MORISKIN WEB APPLICATION

USER'S MANUAL FOR RISK ASSESSORS



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2. Introduction

Administrative context

The MORISKIN project was funded by the Belgian Federal Public Service Health, Food Chain Safety and Environment through the contract RT 18/2 MORISKIN. The original title of the project is "Development of a method for threat analysis in the context of risk of emergence or re-emergence of infectious animal diseases". This project was carried out between January 2019 and April 2021 by a consortium of 4 universities, institutions and companies: Sciensano (coordinator), Avia-GIS, ULiège and UHasselt.

Scientific context

Emerging and re-emerging animal diseases present obvious detrimental impacts on animal health and broader economic implications in terms of lost revenues and societal costs resulting from disease outbreaks. Accurate prediction of the risk of emergence would have direct and indirect favorable effects on animal health and related industries.

A lot of information potentially useful for estimating these risks is already recorded in a structured manner in national and international databases.

Objectives of the project

Risk prediction can be improved when different sources of information are combined. Therefore, the MORISKIN project aims to develop a Web application that enables the monitoring of several risk indicators and then to combine these indicators in order to more accurately assess the risk of entry of the pathogen into Belgium.

The risk analysis provided by MORISKIN focuses on the risks of entry in Belgium of pathogens related to animal diseases. The risks of the Belgian host population getting infected, the risks of spread and the economic consequences are not studied in this project.

MORISKIN should also provide information on the feasibility of the risk assessment method, particularly in terms of user needs, data acquisition and calculation methods (see project report).

This user's manual

The MORISKIN Web application was developed to be as user-friendly as possible. Thus the user should be able to use the MORISKIN application by himself, without reading this manual.

This manual will provide basic information on:

- What you can find on the MORISKIN Web application.
- How to use the MORISKIN application?
- How to interpret the results (risk estimates) of the MORIKSIN application?

Details on methods can be found in the MORISKIN project final report.

3. How to access the MORISKIN Web application?

The MORISKIN application is accessible through this link: <u>https://moriskin.sciensano.be</u>. You need to enter your credentials to access the tool (figure 1).

Please authenticate							
Username :							
1							
Password :							
Login							

Figure 1: Credentials panel

4. What can I find in the MORISKIN Web application?

4.1. HOME TAB



Figure 2: Description of MORISKIN "Home" tab.

After completing your credentials, the application opens on the home tab (figure 2) which presents a summary of the application.

On the top of the Web page, you can see the different tabs of the application:

- Home
- Population Distribution Overview
- Population Distribution
- Trade and Mobility

- Disease Distribution
- Risk Assessment
- Data Accessibility

You can navigate in the application by clicking on the desired tab. The content of each tab is explained in this chapter.

4.2. TAB "POPULATION DISTRIBUTION OVERVIEW"



Figure 3: Screenshot of the tab "Population Distribution Overview". The first map represents the distribution of the human population and the second the population of domestic pigs.

This tab contains an overview (static images) of the distribution of the studied species:

- Human population
- Livestock population:
 - o Pigs
 - o Cattle
 - o Sheep
 - o Goats
- Wildlife:
 - o Wild boars
 - Mosquito vectors
 - Aedes albopictus,
 - Aedes vexans,
 - o Culex. antennatus,
 - Culex. perexiguus,
 - o Culex. pipiens,
 - o Culexx theileri,
 - o Culexx. tritaerhynchus,
 - o Ochlerotatus caspius,
 - o Ochlerotatus detritus.

The distributions are presented on maps with a color gradient. On the left of the screen the user can find information on the sources and data used for these visualizations (figure 3).

The aim of this tab is to present a rapid overview of the distribution of all the studied species on static maps, all maps being presented on the same page.

4.3. TAB "POPULATION DISTRIBUTION"



Figure 4: Description of the tab "Population Distribution", when selecting "Animals" and then "pigs" under the title "Livestock and wild species".

This tab presents the exact same information as the previous one, on dynamic maps with additional visualization options like zoom and popups (figure 4). The species can be selected by choosing first between "Human", "Mosquito vectors" and "Animals", and then choosing the desired species.

4.4. TAB "TRADE AND MOBILITY"



Figure 5: Display of the 3 options of the tab "Trade and Mobility"

The tab "Trade and Mobility" provides an overview of some pathways at risk for animal diseases introduction in Belgium (figure 5) :

- Human by flight (risk of disease spread via fomites)
- Imports of live animals (livestock)
- Imports of animal products for artificial reproduction (for livestock)

For each of these pathways, the data is presented in the form of maps and time series. For the maps, the user can select the period he wants to visualize. For the time series, the whole data set is presented, from 2016 to the last updated date.

4.4.1. Trade and Mobility: Human by flight



Figure 6: Panel presenting the movements of humans by flight.

This tab provides maps and time series presenting the number of people coming to Belgium by flight, by month and by country or by airport (figure 6). The data presented here come from Eurostat database, and can be found via this link :

https://ec.europa.eu/eurostat/databrowser/view/avia par be/default/table?lang=en.

