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TECHNICAL SUPPORT STUDY TO OUA/IBAR-PARC

SYNTHESIS REPORT

P.C. LEFEVRE
F. ROGER
J.J. TULASNE

Cirad-emvt Report n° 98036

June 1998

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CIRAD Department of livestock production and veterinary medicine
Campus International de Baillarguet - BP 5035
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SUMMARY:

The report is composed of four main chapters:

An introduction concerning the **zoosanitary situation in sub-Sahara Africa**, and an estimation of the **economic impact of improvements in animal health.**

A detailed review of the **actors** in the livestock sector and the **tools** available for intervention in the control of Rinderpest and other major diseases.

In a third chapter, **technical strategies** are proposed for the prospective program. This focuses on **disease surveillance and national systems of epidemiological surveillance** with **support for the laboratories and research (Rinderpest, CBPP).**

Proposals for **geographical strategies** of Rinderpest and CBPP control adapted to **different geo-epidemiological contexts** make up the last chapter of this report.

ABSTRACT

After a brief presentation of the **zoosanitary situation** in sub-Sahara Africa and an **economic approach** to the positive impact of health improvement on animal production, this report puts into perspective the **actors and tools** concerned with the control of Rinderpest and other major diseases in sub-Sahara Africa; the consultants stress in particular the important role of **PANVAC,** the quality control laboratory for Rinderpest and CBPP vaccines used in the vaccination campaigns. The **technical strategies** proposed for the prospective program are based on the concept of **disease surveillance and national systems of epidemiological surveillance (NSES).**

The consultants introduce the specific objectives, the flow diagram, and the provisional budgets of these NSES. It is also proposed that **scientific support and financial backing for the national and regional laboratories** is provided as part of the intended program, together with **reinforcement of the objectives of the regional units,** hierarchical intermediaries and essential functions. Finally, prioritising the **fields of research on Rinderpest** (use of **PPR vaccine instead of the equivalent classic Rinderpest vaccine) and CBPP (improvement of current vaccines).**

The final chapter of this report presents the **regional geographical strategies for control of Rinderpest and CBPP** and defines the geo-epidemiological groups in the light of the up-dated zoosanitary situations in West, Central and East Africa, the livestock farming systems, the role of wildlife, the movements of traditional herds and commercial flow.

TABLE OF CONTENTS

1.
INTRODUCTION

Firstly, as an introduction to the present summary report, the consultants wish to place the PARC program in the context of current animal health conditions prevalent in sub-Sahara Africa and provide a complete bibliographical review of the economic impact of health improvements on animal production.

1.1. REVIEW OF THE ZOOSANITARY SITUATION IN SUB-SAHARA AFRICA

1.1.1. Rinderpest

The main result of PARC shows that the epidemiological situation of Rinderpest has ***improved overall for more than a decade. There have been no Rinderpest outbreak in West and Central Africa since mid-1988.*** *In addition, the reports concerning serosurveillance reveal no transmission of the Rinderpest virus in these regions.*

However, ***East Africa is still infected,*** *particularly South Sudan, notably because of the continuing civil war which impedes the setting up of coherent control. Recently the countries to the east of Sudan were still infected, notably Ethiopia where the last outbreak dates back to November 1995. The strains implicated belong to lineage 1; these are the strains responsible for the classic type of Rinderpest. The situation in Somalia remains poorly understood.*

The prominent circulation of lineage 2 strains causes concern; affecting the wildlife in an acute manner (Kenya), this affects cattle in an attenuated form and thus restricts clinical detection.

While the development of vigilance networks can replace vaccination in West Africa, Rinderpest remains current in certain regions of East Africa where vaccination must also be accompanied by surveillance measures that include the wildlife. Central Africa (Chad and CAR) constitute an interface between two epidemiological situations and must be the site of major prophylactic medical and health measures. However, PARC can be considered, overall, a success.

1.1.2 Contagious bovine pleuropneumonia

CBPP is one of the major risks for health and production of cattle in Africa. *CBPP is very widespread there and its incidence seems to be recurring in several West African countries.* ***The situation however remains poorly understood*** *in several regions, in particular Central Africa because of lack of reliable data. In East Africa its strong presence menaces southern Africa: the situation in Tanzania threatens to menace Zambia, Malawi and even Mozambique (see map page 81).*

The bivalent vaccine (Rinderpest / CBPP) seems to have disguised and limited its development in numerous countries for several years. The termination of the use of these vaccines, given the favourable evolution of Rinderpest control, could result in a greater diffusion of the disease in the African continent.

The installation of new vaccination campaigns is necessary together with development of new control tools, primarily more efficient vaccines. An economic approach to prevention is needed in the first instance in order to determine precisely the costs and benefits. The more complex epidemiology of this disease compared to Rinderpest consequently demands new investigations on the actual role of long term carriers and precise evaluation of animal movements.

1.1.3 Other trans-boundary diseases of major importance

- ***Viral diseases***

  - ***Peste des petits ruminants:***

PPR is present in West, Central and East Africa. It is a disease of major economic importance mainly in the rearing of goats. It predisposes animals to secondary infection. With small ruminants being susceptible (but not necessarily sensitive) to the Rinderpest virus, the homologous vaccine currently constitutes the control method of choice: it actually allows to serologically differentiate animals vaccinated with this vaccine from those in contact with the Rinderpest virus (infection or vaccination.)

  - ***The pox viruses:***

- ***Lumpy skin disease***

Widespread throughout intertropical Africa. An economically important disease : degradation of skins and death in the imported exotic breeds.

- ***Sheep pox***

Widespread throughout intertropical Africa. Fatal disease, economically important.

- ***Camel pox***

Although present in all the African countries inhabited by camels, it is a localised benign form in adults, but causes high mortality in the young.

  - ***Foot and mouth disease***

Mostly widespread in tropical Africa, this disease is too often "tolerated" and considered secondary in Africa. Low mortality in general except in industrial farming: milk production and exotic breeds.

  - ***Rift Valley fever***

Declared in Mozambique and Zambia in 1996, suspected in northern Malawi and recently in Kenya and Somalia (97-98). This is a major zoonoses (Egypt 1978, Mauritania 1988).

❑ *African swine fever*

Appearance of the disease for the first time in the Ivory Coast in 1996, in Benin, Nigeria and Togo in 1997. This is an important factor limiting pig farming in Africa. No vaccine available.

❑ *Avian viral diseases:*

The main diseases rife in African poultry are:

◊ *Newcastle disease*
◊ *Infectious bursal disease*
◊ *Fowl pox*
◊ *Marek's disease*

■ *Bacterial diseases*

❑ *Contagious caprine pleuropneumonia*

Mycoplasma capricolum subsp. capripneumoniae agent of CCPP has been isolated in the following countries: Niger, Chad, Sudan, Eritrea, Ethiopia, Kenya, Uganda. The economic consequences of CCPP remain poorly understood. A vaccine (killed, with adjuvant) is available.

❑ *Haemorrhagic septicemia*

A relatively economically import disease that is widespread in intertropical Africa, becoming rife at the start of the rainy season.
The serotype Pasteurella multocida 6 : B present mainly in Ethiopia and north Sudan reached Cameroon in 1994.

❑ *Bovine tuberculosis*

A disease which is rife throughout Africa, mainly at high altitudes (Madagascar and the high plateaux of Eastern and Central Africa) with a very variable prevalence from one country to another: Namibia and Zimbabwe are unaffected. Malawi and Tanzania show prevalence rates above 10%. This rate can reach 25% in Madagascar. In the latter country, BCG vaccination in the regions of high prevalence is considered to be the only possible strategy to control this disease.
It is a zoonosis : in Tanzania and Zambia, Mycobacterium bovis, although less pathogenic to man than Mycobacterium tuberculosis, represents a considerable risk for human health.

❑ *Dermatophilosis*

This significant disease is rife throughout Africa (mostly humid and sub-humid) and in particular West Africa and Madagascar. It is associated with ticks which represent an aggravation factor. It results in considerable economic losses: mortality and impossibility to practice harnessed traction. No vaccine available.

- ❑ *Bovine and small ruminant brucellosis*

This disease is enzootic in sub-Sahara Africa with a prevalence that may reach 30% of the herd. It is the main cause of abortion in nomadic herds. It is an important disease for imported exotic breeds, and also in intensive farming. Brucellosis is a serious zoonosis.

- ❑ *Anthrax*

This is the most serious disease of telluric origin and it is rife throughout Africa. It is a major zoonosis.

- ❑ *Anaerobic bacterial diseases*

These diseases are present in the whole of sub-Sahara Africa. Black leg may be enzootic (Comores). Tetanus, botulism and gas gangrene play a considerable role.

■ *Trypanosomiasis*

Currently animal trypanosomiasis represents, without doubt, the main constraint on farming in humid tropical, sub-humid and arid (camels) Africa. Around 30% of cattle living in the tsetse zone are exposed to the disease.

■ *Principal tick-borne diseases*

They represent a major constraint for the increase in productivity of cattle in humid and sub-humid Africa.

The main diseases are:

- ◊ *babesiosis*
- ◊ *theileriosis: essentially East Coast Fever (Theileria parva) in east and southern Africa.*
- ◊ *anaplasmosis*
- ◊ *cowdriosis which has some economic impact. This disease is often underestimated (numerous cases are unnoticed).*

NB: dermatophilosis is also a disease associated with ticks.

■ *Helminthiasis*

This represents a major constraint in Africa, particularly for intensive farming.

1.1.4 Diseases of secondary importance encountered in sub-Sahara Africa

Some diseases have been identified. Their economic impact is not considered to be a determining factor.

One can quote:

- *Bovine viral diarrhoea (BVD), mucosal disease (MD)*
- *Infectious bovine rhinotracheitis (IBR)*
- *Bovine leucosis*
- *Caprine arthritis/encephalitis : CAEV (Nigeria, Burundi)*
- *Bovine farcy*
- *Melioidosis*
- *Leptospirosis*

1.1.5 Hierarchy of health constraints by country

- *In general one can propose by order of decreasing priority:*

  - *Rinderpest, Peste des Petits Ruminants, CBPP*
  - *Trypanosomiasis*
  - *CCPP, foot and mouth disease, poxviruses*
  - *Abortions (brucellosis, Rift Valley fever)*

- *The study of respiratory diseases in ruminants constitutes a major theme for epidemiological monitoring in itself (abattoirs, areas of slaughter).*

- ***The proposed order of priority would be adapted depending on the zoosanitary characteristics of each country and the skills of the national laboratories.***

1.2 ANIMAL HEALTH AND ECONOMY

1.2.1 Economic consequences of animal diseases

De Haan and Bekure (1991) estimate that the direct costs due to mortality of herds in sub-Sahara Africa reach about 2 billion US $ per year and that the indirect costs (lowering of development rate, fertility and work for draught animals) represent the same amount. This total annual loss of 4 billion US $ per year is equivalent to 24% of the animal production in sub-Sahara Africa.

1.2.2 Estimation of the economic impact of improvements in animal health

Several economic studies are presented whose aims are as follows:

- *To evaluate the interest of the creation of vaccination programs. eg. Rinderpest, CBPP, brucellosis.*
- *To determine the economic impact of health improvements on animal production. eg. trypanosomiasis.*
- *To specify the importance of international programs of epidemiological surveillance. eg. classic swine fever; African swine fever.*

1.2.3 Rinderpest

- *In his doctoral thesis entitled "The control of Rinderpest in Côte d'Ivoire - costs and benefits of preventive campaigns. Problems posed by its eradication" (1994), Emmanuel Couacy-Hymann proposed an economic evaluation of preventative campaigns against Rinderpest. His approach is as follows: "the zoo-technical parameters of farming systems and the effects of the disease on these can give a model of animal production that determines the productivity of the herd in the presence or absence of the disease. The economic losses due to Rinderpest result in differences in production between the hypothesis "with" and "without" vaccination, calculated with the help of a computer simulation model of the changes in the herd (LivmodII).*

- *The zoo-technical parameters are taken from a sample of 139,000 cattle in the north of Côte d'Ivoire.*

- *The following hypotheses have been studied*

  - *Hypothesis A : with vaccination project*
    - *A0 :* * *Presence of Rinderpest in enzootic zone despite vaccination*
      * *Epizootic for 2 years affecting animals of 0-1 years and 1-2 years*
      * *Mortality rate : 4% 1st year*
        2% 2nd year
    - *A1 Ditto with mortality rate higher : 10% 1st year*
      5% 2nd year
  - *Hypothesis B : without vaccination project*
    - ***B1 or high hypothesis :** mortality rate 40% 1st year*
      20% 2nd year
    - ***B2 or low hypothesis:** mortality rate 20% 1st year*
      10% 2nd year

  - *In both hypotheses, A and B, **the epizootic recurs every 5 years;** which is the time necessary in order to reach a critical threshold of sensitive animals and for the herd to reconstite itself.*

  - *The projection is on a **duration of 12 years with 2 epizootic waves** (between years 5-6 and years 12-13).*

- *The costs and losses based on these hypotheses allow **the cost/benefit ratio of vaccination campaigns** to be determined.*

- *The evaluation criteria are:*

  - *The **real net value** (RNV) that is obtained by deducting the real value of costs (RVC) from the real value of benefits (RVB). This provides a precise notion of the total advantage resulting from a project.*

  - *The **internal rate of return** (IRR) currently used to compare projects.*

- ***Modelling costs and benefits of a Rinderpest vaccination project***

Simulations give the following results:

*The cost per animal vaccinated during a PARC project in Côte d'Ivoire varied from 101 FCFA **in 1989 and** 72 FCFA **in** 1991 (1 FCFA = 0.02 FF before devaluation in 1994).*

*The **internal rate** of return **oscillated between** 31.7% (10% hypothetical mortality) **and** 88% (40% hypothetical mortality), according to the mortality rate applied for the simulation in the **two hypotheses** A **and** B over a period of 12 **years** with an initial herd of 1 **million** cattle.*

*The profit created by the vaccination project varies according to the hypothesis from 518 **million** FCFA (hypothetical mortality rate of 10%) to 4883 **million** FCFA (hypothetical mortality rate of 40%). **These results fully justify the vaccination programs against Rinderpest.***

Calculation of evaluation criteria (RNV and IRR) of preventative campaigns against Rinderpest: 12 year projection for a herd of 1 million cattle; current value conversion rate: 10% (x 1000 FCFA) x (1000 cattle)

Mortality rate (A.P.)	Mortality rate (W.P.)	Without project RNV	With project NPV	Profit (*)	IRR (p. 100)
4 p. 100	10 p. 100	62 573,40	63 091,30	518	31,7
	20 p. 100	61 063,60	63 091,30	2 027,80	60,4
	40 p. 100	58 207,90	63 091,30	4 883,40	88
10 p. 100	20 p. 100	61 063,60	62 312,90	1 249,40	51
	40 p. 100	58 207,90	62 312,90	4 105	84

(*)The calculated profit does not take into account the residual value of investments and the growth of the herd. In fact the LIVMOD software is only based on the sales of animals (in our case) to calculated to desired economic parameters.

RNV : real net value
NPV : net present value
IRR: internal rate of return
A.P. : with vaccination project
W.P. : without vaccination project

E. Couacy-Hymann, 1994. University thesis.

❖ *Other examples :*

- *Nigeria 1980 - 1984*
  Rinderpest decimated 382,000 cattle and provoked emergency vaccination of more than 10 million cattle. The total loss was estimated at 2 billion US $; the specific costs of control of epizootics in Nigeria only represents 6.4% of the total (128 million US$) (According to Nawathe et al. 1984).

- *Yemen Republic*
  The estimated profit resulting from vaccination against Rinderpest is 5.4 million US $ per year. This represents about 20% of imported animals each year (A. James, 1991).

- *Ethiopia*
  Tambi and Coll (1998) studied the economic losses due to Rinderpest and the profits engendered by its control concluded:

  The total annual economic loss due to Rinderpest in Ethiopia is 9.3 million US $ and 4 US $ per animal.

  Thus it is clearly demonstrated that the PARC campaigns in Ethiopia with a cost of 0.24 US $ per animal are economically profitable and contribute significantly to the increase in the gross national agricultural product and to the maintenance of food security in Ethiopia.

1.2.4 Contagious bovine pleuropneumonia

- *J.N. Nwanta and J.U. Umoh (1992) studied the epidemiology of CBPP in the northern states of Nigeria (1992) and showed that over a period of 20 years there was a close negative correlation between the number of vaccinations and the number of outbreaks declared.*

The results showed clearly that when the vaccination campaigns were intensified between 1975 and 1986 the number of herds affected diminished significantly.

CBPP Outbreaks and campaign situation in Nigeria 1970-1989.

Year	*No. of outbreaks*	*No. of animals in the affected herds*	*Total death record in the affected herds*	*Mortality (%)*	*Vaccination figures*
1970	*38*	*3 385*	*534*	*15.8*	*326 392*
1971	*89*	*4 830*	*700*	*14.5*	*1 448 288*
1972	*111*	*14 718*	*3000*	*20.4*	*2 602 212*
1973	*47*	*14 139*	*2237*	*15.8*	*2 500 672*
1974	*71*	*8 434*	*725*	*8.6*	*3 014 601*
1975	*35*	*5 392*	*303*	*5.6*	*2 911 246*
1976	*35*	*3 868*	-	-	*3 485 013*
1977	*15*	-	-	-	*2 200 000*
1978	*23*	*7 260*	*608*	*9.8*	*4 542 566*
1979	*15*	*1 570*	*177*	*11.2*	*5 246 988*
1980	*28*	*2 612*	*309*	*11.8*	*6 236 888*
1981	*11*	*1 454*	*77*	*5.3*	*5 900 000*
1982	*36*	*4 735*	*415*	*8.7*	*6 083 475*
1983	*13*	*1 025*	*133*	*13.0*	*4 065 710*
1984	*28*	*1 875*	*204*	*10.9*	*3 642 122*
1985	*25*	*2 386*	*255*	*10.7*	*4 916 682*
1986	*46*	*6 293*	*343*	*5.5*	*6 897 793*
1987	*49*	*5 133*	*559*	*10.9*	*4 980 474*
1988	*64*	*5 584*	*531*	*9.5*	*3 747 587*
1989	*125*	*10 871*	*812*	*7.5*	*2 986 825*

Source : National Rinderpest / CBPP control programme. Annual Report on Field Activities (1984 :1989). Federal Department of Livestock and pest control services, Kaduna, Nigeria.

