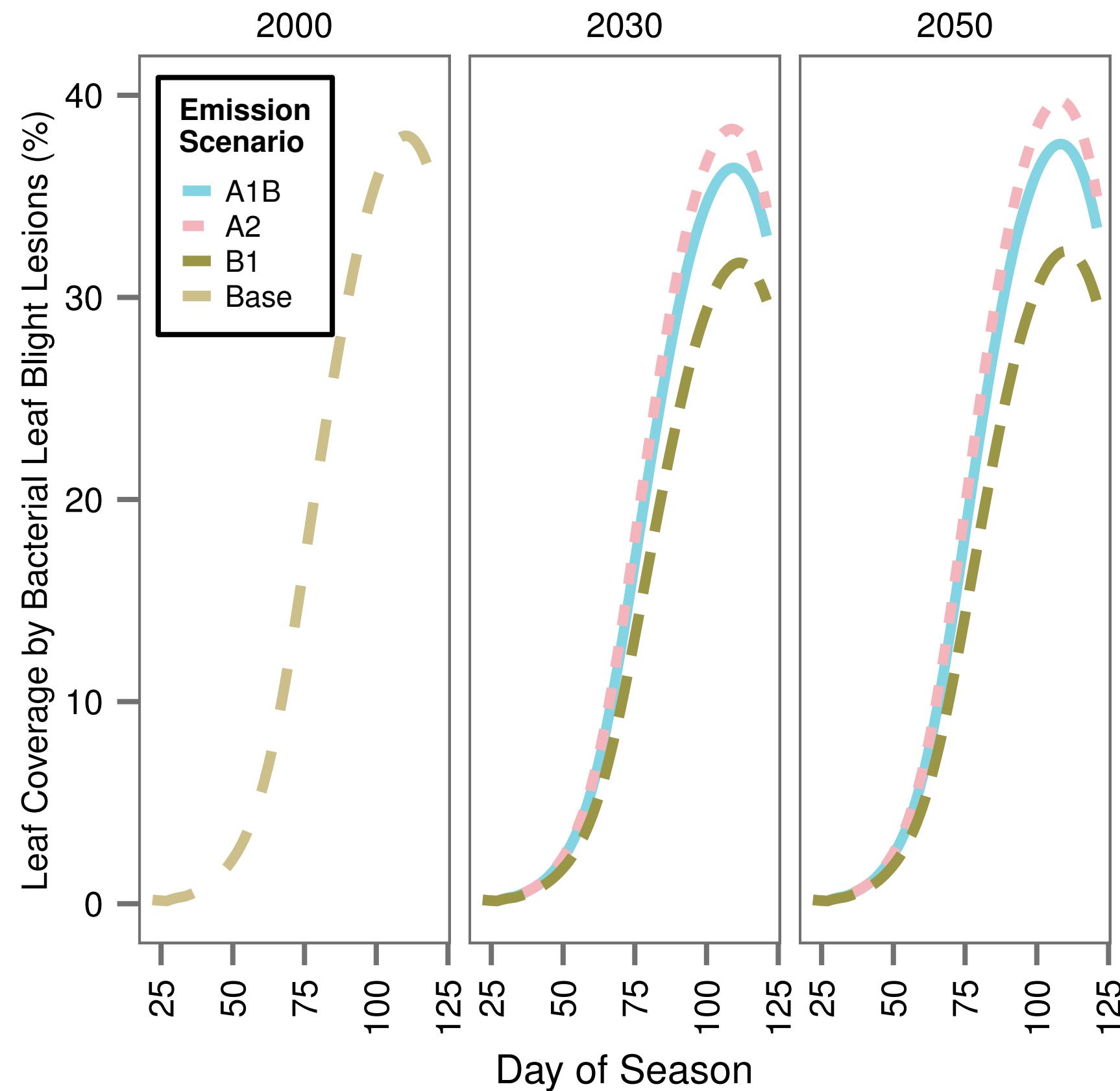
Relative Risk of Brown Spot for India



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An example of the study of effects of climate change on diseases

