

Animal health and emerging diseases

A "poultry motorcycle"
near Hanoi, Vietnam.
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Animal health and emerging diseases

Meeting the challenge of the acceleration in emerging diseases

Animal health organisations are today confronted with an acceleration in the emergence, or re-emergence, of animal and human diseases which are often responsible for economic crises widely reported in the media. Environmental changes and the growth in cross-border exchanges mean the health risks concern every country in the world and transcend the North-South divide. CIRAD is therefore using its experience of tropical animal diseases to control these emerging diseases.

Research for forecasting, surveillance and control

Understanding the cycles of transmission makes it possible to develop models targeting the zones and periods of risk and therefore to forecast incidents likely to affect health. Rapid diagnosis and monitoring of pathogens, exploiting the genetic basis of tolerance or resistance of hosts to infections, control of vectors and the development of suitable vaccines form part of the range of tools that can be used in control strategies.

Reinforcing health networks

Epidemics do not respect borders. Therefore CIRAD contributes to the organisation of international surveillance networks which involve all stakeholders, from national veterinary services through to research. For developing countries, reinforcing the animal health networks contributes to the fight against poverty and helps boost food security, economic development and scientific capacity.

From knowledge of emerging ani

Understanding the cycles of transmission of diseases

Livestock farming plays a central role in the economy and culture of developing countries; in fact, 73% of the world's livestock is found in developing nations. Growth in the human population is accompanied by an increase in the livestock population. New forms of production, food processing and consumption are established in which animal proteins play a major role. The pressures on ecosystems and urbanisation multiply the contacts between humans, domestic animals and wildlife. The globalisation of trade and environmental changes open new niches for vector populations and pathogens. CIRAD's work aims to:

- Understand the relationships between pathogens, their vectors, their hosts and ecosystems
- Analyse and model the dynamics and risks linked to contacts between wildlife, domestic animals and humans
- Integrate concerns about animal health into conservation and development projects involving rural populations
- Implement management methods which are appropriate and compatible with the health of ecosystems

Monitoring the evolution of pathogens, vectors and infected animals

CIRAD studies the genetic diversity of pathogens, vectors and hosts to better understand how they adapt to selection pressures and to detect them.

- Monitoring the diffusion and distribution of pathogens and their vectors
- Identifying the genes involved in the capacity of micro-organisms to either escape the defences of their hosts or to stimulate them
- Characterising the tolerance mechanisms of hosts to diseases
- Understanding the evolution of pathogenicity
- Developing diagnostic tests

Higher education and distance learning

Masters

- Masters *SAEPS, Santé animale et épidémiologie dans les pays du Sud (Animal health and epidemiology in developing countries)* (CIRAD, National Toulouse Veterinary School, Montpellier 2 University), France
- Masters *SEMHA, Surveillance épidémiologique des maladies humaines et animales (Epidemiologic surveillance of human and animal diseases)* and *CES d'Epidémiologie animale (Animal epidemiology)* (CIRAD, National Maisons-Alfort Veterinary School, Paris XI and Paris XII Universities), France
- *MIE, Master International d'Entomologie médicale et vétérinaire (International Masters in medical and veterinary entomology)* (Institut de Recherche pour le Développement, Université Montpellier 2, France ; Institut Régional de Santé Publique, Abomey-Calavi University, Regional Center for Entomological Researches of Cotonou, Benin)

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Distance learning in epidemiology

The RANEMA platform (Refresher course in animal disease epidemiology) was developed with the National Maisons-Alfort Veterinary School, and financed by the French Ministry for Foreign and European Affairs. It offers versions in different languages (English and French, an African/Asian/Caribbean version) and different materials (training modules for use in semi face-to-face sessions). A module financed by the FAO is dedicated to H5N1 bird flu, another contains basic statistics on epidemiology and a new module is being built with the OIE.

