Systems approaches to reduce pest risks: sea containers and their cargoes

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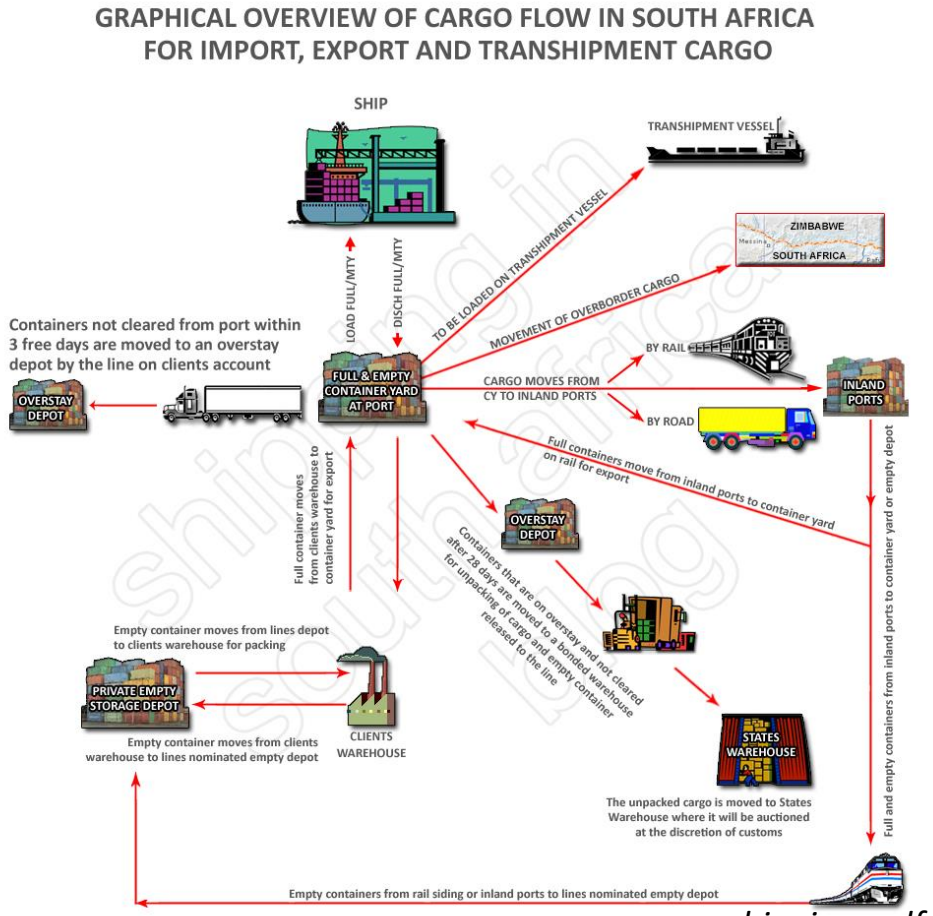
Emerging international efforts towards a more holistic approach to managing trade-related biosecurity risks

- Reliance on single point treatments becoming less viable; preference for multi-faceted risk-based approaches
- Exporting industries seek more cost-effective, least trade-restrictive entry requirements
- Opportunities to recognise commercial practices that reduce risk and leverage increasingly sophisticated production systems and supply chains

