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INSIDE

FOOT-AND-MOUTH DISEASE IN THE UNITED KINGDOM

One month after the first cases had been recognized on 19 February 2001, the United Kingdom's first large-scale outbreak of foot-and-mouth disease since 1967 had spread across the whole country. This disastrous outbreak has followed a period of several years in which the highly contagious livestock disease has been on the increase worldwide. Several countries that had been free of the disease for considerable periods of time suffered outbreaks in 2000 (see page 8).

RINDERPEST ERADICATION IN THE SUDAN – THE WAY AHEAD

Rinderpest control in the Sudan has reached a point where eradication can be envisaged as feasible in the near future. The Sudan should now consolidate and build on the progressive control of rinderpest achieved so far by embarking on the final eradication thrust. Eradication is not that much more demanding than control but it does require a different mindset. Given commitment to the objective by all concerned, it is likely that the goal of eradication could be achieved rapidly – well within two years (see page 2).

VECTOR-BORNE DISEASES CAUSE CONCERN IN THE MEDITERRANEAN BASIN

Recent outbreaks of disease caused by bluetongue and West Nile virus have given rise to concern that their threat might be increasing in the Mediterranean Basin (see page 14).

RINDERPEST

Rinderpest eradication in the Sudan – the way ahead

It is now generally recognized by rinderpest epidemiologists that, when it comes to these situations of stable endemic persistence, rinderpest eradication only really commences once mass vaccination is abandoned.

Background to the current rinderpest situation in Africa

Routine vaccination programmes throughout Africa have undoubtedly served to protect large numbers of cattle from the effects of rinderpest and reduced the incidence of the disease over many years. In many countries this was sufficient alone to interrupt virus transmission. However, control programmes based on routine vaccination have failed to eliminate a small number of residual foci of endemic rinderpest infection which persisted throughout JP15 (Joint Project 15 – the first internationally coordinated attempt to rid Africa of rinderpest) and afterwards. Following JP15, in the 1980s, in what is sometimes referred to as the second great African pandemic, rinderpest virus from the Sudan spread through Central Africa to West Africa, to meet up in Nigeria with rinderpest virus spreading eastwards from an endemic focus in the pastoral herds of Mauritania and Mali. Much of sub-Saharan Africa was devastated by the pandemic. Since that time, large areas of West Africa, for example, have been cleared of rinderpest with the last known outbreaks occurring at the Burkina Faso/Ghana border in 1988. However, the reservoirs of infection in eastern Africa have proved more difficult to eliminate.

It is now clear – as demonstrated again by the Pan-African Rinderpest Campaign (PARC) of 1986 to 1999 – that routine, annual, mass vaccination programmes cannot be relied on to eliminate rinderpest from its last strongholds in extensive pastoral communities. This is partly related to the dynamics of the livestock populations in which the virus persists, but it is also a factor of the remoteness and relative inaccessibility of at least a proportion of the population involved. In these circumstances, it is extremely difficult to generate a broad herd immunity level exceeding 70 percent; 60 percent or even far less is usual. This depresses the impact of the disease but also serves to maintain a situation of endemic persistence within which the virus may be difficult to detect for much of the time.

Experiences in other countries, and most notably in Ethiopia, serve to illustrate how this situation of endemic persistence can be overcome. Despite maintenance of annual vaccination campaigns that reached up to one-third of the entire cattle population each year, rinderpest occurred continuously in Ethiopia into the 1990s. Epidemiological studies in the early 1990s demonstrated a pattern of epidemic extensions of rinderpest from endemic reservoirs of infection that were based in extensive and remote pastoral communities. Recognizing the implications, an innovative approach has been implemented by PARC-Ethiopia since 1993. The approach taken was to cease annual routine vaccination in areas that served only as epidemic indicator areas of infection elsewhere. Instead, efforts were concentrated on intensive vaccination of the herds in which the virus was persisting, employing a combination of conventional and community participatory programmes, and on strengthening early warning (based on surveillance) and ensuring early reaction to rinderpest outbreaks. The strategy was tested rigorously during 1994 when an epidemic of rinderpest occurred in the highlands. Although it took more than six months to arrest, its spread was relatively slow and caused little real damage, even though it moved into Eritrea. Despite this setback, within two years rinderpest was eradicated. Similar experiences from other countries reinforce the lessons learned in Ethiopia.

It is now generally recognized by rinderpest epidemiologists that, when it comes to these situations of stable endemic persistence, rinderpest eradication only really commences once mass vaccination is abandoned.

Current status of rinderpest in the Sudan

In recent years, concerted action by all organizations providing veterinary services in the Sudan has markedly reduced the incidence and distribution of rinderpest and has made significant progress in clarifying the rinderpest epidemiological situation. The last confirmed outbreak occurred in Eastern Equatoria State in mid-1998 and was confirmed to have been caused by Lineage 1 (Africa) rinderpest virus (sequenced at the FAO/ International Office of Epizootics [OIE] World Reference Laboratory for Rinderpest). Prompt control measures, including intensive, focused vaccination by community animal health workers from non-governmental organizations, controlled the outbreak. Since that time no other cases of clinical rinderpest have been detected in southern Sudan despite active investigation of numerous disease incidents reported through the community-based animal health programmes. However, until it can be proved that rinderpest is no longer present in the southeast of the country (bordering Ethiopia, Kenya and Uganda), it is prudent to act on the basis that rinderpest could still be present there. The significant populations of cattle in that area are difficult to access for the purposes of disease surveillance and vaccination. Elsewhere in the Sudan, a comprehensive participatory survey of livestock herders during 2000 provided strong evidence to support the belief that rinderpest has not extended out of the southeast since 1995 or even earlier (FAO Technical Cooperation Programme Project TCP/SUD/8923).

Rinderpest – control versus eradication

Clearly, rinderpest control in the Sudan has now reached the point where eradication can be envisaged as feasible in the near future. Pragmatically it must be realized that it will never be possible to immunize the entire cattle holdings of the pastoralists of southeastern Sudan at one time to a level where virus transmission is interrupted. With existing, or even improved, vaccination practices and the resources that are likely to be available, herd immunity levels are unlikely ever to reach, let alone exceed, some 30 to 50 percent of the cattle population. The inevitable result is that rinderpest will persist in endemic form and cause constant, repeated attrition of the herds and occasional epidemics of variable severity unless an alternative approach is found. The incidence of rinderpest outbreaks would certainly be reduced to a degree by such a vaccination

PHOTO COURTESY OF M. GUERNE

Cattle camp in the western Upper Nile of the Sudan

campaign approach, but the risk of epidemics would remain high and cause alarm, if not actual losses, each time that climatic or human-induced crises caused unusual livestock migrations, mixing of herds and crowding. Thus routine vaccination would have to be continued forever.

Certainly the agencies providing animal health services to livestock owners in southern Sudan have a duty to protect their cattle from the devastating effects of rinderpest, and it could be conceived that this requires continuation of provision of rinderpest vaccination. However, the interests of the families dependent on cattle would be far better served by eradication rather than perpetual control, which creates a situation of continuing vulnerability from rinderpest resurgence in the face of suboptimal protection and lapses in service provision. The vulnerability refers not only to the Sudan but also to the many millions of cattle-dependent families in neighbouring countries in the Horn of Africa. It should not be forgotten that eradication is forever, whereas control is neither absolute nor permanent. Control only has an effect as long as vaccination programmes can be maintained. With the turnover of cattle in the population, susceptibility soon reverts to preimmunization levels as soon as the vaccination campaigns lapse.

