Australian Government
Department of Agriculture, Fisheries and Forestry

In-field next-generation plant pathogens detection with CRISPR/Cas-based methods

15th May 2024

Frank Bedon, PhD
Plant Innovation Centre, Biosecurity Plant And Science Services Division, Post Entry Quarantine Group (PEQ), 135 Donnybrook Rd, Mickleham 3064, VIC, AUSTRALIA

The Plant Innovation Centre (PIC)

Objectives

- Develop in-house capability to conduct trials that address operational issues with a focus on implementing into service delivery
- Further engage with the scientific research community
- Develop closer collaborative links with the education sector

Our Plant Innovation Centre website
https://www.agriculture.gov.au/science-research/pic

Post-Entry Quarantine facility in Mickleham (Victoria, AU)

Diagnose high risk plant imported from overseas

Why plant pest detection ?

TO PROTECT Australia's primary industry and export markets*

- Agriculture $83 billion (2021-22) (equiv. ~3% of GDP)
- Agriculture employs >300,000 people
- Amongst the top 10 global agricultural export countries

TO PROTECT Australia's unique environment (island continent)

- 80% of Australia's fauna and flora are unique

* https://nff.org.au/media-centre/farm-facts/

Identifying exotic plant pests and diseases

Indispensable & necessary

- Surveillance
  - Early detection for early containment
  - Managing potential incursions
- Field and Border inspections
- Pre-export clearance

Protection relies on pathogens identification

In-laboratory diagnostics

The golden standard!

Drawbacks:

- Specialised laboratory
- Trained personnel
- Long turnaround time
- Heavy/expensive equipment

In-field diagnostics / Point Of Care testing

Some are already in use . . . but:

- Not available for every pathogens of interest
- Sensitivity/specificity can be improved
- Only one pathogen detection per assay
- Results reporting is not connected to internet

Advantages:

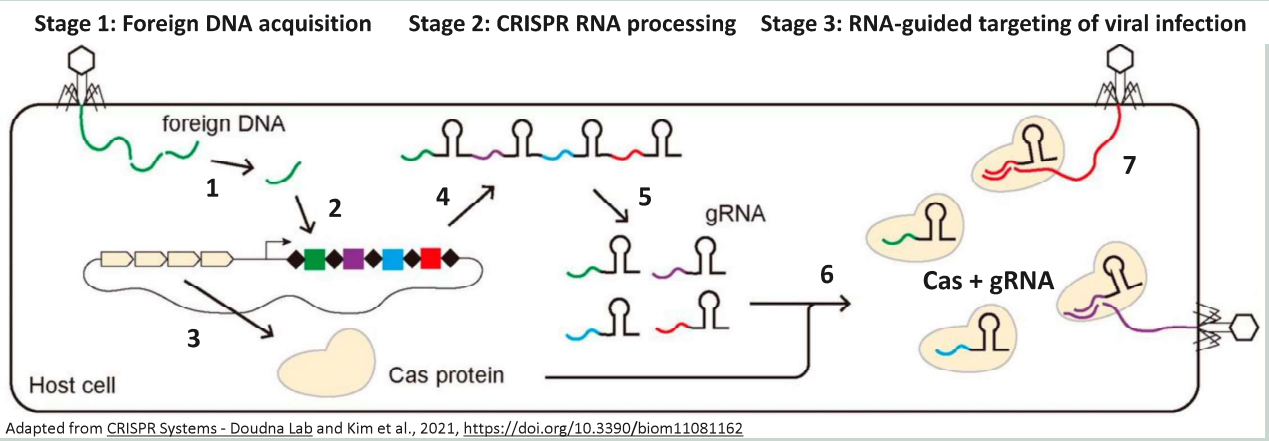
- Simple instruments
- Can be performed by non-experts
- Fast results (usually 30 min or less)
- Simple detection method
- Portable :
  - can be employed at points of incursion
    - airport/seaport screening
    - non-domestic pre-import screening
- Rapid triage and decision on the spot
- Help decrease workload in diagnostic labs

Department of Agriculture, Fisheries and Forestry

CRISPR/Cas

CRISPR-Cas: Clustered Regularly Interspaced Short Palindromic Repeats / CRISPR Associated System

- Bacterial acquired immune system that recognize and destroy invading genomes

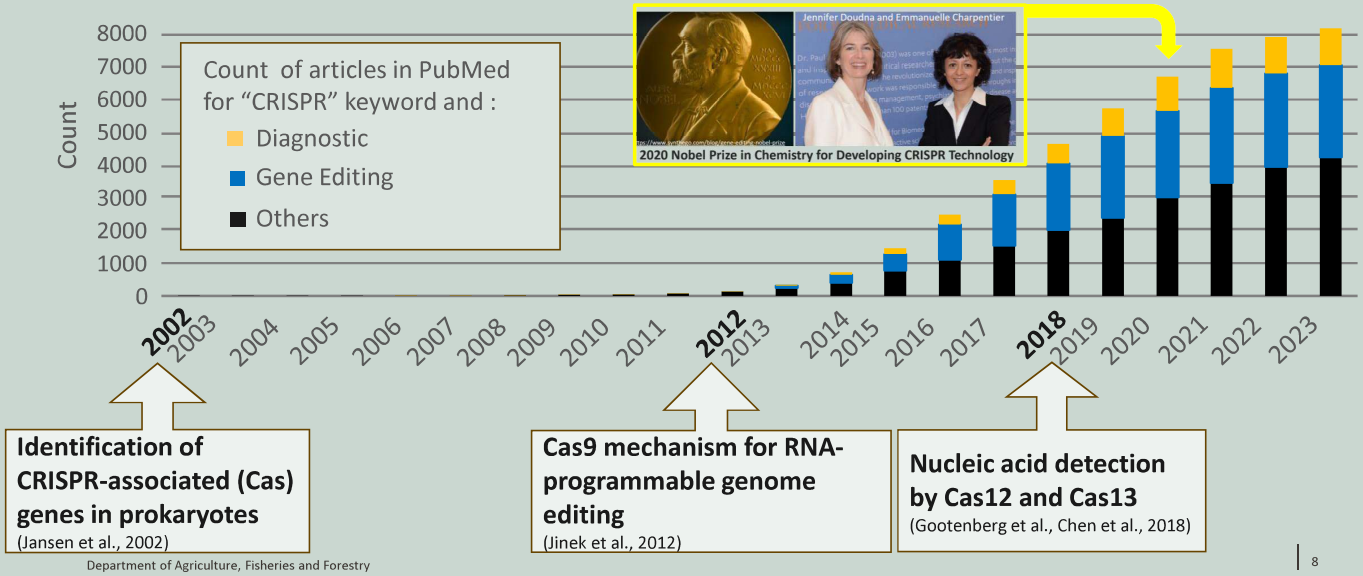


Adapted from CRISPR Systems - Doudna Lab and Kim et al., 2021, https://doi.org/10.3390/biom11081162

CRISPR-Cas RNA (gRNA) associates with **Cas effector proteins** as guides to silence foreign genetic elements that match the crRNA sequence.

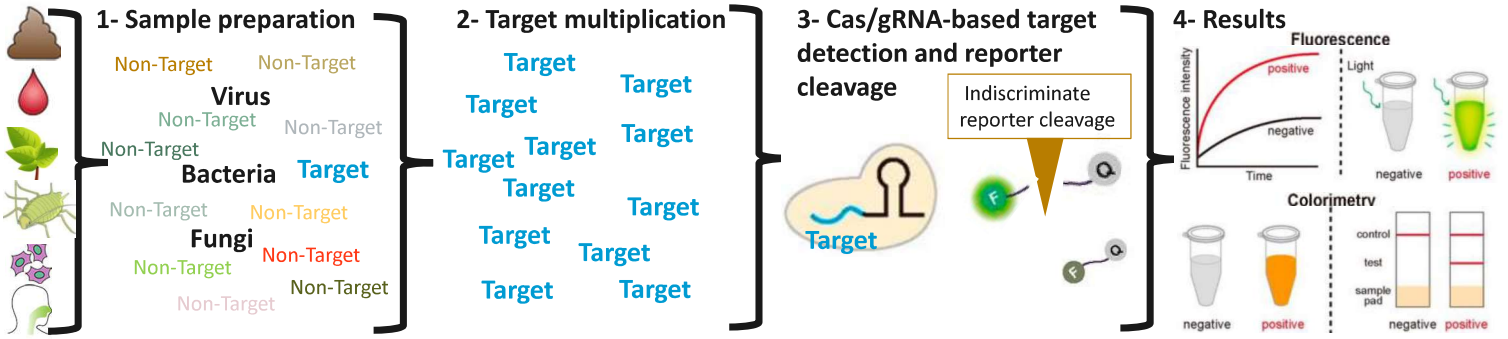
The history of CRISPR-Cas

- Used for diagnosis, gene editing/knockout, therapeutic approaches and basic research



CRISPR-Cas for detection and diagnosis

- CRISPR-Cas system can analyse diverse samples to detect specific nucleic acids targets
- A versatile system with multiple programmable Cas effectors and results readout
- 4 main steps required

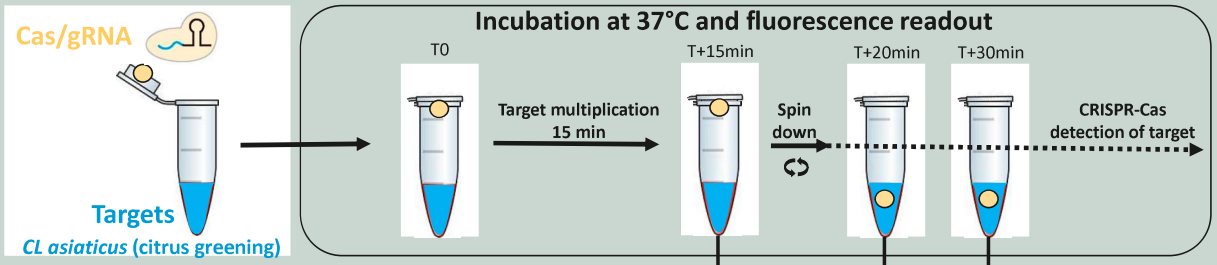


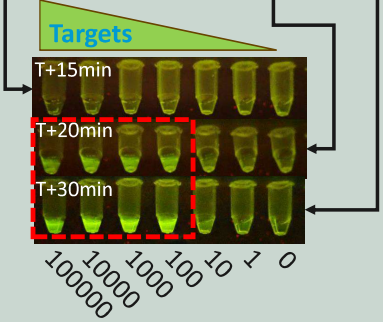
Adapted from Kim et al., 2021 (CRISPR as a Diagnostic Tool, https:// doi.org/10.3390/biom11081162)

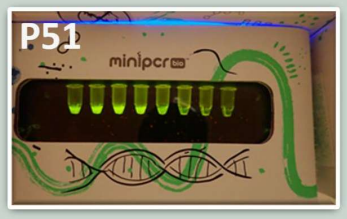
One-pot assay ("all in one reagents")

not opening the tube to add reagents (avoid cross contamination), simple workflow, single temperature, result in less than an hour

"One-pot" pathogen detection (PIC)







CRISPR-Cas: Examples of one-pot assay

References	Pathogens	Nucleic acid	Limit Of Detection	Duration	Visualization	Lyophilised
Marques et al., 2022	Tobacco mosaic virus, Tobacco etch virus, Potato virus X	RNA	healty versus infected	30 min	Fluorescence & Lateral flow strip	No
Lei et al., 2022	Leptosphaeria maculans (Fungi, stem canker in brassica)	DNA	5 targets / uL of crude extract	45 min		Yes

Comparison with current nucleic-acid-based detection methods

- The throughput of field deployable point of care testing remains currently low

Target detection with	Point of care	Detection efficiency	Throughput	Cost
CRISPR-Cas	Yes	***	*	$
In-field amplification	Yes	***	*	$
In-laboratory detection	No	***	**	$$
In-laboratory sequencing	No	***	****	$$

Adapted from Venbrux et al., 2023, Current and emerging trends in techniques for plant pathogen detection, https://doi.org/10.3389/fpls.2023.1120968)

Challenges for *in-field* CRISPR-Cas

- ☑ **Developing bioinformatic approaches to specifically target pathogens of interest**
  - ➢ Optimisation required
- ☑ **A simple preparation of the plant sample for nucleic acid isolation**
  - ➢ Optimisation required
- ☑ **A lyophilised one-pot CRISPR-Cas assay "<u>as good as the golden standard</u>"** recommended by the authority to discriminate healthy and infected plant material
  - ➢ Optimisation required
- ☒ **Integrated to a miniaturised handheld device for result readout (*Detect*), record and communication to datacentre (*Report*)**

Benefits of "CRISPR-Cas detect and report" system in case of pathogen incursion

Offshore testing to improve preparedness
- identify and rank the pathogen's risk accordingly to their occurrence
- alert on the safety of plant product import route and provenance

Map the infected geographical location
- more robust area-freedom data sets
- improved delimiting surveillance
- help identifying buffer zone
- track the spreading of a specific pathogen

Faster recovery from incursions

Reduced demand on diagnostic laboratories

Thank you

Acknowledgements

Plant Innovation Centre (PIC) at Post-Entry Quarantine

Farrall Tom, Abeynayake Shamila, Mudunkothge Janaki, Hetherton Alicia, Fiorito Sonia, Dinsdale Adrian, Whattam Mark

Science and Surveillance Group PEQ

Modern Technologies and Diagnostics Tools program (MTDT)

Biosecurity Innovation Project (BIP)

Questions?

