

Risk Mapping for HPAI H5N1 in Africa  
Improving surveillance for bird flu

## Overview of the Bird Flu Risk Mapping Project



March 2009



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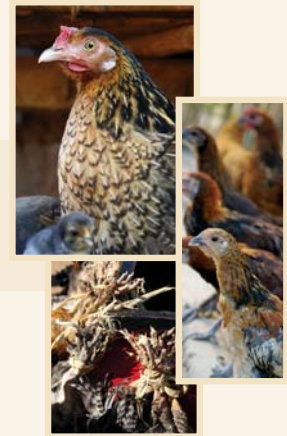
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## What is a risk map?



A risk map is a complex, computer-generated image that shows the spatial distribution of the predicted risk of a disease. It is based on the spatial distribution of “risk factors” — things influencing the occurrence of the disease, such as the location of main transportation routes and wetlands — and the relative importance of each of these risk factors.

Risk maps are increasingly used in both human and veterinary epidemiology.

### Why map the risk for HPAI H5N1 in Africa?

Bird flu is common in many countries and usually self-limiting. However, one strain in particular — highly pathogenic avian influenza H5N1 (or HPAI H5N1) — has proved extremely contagious in poultry and other birds and has also infected humans. Epidemiologists fear that, in addition to having a devastating impact on the poultry sector, this virus strain could mutate into one that spreads from person to person like the common cold — with deadly consequences.

The HPAI H5N1 virus can move from one country to another either through migration of wild birds, or via the legal or illegal trade of infected poultry and eggs. Thus there are many potential pathways for the introduction of HPAI H5N1 into a country, and for its spread once introduced.

More than 85 percent of rural African households raise backyard poultry. Should a virulent strain of bird flu hit the continent, millions of people could lose a vital part of their livelihood as well as a major food source.

In all the documents presenting the work conducted under this risk mapping project, the term “bird flu” always refers to HPAI H5N1.

The risk maps produced as part of this project will help to identify 1) where bird flu is most likely to enter a given region or country, and 2) where it has more potential for spread once introduced.

## Summary

### What can bird flu risk maps do for decision-makers?

- Show the locations where bird flu outbreaks are more likely to occur
- Provide a tool that—*in combination with ground-truthing and other tools*—alerts animal-health specialists to areas vulnerable to the introduction and spread of bird flu
- Help allocate resources for surveillance and manage plans by highlighting high-risk areas

### What can risk maps NOT do?

- Take into account all variables that influence bird flu introduction and spread, especially human practices and beliefs
- Be more reliable than the data on which they are based
- Indicate how best to manage the disease if it arrives.

## How can risk maps help prepare for or manage bird flu?

Veterinary services usually have scarce resources for surveillance and are thus unable to check for disease everywhere at all times. Therefore it makes sense to focus surveillance efforts on places where an outbreak is most likely to occur.

Combined with other tools and assessed critically, risk maps can help policymakers target surveillance activities and prepare management plans for disease control.





## Can risk maps tell us where bird flu will occur next?

Risk mapping is only one tool in the complex effort of risk management. Although based on the best data and calculations we have, the maps will not be an oracle! They show only where outbreaks are more LIKELY to happen. They must be used in conjunction with other tools such as risk assessment and local knowledge.

## What can a bird flu risk map NOT show?

Many economic, social and cultural influences (informal trade, how people live with and manage chickens, hygiene, cooking habits, and traditional beliefs) can have an impact on the course of a disease. However, for the most part such influences are difficult to map. In addition, some of the mappable data are themselves incomplete or out of date, leading to inaccuracies.

## Can risk maps be improved over time?

The risk mapping team is working hard to refine, verify and combine the risk factor data. In addition, epidemiologists will train networks of animal health specialists in how to improve surveillance for bird flu, including how to distinguish it from other diseases. Over time, as our understanding of the epidemiology of bird flu improves and more accurate and up-to-date data is collected, the risk maps can and will be refined and enhanced.

## Who is conducting the bird flu risk mapping project for Africa?

Project partners include the U.S. Agency for International Development (USAID), the International Livestock Research Institute (ILRI), the African Union - InterAfrican Bureau for Animal Resources (AU-IBAR), regional animal health centres, and other national animal health services and veterinary authorities throughout Africa and abroad.