Once rinderpest is eradicated, the way is clear to invest resources in control of the other major diseases that cause serious losses, such as contagious bovine pleuropneumonia (CBPP), contagious caprine pleuropneumonia and peste des petits ruminants (PPR).

Continuing suboptimal vaccination not only serves to maintain endemic persistence and to mask the presence of rinderpest but it also seriously compromises the use of serological studies to disclose the presence of rinderpest (serosurveillance). Vaccination must cease for progress to be made.

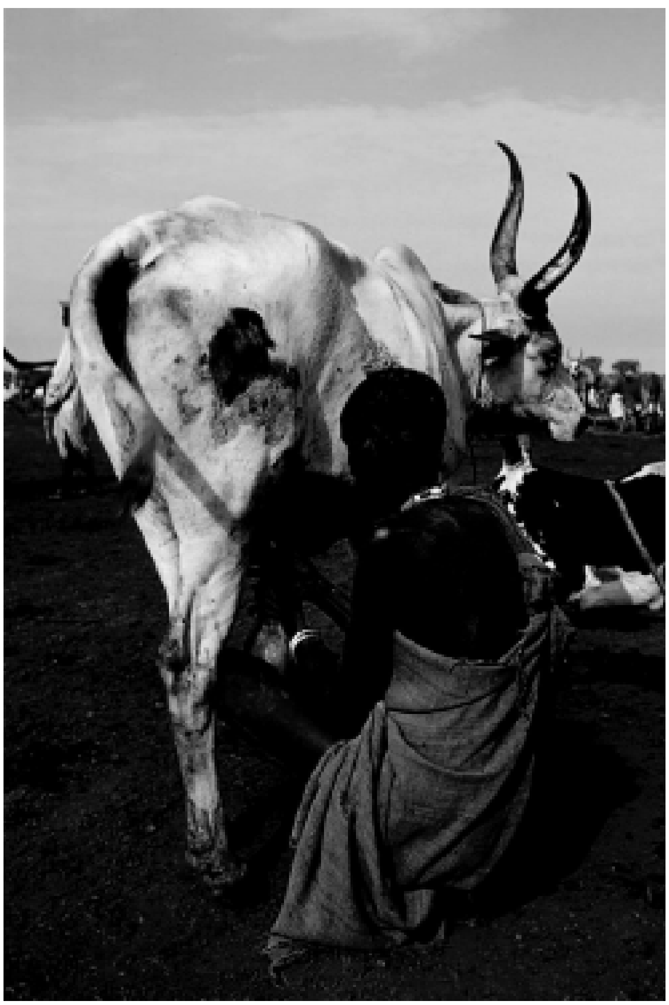

PHOTO COURTESY OF M. GUERNE

The vulnerability refers not only to the Sudan but also to the many millions of cattle-dependent families

Actions proposed

The Sudan should now consolidate and build on the progressive control of rinderpest achieved so far by embarking on the final eradication thrust. Eradication is not that much more demanding than control but it does require a different mindset. Given commitment to the objective by all concerned, it is likely that the goal of eradication could be achieved rapidly – well within two years. It is expected that the Interafrican Bureau for Animal Resources (IBAR), through the regional and national elements of the Pan African Campaign against Epizootics (PACE) programme, and in close collaboration with the Global Rinderpest Eradication Programme (GREP), will give the technical lead needed.

Elements of the actions required to focus on the target of rapid eradication while protecting the cattle-dependent communities are:

- intensive epidemiological investigations of the suspected areas of rinderpest persistence (as initiated by IBAR-PACE) to define the areas affected;
- strengthening of disease surveillance and reporting systems throughout the country for stomatitis-enteritis complex (for surveillance purposes

the disease syndrome which includes rinderpest), all elements contributing to a unified national system;

- strengthening of existing community-based animal health programmes through the Household Food Security Livestock Programme and extension into new areas not served at present, in order to provide:
  - the basic health care required to support livestock-dependent food security,
  - early warning of rinderpest outbreaks,
  - epidemiological definition of rinderpest persistence,
  - ensured early reaction capacity for rinderpest outbreaks,
  - focused immunization for eradication in identified areas of virus persistence;
- strengthening emergency preparedness systems, specifically for rinderpest;
- withdrawal of all stocks of rinderpest vaccine from the field and placing them in vaccine banks maintained at appropriate points for rapid access. In future rinderpest vaccine production should cease except when needed to replenish vaccine banks. If vaccine is required for the control of PPR, the vaccine strain should be obtained from the Pan African Veterinary Vaccine Centre (PANVAC) and homologous PPR vaccine production established.

The community-based livestock services in southern Sudan have proved that they are capable of providing the required system of early warning and reacting rapidly in an emergency, provided that a minimum infrastructure is maintained. The challenge to all concerned parties is to intensify programmes to access those communities currently marginalized and to progress rapidly. Another disease or diseases should be identified as the focus of a specific prophylactic and/or therapeutic thrust to replace rinderpest. Among the candidates are East Coast fever, CBPP and PPR.

The Organization of African Unity (OAU), IBAR-PACE and GREP are initiating a dialogue with all partners in the Sudan to work out the feasibility of this approach and agree on the way forward.

Source: Extracts from a concept paper produced by the GREP Secretary for FAO Technical Cooperation Project TCP/SUD/8923.

Wildlife serosurveillance for rinderpest

The PACE Expert Consultation on Wildlife Surveillance for Rinderpest. Summary, conclusions and recommendations adopted at the meeting held at the Kenya Wildlife Service Veterinary Unit, Langata, Nairobi, 11-13 December 2000

In response to the outbreaks of rinderpest in wildlife experienced in Kenya and the United Republic of Tanzania from 1994 to 1997, which highlighted the role of wildlife in rinderpest transmission in Africa, OAU-IBAR (under the PARC programme) established a wildlife rinderpest surveillance project (African Wildlife Veterinary Project [AWVP]) with funding from the European Union (EU). Its intention was to use wildlife surveillance as an aid to determining the recent distribution of rinderpest in Africa. The major outcome of this project was the collection of over 5 000 wildlife sera from Burkina Faso, Central African Republic, Chad, Ethiopia, Kenya, Uganda and the United Republic of Tanzania, mainly during 1999 and 2000. The sera were subjected to a panoply of serological tests performed in national laboratories (Ethiopia, Kenya, Uganda and the United Republic of Tanzania), the FAO Regional Reference Laboratory for Rinderpest – East Africa (Kenya Agricultural Research Institute [KARI], Muguga, Kenya), the FAO/OIE World Reference Laboratory for Rinderpest (Institute for Animal Health [IAH], Pirbright) and the FAO Collaborating Centre for Morbilliviruses (Centre de coopération internationale

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Buffaloes are highly susceptible to rinderpest

en recherche agronomique pour le développement – Département d'élevage et de medecine vétérinaire [EMVT], Montpellier). The members of the expert panel were supplied with the database of results in mid-2000 and provided their interpretation to OAU-IBAR. The meeting was convened to finalize the analysis of results from the wildlife serosurveillance exercise; to advise the Directors of OAU-IBAR and PACE on their definitive interpretation to enable reporting to countries concerned; to make short- and long-term recommendations on the surveillance and testing protocols for rinderpest in the PACE member countries; and, additionally, to advise on the selection of research topics relating to rinderpest to be supported by PACE. The meeting was comprised of 15 members of AWVP, the PACE team (the Coordination Unit, the Main Epidemiologist and Regional Epidemiologists for East, Central and West Africa), Regional and World Reference Laboratories/Collaborating Centres for Rinderpest, the Kenya Veterinary Department Epidemiology Unit and the Kenya Wildlife Service Veterinary Unit as well as the FAO GREP Secretary.