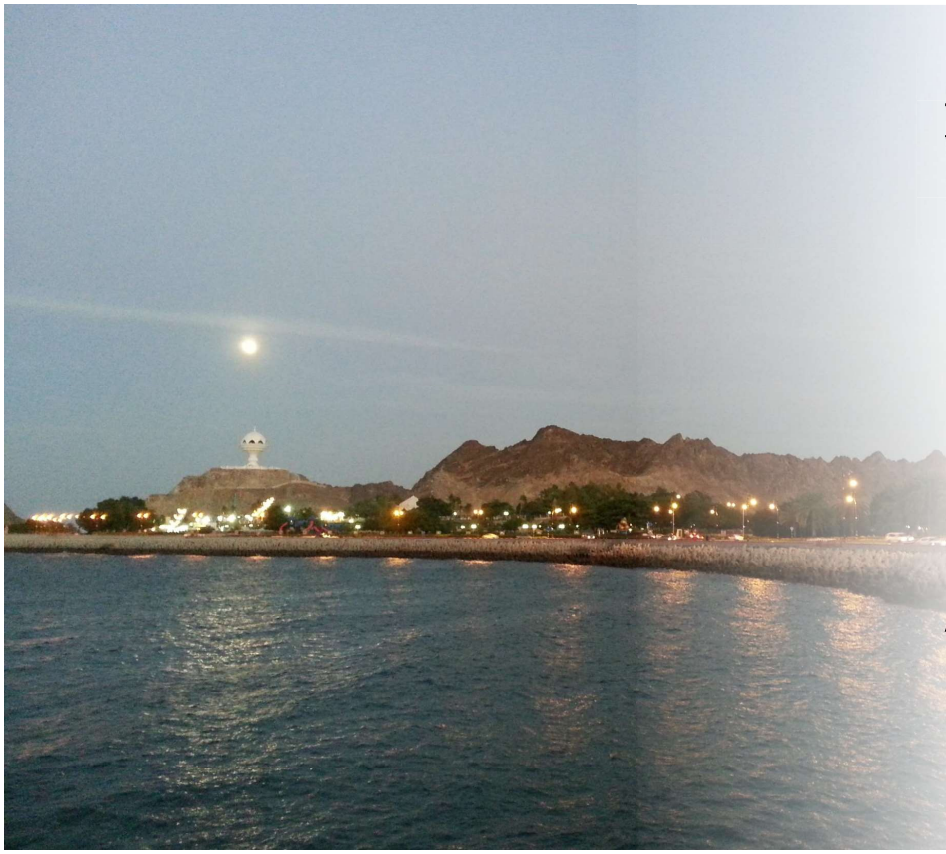
Our Plant Innovation Centre website

https://www.agriculture.gov.au/science-research/pic

Food and Agriculture Organization of the United Nations

Sultanate of Oman
Ministry of Agriculture, Fisheries Wealth & Water Resources

Integrated Biosecurity Management in Food and Agriculture In the Sultanate of Oman



Sultanate of Oman
the third largest country in the Arabian Peninsula

- **Population**: 5,171,344
- **Area**: 309,500 km^2
- **Coastline extends about**: 3165km
- **Location**: Eastern end of the Arabian Peninsula, facing the Indian Ocean and Gulf of Oman

Climate

- Hot, humid coast
- Hot, dry interior
- Dry desert
- Strong southwest summer monsoon (June to September) in far south

The Sultanate of Oman achieved a 35th place (out of 113 countries) in the 2022 Global Food Security Index, reflecting a five-position improvement from 2021.

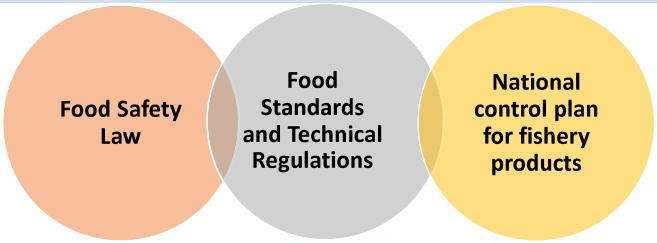
Although the Ministry of Agriculture, Fisheries Wealth, and Water Resources (MAFWR) is the governmental institute supervising the sectors related to animal, plant, fish, water, food security, and food safety, the successful management of these sectors is attributed to their integration and harmonization with other relevant governmental and private institutes.

National strategy and action plan on biosecurity management in food and agriculture In Oman

Establishing Food Safety and Quality Centre by Royal Decree (RD No. 24/2019), to implement and follow up policies, plans and programs related to the management of food safety and quality.

Programs and initiatives that encourage and support local food production and its sustainability (e.g. allocating lands for agricultural investment, establishing food storage facilities (such as silos) for wheat and rice, and creating model farms.)

Legislations contributing in biosecurity management in food and agriculture including:



Legislations and regulations

- Veterinary Quarantine law (Royal decree No. 45/2004)
- Agricultural Quarantine Law (Royal Decree No. 47/2004)
- Ministerial decision no (107/2008) of Executive Regulations of the Veterinary Quarantine Law
- Ministerial decision no (177/2012) Aquaculture And Related Quality Control Regulations
- Ministerial decision no (12/2009) Fisheries Quality Control Regulations
- Ministerial decision (225/2022) Guideline for Imported Shrimp Brood Stock Quarantine
- Unified laws across the Gulf Cooperation Council (GCC) countries aligned with International organizations, committees and Convention (e.g. FAO, WHO, IPPC, WOAH, CAMENET, AQMENET …)

Aquatic and terrestrial animal biosecurity, food safety, plant health and forestry sector specific biosecurity management and policies on integration and harmonization

Coordination and cooperation between governmental institutions in monitoring and inspecting commercial food establishments and factories to secure the food products and establish regulations and legislations to protect public health.

The national committees concerned with biosecurity management e.g. :

- The national committee of food safety by the Ministerial decree no (89/2022).
- National Committee for Epidemic and Infectious Diseases
- National Committee for zoonotic diseases
- National Committee for aquaculture projects technical assessment
- Joint National Committee on Antimicrobial Resistance

The Ministry of Agriculture, Fisheries, and Water Resources (MAFWR) aligned the objectives and mandates of all directorates and departments concerned with food. The most important of these are the Plant Quarantine Department, the Veterinary Quarantine Department, and the Food Safety & Quality Center. This alignment is in line with the 'one health approach'.

Combination of plant , vet and food safety under one section . (the Quarantine and food safety section)

Developing and adopting food product regulations and standards in coordination with food-related institutions.

Aquatic and terrestrial animal biosecurity, food safety, plant health and forestry sector specific biosecurity management and policies on integration and harmonization

The Ministry of Endowment and Religious Affairs in accrediting halal institutions and centers

The Environment Authority regarding the implementation of agreements on endangered species and natural reserves for wild animals, in addition to distributing the epidemiological map in wild animal environments.

The Royal Oman Police (D. G of Customs) regarding import and export of agricultural ,animal and food products and securing the locations of predatory animals and accompanying them during movement, and in managing crises during emergencies that affect animal facilities in a way that supports biosecurity.

The Ministry of Health regarding zoonotic diseases (via the National Committee for zoonotic Diseases)

The Ministry of Transport Communications and Information Technology regarding the approval of the country's ports and the roads leading to those ports

The Ministry of Defence regarding securing the borders and territorial waters to prevent the smuggling of live animals and high-risk animal consignments that threaten the vital security of the state.

National priorities for the improvement of biosecurity management in food and agriculture system

1. Enhance Oman's food safety system across all food supply chains (from farm to fork) by utilizing the best international practices and technologies.
2. Improving biosecurity awareness in the local community.
3. Improving the global food security index of the Sultanate of Oman to be among the top 20 countries by 2040.
4. Implementing an accreditation system for animal and agricultural facilities in exporting countries
5. Establishment of an entity responsible for implementing the One Health approach in the Sultanate of Oman
6. Reinforcing monitoring and diagnostic capabilities to enable early detection of epidemiological and infectious diseases in terrestrial and aquatic organisms, in addition to agricultural pests.

Food and Agriculture Organization of the United Nations

Sultanate of Oman
Ministry of Agriculture, Fisheries Wealth & Water Resources

THANK YOU

Ministry of Agriculture and Rural Development
PLANT PROTECTION DEPARTMENT

Regulations on phytosanitary treatment for regulated articles and updates on phytosanitary treatment measures in Vietnam

Nguyen Tuan Anh
Plant Quarantine Division

Regulations on phytosanitary treatment

- *Law on Plant Protection and Quarantine No. 41/2013/QH13*
- ***Decree 31/2016/NĐ-CP issued on 6 May 2016** regulating penalties for administrative violations against regulations on plant varieties, plant protection and quarantine*
- ***Decree 04/2020/NĐ-CP issued on 3 January 2020** on amending and supplementing a number of Articles of the Government's Decree No. 31/2016/ND-CP; Decree 90/2017/NĐ-CP issued on 31 July 2017 on penalties for administrative violations against regulations on veterinary medicine*
- ***Decree 66/2016/NĐ-CP issued on 1 July 2016** on regulations on requirements for investment in protection and quarantine of flora, plant varieties; common wild animals; aquatic animals; foods and husbandry*
- ***Decree 123/2018/NĐ-CP issued on 17 September 2018** amending Decrees on investment and business requirements in the agriculture sector*

Regulations on phytosanitary treatment

- *Circular 05/2015/TT-BNNPTNT* issued on 12 Feb 2015 *on procedures to certify the phytosanitary treatment practicing for regulated articles*
- *Circular 15/2021/TT-BNNPTNT* issued on *06 Dec 2021 amending and supplementing several articles of Circular No. 05/2015/TT-BNNPTNT prescribing procedures to procedures to certify the phytosanitary treatment practicing for regulated articles and Circular 33/2014/TT-BNNPTNT issued on 30/10/2014*

Phytosanitary treatment measures in Vietnam

Law on Plant Protection and Quarantine No. 41/2013/QH13

Article 36. Treatment practice of regulated articles

1. The treatment of regulated articles must be performed by the organization that holds the Certificate of phytosanitary treatment practicing for regulated articles

2. Treatment practices of regulated articles include:

a) Fumigation treatment;

b) Heat treatment;

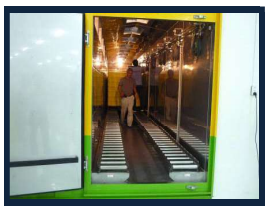
c) Vapor heat treatment;

d) Irradiation;

d) Other techniques.