The risk maps will represent the work of dozens of people—biologists, geographers, cartographers, Geographic Information



System (GIS) specialists, veterinarians and animal health specialists, epidemiologists, farmers, and government officials at all levels.

What products will the risk mapping project provide?

- 1) The **Initial Bird Flu Risk Map Report**, which explains the methodology in depth and features
  - The results of a literature search on what is known about risk of bird flu in Africa
  - 9 “risk factor layers”—maps that show the spatial distribution of risk factors—but not the relative importance of each. The layers are not to be used for estimating risk scores. They are a step toward...
  - A dozen “risk maps,” for the continent and five key areas: West, East, and Southern Africa, plus Nigeria and Uganda. Each combines the risk factor layers, and indicates relative level of risk by location.
- 2) The **Final Bird Flu Risk Map Report** will feature a state-of-the-art atlas of risk maps that have been validated and improved through field work, an experts’ workshop, and newly available data.
- 3) In addition **training briefs** and other shorter documents for specific audiences will be produced.

## How are the risk maps being created?

Here is the basic process for the creation of knowledge-driven risk maps:

### 1) *Identify risk factors for disease introduction and spread*

Researchers surveyed all relevant scientific papers to identify geographic, demographic and other mappable risk factors associated with the introduction and spread of bird flu in Africa. These include:

- Wetlands, lakes and rivers where migrating birds rest or breed
- Ports, airports and major roads where poultry is transported
- Markets and major cities where poultry is sold and consumed
- Rural and urban areas where people raise poultry either in their yards or on farms.

### 2) *Map risk factors*

Researchers sourced maps for each of the identified risk factors and created a “layer” to use in the final risk map. Layers show, for instance, transboundary highways, ports, density of poultry, and locations of water bodies. Some of these layers show factors that increase the risk of disease introduction and others show factors that increase the risk of disease spread.

The risk-factor layers are based as much as possible on maps and other information in the public domain—sources freely available to national and local researchers. It turns out, though, that this information varies widely in accuracy and detail. Therefore the layers vary in reliability, too, as will the final risk maps.

### *3) Determine relative importance --“weight”-- of risk factors*

A given risk factor may matter more than others. And where risk factors overlap, risk heightens. For instance, an area with chicken farms located near a lake where wild geese nest will be more vulnerable than an area with just chicken farms or just wild geese. Risks will be carefully analyzed and weighted.

### *4) Create initial risk maps by combining the risk-factor layers, taking into account their relative importance*

Using complex computer calculations, mappers overlaid the risk factor maps, calculating the degree of risk for each spot or “pixel” on the map (See Figure 1 on page 9).

These maps, in which a risk score is shown visually for each pixel, are the initial risk maps. They show areas at lower to higher risk, for both introduction and spread—for the African continent, three sub-regions, and two individual countries.

*Note: This is the current stage of the project. The initial risk maps have been used to assemble the Initial Bird Flu Risk Map Report.*

### *5) Add improved data, validate and refine to create second-generation risk maps*

Geographical data will be refined and cross-checked with information from the field.

Information derived from expert workshops, extensive consultations and field surveys will be incorporated into the maps. Results will be validated with local and international experts.

Feedback and updates will be solicited from all those involved or interested in the Bird Flu Risk Mapping Project. The project team will welcome your observations and thoughts!

The second-generation risk maps will be used to assemble the Final Bird Flu Risk Map Report.

*For more information, or to participate in the project, contact:*

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Building process of a risk map (Figures 1a and b)