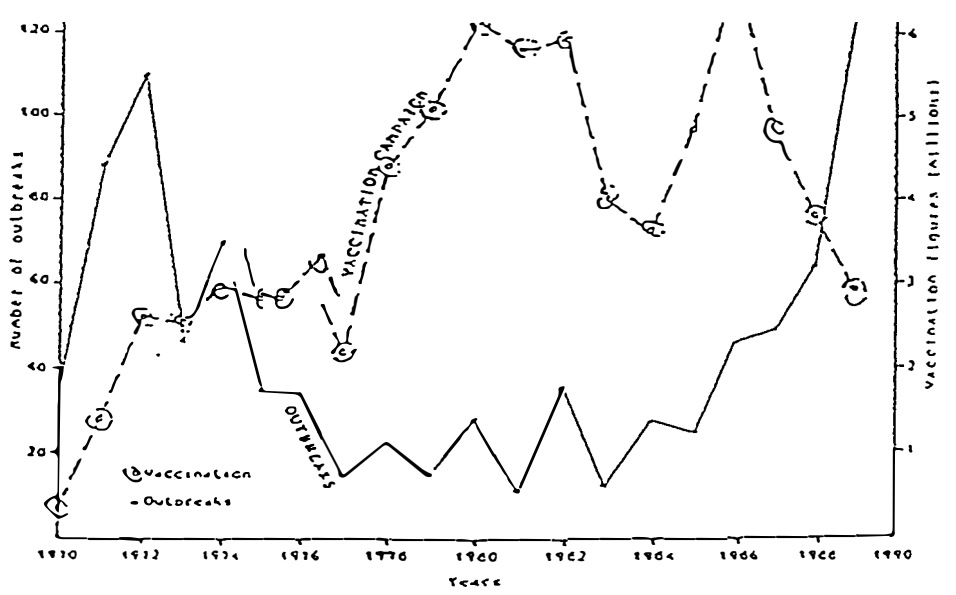


Fig. 1 : The relationship between vaccination campaign and incidence of CBPP in Nigeria (1970-1989).

Nwanta J.N., UMOH J.U. - Epidemiology of Contagious bovine pleuropneumonia (CBPP) in Northern states of Nigeria : an update. Rev. D'Elev. Med. Vet. Pays Trop. 1992 - 45(1) : 17-20.

- *S.B. Oluokun (1980), studying the cost/benefits of CBPP control programs in Nigeria showed :*

  - *The total loss due to CBPP in Nigeria in the absence of control programs for the disease is 500 million Naira.*
  - *The total loss due to CBPP within an eradication /control program such as JP28 is 200 million Naira.*
  - *The total profit due to tactical eradication /control is therefore around 300 million Naira.*
  - *The total cost of campaigns of continuing or proposed eradication / control being about 20 million Naira, the cost/benefit ratio of such a campaign is around 15/1, which fully justifies the creation of these programs of health improvement.*

1.2.5 Bovine brucellosis

J. Domenech et al. (1982), studying the economic impact of bovine brucellosis in central Africa (Chad, Cameroon) as well as the costs and benefits of improvement operations, clearly demonstrated that:

- *Bovine brucellosis in the region where the infection rate is 30% of reproductive females (thus about 20% of the total herd) causes economic losses of about 5.8% of the gross revenue per animal.*

- *The use of a computer simulation model has permitted the calculation of costs and benefits of improvement operations in the zones with infection rates of 30 and 40%.*

  In both cases, improvements due to vaccination represent a definite economic interest, by extrapolating to the impact on public health, particularly in the zones where the infection rate is very high (40%).

1.2.6 Animal trypanosomiasis

Tsetse flies limit or prevent animal production in humid tropical Africa over an area of nearly 7 million km² which would otherwise provide important potential grazing. The experts estimate that 33 million extra cattle could be farmed.

FAO indicates that 60 million cattle and 100 million small ruminants are currently exposed to the disease.

■ *What are the direct effects of trypanosomiasis on sensitive cattle ?*

- *Reduction of birth rate by 10 to 20%*
- *Increase in mortality rate of calves by 10 to 20%*
- *Reduction in milk production of 10 to 40%*
- *Reduction in meat production of 5 to 30%*
- *Reduction in work by harnessed cattle of 30%*
- *Reduction in production of small ruminants by 5 to 38%*

In general, trypanosomiasis reduces the cattle density by 37% in sub-humid zones and by 70% in humid zones, and the total agricultural production is reduced by 2 to 10% in these same zones (B. Swallow, PAAT Maputo, 1997).
In the mixed agriculture/stock-breeding systems, the areas of cultivation or farming can be reduced by 50%.

The sub-humid zones provide an important potential to cope with projected meat deficits in sub-Sahara Africa, subject to control of trypanosomosis. According to the World Bank calculations, animal production must increase in the next 30 years by around 4% per year to cover the African demand (1.1% per year for bovine meat). Msellati and Tacher (1991) comparing zones unaffected by tsetse flies and treated zones estimated that eradication of tsetse flies could increase meat production by 16% and milk production by 18% for ruminants in sub-Sahara Africa.

1.2.7 Classic swine fever

■ *Based on cost/benefit analysis, James and Ellis (1979) evaluated the impact of vaccination in financial and statistical terms:*

- *The expected net profit from vaccination is about 4 ECU / pig*
- *The probability of non-vaccinated pigs becoming infected is 0.17 while the same probability for vaccinated animals is only 0.0085.*

■ *Ellis et al. (1977) used this same method in order to propose a standard control strategy against classic swine fever applicable to the whole of the European Union. The absence of common health policies limits commercial flow.*

- *They compared four possible strategies:*

  A - Each European country continues to apply its own strategy
  B - Indefinite mass vaccination
  C - Cessation of vaccination; serological surveillance and elimination of positive animals
  D - Same as C but more intensive

- *They clearly concluded that in terms of costs and benefits the best strategy is C: a halt in vaccination, serological surveillance and elimination of positive animals.*

- *Over 10 years, with respect to strategy B:*

  A - costs 4 times less
  D - costs 4.8 times less
  C - costs 6.15 times less

1.2.8 African swine fever

- *This disease was declared in the Côte d'Ivoire in 1996, resulting in the death of 40,000 pigs and the emergency slaughter of 80,000 animals resulting in a total loss of 120,000 head between May and July 1996.*

  The farmers received compensation of 1.8 billion FCFA (2,7 million ECU) from the Côte d'Ivoire state.
  The total economic cost is estimated at 10 billion FCFA per year (15 million ECU).

- *Following this epidemic, FAO set up a TCP for the implementation of an emergency network of regional epidemiological surveillance in eight countries (Benin, Burkina-Faso, Côte d'Ivoire, Ghana, Guinea, Liberia, Mali and Togo). The proposed budget for this TCP FAO is 286,000 US $ or 268,000 ECU.*

  The interest of such a preventative strategy is evident in the light of payment of 2.7 million ECU in 1996 by the Côte d'Ivoire government to compensate the farmers who were victims of African swine fever; the total economic cost was 15 million ECU following the epidemic of 1996.

2.
ACTORS AND TOOLS

First of all the actors and tools available for intervention in support of the future control program for Rinderpest and the other dominant diseases in sub-Sahara Africa should be placed briefly in perspective. During the course of the present summary, their roles will be amplified in detail.

2.1 THE ACTORS

2.1.1 The farmers

In terms of Rinderpest control, the farmer will find himself in two situations:

- to be associated with vaccination of his herd
- to be at the heart of a surveillance network

For this second point in particular, it is important to motivate the farmers and to provide them with specific information to encourage them to declare a pestivirus like disease.

2.1.2 Farmers associations

They favour the establishment of surveillance networks and participate actively in Animal Health Associations (AHA).

2.1.3 Animal Health workers

Their role and allocation can vary depending on the national and local (ethnic) context. A sociological approach may be necessary: the power conferred by the possession of medicines and their usage can damage the traditional power within a given ethnic group. At their level, the auxiliaries will play an essential role as part of epidemiological vigilance (training).

2.1.4 The veterinary services

Faced with the development of the free sector, the State veterinary services have lost importance. They have an essential role to play in matters of control of epizootics. This includes an organisational (farmers' co-operatives, for example), institutional and, in particular, statutory (sanitary mandate, veterinary association) viewpoint, in addition to public hygiene. The future PARC program must be an integral part of the national veterinary services. It will be the "pivot" of the animal health department of veterinary services in a country.

2.1.5 The liberal veterinary sector

The involvement of private veterinarians in the control of Rinderpest is dependent on the existence of a ***sanitary mandate*** *involving rights and duties in relation to the State. This mandate must include the other major diseases.*

The situation in the liberal sector is very variable depending on the country and should be harmonised. Some countries have not yet created ***veterinary associations,*** *nor have they set up* ***sanitary mandates.***

Moreover, this idea of sanitary mandate is often badly integrated by the agents in veterinary practice. As part of the future program, problems such as the method of ***payment for private veterinarians,*** *the means for aid and* ***fiscal help for installation,*** *along with* ***further education*** *of independent practitioners under the auspices of the sanitary mandate will be considered.*

2.1.6 Abattoirs and slaughter areas

Renovation *of some of these structures must be envisaged. Surveillance at the level of abattoirs provides* ***important information*** *for the determination of the prevalence of CBPP in a country and the screening of possible attenuated forms of Rinderpest.*

2.1.7 National laboratories for veterinary analysis

The ***relations PARC/Laboratory*** *should be redefined and harmonised. The status of these laboratories with respect to PARC co-ordination is often ill defined and differs between countries. The future program must provide* ***direct financial and technical support*** *to these laboratories in the fields which concern them (serology and microbiology) notably for specific laboratory equipment, consumables and working budgets.*

2.1.8 Technical assistance

The maintenance of a technical assistance in the ***cordon(s)*** *as well as in* ***recently infected or infected countries*** *is necessary.*

2.1.9 Regional units

In the proposed strategies, the role of current co-ordinators (Bamako, Nairobi) should be reinforced in the field of epidemiological surveillance and ***extended to other spheres*** *in the following sectors:*

- *Laboratories*
- *Animal Health Associations*
- *Quality control of vaccines used in the field*

2.1.10 Reference laboratories

The regional and world reference laboratories have a primordial role of scientific support and network co-ordination of the regional and national laboratories.

2.1.11 International organisations

They intervene through OAU/IBAR (European Union) each one in their field of competence. In the future program, the institutional and technical co-ordination between OIE, FAO, IAEA, PANVAC and the reference laboratories on one hand and OAU/IBAR on the other must be reinforced.

2.2 THE TOOLS

2.2.1 Vaccines

■ *Rinderpest*

It is currently recommended that the use of the thermostable vaccine be standardised taking into account the following constraints:

- ❖ *The technology transfer to producing laboratories involves good quality industrial equipment, maintenance and training.*
- ❖ *The relative thermostability involves information for the users.*

The proposed end to the use of Rinderpest vaccine in ruminants leads to a change towards use of vaccine for peste des petits ruminants. This will allow the differentiation of infected and vaccinated animals. This outlook is more fully explained in the chapter "Lines of research".

■ *Contagious bovine pleuropneumonia*

The weak immunity conferred by the current vaccine leads to the development of several lines of research aiming to ameliorate the thermostability, the duration of immunity and the safety of vaccines. These projects are presented in the chapter "Lines of research".

■ *It is evident that the external thus independent context of the control carried out by the PANVAC laboratory (Ethiopia) must be maintained and reinforced. This important point is developed in the chapter "Technical strategies".*

2.2.2 Epidemiological methodology

- *It seems necessary to reinforce the capacities of national constituents in the field of **sampling** (serological monitoring, serological surveillance..), data **analysis and exploitation of results**.*

- *The use of **geographic information systems (GIS)** applied to the control of infectious diseases is recommended.*

  *This is involved in terms of the spatial representation of different data (**cartography**): **movements and density of herds** (including the wildlife : contact zones between domestic and wild ruminants), vaccination coverage…*

  The development of GIS sensu stricto could be the object of a specific research program in the future and could result in a helpful tool for use in decision making. In the framework of emergency intervention plans, a geographical information system could also allow the rationalisation of interventions in the management of an outbreak taking into account its locality, the buffer zone, the distances between the outbreak and the veterinary services, the number of animals the road access, etc…

2.2.3 The legislative apparatus

*The **legislative texts** must be defined within the frame of national directions of veterinary services in close co-operation with the future program. They concern:*

- *Passports / **international certificates** of vaccination in the sanitary cordons*
- *The **Animal Health Associations (AHA)***
- ***Legally contagious" diseases***
- ***Surveillance measures***
- *The **emergency preparedness plannings***
- *The **sanitary mandate***
- *The **veterinary associations***

This indispensable regulatory context should allow the state veterinary services to reposition themselves with respect to the farming agents.

2.2.4 Standard methods of laboratory analysis

*OIE and AIEA/FAO have **validated** a certain number of standard methods with the assistance of world reference laboratories (c-ELISA and Rinderpest immunocapture, CFT for CBPP). Others are in the process of validation (c-ELISA CBPP).*

2.2.5 *Communication*

*This section must be reinforced with respect to the **epidemiological surveillance network**. Its role is essential to insure the setting up and assessment of **sanitary cordons** and the farmers' information for the declaration of **Rinderpest-like-diseases**.*

2.2.6 *Training*

*This concerns **all the actors of the epidemiological surveillance network**. This section is fully explained in the present report.*

3. TECHNICAL STRATEGIES

*This chapter explains in detail the technical strategies permitting the member countries of the proposed program to **undertake control of Rinderpest within the procedures of OIE**. It also considers progressively the other major zoosanitary constraints within the integrated strategies whose "pivot" is represented by the "**national system of epidemiological surveillance** ".*

3.1 EPIDEMIOLOGICAL SURVEILLANCE AND THE NATIONAL SYSTEM OF EPIDEMIOLOGICAL SURVEILLANCE (NSES)

3.1.1 *Generalities*

- *Epidemiological surveillance is a method based on continued recording that allows the state of health or the risk factors of a defined population to be assessed. In particular it slows down the appearance of pathological processes and permits studies of the development over time and space of the adoption of appropriate measures of control (Glossary of epidemiology, Toma, B. et al, 1991).*

- *Epidemiological vigilance is just a form of epidemiological surveillance aiming to locate the introduction of disease absent in the country.*

■ *Epidemiological surveillance is characterised by:*
- ❖ ***simplified procedures of data collection***
- ❖ ***representative sampling*** *of farming or villages under study*
- ❖ ***rapid circulation of reliable information*** *from the decision makers and the field agents*

■ *All the available human and technical means within a country, whose aim is to collect* ***analyse*** *and retransmit information, constitute* ***the national system of epidemiological surveillance*** *(NSES). Its aim is to provide the decision-makers with reliable information in time limits compatible with decision making. The services in charge can prioritise the diseases, establish strategies, determine actions to undertake and evaluate the impact of actions based on this information.*

For a NSES to be able to carry out its role, at least two conditions must be fulfilled:
- ❖ *the durability of the system put in place*
- ❖ *the co-operation of the maximum number of agents*

■ ***Reminder of definitions***

❑ *Serological monitoring:*

This is the research by serological methods for the presence of antibodies in vaccinated animals. In reality, it is the ***search for negative animals*** *in a population previously considered positive.*

❑ *Serological surveillance:*

This is the research by serological methods for the presence of antibodies in non-vaccinated animals. It is an ***active search for positive animals*** *in a population previously considered negative. It is one of the methods used to confirm that the Rinderpest virus is not circulating.*

3.1.2 Specific objectives of a NSES:

■ *In a country, the* ***current Rinderpest network*** *represents the first* ***component*** *of the system. Within this framework, the aim is to* ***extend the epidemiological surveillance to other diseases,*** *taking into consideration the dominant pathologies by country (CBPP in the first place, of course.)*

■ *The* ***future sera collections*** *for Rinderpest constitute a precious sampling basis for the approach to other diseases.*

■ *Very schematically, the objectives of a NSES are of two orders:*

❑ *In the first place,* ***ensuring active surveillance of Rinderpest.*** *This includes:*
- ❖ *For infected countries :*

- *Active research for residual outbreaks (clinics and laboratory support)*
- *The study of methods of progression of the disease*
- *The setting up of control strategies (vaccination, serological monitoring...)*

❖ *For the sanitary cordons:*

Control strategies: Cf. above.