This data is updated in the Eurostat database only twice a year, so the information cannot be directly available unlike the majority of the data used in MORISKIN.

4.4.2. Trade and Mobility: imports of living animals



Figure 7: Panel presenting the imports of live animals in Belgium

This tab provides information on the imports of live animals (cattle, sheep, goat, pig) in Belgium. It uses the data from the TRACES database. By selecting the type of animal, "production" or "slaughter", the user will see respectively the animals imported to a farm or those sent directly to the slaughterhouse. The user also has the option to visualize the number of animals moved or the number of batches or trucks entering Belgium by selecting "count of animals" or "count of movements" respectively (figure 7).

4.4.3. Trade and Mobility: imports of animal products for animal reproduction



Figure 8: Panel presenting the imports of animal products for livestock reproduction

This panel (figure 8) presents the data from the TRACES database on the imports of animal products for animal reproduction (semen, ova, embryos, etc.).

Here, the user can select 'movements' or 'packages'. When selecting 'movements', you will visualize the total count of movements (trucks) with the selected material, aggregated by week (or by the selected period). If you select 'packages', the total count of packages will be displayed. There is no clear definition of a "package" in the TRACES data set, in one movement multiple packages can be sent. Information on the number of doses of semen, ova and embryos is not available in the TRACES database.

The other kinds of animal products like meat is not presented in the MORISKIN tool because the registration is not mandatory for these kinds of products and consequently the data in TRACES is not representative of the real number of imports of meat.



4.5. TAB "DISEASE DISTRIBUTION"

Figure 9: View of the tab "Disease distribution"

By clicking on the tab "Disease distribution", the user has the choice between 2 databases: ADNS or OIE. After choosing the database, the user has to select the disease, the animal species and the time period. Then he will visualize the number of cases of the selected disease occurring in the selected species during the selected time period displayed on a map or in a time series graph (figure 9).

Note that the data sources are not always giving the same information. For the disease declarations in Europe, the ADNS database seems to be more reliable.

4.6. TAB "RISK ASSESSMENT"



Figure 10: View of the tab "Risk assessment"

This tab provides the estimations of the risk of entry of the studied pathogen. In the current (2021) version of the tool developed for the MORISKIN project, only the risk about African swine fever (ASF) introduction is studied (figure 10).

The risk of introduction of ASF into Belgium is expressed as the probability that at least one animal or person carries the pathogen from a risk country to Belgium. Caution: only the risk of disease introduction is assessed, the risk of disease persistence and spread in Belgium is NOT considered.

The risk is presented for each studied risk pathways and for the combination of these pathways. The studied pathways are:

- Imports of live animals to farm
- Imports of live animals to slaughterhouses
- Imports of animal products for reproduction (ova, semen, embryos, etc.)
- Human movements via flight, taking into account (as risky):
 - The potential presence of farmers in a flight to Belgium
 - \circ $\;$ The potential presence of hunters in a flight to Belgium
 - The potential presence of infected meat in a flight to Belgium

As much data as possible has been used to compute these risks (see point 6). Nevertheless, some unknown or uncertain parameters remain. The user is given the option to modify these uncertain parameters to improve the accuracy of the computation according to his expertise, or to visualize this uncertainty in the final risk evaluation:

- **Underreporting factor**: level of ASF cases underreported in pig herds and in wildlife for a defined time step (week). e.g. if the underreporting factor is set at 4, the number of cases in pigs is considered to be 4 times higher than the declared number of cases in pigs. Adkin *et al.* (2004) assume an underreporting factor of 4 in the case of ASF.
- **Undetected infection in domestic pigs**: probability of undetected infection (Ud). Elbers *et al.* (1999) assume Ud = 0.1, meaning that 90% of the cases will be detected and consequently not exported.
- **Potential for a wild boar to infect a domestic pig**: number of pig herds infected by a single wild boar during one week in an area with wild boars and domestic pigs (for example 0.1 means that 10 infected wild boars will infect 1 herd, on average).
- In an infected herd, probability that the virus infects reproducer pigs: estimated as 0.1.

At this stage, the considered countries of origin for the risk computation are only the following countries: Austria, Bulgaria, Croatia, Cyprus, Czech republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.

Time series: If the probability of introduction into Belgium is very low, the values can be displayed with mu, n or p which correspond to micro (10-6), nano (10-9) and pico (10-12). Time series are dynamic and enable zoom by selecting an area of the plot or country selection by double click on the country of interest.

MORISKIN project: V1.0	HOME	POPULATION DISTRIBUTION OVERVIEW	POPULATION DISTRIBUTION -	TRADE AND MOBILITY 👻	DISEASES DISTRIBUTION -	RISK ASSESSMENT	DATA ACCESSIBILITY		
AV/A/S Sciensand Universiteit LIÈGE									
Population data									
Human									
Gridded population of the World project.									
	Livestock								
	The dataset is from models output published by Gridded Livestock of the World project.								
	Wildboar								
	The dataset is from models output published by Alexander et al. (2016)								
	Vectors								
		Vector di	istribution are from model's o	Itput produced by Avia-G	IS (data driven model based	d on ECDC data: Vec	torNet project).		
Disease reports									
	OIE								
	Available on request from WAHIS Interface								
	ADNS								
	Available on request from Animal Disease Notification System (ADNS)								
	PADI web platform								
				Available on req	uest from Cirad				

4.7. TAB "DATA ACCESSIBILITY"

Figure 11: Tab "Data accessibility".