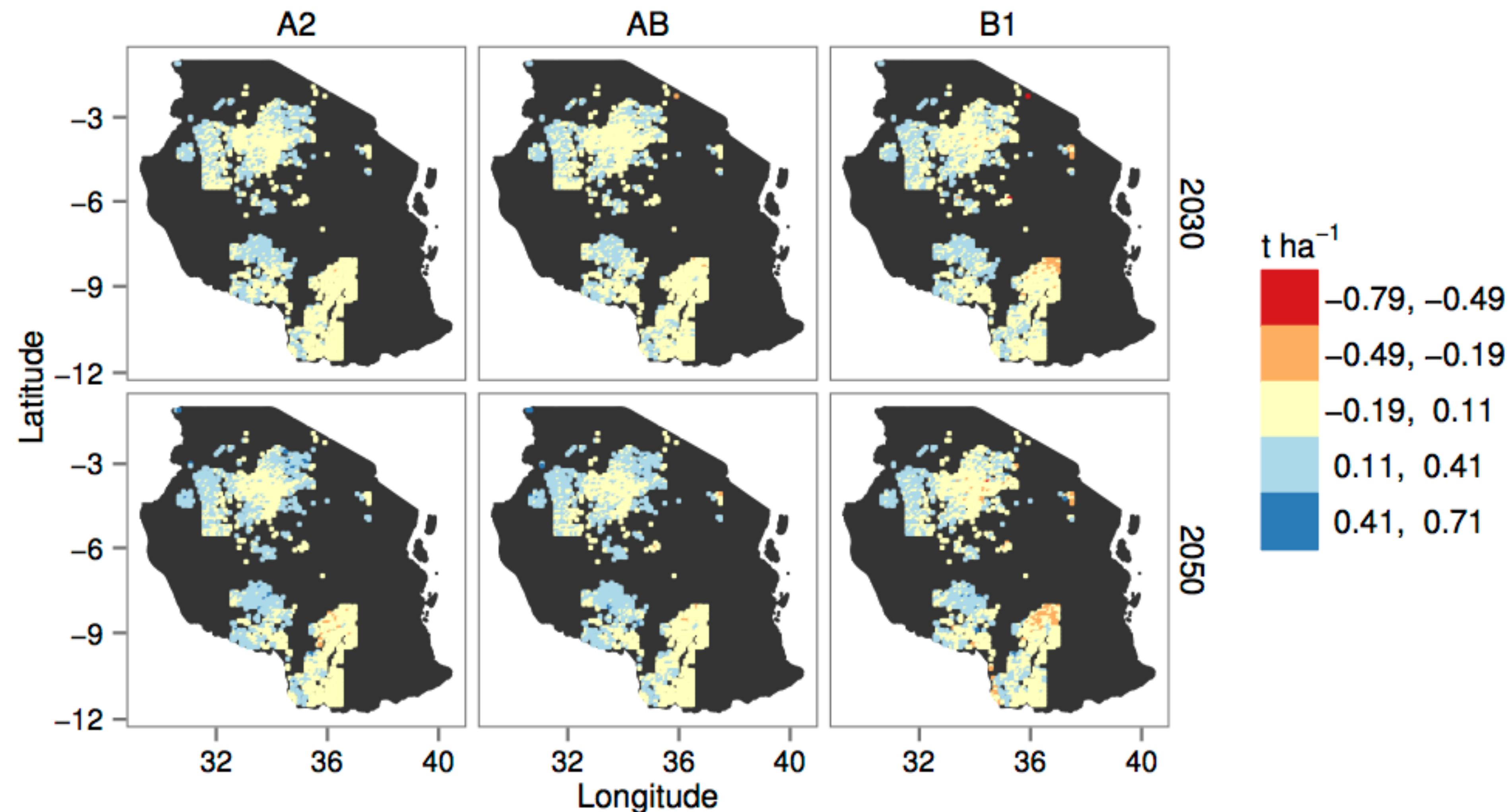
Linking EPIRICE and RICEPEST



Bacterial Blight in TZA

Duku, C., Sparks, A. H. and Zwart, S. 2016. Spatial modelling of rice yield losses in Tanzania due to bacterial leaf blight and leaf blast in a changing climate. *Climatic Change* 135(3).

Change in Yield Losses Due to Bacterial Blight, Tanzania



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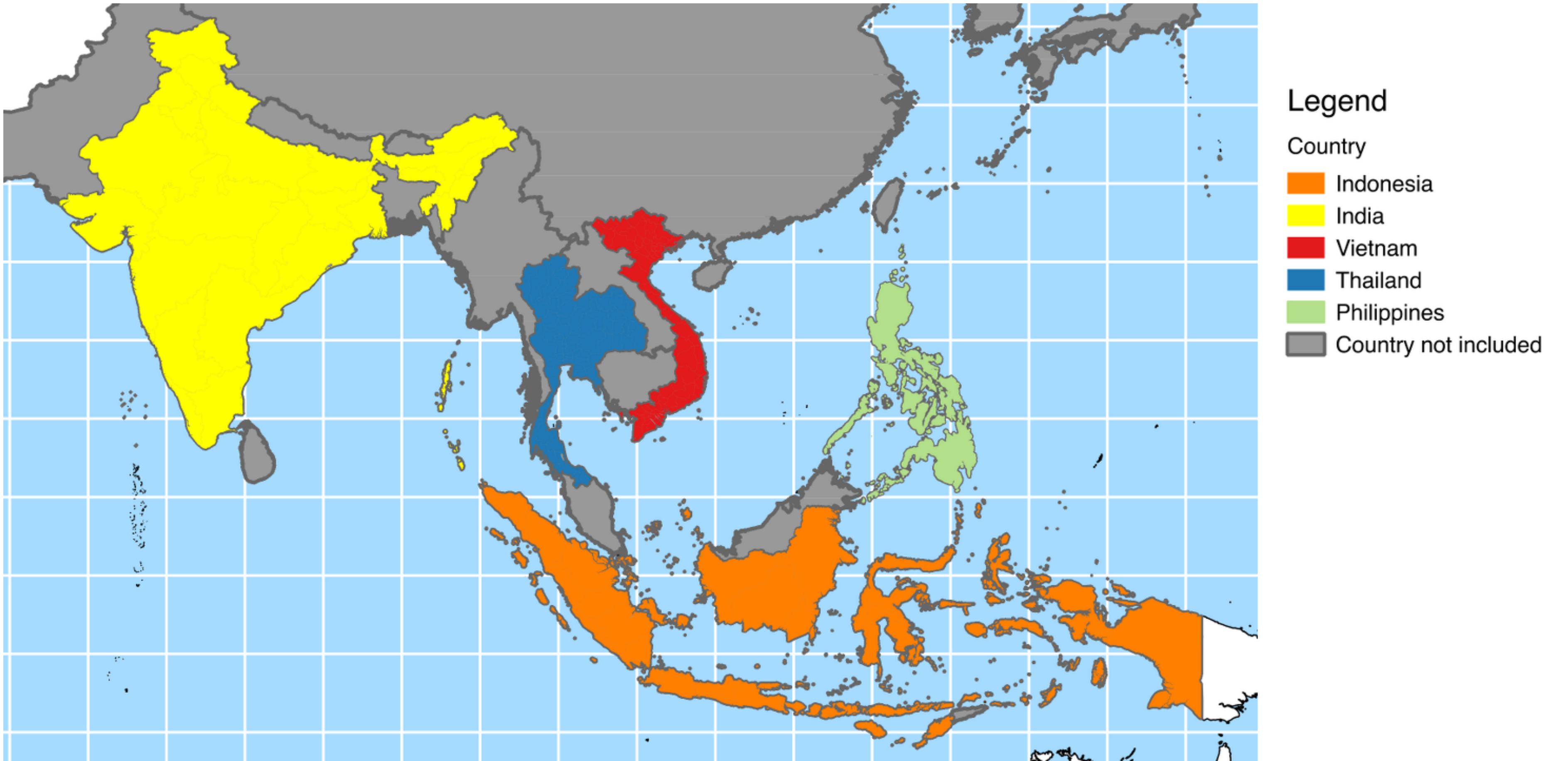
**A Survey Portfolio
for the Characterization
of Rice Pest Constraints**

Serge Savary, Francisco A. Elazegui, and Paul S. Teng

Tool # 2 - Surveys

*Creating actionable information
from in-field data*

IRRI
INTERNATIONAL RICE RESEARCH INSTITUTE





PRiSM

Philippine Rice
Information System

PRISM is a collaboration between

Philippine Department of Agriculture (DA)

DA-PhilRice – capacity building, technology development and custodian of PRISM

DA-Rice Program – key end user of PRISM

DA-Regional Field Offices & Local Government Units – field expertise, surveys, key end users of PRISM

Regional Crop Protection Centers – field expertise, surveys, key end users of PRISM

