One of the biggest constraint of livestock development in Africa and particularly for poor farmers, is animal health. Among the most important diseases (ILRI 2002), we selected diseases and topics according to several criterias:
- economic importance for poor farmers,
- feasibility in a time frame (5 years),
- expertise of IAH and CIRAD,
- “orphan diseases” or diseases for which there is no sustainable funding.

We then focused our proposal on:
- the development of new vaccines against CBPP and CCPP,
- the epidemiology and control of FMD,
- impact of tuberculosis and brucellosis,
- the epidemiology and control of RVF,
- the improvement of diagnostic and epidemiological control of ASF.
- the development of new generation of ASF vaccines,
- emerging diseases.

1 – CBPP - CCPP

Developments in Contagious Bovine Pleuropneumonia (CBPP) and Contagious Caprine Pleuropneumonia (CCPP) research: studies on mycoplasma virulence and protective antigens, host immune response, vaccines, treatments and epidemiology.

**Acronym**
CBPP-CCPP

**Strategic objectives**

- Development of new types of vaccines for CBPP and CCPP
- Development of companion diagnostic tests
- Development and evaluation of new epidemiological tools
- Definition of improved control strategies for CBPP and CCPP in Africa

**Abstract**

Contagious bovine pleuropneumonia (CBPP) is an infectious disease of cattle belonging to List A of the OIE. It is caused by a mycoplasma, *Mycoplasma mycoides* subsp. *mycoides* small colony biotype (MmmSC). CBPP is characterized by the onset of respiratory disorders and conspicuous lesions of pneumonia, pleurisy, sequestra... CBPP has been eradicated in most developed countries by strict slaughter measures. However, the last outbreaks were...
reported in Portugal in 1999. In Africa CBPP was never eradicated and its prevalence is on the increase since international vaccination campaigns against rinderpest, which were combined with CBPP immunisation, ceased. CBPP is now considered the most threatening infectious disease by most African veterinary services. CBPP control strategies may involve various measures such as slaughtering of infected herds, vaccination of cattle at risk and control of animal movements. However, cattle owners often use antibiotic treatments and are reluctant to declare the disease. The failure to control CBPP in Africa, in spite of the use of millions of vaccine doses, calls for renewed efforts in research.

The aim of this CBPP-DEV project is to improve our knowledge on CBPP in order to improve control strategies. This will be achieved through a close collaboration between European and African research centres, which will permit the application of advanced technology from one side (high-throughput sequencing of mycoplasma genome, microarray technology to investigate the host response) and a recognized expertise in reproducing CBPP from the other side. This close association should enable the development and validation of new types of vaccines composed either of adjuvanted, subunit preparations of defined antigens or live, attenuated mutants created by specific knockout of virulence genes. The evaluation of various treatments and diagnostic tests should also be allowed through this collaboration. Epidemiological studies will concentrate on CBPP-tailored tools such as specific surveillance systems, including participatory approaches, and mathematical modelling for strategy evaluations.

Contagious caprine pleuropneumonia (CCPP) is a similar disease that affects goats exclusively. As such, it is often overlooked as goats do not play a major role in the “official” economy of developing countries. However, goat raising is socially very important as it is often the responsibility of women, therefore contributing to the well feeding of children. It is also important in case of drought as the renewal rate of goat herds is faster than for cattle herds. CCPP is caused by a mycoplasma, *Mycoplasma capricolum* subsp. *capripneumoniae* (Mccp) that belongs to the same phylogenetic group as MmmSC, the agent of CBPP. Therefore a comparative study may be more fruitful than a study devoted to only one disease. The development of new multivalent vaccines protecting against the major diseases affecting goats, such as Peste des Petits Ruminants or Heartwater, may be one way to reduce the cost of vaccinations for these animals. Improving the health status of goats would have a major impact on the livelihood in many developing regions in Africa.

2 – FMD

Characterisation of FMD strains and FMD endemic areas in West Africa.

**Acronym**

FMDWA

**Strategic objectives**

- Strengthening of FMD surveillance system
- Identification of primary endemic areas
- Identification and characterisation of FMD strains circulating in West Africa
Abstract

FMD is one of the most contagious disease known affecting cloven-hoofed animals. In 2001, the upsurge of FMD all over the world (South America, South East Asia, Europe and Southern Africa) stressed the importance of endemic areas as major source of propagation of the virus. West Africa is one of these endemic areas but FMD epidemiology in this region is poorly known. As an incentive to set up generic disease surveillance systems the development of FMD surveillance network can have a direct impact for other diseases and then alleviate poverty.

FMD strains are classically divided in 7 serotypes. Within these types, antigenic variations are such that sometimes a strain is different enough to require different vaccine. When they are isolated in a specific place, these strains are called topotypes. Topotypes have been identified at least for serotype O and SAT1 in West Africa but the adaptation of current vaccines to these types is little studied.

The first objective of this proposal is to reinforce the FMD surveillance systems established on the existing networks (e.g. PACE) and more specifically developed on participatory approaches. Using indigenous knowledge, aims are collecting samples in suspected area, measuring the impact of the disease and identifying primary endemic areas.