❖ *For unaffected countries:*

- *Serological surveillance, clinical surveillance and active searching for the virus according to the OIE pathway (1993).*

❖ *An early warning system and emergency preparedness for all the countries.*

❑ *Ensuring **passive and active epidemiological surveillance** of the territory: taking into account the main health constraints of each country (Rinderpest, PPR, CBPP..)*

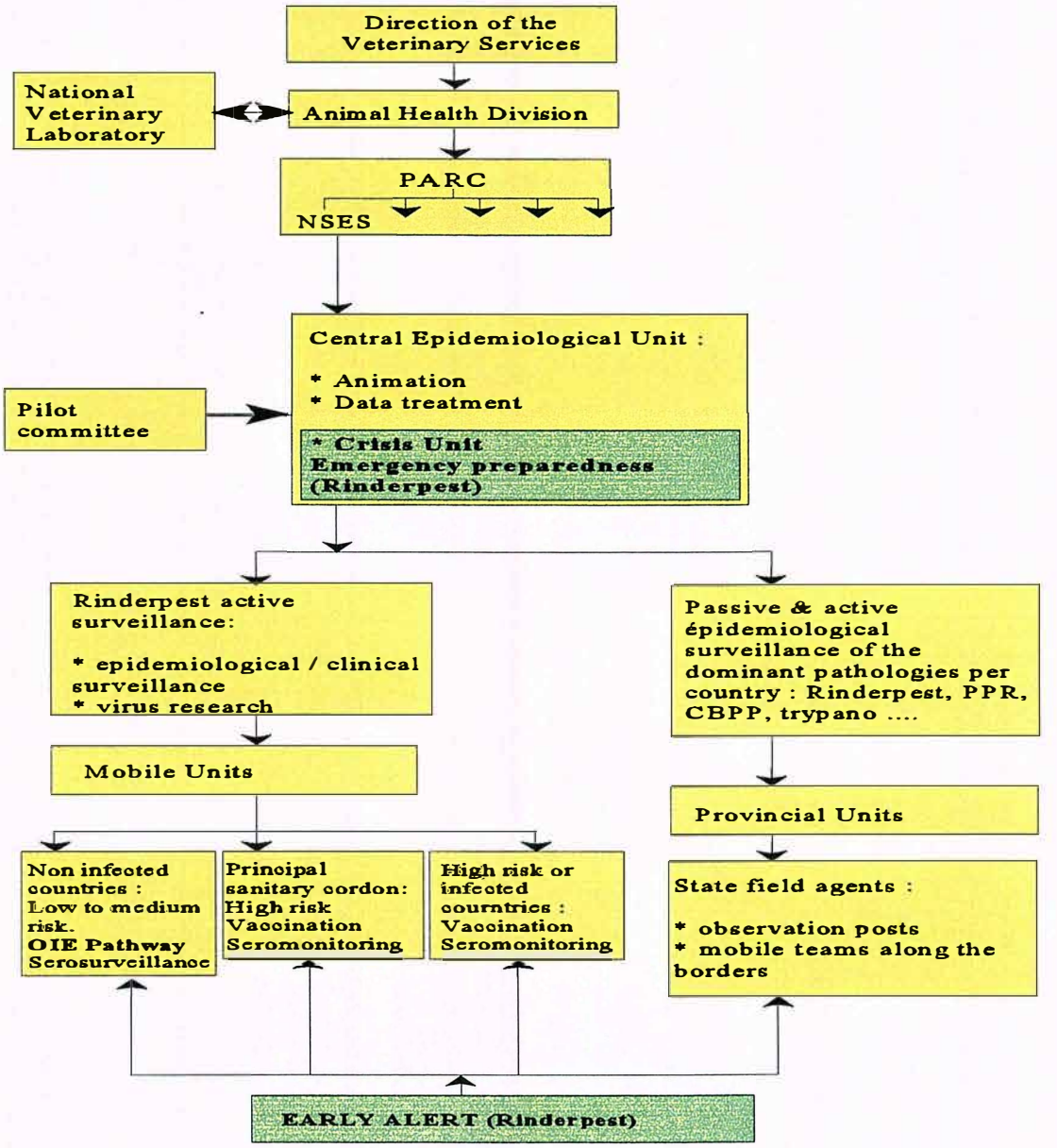
3.1.3 Definition of six groups of countries in terms of the Rinderpest situation

Groups	Country or Régions	Risk for Rinderpest	Strategies
① Coastal Africa	■ Côte d'Ivoire ■ Bénin ■ Congo ■ Gabon ■ Ghana ■ Guinea Bissau ■ Libéria ■ CDR Ouest ■ Sierra Léone ■ Togo	Very weak	**OIE Pathway**
② Sahelian Africa	■ Sénégal ■ Burkina Faso ■ Gambie ■ Mali ■ Mauritania	Weak	**OIE Pathway**
②/③ Sahelian Africa Country type : Chad	■ Cameroon * ■ Niger ■ Nigéria	Average	**OIE Pathway**
③ Central Africa	■ Chad ■ RCA	High	**Principal Sanitary cordon** (includes the Western part of Sudan) **Vaccination & Vigilance**
④ Africa of the Great Lakes	■ Uganda ■ Burundi ■ CDR-Est ■ Rwanda ■ Tanzanie-West ■ Zambie	Very high	**Limited vaccination** (including Uganda) **Cordon & Surveillance**
⑤ Infected countries or recently infected	■ Ethiopia ■ (Djibouti) ■ Erytrea ■ Kenya ■ Somalia ■ Tanzanie-North ■ **Sudan** **	Infected or very high risk	**Maximum vaccinal coverage** in totality or in part (sectorial cordons) **Surveillance**

** In order to further harmonize the different groups on an epidemiological point of view, it might be necessary to include the Southern aeras of Nigeria and Cameroon in group 1. ** The outbreaks in Sudan have been located in the Eastern part of the country (Right bank of the Nile) whereas the Western part seems unafected.*

3.1.4 Proposed general scheme for a NSES

■ *Considering the identified objectives (Cf. paragraph 3.1.2) and the geographic situation of Rinderpest (Cf. paragraph 3.1.3) the following scheme is proposed:*



■ *The partners of NSES are essentially:*

- ❖ *The veterinary services direction (VSD) in charge of the system*
- ❖ *The national co-ordinator of the PARC project*
- ❖ *The veterinary board council and the professional associations*
- ❖ *The national veterinary laboratory*
- ❖ *The agents of public and parapublic organisations involved in farming*
- ❖ *The private veterinarians*
- ❖ *The slaughter houses*
- ❖ *The farmers, farmers associations and Animal Health Associations*

■ *Comments*

- ❑ *One of the major concerns of the proposed program is to be able to provide **institutional support** to the member countries by the creation of **durable** NSES associating all the agents and whose **first vocation resides in epidemiological surveillance of Rinderpest in the countries where it no longer exists.***
  *On the other hand, **the control of this disease, as well as active surveillance, remains an absolute priority in the infected countries or those with a high or very high risk.***
- ❑ *Considering the specific zoosanitary situation with regard to Rinderpest and other major diseases, each member country of the proposed program could decide, within the framework of its NSES to broach **other themes such as CBPP**, by defining the **particular protocols** of control and epidemiological surveillance adapted to each disease considered by the NSES.*
- ❑ *In this perspective, the logistic and financial advantage of a NSES resides in the fact that the **"basic" agents are in general the same for the different "themes".***
  On the other hand, while a country would have been recognised as unaffected by Rinderpest according to the OIE, its NSES will continue to "take charge" of other dominant diseases.
- ❑ *Thus, the creation of the NSES will permit installation of **durable and polyvalent systems without the creation of heavy and costly structures.***
- ❑ *The constitution of a NSES implies the **re-positioning of national veterinary services** that are often unmotivated and unstructured faced with the growth of the liberal sector as well as the **reinforcement of their missions.***
- ❑ *Finally, the NSES must favour the creation of a **consultation forum of the different agents;** this aspect is currently very much at fault in the national constituents visited by the consultants.*

3.1.5 Description and calculation of costs of different constituents of a NSES

■ ***Pilot committee***

- ❑ *Chaired by the director of veterinary services, it is the organ of decision that defines the policies to be carried out.*
- ❑ *It determines the working themes, supervises the central epidemiological unit, governs the different possibilities between the agents, and controls the edition and diffusion of a periodical information bulletin.*
- ❑ *No specific costs identified at this level.*

■ ***Central epidemiological unit***

- ❑ *It is the kingpin of the NSES*
- ❑ *It regroups the national skills available in epidemiology, diagnosis, statistics, computing, communication ...*

- *The assignments are :*
  - *At the start, at the request of the pilot committee to set up different levels of NSES, to specify the objectives, to redirect the internal regulations.*
  - *To establish on the other hand the sampling bases, to standardise the collection procedures as well as their periodicity, to determine the supports and methods of information diffusion.*
  - *To organise the network: training of interviewers, centralisation, analysis and diffusion of information*
  - *To set up crisis units for Rinderpest (emergency preparedness)*

- *Estimation of costs for the central epidemiological unit*

  - *The two main organisations involved are*
    - the Director of veterinary services
    - the national veterinary laboratory
  - *Two 4x4 vehicles: 25,000 ECU x 2 ..... 50,000 ECU*
  - *Computer equipment, sampling material,*
    treatment of samples, autopsy instruments ..... 15000 ECU
  - *Photocopier ..... 5000 ECU*
  - *Communication*
  - *1 fax/telephone ..... 1500 ECU*
  - *Edition: information bulletins, posters, notices*
    questionnaires ..... 15000 ECU
  - *Field trips:*
    Two people 60 days x 2
    50 ECU x 60 x 2 ..... 6000 ECU
  - *Responsibility allowance: 25% monthly salary*
  - *Assignment expenses for intervention in the field are also planned for the mobile units, the provincial units and the field agents (Cf. § 5.3, 5.4, 5.5)*

- *GIS and infectious disease: Rinderpest and CBPP*

The installation of mapping systems and geographic information necessitates having reliable field data available. These data will come from NSES for financial reasons.

GIS and animal movements

Aims:
- *Improve definition of risk zones for Rinderpest and CBPP*
- *Identify the control zones (cordon)*
- *Identify the meeting zones (vaccination)*

Implementation by:
- *Use of existing but dispersed data (e.g. Chad)*

- *Acquisition of data: NSES (and frequent surveys); geo-reference of departure and arrival points.*

To represent not only the movements but also the quantitative aspects.

Costs of software:

MapInfo Professional 4.5 : . . . . . 2000 ECU (before tax)
Outil Fluxour (cartes de flux et d'oursins:
representation of exchanges, importance of movements,
realisation of centres of attraction, etc . . . . . 460 ECU (before tax)
GPS . . . . . 800 ECU (before tax)

Support mission
To be implemented at the level of co-ordination in Abéché for the sanitary cordon and the regional co-ordination.

GIS and the Emergency Plan

Use of a GIS integrating the previous data (movement) and logistic data; management of outbreaks ie. taking into account the following data: localisation of outbreaks, buffer zone, distance between outbreak and veterinary services, number of animals, road access etc..

Management by the co-ordination and development in the NSES (integrating within the epidemiological units).

- ***Mobile units: Rinderpest***

  - *OIE Pathway*

    - *The objectives are:*

- serological surveillance
- clinical surveillance
-active search for the virus
- rapid intervention

  - *Standard sampling methods for epidemiological surveillance of Rinderpest (OIE, 1993) :*

    - ***Serological surveillance:***

The basic principle of sampling is as follows:
300 herds / stratum for 3 years

The number of blood samples will be ***from 10 to 57 per herd of 10 to 100 animals****. This corresponds to the sample size necessary to obtain a probability of 95% detection of a disease whose prevalence is 5% among animals non-vaccinated for more than 1 year.*

❖ *Clinical surveillance*

*Same principle: **300 herds / stratum for 3 years.***
Corresponds to the sample size necessary to obtain a probability of 95% detection of a disease whose prevalence is 1%. A stock can be composed of 10 to 1000 animals for example.

❖ *Rapid emergency preparendness*

- In case a suspected case of Rinderpest is confirmed, an emergency intervention plan must be available and thus previously defined.

- The efficacy of the plan could be tested using simulations based on an identified source of CBPP or foot and mouth disease, for example, and thus lead to an analysis of the critical points in order to reinforce the capacities.
- Basic logistics must constantly be provided:
*. **A stock of Rinderpest vaccine** is available*
. A permanent veterinary cash advance for rapid intervention
*. Field intervention: one specific **4x4 vehicle** and an identified **mobile team** (veterinary services + laboratory) ready to intervene.*
*. A **national operational laboratory** (Cf. chapter "PARC support to laboratories")*

❑ *Outside of the OIE Pathway:*

Mobile units planned for unaffected areas, buffer zones, cordon sanitaires and infected areas in particular for vaccination, serological monitoring and surveillance.

❑ *Number of strata per country*

❖ *The strata allow the population to be subdivided into groups exposed to the same risks of persistence of Rinderpest.*
❖ *The risks depend on*
** the geographic region*
** the production system*
❖ ***Within the OIE pathway one can consider 1 to 3 maximum strata per country***
❖ ***Outside the OIE pathway : for harmonisation one can also retain the idea of strata for a buffer zone, a sanitary cordon and an infected zone.***

❑ ***In principle, one mobile unit per stratum,** except for the main sanitary cordon for which are proposed two mobile units for each of three countries concerned (Chad, CAR, south Sudan) being six mobile units in total in this cordon.*

❑ *Estimation of costs for a mobile unit:*

- ❖ *1 4x4 vehicle per unit. . . . . 25,000 ECU*
- ❖ *Autopsy kit + material . . . . . 2,000 ECU*
- ❖ *Diverse field equipment (conservation) . . . . . 5,000 ECU*
- ❖ *1 mobile team composed of*
  - *1 veterinarian*
  - *1 technician*
  - *1 driver*
- ❖ *staff expenses:*
  - *per diems for field trips. . . . . 10,000 ECU/year*
  - *incentive allowance: 25% of monthly salary*
- ❖ *Running costs (petrol, vehicle maintenance consumables) . . . . . 10,000ECU / year*

■ *Provincial units*

❑ *Considered as indispensable relays between the central epidemiological unit and the field agents to ensure good co-ordination of the NSES, the diffusion of information and training.*

❑ *1 provincial unit for 10 field observation posts.*

❑ *Estimation of costs for a provincial unit :*

- ❖ *1 4x4 vehicle per unit. . . . . 25,000 ECU*
- ❖ *1 cold chain (acquired in general)*
- ❖ *The team is composed of :*
  - *1 state veterinarian*
  - *1 driver*
- ❖ *Per diems for field mission: . . . . . 3,000 ECU/year*
- ❖ *Running costs (petrol, vehicle maintenance, telephone, electricity) . . . . . 5,000 ECU /year*
- ❖ *Incentive allowance: 25% of monthly salary*

■ *State field agents*

❑ *The tasks of these agents are as follows:*

❖ *Observation posts:*

* *Active epidemiological surveillance of the territory for Rinderpest and the other major health constraints identified per country (clinical assessments, questionnaires, surveillance of markets, abattoirs..)*

* *The role of questionnaires is important to provide information on the actual situation of Rinderpest in a given zone, for example in order to try to prevent the possible extension of the disease. They provide useful information on herd movements (nomads, commercial flow, markets ..). Ethiopia uses very complete specific questionnaires for the nomadic zones and the highlands. They must be extended to CBPP and other dominant diseases. The questionnaires are*

considered a good approach to facilitate and reinforce the relations on the field between the veterinarians, the technicians and the stockbreeders and to maintain a state of alert.

* *Control of vaccination certificates and international passports.*
* *For Rinderpest in particular: early warning system,*

Reminder: one provincial unit for 10 observation posts.

❖ *Mobile teams along borders:*

* *Known as "Goumiers" in the Central African Republic*
* *Their role is to collect information from the borders (herd movements, vaccinated and non-vaccinated animals, disease identification)*
* *No direct control role*

❑ *Estimation of costs for these agents:*

❖ *Observation post:*

** one post over 5 years*
** one state agent: 12 months salary: . . . . . 2,000 ECU/year*
** one incentive allowance: 25% of monthly salary . . . . . 500 ECU/year*
** one motorbike per agent: renewable after 3 years*
3600 ECU/3 years = ... 1,200 ECU/year
** autopsy kit (renewed once) . . . . . 100 ECU /year*
** ice box + ice packs . . . . . 200 ECU/year*
** NB: renewal: 1/2 refrigerator / 5 years*
** running costs + motorbike maintenance . . . . . 1,000 ECU/year*
TOTAL: . . . . . 5,000 ECU/year
** The number of observation posts necessary per country will be defined by the OAU-IBAR taking into account the number of heads of cattle (bovine, small ruminants) / territory surface.*

❖ *Mobile teams along the borders:*
** one "Goumier" per border posts*
** salary: 125 ECU/month x 12 = ... 1,500 ECU/year*
** incentive allowance: 25% of monthly salary . . . . . (375 ECU/year)*
** means of locomotion (scooter, motorbike or horse)*
1 motorbike : approximately . . . . . .3,600 ECU
(taking into account material about to be supplied)
** running costs: . . . . . 1,000 ECU/year*
** The number of agents along the borders is also defined by country by OAU/IBAR, taking into account the health risks of the sub-region and the length of state borders.*

■ *How are the agents of a NSES motivated ?*

❑ *A question:*
*How can one **keep a permanent field network going** while the fear of Rinderpest is remote and when a more 'insidious' and 'less evident' disease, CBPP, makes it difficult to mobilise the farming partners?*

❑ *Elements of the answer:*

❖ *2 possibilities:*
* *Either with **no incentives**; the participation in a NSES forms part of the farming agents' work. It is a change of function: the vaccination over, the time for surveillance has come!*
* *Or on the contrary, **an incentive is possible**.*

❖ ***In this case, definition of a "lump sum":***
* *Inconvenience : however much, it risks being considered as a prerogative.*
* *So a parallel **evaluation system** must be implemented: a **budget is allocated depending on the results**. The agents are remunerated in relation to the quality and quantity of work provided.*

❑ *General methods of attribution of incentive allowances*

❖ *A **budget is allocated per country**. The regional supranational unit in consultation with the central epidemiological unit of the NSES of each country manages it.*

❖ *The sum is spread between the agents involved in the network: co-ordinator, administrative agents, field agents, laboratories, private veterinarians, farmers*

❖ *The sum is put at the disposal of the regional unit by the PARC headquarters twice a year*

❖ *Advantage of regional unit management*
* *it is not a privilege for the employees*
* *this must not put the country in difficulty (it is not an acquired advantage).*

❖ *The plans are:*
* *an **evaluation sheet per employee***
* *an **overall evaluation per country***

❑ *Proposals for:*

❖ *The **state agents:***
*An allocation corresponding to **25% of the monthly salary** is proposed for different levels of the NSES: Central epidemiological unit, mobile units, provincial units, field agents (observation posts, mobile teams along borders).*

❖ *The **private veterinary practitioners** :*
*Within the exercise of the clients, they will be granted a **sanitary mandate** for epidemiological surveillance of Rinderpest (OIE pathway) and the major diseases (CBPP in particular). In addition, there will be a mandate for the active search for pest virus and their participation in the early warning system and emergency preparedness.*
*In this respect, an incentive allowance of **5,000 ECU per year** (corresponding to the annual costs of an observation post) is proposed.*

❖ *The **farmers** :*
*Direct support for the **farmers' associations** or the **Animal Health Associations** would be preferable in the first place along with a system of running costs (purchase of medicines etc).*
*However, at the individual level one could consider an allowance to **motivate the farmers** to maintain the active search for the virus, **mainly in the zones unaffected by Rinderpest**. The allowance could be **50 ECU** for each confirmed alert (Cf. above), preferably in the form of **animal care or medicines**.*

The methods of granting this allocation to the farmers are as follows:
* *The eligible Rinderpest-like diseases, corresponding to a stomato-enteric syndrome not including Rinderpest, are PPR, IBR, BVD/ MD and malignant catarrhal fever, with the **exclusion of foot and mouth disease**.*
* *The establishment of a clinical relationship to a Rinderpest like disease by the veterinary services.*
* *A confirmed laboratory result at the regional level demonstrating a disease corresponding to the list of eligible diseases.*

The farmers' allocation could be distributed directly by the national constituent without agreement of the regional unit. This would simplify the process and keep up their motivation.

