Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

Canadian Food Inspection Agency




Our vision:
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Our mission:
Dedicated to safeguarding food, animals and plants, which enhances the health and well-being of Canada's people, environment and economy.

Adapting existing models for use in other countries

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Outline of presentation

1. What does “adapting” a model mean?
2. Benefits to the recipient country and the model developers
3. Examples of using models in other countries
4. Requirements for such projects

Models of highly contagious diseases are developed to:

- Gain an understanding of a specific disease process
- Support contingency planning efforts by providing exploratory scenarios
- Perform retrospective analyses of past outbreaks to improve understanding of their characteristics and be better prepared for future outbreaks
- Support response activities during highly contagious disease incursions

The process of model building is dependent on many factors

- **The disease status of the country and the objective of the modelling work**
  - **Contingency planning?**
  - **Evaluation of current control strategies?**
- **The experience of the country with highly contagious disease**
  - **Data available for model building?**
  - **Knowledge of past outbreaks?**
- **The experience of the model developers**
  - **Mathematical modelling vs simulation…**

Therefore models can be:

- **Very specific to:**
  - **An area or region of a country**
  - **A specific disease**
  - **A specific epidemic**

  - **May still allow modifications of some parameters**

- **Model frameworks allow the user to:**
  - **Adapt the parameters to create models of different diseases**
  - **Adapt the parameters to represent different populations and contact structures**

The process of building a highly contagious disease model requires resources:

- **Multi-disciplinary teams: epidemiologists, computer scientists, economists, sociologists, mathematicians, climatologists etc…**
- **Funds to support the model development work**
- **Funds for data collection and analysis**
- **Data for model building and evaluation**

Resources and / or expertise might be an issue in various countries

Therefore some countries might be interested in using an already existing model

- **Means we might have to "adapt" a model:**
  - **Is it a matter of simply changing model parameters?**
    - **Does the model accommodate this easily?**
    - **Is the interface "user friendly"?**
    - **What is the level of training required?**
  - **Does the model code have to be changed to represent:**
    - **Another disease process and epidemiological parameters?**
    - **A different livestock population and husbandry system?**
  - **The level of adaptation will depend on the type of model:**
    - **Specific model might require more changes than a simulation framework which is highly flexible**
    - **Highly flexible models might require more parameters and data…**

Benefits of using an existing model to the receiver

- **Low cost and shorter timeframe – don't need to build a model framework from the ground up**
- **Training and capacity building in epidemiology and modelling:**
  - **Users forced to think through the disease transmission process and control in a structured way**
- **Support contingency planning or evaluation of current or alternative response strategies**
- **Access to specialists and collaborations**
  - **Analysis of existing data of past outbreaks**
  - **Analysis of livestock movement data**

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Benefits to the model developers and their country in sharing the model

- **Access to data not available in their countries**
  - **Outbreak data, contact data, population structure data…**
- **Value for modeller / epidemiologist in disease free (FMD, CSF etc..) countries:**
  - **Gain knowledge of foreign animal diseases based on other countries' experiences**
- **Validation of model: increasing confidence in conceptual model and outputs**
- **Support highly contagious diseases eradication measures overseas**

Issues that are faced when trying to use a model in another country

- What is the objective or question to be answered?
- Are there data available to fit into the model?
  - Population / locations / farm type / size
  - Contact rate information
  - Surveillance data
  - Control measures
- Are there resources and expertise to perform modelling work?
  - Long-term capacity building or shorter term collaboration projects
- Can the model be changed / adapted to represent the new population and parameters?