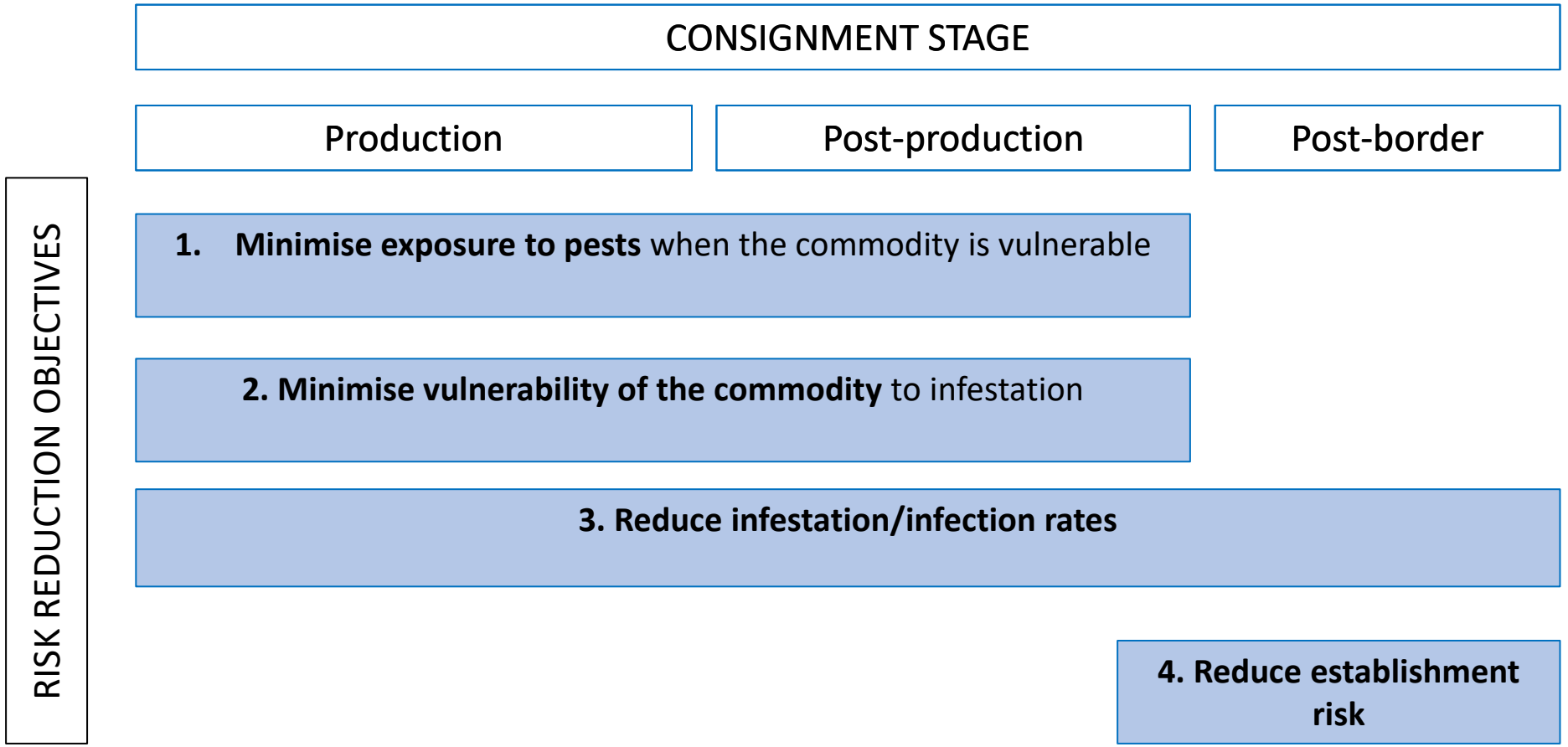


www.shippingandfreightresource.com

Improved risk science enables more accurate estimates of risks, analysis of how commercial practices or technologies reduce risks, and smarter use of diverse data sources …

… towards practical entry requirements better matched to actual risks and aligned with supply chain systems

Risk reduction framework for phytosanitary (biosecurity) risks



Adapted from Van Klinken et al. 2020 https://doi.org/10.1016/j.cropro.2019.104994

Menu of measures – from a review of all managed pathways

RISK REDUCTION OBJECTIVES

CONSIGNMENT STAGE

Production	Post-production	Post-border

Minimise exposure to pests when the commodity is vulnerable

Pest freedom or low pest prevalence
- Area-wide
- Registered site

Pest management
- Agrochemicals
- Attract and kill
- Biological control
- Hygiene
- Sanitation
- Other pest management tools
- Integrated Pest and Disease Management

Pest avoidance
- Restricted to poor pest habitat
- Limit seasonal overlap
- Limit exposure time to pest
- Isolation from hot spot
- Habitat manipulation

Pest exclusion
- Protected facilities
- Safeguarding
- Protected units
- Segregation
- Maintain buffer zone
- Pest-free inputs

Reduce establishment risks

Limit propagule pressure
- Trade volume
- Consignment and packaging size
- Prevent escapes

Limit export destinations or use
- Restricted to poor pest habitat
- Poor time of year
- Restricted end-use

Minimise vulnerability of the commodity to infestation

Poor host or carrier

Poor host or carrier status; Poor developmental stage; Quality specifications; Modify vulnerability; Remove/prohibit parts of commodity