3.1.6 Evaluation of a NSES

■ ***Proposals for performance indicators***

In order to evaluate the efficiency of the implementation and the running of this structure, a certain number of indicators are proposed:

❖ *The **prescribed deadline for the creation of a national network is respected***
❖ *For Rinderpest, the **status of a country** with respect to the OIE pathway is **maintained** (unaffected countries) or **advanced** (infected countries becoming provisionally free).*
❖ *The **standard sampling methods for epidemiological surveillance of Rinderpest** (clinical and serological surveillance) **are effectively applied: 300 herds / strata over 3 years***
❖ *The **time limits for transmission and employment of questionnaires** (zoo-sanitary forms) and reports required by the Central Epidemiological Unit are respected: **more than 80%** of these documents supplied to this unit within the required deadlines.*

- ❖ *Early warning system and emergency preparedness:*
  - * *80% of all the agents alerted within 72 hours*
  - * *The Central Epidemiological Unit reacts in the field within 48 hours (Mobile Unit present)*
  - * *All the identified clinical cases of Rinderpest-like-diseases are taken into account by the Central Epidemiological Unit*
  - * *To test this indicator (notably in the unaffected countries) an early warning simulation and rapid intervention is envisioned and the reactions of this simulation are evaluated*
- ❖ *Support from national laboratories: all the samples corresponding to Rinderpest-like diseases (stomato enteric syndrome) are analysed by the laboratory within time limits compatible with the methods of analysis used, and transmitted to the regional laboratory.*
- ❖ *In the case of a confirmed source of Rinderpest, the Director of veterinary services of a country immediately warns the headquarters of OAU/IBAR in Nairobi via the intermediary of the regional unit as well as the OIE.*
- ❖ *The implementation of an epidemiological surveillance network for the other dominant diseases (notably CBPP) is effective within a time limit of 2 years after the commencement of a NSES in a given country*

■ *External audit of the network*

- ❖ *An external evaluation of the NSES is necessary*
- ❖ *It could be carried out by OIE: by groups of countries within the OIE pathway.*

Reminder: the regional unit who co-ordinates the NSES evaluates them continuously.

3.1.7 Training plan for a NSES

■ *Field agents*

- ❑ *General training*
  - * *Epidemiological surveillance (NSES)*

- ❑ *Specific training*
  - * *Clinical diagnosis, necropsy, inspection of abattoirs*
  - * *Sampling (type, packaging, transport)*
  - * *Survey forms*

- ❑ *In each country*

For all the executives and technicians concerned (including the private veterinarians):

- * *1st year: 1 week /country*
- * *Following years: 2/3 days of retraining / year*
- * *Cost of one week for 10 people: ..... 5,000 ECU*

■ *National laboratory*

- ❑ *Training provided by PARC only for the following techniques:*

  * *Rinderpest: c-ELISA, immunocapture*
  * *CBPP: c-ELISA, CFT*
  * *PARC will not take into account the training of agents in "provincial" laboratories*

- ❑ *A workshop twice during the total duration of the program:*
  Cost for 5 people with consumables and the trainer . . . . . 7,000 ECU

■ *Permanent education*

- ❑ *Inter state school of science and veterinary medicine of Dakar (ISSVM) - Senegal*
- ❑ *Faculty of veterinary medicine of Debre Zeit - Ethiopia*
- ❑ *Twice a year in each veterinary school*
- ❑ *Information on recent techniques*
  E.g. PCR, GIS, statistics, infectious and parasitic diseases, epidemiology
  1 week: 25,000 ECU / 10 people + trainers

■ *Long term training*

- ❑ *In epidemiology (methodology, statistics, computing)*
- ❑ *2 people per country*
- ❑ *1 per year in a specialist field (10 months theory + 1 field dissertation as at Debre Zeit)*
- ❑ ***Cost 30,000 to 40,000 ECU / year for 1 person***
- ❑ *Proposed veterinary schools:*
  ISSVM Dakar (Senegal)
  FVM Debre Zeit (Ethiopia)

■ *Veterinary training for West and East Africa*

E.g. Annual cost for one veterinary student at ISSVM of Dakar:

- ❖ *Teaching costs . . . . . 4,000 ECU /year*
- ❖ *Subsistence allowance . . . . . 1,500 ECU /year*
- ❖ *Air fare and other expenses . . . . . 1,000 ECU /year*
- ❖ ***Total : . . . . . 6,500 ECU/year***

3.2 LABORATORY SUPPORT IN THE PROPOSED PROGRAM

3.2.1 Generalities

- *Two levels of intervention are proposed for the laboratories:*
  - *National laboratories*
  - *Regional laboratories (operating for a group of countries)*

- *Within this terminology, the regional supranational laboratories should not be confused with the provincial laboratories described as "regional" that are specific to each country and answerable to the national laboratories.*

- *The regional laboratories are considered as indispensable strategic relays between the national and world reference laboratories. (Pirbright and Cirad-Emvt).*

- *In order to strengthen the liaison PARC-laboratories, the consultants propose that PARC provide financial support for the running of the national and regional laboratories within the framework of assignments that are entrusted to them in support of the NSES.*

3.2.2 Laboratory objectives

- *National laboratories*

  - *Serological surveillance*

    - *From polyvalent samples of sera the laboratories carry out the serological diagnosis of at least 4 diseases considered for a country such as the dominant existing or potential diseases (Rinderpest PPR CBPP etc)*
      The idea of "polyvalent" samples permits the considerable reduction of costs due to sampling in the field.

  - *Active search for the Rinderpest virus:*

    - *The laboratories will provide a minima the differential diagnosis of Rinderpest – PPR (Immunocapture) from samples that have come from suspected outbreaks of Rinderpest.*
    - *These same samples must then be transmitted to the regional laboratories for confirmation of the differential diagnosis with the other Rinderpest-like-diseases.*

- ❖ *The consultants propose that PARC provides **financial support to the national laboratories only to assure the setting up and routine use of the following basic techniques:***

Rinderpest: *c-ELISA*
Immunocapture (Rinderpest – PPR)

CBPP: *c-ELISA*
CFT (Complement fixation test)

- ❖ *Each national laboratory is, of course, quite free, to implement other complementary diagnostic techniques (PCR, isolation, identification, and differential diagnosis) **under its own means** and / or to equip the provincial laboratories. **The additional costs cannot be taken into account by PARC.***

■ *Regional laboratories*

- ❑ ***Analysis of samples from suspected sources of Rinderpest-like-diseases** transmitted by the national laboratories for:*
  - ❖ *Confirmation of Rinderpest diagnosis*
  - ❖ *Differential diagnosis of Rinderpest – Rinderpest-like-diseases:*
    PPR, BVD/MD, IBR, malignant catarrhal fever, foot and mouth disease
    implementing complimentary diagnostic techniques (PCR, isolation, identification, ELISA…)

- ❑ ***Confirmation of diagnosis for the other dominant diseases** (CBPP in particular)*

- ❑ ***Quality assurance and networking** of national laboratories.*

- ❑ ***Proposition of two regional laboratories:***

*In order to limit the support of PARC to the running costs of these laboratories the consultants propose **only two laboratories**, considering the comparative technical and scientific level of the different candidate laboratories:*

- ❖ ***For East Africa: the Muguga laboratory in Kenya**, the FAO regional reference laboratory for Rinderpest.*
- ❖ ***For West and Central Africa the consultants propose:***
  - * ***Either the Bingerville laboratory in Côte d'Ivoire**, which possesses an important scientific framework for Rinderpest and the Rinderpest-like-diseases (three veterinary doctors one of whom is a doctor of science in addition to senior technicians). This laboratory is also well situated geographically between West Coast and Saharan Africa and Central Africa (risk zones of the sanitary cordon).*
  - * ***Or the laboratory of Dakar-Hann (ISRA) in Senegal**, FAO African reference laboratory for Rinderpest, PPR, CBPP and african horse sickness.*

3.2.3 Overall evaluation of PARC support to laboratories

- *National laboratories*

  - *3 possible levels of support:*

    - *Level 1: countries where the laboratories need renovation (water, electricity, refurbishment of some buildings): . . . . . 30 to 40,000 ECU in total*
    - *Level 2: countries needing reequipment of laboratory material :*
      - ELISA reader . . . . . 10,000 ECU
      - small apparatus (pipetman, etc) . . . . . 6,000 ECU
      - computer and printer 4,000 ECU
      - TOTAL: . . . . . 20,000 ECU
    - *Level 3: provision of consumables only:*
      40,000 ECU / year over the first 3 years of the project
      20,000 ECU / year the next two years for serological surveillance (Rinderpest, PPR, CBPP) and immunocapture (Rinderpest – PPR)
      See details of costs later.

  - *Estimation of level at which the different national laboratories known to the consultants can be placed:*

    - *Level 1*
      - Burundi,
      - Kenya (Kabete),
      - Uganda,
      - Congo Democratic Republic,
      - Rwanda,
      - Sudan.

    - *Level 2 - Eritrea,*
      - Guinea
      - Niger,
      - Tanzania,
      - Chad.

    - *Level 3 - Cameroon*
      - Côte d'Ivoire
      - Ethiopia
      - Mali
      - CAR (on the way towards rehabilitation)
      - Senegal

❑ *Costs of providing consumables (level 3) by PARC*

❖ *Estimate of number of serological tests for Rinderpest and CBPP per year:*

* *If one considers an average of 25 blood tests per stock, 300 stocks per stratum and two strata per country, one obtains:*
25 x 300 x 2 = 15,000 serological tests per year (over a minimum of 3 years).
The average level of activity of laboratories can be estimated at 5,000 serological tests / year: data that must be taken into account for the costs in consumables.

* *On the other hand, one could estimate the number of serological tests for CBPP at 5,000 per year.*

❖ *Current cost of diagnostic kits:*

* *Rinderpest:*
c-ELISA (BDSL): 5,000 US $ / 5,000 samples or 1 US $ / sample –
TOTAL: 0.9 ECU / sample

* *Immunocapture Rinderpest-PPR (BDSL):*
1,000 US $ / 100 samples or 10 US $ / sample – TOTAL: 9 ECU / sample

* *CBPP:*
c-ELISA (CIRAD-EMVT): 300 US$ / 400 sera, or 0.75 US $ / serum = 0.7 ECU / serum or 2,000 US $ / 4,000 sera or 0.5 US $ / serum = 0.5 ECU / serum
CFT: approx. 0.6 ECU / serum

❖ *Calculation of costs:*

Serological surveillance

* *c-ELISA, Rinderpest: 0.9 x 15,000 = ... 13,500 ECU / year*
* *c-ELISA, CBPP: 0.7 x 5 000 = ... 3,500 ECU / year*
* *CFT (CBPP): 0.6 x 5 000 = ... 3,000 ECU / year*
Sub total ..... 20,000 ECU / year
* *Other serological tests and diverse consumables .... 10,000 ECU / year*
TOTAL: ..... 30,000 ECU / year

Immunocapture: Rinderpest-PPR

* *If one considers approximately 250 suspected outbreaks per year and 9 ECU per sample, one obtains: 250 x 9 : ..... 2,250 ECU / year*
* *diverse consumables ..... 2,750 ECU / year*
TOTAL: ..... 5,000 ECU / year

TOTAL COST:

* *Serological surveillance: ..... 30,000 ECU / year*
* *Immunocapture: ..... 5,000 ECU / year*
* *Transport of samples to the regional laboratory: ..... 5,000 ECU / year*
TOTAL : ..... 40,000 ECU / year

One can anticipate support from PARC to the level of:
40,000 ECU / year for the first three years of the project
20,000 ECU / year over the next two years

■ *Regional laboratories:*

PARC could consider the following budgetary proposals:

- ❑ *Staggered renewal of existing equipment: . . . . . 30,000 ECU in total*
- ❑ *Equipment for transport of samples and transport costs . . . . . 3,000 ECU / year*
- ❑ *Differential diagnosis of suspected outbreaks of Rinderpest, confirmation of diagnosis for the other dominant diseases, quality control and networking of national laboratories 20,000 ECU / year*

■ *Networking of national and regional laboratories:*

- ❑ *Essentially the support assignments of regional laboratories towards national laboratories: 10 missions in total (West Africa + East Africa) thus:*
  - *8 regional laboratories towards national . . . . . 30,000 ECU / year*
  - *2 specialists from Pirbright and CIRAD-EMVT towards the regional laboratories . . . . . 10,000 ECU / year*
- ❑ *2 annual meetings (West and East Africa) 10,000 ECU / meeting thus . . . . . 20,000 ECU / year*

TOTAL . . . . . 60,000 ECU / year

3.2.4 Constitution of an African network of diagnostic veterinary laboratories:

■ *Coordinated by CIRAD-EMVT and Pirbright*
■ *Aims:*
  * *Maintain the technical standard (guarantee the quality of services)*
  * *Training*
■ *Other proposed activities:*
  * *Creation of a regional test network*
  * *Edition of a report on good laboratory practice*
■ *Provisional costs for running the network for each reference laboratory (the CIRAD-EMVT and Pirbright)*
  * *Edition of technical data sheets followed by the standardization of techniques and quality control . . . . . 5,000 ECU / year*
  * *Reception of African students in Europe . . . . . 10,000 ECU / year*
  * *Support missions on demand from specialists from reference laboratories . . . . . 10,000 ECU / year*

Thus a total of 25,000 ECU / year for each reference laboratory.

3.3 CONTROL OF RINDERPEST AND CBPP VACCINES BY PANVAC

3.3.1 Generalities

- *This is provided by the **PANVAC laboratory** (OUA/IBAR) of Debre-Zeit (Ethiopia).*

- *All the control results of batches produced by different African laboratories, **whether they conform or not**, are sent **officially** by PANVAC to the following organizations:*

  - *The laboratory that has produced a given batch*
  - *The OAU/IBAR*
  - *The regional coordinators of PARC (Nairobi, Bamako)*
  - *The European Union*
  - *The FAO (Rome, Italy).*

- ***It is up to the regional coordinators to send the PANVAC control results to the national components.***

3.3.2 Review of the controlled vaccines

- *When **batch numbers of Rinderpest and CBPP vaccines, conforming to international standards officially sent to the consultants by the Director of PANVAC,** are compared with the batch numbers actually used by the different national constituents it appears clear that **in some countries a high percentage of non-certified vaccines were used in the field.***

  The absence of PANVAC certificates for a given batch of vaccine can have different meanings:

  - *The national authorities did not demand the certificate from the supplier*
  - *The batch of vaccine was not sent to PANVAC for controls.*
  - *The titer of the batch did not conform*
  - *The batch was contaminated.*

  This situation is unacceptable.

For each batch of vaccine used in the field as part of the pan-African campaign, the national constituents must demand from the producing laboratory the corresponding certificate of PANVAC conformity.

3.3.3 Comments

- *The laboratories producing vaccines must destroy their non-conforming batches: absence in general of a **national authority of quality control.***

- *The **regional unit** must become more involved in quality control of vaccines used in the field and verify the PANVAC certificates.*

The regional unit could :

* *guarantee the Delegation of the European Union of a country buying vaccine that it would pay the suppliers directly for the doses bought by the country;*
* *or pay the same suppliers directly by specific budgetary lines attributed to the regional units by the PARC headquarters in Nairobi.*

It should be remembered that the system was actually in force during the setting up of PARC. However, the sale of vaccines has gradually allowed the regional coordinators to have at their disposal the specific funds to buy the vaccines directly from the producing laboratories.

The conformity of vaccines is essential to achieve a final eradication of Rinderpest.

■ *How much does it cost for PANVAC to certify a dose of vaccine?*
The cost according to "the study of the cost recovery of PANVAC" is about 1,450 US $ based on a batch of 500,000 doses. This study also proposed a graded tariff with 300 US $ the first year (1996-1997), 700 US $ the second year (1997-1998) and finally, 1,450 US $ the third year of the project.

*Currently, **the real cost is 700 US $ per batch which is:***

- ❖ *For a batch of 500,000 doses: 0.84 FCFA/dose*
- ❖ *For a batch of 1,000,000 doses the cost is reduced to 0.42 FCFA/dose.*

For the production of 500,000 doses of vaccine sold for 15 FCFA and 40 FCFA, the cost of certification represents a respective surcharge of 5.6% and 2.1%.

3.4. THE REGIONAL UNIT

■ *For the consultants, the regional unit represents a hierarchical and functional intermediary necessary between the PARC headquarters and the national constituents. It insures good regional coordination of the NSES and plays a permanent role in evaluation. The objectives of the current regional units must be reinforced and extended to other competencies.*

■ *The role of the regional unit:*

* ***Coordinate the NSES and continuously evaluate them (incentive allowance).***
* ***Standardize the data sent in by each country:** standard weekly epidemiological report (see the OIE and FAO examples).*
* *Publish the **regional bulletin.***
* ***Biannual regional meetings.***
* *Network coordination: fax, telephone & e-mail.*
* *The regional unit must become more involved in the **quality control of vaccines** used in the field and verify the **PANVAC certificates.***
* *On the other hand, it could provide among other things, support for the national laboratories (quality assurance) as well as the setting up and assessment of animal health associations.*

■ *Comments*

* *The official declaration of a disease must be presented to OIE and the FAO by the veterinary services of each state and not by the national and regional PARC constituents.*

* *The new project could participate in the creation of regional OIE offices whose running costs are estimated at 90,000 ECU / year. The cost of running the regional unit would be of the same order.*

3.5 LINES OF RESEARCH

Two themes of research priorities are presented:

- ***Rinderpest:***
  Two projects:
  - *One main collaborative project with Cirad-emvt (Montpellier, France) and IAH (Pirbright, UK)*
  - *One complementary project IAH (Pirbright, UK)*

- ***CBPP:***
  Two EMVT projects:
  - *1 main project*
  - *1 complementary project*

3.5.1 Rinderpest

- ***Main collaborative project Cirad-emvt-IAH***

  - *This is considered a priority in terms of Rinderpest. The main intention is to study the possibility of using **PPR vaccine instead of the equivalent classic Rinderpest vaccine** for bovines and ruminants in a general manner against Rinderpest in emergency interventions. The use of a different vaccine would allow the infected animals to be differentiated from the vaccinated ones (c-ELISA tests for Rinderpest and PPR). This would facilitate the detection of serological traces of Rinderpest in sensitive animals. This is an important point with respect to the **risk of the Rinderpest virus spreading** where it has declined in East Africa in addition towards Central and West Africa.*

  - *In this respect the project*

    - *Will define the **minimum dose of vaccine**.*
    - *Determine if the cattle vaccinated with PPR vaccine then infected with a virulent strain of Rinderpest are **asymptotic carriers** of the Rinderpest virus and consequently a source of contamination.*

    - *Study the **impact of the vaccine in the declared outbreaks of Rinderpest***
    - *Specify the **duration of immunity conferred.***
    - *Finally, study the technological possibilities of ameliorating the **thermostability** of the PPR*

vaccine.