The results were compatible with the understanding of rinderpest distribution gained from surveillance of domestic livestock and provided no evidence for the recent spread of infection outside the known affected areas in eastern Africa (i.e. Southern Sudan and Southern Somalia ecosystems). It was also concluded that wildlife sampling should be an integral part of epidemiological surveillance for rinderpest with regular sampling of sentinel populations in key areas.

Results of the serological survey

None of the serological tests for rinderpest that are currently available are perfect, and all differ in their performance characteristics. One outcome of the meeting, after detailed debate, was a statement as to the interpretation of the results of the serological survey. The results clearly show that serosurveillance of certain wildlife species and populations is an appropriate tool for monitoring the presence or absence and periodicity of rinderpest virus circulation in Africa. In some populations and using certain tests it is possible to be certain about the detection of antibodies, indicative of earlier infection in some populations; in others, the inferior performance characteristics of some of the assays used tend to confuse the issue. Overall it was concluded that this had been a most valuable exercise and that serological profiling of wildlife populations should continue under PACE. In order not to pre-empt reporting of the results by OAU-IBAR to the countries concerned, the results are not detailed here; however, the results were compatible with the understanding of rinderpest distribution gained from surveillance of domestic livestock and provided no evidence for the recent spread of infection outside the known affected areas in eastern Africa (i.e. southern Sudan and southern Somalia ecosystems). This is further evidence that wildlife do not maintain rinderpest virus infection indefinitely.

It was concluded that wildlife sampling should be an integral part of epidemiological surveillance for rinderpest with regular sampling of sentinel populations in key areas. Where baseline data in key populations are not given, they should be obtained as soon as possible. The OIE Animal Health Code is non-specific in the area of wildlife surveillance in relation to the OIE pathway. Rigid sampling frames are inappropriate, particularly in West Africa where wildlife populations are sparse; the role of wildlife is primarily as a sentinel and early warning system for the re-emergence of rinderpest. The main ecological zones for intensive investigation have been identified and prioritized. They include: (1) the Lineage II ecocluster comprising the Somali ecosystem (Ethiopia, Kenya and Somalia), the Tsavo ecosystem (Kenya and the United Republic of Tanzania), the Amboseli-Mara-Serengeti-Tarangire complex of Masailand (Kenya and the United Republic of Tanzania); (2) the Lineage I ecocluster comprising Boma plateau, Eastern equatoria including the Sobat basin, Jonglei (the Sudan), northern Uganda and Kenya and southwestern Ethiopia. In West and Central Africa the main zones include southern Chad, northeastern Central African Republic, the Bemoue ecosystem, eastern Nigeria and Cameroon, and the Pendkari ecosystem (northern Benin and southeastern Burkina Faso). It was recommended that all sampling be done on an ecosystem basis and coordinated across national borders, including close integration with livestock sampling strategies. The sampling should involve animals born since the last epidemic that affected the population, and mainly animals aged 18 months and above to avoid confusion caused by the presence of maternal antibodies. There may, however, be occasions when younger animals are sampled for specific studies, e.g. prevalence of maternal antibodies at a given age in an affected population. The species involved should include buffalo, eland, giraffe and warthog, where these are available, and other susceptible species that have shown historical evidence of antibody development.

It was strongly recommended that some emergency measures for wildlife disease investigation be made available within the Regional PACE Units to ensure rapid diagnosis without recourse to the National PACE allocations.

Research proposals

The meeting recommended that research priorities be set by the PACE Coordination Unit and include epidemiological research (such as temporal and spatial analyses of disease data) as well as laboratory-based research, which is to be coordinated by the FAO/OIE World Reference Laboratory for Rinderpest. The topics elaborated on at the GREP Consultations held in Rome in May and June 2000 were discussed and amended. Four topics were supported: (1) tests for rinderpest surveillance; (2) tests for differential diagnosis within the stomatitis-enteritis syndrome; (3) marked rinderpest vaccines to allow differentiation between vaccination and infection; and (4) transmission of rinderpest between wild and domesticated animals. One other topic – validation of “penside” diagnostic tests – is being supported by FAO and is expected to receive support from the Department for International Development (DFID), the United Kingdom; it should therefore need no further assistance. A guiding principle that was stressed was that research be conducted, to the maximum extent possible, by African scientists in African laboratories or World Reference Laboratories.

FOOT-AND-MOUTH DISEASE

Recent developments

The UK epidemic

One month after the first cases were recognized on 19 February 2001, the United Kingdom's first large-scale outbreak of foot-and-mouth disease (FMD) since 1967 had spread across the whole country.

PHOTO COURTESY OF P. RODER, EMPRES

Sheep flock in the United Kingdom

France and the Netherlands are the only other European countries that have been affected, to a lesser extent, by the disease, which was caused by animals originating from the United Kingdom. So far, only two cases have been confirmed in France, whereas in the Netherlands, as of 22 April 2001, 26 cases have been declared by the Dutch Agricultural Ministry.

Epidemiological models predicted that the epidemic would probably peak in early May and could go on until August. This and other considerations have led to a review of the strategy and logistics for slaughter and carcass disposal. A policy for slaughter of infected contact animals within 24 hours of diagnosis and slaughter of at-risk animals within 48 hours was adopted. The latest figures show that there have been a total of 1 448 outbreaks (as of 23 April), that the epidemic has already peaked and is in decline.

Import bans

Following the confirmation of the case in France, some 90 countries around the world imposed bans on imports of livestock and on meat and milk products from all 15 countries in the EU. Others went further and banned imports of European agricultural products such as cereal. The EU condemned the action as excessive and unnecessary and talked of appealing to the World Trade Organization to get the bans lifted. Press reports hinted at the possibility of a wider trade dispute developing out of the agricultural crisis.

FMD on the rise worldwide

This disastrous outbreak of FMD in the United Kingdom has followed a period of several years in which this highly contagious livestock disease has been on the increase worldwide. Several countries that had been free of the disease for considerable periods of time suffered outbreaks – such as Japan (free since 1908), the Republic of Korea (free since 1934), Mongolia (free since 1973) and South Africa (the last outbreak in the free zone was in 1957). Other countries with more recent and very hard won freedom from the disease, such as Uruguay (1990), Namibia (1994), the Russian Federation (1995) and the state of Rio Grande do Sul in Brazil (1993) had new outbreaks of the disease (see *EMPRES Bulletin* No. 14/2 – 2000 available on the EMPRES Web site at the following address: *www.fao.org/DOCREP/003/X8491E/X8491E00.HTM)*.

After alerts of FMD in August 2000 (see *EMPRES Bulletin* No. 14/2 – 2000), Argentina reported confirmed cases of the disease in March 2001 in several provinces of the country.

It is important to note that these outbreaks are due to serotype A, which is a different serotype from that involved in the United Kingdom epidemic. As of 14 April 2001, 291 outbreaks had been confirmed and the origin of the outbreaks is still under investigation.