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How to control animal diseases

Designing new vaccines

Not all individuals react in the same way to the same pathogen. This is true both for the same species and for one species to another (for example, avian species and the transmission from animals to humans). Lethal diseases, chronic infections, the absence of clinical expression and the elimination of pathogens are the range of possible host responses to the same pathogen. This wide range has consequences for vaccinology.

- Studying the different responses to pre-identified antigens and the systems used to deliver these antigens to animals
- Developing new vaccines
- Evaluating vaccination strategies for disease control

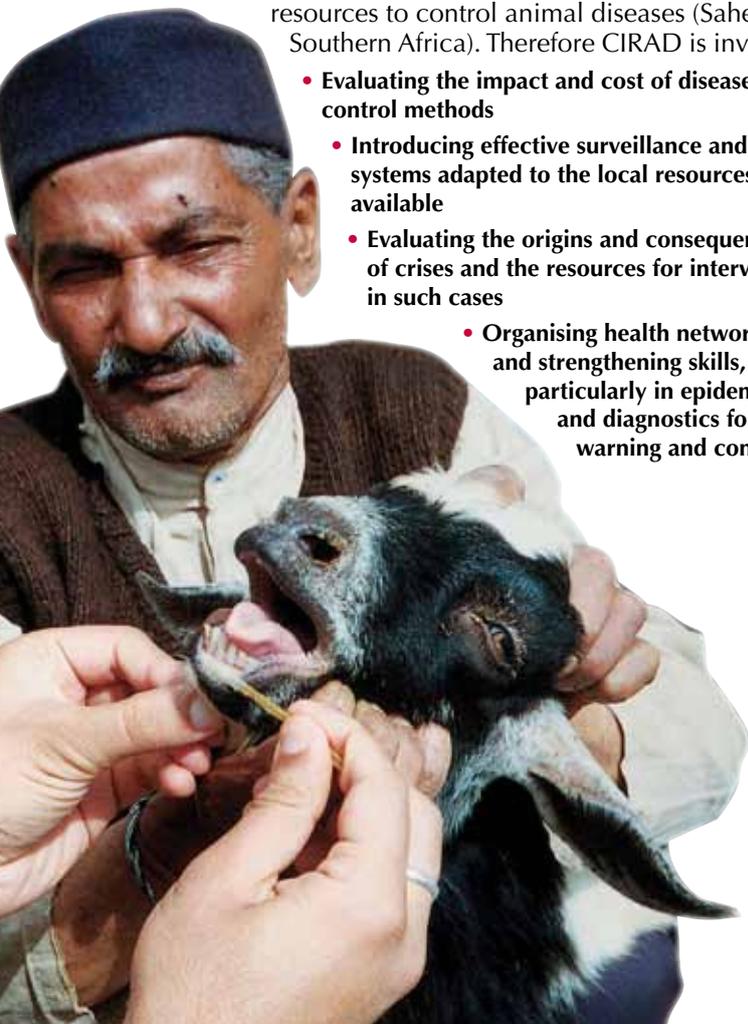
Developing research and surveillance networks

The role of animal health surveillance networks (observatories) is to identify and evaluate the health risks which could hinder the economic development and food security of developing countries. CIRAD develops research and training courses, and conducts expert assessments for:

- Implementing and improving surveillance systems
- Ensuring better diagnosis for animal diseases
- Facilitating the exchange of information on animal health

Primarily CIRAD works in partnership with local institutions, in specific regions with a high risk of disease emergence, such as highly anthropised areas (Caribbean region, Indian Ocean, urban and peri-urban zones in South-east Asia) and/or areas lacking the resources to control animal diseases (Sahelian and Southern Africa). Therefore CIRAD is involved in:

- Evaluating the impact and cost of diseases and control methods
- Introducing effective surveillance and control systems adapted to the local resources available
- Evaluating the origins and consequences of crises and the resources for intervention in such cases
 - Organising health networks and strengthening skills, particularly in epidemiology and diagnostics for early warning and control