- *Cf. Complete protocol and estimate of costs of the collaborative project CIRAD-EMVT-IAH in appendix 1 for a total sum of 1,054,967 ECU.*

The specific budgetary lines will be identified in the national constituents for their participation in this project.

■ *Complementary project IAH (Pirbright, UK)*

- *In this project, several lines of research and development oriented towards the study of the pathological power of the Rinderpest virus and the epidemiology of the disease are proposed.*

- *It is suggested, first, that* ***if the attenuated strains of Rinderpest identified over the last few years persist in the wildlife, their pathogeni city could increase after serial passage in cattle.***

An experimental protocol in cattle, sheep and goats is proposed to study this hypothesis.

- *In addition, an experimental protocol is proposed: it concerns the study of the* ***excretion of the Rinderpest virus in cattle*** *infected with three strains of differing virulence.*

- *Two protocols are proposed in* ***molecular epidemiology:***

  - ***PCR detection of the viral genome in the vaccine***
    The genome has been identified in the field in Tanzania and Kenya from ocular ecouvillons; these results are worth confirming.

  - ***Field validation of the Pen-side test*** *(clearview test)*
    This rapid diagnostic test developed by the IAH has yielded very promising preliminary results and requires ***field validation*** *at this stage.*
    This quick and easy test based on the use of monoclonal antibodies shows a perfect correlation with PCR.
    It will allow the field surveillance methods to be strengthened.

- ***Pirbright then proposes the appointment of a grant to an African scientist to*** *ensure the liaison PARC-IAH in the fields of epidemiology, molecular characterization in addition to training of other African scientists.*

- *Cf. Complete protocol and cost estimate of project IAH (Pirbright) in appendix 2 for a total sum of* £135,019
  or approximately ..... 205,000 ECU

3.5.2 Contagious bovine pleuropneumonia

■ *Main project Cirad-emvt*

- ❑ *This is considered a priority in terms of CBPP. Its main objective is* ***the improvement of current vaccines.***

This presents the following inconveniences:

- ❖ ***Duration of post vaccination immunity*** *is less than 1 year.*
- ❖ *Live vaccines: problems of* ***stability of the vaccine strain.***
- ❖ *In certain cases* ***problems of safety*** *in the target animal (taurins in particular).*
- ❖ ***Absence of vaccination marker.***

- ❑ *The research themes are as follows:*

- ❖ *Identification of* ***genes coding for the virulence factors.***
- ❖ *Characterization of the* ***cellular immune response*** *after vaccination or infection.*
- ❖ *Identification of* ***antigens inducing protection.***
- ❖ *Selection and cloning of the* ***genes coding for these antigens.***
- ❖ *Selection of* ***expression vectors*** *and construction of* ***thermostable, marked, recombinant vaccines*** *expressing the proteins involved in the protection.*
- ❖ *Selection of* ***adjuvants*** *of immunity.*
- ❖ *Field trials with candidate vaccines.*
  -evaluation of ***safety***
  -of ***protection*** *(efficacy tests by proven vaccines)*
  -of the ***duration of immunity***

Cf. Complete protocol and cost estimate of project CIRAD-EMVT in appendix 3 for a total sum of 644,400 ECU.

■ *Complementary project CIRAD-EMVT*

- ❑ *Its objective is the study of the* ***efficiency of antibiotic treatments*** *used in cattle suffering from CBPP.*

Antibiotics are widely used by farmers in this situation under non-standard conditions. The problem of their actual efficacy and cost is regularly raised by the authorities and veterinary institutions. This subject merits a specific field and laboratory study (methods of treatment, impact on chronic carriers.)

- ❑ *Cf. Complete protocol and cost estimate of the project CIRAD-EMVT in appendix 4 for a total sum of 100,000 ECU.*

3.5.3 *Total for all the projects*

Rinderpest *1,054,967*
\+ *205,000*

CBPP *644,400*
\+ *100,000*

TOTAL ..... *2,004,367 ECU*

3.5.4 *Hierarchy of priorities*

In the first place, it is proposed:

- *Rinderpest*
  - *Use of the PPR vaccine*
    To protect ruminants against Rinderpest
    - *IAH Pirbright: 443,190 ECU*
    - *Cirad-emvt: 611,777 ECU*
  - *Field validation of the pen-side test*
    - *IAH Pirbright: 109,695 ECU*
- *CBPP*
  - *Improvement of current vaccines*
    - *Cirad-emvt: 644,400 ECU*
- *GRAND TOTAL 1,809,062 ECU*

3.5.5 *Four appendices*

PROPOSAL:

USE OF PPR VACCINE TO PROTECT RUMINANTS AGAINST RINDERPEST

I) AIM:

The EMPRESS expert consultation which was held in Roma in July 1997 has recommended the use of PPRV vaccine instead of the rinderpest one to vaccinate animals against rinderpest in endemic areas. The intention for the use of this heterologous vaccine is to ease the detection of serological traces of rinderpest virus in susceptible animals. This is very important when facing mild rinderpest virus strain which might circulate in susceptible animal population without causing significant clinical signs. The important prerequisite for such strategy is the availability of data which prove that PPR vaccine is effective for the protection of animals, particularly cattle, against rinderpest. The aim of the present project is to provide the information when deciding to shift from homologous to heterologous vaccine in rinderpest eradication campaigns.

II) Background:

Because of its high mortality and high morbidity rates, at least in its classical form, rinderpest is one of the most dreaded animal diseases. Concerted international efforts have confined this disease to few foci in Africa, the Middle East and Asia. In this way, they have contributed to reduce losses due directly to rinderpest itself. However, in endemic areas, it still remains a serious cause of economic losses araising from:

- the exclusion of the infected country from international animal trade,
- the negative impact on tourism income when visits of natural parcs have to be restricted during rinderpest outbreaks in wildlife.
- the necessity, in some circumstances, to maintain vaccination campaigns to control the disease. If the cell culture attenuated vaccine currently used is not expensive itself, the logistics which are implemented during rinderpest vaccination is costly.

Because of this economic importance of rinderpest, efforts are being made to eradicate this disease from the world. For such endeavour, an OIE expert consultation meeting outlined in 1989 a serie of steps which start from "the intention of rinderpest eradication

(vaccination)" to "the provisional freedom from disease (cessation of vaccination)", "freedom from disease" and finally "freedom from infection". This last step implies that no rinderpest antibody should be detected in susceptible animals for at least two years of intensive epidemiosurveillance.

Following the rinderpest mass vaccination which has been conducted since 1980's, in many areas in Africa, the Middle East and Asia, no disease case has been recorded for years. The authorities of the concerned countries are ready to declare themselves provisionally free from the disease. Unfortunately, some rinderpest foci still exist in countries in which vaccination campaigns should be continued. The same status should be maintained in disease free areas which are at the borders of the infected ones in order to serve as a buffer to prevent rinderpest from escaping into large vulnerable zones. There is no possibility now to distinguish antibodies arisen by wild type of RPV from those obtained after vaccination with the attenuated RPV strain. Therefore, the use of this latter virus might overlook the presence of a mild RPV which is not causing serious clinical symptoms but which could be detected easily by a serosurveillance. Thus, there is a need to conciliate the necessity of controlling rinderpest in infected and buffer zones by vaccination with the objective to go very quickly to the situation of "NO RINDERPEST ANTIBODIES IN SUSCEPTIBLE ANIMALS". This conciliation can be obtained by the use of a vaccine distinguishable from wild types RPV. The PPR vaccine strain is a good candidate for such purpose because a test is available for the detection of PPR specific antibodies (Libeau et al., 1995). Peste des petits ruminants virus (PPRV) and rinderpest virus belong to the *Morbillivirus Genus* in the *Paramyxoviridae* family. This genus regroups closely related viruses and includes measles virus (MV), canine distemper (CDV), phocine distemper virus (PDV), dolphin and porpoise morbilliviruses (DMV and PMV). Mornet et al. (1956), Gibbs et al. (1979) have shown that cattle given virulent PPRV did not show an overt disease but are protected against a challenge rinderpest virus. In the same way, small ruminant given rinderpest virus are protected against PPR (Gibbs et al.; 1979). This crossprotection between RPV and PPRV has been exploited with success for many years to protect small ruminants against PPR by the use of live attenuated rinderpest virus as heterologous vaccine (Bourdin et al., 1970; Taylor W.P., 1979; Bonniwell M.A., 1980). In 1995, Couacy et al. have demonstrated that attenuated PPRV can be used to protect goats against virulent rinderpest infection. However this reported challenge had been carried out 3

weeks after vaccination. There is no report concerning a long term immunity provided in small ruminants by PPR vaccine against rinderpest. Neither is data relative to the use of this vaccine in cattle available. Morbilliviruses are epitheliotropic and lymphotropic viruses. Rossiter and W ardley (1985) have demonstrated that virulent RPV grows more readily in bovine than in small ruminants lymphocytes whereas virulent PPRV grows better in sheep and goats lymphocytes. However there is no significant difference in the infection rate of both types of lymphocytes by the attenuated rinderpest virus, a rate which is very low in comparison with those obtained with virulent viruses. Such experiment which can provide preliminary information on the mechanism of the immunity against PPR or rinderpest has not been carried out yet with the attenuated PPRV. Thus, preliminary investigations should be carried out to prove the efficacy and safety of this virus as a heterologous vaccine against rinderpest. The informations expected from these investigations are relative to:

-the minimum effective dose,

-the status of vaccinated animals subsequently infected by virulent rinderpest virus (are they asymptomatic RPV carriers and, thereby, sources of contamination?),

-the effect of vaccination during an outbreak,

-the duration of immunity.

The present project aims to undertake experiments in view to provide information on the above mentioned subjects. Another objective is to improve the thermostability of the attenuated PPRV vaccine by the same as done by Mariner et al. (1990) for tissue culture rinderpest vaccine.

PROTOCOLS

1) *Determination of the minimum infectious dose with the minimum effective dose of PPRV vaccine in cattle and goats.* In order to provide an easy means to assess vaccine potency of the tissue culture attenuated rinderpest virus, Plowright (1962) has carried out a comparative titration in parallel in primary BK cells and cattle. He found identical results in both systems. This suggested that cell culture can be a substitute for cattle in assessing the potency of attenuated rinderpest vaccine produced in BK cells. Taylor and Best (1977), with the objective of using rinderpest vaccine in goat for protection against PPR, undertook the same type of comparative titration and found that $10^{5.4}$ TCID50 of tissue culture rinderpest vaccine (TCRV) corresponded to $10^{5.2}$ goat ID50. Based on that result, and although any relationship between

the immune reponse to TCRV and the ability to withstand challenge by PPRV was not clearly established, they proposed to use BK cells for the prediction of immunising efficacy of this vaccine in goats against PPR. Martrenchar et al. (1997) found that at least $10^{0.6}$ TCID50 of attenuated PPRV are sufficient to protect goats against PPR challenge. Unfortunately, their experiment was incomplete since the minimum effective dose was not determined. Experiments to be carried out during the present project will fill in this gap. A virus stock will be titrated simultaneously on vero cells, goats and cattle. To establish a relationship between immunising dose 5O (ID50) and the vaccine efficacy, the inoculated animals will be challenged. A tenfold dilution series will be made from a virus stock and and four dilutions with estimated titres ranging from 100 TCID50 to 0 will be titrated on vero cells. The same virus dilutions will be inoculated to cattle and goats: 5 cattle/dilution but 10 goats/dilution. The animals will be followed clinically with serum collection at 0, 7, 14 and 21 days post-vaccination. After the last bleeding, the animals will be challenged with virulent RPV (all cattle and half the number of goats/dilution) and with virulent PPRV for the other half of goats (see table 1). The challenge is carried out by subcutaneous route. Each group of animals is in individual loose box and is handled in such a way to avoid transporting possible excreted virus from one group to another. From day 0 of challenge to day 14, the animals are bled every two days for serum and lymphocyte collection. Nasal and ocular swabs are collected with the same frequency. Lymphocytes and swabs will be analysed by PCR for the presence of virulent virus (detection of challenge virus multiplication and excretion). The collected serums will be titrated against both PPRV and RPV.

OUTPUTS of this experiment:

-relation of TCID50 and immunising dose (ID50) for goats against PPR or against RP,

-relation of TCID50 and immunising dose (ID50) for cattle against RP,

-relationship between ID50 and minimum effective dose in cattle or goats against RP,

-recommendation of dose to be used for routine vaccination.

Table 1

animal species	*group n°*	*vaccine dose*	*challenge virus*
cattle	1	100	RPV
cattle	2	10	RPV
cattle	3	1	RPV
cattle	4	0	RPV
goats	5	100	RPV
goats	6	10	RPV
goats	7	1	RPV
goats	8	0	RPV
goats	9	100	PPRV
goats	10	10	PPRV
goats	11	1	PPRV
goats	12	0	PPRV

2) Status of PPRV vaccinated animals (goats and cattle) and challenged by intranasal route. 5 goats and 5 cattle will be vaccinated with recommended PPR vaccine dose. After 3 weeks, they will be challenged intranasally with virulent rinderpest virus (Saudi strain). The day following this challenge, each group of species is moved to new loose boxes. They are maintained with two in-contact susceptible cattle for each box (cattle are better than goat as sentinels for rinderpest, see couacy et al., 1995; Anderson et al., 1990). Animals are daily followed clinically. Swabs and blood (serum, lymphocytes) are collected every two days in view to detect, by PCR, challenge virus multiplication and excretion. Personel who handle vaccinated and challenged animals are different from those handling the control one in order to avoid crosscontamination by animal attendants. The animal surveillance is carried for 3 weeks if necessary.

OUTPUT OF THIS EXPERIMENT: determination whether or not PPRV vaccinated animals could be asymptomatic rinderpest carrier.

3) Determination of delay between vaccination and effective protection against RP. The FAO experts would like to recommend the employment of the attenuated PPRV as heterologous vaccine in both infected and buffer zones. In case of its use in infected zones, some animals will be vaccinated while in rinderpest incubation or will be infected soo after the vaccination. The present experiments are designed to predict the outcome of the disease in such situations.

-Short term challenge.Four groups of vaccinated animals, each composed of 5 goats and 2 cattle, will be challenged by intranasal route with virulent RPV at 2, 5, 7 and 14 days post- vaccination. The day following the challenge, 2 sentinel cattle are introduced into each group. A fifth group, composed of non vaccinated susceptible animals (5 goats+2 cattle) will serve as control for the challenge. Each group is maintained separately in a loose box. The sentinel animals are never handled to avoid mechanical contamination. The other animals are followed clinically with the collection of blood and nasal-ocular swabs every two days post-challenge. The clinical survey is carried out for 2 weeks (the use of RPV Saudi usually leads to the death of control animals in one week).

-Prechallenge followed by vaccination. The scheme of this experiment is similar to the precedent but here the vaccination follows the challenge. Four groups of RPV challenged animals (by intranasal route), each composed of 5 goats and 2 cattle, will be vaccinated at 0, 2, 5, and 7 days post-challenge. The RPV strain to be used in the challenge should have an incubation period longer than 3 days (/RPV Nigeria Buffalo). This condition excludes the most virulent RPV strain: the RPV Saudi. The day following the vaccination, 2 sentinel cattle are introduced into each group. A fifth group, composed of non vaccinated susceptible animals (5 goats+2 cattle) will serve as control for the challenge. Each group is maintained separately in a loose box. The sentinel animals are never handled to avoid mechanical contamination. The other animals are followed clinically with the collection of blood and nasal-ocular swabs every two days post-challenge. The clinical survey is carried out for 2 weeks.

OUTPUTS OF THESE EXPERIMENTS: Information on the short term protection provided by the vaccine against rinderpest are provided.

4) Study of the cellular immune responses induced by the PPR vaccine and the duration of provided immunity. The immunity provided by morbilliviruses is related to both humoral and cellular mediation. Therefore in order to evaluate the effectiveness of the PPR vaccine, both types of immune responses will be studied in cattle and goats on a three year period. By comparing the responses obtained in goats and cattle, the antigens involved in each case and the persistence of the PPRV-specific memory T-cells, it should be possible to predict the effectiveness of a PPR vaccine in protecting ruminants from PPR and RP. To that effect, 30 cattle and 40 goats will be vaccinated and maintained in a disease-free condition until needed for the challenge experiment. Nevertheless, 10 PPR/RPV susceptible goats will be maintained with the vaccinated animals. They will serve as controls for an accidental introduction of PPRV (or RPV).The kinetics of the cellular immune responses induced by the PPR vaccine will first be studied during the first 3 months of the experimentation. Identification of the subsets of recruited lymphocytes and of the viral protein(s) involved will be achieved. To that effect, 5 cattle and 5 goats will be bled on a weekly basis for 3 months. Peripheral blood mononuclear cells (PBMC) will be purified by a Ficoll-Paque density gradient. PBMC will be phenotypically characterized using monoclonal antibodies specific for bovine or goat leukocyte differentiation antigens. The evolution of the various cell populations (B-cells; CD4 T-cells; CD8 T-cells; g/d T-cells and monocytes) and of their state of activation will then be studied by flow cytometry. The lymphotropism of the PPRV in cattle and goat PBMC will also be studied by the same technique. The responsiveness of the PPRV-primed T-cells will be checked by performing lymphoproliferation tests (LP). PBMC from cattle and goats will be stimulated *in vitro* with PPRV and RPV. Identification of the protein(s) involved in T-cell activation will be achieved using the whole virus and the various purified proteins. Since we are dealing with intracellular organisms, the cytotoxic T-cell (CD8) response should also be evaluated in terms of functionality. The function of the CD8 T-cells is to lyse autologous infected cells, presenting the recognized antigens on its surface. Therefore, for this test, autologous cells will be infected *in vitro* by PPRV or by RPV and labelled in order to follow the lysis. To avoid the use of radioactive component (^{51} Cr), which is the classical method, the target cells will be labelled with a fluorescent component (calcein). The CD8 cytolytic activity will be determined by the calcein-release, due to the lysis of the target cells after incubation *in vitro* with the CD8 T-cells, measured by a cytofluorometre. For the humoral immune response study, serum

collection will be done every two months until the sixth month for each animal and at the day of every challenge.