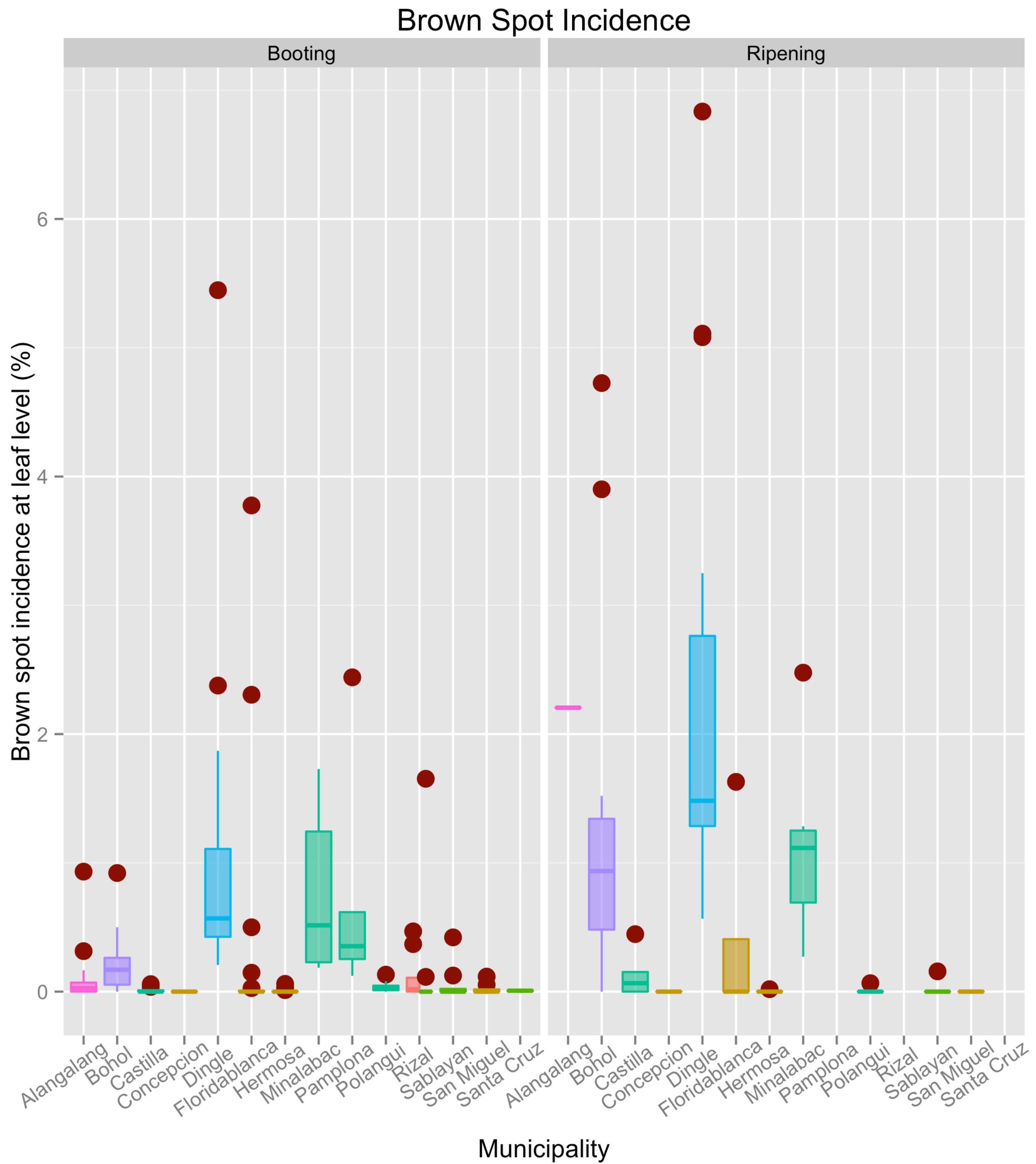
IRRI – technology development, capacity building and project management

sarmap – remote sensing technology provider

Smart phones replace pen and paper data collection

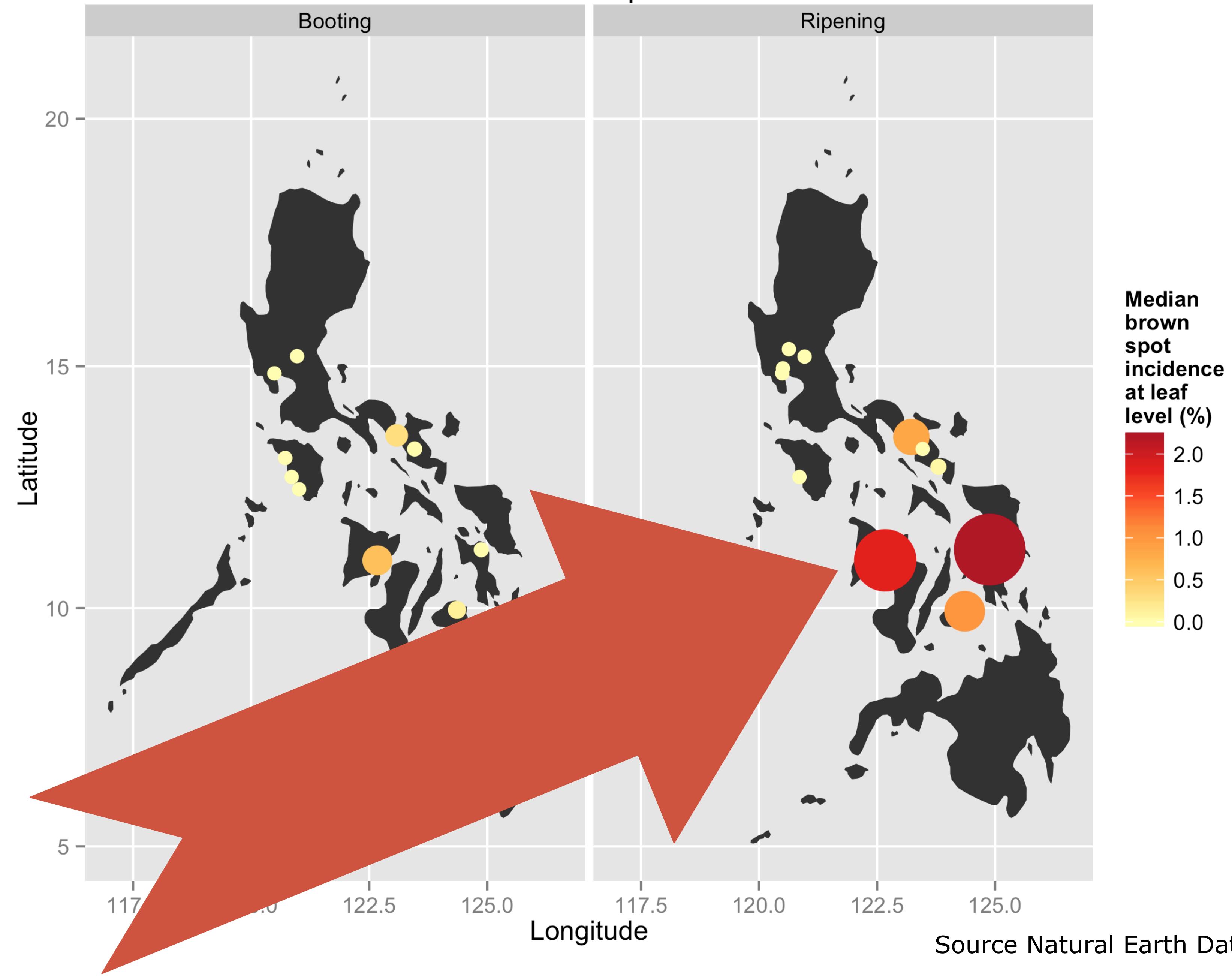
- Data collection forms
- GPS for location and time
- Camera for documentation and observations
- Direct transfer of field data to cloud platform using mobile network
- ***Rapid field information in event of a calamity or outbreak***