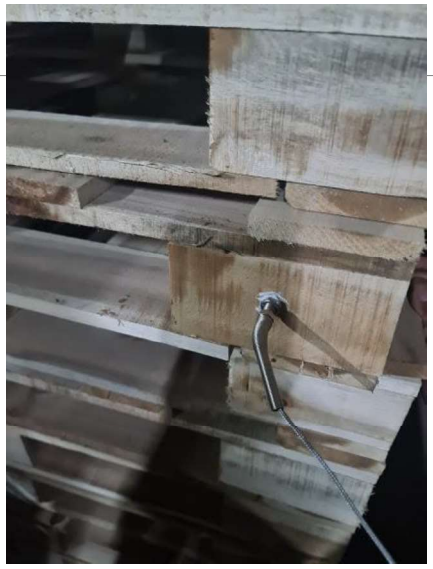

Fumigation treatment facility: 41





Vapor heat treatment facility: 08

Heat treatment facility: 27



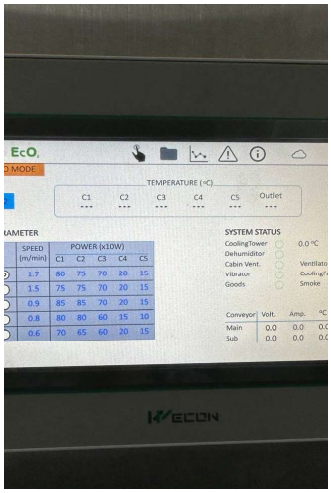
Cold treatment facility: 03

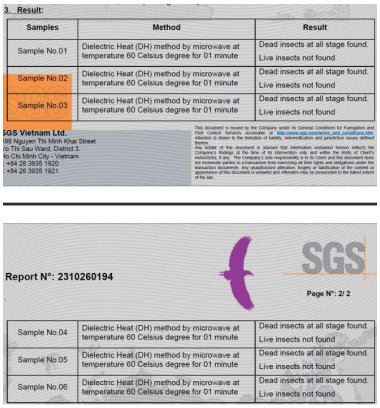
Irradiation treatment: 04

Controlled Atmosphere (CA) facility: 03

CONTROLLED ATMOSPHERE AS A SAFE ALTERNATIVE

- Treatments are 100% natural without using any toxic chemicals
- Based on the principle: No Oxygen = No Life, oxygen levels are reduced to a level which is lethal to insects using Carbon Dioxide or Nitrogen.
- Treatment methods are safe and can be applied in organic production





3. Result:

Samples	Method	Result
Sample No.01	Dielectric Heat (DH) method by microwave at temperature 60 Celsius degree for 01 minute	Dead insects at all stage found. Live insects not found
Sample No.02	Dielectric Heat (DH) method by microwave at temperature 60 Celsius degree for 01 minute	Dead insects at all stage found. Live insects not found
Sample No.03	Dielectric Heat (DH) method by microwave at temperature 60 Celsius degree for 01 minute	Dead insects at all stage found. Live insects not found

SGS Vietnam Ltd.
96 Nguyen Thi Minh Khai Street
Ho Chi Minh City - Vietnam
+84 28 3935 1920
+84 28 3935 1921

Sample No.04	Dielectric Heat (DH) method by microwave at temperature 60 Celsius degree for 01 minute	Dead insects at all stage found. Live insects not found
Sample No.05	Dielectric Heat (DH) method by microwave at temperature 60 Celsius degree for 01 minute	Dead insects at all stage found. Live insects not found
Sample No.06	Dielectric Heat (DH) method by microwave at temperature 60 Celsius degree for 01 minute	Dead insects at all stage found. Live insects not found

Microwave Dielectric Heating : 01

Requirements for phytosanitary treatment providers

Technical equipment and facilities

- Have locations for fumigation, workshops, stores and equipment which are suitable with the scope, measure and type of treatment in accordance with national technical regulations;
- Have sufficient equipment and facilities for each treatment measure as regulated in Appendix 1 of Circular 05/2015/TT-BNNPTNT and Decree 66/2016/NĐ-CP.

Human resources

- The persons directly involved in management and execution of the treatment organizations must have a university degree suitable with the treatment measure; have good health as regulated.
- Persons who are directly involved in treatment of regulated articles must has completed a training course and be issued a practising card issued by Plant Protection Department

The procedures for issuing the Certificate of treatment practicing for regulated articles

a) Application dossier

- Application form as regulated in Appendix II of Circular 05/2015/TT-BNNPTNT;

- Justifications of technical procedure, equipment;

- Copies of evidence to show qualification of the persons directly involved in management and execution;

- Health check certificates of the persons directly involved in management and execution and the persons directly conducting phytosanitary treatment.

- List of the persons directly conducting phytosanitary treatment and having practicing certificates;

- Copies of documents related to fire prevention and fighting conditions and environmental protection

The procedures for issuing the Certificate of treatment practicing for regulated articles

b) Procedure

- Applicant submits an application dossier to PPD.

- Within 5 working days, PPD appraises the application dossier and inform result

- Within 15 working days after receiving valid application dossier, PPD organize onsite inspection and issue certificate; or reply in writing, stating reasons, if not issuing certificate.

- Onsite inspection items:
  - + Equipment and facilities;
  - + Actual practicing of phytosanitary treatment of regulated articles.

The procedures for issuing the Certificate of treatment practicing for regulated articles

a) Reissue certificate if it is lost, damaged or information related to name of the organization changes

- Application dossier:

+ Application form;

+ Issued original Certificate (except for the case where the certificate is lost);

+ Copies of papers showing the change in name (if changing name).

- Procedure: PPD reissues certificate withing 5 working days after receiving valid application dossier.

The procedures for issuing the Certificate of treatment practicing for regulated articles

b) Reissue certificate when address, practicing scope change; or when certificate expires

- Application dossier:

+ Application form;

+ Copies of papers showing qualification of persons directly involved in management and execution (if there is change);

+ Health check certificate;

+ List of the persons directly conducting phytosanitary treatment and having practicing certificates at the time of application;

+ Justifications of technical procedure, equipment;

+ Copies of documents related to fire prevention and fighting conditions and environmental protection

- Procedure: Follow the same procedure as issuing a new practicing certificate

Managing treatment practising of regulated articles

PPD's responsibilities for treatment of regulated articles

- Check the conditions to issue, reissue certificates of treatment practicing for regulated articles in compliance with Circular 05/2015/TT-BNNPTNT.
- Organize training and professional check, and issue practicing certificates.
- Develop training on treatment
- Nominate and supervise the treatment of regulated articles having quarantine pests or regulated pests of Viet Nam or exotic pests.
- Conduct regular or ad-hoc inspection of treatment practicing organizations which violate the current legislation.

Responsibilities of provincial-level Plant Protection Sub-departments (PPSD) for treatment of regulated articles

- Supervise the treatment of regulated articles in the local areas as informed by the treatment practicing organizations.

Violations against regulations on treatment of regulated articles

Article 23 Decree 31/2016/NĐ-CP issued on 6 May 2016

1. A fine of from VND 5,000,000 to VND 10,000,000 shall be imposed for any of the following violations:

a) Manager of an organization practicing treatment of regulated articles does not possess professional qualifications as regulated;

b) Using persons who directly practices the treatment of regulated articles without practicing cards for treatment of regulated articles;

c) Failing to meet requirements on technical methods, facilities and equipment for practicing the treatment as regulated;

d) Failing to meet requirements on warehouse of fumigants.

Violations against regulations on treatment of regulated articles

Article 23 Decree 31/2016/NĐ-CP issued on 6 May 2016

2. A fine of from VND 7,000,000 to VND 10,000,000 shall be imposed for any of the following violations:
a) Using a type of fumigants whose commercial name is not in the list of pesticides permitted for use in Vietnam;
b) Using fumigants which are not in conformity with applicable standards and corresponding technical regulations;
c) Treatment of regulated articles and/or wooden packages is not in conformity with regulated technical processes;
d) Practicing treatment of regulated articles without obtaining a practicing certificate
3. A fine of from VND 10,000,000 to VND 15,000,000 shall be imposed for any of the following violations committed while practicing the fumigation:
a) Using types of fumigants in the list of pesticides banned from use in Vietnam;
b) Failing to comply with regulations on use of fumigants which causes adverse effect on quality of regulated articles being fumigated;
c) Practicing treatment of regulated articles which are stated in violation announcements by competent plant quarantine agencies in importing countries;

Violations against regulations on treatment of regulated articles

Article 23 Decree 31/2016/NĐ-CP issued on 6 May 2016

4. Additional penalties
a) Suspend practicing cards for treatment for 01 - 03 months if having aggravating factors for the violation mentioned in Point c Clause 2 of this Article;
b) Suspend practicing certificates for treatment for 01 – 06 months if any of the violations mentioned in Points a, b Clause 2 and Points a, b Clause 3 of this Article is committed;
c) Suspend practicing activities for treatment for 01 – 03 months if any of the violations mentioned in Clause 1 of this Article is committed;
d) Suspend practicing activities for treatment for 03 – 06 months if the violation mentioned in Point c Clause 3 of this Article is repeated.

Persons who are directly involved in treatment of regulated articles must has completed a training course and be issued a practising card


CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc Lập - Tự Do - Hạnh Phúc

THẺ HÀNH NGHỀ XỬ LÝ VẬT THỂ THUỘC DIỆN KIỂM DỊCH THỰC VẬT

Số thẻ: 2023.005

Họ và tên: Lê Gia Thành Nguyên

Ngày sinh: 04/6/1985

Biện pháp xử lý: Chiếu xạ

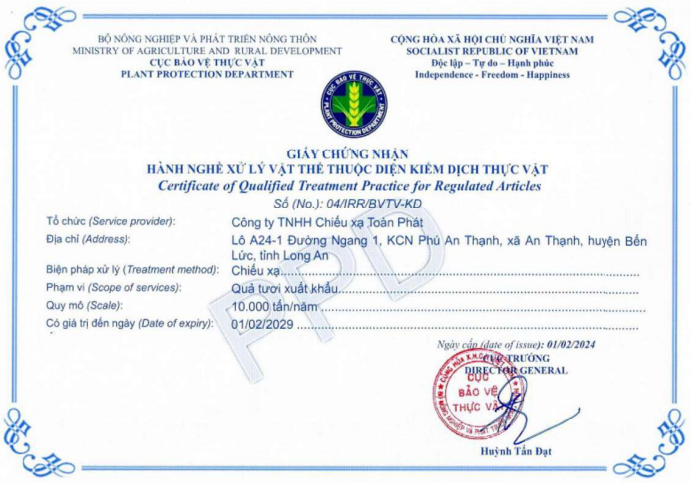
QUY ĐỊNH ĐỐI VỚI NGƯỜI ĐƯỢC CẤP THẺ

- Thẻ này được cấp theo quy định kiểm dịch thực vật hiện hành.
- Chỉ dùng thẻ khi thi hành nhiệm vụ.
- Không cho mượn, tẩy xóa, làm hư hỏng thẻ.
- Khi bị mất thẻ phải báo ngay cho cơ quan công an và cơ quan chủ quản.