Primary endemic areas are places where conditions are suitable for a constant maintaining of the infection. Identification of such areas has been a key element for the quasi complete eradication of FMD in South America. Primary endemic areas in West Africa will be identified coupling participatory epidemiology, surveillance systems and spatial analysis techniques.

3 – TUBERCULOSIS AND BRUCELLOSIS

Evaluation of the impact in animal and public health and of the zoonotic risk of tuberculosis and brucellosis in Central and West Africa.

Strategic objectives

- Assessment of the different potential sources of infection with Brucella spp.
- Estimation of the importance of TB in animal health
- Research of brucellosis and bovine TB in wildlife reservoirs
- Assessment of the economic impact (disease and controls) of TB and Brucellosis
- Role of Mycobacterium bovis in the aetiology of tuberculosis in human patients – Evaluation of the zoonotic risks factors linked with the dairy and meat sector.
- Role of Brucella spp. in human fever syndromes – Is the dairy sector a threat for human health?
- Providing to government tools for risk assessment and disease control.

Abstract

Tuberculosis is an economic plague as well as a major zoonosis. Each year 2 million people die from this curable disease. Part of them has been infected by bovine tuberculosis agent Mycobacterium bovis. With the spread of HIV in West Africa tuberculosis become the first
cause of mortality in AIDS patients. The knowledge about the implication of bovine tuberculosis in the human cases has to be developed. The role of the different commodity chains (milk and meat) has to be evaluated.

*Brucella* spp. are intracellular bacterial pathogens that causes a debilitating acute disease and establishes a chronic undulating febrile disease in man. Few studies have attempted to measure infection in the general human population, but a recent study in southern Saudi Arabia showed about 20% of the population had serological evidence of exposure. High-risk groups include those exposed through occupation in contexts where animal infection occurs, such as slaughterhouse workers, hunters, farmers and veterinarians. The first objective is to evaluate the importance of human brucellosis and the economic impact of this disease in the animal sector. Another objective is to determine whether the infections are primarily of food-borne or occupational origin. The identification of previously unrecognized infections in animals which may cause human infections will also be a main part of this research project.

Fields: Uganda; Burkina-Faso/Mali/Senegal.

### 4 – RIFT VALLEY FEVER

**Strategic objectives**

- Implementation or improvement of monitoring tools in endemic countries.
- Identification of key factors underlying process of introduction emergence and spreading, using risk analysis and modelling tools.
- Assessment of the risk of RVF occurrence in endemic and areas at risk.

**Abstract**

Rift Valley fever (RVF) is an acute arthropod-borne zoonosis, due to a virus belongs to the genus *Phlebovirus* of the *Bunyaviridae* family. This virus causes epizootics with hemorrhagic fever or abortion for ungulates (cattle, sheep, camels, goats) and associated human epidemics. It is usually transmitted by several arthropods, the mosquitoes *Culex* and *Aedes* genera being the most widely cited. The disease, which is often unapparent or mild in adult sheep or cattle, may conduct to abortion and death in young animals. During RVF outbreaks, people become infected either by being bitten by mosquitoes vector or through contact with the blood, other body fluids or organs of infected animals. RVF in humans manifests a broad spectrum of disease, from asymptomatic infection to a benign febrile illness, to a severe illness in 1%-3% of cases including retinitis, encephalitis, and hemorrhagic fever.

RVF is endemic in many African countries, with recent dramatic expansion in Saudi Arabia and Yemen during the year 2000. In addition to the human illness, disability, and suffering, RVF outbreaks can result in devastating economic losses when livestock in an agricultural society are affected. This economical impact may be high, with direct losses of live animals, and especially trade restrictions for domestic animals and their products for years. In Egypt, direct and indirect losses during the first outbreak (1977) were estimated to 82 millions of US dollars. More recently, RVF outbreaks in East Africa in 1997-1998 associated with years of unusually heavy rainfall led to ban livestock trading from the horn of Africa (Somalia, Ethiopia) to Arabic peninsula. Losses were estimated to 60 millions of US dollars a year.
RVF epidemiology as a consequence of a combination of many various intrinsic or extrinsic factors is very complex and little is known. In addition, the absence of specific treatments and a safe and efficient vaccine, combined with the lack of high-performance epidemiological surveillance structures, may explain the difficulties for affected countries to forecast the outbreaks and control the disease.

The first aim of this proposal is

(i) to provide some data to understand disease processes in endemic areas
(ii) to develop predicting models of the occurrence and the spreading of the disease.

Epidemiological field researches are then required to identify risk factors of the disease occurrence and to assess the impacts of global or local changes - climate, landscape modification, livestock movements, human activities, vector capacities- on the risk of emergence or re-emergence. Some existing surveillance networks proved their ability to gather information by routine sampling of human populations and sentinel herds in target areas and recurrent RVF serology testing. Thus, the second goal of this proposal is the improvement of national monitoring networks ad the implementation of such networks in threatened areas. Collected data should be implemented in a GIS tool and contribute to the development of predicting models. Finally, it aims to give users and decision-makers a tool for the analysis, prevention and protection against RVF in epidemiological areas potentially at risk.