The tab "Data accessibility" summarizes the sources used by MORISKIN. The texts in green are hyperlinks to the Web pages of the different sources of data used in the MORISKIN project.

5. How to use the MORISKIN application?

5.1. USE OF SPECIFIC BUTTONS



5.2. HOW TO PLAY WITH MAPS?

- Maps can be zoomed using double click or the plus/minus button on the top left.
- Use your mouse to see popups with specific information on the country where the curser is.
- You can modify the display options on the top right of the map.
- All maps can be downloaded as .png images via the "Download" button.

5.3. HOW TO PLAY WITH TIME SERIES?

- Put your cursor on the points of the graph to see the values.
- Click and drag with your mouse to zoom on a period.
- Double click on the graph to reset default zoom.
- Simple click on a country in the legend in the right to add or remove this country of the graph.
- Double click on a country to see only this country in the graph.
- Double click in the legend panel to reset the view of all countries..

5.4. WHAT COULD RISK ASSESSORS USE MORISKIN FOR?

- To visualize disease events \rightarrow tab "Disease Distribution".
- To visualize risk indicators (pathways) of disease entry in Belgium \rightarrow tab "Trade and Mobility".
- To visualize population distributions \rightarrow tab "Population Distribution".
- To estimate the risk of introduction in Belgium of a specific pathogen \rightarrow tab "Risk Assessment".
- To compare the risk of introduction between countries \rightarrow tab "Risk Assessment".
- To compare the risk of introduction between introduction pathways \rightarrow tab "Risk Assessment".
- To compare the risk of introduction between diseases (not available yet, as only ASF is studied).
- Then to prioritize countries, pathways or diseases in surveillance or research programs → tab "Risk Assessment".

5.5. HOW COULD RISK ASSESSORS USE MORISKIN?

Here is an example of a workflow that the risk assessor could follow:

- 1. First look in the "Risk Assessment" tab at the graph displaying the risk for all pathways combined.
- 2. Identify a country and a period of interest (with a high risk).
- 3. Look at the other graphs in this tab to identify the pathway at risk for this country and period.
- 4. Look at the tabs "Trade and Mobility" and "Disease Distribution" to identify if this increased risk is due to an increase in the movements or/and to an increase of the disease in the country.

After following these 4 steps, the risk assessor has a better understanding of the identified risk and of the origin of the risk.

6. How is the risk computed?

The probability of introduction of the pathogen computed in MORISKIN is specific to the studied pathogen, here ASF. This probability is computed in 2 steps:

- 1. Estimation of the prevalence in the country at risk (country of origin)
- 2. Combination of the prevalence with the number of movements from the risk country to Belgium

This computation takes into account:

- That the disease may have been present in the risk country up to 3 weeks before the detection.
- That the disease may not have been detected at all.
- That the disease may not have been reported.
- That the presence of infected wild boars increase the probability of infection in the domestic pigs, proportionally to the area shared by both species in the risk country.
- The estimations of within-herd and between-herd prevalence.
- 4 introduction pathways:
 - o Imports of live animals to farm
 - Imports of live animals to slaughterhouses
 - Imports of animal products for reproduction (ova, semen, embryos, etc.)
 - Human movements via flight, taking into account (as risky):
 - The potential presence of farmers in a flight to Belgium
 - The potential presence of hunters in a flight to Belgium
 - The potential presence of infected meat in a flight to Belgium
- The number of animals imported and the number of incoming movements (trucks)
- The estimation of the proportion of farmers in the population of the country at risk.
- The estimation of the proportion of hunters in the population of the country at risk.
- The estimation of the proportion of infected meat in the country at risk.

Please look at the official final report of the RT 18/2 MORISKIN project for the detailed explanation, with equations, of the probability of introduction. The annex 1 provides a schematic view of this computation.

7. How to interpret MORISKIN's risk outputs?

The risk provided in the "Risk Assessment tab" is the probability that at least one animal or person coming in Belgium from a risk country carries the pathogen. This probability is computed per week, so a probability of 0.25 is very high and means that there is 25% of chance that the pathogen enters the country this week. You can also compute 1/probability to obtain the number of weeks after which you should expect to have one entry of the pathogen: in this example it could occur after 4 weeks if this probability of 0.25 remains the same during the whole period.

Nevertheless, even if MORISKIN provides a quantitative risk expressed as a probability, this computation only takes into account a limited number of parameters and pathways of introduction. For this reason, the risk assessor should not only be interested in the high risk values but also in the evolution of the risk over time, and especially in the increased risk.

8. ANNEX 1 : Schema of the calculation of the weekly risk of introduction of ASF from 1 risk country to Belgium

Schema of the calculation of the weekly risk of introduction of African swine fever (ASF) from 1 risk country "C" to Belgium:

