Framework for the evaluation of the spatial factors that influence the quarantine station and exporting farm performances in China

Authors: Nicola Ferrè[1], Qiu Songyin[2], Matteo Mazzucato[1]

[1] Istituto Zooprofilattico Sperimentale delle Venezie, Legnaro (PD), Italy
[2] Chinese Academy of Inspection and Quarantine, Beijing, China

Table of Contents

Sommario

Credits

This document has been produced in the framework of the OIE Cooperation Project “Capacity development for implementing a Geographic Information System (GIS) applied to surveillance, control and zoning of avian influenza and other emerging avian diseases in China”.

Framework for the evaluation of the spatial factors that influence the quarantine station and exporting farm performances in China

Related documents

The present document originates from the elaboration of the following documents:

- GIS applications to support entry-exit inspection and quarantine activities
  Authors: Nicola Ferrè, Qiu Songyin, Matteo Mazzucato, Andrea Ponzoni, Paolo Mulatti, Matteo Morini, Ji Fan, Liu Xiaofei, Dou Shulong, Lin Xiangmei and Stefano Marangon
- A pilot study to evaluate the spatial factors that affect the status of biosecurity in quarantine station and exporting farm in China
  Authors: Nicola Ferrè and Qiu Songyin

Terminology

Candidate facility

A farm or a quarantine station that has submitted the request to become an exporting farm or a quarantine station.

Constraint

A factor that includes or excludes the related POI impact in the calculus of the total impact.

Impact

The effect that the presence of a POI in the study area produces in the evaluation process of the Candidate facility performance.

Performance

The capability of a Candidate facility of reducing or even eliminating the threat of introducing diseases in an area.

POI (Point Of Interest)

Facility that exposes or is exposed to a risk of infection or contamination due to the presence of a Candidate facility located nearby.

Quarantine station

An establishment under the control of the Veterinary Authority where animals are maintained in isolation with no direct or indirect contact with other animals, to ensure that there is no transmission of specified pathogen(s) outside the establishment while the animals are undergoing observation for a specified length of time and, if appropriate, testing and treatment [ref. OIE - Terrestrial Animal Health Code].

Total impact

The cumulative effect of the whole POI impacts in the study area.

WebGIS

A technology that is used to display and analyse spatial data on the Internet. It combines the advantages of both the Internet and GIS. It offers the public a new means to access spatial information with no need of expensive GIS software.

Framework for the evaluation of the spatial factors that influence the quarantine station and exporting farm performances in China

1. Introduction

The CAIQ GIS office is in charge of the evaluation of the requests about the candidate facility. The candidate facility evaluation encompasses several factors such as:

- physical or spatial factors that affect the status of biosecurity in a compartment;
- infrastructural elements;
- biosecurity issues.

At present, the analysis of physical or spatial factors is based on a process that exploits a desktop GIS software, a set of spatial data acquired by a private company (this set of data presents information on the spatial location of POI and, under certain circumstances, the type of activities), and a set of information collected by means of a survey performed by the GIS coordinator (this survey has been performed for a limited number of candidate facilities). The analysis of the available data is based on a visual spatial analysis. To improve the reliability of the spatial analysis outcomes, a framework based on the adoption of a webGIS to collect data, a process for field data collection made by the local CIQs and a spatial analysis based on Multi Criteria Method are proposed.

1.1 Purpose of Document

Proposal of a framework dedicated to the evaluation of the spatial factors that influence the candidate facility performances.

The proposal consists of a master plan that describes the constitutive elements to perform the risk analysis related to the spatial factors that influence the performances of the candidate facility.

2. Master Plan

The framework for the evaluation of the spatial factors that influences candidate facility's performances is based on the following elements:

1. webGIS tool for the collection of the candidate facility or POI's spatial/non-spatial information;
2. protocol for the editing of the candidate facility spatial information made by the local CIQ operator;
3. protocol for POI detection and the collection of related data made by the local CIQ operator;
4. protocol for the analysis to evaluate the spatial factors that influence the candidate facility's performances and the Exporting Farm risk evaluation.

2.1 WebGIS tool

The webGIS tool is used by the local CIQ to edit the spatial information and the related relevant characteristics of:

1) candidate quarantine farms;
2) POIs that surround the candidate facility and Exporting Farm.

The webGIS allows the collection of the coordinates by means of two methods:

1. Indirect. The indirect method consists of marking the place directly in the map. The local CIQ by looking at the map presented by the webGIS is able to recognise the candidate facility, or POI facility/ies. He/she uses the webGIS mark tool to place a point in correspondence of the facility/ies.
2. Direct. The local CIQ records the coordinates of the candidate facility, or POI facility/ies by means of a GPS and then he/she edits the point in the webGIS at the duty station.