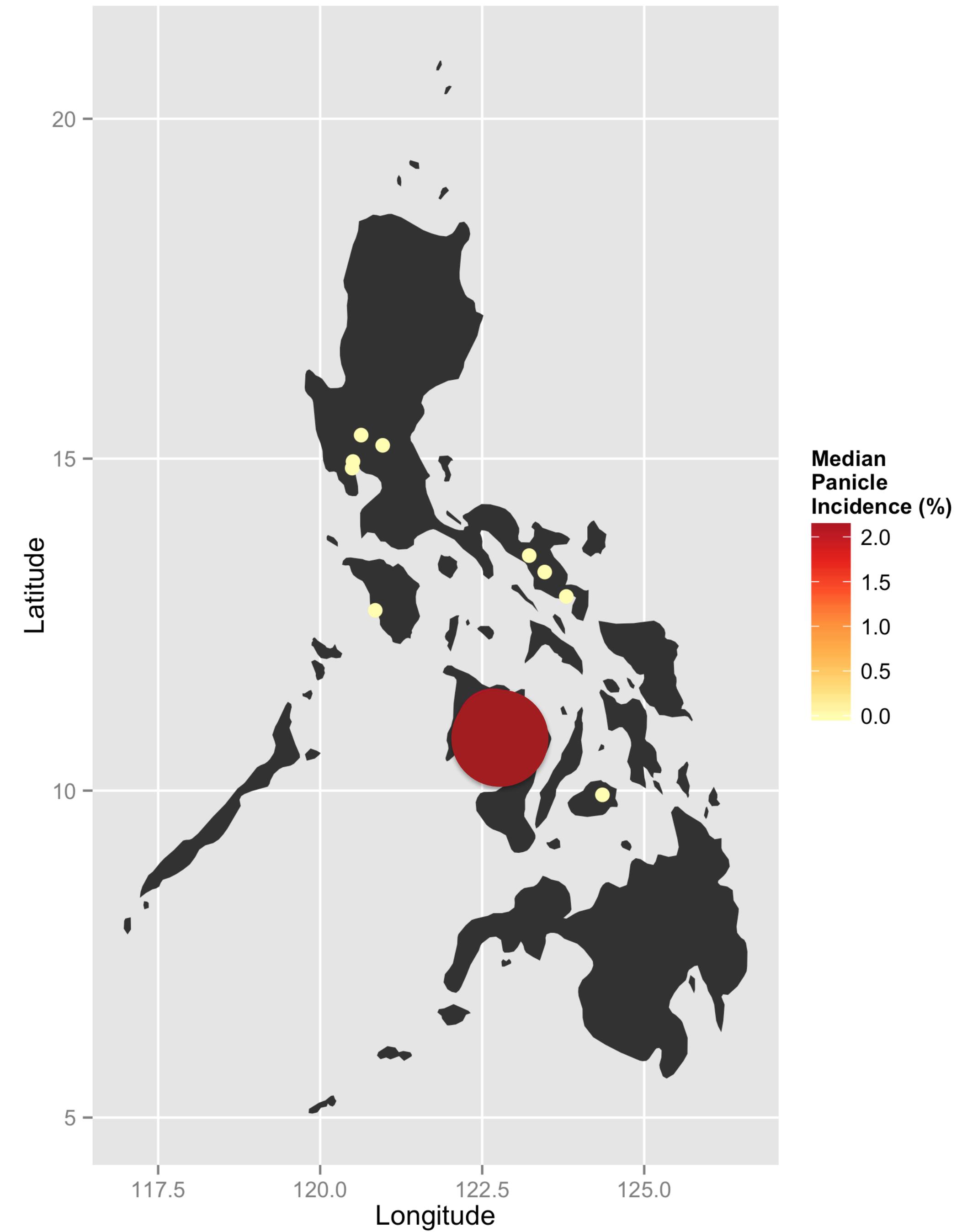
Source PRISM

Brown Spot





Neck Blast



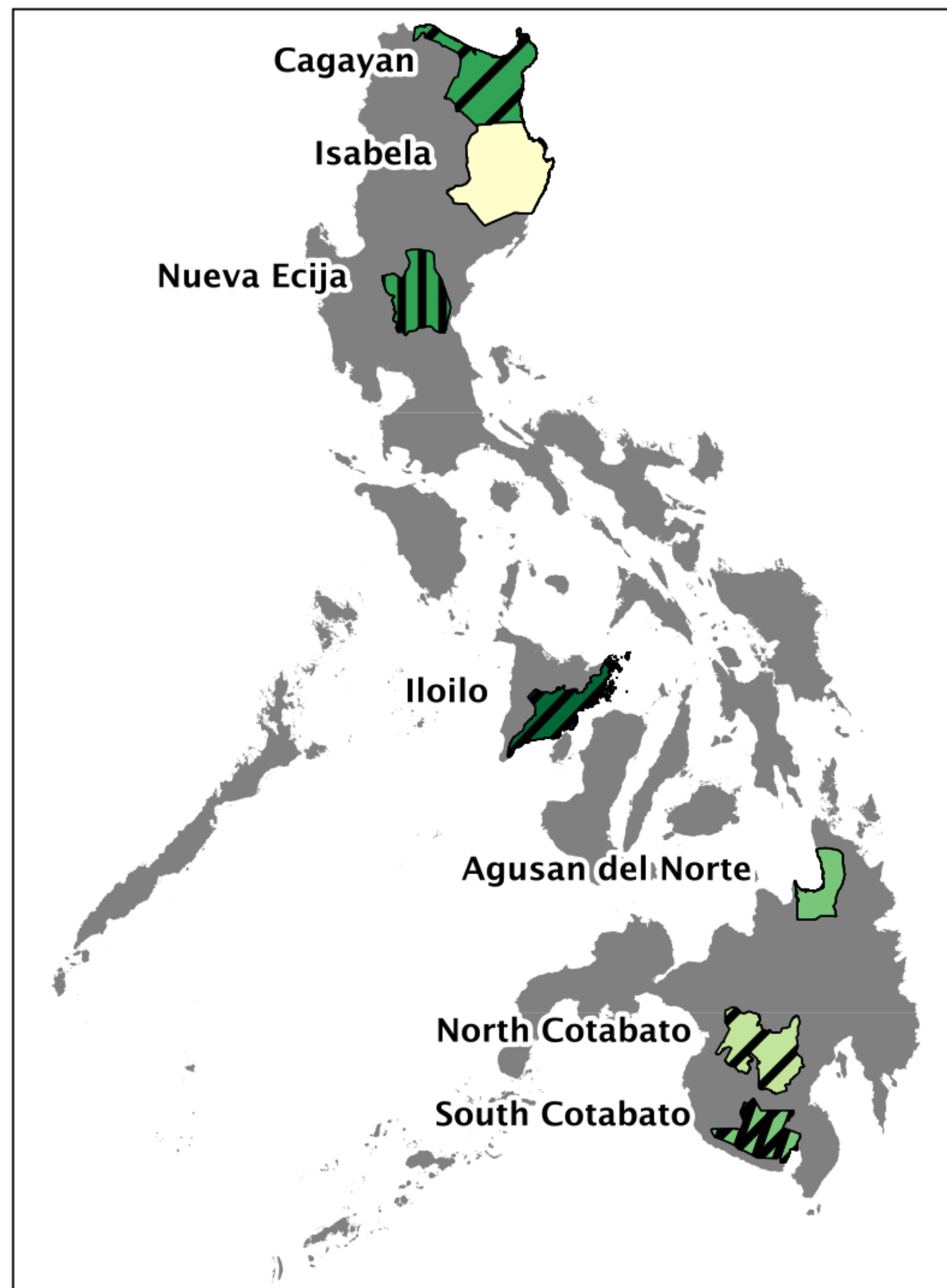
This map shows the incidence of leaf blast and the average annual number of fungicide applications made per province surveyed.