The persistence of the PPRV-specific memory T-cells will be followed after each challenge during a 3-year study and their usefullness as protective against RP. 4-5 cattle and 5 goats will be withdrawn from the group and challenged with RPV Saudi at 6, 12, 18, 24, 30 and 36 months post-vaccination. The day following the challenge, they will be housed in new boxes with 2 cattle sentinels. Two other cattle, in a separate box, will serve as controls for the challenge. Clinical survey will be carried out for two weeks, with collection of nasal-ocular swabs every two days with blood collection for serum and lymphocytes. These latters will serve for the study of the persistence of the PPRV-specific memory T-cells. After slaughtering the animals, the lymph nodes will be collected too. Circulating (blood collected cells) and resident (lymph nodes cells) PPR-specific memory T-cells will be stimulated *in vitro* (LP tests) with PPRV, RPV and with the appropriate purified proteins. These cells will be phenotypically studied by flow cytometry and functional tests will be carried out for CD8 memory T-cells.

If the PPRV-primed T-cells respond similarly to PPRV and RPV and according to the clinical survey, this will demonstrate that the PPRV-specific memory T-cells can induce a cross-protection against RP.

The duration of immunity provided by the attenuated PPRV against rinderpest will be analysed for a 3 year period (a total of 6 challenge experiments at 6,12,18,24, 30 and 36 months post vaccination). However, if at the end of the first year, the results obtained are similar between PPRV and RPV in terms of subsets of lymphocytes recruited and protein(s) involved and since it is known from previous studies that the attenuated PPR vaccine can protect goats for at least 3 years, one might extrapolate that these PPRV-memory T-cells can also protect against RP for 3 years. Thus, cattle vaccination with PPRV vaccine could be recommended at the end of the first year of the project.

OUTPUTS OF THESE EXPERIMENTS:

-long term duration of immunity by PPR vaccine against RP;

-identification of the subset of lymphocytes stimulated by the PPR vaccine in small ruminants and cattle and responsible for the immunity.

5) Production of a thermostable PPR vaccine. PPRV, like all morbilliviruses, is thermolabile. The half-life of PPRV in liquid form as been estimated to be 2.2 mn, 3.3 hours, 9.9 days and 24.2 days at respectively 56, 37, 4 and -20 °c (Rossiter and Taylor,). There is no data available about the virus in the lyophilized state. However it could be assumed that the PPRV thermostability in that state will not be different from that of RPV. Even though the attenuated PPRV is effective, its use in RP/PPR vaccination campaign will require a constant maintenance of the cold chain in all steps of the process. This necessity will make the campaigns costly. Therefore, in order to eliminate the necessaty of the cold chain, it is intended to develop a thermostable PPR vaccine based in the same manufacturing techniques which were successfully used with tissue culture rinderpest vaccine (Mariner et al., 1990). The vaccine, once produced, will be stabilized in different mediums which were tested by Mariner et al. (1990): LS, BUGS, LGS. Then it will be freeze dried in a total cycle of 72 or 76 hours with vacuum regulated at 10 mTorr or 100mTorr. The stability of these products will be tested, in lyophilized form and also when reconstituted in diluent (physiological water), at the following temperatures: -20, +4, 37, 42 and 50 °c. The virus recolted at each point will be titrated on vero cells in microwells plate.

OUTPUTS OF THE EXPERIMENT: obtention of a thermostable PPR vaccine.

CONCLUSION

Different rinderpest vaccination campaigns are in a consolidation phase aiming at the eradication of this dreaded animal disease. The use of an effective vaccine which can be distinguished serologically from the wild type rinderpest virus will improve the confidence in the seroepidemiosurveillance and will speed up the steps leading to the eradication of the disease. The PPR vaccine, which has been proven to be safe in PPR control, might be used successfully as a heterelogous vaccine against rinderpest. Tests are available for this specific distinction from rinderpest viruses. This present project is expected to provide immunological and clinical tests data for an eventual use of PPRV vaccine in rinderpest eradication campaign. The experiments are designed to test the duration of immunity on a period of 3 years. However, if the one year immunity test is positive, it could be advised to employ this vaccine for routine use in rinderpest control campaign without waiting for the 3 year term immunity results. Since it is known that sheep and goats given PPRV vaccine are protected for at least

3 years (Colas et al., unpublished data), and if the comparative analyses prove that there are identical immunological mechanisms in goats and cattle with PPRV vaccine, one can expect to have the same long term immunity in both species.

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Additional support staff :

Additional support staff in European laboratories are 2 scientists and 1 laboratory technician.

An immunologist and a veterinarian are needed for the 3 years of this project. The immunologist will be in charge of the study concerning the cellular immune responses induced by the PPR vaccine and the RP vaccine. He will stay at CIRAD-EMVT for the main part of his work and will go overseas to collect samples after every challenge.

The veterinarian will spend 1 year at the IAH-Pirbright laboratory to follow all the animal experimentations. The next 2 years, he will come to CIRAD-EMVT, as responsible for the development of the thermostable PPR vaccine and will be in charge of every field trials overseas.

The laboratory technician will be employed for two years by the IAH-Pirbright laboratory to perform all the serological assays corresponding to the animal experimentations.

Additional equipment :

* CIRAD-EMVT

- One cytofluorometre :

The aim of this project is to study the cellular immune response of intracellular organisms. In this contexte, the cytotoxic T-cell (CD8) response is mainly involved in the immune response. Therefore, the CD8 response has to be evaluated, not only phenotypically in terms of frequence and activation state but also in terms of functionality (lyse of autologous infected cells presenting the recognized antigens on its surface). In order to avoid the use of radioactive component (^{51} Cr), which is the classical method, the cytotoxic assays have to be performed with target cells labelled with a fluorescent component (calcein). The CD8 cytolytic activity will then be determined by the calcein-release which is measured by a cytofluorometre.

* IAH-Pirbright laboratory

- One -70°C freezer :

A -70°C freezer is needed to keep cells, viruses and samples taken from the animal experimentations.

Financial cost (in ECUs) for CIRAD-EMVT

	1rst year	2nd year	3rd year	**Total**
Personnel				
immunologist	50,250	50,620	53,654	**154,524**
veterinarian	nil	50,620	75,750 (oversea stay)	**126,370**
Consunmable	45,460	47,750	50,130	**143,340**
Equipment	27,280	nil	nil	**27,280**
Travel, meetings and conferences	9,100	7,600	7,600	**24,300**
Project coordination	8,000	8,000	8,000	**24,000**
Unforseen expenses	3,000	3,500	3,500	**10,000**
Sub-total	143,090	168,090	198,634	**509,814**
Overheads	28,618	33,618	39,727	**101,963**
Total	171,708	201,708	238,361	**611,777**

Financial cost (in ECUs) for IAH-Pirbright Laboratory

	1rst year	2nd year	3rd year	**Total**
Personnel				
veterinarian	47,740	nil	nil	**47,740**
Technician	32,820	34,130	nil	**66,950**
Consummable	15,000	15,000	nil	**30,000**
Equipment	6,000	nil	nil	**6,000**
Animals				
68 cattle	142,580	nil	nil	**142,580**
140 goats	42,220	nil	nil	**42,220**
Unforseen expenses (+advertisement and shipment cost)	14,100	11,100	nil	**25,200**
Travel, meetings and conferences	3,830	4,800	nil	**8,630**
Sub-total	304,290	65,030	nil	**369,320**
Overheads	60,860	13,010	nil	**73,870**
Total	365,150	78,040	nil	**443,190**

Total cost of the project (in ECUs)

	1rst year	2nd year	3rd year	total
CIRAD-EMVT (Coordinator)	171,708	201,708	238,361	**611,777**
IAH-Pirbright laboratory	365,150	78,040	nil	**443,190**
Total	536,858	279,748	238,361	**1,054,967**

Project proposal for PARC related research

Institute for Animal Health
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AIM:

As the Pan African Rinderpest Campaign (PARC) progresses there are still some unresolved questions to be answered regarding the pathogenicity and epidemiology of the disease. There have been suggestions that "mild" strains may persist in wildlife but become more pathogenic after serial passage in cattle but there is very little evidence to support this. Recent technological advances such as the polymerase chain reaction (PCR) have increased the sensitivity of diagnostic assays and resulted in the detection of virus genome in a number of eye swabs from cattle in Kenya and Tanzania. Following nucleotide sequencing of the PCR products, some of the positive results may be due to the presence of vaccine virus RNA in the eye swabs. This was unexpected based on previous reports and deserves further investigation if we are to correctly interpret diagnostic results. Preliminary development of a rapid pen-side diagnostic assay shows great promise but the test requires further field trials. This project is designed to investigate these important issues which have a major bearing on the future strategy of PARC.

There are also other activities, which although not research projects are equally essential to the success of PARC. Molecular characterisation of rinderpest virus strains has offered the opportunity for tracing the origin of outbreaks and has led to a greater understanding of the epidemiology of the disease in East Africa and elsewhere. Continued funding is required to support this expensive service so essential to PARC, along with funds for large animal

experimentation to establish the pathogenicity of newly isolated strains of virus. Closely allied to all of these investigations is the need to train and continually update African scientists in the latest technical advances, especially those who are employed in the Regional Reference Centres. It would be highly appropriate if the projects and duties described below were carried out at the FAO World Reference Laboratory for Rinderpest (WRLR) by an African scientist actively involved in PARC. This could be accomplished in the form of a biennially renewed EU-PARC Fellowship which would not only increase our understanding of the disease but also provide invaluable specialist training leading to future self-sustainability.

1. Serial passage of "mild strain" of rinderpest virus in cattle

Introduction

Contrary to some reports, the rinderpest virus strain isolated from eland in Nairobi National Park, Kenya in 1996 does not result in a mild disease in all cattle. Following experimental infection of four cattle, three cattle showed mild clinical signs but one showed full clinical rinderpest and died at 18 days post infection (dpi). The question remains, whether serial passage of this virus in cattle will increase its virulence even further. The PARC epidemiologist, Paul Rossiter, in a personal communication reported that he had observed full clinical rinderpest with the three "D's" (death, discharge and diarrhoea) in cattle following the Nairobi Game Park outbreak, and suggested that the strain had become more virulent after passage in cattle. Since then there have been conflicting reports from the field and the hypothesis that wildlife strains can become increasingly virulent for cattle after serial

passage requires further investigation.

Following outbreaks in Kenya and Tanzania the main strategy has been mass vaccination of all cattle. This does not take into account any possible involvement of sheep and goats. Although not thought to be a major factor in the past, further work is required to establish the role of small ruminants with this particular strain. Studies are required to determine the susceptibility of sheep and goats to the current strain and establish if transmission takes place between cattle, sheep and goats. This should be linked to the experiments on passaging the eland strain through cattle and may have major implications on the eradication strategy used in this region.

Experimental design

A minimum of five cattle per passage will be required due to variation in animal susceptibility. Five cattle will be infected subcutaneously with a suspension of the original Kenya/eland/96 isolate. Cattle will be housed 2 or 3 to a box dependent on animal size and examined daily for clinical signs. Blood samples will be collected daily to monitor the humoral immune response. Duplicate eye swabs will be collected every two days for evaluation of the pen-side diagnostic test and also for PCR. Any PCR products will be nucleotide sequenced. Assuming that some animals develop clinical signs, material from the animal showing the most severe clinical signs will be collected and passaged into a further five cattle (if no animals develop clinical signs a further five cattle will be infected with the original material). This process will be repeated four times.

Simultaneously 2 sheep and 2 goats will be infected with the original Kenya/eland/96 strain.

The animals will be monitored for clinical signs and blood samples and eye swabs collected. If sheep or goats develop clinical signs the material will be passaged into a further 2 sheep and 2 goats. If no clinical signs are evident, material from the cattle passage will be used.

If/when cattle show clinical signs susceptible sheep and goats will be introduced into the animal box for transmission studies. Similarly, if sheep and goats show clinical signs, or during the last passage in sheep and goats, susceptible cattle will be introduced for evidence of transmission.

Outputs

1) Establish if serial passage of "mild" strains increases their pathogenicity.

2) Establish susceptibility of sheep and goats to Kenya/eland/96

3) Establish if transmission of Kenya/eland/96 virus takes place between cattle, sheep and goats

4) Further our understanding of the role of sheep and goats in the epidemiology of rinderpest.

2. Transmission experiments and investigation into amounts of virus excreted by animals infected with different strains.

Introduction

Little is known about the transmission rate of the "mild" strains of rinderpest virus. This has a major bearing on the size of the cattle population needed to maintain the virus in the field (i.e. R_0 value). If an estimate of the transmission rate for different strains could be determined, these figures could be introduced into the computer model to give a more

meaningful analysis. If the Kenya/eland/96 strain shows increased virulence following passage in cattle (see experiment 1) then the transmission rates of the low and high passage viruses could be compared. These in turn could be compared to a more virulent strain. If the Kenyan strain shows no detectable increase in virulence, then it could be compared to two other strains of epidemiological interest. Eye and nasal swabs samples will be collected and titrated in tissue culture to estimate the amount of virus excreted at the various stages of infection by the various strains. This may give a correlation between the amount of virus excreted and the transmission rate.

Experimental design

One steer each will be infected with each of the three rinderpest virus strains and maintained in separate housing. Four susceptible steers will be introduced into each box to allow contact transmission. Ocular and nasal swabs will be collected daily. Blood samples will be collected for detection of the humoral antibody response and rectal temperatures will be recorded daily. The ocular and nasal swabs will be titrated in tissue culture to compare the amount of virus excreted for each strain of virus.

Outputs

1. Establish the duration of virus excretion in cattle following infection with three .different virus strains.
2. Evaluate correlation between the level of virus excretion and the transmission rate.
3. Generate data for inclusion in the computer model to provide more meaningful analysis.

3. Detection of vaccine virus genome in eye swabs by PCR following vaccination

Introduction

During the recent outbreaks in Kenya and Tanzania eye swabs submitted for diagnosis have been positive by the "Clearview" pen-side test and also by PCR. Subsequent nucleotide sequencing has shown the virus to be similar to Kabete O, the vaccine strain. This could be explained by the animals being recently vaccinated in the face of an outbreak, but it has always been believed that the vaccine virus has lost its epitheliotropism and should not generalise sufficiently to reach the eye. Alternatively, a field strain may be circulating which has a similar nucleotide sequence to the vaccine strain. Because of the importance of PCR using eye swab material in the diagnosis of rinderpest, particularly that due to mild strains, experiments are required to determine if vaccine virus can be detected in eye swabs following vaccination and if so to establish when and for how long samples remain positive.

Experimental design

Ten cattle will be vaccinated using the RBOK attenuated vaccine. Duplicate eye swabs will be collected daily over one month and tested for RPV antigen and RNA using the pen-side diagnostic assay and PCR. All PCR products will be nucleotide sequenced.

Outputs

1) Establish if /how long rinderpest virus is present in the eye following vaccination.

2) Clarify the significance of finding virus with a nucleotide sequence similar to the vaccine strain in eye swabs collected in both Kenya and Tanzania.

4. Field trials of pen-side diagnostic tests

Prototypes of a pen-side diagnostic test based on Clearview technology have been field-trialed in Pakistan and to a limited extent in Tanzania. The results have been promising and devices have been used successfully in both countries to diagnose rinderpest. The test is currently being optimised and an alternative production company has been identified. Funds are required to undertake more extensive field trials. Once validated and adopted for use in PARC, funds should be allocated for purchase of the devices for national field services, particularly of those countries considered most at risk. The use of this technology would also provide support for government declarations to OIE for freedom from disease, by providing an efficient surveillance system.

It is envisaged that field trials will take place in a country in East Africa where disease is present at the appropriate time.

Outputs

1) Field validation of the pen-side diagnostic test

2) Enable rapid pen-side diagnosis and allow rapid implementation of control measures, hopefully resulting in a reduction in animal losses

5. Molecular characterisation of isolates and large animal pathogenesis studies

Introduction

Although not a research project, funding must be set aside for the molecular characterisation

of all rinderpest virus isolates. This provides the only means of tracing the source of outbreaks and has proved crucial in enhancing our understanding of the epidemiology of the disease in East Africa. There is an immense amount of work involved, particularly when the samples have to be cloned and many clones sequenced. Funding is currently supplied by FAO for the basic diagnostic service but does not cover the more expensive techniques such as molecular characterisation. Further funding is required to provide a full-time dedicated service for PARC.

Funding is also required for animal experimentation. This is particularly important when examining "mild" strains or strains isolated from game animals, to determine their virulence in cattle. Particularly isolates giving a similar nucleotide sequence to the vaccine virus strain. Until now the pathogenicity studies carried out at Pirbright have been at the Institute's expense. It is proposed that a sum of money should be set aside at the PARC Co-ordination Unit, Nairobi to cover animal experimentation costs as and when deemed necessary. The selection of strains and design of experiments would be by mutual consent between PARC and IAH as new outbreaks occurred or when strains are isolated. Funds would be disbursed to IAH to cover the animal costs on completion of a suitable report.

All these activities should be based at the WRLR and it would be highly appropriate if they were undertaken in the form of a Fellowship by a scientist from one of the countries involved in the PARC. The Research Fellow would also carry out the above research projects within the two year period under the supervision of staff at the IAH Pirbright. This would serve almost as an apprenticeship and would be ideal training for a scientist ultimately to be responsible for a Regional Reference Laboratory. This could be operated as a revolving post

with the post holder replaced biennially, ensuring a constant updating of relevant staff.

Outputs

1) Fast, sustainable service for the molecular characterisation of rinderpest virus isolates.

2) Better understanding of the epidemiology of rinderpest in Africa.

3) Increased understanding of the virulence of contemporary virus isolates.

4) Regular, updating and training of African scientists and creation of a pool of knowledge as a sustainable resource for the future.