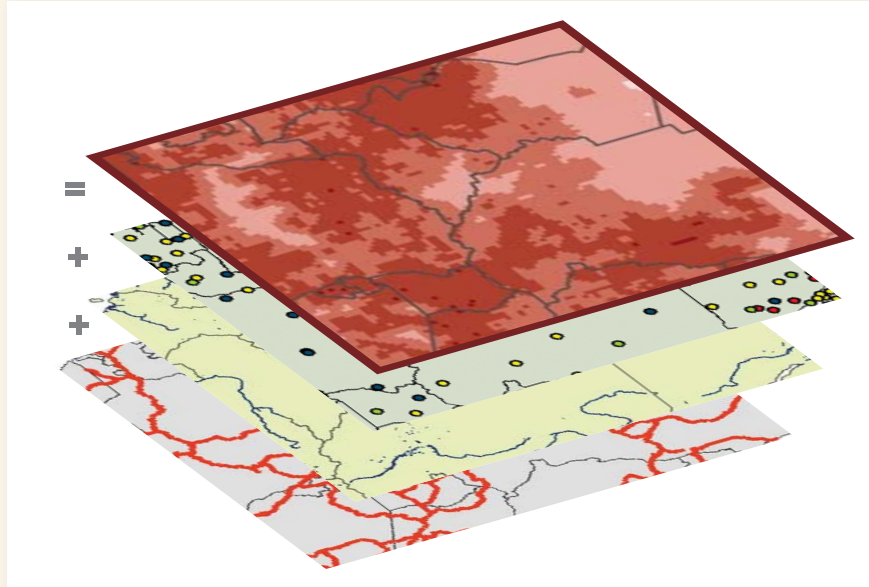


Figure 1a: Building process of a knowledge-driven risk map. The spatial distributions of the different risk factors (bottom three layers) are combined in order to produce the risk map (topmost layer).

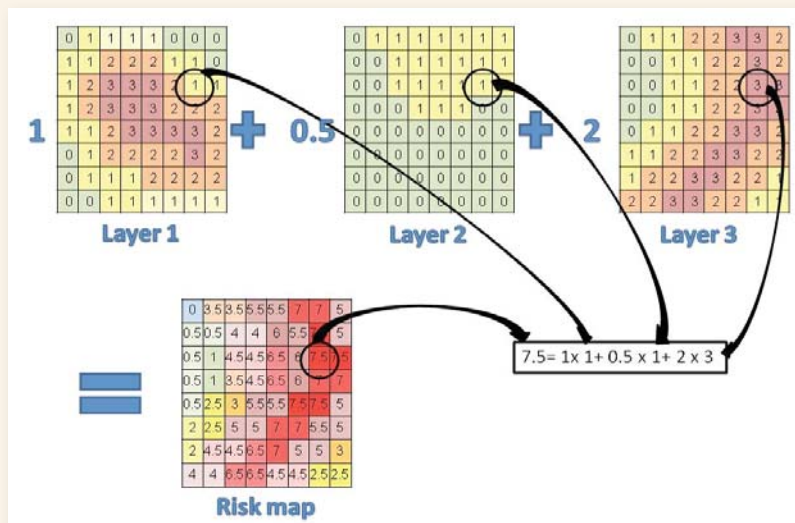


Figure 1b: Building process of a knowledge-driven risk map. For each pixel of the area considered, the risk score of all risk factors are combined according to their relative importance, resulting in an overall risk score for each pixel of the risk map.

## Glossary

- Introduction:** A first outbreak of the disease in a given country or region. As opposed to “spread” see below.
- Risk:** The likelihood that an unwanted event will occur. In this case, the likelihood that an outbreak of HPAI H5N1 virus will occur in a particular area.
- Risk factor:** Something known to be associated with this unwanted event. For bird flu, risk factors include geographical features such as water bodies and roads, plus economic, social and cultural factors such as how poultry are traded, raised and cooked, and how sick birds are handled. Social and cultural aspects cannot be mapped—one of the reasons a risk map can never be completely accurate.
- Risk-factor layer:** A digitized map indicating the spatial distribution of one risk factor. Multiple risk-factor layers are combined to create one risk map.
- Risk management:** Process of evaluating policy alternatives to prevent or contain an outbreak, as well as implementing, monitoring and reviewing the policy selected. The process relies on different analyses such as risk assessment, cost-benefit analysis or risk mapping. Risk mapping can aid risk management by showing where it is most vital to implement prevention measures or prepare emergency plans.
- Risk map:** A digital map showing the variation in relative risk of disease for a given country or region, providing a risk score for any point on the map. Data-driven risk maps show absolute risk estimates whereas knowledge-driven risk maps show relative risk scores (they identify areas at higher or lower risk of disease occurrence). While useful, a risk map needs to be used in conjunction with other types of tools for assessing the risk of disease (risk assessment, disease modelling, etc.). Risk mapping is only one tool in the arsenal of disease risk management.
- Spread:** The progress of an outbreak if not contained. Risk factors for spread may differ from those for introduction.









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