Iloilo has the highest leaf blast incidence but only a provincial average of 0.4 applications of fungicide per field per season. These data could indicate that leaf blast is a problem in Iloilo and perhaps fungicide sprays are not effectively controlling it or farmers that use it get good control, further investigation of the situation is required. Note that the disease appears not to be a problem in Isabela, where leaf blast severity was lowest and fungicide applications were zero.

2010 - 2011 Provincial Average Wet Season Leaf Blast Severity and Fungicide Applications

Average No. Fungicide Sprays	Average Leaf Blast Severity Rank
0	Low
0.1	Moderately Low
0.3	Moderate
0.4	Moderately High
0.6	High
Province not Surveyed	

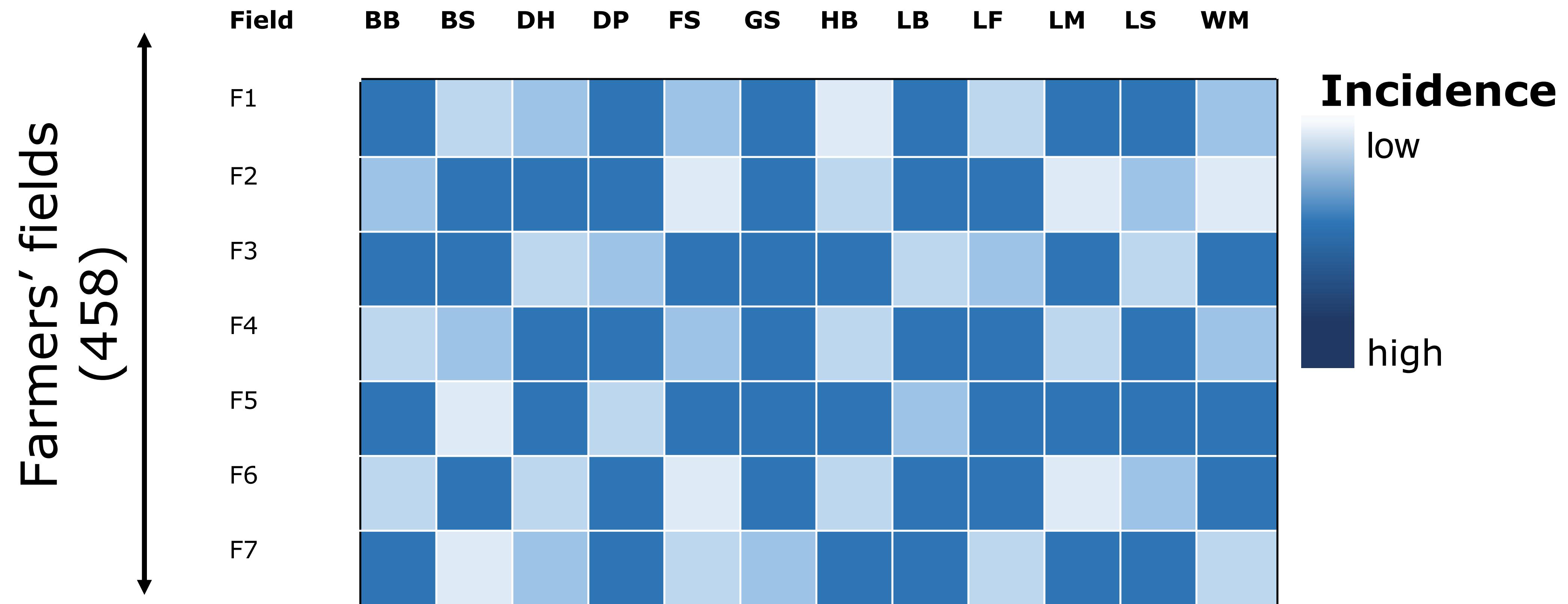
Data source: 2010 and 2011 RSSP surveys conducted by PhilRice in conjunction with IRRI



Using Survey Data

Designing Crop Protection Regimes

Injury variables (31)