The webGIS allows to edit the non-spatial data related to the candidate facility, or POI in the webGIS while he/she performs the survey on-site (this option requires a mobile device). The webGIS allows also to edit the collected information once the operator returns to his/her duty station.

The list, the meaning and characteristics of non-spatial data related to the candidate facility, or POI are illustrated in the "webGIS user manual".

2.2 Candidate facility data collection

A well-defined protocol for the candidate facility data collection integrated with the webGIS tool is illustrated in the “webGIS user manual”.
The protocol has the purpose:

1. to define the sequence of steps that a local CIQ should follow in order to georeference the candidate facility;
2. to collect the required non-spatial data;
3. to inform the CAIQ GIS expert of the new request.

2.3 POI data collection

A well-defined protocol for the POI on-site data collection integrated with the webGIS tool is illustrated in the “webGIS user manual”.
The aims of the protocol are:

1. to define the sequence of steps that a local CIQ should follow in order to detect POIs surrounding the candidate facility;
2. to collect the relevant data for the detected POI.

The method for the detection combined the visual target detection method with the surface survey one. The visual target detection aims to detect possible POIs by means of an image made available by the webGIS. Once the local CIQ has detected a possible POI, he/she plans the route to reach the identified location. The design of the route should consider to cover as much as road surrounding the candidate facility as possible (unsystematic survey). Along the path, every time he/she recognises a POI (POI that was not possible to recognise form the aerial image or he/she reaches one of the targeted POI) he/she stops the vehicle and performs the identification of the POI and the related data collection.

This protocol requires the availability of route map and background maps in the webGIS tool.

2.4 Spatial Data analysis

The data collected by the local CIQ are stored in a centralised geodatabase. The CAIQ GIS experts use these data to perform the spatial data analysis. The spatial data analysis consists of three elements:

1. protocol to perform the explorative spatial data analysis.
   This phase aims to perform the preliminary evaluation about the presence of POI on orographic elements that have a high impact on the evaluation of the candidate facility performance according to the defined standards;
2. protocol to arrange the collected data and to perform the total impact calculation for the exporting farm. The main outcome of this protocol is the calculation of the total impact value;
3. protocol to embed the spatial analysis outcome in the risk analysis.

2.4.1 Protocol to perform the explorative spatial data analysis for the candidate facility

The purpose of the Explorative Spatial Data Analysis (ESDA) is to identify the presence of critical POIs in the study area and the major orographic elements that can influence the candidate facility performance within the 10Km radius.
The presence of the critical POIs are determined by a sequence of GIS functions. The presence of any critical POIs nearby the candidate facility leads to reject the request.

The presence of orographic elements that can have an influence on the candidate facility (i.e.: river, lakes, major road, mountains, etc.) are detected from the spatial ancillary data that are uploaded in the GIS project. Specific ESDA (Exploratory Spatial Data Analysis) will be defined once the spatial ancillary will be identified and integrated in the process.

2.4.2 Protocol to arrange the collected data and to perform the total impact calculation for the Exporting Farm

The data collected by the local CIQ about the POIs are used to calculate the cumulative influence of the POIs on candidate facility performance. The data must be extracted and stored in a dedicated excel file by using a well defined sequence of GIS functionalities.

The impacts of the POIs in the area surrounding the candidate Exporting Farm are calculated by means of a series of operation that are already uploaded in the excel file. The sequence of operation is based on the SAW (Simple Additive Weighted) method that is described in the “Spatial decision support systems for risk analysis of the Exporting Farm” (Annex 3 - Spatial decision support systems for risk analysis of the Exporting Farms in China).

The result of this phase is the calculation of the total impact value for the candidate Exporting Farm.

2.4.3 Protocol to embed the spatial analysis outcome in the risk analysis

This final step of the framework aims to organise the documents produced during the previous phases and to provide a report organised with the following elements:

1. Set of maps of the candidate facility area;
2. Brief description of the orographic elements with a specific judgment about the possible influence of elements that can affectthe candidate Exporting Farm performance;
3. In case of presence of critical POIs in the study area, brief description of the detected POIs and evaluation of that presence with respect to the distance from the candidate Exporting Farm;
4. Brief report that describes the outcome of the Total impact value with an evaluation of the obtained value with respect to the “accept/reject scale value”.