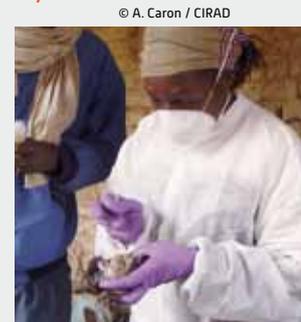
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Gripavi Project > Ethiopia, Mali, Madagascar, Mauritania, Zimbabwe, Vietnam

(Funded by the Ministry of Foreign and European Affairs, 2007-2011)

This project uses six observatories in Africa and South-east Asia to improve knowledge on the ecology of bird flu (emergence, spread, endemism) and of Newcastle disease, to generate recommendations, introduce decision support tools for the surveillance and control of these diseases and to improve the competencies of veterinary services and laboratories.

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REVASIA programme > Europe, South-east Asia

The objective of REVASIA is to study the methods and evaluation tools in surveillance systems for bird flu. The project will make it possible to choose between the most relevant methods and the best adapted tools in the context of different countries (Europe, South-east Asia): probabilistic modelling, capture-recapture, multi-agent modelling.

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EDENext project > Europe, Turkey, Senegal (Funded by the EU-FP7, 2011-2014)

Following EDEN, which targeted the effects of environmental change on emerging vector-borne diseases (mosquitoes, ticks etc.), EDENext is focusing its research on understanding cycles of transmission in order to offer prevention strategies adapted to populations exposed to these risks. It has a particular focus on the social and economic factors which favour disease outbreaks.

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ATP Emergence > Mediterranean

(Funded by CIRAD, 2011-2013)

Emerging animal and plant diseases are at the centre of this multi-disciplinary project which seeks to characterise emergence and responses to crisis situations (Which diseases? Where and how? Who does what?), to contribute to the creation of models and scenarios, to improve the efficacy of disease surveillance networks and prevention strategies, notably through analysing the behaviour of the actors involved.

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Varied, top-level outputs

> CIRAD is a **collaboration centre** and centre of reference for both the FAO and OIE in animal health.

> It is the **contact point in southern Europe** for the VBoNet surveillance network for vectors and vector-borne diseases of the European Centre for Disease Prevention and Control (ECDC), and a member of the European network ArboZoonet (FP7 2008-2011) (West Nile fever, Rift Valley fever, Crimea-Congo haemorrhagic fever).

> It provides numerous **professional training courses and degrees and assists students** in partnership with universities and national veterinary schools in France, Asia and Africa.

> Its researchers publish in **reference journals** such as *Behavioral Ecology*, *Journal of Applied Ecology*, *Emerging Infectious Diseases*, *Epidemiology and Infection*, *Genetics and Evolution*, *Journal of Veterinary Medicine and Animal Health*, *Veterinary Parasitology*, *PLoS Neglected Tropical Diseases*, *Vaccine* etc.

> Its researchers regularly organise **world conferences** such as *Emerging diseases in a changing European environment* in Montpellier in 2010, or lead sessions, such as during the *International Conference on Animal Health Surveillance (ICAHS)*, *World Veterinary Year (Vet2011)* in Lyon in 2011, the XXX World Veterinary Congress - *Caring for animals: healthy communities* in 2011 in Cape Town and the 2009 *ISVEE, International Society of Vet Epidemiology and Economics Congress* in Durban, South Africa.

> It publishes reference works: *The biogeography of host-parasite interactions* (Editors: Serge Morand, Boris Krasnov, Oxford University Press, 2010), *La surveillance épidémiologique en santé animale / Epidemiological surveillance in animal health* (Editors: Barbara Dufour, Pascal Hendrikx, OIE, 2009).

> For the past 60 years, CIRAD has published *Revue d'élevage et de Médecine Vétérinaire des pays tropicaux*, a scientific review available on open access.