5 – DIAGNOSTIC, EPIDEMIOLOGY AND CONTROL OF AFRICAN SWINE FEVER (ASF)

Acronym

ASFDEC

Strategic objectives:

- Development and evaluation of new diagnostic and epidemiological tools
- Definition of improved control strategies

Abstract:

The significance of pigs in assuring food security is being recognized especially for the rural poor in Africa. An extensive free-range pig breeding is of a growing importance for the subsistence of village farming in sub-Saharan African countries. During the last decade, small and sometimes bigger commercial pig farms have been developed in urbanized areas. Pigs’ owners are mostly women farmers who play a major role in the feeding and the management.

Outbreaks of African Swine Fever (ASF) have emerged or re-emerged on a regular basis in many African countries since the mid 90s: e.g. Ivory Coast (1996), Benin (1997), Togo and Nigeria (1997-1998), Madagascar (1998), Ghana (1999), Burkina-Faso (2003). Moreover, ASF has been enzootic in Cape Verde Islands and Senegal for many years. The ASF viruses have in these countries decimated most of the traditional and commercial pig farms. The affected countries, which generally could not afford the financial cost of compensation, let the
In order to survey and control the disease, and since there is no available treatment and vaccine, laboratory and epidemiological tools and methods need to be promoted to enhance the early detection/early reaction systems and to restrict the spreading of the disease. Improved and cheap diagnostic tools should be made available to African laboratories. Rapid pen-side and laboratory assays, using dried biological samples, for detection of ASFV and antibodies and better methods for molecular tracing of virus isolates are expected. Accurate field studies are also needed and should be related with genotyping investigations and based on new diagnostic tools. Epidemiological researches are required to describe the occurrence of ASF, to identify risk factors - including the role of the wildlife compartments (soft ticks, wild pigs) - and to support risk analyses and economical studies. Risk analysis including communication processes, as well as economical studies, should provide data and facts to veterinary services and livestock policy makers for a better control of the ASF in Africa.
**6- DEVELOPMENT OF AFRICAN SWINE FEVER VIRUS VACCINES**

**Acronym**

ASFVAC

**Strategic objectives:**

- Development of new generation of ASF vaccines based on genetically attenuated ASFV strains, defective ASF viral particles or recombinant virus vectors
- Evaluation of potency and safety of the candidate vaccines

**Abstract:**

African swine fever (ASF) occurs in many African countries as either an epizootic or enzootic disease. Many recent outbreaks have caused devastating losses to the rural poor as well as in commercial farms. No vaccine is currently available against ASFV. Recently, major advances have been made in understanding the function of ASFV encoded proteins and of the host response to infection (2-10). In addition methods for manipulation of the ASFV genome (2, 11) and vectors based on Aujeszky's virus, which are suitable for delivery of several foreign genes in pigs (12-14), have been developed. Together these advances make the development of a vaccine for control of ASFV a realistic possibility.

Attenuation of ASF viruses will be achieved by the deletion of more than one virus gene. The selection of genes will be based on existing knowledge of virus immune evasion genes and genes known to reduce virus virulence and other late-expressed genes identified as non lethal for the virus by an approach based on RNA interference.

The second approach will be to construct defective strains of ASFV which do not produce infectious progeny virions.

The third approach will be to use a virus vector to introduce genes encoding four ASFV proteins. The Aujeszky’s vector is one the candidates for this approach.

Candidate vaccine strains will be used to inoculate pigs to test their pathogenicity and their ability to protect pigs from challenge with different virulent strains of virus.

The ability of vaccine strains to be transmitted to and replicate in Ornithodoros moubata ticks will be determined as well as transmission from pig to pig. These analyses will establish which of the candidate strains are the most promising for further investigation including larger scale challenge experiments.

**7- EMERGING DISEASES**

Over the past few years, several infectious diseases affecting animals and/or humans have emerged in regions far from their traditional endemic areas. At the same time, some critical
vectorial diseases are in extension or intensification in tropical countries. These emerging
dynamics can be regarded as consequences of global change and modifications in ecosystems
condition. Changes in the distribution and abundance of insects are likely to be amongst the
most important and immediate effects of climate change. Locally, human growing
populations, evolution in agricultural practices, land use and new activities change the
landscapes and insects’ habitats and affect the epidemiological patterns. Opening up of
borders, liberalisation of exchanges and an increase in contacts and movements of humans
and animals for commerce and tourism are breaking down the ecological, physical and
regulatory barriers which had limited the spread of pathogens. Finally, in some countries, the
lack of high-performance epidemiological surveillance structures, the degradation of research
and health systems considerably increases the risks of introducing or spreading these diseases
in naive countries.

Innovative tools (GIS, models, remote sensing data), multidisciplinary and integrated
approach, co-ordinated international collaborations are deployed to inventory the most likely
hot-spots, propose predictive scenarios and promote surveillance and early warning tools.
Integrated project gathers the main partners in North and South countries are needed to face
this new challenge.