1. Costings for animal experiments

a. Serial passage of mild strain in cattle, sheep and goats

24 cattle at £500 each:	£12,000
Cattle accommodation charges (£500 per month):	£12,000
12 sheep (£70 each)	£840
12 goats (£70 each)	£840
Sheep/goat accommodation (£100 per month)	£2,400

b. Contact transmission experiments

15 cattle at £500 each:	£7,500
Cattle accommodation charges (£500 per month):	£7,500

c. Detection of vaccine virus genome in eye swabs by PCR following vaccination

10 cattle at £500 each:	£5,000
Cattle accommodation charges (£500 per month)	£5,000
Total:	**£53,080**

2. Costs for field validation of pen-side test

Approximate airfares x 2 (Veterinarian and Scientist):	£1,800
Per diem for 2 weeks Veterinarian:	£1,400
..... Scientist:	£1,400
Local costs (fuel, field allowance):	£2,500
Total:	£7,100
Sub-total:	**£60,180**

3. Costs for EU-PARC Fellowship (annual).

(Ideally the salary and airfares would be paid directly to the Research Fellow):

Research Fellow salary (approx):	£26,400
National insurance/superannuation	£6,336
Airfare (approx):	£1,500
(dependant on nationality of scientist)	
Consumables:	£14,100
(standard IAH annual bench fee)	
Supervisors fee (10% Band 4)	£4,000
Total:	£52,336

Sub-total:	£112,516
Overheads:	£22,503
Total:	£135,019

Now that RP is on the verge of eradication in Africa, CBPP is becoming the greatest threat to cattle raising.
The reasons for this predicted and seemingly unavoidable re-emergence are numerous. For many years, the vaccination campaigns against rinderpest had also contributed to the fight against CBPP as combined vaccines were used. Repeated vaccinations raised the immunity of the cattle populations significantly and CBPP was under control with few sporadic outbreaks. Still now, countries that do vaccinate against CBPP on a regular basis, whatever the vaccine used, do not suffer from many outbreaks. These outbreaks are very often caused by importation of sick animals from neighboring countries.
The abandon of mass vaccination against rinderpest will automatically induce a drop in the immune status against CBPP and favour dissemination of the disease. This is what happened in the horn of Africa in 1994-1995 with the re-establishment of CBPP in countries such as Kenya, Tanzania and Uganda, which had been CBPP-free for many years.
Sporadic vaccination campaigns against CBPP are not likely to induce a significant drop in the prevalence of the disease.
The best prophylactic approach for disease-free and infected areas should continue to be that of large scale and repeated vaccination. Good diagnosis tools need also to be available.

However, the currently used attenuated live vaccines suffer from some limitations: short-term protection (at best, vaccinated animals will be protected for one year), not all the animal are protected, use of live material with problems of stability of the strain, no vaccinal marker...Furthermore, even if the quality control has been improved by the establishment of PANVAC, only a limited number of batches are controlled and vaccination failures can then also be due to other factors including bad manufacturing process, improper storage and mishandling by the vaccinators.

Comparatively, recent research has dramatically improved the diagnostic procedures. Direct detection by the Polymerase Chain Reaction (PCR) now allows a specific and rapid identification of the CBPP agent. This technique has the advantage that it could be used on dried samples (i.e. loaded on paper filter) sent to regional reference center without the need of a cold chain. New serological tests, as the competitive ELISA were developed and should also permit to establish a reliable evaluation of the disease prevalence. Furthermore, molecular techniques also allow now the differenciation of strains coming from various regions.

Therefore, in order to achieve the eradication of CBPP, the major tool which is still missing is a good vaccine. For this purpose, the main goals which should be pursued are: all vaccinated animals should be protected, improvement of the duration of protection, it should last at least 2 years and improvement of the thermostability (vaccine efficacy should less depend on the cold chain).

Many approaches can be checked to develop new CBPP vaccine. The use of inactivated preparation certainly merits attention as new adjuvants, now available, may offer a better antigenic presentation and a better orientation of the immune responses. The development of recombinant vaccines could be very useful. By selecting the appropriate vector and protective protein(s), these type of vaccines could overcome the problems encountered with the classical ones, including the thermostability. Furthermore, the recombinant vaccines allow the introduction, in their genome, of a vaccinal marker.

However, whatever the approach selected, preliminary studies have to be developed since vaccine efficacy rely on the development of a protective immune response and on the long-lasting of this protection. Therefore, in order to select the appropriate adjuvant for an attenuated vaccine or the appropriate antigen(s) inducing the protective response, one must know before what characterizes a CBPP-protective response. The preliminary step will then be to understand the immunopathological mechanisms leading to a state of disease or immunity to CBPP and to define what aspects of the

immune response are responsibles for protection, which specific antigens confer protective immunity and also the duration of this immunity.

It is already known that whereas humoral immune responses play a major role in protection against systemic infections, protection against mycoplasma diseases of the mucosal surface appears to be accomplished via complex local and cell-mediated immune mechanisms.

Therefore, cellular immune responses of cattle facing CBPP have to be studied to identify the subpopulation of lymphocytes recruited during the infection and by which antigen and the cytokine released. Understanding the interaction between the multiple cells of the immune system and the role of regulatory factors produced by these cells will help to explain the immunopathology of the disease. A comparison of lymphocyte recruitment, antigen involved, cytokines factors released between infected, recovered and vaccinated animals will define the protective responses and the pathogenic ones.

According to these results, it will be possible, among the wide variety of adjuvants, to select the one which help to recruit the appropriate subpopulation of lymphocytes leading to the development of a protective immune response.

A long-lasting protection is based on the development of immunological memory which rely on the presence of pathogen-specific-memory cells having a long lifespan. This immunological memory, is defined by the acquired property of the immune system to respond more rapidly and more intensively to a second antigen stimulation. Therefore it is important, when selecting antigens to develop recombinant vaccines, to identify the ones which, not only induced a protective immune response but also long lasting memory cells. The memory cells have then to be used to screen the various mycoplasma antigens obtained by protein fractionation, in order to identify those eliciting an immune response which last over a long period after the vaccination.
Therefore, in order to develop new CBPP vaccine, the study of the cell-mediated immunity is the first step. The second step, to construct recombinant vaccine or subunit vaccine, will be the identification of the proteins involved in long-term protection, the selection of the genes coding for these proteins and their expression in appropriate vectors. The next steps will correspond to the selection of the right adjuvant and vaccinal marker and then to check the new CBPP vaccine efficacy in the field by performing challenge experiments.

OUTCOMES OF THESE EXPERIMENTS :

- Study of the cellular immune responses leading to disease or protection
  identification of the subpopulation of lymphocytes recruited
  identification of the cytokines released
  study of the responsiveness of the memory cells to various mycoplasma antigens
- Identification of antigen(s) involved in protection
- Selection and clonage of the gene(s) coding for this (these) antigen(s)
- Selection of the appropriate vector and construction of a genetic recombinant expressing the protein(s) involved in protection
- Selection of the appropriate adjuvant
- Test of the vaccine efficacy by performing immunisation and challenge in the field

CONTAGIOUS BOVINE PLEUROPNEUMONIA

EUROPEAN UNION

Five year plan

Main objective

Improvement of vaccines

Identified sub-objectives

Seting up of a technique enabling the identification of the curently used T1 vaccine
Identification of genes coding for virulence factors
Characterization of the cellular immune response triggered after a vaccination or during the onset of the disease
Identification of antigens eliciting a protective response
Preliminary field trials with newly developped candidate vaccines

Measurable parameters for the control of the implementation of the project

Sequencing: 250.000bp (representing 1/5th of the complete genome)
Cellular immune response analyzed in 1000 samples
Expression and purification of 10 major antigens
Experimental CBPP reproduction in a high security confinment: 2 times 6 animals
Experimental vaccine trials in developping countries: 3 times 50 animals

Year	1	2	3	4	5	Total
Technician	17	17	34	34	-	102
Consumable	50	50	35	35	35	205
Travel	-	-	8	8	8	24
Equipment	40	-	60	-	-	100
Experiment animals						
High sec. Conf	15	15	-	-	-	30
Dev. Country	-	-	30	30	30	90
Coordination	5	5	5	5	5	25
Sub Total	127	87	167	112	78	576
Overheads	15.2	10.4	20	13.4	9.4	68.4

Total: 644.4 kECU

CONTAGIOUS BOVINE PLEUROPNEUMONIA

EUROPEAN UNION

Five year plan

Main objective

Study of antibiotic treatment efficacy

Although antibiotic treatment of CBPP cases is discouraged by most official policies of veterinary services, it is obvious that owners do treat their animals knowingly or not. In countries where CBPP is highly prevalent and where eradication cannot be reached rapidly, well monitored antibiotic treatments might play a role in dicreasing the infective presure thus diminishing the spread of CBPP. These treatment will have to be chosen according to the expected efficiency in vitro but also according to their expected cost.

Identified sub-objectives

Clinical improvement of treated animals

Evaluation of the impact of treatment on the number of chronic carriers

Measurable parameters for the control of the implementation of the project

Number of animals used

Follow up of infected control animals

Isolations of *M. mycoides* subsp *mycoides* SC

Finance

Year	1	2	3	4	5	Total
Dev. Country	20	20	20	20	20	100

4.
GEOGRAPHICAL STRATEGIES

4.1 RINDERPEST

Geo-epidemiological groups have been defined (see table in NSES paragraph) dependent on:

- *the geographical position of the country with respect to residual outbreaks*
- *the zones and major farming systems; the wildlife*
- *commercial exchanges (see map page 73)*

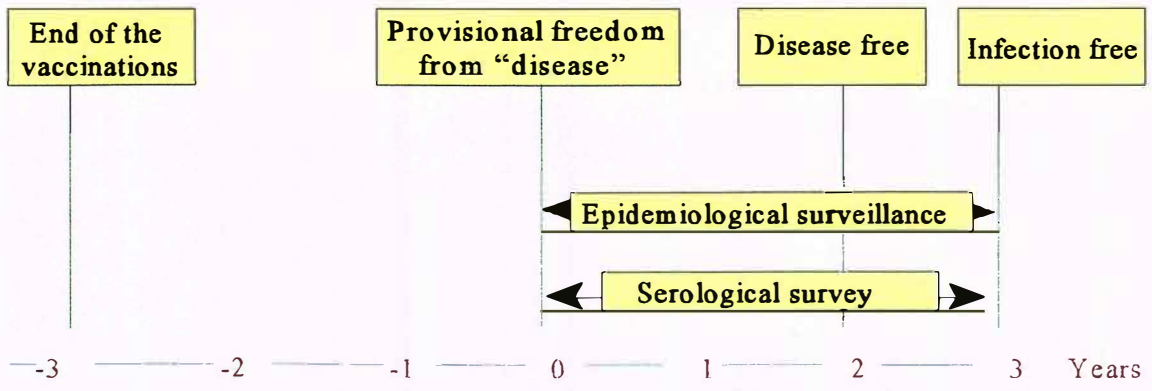
The risk of Rinderpest can be determined from these groups (shown in map page 72) and a strategy can be developed.

4.1.1 West Africa

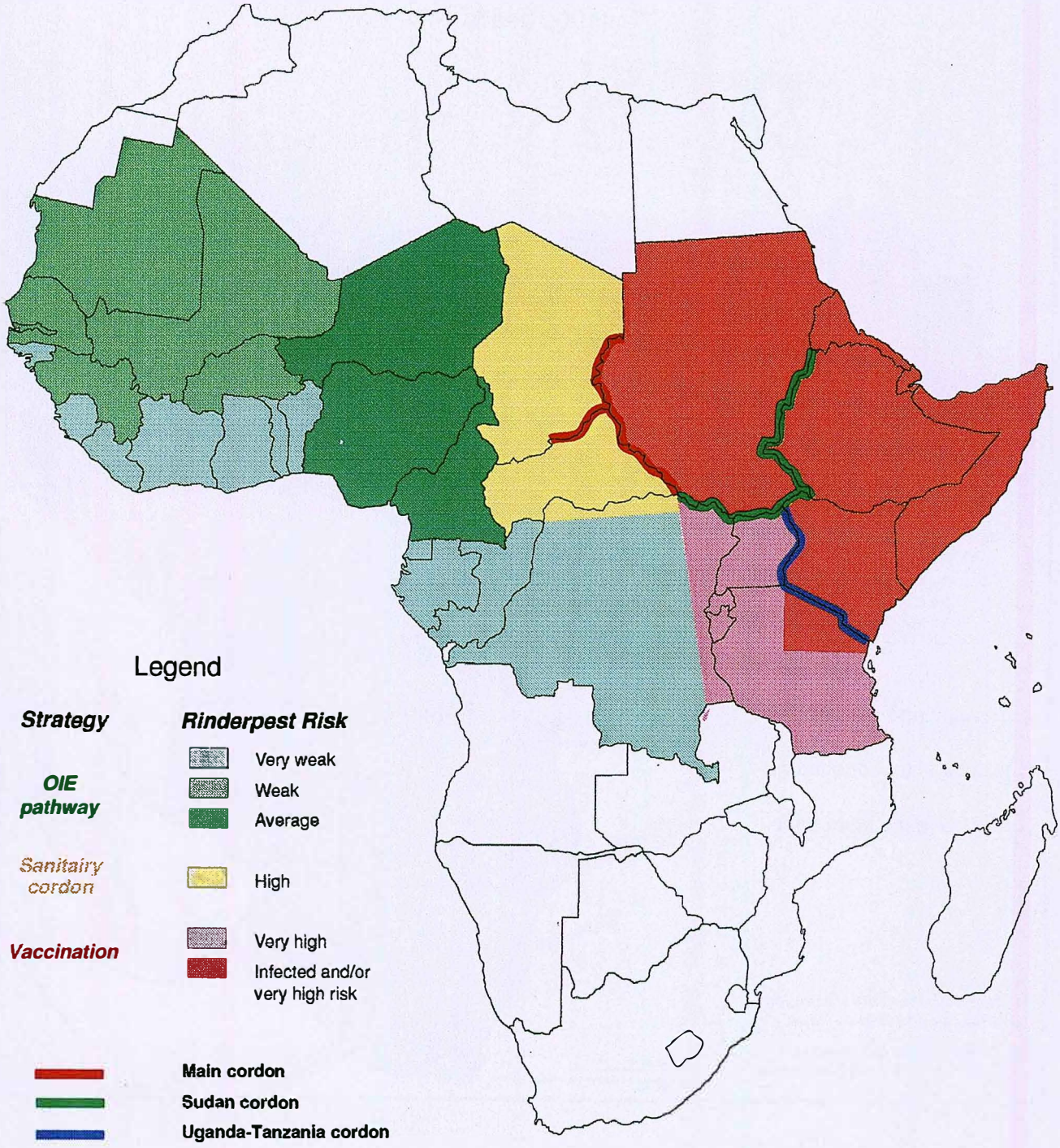
An end to vaccination, implementation of a NSES (3 years) and assessment of the OIE pathway: OIE pathway: "For a country to be able to declare that it is provisionally unaffected by Rinderpest, it must fulfil the following conditions:

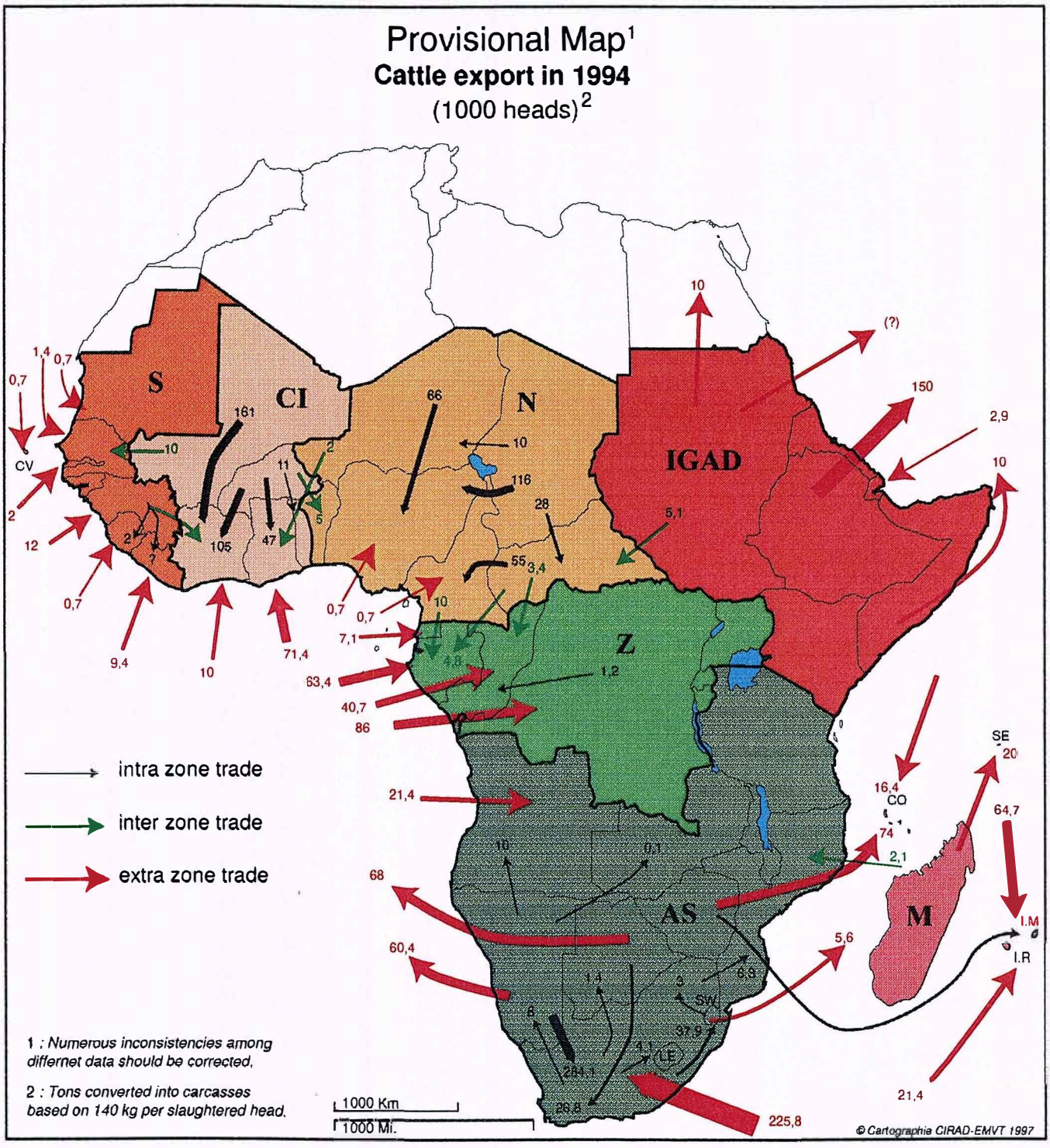
- *Absence of clinically detectable disease for at least 2 years;*
- *Existence of a veterinary service able to watch over changes in animal health in the country;*
- *Conduction of surveys by this service in the presence of any clinical sign suggestive of Rinderpest;*
- *Presence of an efficient system of declaration both from the field towards the central veterinary administration and from the latter to the OIE;*
- *Existence of a reliable warning system for the introduction of infection by means of borders controls, quarantine measures, etc*
- *Total end to vaccination against Rinderpest at the date of the declaration, this decision firstly being notified in writing to OIE and to the bordering countries with mention of the date of end of vaccination."*

(OIE recommendation reprinted in June 1993. Formerly entitled: Report of the expert consultation on Rinderpest surveillance systems, Paris, 16-18 August 1989).