New virus strain travels large distances

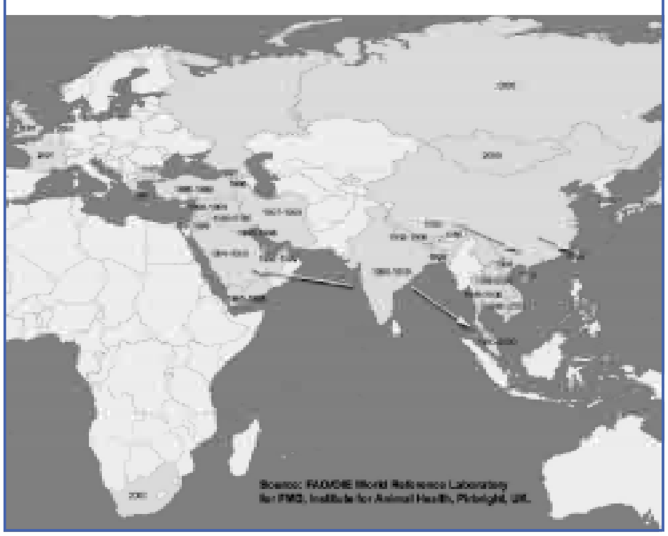
There are seven serotypes of FMD and the disease has an incubation period of between three and fifteen days. The Pan-Asian strain, which belongs to the Near East-South Asia topotype of type O – the virus responsible for the epizootic in the United Kingdom – is particularly virulent and originated in India in 1990. From there it spread as far west as Greece and Bulgaria in 1996, as far east as Taiwan Province of China in 1997 and to the Republic of Korea, Mongolia, the Russian Federation, Japan and South Africa in 2000. Because of its rapid and wide geographical spread, particularly across Asia, it has features of a pandemic – hence the name “Pan-Asian”. The conjectured spread of this strain was reported in *EMPRES Bulletin* No. 14/2 – 2000 and is shown on the map below.

One characteristic of this strain is the absence or mildness of clinical symptoms in adult sheep, one reason for the delayed detection of the disease in the United Kingdom.

A recent risk analysis conducted by the FAO-hosted European Commission for the Control of Foot-and-Mouth Disease (EUFMD – see Box) showed that 50 percent of the risk of introducing FMD to Europe was accounted for in three ways:

- illegal movements of livestock or animal products;
- foodstuffs carried by tourists or immigrants;
- legal trade in animal products.

CONJECTURED SPREAD OF THE PAN-ASIA LINEAGE OF THE NEAR EAST-SOUTH ASIA TOPOTYPE OF FMDV-O



Although the origin of the outbreak in the United Kingdom is not clear at this point, there is speculation that the virus entered the country in illegally imported meat fed as pigswill. The country of origin is not known.

THE EUROPEAN COMMISSION FOR THE CONTROL OF FOOT-AND-MOUTH DISEASE

The European Commission for the Control of Foot-and-Mouth Disease (EUFMD) was established in 1954 under the aegis of FAO, while FMD was endemic in Europe. Its initial goals were:

- to combat and eradicate FMD in Europe;
- to coordinate national control programmes.

FMD was eradicated in Europe in the 1980s.

The current thrust of the Commission is:

- to prevent reintroduction of the FMD virus to Europe;
- to limit the risk from countries surrounding Europe.

Normative activities

- Circulate information on all aspects of FMD to member countries.
- Provide advice to member countries on preventing and controlling the disease.
- Organize technical workshops.
- Establish guidelines for:
  - security measures in FMD laboratories,
  - contingency plans for FMD control,
  - disposal of carcasses in the case of stamping out,
  - standardization of laboratory FMD tests and standardization of reagents,
  - revision of the FMD monograph of the European Pharmocopeia.

Operational activities

- Coordinate measures to combat the disease if it occurs.
- Organize vaccination campaigns in the regions at risk.
- Combat the disease and create buffer zones.
- Participate in FMD surveillance activities.
- Some recent activities undertaken jointly with the European Community:
  - control of the epidemic in Albania and The Former Yugoslav Republic of Macedonia in 1996,
  - vaccination against the new type A virus in Thrace, Turkey in 1998,
  - creation of a buffer zone in the Caucasus in 1999 and 2000,
  - advice on control and surveillance activities in the North African outbreak of 1999,
  - coordination of an FAO Technical Cooperation Project in the Islamic Republic of Iran and Turkey on strengthening the veterinary services' capacity to respond to the threat of FMD.

Globalization means global diseases

Globalization – of markets in particular – also means global scope for diseases that were previously limited to specific regions. The rapid spread of the Pan-Asian strain is witness to this. As the United Kingdom outbreak has spread to France and the Netherlands, it appears that FMD is a global threat and that the only real solution is to tackle the problem at its source, providing more assistance to developing countries to tackle the disease in the endemic areas in Africa, the Near East, Asia and South America.

Stamping out versus vaccination

The United Kingdom, in keeping with EU policy, is attempting to stamp out the disease by slaughtering all infected animals and all animals at risk, i.e. all susceptible animals that have been in contact with infected livestock. As the situation worsened in the country, a mass preventive cull was announced, to include apparently healthy animals within a 3-km radius of infected areas in the worst hit counties.

Vaccination is seen as a last resort because it creates other complications. Vaccinated animals are not 100-percent resistant to FMD and can excrete the virus. Regular revaccination is also necessary. Currently, it is not possible to distinguish between vaccinated animals and animals that have had FMD. This means that countries that vaccinate cannot be certified free of the disease, and may face trade embargoes.

However, ring vaccination can be used as part of the eradication process, as in South Africa and Argentina, particularly where the number of animals affected is so high that stamping out poses operational and public acceptance problems.

M. GRIFFIN/FAO/18039

Vaccination remains important for the control of certain major transboundary animal diseases in developing countries

The **OIE International Animal Health Code** establishes how vaccination affects a country's FMD status. Emergency vaccination in limited areas, as part of a stamping out process, leads to loss of status and, therefore, of trade opportunities with other FMD-free countries for three months after the last vaccinated animal is slaughtered. When FMD occurs in an FMD-free country or zone where vaccination is practised, the following waiting periods are required to regain the disease-free status: one year after the last case where stamping out is applied, or two years after the last case without stamping out, provided that an effective surveillance has been carried out.

New tests may make vaccination a more acceptable option

Work is continuing to develop a test that would distinguish between vaccinated and infected animals. During infection by the FMD virus, antibodies to both structural and non-structural proteins are produced in the animal, whereas vaccination generally only induces antibodies to structural proteins. Research has shown that the detection of antibodies to the non-structural protein known as 3ABC can be a useful tool in the diagnosis of the FMD virus and the differentiation between infected and vaccinated animals.

A test of this kind developed at the Istituto zooprofilattico sperimentale della Lombardia e dell'Emilia (IZSLE), Brescia, Italy, has already been successfully used in the investigation of sera from Albania, The Former Yugoslav Republic of Macedonia and the Caucasus. It has also been used in Argentina to demonstrate the absence of a circulating virus, and more recently during the outbreak in South Africa.

It is expected that this test, known as the 3ABC ELISA, will become a major tool in FMD surveillance. Under new EC legislation in preparation for FMD control, it is foreseen that if ring vaccination is used to control an outbreak, the 3ABC test will be required for all vaccinated animals.

The importance of emergency preparedness: GEMP

Emergency preparedness plans for animal disease outbreaks such as FMD in the United Kingdom are vital for effective management of potentially devastating epizootics.

EMPRES has developed a multimedia program to help countries create emergency preparedness contingency plans based on:

- early warning;
- early reaction; and
- control measures.

The Good Emergency Management Practices (GEMP) program is part of FAO's Emergency Prevention System (EMPRES) for Transboundary Animal and Plant Pests and Diseases. It offers standard control measures to be implemented during an emergency, from the first suspicion of a disease through to its eradication.

GEMP also provides information on laboratory techniques for disease detection, including an extensive photo library illustrating disease symptoms to aid diagnosis. The program also contains training materials, video clips and links to laboratories and organizations worldwide involved in emergency management.