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Being able to represent the livestock population and its structure is a major issue to consider

1. **InterSpread Plus – simulation model framework for highly contagious diseases developed in New Zealand used in various other countries**
   - **Example of FMD study in Korea**
2. **Tildesley and Keeling, 2008 – simulation model of FMD from UK used in Denmark**
3. **Use of NAADSM in South America**

Example 1: InterSpread (Plus) in Korea: - objectives

- **Modellers:**
  - **Can IS+ re-create the 2002 FMD epidemic in Korea?**
- **Recipient country:**
  - **What if controls had been implemented sooner or later in the epidemic?**
  - **What would have been the effect of ring vaccination at 3km? At 5km?**
    - **Under limited standard depopulation strategy or extensive pre-emptive depopulation**

Yoon et al., 2006. Prev. Vet. Med. 74, 212-225

Approach used – training and collaboration

- **Koreans worked on population at risk, parameters for movement frequencies, distances of movements, meteorological data**
  - **Created a baseline scenario to which control measures were applied**
- **Modelling work done in New Zealand**
- **3-4 days face-to-face intensive work in New Zealand**
  - **Remaining communications by e-mail**

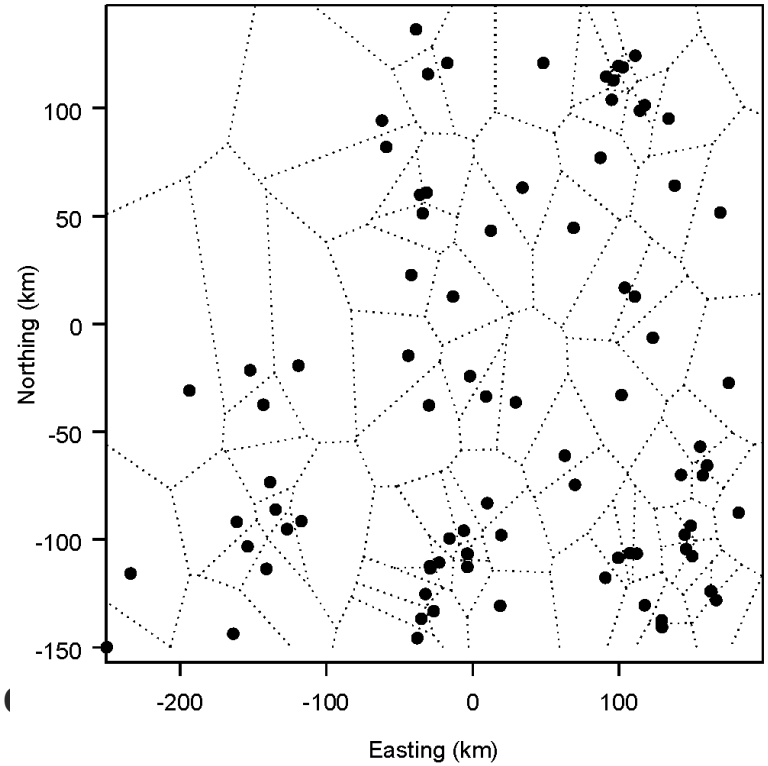
Issues associated with population at risk

- Census of number of farms and number of animals in each farm was available

- No actual location of each farm recorded: only the “ri” which is equivalent to the parish in the UK

- An electronic map of the boundaries o the ri was not available

- Developed ri boundaries from centroid information and then randomly distributed points within each unit



Example 2: UK model transported to Denmark - Objectives

- **Modellers:**
  - **Can a model built specifically for the UK 2001 FMD outbreak be used during different epidemics or in different countries and be useful?**

- **Recipient country:**
  - **Contingency planning:**
    - **Part of the comparison project at EpiLab**
    - **Evaluate potential consequences of FMD introductions in the country**
    - **Identify optimal control measures**

Tildesley and Keeling, 2008. Prev. Vet. Med. 85, 107 - 124

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The main adaptation required was to represent the livestock demographics in DK