Hà Nội, ngày 13 tháng 01 năm 2023

CỤC BẢO VỆ THỰC VẬT
CỤC TRƯỞNG

Hoàng Trung


BỘ NÔNG NGHIỆP VÀ PHÁT TRIỂN NÔNG THÔN
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
CỤC BẢO VỆ THỰC VẬT
PLANT PROTECTION DEPARTMENT

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
SOCIALIST REPUBLIC OF VIETNAM
Độc lập – Tự do – Hạnh phúc
Independence - Freedom - Happiness

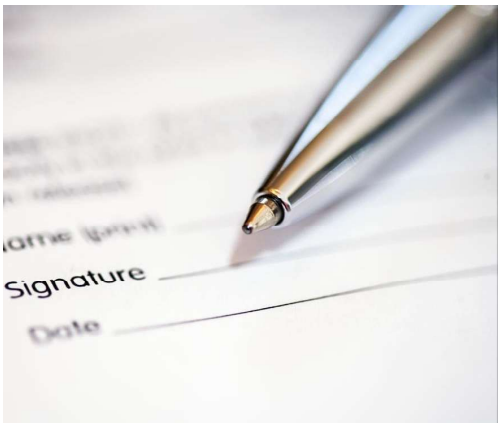
GIẤY CHỨNG NHẬN
HÀNH NGHỀ XỬ LÝ VẬT THỂ THUỘC DIỆN KIỂM DỊCH THỰC VẬT
Certificate of Qualified Treatment Practice for Regulated Articles
Số (No.): 04/IRR/BVTV-KD

Tổ chức *(Service provider)*: Công ty TNHH Chiếu xạ Toàn Phát
Địa chỉ *(Address)*: Lô A24-1 Đường Ngang 1, KCN Phú An Thạnh, xã An Thạnh, huyện Bến Lức, tỉnh Long An
Biện pháp xử lý *(Treatment method)*: Chiếu xạ
Phạm vi *(Scope of services)*: Quả tươi xuất khẩu
Quy mô *(Scale)*: 10.000 tấn/năm
Có giá trị đến ngày *(Date of expiry)*: 01/02/2029

Ngày cấp (date of issue): 01/02/2024
CỤC TRƯỞNG
DIRECTOR GENERAL

Huỳnh Tấn Đạt

Certificate of treatment

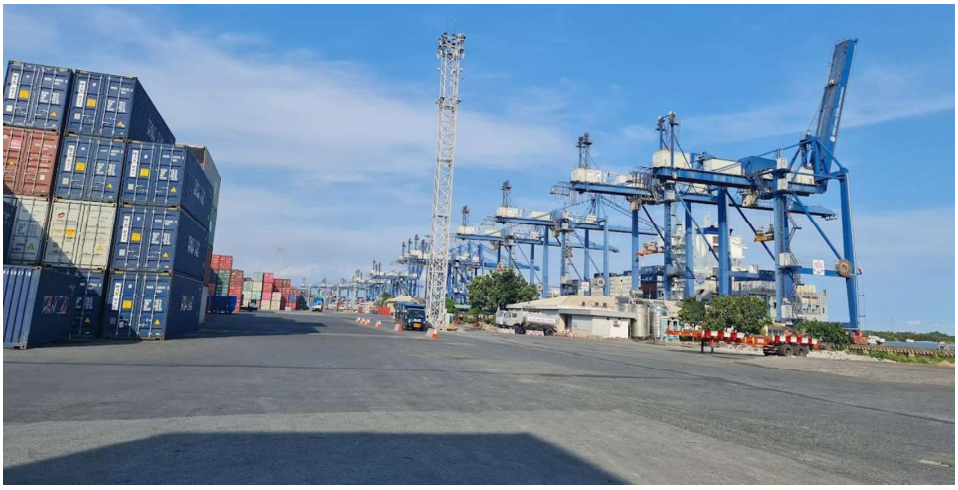


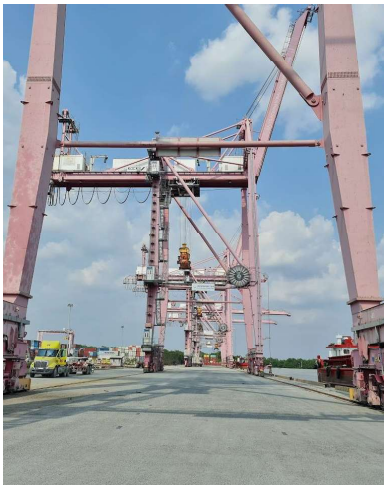
Certificate of treatment

Validity of the practicing certificate of the treatment of regulated articles

1. The practicing certificate of the treatment of regulated articles shall be valid within 05 years.

2. Before 03 months till the date on which the practicing certificate of the treatment of regulated articles is expired, the practicing organization must submit their documents to competent certification agencies if they wish to get their certificate renewed.





Thank you for your attention

Analytics that inform decisions

Centre of Excellence for Biosecurity Risk Analysis

Andrew Robinson

CEBRA, University of Melbourne

May 17, 2024

cebra
Centre of Excellence for
Biosecurity Risk Analysis

Agenda

An Algorithm for Decision-Supporting Analytics

Illustrative examples
- CEBRA Value Model
- CEBRA Project 21D: Value-Added
- 21B: Forecasting biosecurity risk under climate change
- Sea Container Hygiene Scheme
- Structured Expert Judgement

Thanks! Questions?

An Algorithm for Decision-Supporting Analytics

An Algorithm for Decision-Supporting Analytics

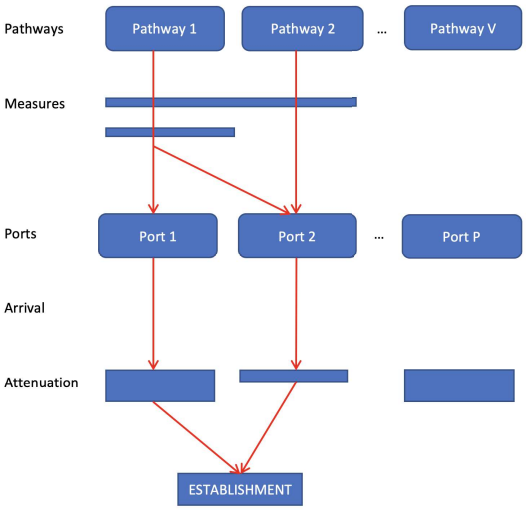
1. Identify the decision
2. Model the process
3. Gather data
4. Augment the data
5. Use the model
6. Support the decision
7. Review

Identify the decision

1. Locate the decision-maker/s
2. Establish the decision mechanism
3. Identify the cost/s of error
4. Determine how the outcome will be assessed
5. Measure the appetite for risk and uncertainty
6. Confirm the vocabulary for communication

Model the process

1. Identify the drivers
2. Construct box and arrows diagram/s
3. Review with experts
4. Translate into code
5. Test scenarios
6. Identify sensitivities



Gather & use available data

1. Identify relevant data sources
2. Source data
3. Harmonise
4. Clean
5. Fit necessary models
6. Estimate key quantities
7. Document shortcomings

```r
if ("scripts" %in% list.files()) setwd("scripts/")

library(ggplot2)
library(splines)
library(mgcv)
library(data.table)
library(lme4)

library(dm)
library(tictoc)

source("ggc.r")

(data.file.names <-
    grep("(QPR)", list.files("../images", full.names = TRUE), # Ignore AIMS
         value = TRUE))

for (data.file in data.file.names) load(data.file)

load("../images/aa_dm.RData")

load("../images/aaa.RData")

results <- dm_flatten_to_tbl(aa_dm_all_keys,
                             .start = auditCriteriaResult,
                             .recursive = TRUE)

str(results)

results <- merge(results, audits.s[, .(`Audit SK`, duration)],
                 all.y = TRUE,
                 by = "Audit SK")
```

Augment the data (Light a Candle!)

Structured Expert Judgement

1. Ask questions that have clear operational meanings
2. Follow methodological rules (traceable, repeatable, open to review)
3. Thoroughly documented
4. Provides opportunities for empirical evaluation and validation
5. Anticipates and mitigates cognitive and motivational biases

Then . . .

Use the model

1. Final stress & sense testing
2. Evaluate scenario
3. Check resilience

Support the decision

1. Communicate outputs
2. Respect uncertainty

Review

1. Register outcomes
2. Identify key sources of uncertainty
3. Contemplate follow-up

Illustrative examples

CEBRA Value Model
CEBRA Project 21D: Value-Added
21B: Forecasting biosecurity risk under climate change
Sea Container Hygiene Scheme
Structured Expert Judgement

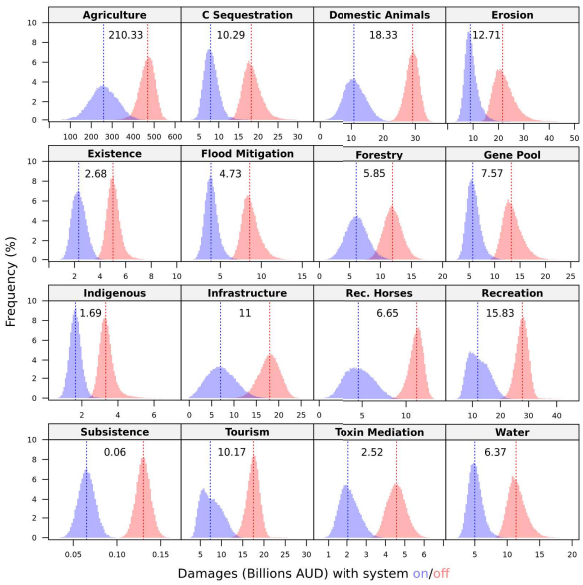
CEBRA Value Model: The Value of Biosecurity to Australia

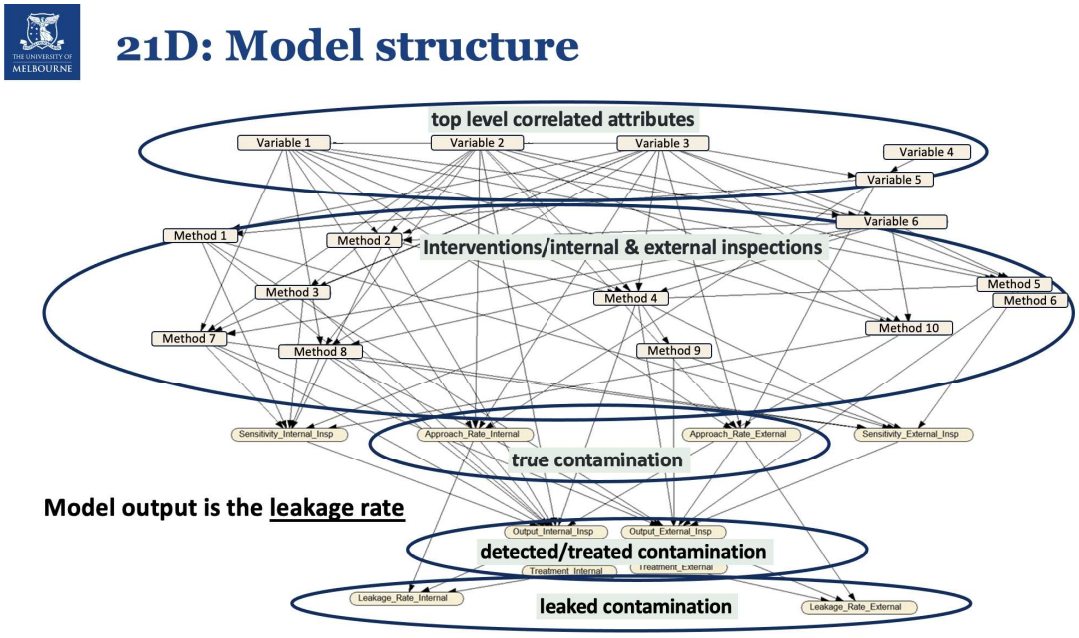
Setup

- 2500m resolution
- 40 biological hazards
- 50 years, 1-year intervals
- 50,000 iterations per state
- Discount: 5% Fin; 3% Env

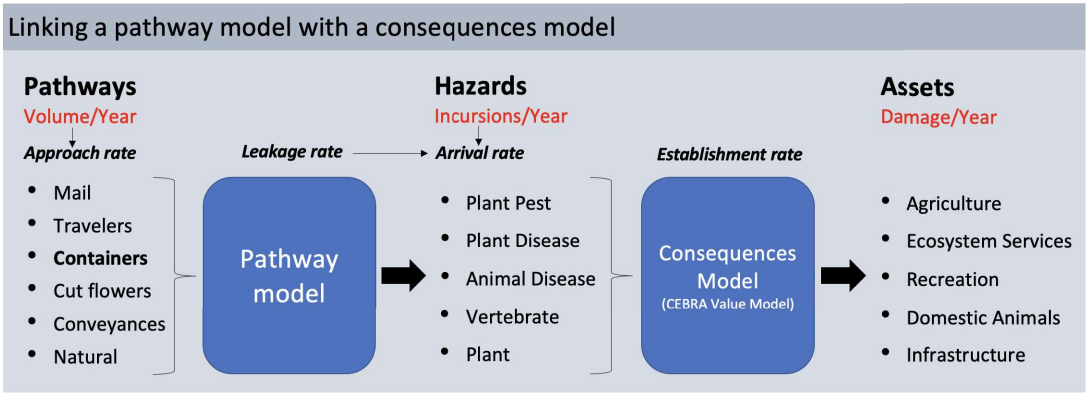
Output

- Benefit: A$325.26 bn
- Costs: A$10.45 bn
- Net PV: A$314 bn
- Average ROI: 30:1