Epidemiology and molecular biology: tracking the virus

Molecular biology is a key tool in the battle against animal diseases such as FMD. Using genetic characterization, the phylogeny of a virus can be defined and the origin and movement of an FMD outbreak can be precisely tracked. Accurate characterization of the virus strain is particularly important in the case of FMD, because, in epidemiological terms, it is not one disease, but several.

Serotyping at national level (supported by the Joint FAO/International Atomic Energy Agency (IAEA) Division for Nuclear Techniques in Food and Agriculture) and antigenic and molecular analysis at the FAO/OIE World Reference Laboratory for FMD Institute for Animal Health in Pirbright, United Kingdom, are both necessary for the full characterization of a virus.

Reporting based on clinical disease alone is not sufficient for a full understanding of FMD epidemiology, or for the selection of vaccines that are likely to be effective in control. All countries should make routine collection and examination of specimens from all outbreaks of FMD – at national and international levels – part of their national programmes for the control of the disease. At present, this is not done, and understanding is severely lacking.

PHOTO COURTESY OF IAH, PIRBRIGHT, UK

Genetic sequencing for characterization of FMD strains at the FAO/OIE World Reference Laboratory for FMD

At the country level, epidemiological studies can identify areas of endemic disease persistence and patterns of transmission from them. They can also show how the local animal husbandry techniques and traditions affect the behaviour of the disease.

In the Mekong river valley in Southeast Asia, for instance, the periodic flooding of the river creates ideal conditions for FMD transmission. During floods, livestock are either sold or crowded together on high ground. After about a month, when the waters recede, the animals return to their villages and seed out the disease into village populations.

An understanding of the patterns and dynamics of transmission such as these, coupled with accurate virus characterization, leads to focused and intensive control and eradication measures that are both more effective and less costly than blanket approaches.

FAO/OIE international conference

FAO/OIE International Scientific Conference on Foot-and-Mouth Disease, 17-18 April 2001, OIE, Paris

The work of the FAO/OIE International Scientific Conference on Foot-and-Mouth Disease, held on 17 and 18 April 2001, benefited from the contributions of leading world scientists and representatives of the five OIE Regional Commissions, acting on behalf of the 157 OIE member countries from the five continents.

This conference was organized jointly with FAO, within the framework of the Organization's mandate in regard to global animal disease control, particularly for the benefit of developing countries.

In the light of current scientific knowledge on the disease and of the methods used to combat it, the conference examined ways in which international rules governing control methods and precautionary measures could be developed within the context of international trade in animals and animal products.

The resolutions of this conference are destined mainly for the OIE Specialist Commissions that will need to transform them into standards, possibly for submission to the International Committee (the General Assembly of OIE member countries) at the end of May. They are also destined for FAO and international aid agencies to direct their support to animal disease control and eradication activities.

Governments will also be interested in these resolutions. It is important that they recognize that the control and eradication of the principal animal diseases are vital for the alleviation of poverty, and for economic development, while at the same time protecting the international community against the risks of animal diseases.

These resolutions, which will soon be available on the OIE and FAO Web sites, cover the following areas:

- more specific conditions for the international recognition of the health status of countries with regard to FMD, particularly when the virus circulates among animals that do not exhibit symptoms of the disease;
- the orientation of research work and study groups to establish whether vaccination can be used in certain conditions, particularly by the rapid evaluation of new generations of vaccines and tests and by a re-evaluation of the risk linked to certain products of animal origin from vaccinated animals that have not been in contact with the FMD virus;
- certain measures that would, depending on the circumstances, avoid stamping out of rare animal species, animals of great value or those being used for the purposes of scientific research;
- priorities of veterinary research in the field of FMD, with a view to offering alternative methods to control the disease and thus avoiding mass slaughter;
- increase in the awareness of the general public and of governments to reinforce the need to strengthen veterinary services; this will lead to enhanced protection against

animal diseases and the creation of international control and eradication programmes against epizootic diseases, which would not only be in the interests of developing countries but would also reduce the risk of the spread of such diseases across the globe.

Furthermore, these resolutions will be conveyed to international agencies for aid and development so that they can establish control and eradication programmes for these diseases, which can be implemented with the assistance of FAO and OIE.

VECTOR-BORNE DISEASES CAUSE CONCERN IN THE MEDITERRANEAN BASIN

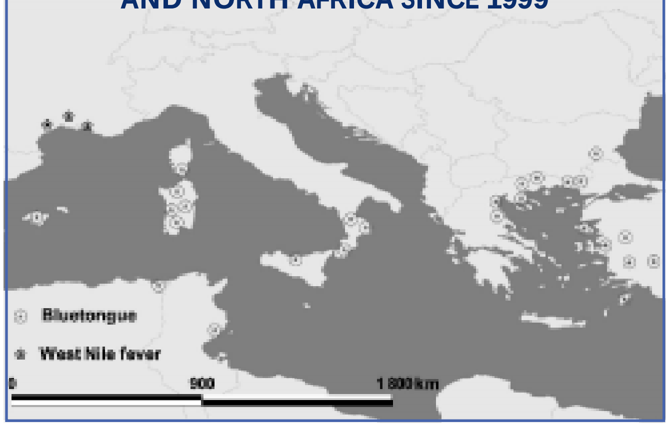
This was the first time that bluetongue had been reported from mainland Greece and, in Bulgaria it extended well north of latitude 40° N, which until recently was generally considered to be the northernmost extension of its range in Europe.

Recent outbreaks of disease caused by bluetongue virus (BTV) and West Nile virus (WNV) have given cause for concern that their threat might be increasing in the Mediterranean Basin.

Between June and August 1999, reports of bluetongue from the southern border area of Bulgaria signalled the start of an epidemic caused by BTV serotype 9. Reports from Turkey and Greece soon indicated that the epidemic had extended across the borders of the three countries. This was the first time that the disease had been reported from mainland Greece, and in Bulgaria it extended well north of latitude 40° N, which until recently was generally considered to be the northernmost extension of its range in Europe. In Turkey and Greece (extending westwards) outbreaks continued to occur until the end of the year. Outbreaks in the Greek islands close to the Turkish coast, in Lesbos (returning after an absence of 20 years) and the Dodecanese islands (previously affected in 1998) were associated with BTV serotype 4 (and possibly serotype 16 and others), although outbreaks in the Dodecanese islands had last been associated with BTV serotype 9. This raised concern that the virus involved there could have originated from a BTV serotype 4 vaccine used in Western Anatolia, Turkey, in August 1999. Turkey again reported outbreaks in August 2000. Bulgaria and France (Corsica only) resorted to vaccination in March and November 2000 respectively.

Further to the west, a separate epidemic, this time associated with BTV serotype 2, commenced with reports from Tunisia of outbreaks in December 1999 and January 2000, close to the Algerian border. This was the first time the disease had been reported from North Africa. After a lull during the winter, outbreaks started again in June 2000 and were widespread in coastal districts until October. This incidence was matched by outbreaks in contiguous coastal areas of neighbouring Algeria, reported in July and August 2000. From there it appears that infected vectors carried bluetongue to Europe. Outbreaks were reported by Italy (August: Sardinia; November: Calabria and Sicily), France (October: Corsica, for the first time) and Spain (October and November: Balearic Islands, last infected in 1960). Mainland France and Spain remain officially free.