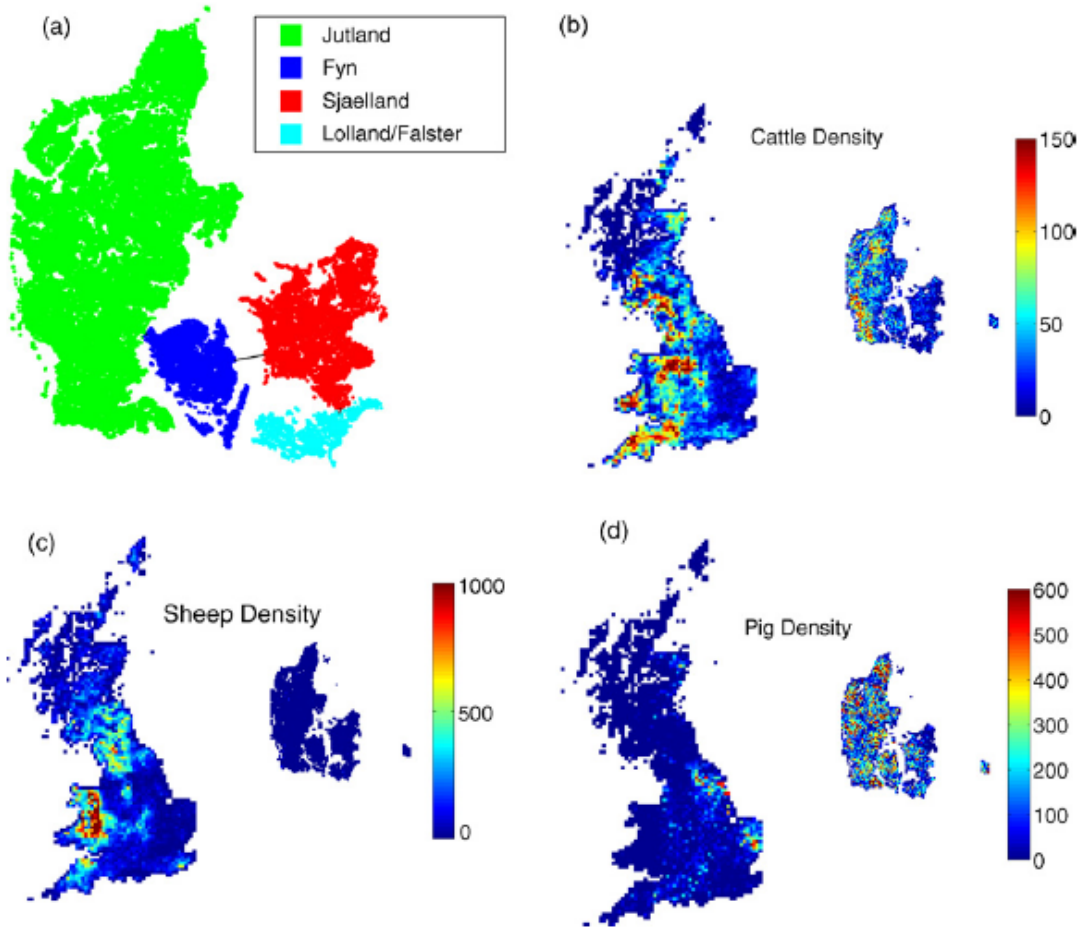

Fig. 1. (a) A map of Denmark highlighting the four regions—Jutland, Fyn, Sjaelland and Lolland/Falster. (b) Cattle density, (c) sheep density and (d) pig density in the UK and Denmark in 10 km ×10 km grids. The colour scale shows the number of animals per square kilometre within each grid square.

Differences in livestock demographics meant changes to parameters were required

- **Dispersal or transmission kernel:**
  - What is the extent of distances for spread to occur?
  - What is the height and width of the dispersal kernel in DK?
- **Epidemiological parameters:**
  - Susceptibility and infectivity of pigs?
- **Assumptions used and tested:**
  - UK parameters for sheep and cattle for susceptibility and infectivity
  - Used kernel from UK as a starting point
  - Unknown parameters were varied to evaluate their impact

Example 3: use of NAADSM in South America - objectives

- **Built in a "disease-free" (FMD, CSF..) region of the world where data on contacts and population is scarce**
  - **How well can it represent the livestock population and disease spread in other regions of the world?**
- **Contingency planning and evaluation of current control strategies:**
  - **Counter-terrorism and capacity building project in South America in collaboration with PANAFTOSA**

NAADSM in South America: technology transfer counter-terrorism and capacity building project