Reduce infestation rates

Reduce pest in commodity
- Treatment (to kill or inactivate the pest): heat, cold, drying, irradiation, agrochemicals, high pressure, cold + MA; combination kill treatment; Other
- Physical disturbance and processing
- Surface cleaning
- Remove contaminants

Remove infested commodity units
- Symptom grading
- Risk profiling

Remove infested consignment
- Inspect product and reject
- Quarantine and reject

Van Klinken et al. 2023. Biological Invasions

Sea container Measures

RISK REDUCTION OBJECTIVES

CONSIGNMENT STAGE

Post-production

Minimise exposure to pests when the [sea containers are] vulnerable

Pest freedom or low pest prevalence
- Area-wide
- Registered site

Pest management
- Agrochemicals
- Attract and kill
- Biological control
- Hygiene
- Sanitation
- Other pest management tools Integrated Pest and Disease Management

Pest avoidance
- Restricted to poor pest habitat
- Limit seasonal overlap
- Limit exposure time to pest
- Isolation from hot spots
- Habitat manipulation

Pest exclusion
- Protected facilities
- Safeguarding
- Protected units
- Segregation
- Maintain buffer zone
- Pest-free inputs

Minimise vulnerability of [sea container] to [contamination]

Poor host or carrier

Poor carrier status; Poor developmental stage; Quality specifications; Modify vulnerability; Remove/prohibit parts of [container]

Reduce [contamination] rates

Reduce pest in [shipping container pathway]
- Treatment (to kill or inactivate the pest): heat, cold, drying, irradiation, agrochemicals, high pressure, cold + MA; combination kill treatment; Other
- Physical disturbance and processing
- Surface cleaning
- Remove contaminants

Remove [contaminated sea containers]
- Symptom grading [then clean/treat]
- Risk profiling

Post-border

Reduce establishment risks

Limit propagule pressure
- Trade volume
- Consignment and packaging size
- Prevent escapes

Limit export destinations or use
- Restricted to poor pest habitat
- Poor time of year
- Restricted end-use

Remove [risk] in [contaminated pathway]
- Inspect product and [consequence for pathway]
- Quarantine and reject

Reported/Suggested
Potential

Exposure risk

Minimise exposure to pests when [shipping containers are] vulnerable

Pest freedom or low pest prevalence
- Area-wide
- Registered site

Pest management
- Agrochemicals
- Attract and kill
- Biological control
- Hygiene
- Sanitation
- Other pest management tools
  Integrated Pest and Disease Management

Pest avoidance
- Restricted to poor pest habitat
- Limit seasonal overlap
- Limit exposure time to pest
- Isolation from hot spots
- Habitat manipulation

Pest exclusion
- Protected facilities
- Safeguarding
- Protected units
- Segregation
- Maintain buffer zone
- Pest-free inputs

Measures that limit the exposure risk of sea containers to contaminants

- Can apply both to general risks of contamination (e.g. protected facilities) or targeted, high-risk pests (e.g. PF or LPP)
- "Vulnerability" may be greatest when doors are open
- Measures arguable under-exploited
- Pest-free inputs: e.g. **cargo**, packaging
- Examples
  - Sea container Hygiene System (Aus-NZ): stunning results for Pacific Islands

Images provided by Rama Karri (DAFF)