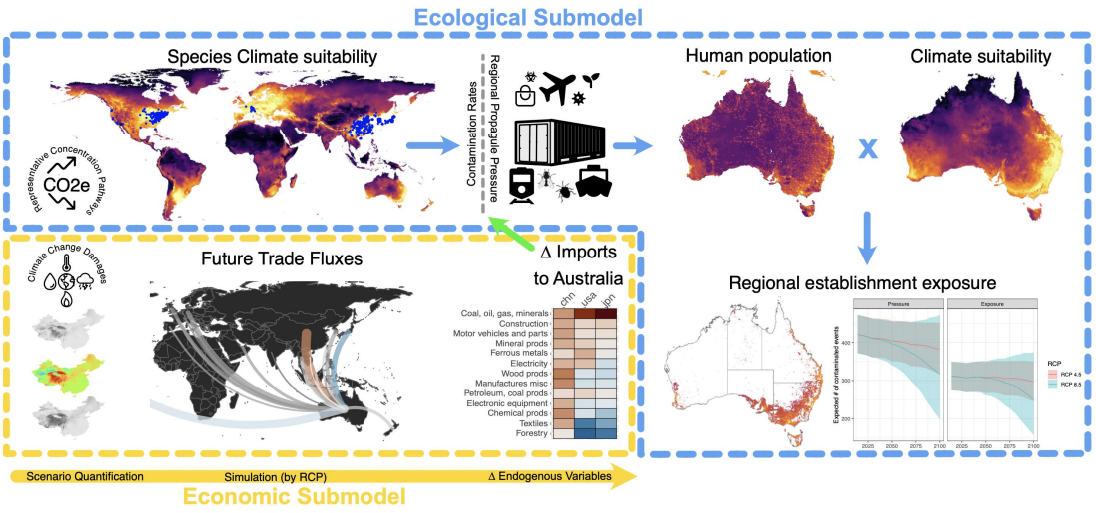




21D: Estimating damages for a pathway



21B: Forecasting biosecurity risk under climate change



https://cebra.researchsoftware.unimelb.edu.au/trade-dashboard/

Sea Container Hygiene Scheme

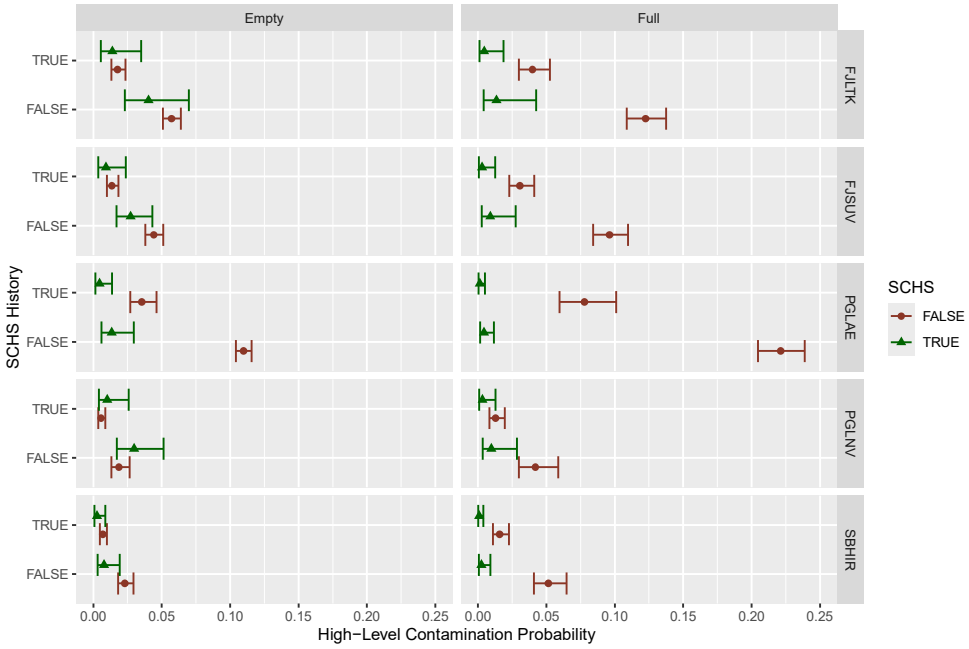
High-level Summary

- Designed by DAFF and MPI
- Participating shipping lines and ports in the Pacific Islands undertake cleaning of containers prior to export to NZ or Australia
- These facilities are audited periodically to ensure they continue to comply
- Containers are inspected on arrival in NZ and Australia at a rate based on previous compliance history

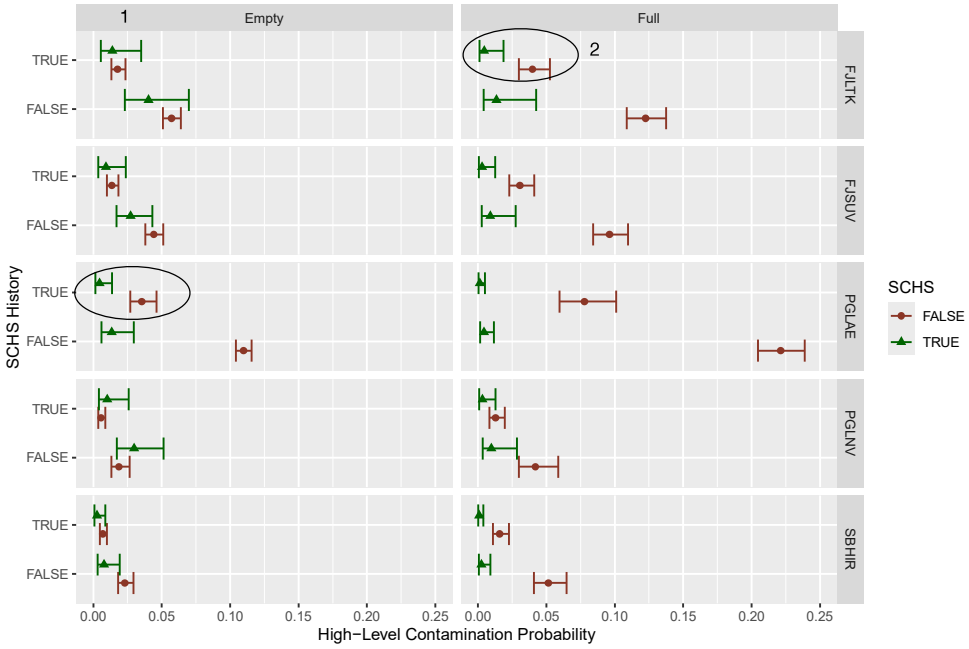
. . . Now . . . Does it work?

- Q1: Are containers arriving under SCHS less contaminated?
- Q2: Is there a residual benefit?

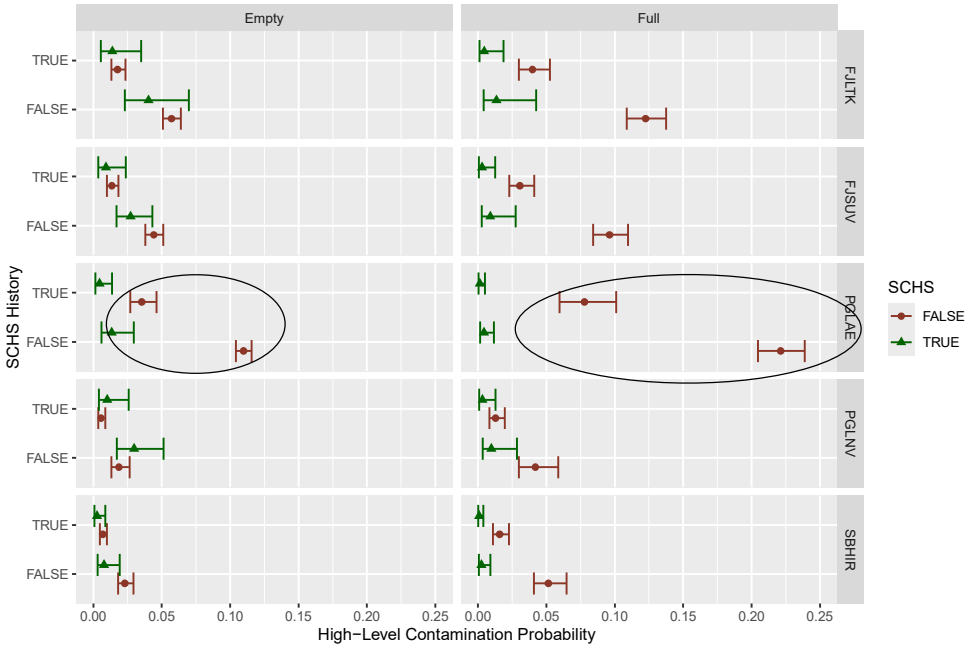
Sea Container Hygiene Scheme



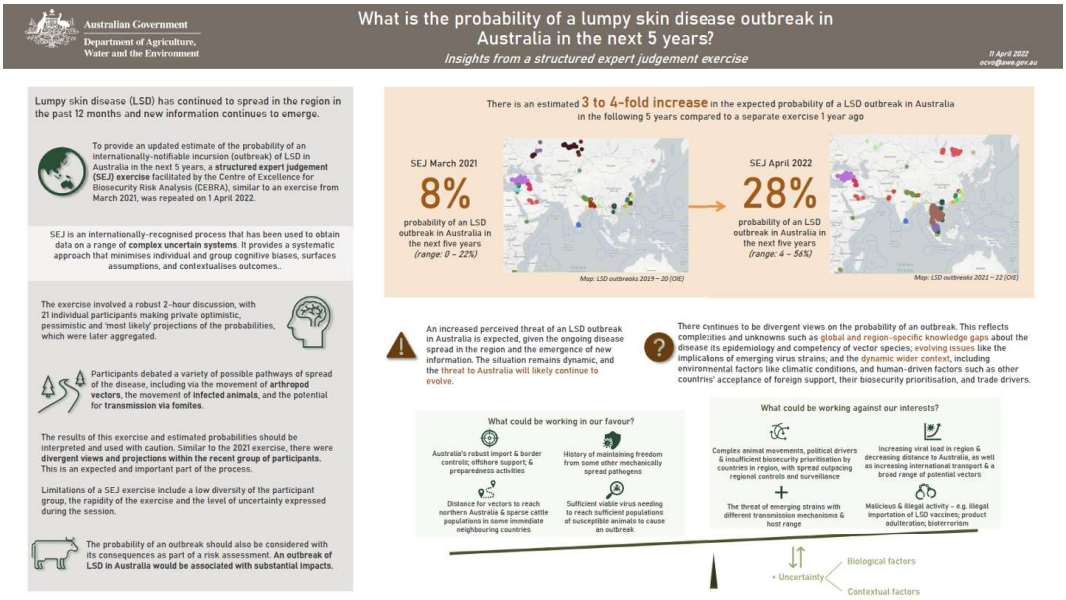
Sea Container Hygiene Scheme: Immediate effect?



Sea Container Hygiene Scheme: Residual benefit?



Structured Expert Judgement example



Thanks! Questions?

Australian Government
Department of Agriculture, Fisheries and Forestry

Using Advance Data to manage biosecurity risk in the mail pathway

Friday 17 May 2024

Mirelle Anthony

Director, Profiling and Targeting

Operational Intelligence Coordination Branch
Compliance and Enforcement Division

Import pathway profiling strategies

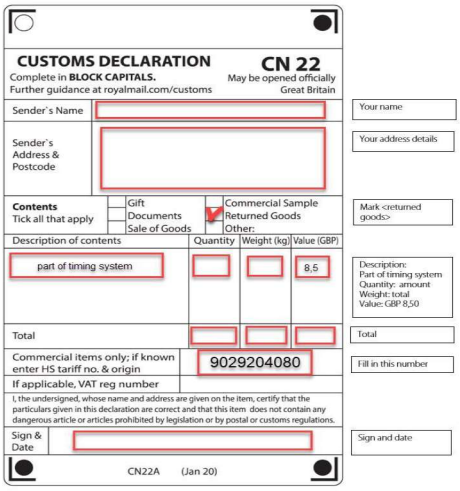
CARGO (commercial & non-commercial)
4,700 profiles (compliant reporters; targeted)

TRAVELLERS
14,000 profiles (cohort; targeted)

MAIL
500 profiles (cohort)

What is Electronic Advance Data?