What a network can identify

Highly central nodes

Identification of important
connectors

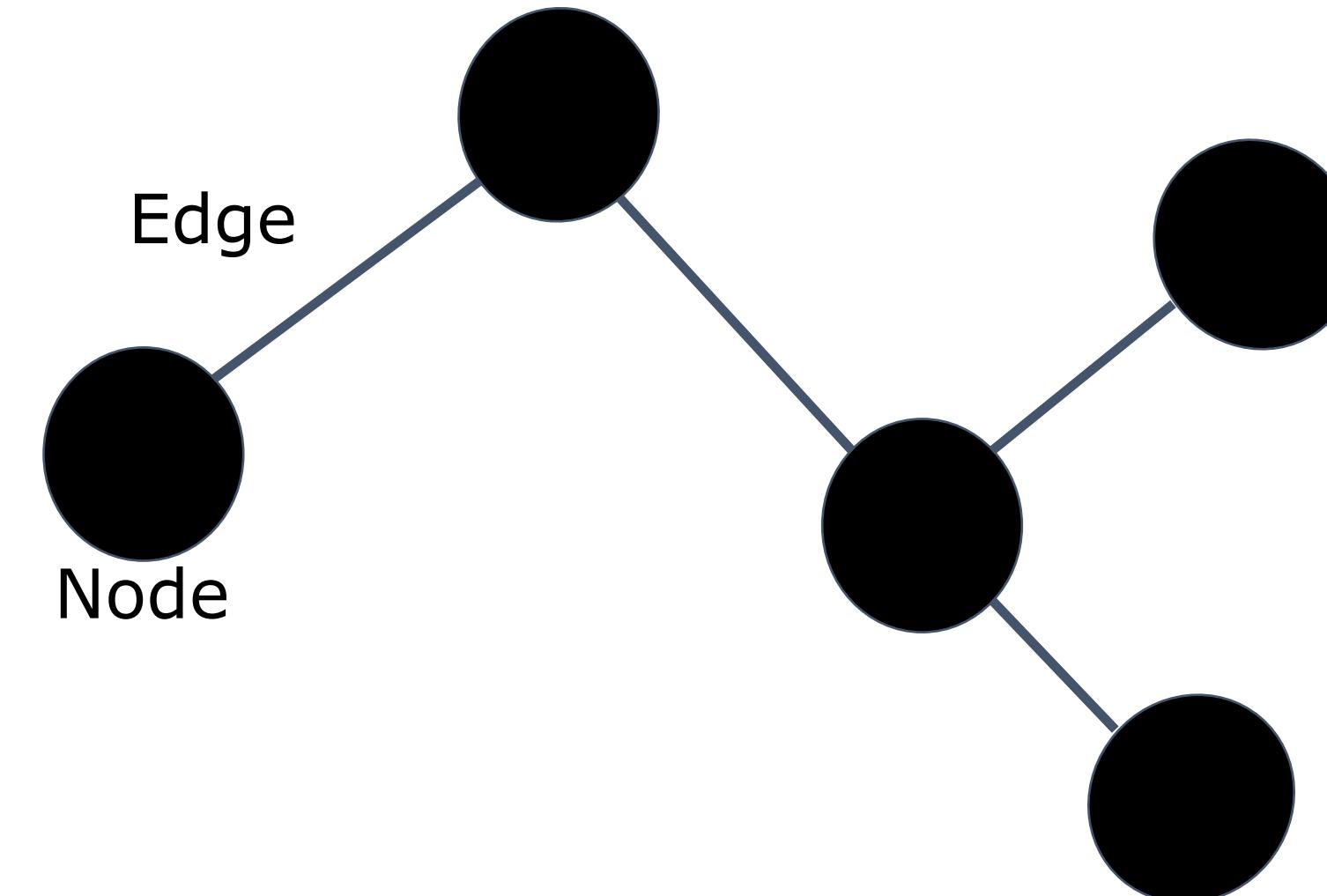
A clustered region

Network analysis

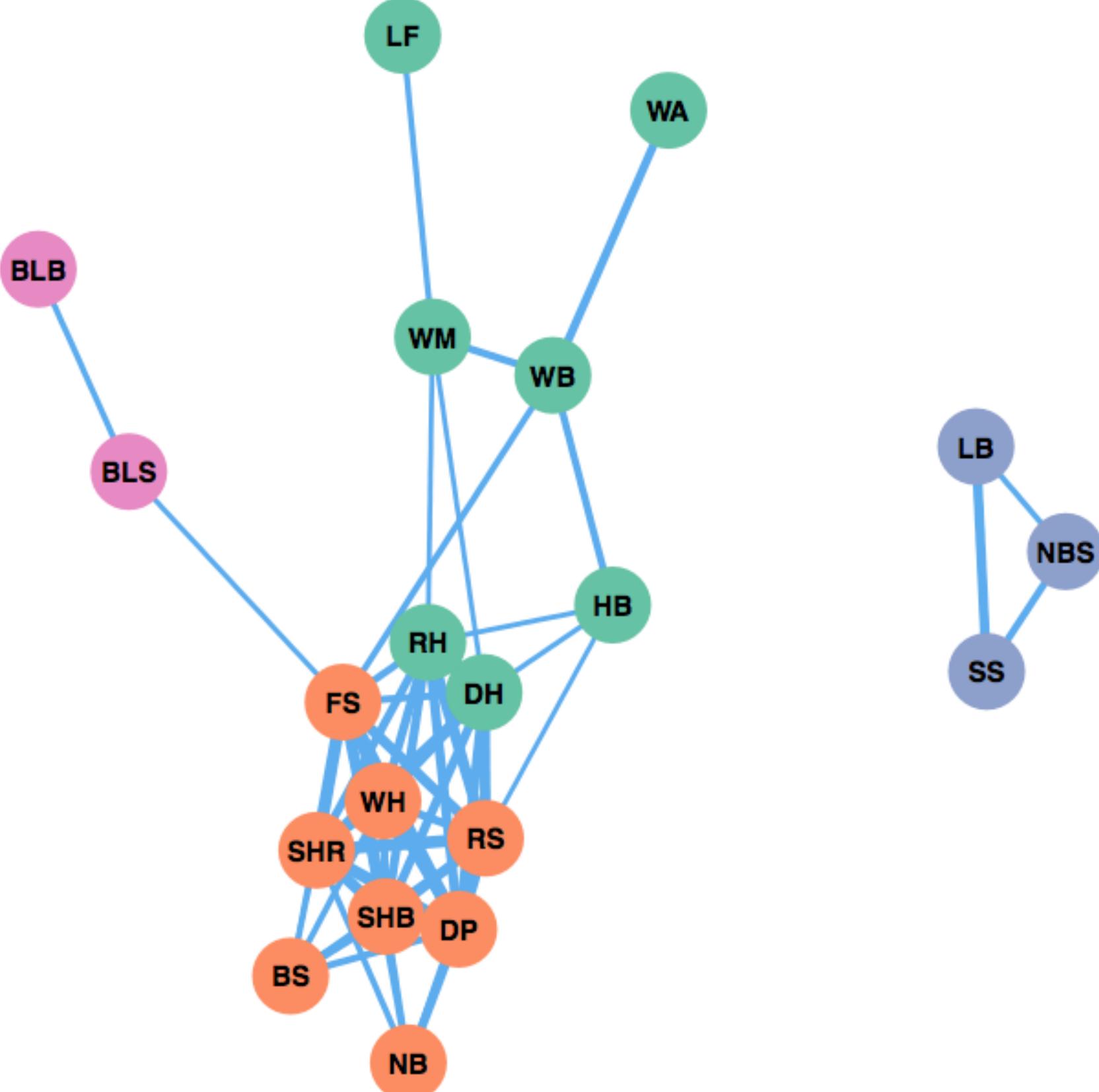
Data (relational)