Carrier vulnerability

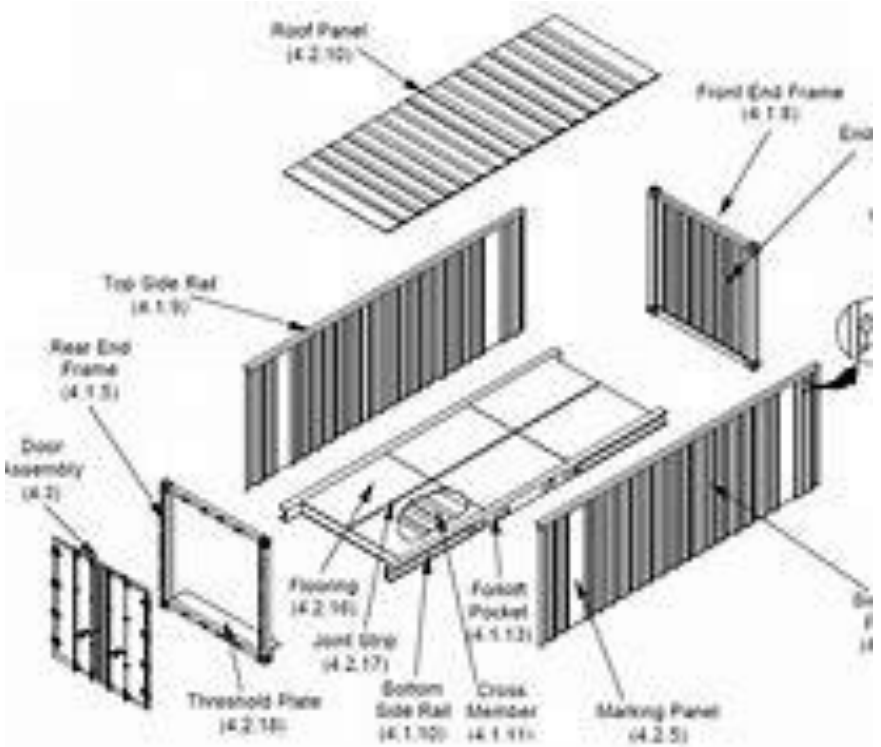
Minimise vulnerability of [sea containers] to [contamination]

Poor host or carrier

Poor carrier status; Quality specifications; Modify vulnerability; Remove/prohibit parts of [shipping container]

Measures that affect the likelihood of becoming contaminated at a given exposure risk

- Poor-carrier status: e.g. composite containers (integral steel floors rather than wooden floors)#
- Quality specifications: e.g. “use high grade containers”
- Modify vulnerability: e.g. use “non-sticky” paint, seal air vents
- Prohibit parts of container: e.g. “prohibit exposed timber components of containers”



#Steel floors can also make measures that rely on surface cleaning or inspection more effective

Reduce infestation (contamination) rate

Reduce [contamination] rates

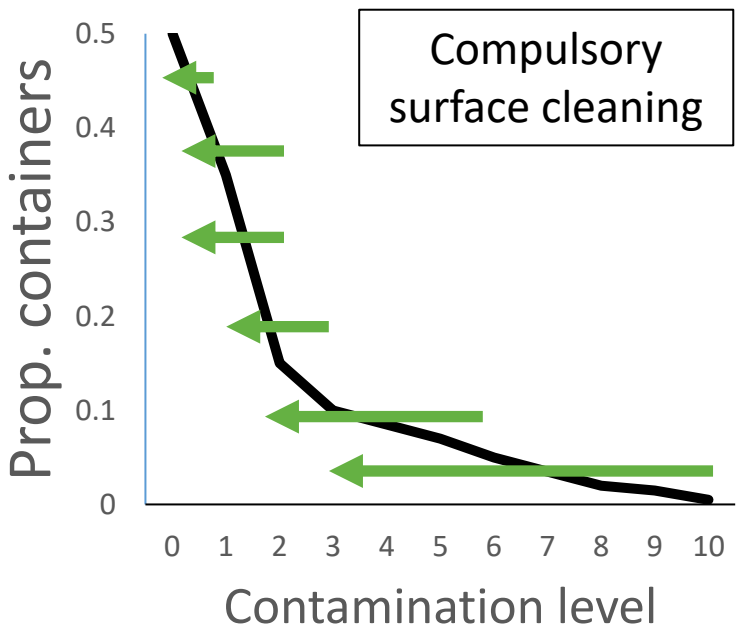
Reduce [contamination] in [sea container pathway]
- Treatment (to kill or inactivate the pest): heat, cold, drying, irradiation, agrochemicals, high pressure, cold + MA; combination kill treatment; Other
- Physical disturbance and processing
- Surface cleaning
- Remove contaminants