- Transmitted by sender postal organisations in Universal Postal Union (UPU) countries
- Collated by Australia Post
- Submitted to border authorities prior to physical arrival



CUSTOMS DECLARATION **CN 22**

Complete in **BLOCK CAPITALS.** May be opened officially
Further guidance at royalmail.com/customs Great Britain

Sender's Name		Your name
Sender's Address & Postcode		Your address details
Contents Tick all that apply	☐ Gift ☐ Documents ☐ Sale of Goods ☑ Commercial Sample ☐ Returned Goods ☐ Other:	Mark <returned goods>

Description of contents	Quantity	Weight (kg)	Value (GBP)	
part of timing system			8.5	Description: Part of timing system Quantity: amount Weight: total Value: GBP 8.50
Total				Total

Commercial items only; if known enter HS tariff no. & origin	9029204080	Fill in this number
If applicable, VAT reg number		

I, the undersigned, whose name and address are given on the item, certify that the particulars given in this declaration are correct and that this item does not contain any dangerous article or articles prohibited by legislation or by postal or customs regulations.

Sign & Date		Sign and date

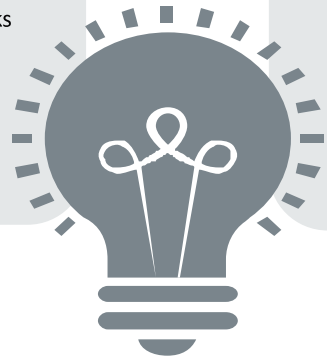
CN22A (Jan 20)

OPPORTUNITIES

- conveys information about mail articles ahead of their arrival
- allows for risk-based decision making
- presents opportunities for better pathway management
- is a source of entity rich data
- is able to be exploited for identity resolution and establishing networks

CHALLENGES

- incomplete data set
- inherent data issues
- manual intervention process
- difficult to scale



EAD implementation pilot

220 Number of profiles deployed

81% Percentage of profiled articles inspected

92% Non-compliance in inspected articles

Phase 1
Compliantly reported biosecurity risk goods (select GDD) from select countries

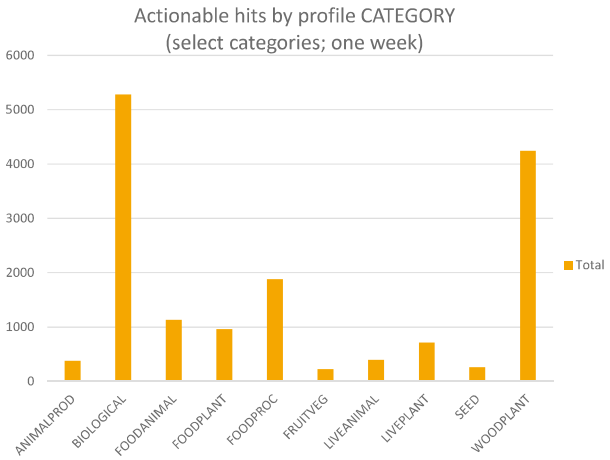
Phase 2
Entities and profiles owned by the Compliance and Enforcement Division

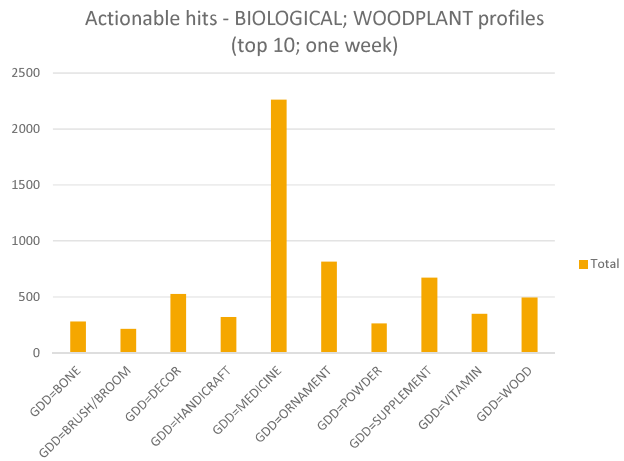
Phase 2b
Expired and suspended permits

Phase 2c (planned)
Hybrid; non-compliance profiling & high risk BRM

Pilot – planned expansion

- Phase 2c: (planned) – hybrid; non-compliance profiling & high risk BRM





Case study: *Cannabis spp.* seeds ex Spain

The department maintains profiling based on anomalies associated with sender addresses:

Non-compliance rates

- 1,833 referred for inspection; 1,677 inspected
- 1470 positive detections for seeds
- ***Crude interception rate of 91%***
- ***Positive detections in 88% of inspected articles.***

Observations:

- electronic and physical misdeclaration
- concealed within various low-cost household items
- evolution of concealment methodology observed

Thank you

SOLOMON ISLANDS NATIONAL BIOSECURITY SYSTEM AND THE WORK OF BIOSECURITY SOLOMON ISLANDS

Presenter: Steward Laukona Teoga

Quarantine Regulations Meeting 2024

BRIEF OVERVIEW OF BIOSECURITY SOLOMON ISLANDS

- Biosecurity Solomon Islands (BSI) is a Department under Ministry of Agriculture and Livestock.
- Operations team
- Surveillance team
- Market Access team
- Administration team
- Solomon Islands has 4 Designated Primary Points of Entry and 6 Designated Secondary Point of Entry.
- BSI has a total of 40 staff manning this points of entries.
- BSI operates within Biosecurity Act 2013, Regulations 2015, Procedure manual.

INTRODUCTION

Agriculture: Agriculture is a significant sector in the Solomon Islands, providing livelihoods for a large portion of the population. Introducing pests or diseases could devastate crops and agricultural productivity, leading to food shortages and economic losses.

Biodiversity: The Solomon Islands boast rich biodiversity, with unique species of plants and animals found nowhere else in the world. Biosecurity measures are crucial for preventing the introduction of invasive species that could threaten native flora and fauna..

Ecosystem Health: Invasive species can disrupt fragile island ecosystems by outcompeting native species, altering habitats, and causing ecological imbalances. Protecting the natural environment through biosecurity measures helps maintain ecosystem health and resilience.

Tourism: The Solomon Islands rely on tourism as a significant source of revenue. Preserving the pristine natural beauty and unique biodiversity through effective biosecurity measures enhances the country's appeal to tourists and supports sustainable tourism development.

Given these factors, biosecurity is a critical aspect of governance and policy in the Solomon Islands to ensure the protection of its environment, economy, and public health.

Biosecurity Policy and Framework:

Ministry of Agriculture Sector Policy, Biosecurity Act 2013, Regulation 2015 is integrated. Biosecurity functions and strategic goals :

Biosecurity Act 2013

(a) to protect Solomon Islands against the entry of regulated pests and diseases affecting animals, plants, human beings and the environment;

(b) to carry out surveillance and monitoring of pests and diseases in Solomon Islands and assess the status of regulated pests and diseases;

(c) to prevent the establishment and spread of regulated pests and diseases and the release of organisms that might adversely affect animals, plants, human beings and the environment in Solomon Islands;

(d) to eradicate, contain or control the movement of regulated pests and diseases that are already present in Solomon Islands;

Biosecurity Regulations 2015

Biosecurity Policy and Framework:

e) to regulate movement of pests and diseases into Solomon Islands;

f) to facilitate the safe importation of animals and plants and their products, and related equipment and technology;

g) to facilitate the export of animals and plants and their products in accordance with the biosecurity requirements of the receiving countries; and

h) to facilitate international cooperation to prevent the spread of pests and diseases affecting plants, animals, human beings and the environment

RISK ASSESSMENT AND MANAGEMENT:

BSI MANAGES ITS RISK ACROSS BIOSECURITY CONTINUUM

- Pre border
  - Pest Risk Analysis/Import risk assessment
  - Permit
  - Import Conditions
  - Treatment
  - Audit
  - Inspection
  - Certifications
- Border
  - Inspection , search and seizure
  - Treatment
  - Re shipment/ reconsign
  - Destruction
  - Inspect documents e.g Manifest, phytosanitary, Health/ zoosanitary cert. treatment/fumigation cert.
  - Containment/ restrict movement/ biosecurity controlled area.
  - Certification
- Post Border
  - Treatment
  - Destruction
  - Containment
  - Eradication
  - Long term management and control.
  - ERP – Cost benefit analysis , Feasibility study

SURVEILLANCE AND MONITORING SYSTEMS:

Biosecurity Solomon islands Surveillance and Monitoring system is an Ad hoc due to lack of technical resources and funds (SIG)

- BSI benefited with Joint Plant heath surveys conducted annually with DAFF AUST
- Fortnightly Fruit fly monitoring
- SPC/Sol Pest database

RESPONSE AND EMERGENCY PREPAREDNESS:

- Generic ERP
- Specific ERPs develop for CRB, GAS, ASF, FAW, AST currently in draft as it lucks financial support from the Government.
- Declaration of an emergency is done by the Minister (MAL)

INTERNATIONAL COOPERATION AND COLLABORATION:

- SI Biosecurity Act 2013 is a modernized and harmonized legislation that seeks to facilitate international cooperation required under international organizations which Solomon Islands is a member and signatory to.
- Such organizations as WTO , Codex Alimentarius, WOAH, CITIES. Etc.
- At the regional approach such organizations as PPPO , PICTA , SPREP , MSG.

EMERGING THREATS AND FUTURE CHALLENGES:

- ASF and all animal related disease
- Sea border between SI and PNG
- Climate change
- Potential challenges in maintaining effective biosecurity .Constraints in technical capacity and infrastructure
- Limited manpower and infrastructure in Provincial stations

Example of real situations faced.

- The incursions on Coconut rhinoceros beetle, Fall Army Warm , GAS and Asian Subterranean termite continues to impact Solomon Islands especially on economy ,food security and livelihood.
- These pest continues to spread across the whole of Solomon Islands as our pest control and monitoring system is weak.
- The decline in the export earnings on coconut and copra continues to impact Solomon Islands. The pests continues to spread across other Pacific Islands countries.
- One common but sad thing about Solomon Islands perspective from the past 20 years - pest and diseases are here to stay.

CONCLUSION:

- Solomon Islands faces challenges in preventing pest incursions due to lack of technical resources, capacities, and finance.
- The open border with Papua New Guinea and Vanuatu presents a challenge for collaboration between SIG and its neighboring countries.
- Unregulated pathways and cross-border trade between PNG and SI will always pose significant threats.
- Implementing an MOU and seeking donor support is crucial.

STDF | STANDARDS and TRADE DEVELOPMENT FACILITY

Catalysing safe agri-food trade through partnerships and innovation: Lessons from STDF's work

Regulation and Collaboration: the future of biosecurity

Quarantine regulator's meeting
HCMC, Viet Nam
15-17 May 2024

Food and Agriculture Organization of the United Nations | World Organisation for Animal Health | WORLD BANK GROUP | World Health Organization | WORLD TRADE ORGANIZATION

www.standardsfacility.org STDFSecretariat@wto.org #STDF

Changing global landscape

- Pandemic, global insecurity, war
- Rise in prices (food, fuel, agric inputs, etc.)
- Growing food insecurity
- Trade costs in agriculture still much higher than in manufacturing
- Growth in agri-food value chains and economic interdependency
- Concerns about biodiversity, environment, climate change, food loss and waste
- Calls for food systems transformation and One Health approaches

WTO SPS Agreement

Recognizing the right to protect human, animal and/or plant life and health

Obligation to avoid unnecessary barriers to trade

CODEX ALIMENTARIUS | World Health Organization | Food and Agriculture Organization of the United Nations

World Organisation for Animal Health
Founded as OIE

International Plant Protection Convention

WTO Trade Facilitation Agreement (TFA): Highly relevant for SPS authorities

- Border agency coordination, integrated risk management
- Consultation of border agency with private sector
- Pre-arrival processing of documents for import shipments
- Publication of import/export requirements, fees, etc.
- Fast tracking of perishable goods clearance
- Right for economic operators to a second test

Persistence of SPS procedural obstacles

- Limited information on requirements
- Complex, lengthy procedures
- Excessive document requirements
- Multiple inspections
- No complaints / appeal procedures
- Arbitrariness, unpredictability

Why it matters?