Graph theory

Network model

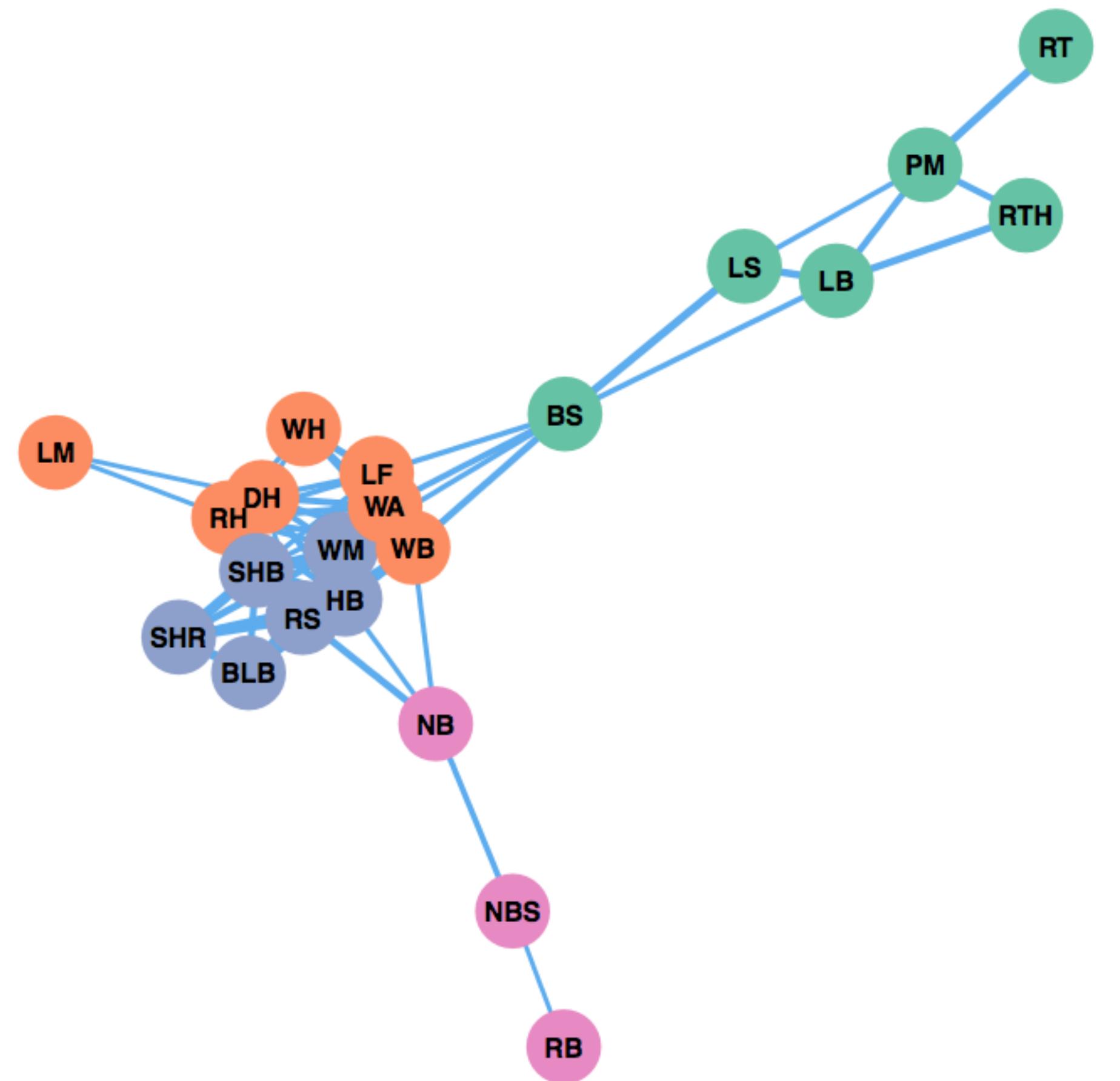


Correlation analysis of an injury co-occurrence network in dry season in Central Plain, Thailand



Legend

BB	= bug burn
BLB	= bacterial leaf blight
BLS	= bacterial leaf streak
BS	= brown spot
DH	= deadheart
DP	= dirty panicle
FS	= false smut
GS	= grassy stunt
HB	= hopper burn
LB	= leaf blast
LF	= leaffolder injury
LM	= leaf miner injury
LS	= leaf streak
NB	= neck blast
NBS	= narrow brown spot
PM	= panicle mite injury
RB	= rice bug injury
RGS	= ragged stunt
RH	= rice hispa
RT	= rat injury
RS	= red stripe
RTG	= rice tungo
RTH	= rice thrip injury
SHB	= sheath blight
SHR	= sheath rot
SR	= stem rot
SS	= silver shoot
WA	= weed above
WB	= weed below
WH	= whitehead
WM	= whorl maggot injury
●	= syndrome1
○	= syndrome2
○	= syndrome3
●	= syndrome4



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Correlation analysis of an injury co-occurrence network in wet season in Central Plain, Thailand

RICE-PRE

A prescription for rice crop health

RICE-PRE

- A crop health syndrome model,
- Inspired by EPIPREE by Zadoks (1981),
- Based on agroecologies as defined by Nelson et al., and
- Based on survey data from 456 lowland rice farmers' fields in tropical and sub-tropical Asia

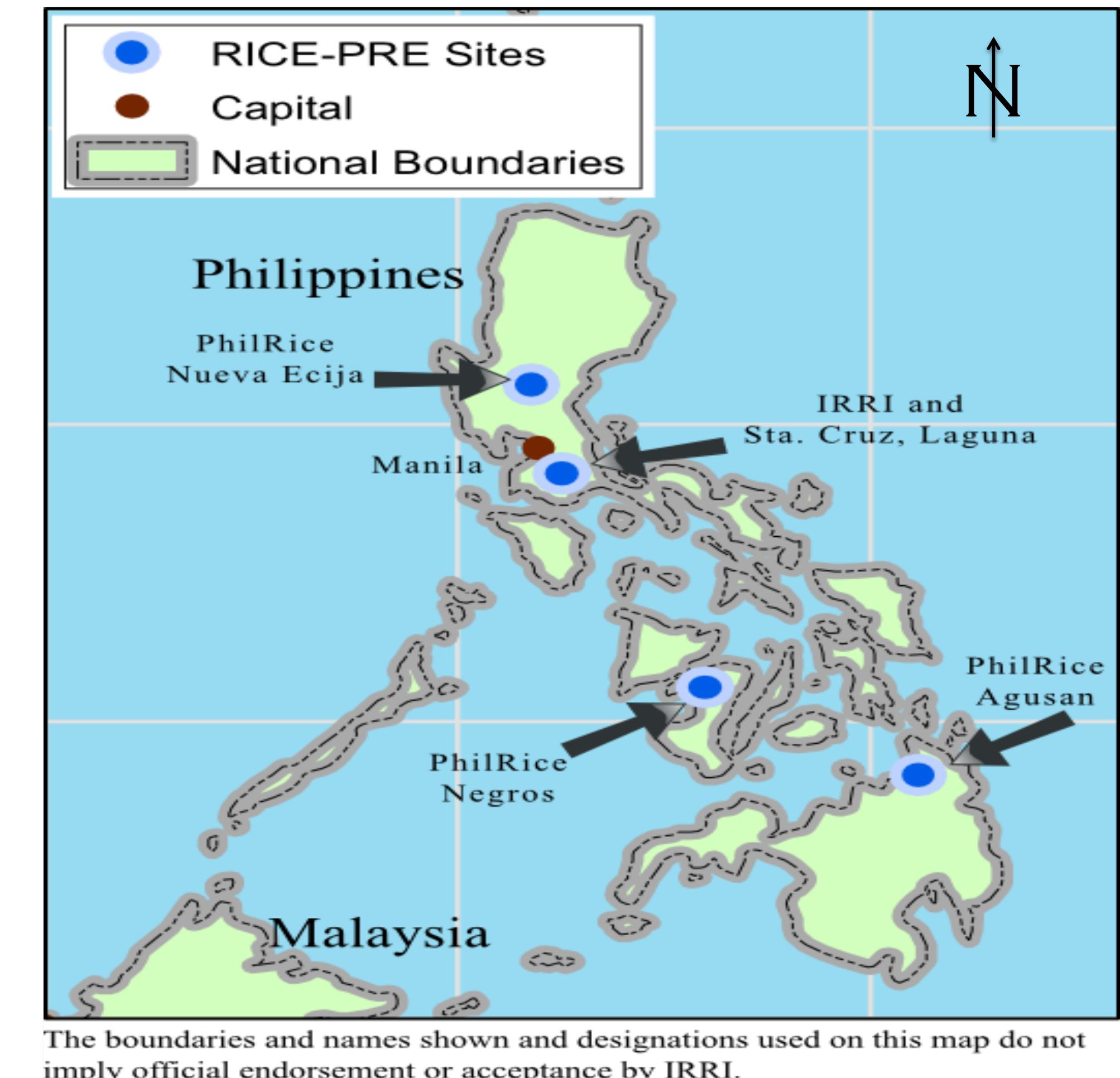


Agroecologies

Agroecology code	Description
1 - IR	Single season, irrigated rice, no other crop
2 - IR / other	Double season, irrigated rice / irrigated other crop
3 - IR / IR	Double season, irrigated rice / irrigated rice OR Triple season, irrigated rice / irrigated rice
4 - IR / IR / other	Triple season, irrigated rice / irrigated rice / irrigated other
5 - RF	Single season, rainfed rice, no other crop
6 - RF / RF	Double season, rainfed rice / rainfed rice
7 - RF / RF other	Double season, rainfed rice / rainfed other
8 - RF Dry/Upland	Single season, rainfed rice, not bunded