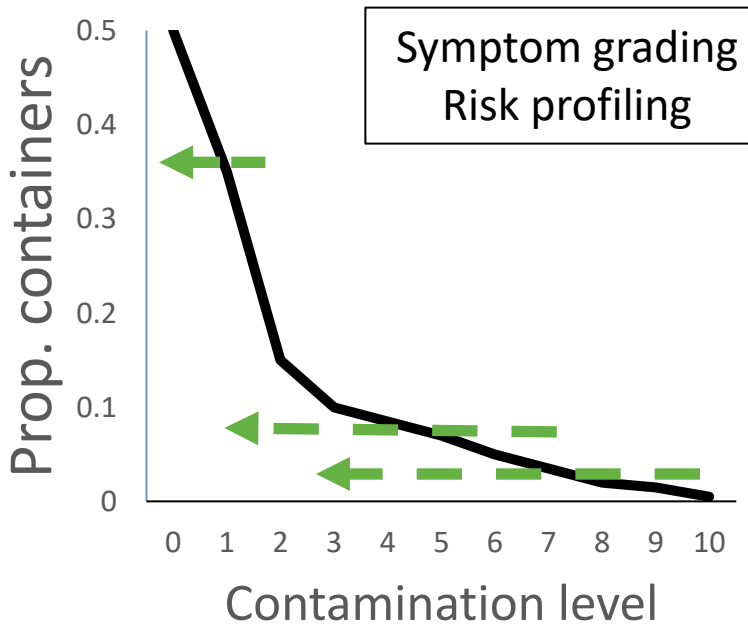
Remove [contaminated sea containers]
- Symptom grading [then clean/treat/substitute/reject]
- Risk profiling

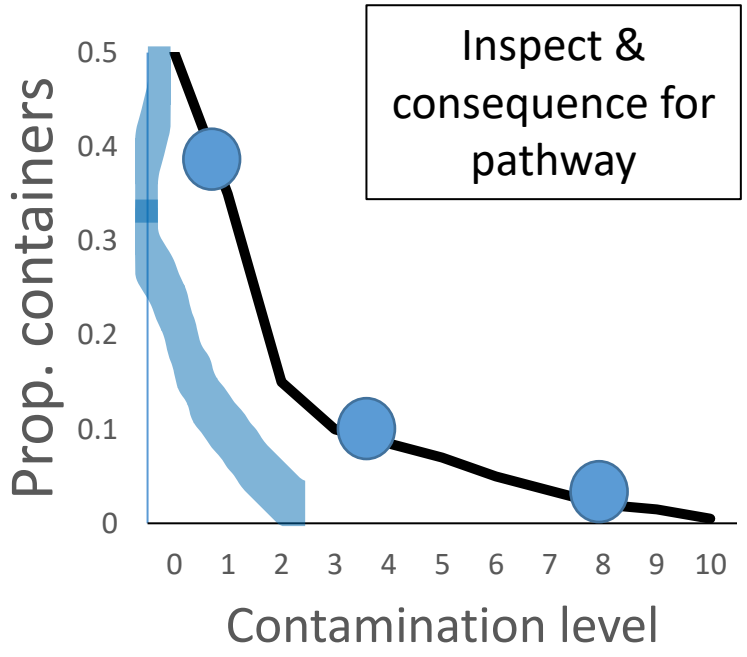
Remove [risk] in [contaminated pathway]
- Inspect product and [and consequence for pathway]
- Quarantine and reject

Measures that reduces contamination rate in containers

- Inspection and cleaning can be important “measure elements”







e.g. Adaptive Inspection Schemes

Establishment risk

Reduce establishment risks

Limit propagule pressure
- Trade volume
- Consignment and packaging size
- Prevent escapes

Limit export destinations or use
- Restricted to poor pest habitat
- Poor time of year
- Restricted end-use

Measures that reduce risk of establishment in the event that contaminants arrive

- Preventing escapes: is especially critical if empty containers must be washed prior to return
- Poor pest habitat: could include limiting movement to rural areas; ensuring depots/transitional facilities are “poor habitat” for establishment
- Restricted end-use: e.g. containers can only be used for export.

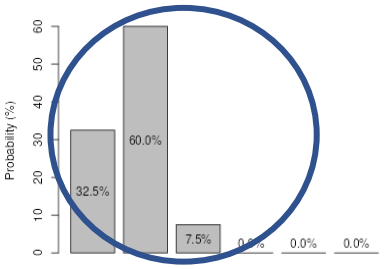
PRReSTo: **P**est **R**isk **R**eduction **S**cenario **T**ool

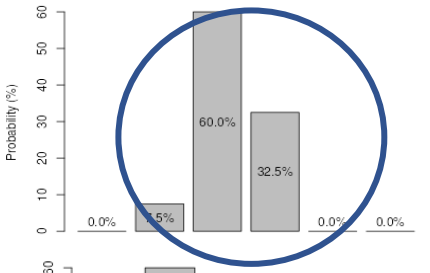
- **Risk assessment and management tool**
  - Quantify unrestricted risk
  - Quantify how measures reduce risk, individually and in combination
- Designed to allow assessment of all measures in the menu of measures
- Captures uncertainty (e.g. for “good will” measures)
- Generalisable and customisable (pest, commodity, situation)
- If no data then can at least estimate how effective a measure needs to be