CIRAD's animal health research in numbers

More than **50 years'** experience

More than **100 researchers**

Four research units

Work involving more than **50 countries**

25 regional partnership projects concerned with emerging diseases

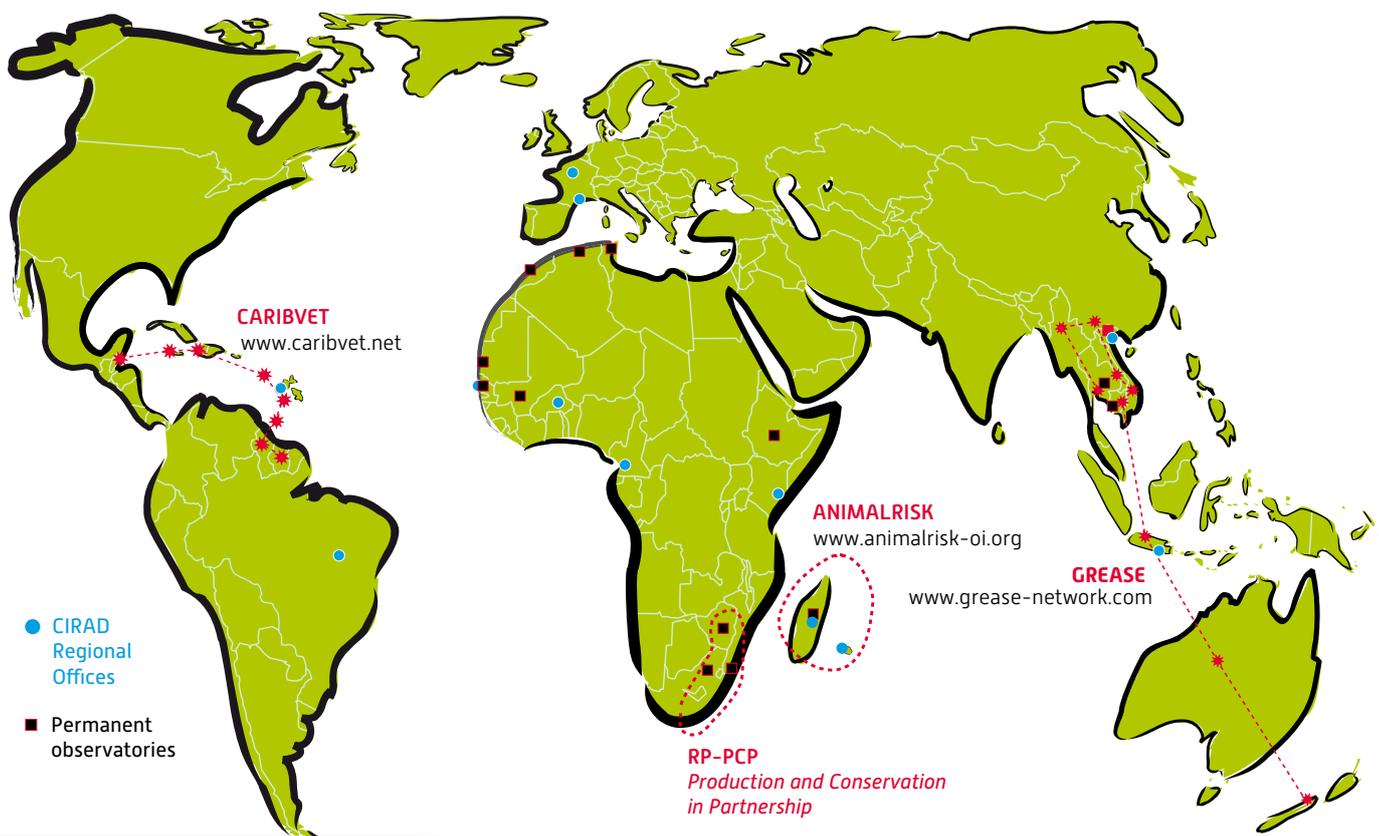
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CIRAD is a founding member of Agreenium, the French national consortium for agriculture, food, animal health and the environment.