BLUETONGUE AND WEST NILE FEVER IN EUROPE AND NORTH AFRICA SINCE 1999



Similarly, WNV (a zoonosis[1]; vectors *Culex* and *Aedes* sp. mosquitoes) has been on the move not only in the United States, which was invaded in August 1999 and where it is now endemically established. Cases in geese were reported from Israel in November 1999 and more than 150 human cases were reported to WHO in 2000. After an absence of more than 30 years, and apparently unrelated to the Israeli incident, WNV returned to France in August 2000, killing horses in the "Camargue" area of Languedoc-Roussillon region in the south. The virus identified in September is similar at the phylogenetic level to viruses isolated in horses in Morocco in 1996, in Italy in 1998 and in mosquitoes in Senegal in 1993.

What has caused these incursions of disease? In the east it is likely that BTV-infected vectors (*Culicoides* sp. midges) were carried on winds from the Tigris and Euphrates valleys; in the west BTV carriage of vectors across the Sahara from the endemically infected areas of West Africa seems to be implicated. In the case of WNV, migratory birds are a more likely source. Quiescence of such vector-borne diseases is to be expected during the winter period which suppresses vector activity. Whether or not outbreaks will resurge later in 2001 remains to be seen. Is this part of a long-term trend relating to global warming? Only time will tell. Clearly it would be wise to continue epidemiological studies and to strengthen emergency preparedness for vector-borne diseases in this region. Another question that demands attention relates to the desirability of using live virus vaccines produced from strains to be found in distant parts of the world, when serotype designations reflect only expression of one small part of the segmented viral genome and recombination occurs readily.

Sources of data: OIE Disease Information (*www.oie.int/eng/info/hebdo/a_info.htm*) and WHO Communicable Disease Surveillance and Response (*www.who.int/disease-outbreak-news/index.html*).

RIFT VALLEY FEVER

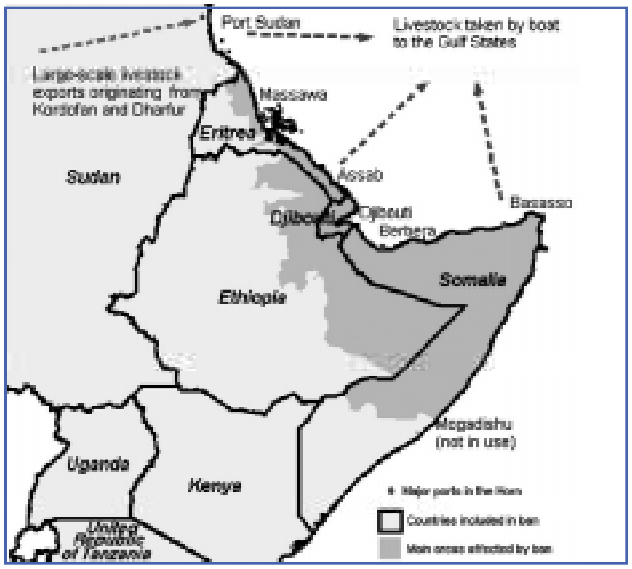
Rift Valley fever threatens livelihoods in the Horn of Africa

Saudi Arabia banned livestock exports from the Horn of Africa between February 1998 and April 1999, as a result of an RVF outbreak in Kenya and Somalia, and the scale of the economic losses at that time is indicative of what is to come. Pastoralists in Somaliland, Somalia, Zone V of Ethiopia and Eritrea, where most of the Gulf imports originate, saw the volume and value of livestock exports tumble.

For the second time in less than three years livestock producers and traders in the Greater Horn of Africa are facing the devastating consequences of Rift Valley fever (RVF). An outbreak of RVF in southern Saudi Arabia and Yemen (the first reported outside Africa) in September and October 2000 has left dozens of people dead and hundreds infected. As a consequence six Gulf States – Saudi Arabia, Bahrain, Oman, Qatar, Yemen and the United Arab Emirates – have now banned livestock imports from nine African countries, principally in the Horn. Although RVF is endemic in the affected countries (see map) none has reported a recent RVF epidemic. Although they are therefore not experiencing the direct impacts of the disease, the livestock trade embargo will undermine a precarious regional food security situation.

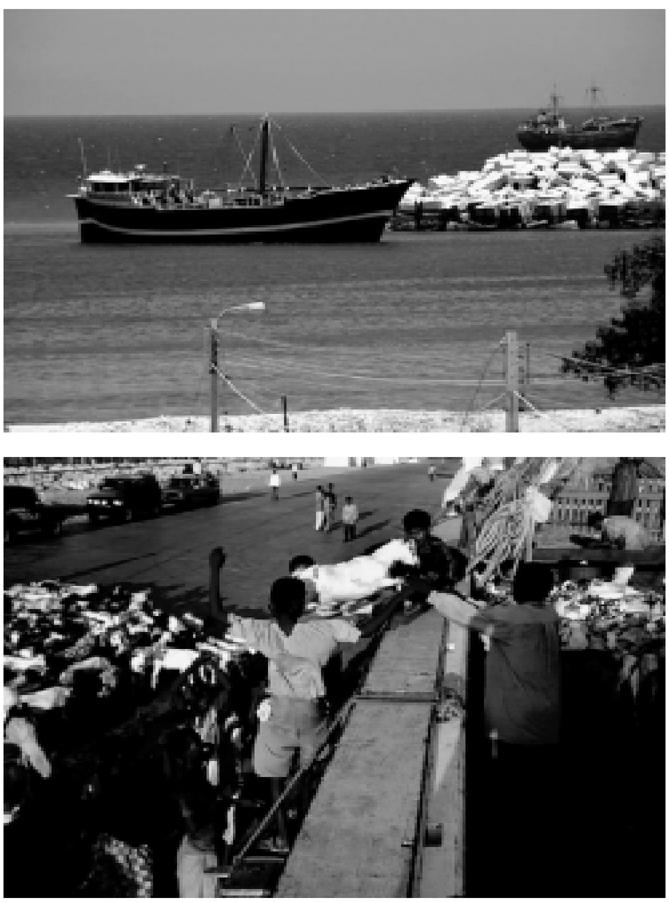
The economic impacts of this ban are likely to be massive. Saudi Arabia banned livestock exports from the Horn between February 1998 and April 1999 as a result of an RVF outbreak in Kenya and Somalia, and the scale of the economic losses at that time is indicative of what is to come. Pastoralists in Somaliland, Somalia, Zone V of Ethiopia and Eritrea, where most of the Gulf imports originate, saw the volume and value of livestock exports tumble. Exports from the major livestock-dealing port of Berbera in Somaliland dropped from nearly three million head in 1997 to just over one million in 1998, equivalent to around US$100 million

[1] *More information on WNV can be found at the Center for Disease Control Web site: www.cdc.gov/ncidod/dvbid/westnile/*



of lost exports. It is estimated that half of these livestock originated in Somalia and half in Zone V of Ethiopia. Prices of livestock fell by around 30 percent in Eritrea, Ethiopia and Somalia as a result of the ban. Other Horn countries included in the ban were only marginally affected as the Gulf is not a significant importer from these countries.

The current ban may cause even greater economic losses. Previously Horn of Africa countries were able to redirect exports to alternate Gulf markets – an option unavailable this time as more Gulf states have joined the import embargo. The Sudan, which normally exports hundreds of thousands of livestock to the Gulf, has also been included on this occasion. Many of the areas affected also coincide with extremely vulnerable and food-insecure areas currently receiving emergency assistance.



PHOTOS COURTESY OF M. GUERNE

Trade of livestock between the Horn of Africa and the Arabian peninsula (Port of Berbera, Northern Somalia)

A quick lifting of the ban is unlikely – the last ban lasted 18 months. The current ban could run the three years recommended by the OIE, in spite of the fact that the epidemic will naturally subside with the coming dry season in the Gulf. The potential to redirect livestock exports is limited for a number of reasons, including poor economic competitiveness, quality standards and the regional preference for meat of the local breeds. In these circumstances what can be done to minimize the disruptions to pastoral livelihoods?