Horticulture application freely available on-line: modification needed for sea containers

The effect of measures contamination risk (illustrative only)

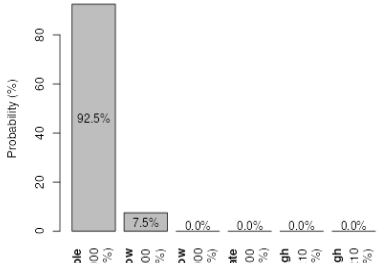
Low contamination exposure risk

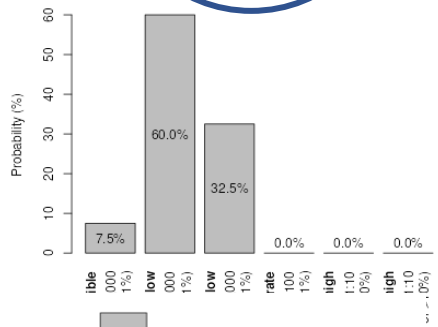




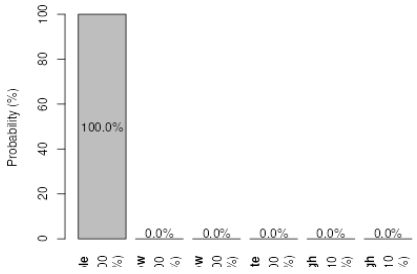
Moderate contamination exposure risk

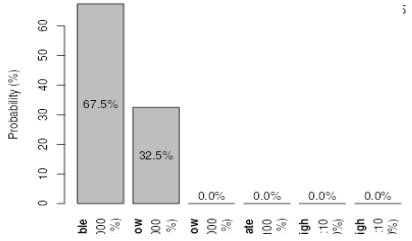
Surface cleaning: 90% efficacy





Surface cleaning: 99% efficacy



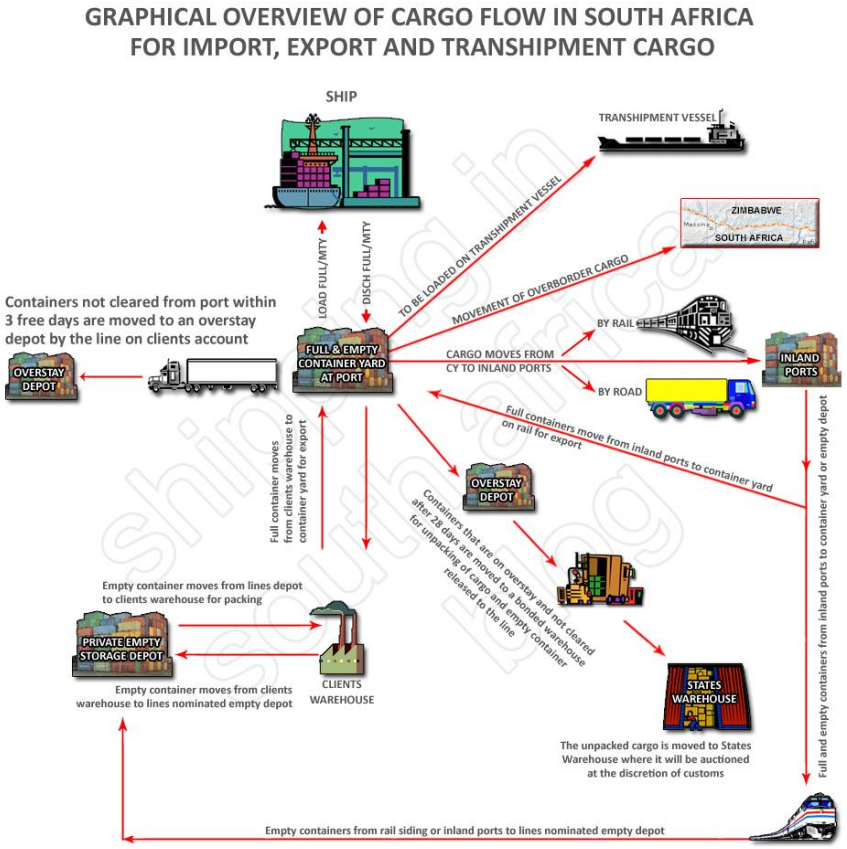


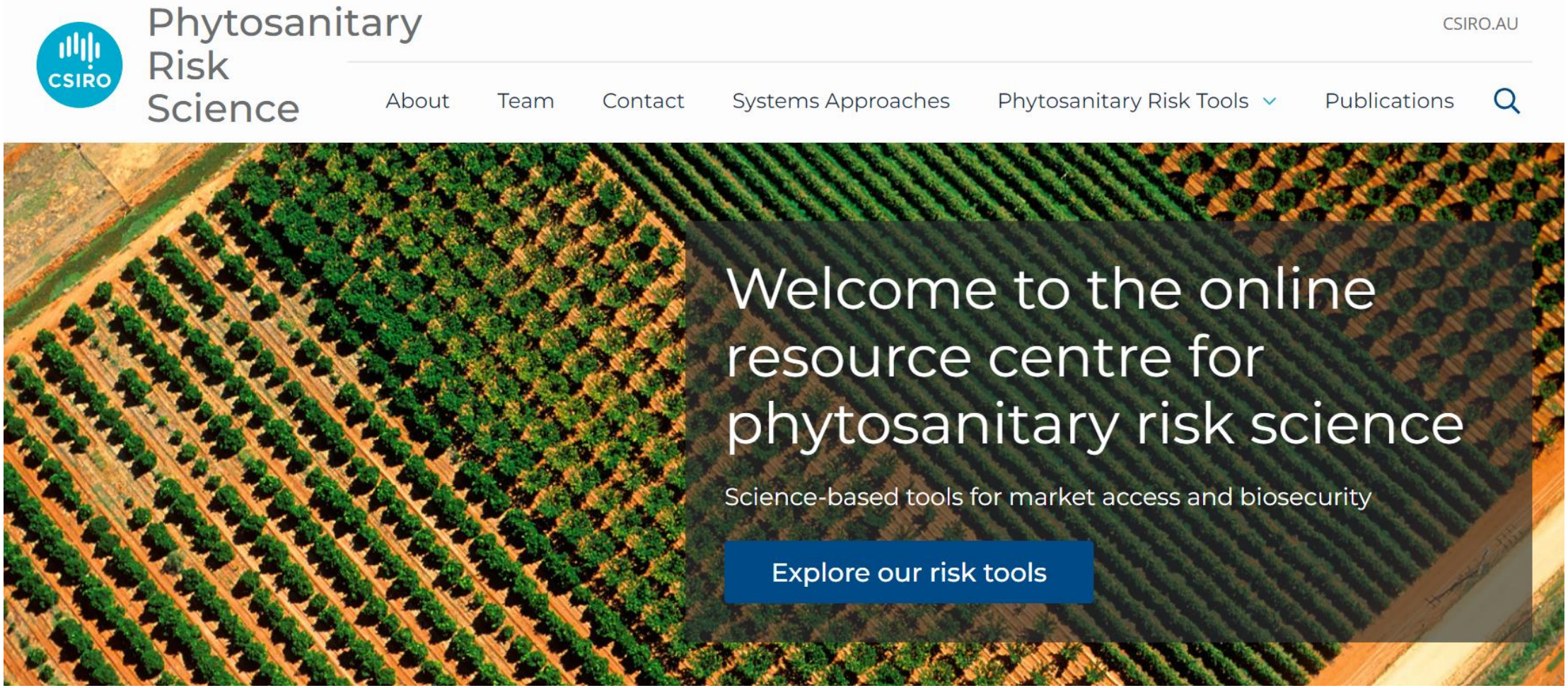
Contamination rate (negligible to very high)

- Contamination risk is very sensitive to risk of exposure
- Measures don’t have to be fully effective to be useful

Conclusions

- The Risk Framework and Menu of Measures provides a risk-based classification for available measures
- There is potentially a much broader tool kit available than recognised in most existing documents
- Modelling can assess the relative value of different measures within a systems approach, including to reward “good practice” where risk reduction value can be demonstrated (“outcomes based”)
- Modelling can also be used to identify where data is best needed to guide measure selection and design.





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