More controls than justifiable

Longer than necessary waiting times

Uncertainty

Increased costs for traders and governments

Impact on food loss and environment

STDF's global partnership to facilitate safe trade

Global network of organizations involved in SPS capacity development

Knowledge work

Grants for innovative and collaborative projects that facilitate safe trade

Driving catalytic SPS improvements to facilitate safe trade

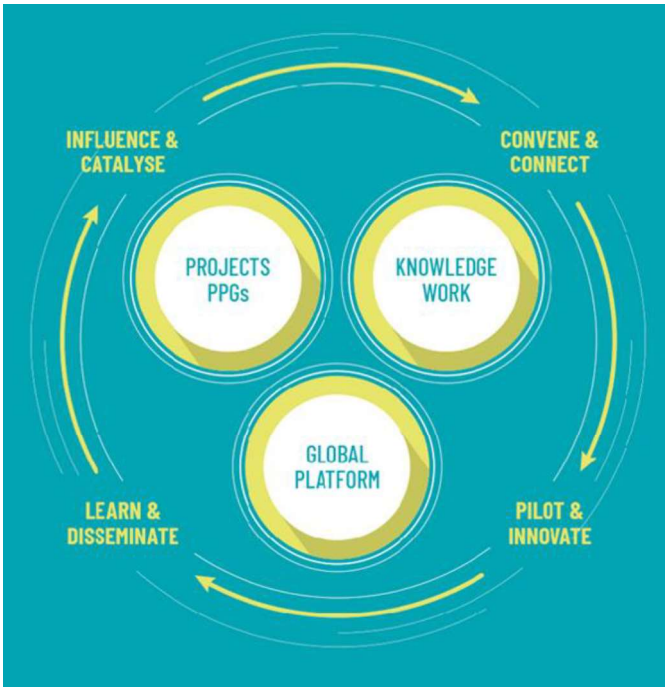
Goal

Increased and sustainable SPS capacity in developing countries

Outcomes

1. More synergies and collaboration driving catalytic SPS improvements in developing countries

2. Greater access to and use of good practices and knowledge products at global, regional and national level



Grants to develop and implement safe trade projects

PPGs

Seed funding (up to US$50,000)

Develop new projects

Use capacity evaluation / prioritization tools

Feasibility studies

Projects

Identify, develop or share good practice

Include regional/global approaches

Innovative, replicable, collaborative, inter-disciplinary

STDF Project: Boosting seed trade in Asia-Pacific region

- Phytosanitary gaps related to pest risk analysis and international standards (ISPM 2, 11, 12)
- Help countries in region participate in, and benefit from, seed trade
- Collaborative approach where NPPOs work with industry associations
- APAARI, ISF, ASTA, public and private sector in Bangladesh, Cambodia, Lao PDR, Nepal, Philippines, Thailand, Viet Nam, other stakeholders

See more: https://standardsfacility.org/PG-755 -

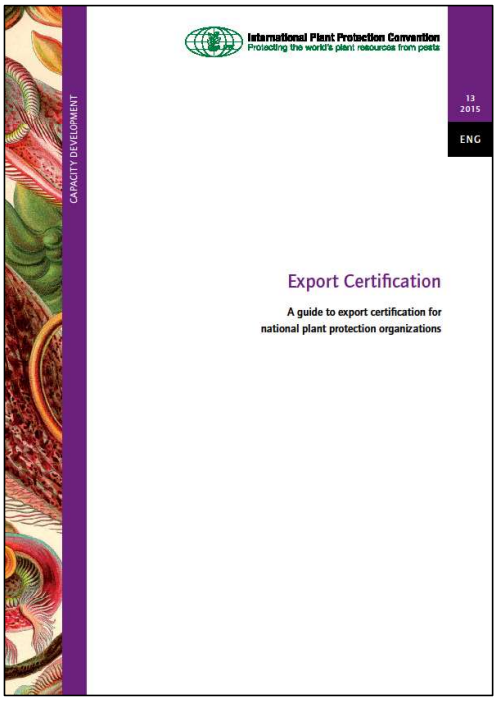
STDF Safer Spices Project in Viet Nam, Lao PDR and Cambodia

- Challenges for smallholder peppercorn farmers to meet SPS requirements in high-value markets
- Use PPPs to encourage use of good agriculture, hygiene and manufacturing practices based on Codex standards
- Regional cooperation for knowledge transfer, capacity development and traceability
- Contribute to climate-resilient agriculture

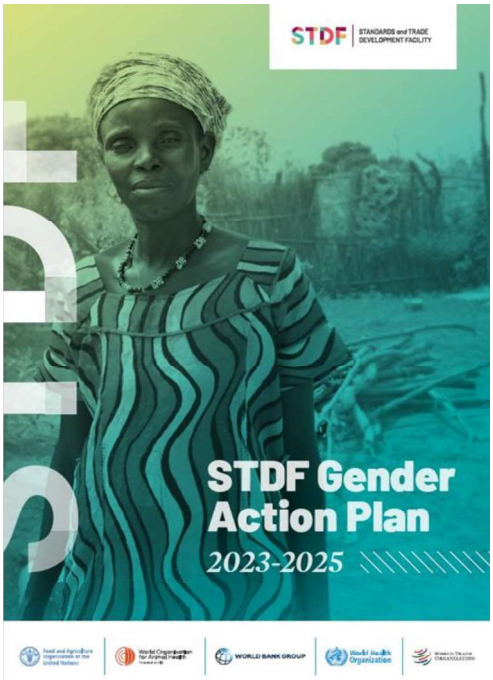
STDF Project: Capacity building tools for ISPMs

- Capacity gaps (knowledge and skills) limit the uptake and use of ISPMs
- Series of manuals and guidelines to support NPPOs on import verification, export certification, managing stakeholder relationships, plant pest surveillance, diagnostics, etc.
- Collaborative approach with NPPOs in developed and developing countries
- IPPC/FAO with others (e.g. Korea, Viet Nam, New Zealand, OIRSA, etc.)

https://standardsfacility.org/PG-350



Knowledge: Connecting stakeholders, co-creating and sharing good practices



Public-private partnerships

Evidence-based approaches to prioritize SPS investments

SPS eCertification and digitalization

Good regulatory practice

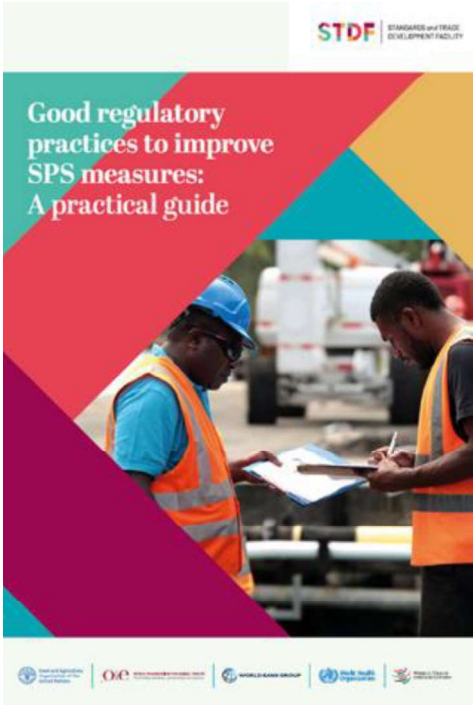
Mainstreaming cross-cutting issues (gender; environment, climate change and biodiversity)

Scaling up SPS e-certification: Lessons from STDF ePhyto project

- Harmonization of certificates is key
- Relatively minor investments in digitization can have significant catalyzing effects
- Need to address IT access and equipment challenges
- Industry is interested, engaged and willing to contribute, in right circumstances
- Implementation of SPS e-cert does not need to be all or nothing
- Collaboration is key (public-public, public-private)

OECD estimates that the total value of agri-food exports could grow by 17-32% over two years period with SPS e-certificates (OECD)

Safe trade solutions: Using Good Regulatory Practice to ensure SPS measures are fit for purpose



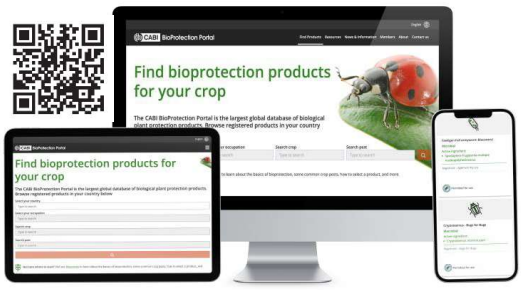
Examples of GRPs

- Transparency for clarity and accessibility of regulations
- Coordination for coherence on SPS measures across government
- Consultations to understand views of private sector, consumers and others
- Stocktaking to reduce inconsistencies, gaps, overlaps and outdated measures
- Monitoring to understand if regulations are achieving expected impacts

Looking to the future, learning from the past: What's needed?

1. Urgency, openness and readiness for change
2. Use international standards
3. Collaboration to connect, learn and leverage collective strengths and expertise
4. Mainstream cross-cutting issues to improve results and sustainability
5. Leverage financing and incentives
6. Focus on innovation, learning and change management
7. Harness strategic opportunities (digitalization, climate change resilience, etc.) to drive SPS improvements and facilitate safe trade

STDF collaboration with CABI BioProtection Portal



Free tool to help growers and advisors **identify, source and apply bioprotection products** against pests

Users can search for **registered bioprotection products in their country** and explore the **resources area** for information and self-study courses on biological control and IPM.

Live in >40 countries

>4,000 registered products in database

Available in **local languages**

Online and offline

https://bioprotectionportal.com

CABI BioProtection Portal

Find out more

Sign up for STDF e-news

Use STDF knowledge products, videos, etc.

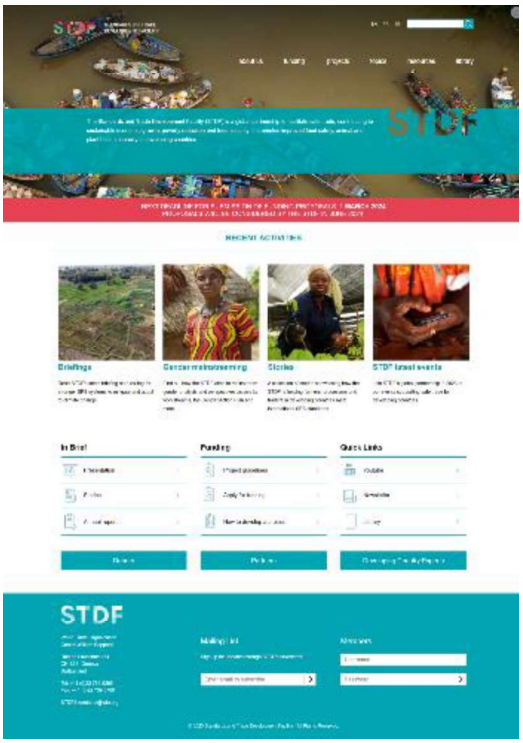
Apply for STDF funding

Attend STDF events and webinars

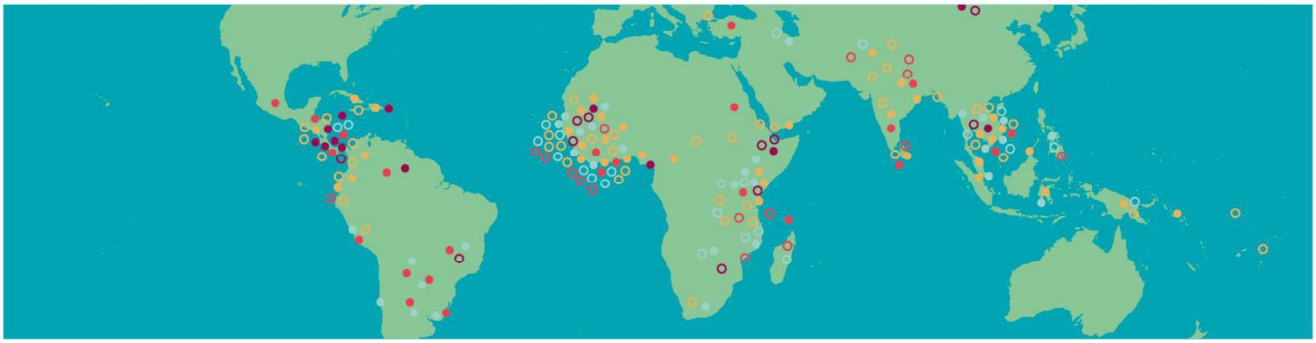
Share your stories on safe trade solutions via STDF's network

www.standardsfacility.org

STDFSecretariat@wto.org



Apply for funding



Browse web pages for aims & eligibility criteria: standardsfacility.org

View examples of previous projects and read the guidance note for applicants
Eligibility and developing country contribution based on OECD DAC list
Consult stakeholders in the country/region