- **Trace the origins of the outbreak** It is important to establish whether this is a new introduction of the virus or whether in fact the pathogen has been present for some time in Yemen and Saudi Arabia and has only now come to the attention of public health authorities.
- **Establish testing and quarantine procedures for exports** Countries of the Horn of Africa will have to establish testing systems to prove the absence of RVF in animals for export. Although recommended after the last ban no action was taken. There is an excellent enzyme-linked serum assay (ELISA) test for RVF. ELISA tests can be routinely

PHOTOS COURTESY OF M. GUERNE

Testing small ruminants for brucellosis before export (Puntland, Somalia)

run by local laboratories (including private Somali laboratories), and are generally easy and reliable.

- **Establish national surveillance systems** Given the relationship of RVF epidemics to climatic conditions, it is possible to use remote sensing products to forecast future RVF epidemics – as has been done with malaria. This provides a lead time of over a month during which preventive measures may be taken.[2]
- **Analysis of impacts at the household level** Using the food economy baselines available (at least for Somalia), it is possible to model, for each area, whether or not decreased livestock sales and prices will translate into a household food deficit justifying external assistance, given the alternative income and food sources.
- **Link livestock off-take and emergency feeding programmes** A collapse in the demand for livestock is likely to result in both a rapid growth of small stock numbers (possibly resulting in environmental degradation) and an increase in emergency relief needs. Practical and proven interventions are the purchase, slaughter and local distribution of the meat as a protein supplement. If a small fraction of the funds allocated to current feeding programmes could be utilized for this purpose, it would provide significant assistance to needy pastoralists.

Source: Famine Early Warning System (FEWS); more information on FEWS is available at *www.fews.net*.

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[2] *Editorial note.* This is probably true in certain ecosystems but requires much more development to become an operational early warning system.

AFRICAN SWINE FEVER

African swine fever in the Gambia

So far, analysed data show that 8 511 pigs have died out of 10 291 cases in 38 foci of infection. These foci of infection are found throughout the country, with the exception of Lower River Division that has no record of an outbreak.

Current situation in the Gambia

In March 2000, the Department of Livestock Services in the Gambia reported outbreaks of African swine fever (ASF) in Greater Banjul area and Western Division. The epidemic spread to North Bank in April/May and, by June 2000, ASF outbreaks were being reported in Lower and Upper River Divisions.

In June 2000, FAO approved a project entitled “Emergency eradication of African swine fever and enhancement of logistical and technical capacities of the Department of Livestock Services” (TCP/GAM/0065) to assist the Government of the Gambia contain the further spread of this epidemic.

The activities of the project, which are in different stages of implementation, mainly concern staff training, enhancing the technical and logistic capacities of the Department of Livestock Services, developing the disease reporting, surveillance and monitoring system to a good level and efficient database management for ASF. There will be a programme of sensitization and education of pig farmers in the country and other stakeholders in the pig industry on the disease in order to establish an early warning/early reaction system.

The current status of ASF

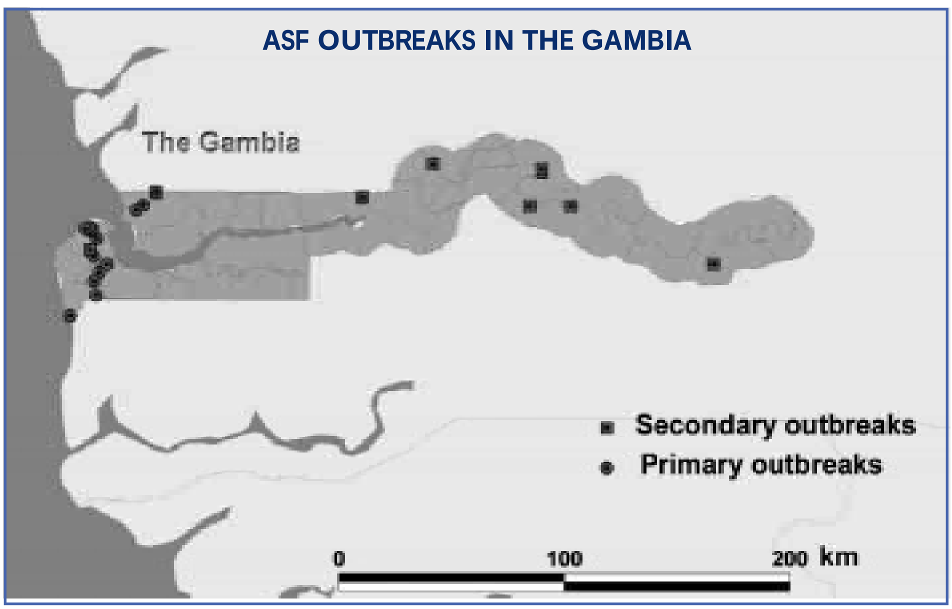
A three-week nationwide epidemiological survey and pig census was carried out between 11 and 29 November 2000. The aim of the exercise was to define the foci of infections and determine the number of pigs in the country.

Data entry is under way using TADInfo, and it is expected that over 2 000 records will be entered following the survey. A preliminary analysis of the data already entered has shown a definite pattern of spread, which is consistent with the information collected during workshops and field visits.

To date, analysed data show that 8 511 pigs have died out of 10 291 cases in 38 foci of infection. These foci of infection are found throughout the country, with the exception of Lower River Division that has no record of an outbreak.

The Greater Banjul area recorded the highest mortality, with 4 063 pigs dying out of 4 666 cases in eight foci of infection. Upper River Division was least affected, with eight mortalities out of 25 cases in only one focus of infection.

ASF OUTBREAKS IN THE GAMBIA



By month, March and August witnessed the highest numbers of cases with 2 392 and 2 628 cases respectively. However, April recorded the highest number of foci of infection, with nine different foci erupting in the month. In November 2000, only one focus of infection was recorded.

This survey has covered over 2 000 pig units. The map shows the ASF status as of November 2000.

African swine fever in Ghana

Current situation in Ghana

ASF was recorded for the first time in Ghana in September 1999. The outbreaks occurred in Greater Accra Region and parts of the Volta Region. Stamping out measures were instituted to eradicate the infection, followed by intensified surveillance activities and a "sentinelization" process that came to an end in September 2000. In October 2000, the Government declared freedom from ASF disease and infection and lifted the ban that had been imposed. The pig populations in the affected areas are Greater Accra Region (20 000 pigs), Central Region (16 000 pigs) and Volta Region (47 000 pigs). During the outbreak, about 600 pigs were lost and 6 927 were slaughtered with compensation awarded to the owners. Ghana has an estimated pig population of about 350 000.

ASF outbreak

Although neighbouring Côte d'Ivoire and Togo experienced successive outbreaks of ASF in 1996 and 1997 respectively, Ghana remained free from the disease until October 1999. Faced with such a threatening situation with two of the country's neighbours, Ghanaian veterinary authorities took steps to avert the introduction of ASF into the coun-

PHOTO COURTESY OF D. NYAKAHUMA, EMPRES

The stamping out exercise in Ghana

PHOTO COURTESY OF D. NYAKAHUMA

Vehicle disinfection during stamping out exercise

try. They thus made a considerable investment in training field staff and raising public awareness. Strict border controls were instituted, and massive public sensitization campaigns were mounted through media and workshops about the dangers of the introduction of ASF from neighbouring countries. These and other activities were carried out under the FAO/TCP project on "Enhancing prevention capacities for emergency intervention against African swine fever in West Africa" (TCP/RAF/7822). In addition, the enhanced early warning capacity of the veterinary services achieved under this project enabled timely detection of the present ASF outbreak in Ghana. The outbreak, the first in the history of the country, prompted the Government to seek external assistance to combat the emergency. In response, FAO contributed US$306 000 through a subsequent project entitled "Emergency assistance to eradicate African swine fever from Ghana" (TCP/GHA/8925).