RICE-PRE Plot Locations

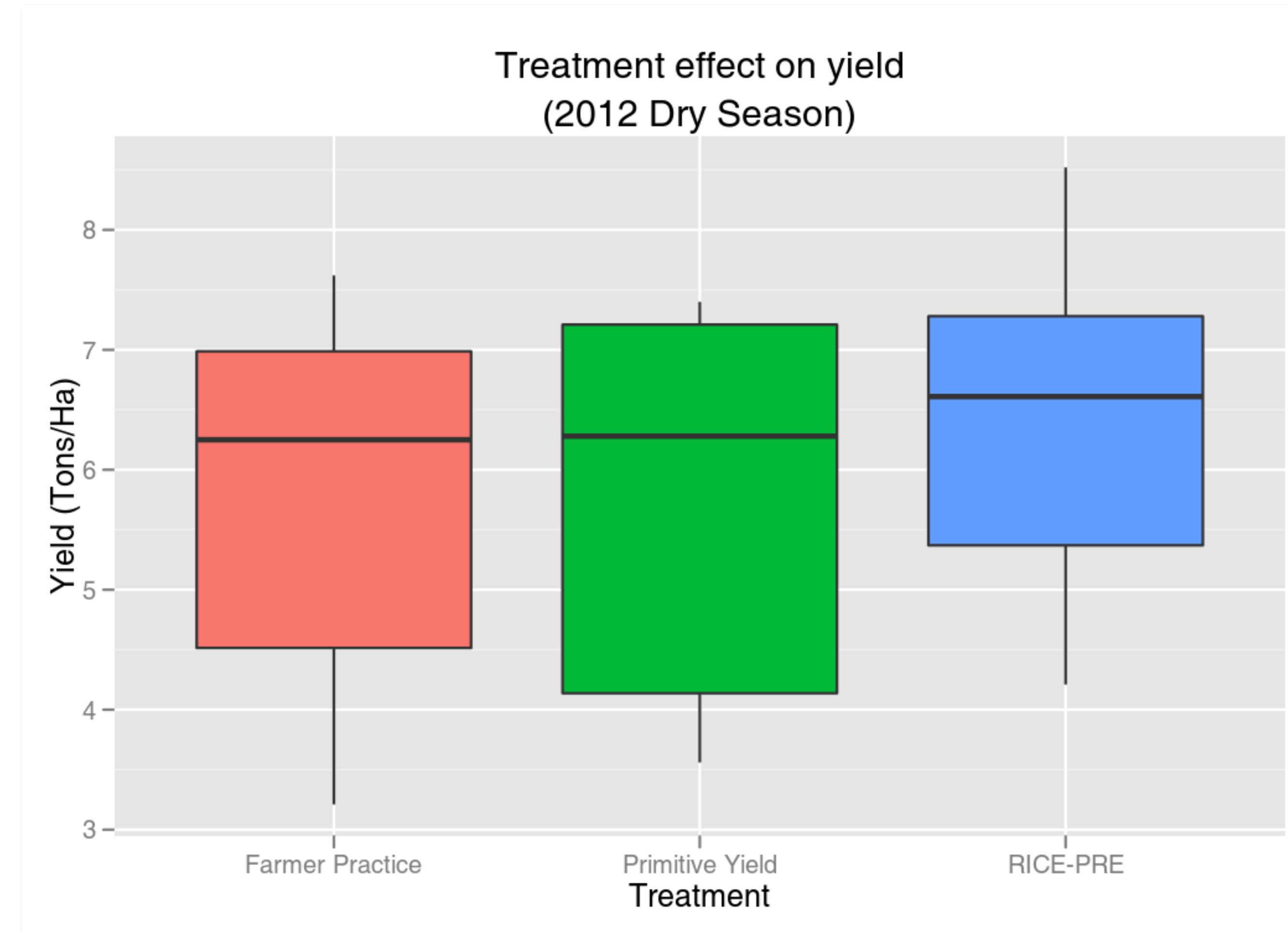
2011 to 2015



Philippines Prescription

- Use certified seed
- Thorough land preparation and leveling
- Varieties with good local adaptation (BPH, WH)
- 5 cm of standing water up to DVS=80
- IF TR = post emergence herbicide application at DVS=10 and DVS=20 or hand weeding or mechanical weeding
- IF DS = pre-emergence herbicide and post emergence herbicide at DVS= 10
- Mineral fertilizer (NPK) application suitable for location, per Rice Crop Manager
- Do not spray insecticides

Results



Sparks et al. unpublished

Two Tools

From breeders' plots to farmers' fields

RICEPEST and EPIRICE

- Mapped relative disease severity
- Effects of climate change

Surveys

- PRISM
- Network Analysis
- RICE-PRE



Digital Insights

From the field to the computer and back again

Developing new ways of gathering, analysing and sharing data and information



Robert S. Zeigler, keynote speaker at the 7th International Rice Blast Conference (IRBC07), urged the participants to pay attention to climate change. "We must work with our crop modelers to try to predict where climate might exacerbate future problems with the fungus. Changes in management practices will be critical in determining remedies for decades to come."

READ: <http://bit.ly/2dHv7MD>



Rice blast, a continued threat to global food security

MANILA, Philippines— "Rice blast plays a major reason for the loss of production of rice grain. That loss of rice production feeds into p..."

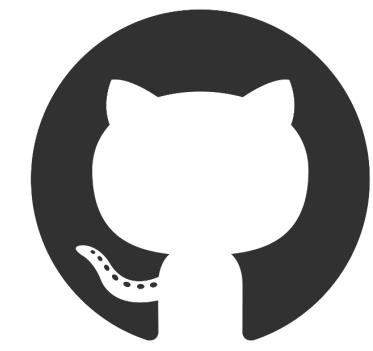
Acknowledgements

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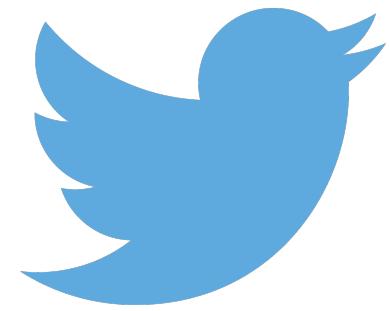
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