Next deadline: 2 August 2024

Send concept for feedback: STDFSecretariat@wto.org

Submit application online

STDF development partners

Law of the Republic of Indonesia **Number 21 of 2019** concerning **Animal, Fish, and Plant Quarantine**

Presidential Regulation of the Republic of Indonesia **Number 45 of 2023** concerning **the Indonesian Quarantine Authority**

LEGAL BASIS

SALINAN

PRESIDEN
REPUBLIK INDONESIA

UNDANG-UNDANG REPUBLIK INDONESIA
NOMOR 21 TAHUN 2019
TENTANG
KARANTINA HEWAN, IKAN, DAN TUMBUHAN

DENGAN RAHMAT TUHAN YANG MAHA ESA
PRESIDEN REPUBLIK INDONESIA,

SALINAN

PRESIDEN
REPUBLIK INDONESIA

PERATURAN PRESIDEN REPUBLIK INDONESIA
NOMOR 45 TAHUN 2023
TENTANG
BADAN KARANTINA INDONESIA

DENGAN RAHMAT TUHAN YANG MAHA ESA
PRESIDEN REPUBLIK INDONESIA,

IQA Transformation

INDONESIAN QUARANTINE AUTHORITY

Transformation	Before 2023	As per 2023
Name of organization	Indonesia Agricultural Quarantine Agency (IAQA)	Indonesian Quarantine Authority (IQA)
Legal basis	Law No. 16 Year 1992	Law No. 21 Year 2019
Level of organization	Under the Ministry of Agriculture, Republic of Indonesia	Under the President of the Republic of Indonesia
Scope of organization	Animal and Plant Quarantine	Animal, Fish and Plant Quarantine
Scope of Works	Prevent the introduction, establishment, and spread of quarantine pests of animals and plants into the territory of the Republic of Indonesia	• Prevent the introduction, establishment, and spread of quarantine pests of animals and plants into the territory of the Republic of Indonesia • Supervision and/or control of food and feed safety, food and feed quality, GMO, genetic resources, biological agents, IAS, endangered species of wild fauna and flora

Transformation of Resources and Management

INDONESIAN QUARANTINE AUTHORITY

Before

Operational office

50 Animal and Plant Quarantine Station

Supporting Facility

- Applied Research Institute for Agricultural Quarantine
- Standard Laboratory for Agricultural Quarantine

Human Resources

- Plant Quarantine Officer
- Animal Quarantine Officer

After

Operational office

- 6 Animal, Fish, and Plant Quarantine Station
- 32 Animal, Fish, and Plant Quarantine Services
- 153 Animal, Fish, and Plant Quarantine Service Unit

Supporting Facility

- Applied Research for Animal, Fish, and Plant Quarantine, IQA
- Standard Laboratory for Animal, Fish and Plant Quarantine

Human Resources

- Animal Quarantine Officer
- Fish Quarantine Officer
- Plant Quarantine Officer

VISION & MISSION

Vision

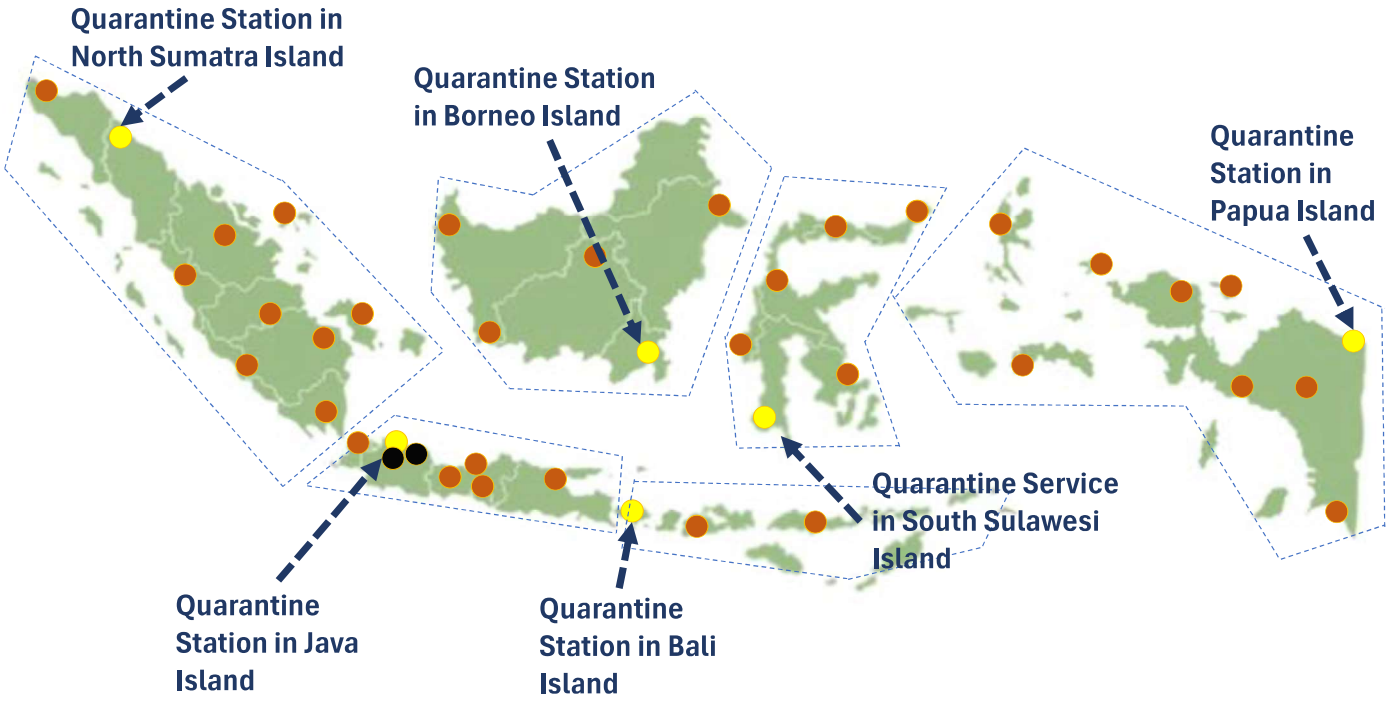
To become a strong and sustainable quarantine in realizing the protection of biological natural resources for the prosperity of people's lives

Mission

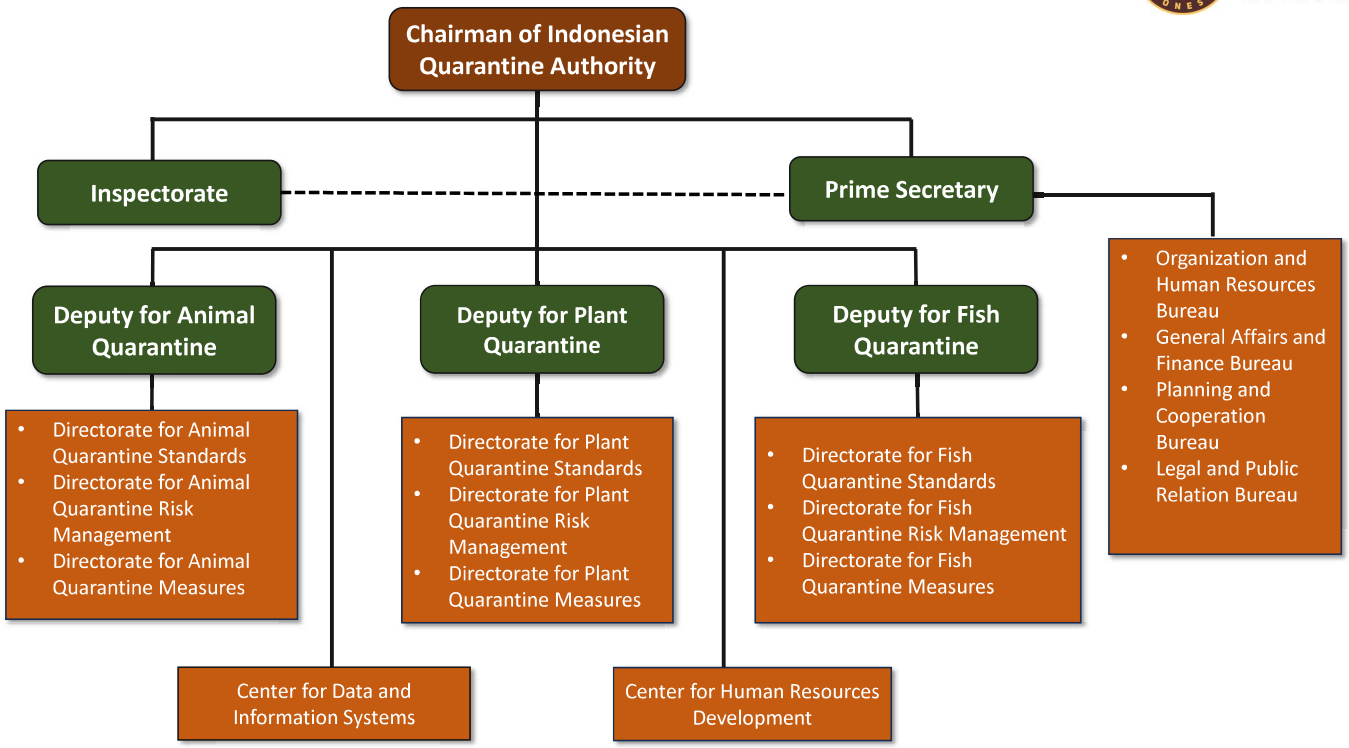
1. Organising an integrated quarantine system to protect biological resources and ensure the safety and quality of food and feed
2. Improving the role of quarantine in market access and acceptability of Indonesian animal, fish, and plant commodities
3. Building community involvement in the implementation of quarantine
4. Managing a clean, effective, and trustworthy Indonesian Quarantine Authority

Scope of services to cover Indonesia as an archipelagic country

INDONESIAN QUARANTINE AUTHORITY



Organizational Structure IQA

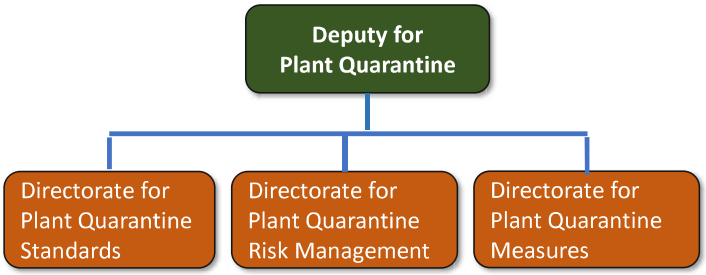


Indonesian National Plant Protection Organization
Contact Point

Indonesia

IPPC Official Contact Point

Mr. Bambang -
Deputy of Plant Quarantine
Indonesian Quarantine Authority
Ministry of Agriculture, E Building 5th Floor, Jalan Harsono RM Nomor 3, Ragunan, Pasar Minggu, Jakarta 12550 Indonesia
Email: deputikt@karantinaindonesia.go.id
Alternate Email: ippc.indonesia@gmail.com
Preferred languages: English
Website: https://karantinaindonesia.go.id
Date contact registration: 05 Feb 2024



IQA Policy Focusing on Strengthening Pre-Border Measures

Strengthening international cooperation is **a priority.**

Strengthening pre-border measures is **a priority** in mitigating biosecurity risks.