- **Main partner: PANAFTOSA**
- **Objectives for modellers:**
  - **Provide experience to the modellers and epidemiologists from North America in understanding the epidemiology of FMD in that region**
  - **Test its ability to represent the demographics and contact structure in the region**
  - **Validation through expert review**
  - **Obtain data to support improvements to NAADSM**

NAADSM in South America - continued

- **Objectives for PANAFTOSA and recipient countries**
  - **Contingency planning tool for FMD-free countries**
  - **Training of epidemiologists on epidemiological modelling**
  - **Collaborations with North America**
  - **Provide continuous training and support in the region by creating a pool of experts**
  - **Possibility to tailor the model to the needs of the region:**
    - **Sense of ownership in the model for the region**

Activity 1, March 2008: Meeting with subject matter experts (training and orientation)

- **Objectives:**
  - **Train SA epidemiologists with expertise in FMD to use NAADSM**
  - **Gain understanding of the characteristics of the livestock population, contacts, FMD epidemiology and control in the region**
  - **To identify potential modifications necessary for representing the livestock population and contact patterns in SA**
    - **Husbandry practices might be different than in NA**
  - **Increase confidence and validation in NAADSM:**
    - **Review by FMD experts**
    - **Use in pilot studies in SA where outbreaks have taken place**

Activity 1, March 2008 - Continued

- **Provided translated user-interface to participants**
- **5 days of training and discussion:**
  - **Learned about population structure – production systems in some countries of South America**
  - **Discussed issues such as vaccination, detection and livestock markets**
  - **Identified 3 countries for pilot studies: Brazil, Chile, and Colombia**
  - **Identified 5 items to be adapted in NAADSM for use in SA, but also the rest of the world if required**

The main discussion topic was the representation of the production systems:

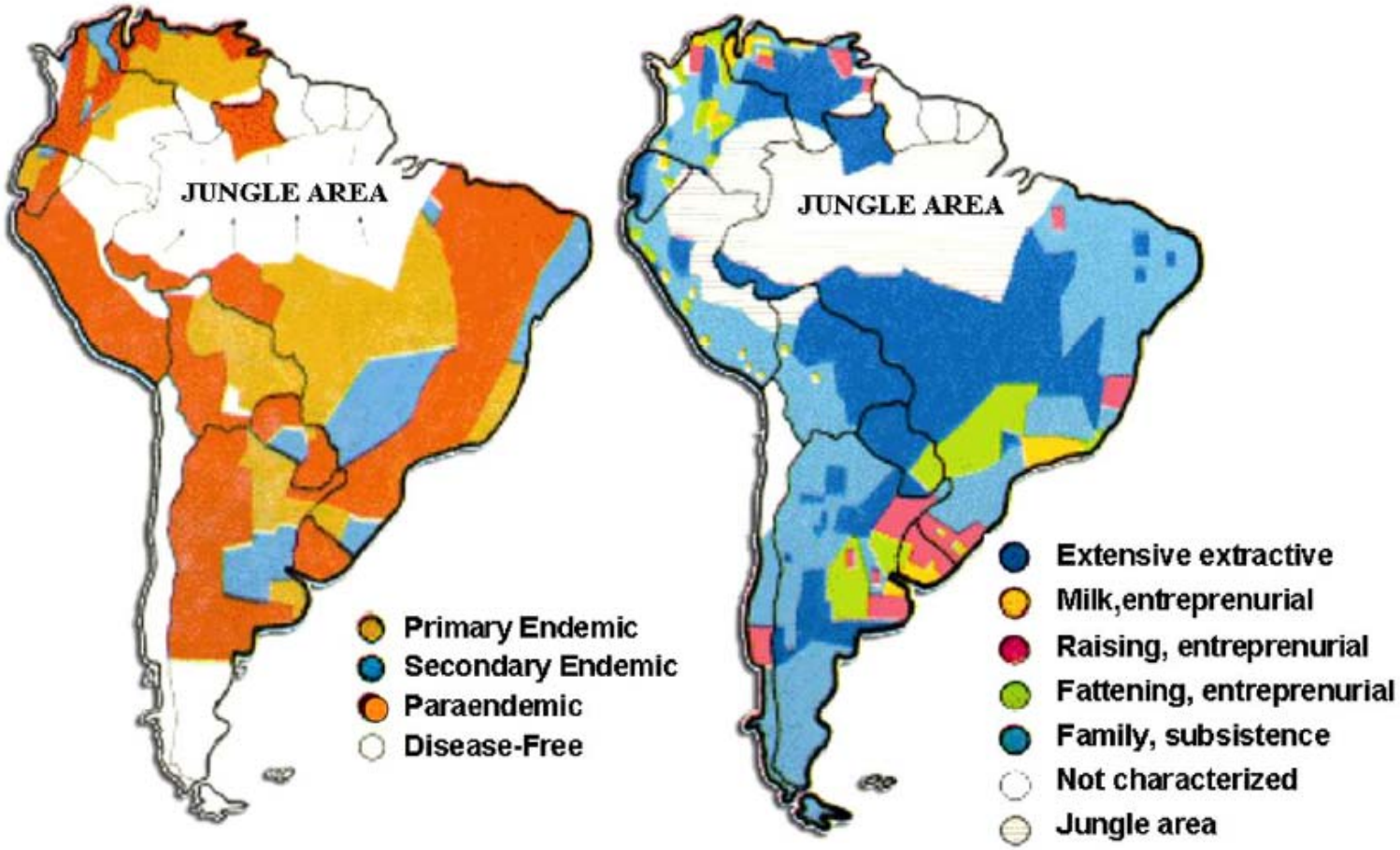

Fig. 1: Forms of Production and FMD Ecosystems

Pilot studies: using NAADSM in South America

- **Important: the work is done locally with support from NAADSM team**
- **2 years**
  - **Year 1: Develop parameters for population, contacts and control measures**
    - **Test current version of NAADSM**
  - **Year 2: Refine parameters based on adapted NAADSM**
    - **Test improved version of NAADSM**
    - **Presentations by the pilot studies representatives to all countries of South America**

Requirements for adapting existing models to other countries - 1

- **The model building process must be transparent:**
  - **Documented assumptions available for review**
  - **Proper code language, programming practices and documentation**
  - **Proof that the model has gone through a series of steps for:**
    - **Verification and validation**
- **The model should be easy to understand:**
  - **Model description**
  - **Easy-to-use user interface**
  - **Detailed user's guide and documentation**

Requirements for adapting existing models to other countries - 2

- **The model proposed should be flexible:**
  - **Represent the differences in livestock demographics and management practices**
    - **Spatial models that take into account different species**
    - **Modellers need an understanding of the contacts in the population and how these are represented in the model**
  - **Account for different strains and starting conditions**
  - **Account for differences in susceptibility and infectivity and clinical signs by species (if applicable)**
  - **Include various control measures and combinations of control measures**

Requirements for adapting existing models to other countries - 3

- **Should have a tool that is easily accessible**
  - **Preferably in language of recipient country**
  - **Easy to use user-interface**
  - **Available on the web for download**
- **Provide training using translation services**
  - **Basic epidemiology and data analysis?**
- **Depending on the goal and duration of the project:**
  - **Should aim at building long term capacity**
    - **Provide ongoing support**
    - **Countries that have the resources should be able to use the model themselves**
  - **Collaborative short term projects in countries with no resources**

Conclusions

- **The level of adaptation that will be required depends on:**
  - **The type of model:**
    - **Is it a disease/epidemic/region specific model or a model framework that allows flexibility in parameters?**
  - **The availability of data in the recipient country**
  - **The objective of the modelling work**
    - **Are we using a model for a purpose different than what it was designed to represent?**

Conclusions

- **The process of building a model leads to a greater understanding of the livestock demographics and contact structure in the region or country for which it is designed**

- **The process of using a model in another region or country is extremely challenging, educational and rewarding**
  - **Forces the modellers to think about their design and make adjustments: models should be improved as a result**
  - **Forces users to think about the disease transmission process and approaches to control**
  - **Provides training and collaboration opportunities**

Questions?


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