The World Bank also responded positively and made funds available (US$300 000) from the National Livestock Services Project. These funds greatly complemented the resources under the present TCP project as they served as a compensation fund for farmers whose pigs were destroyed under the stamping out order. This policy entailed the destruction of all animals on affected premises, including slaughter of free-range village pigs in and around affected areas. Farmers were paid at a cost price of ¢3 000/kg live weight (US$1=Cedis ¢3 000). These and other stringent measures on animal movements were essential for ASF to be eradicated from the country.

PHOTO COURTESY OF D. NYAKAHUMA

The stamping out exercise in Ghana

"Sentinelization" phase

At the beginning of the "sentinelization" period, ASF-free farms were identified. Sentinel pigs were identified, tested, purchased and deployed.

For this exercise, 200 pigs were purchased, deployed in 20 groups (ten pigs per group) in locations that had previously experienced ASF outbreaks. After a period of six weeks, serum was collected and tested using an ELISA ASF antibody test. All the pigs purchased were still alive at the end of the sentinelization phase.

Because of the ban on pig movement throughout the country, the pigs were enclosed in pigsties; leaving them to roam would have given the impression that the pig ban had been lifted.

Epidemio-surveillance

Following the stamping out, mopping-up operations, training workshops and public awareness campaigns, there was no restocking whatsoever in the affected area. Local communities destroyed residual pigs that had fled to the bush. The state of complete depopulation has remained in place from December 1999, and no clandestine movements have occurred. Rumours of pork and pork products that were reportedly brought into the country were promptly and fully investigated. In the other unaffected regions, reports of suspicious pig illnesses and/or deaths were fully investigated.

Public sensitization activities

The continuation of public sensitization activities is necessary following the verification of freedom from ASF and infection. This will ultimately be followed by the lifting of the ban on movement of pigs and pig products that is currently in place.

Partial lifting of the ban

In January 2000, after the slaughter exercise, two active foci were reported. These were investigated fully and stamped out. To relieve pressure from producers in ASF-free areas (created by growth in their stock resulting from the ban that had been in place for four months), a partial ban was instituted at the end of January 2000. This allowed sale of stock under the full supervision of the veterinary services. With this controlled slaughter policy, pork processors bought pigs from farms approved by the veterinary services, which were then slaughtered only at the Accra abattoir. This eased the pressure from producers who were making losses as a result of high costs of overstocking, and gave them an opportunity to offset their running costs.

Restocking

In order to maintain vigilance on surveillance, the veterinary staff is fully involved in the process of restocking. The purpose is to guide those interested in restocking on suitable sources that are known to be ASF-free. This will also give the veterinary staff a picture of the movements of pigs and throw light on areas of intensified monitoring activities.

The lessons from Ghana

The eradication of ASF in Ghana demonstrated that a strong and committed veterinary service is the key to competent, rapid utilization and mobilization of international assistance and cooperation programmes. There are challenges ahead in keeping ASF out of Ghana. With the lessons from the past epidemic, Ghana fully appreciates the importance of around-the-clock epidemio-vigilance and prompt follow-up investigations and action in the case of reports of suspicious cases.

NEWS

Manuals

The manual on the recognition of peste des petits ruminants is now available in French and can be accessed on the EMPRES Web site at *www.fao.org/WAICENT/FAOINFO/AGRICULT/AGA/AGAH/EMPRES/Info/PPR/PPRarch.htm*

A manual on participatory epidemiology is available in the FAO Animal Health Manual series.

FAO ANIMAL HEALTH MANUALS

1. Manual on the diagnosis of rinderpest, 1996
2. Manual on bovine spongiform encephalopathy, 1998
3. Epidemiology, diagnosis and control of helminth parasites of swine, 1998
4. Epidemiology, diagnosis and control of poultry parasites, 1998
5. Recognizing peste des petits ruminants – a field manual, 1999 (also available in French)
6. Manual on the preparation of national animal disease emergency preparedness plans, 1999
7. Manual on the preparation of rinderpest contingency plans, 1999
8. Manual on livestock disease surveillance and information systems, 1999
9. Recognizing African swine fever – a field manual, 2000
10. Manual on participatory epidemiology. Methods for the collection of action-oriented epidemiological intelligence, 2000

These and other FAO documents can be purchased through FAO sales agents. A complete list of publications, prices and agents is available at *www.fao.org/catalog/giphome.htm*, or contact:

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Introduction of new staff

Henri Kaboré

We are pleased to announce the arrival of Dr Henri Kaboré, who will work in the Agricultural Departmental Group, Livestock Unit, FAO Regional Office for Africa. He will join the EMPRES group as an Associate Professional Officer (APO). Dr Kaboré is taking over from Dr David Nyakahuma who was transferred to FAO headquarters, Rome, over a year ago.

Dr Kaboré, a veterinarian, is a national of Burkina Faso, where he worked in the National Agriculture Research System on tropical animal health prior to taking up duties with FAO in December, 2000.

Dr Kaboré graduated from the Inter-state School of Science and Veterinary Medicine, Dakar, Senegal. He later proceeded to the Institute of Tropical Medicine, Antwerp, Belgium, where he obtained an M.Sc degree in tropical animal health.

He also holds an International Civil Servant Diploma conferred by the International

School of the French-speaking Community of Bordeaux, France. His APO assignment is sponsored by the International Organisation of the Franchophonie (IOF).

His assignment in FAO will focus on the *Contribution of transboundary animal diseases containment, eradication and emergency preparedness to promote EMPRES key ideas and TADinfo software in West Africa*. Dr Kaboré will travel extensively in West African countries to establish and strengthen EMPRES and TADinfo activities.

William Amanfu

Dr William Amanfu, a national of Ghana, has joined the Infectious Diseases EMPRES Group of the FAO Animal Health Service on a short-term appointment (six months) as Animal Health Officer with effect from 4 March 2001.

Willie graduated in veterinary medicine in 1973 and obtained his Master's Degree in 1980 in veterinary microbiology and preventive medicine from Iowa State University in the United States. He has served as a consultant for FAO and the Joint FAO/IAEA Division in Vienna on CBPP projects in Zambia, the United Republic of Tanzania, Malawi and Cameroon. He has also served as a consultant for the African Development Bank (Côte d'Ivoire) on livestock projects in Kenya, Mozambique and Botswana, and has a significant number of scientific publications on CBPP and other bacterial diseases of livestock to his credit. Currently, he is Director of the National Veterinary Laboratory of Botswana.

Vincent Martin

Dr Vincent Martin joined the FAO Animal Health Service EMPRES Group in April 1998, as an APO sponsored by France. He has now been appointed as Animal Health Officer, Infectious Disease Analysis. His prime responsibilities will be to analyse and disseminate information and data on the evolution of epidemic and emerging livestock diseases, and design and implement programmes and projects related to EMPRES. He will participate in the development of disease forecast models for weather-dependent epidemic diseases based on remote sensing satellite and other data and assist in the development of temporo-spatial disease risk and disease-spread models. He will also continue to be the editor of the *EMPRES Transboundary Animal Diseases Bulletin*.

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