Rinderpest strategies : geo-epidemiological groups




Provisional Map[1]
Cattle export in 1994
(1000 heads)[2]
S
CI
N
IGAD
Z
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M
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CO
SE
I.M
I.R
SW
(E)
(?)
intra zone trade
inter zone trade
extra zone trade
1 : Numerous inconsistencies among differnet data should be corrected.
2 : Tons converted into carcasses based on 140 kg per slaughtered head.
1000 Km
1000 Mi.
© Cartographie CIRAD-EMVT 1997

4.1.2 *Central Africa*

Main zone of cordon sanitaire

The cordon sanitaire must involve the three countries bordering the infected and unaffected zones, Chad, CAR and Sudan. In the first place, it is a question of protecting Central and West Africa from reintroduction of Rinderpest from localized outbreaks for lineage 1 of the virus in the East and Southeast of Sudan.

The fact that there has been no Rinderpest in Chad and CAR despite the situation in Sudan and the weak immunization rate in the cordon can be explained by:

- *Sudanese outbreaks situated in the south east of the country (right bank of the Nile)*
- *Weak transverse movements (essentially north-south)*
- *Inter-epizootic period: from 10 to 15 years but increased even by partial vaccination.* ***The last outbreaks in West and Central Africa date back to mid-1988.***

This cordon is defined in the first place as a vaccination cordon that includes the activities of surveillance and active search for the virus.
The requirement of 70-80% of animals vaccinated in order to control infectious disease is challenged by many studies and is to be modified depending on the infectious disease. ***For the morbillivirus it seems that the minimum rate required is 90%*** *(studies of measles and Rinderpest.)*

The borders of the cordon must take into account: :

- *the migratory movements of the herd*
- *the commercial flows*
- *clearly identified geographical limits, road and hydrographic networks*
- *national parks which can be used as sentinels in Chad and CAR.*

Elaborated from these different points, the following maps (pages 79 and 80) shows the theoretical limits for a cordon. It has an average frontier extent of 150 km in addition to a buffer zone of 150 km with respect to a vaccination cordon (cordon + buffer = 300 km, average distance that can be covered by Rinderpest in 1 week assuming transverse movements.)
The actual limits of the cordon, based on physical boundaries, will be defined in detail for each country.

We propose:

- *Chad*

Characteristics: north-south animal movements; entry of animals by CAR and encounters with animals from Sudan (notably Tizi lake); commerce with Cameroon and Nigeria.

We can define:

1. *A sanitary/vaccinal cordon fixed on the route Abéché-Sahr2,*
2. *A buffer zone (route Ati-Mongo-Melfi-Mounou) where the seropositive / vaccinated animals can be detected.*
3. *A third zone outside the buffer zone.*

- *CAR*

Characteristics: Concentration of cattle and major transits to the northeast of the country; important wildlife.

1. *Vaccination and cordon sanitaire for the part bordering Chad and the northeast, bordering Sudan (see map);*
   Sanitary cordon in the southest of CAR: little or no cattle however with increased passage in the south (commerce) and the surveyed cattle in the park of this region according to certain sources. The reduction in the pressure of tsetse flies in this zone linked to the reduction in wildlife density has allowed farmers to penetrate this environment.
2. *Buffer zone, including notably the main cattle production zone (Bambari-Bria.)*
3. *A third zone outside the buffer zone.*

For Chad and the CAR zones 2 and 3 will be the object of progressive installation of the OIE pathway based on:

- *clinical surveillance: 300 herds per zone (= stratum)*
- *serological surveillance: 10 to 57 sera per stock of 10 to 100 cattle for a sum total of 300 stocks per stratum.*

The buffer zone has an intermediate epidemiological status. With an extent of 150 km, it is a non-vaccinated zone (end of vaccination planned for 1999 in the buffer zone by PARC Chad) but within which animals that may have been vaccinated will pass through. This zone however needs to be defined administratively so that controls are reinforced on the traditional movements and commercial flow.

- *Sudan*

For south Sudan, a proposal of redefining it epidemiologically and strategically in 4 north-south zones for the southern part (see maps pages 79 and 80):

1. *Vaccination and cordon sanitaire (zone C "Cordon") along the borders with Chad and CAR and up to the Nile for the southern part. This concerns the following prefectures (the first two are easily accessible):*
   - *western Darfour*
   - *southern Darfour*
   - *western Barh El Ghazal*
   - *northern Barh El Ghazal*
   - *western Equatoria*
   - *Barh El Djebel*
   - *El Bouheirat*
   - *Ouarab*
   - *El Ouahda*

2. *Infected zone with a central interior part of triangle Wau – Malakal – Juba of uncertain status and difficult to reach (zone D "Disease"):*
   - *eastern Equatoria*
   - *Jonglei*
   - *Upper Nile*
   - *Blue Nile*
   - *South of western Kordofan*
   - *southern Kordofan (suspicion of Rinderpest in the Nouba mountains?)*

3. *Zone B "Buffer": maximum vaccination coverage (zones accessible to PARC Khartoum), set up of NSES.*
   - *south of northern Darfour*
   - *north of western Kordofan*
   - *Guezirah*
   - *Guedaref*
   - *Khartoum*
   - *Kassala*

4. *Zone A: reduced farming. Integration in a NSES (with camel disease?):*
   - *(north of northern Darfour*
   - *(North)*
   - *Nile*
   - *Red sea*

The following activities to be carried out in the main cordon, Chad-CAR and zone C of Sudan:

- *massive and continued vaccination (use of the thermostable vaccine); that represents a total of 8 – 10 million cattle (1 – 1.5 million of which in Chad, 100,000 – 200,000 in CAR but with periods where the concentration of animals is greater; in particular in CAR with migration and commercial transit from Sudan and Chad);*
- *serological monitoring: by rigorous sampling as defined by PARC for evaluation of vaccination.*
- *active surveillance for Rinderpest by mobile teams: 2 per country based on surveys (markets, water holes, rumors) and sampling in clinical Rinderpest-like-diseases.*
- *management and up-dating based on geographic data on animal movements including the meeting zones and watering places; management at Abéché (coordinator) / N'Djamena (to be defined); this in order to optimize the follow up, vaccination and emergency intervention plans (must integrate routes, veterinary centres etc). Missions are necessary (2 per year) in addition to training (1 leader in Chad, equivalent to AT base at Abéché); material (computer, MapInfo software, Fluxour module, GPS)*
- *at the limits of the cordon: guards, NSES posts and communication systems. Entry and exit control of the cordon and between countries: use of international vaccination certificates.*
- *quarantine zones allowing entering and exiting animals to be vaccinated*
- *coordination between the 3 countries with regular visits between Abéché (Chad), Nyala (Sudan) and Birao (CAR)*
- *dependence on the epidemiological surveillance network that covers the whole territory*
- *legislative arsenal to be elaborated (consultancy to be planned).*

4.1.3 East Africa

Vaccination and setting up of the NSES

Vaccination cover in Kenya and Uganda for the years –1 and –2
Are defined:

- *sectoral cordon sanitaires: vaccination, serological monitoring and surveillance:*
  1. *Cordons around south Sudan*
  2. *Cordons Uganda / Kenya and Kenya / Tanzania*
- *buffer zones: surveillance*
- *unaffected zones: application of OIE pathway*

Each zone constitutes a stratum in which the OIE system can be applied (herd sentinels, serology).

The following table specifies the schedule and the different activities to be carried out within the different cordons.

<table>
<tr><td>Year</td><td>I</td><td>II</td><td>III</td><td>IV</td><td>V</td></tr>
<tr><td>West Ethiopia</td><td colspan="3" rowspan="4">VACCINATION and DURATION OF THE IMPLEMENTATION OF NSES</td><td colspan="2" rowspan="4">SURVEILLANCE (Continuation of vaccination : depending on evolution in South-Sudan)</td></tr>
<tr><td>North Kenya</td></tr>
<tr><td>North Uganda</td></tr>
<tr><td>CDR / Sudan (?)</td></tr>
<tr><td>Sudan (Zone B)</td><td colspan="5">VACCINATION and SURVEILLANCE</td></tr>
<tr><td>Uganda / Kenya</td><td colspan="3" rowspan="2">VACCINATION and DURATION OF THE IMPLEMENTATION OF NSES</td><td colspan="2" rowspan="2">SURVEILLANCE</td></tr>
<tr><td>Kenya / Tanzania</td></tr>
</table>

4.2. CONTAGIOUS BOVINE PLEUROPNEUMONIA

The following map (map page 81) defines :

1. *The primary outbreaks (4) : High Guinea /Niger interior delta; around lake Chad; Sudan/Ethiopia; Angola. These are defined zones.*
2. *Countries which declared CBPP in 1997.*
3. *The zone of extension of the disease and/or the infection (probable or confirmed zone).*

It is recommended to base the CBPP control on :

4.2.1. Primary outbreaks.

- *Vaccination during several years with an intensive vaccinal scheme during the first year (at 0, 3 and 9 months), then once a year, **on the same identified animals**. In all, the cattle population in the primary outbreaks is estimated at 20 millions, with about 10 millions for the eastern region.*

- *Serological evaluation of the diminution of prevalence in the primary outbreaks (c-ELISA, serology on animals vaccinated for more than 6 months). Sample of about 3 x 5000 sera. Starting year 2.*

- *Surveillance in the abattoirs and slaughter areas.*

4.2.2. Other regions

- *Vaccination in the other zones : should be adapted according to the local prevalence.*

- *Prevalence is often underestimated; in a first time, it is recommended to make a serological evaluation of the prevalence per country, using the Rinderpest sera collections.*

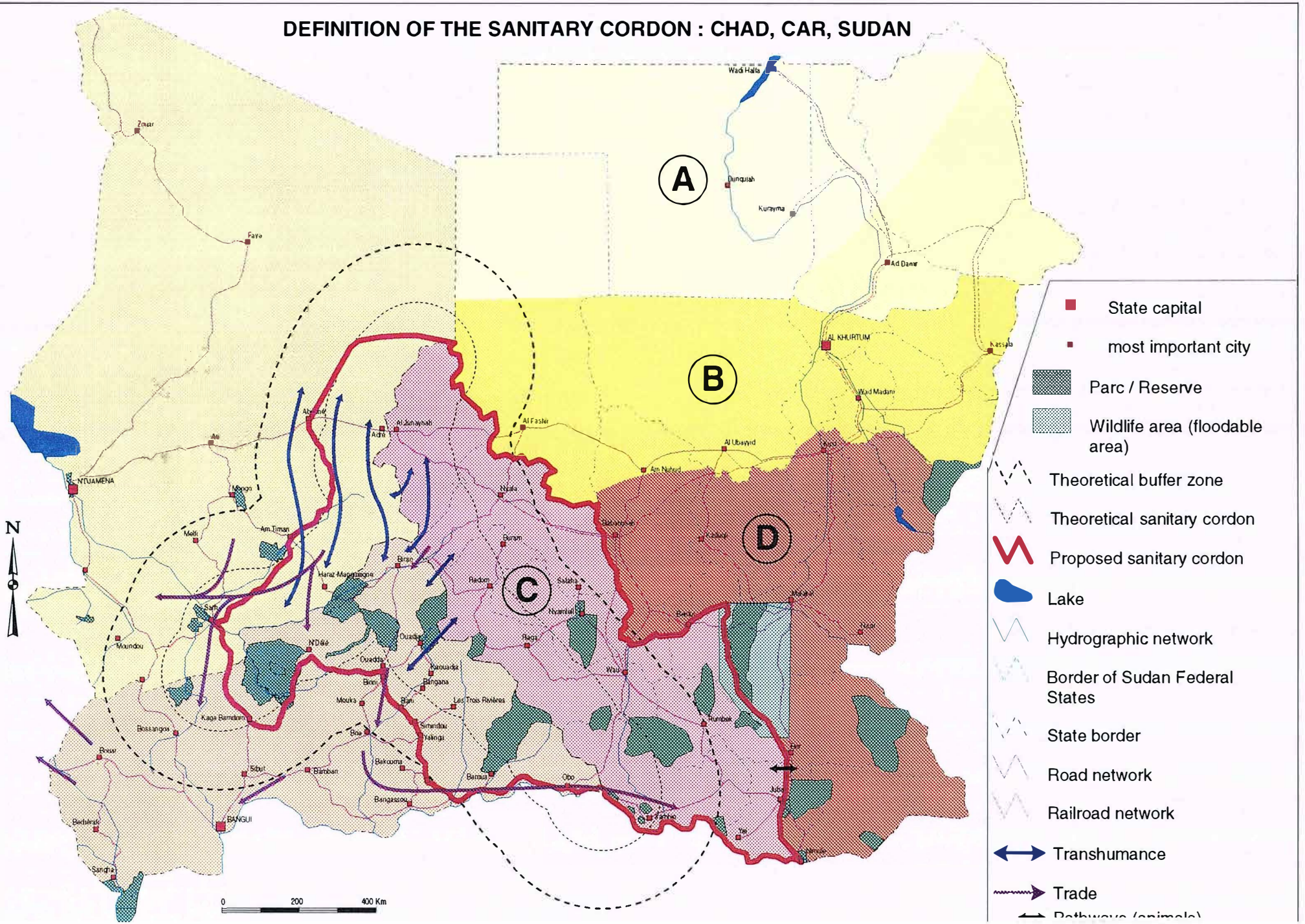
	Year	I	II	III	IV	V
Primary Outbreak	Vaccination	0, 3, 9 mths				
	Serology					
Other zones	Serology					
	Vaccination		Implementation vaccination according to serological results			

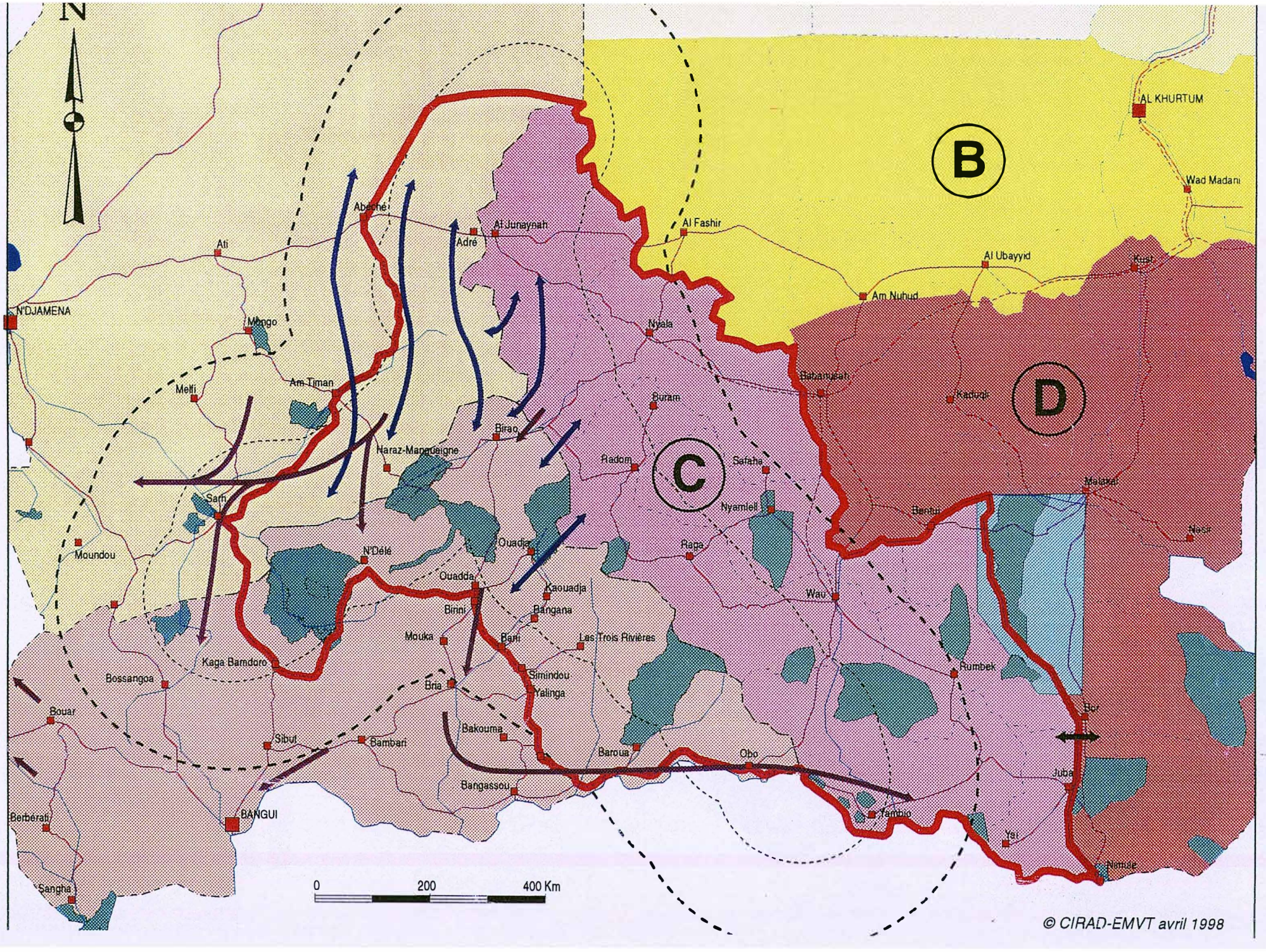
- *Analysis of animal movements (Cf specific chapter).*

- *Epidemiosurveillance*

- *Development of laboratory competencies : isolation and serology (Cf Chapter Laboratories)*

DEFINITION OF THE SANITARY CORDON : CHAD, CAR, SUDAN

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Birini
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Les Trois Rivières
Kaga Bandoro
Rumbek
Bossangoa
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Juba
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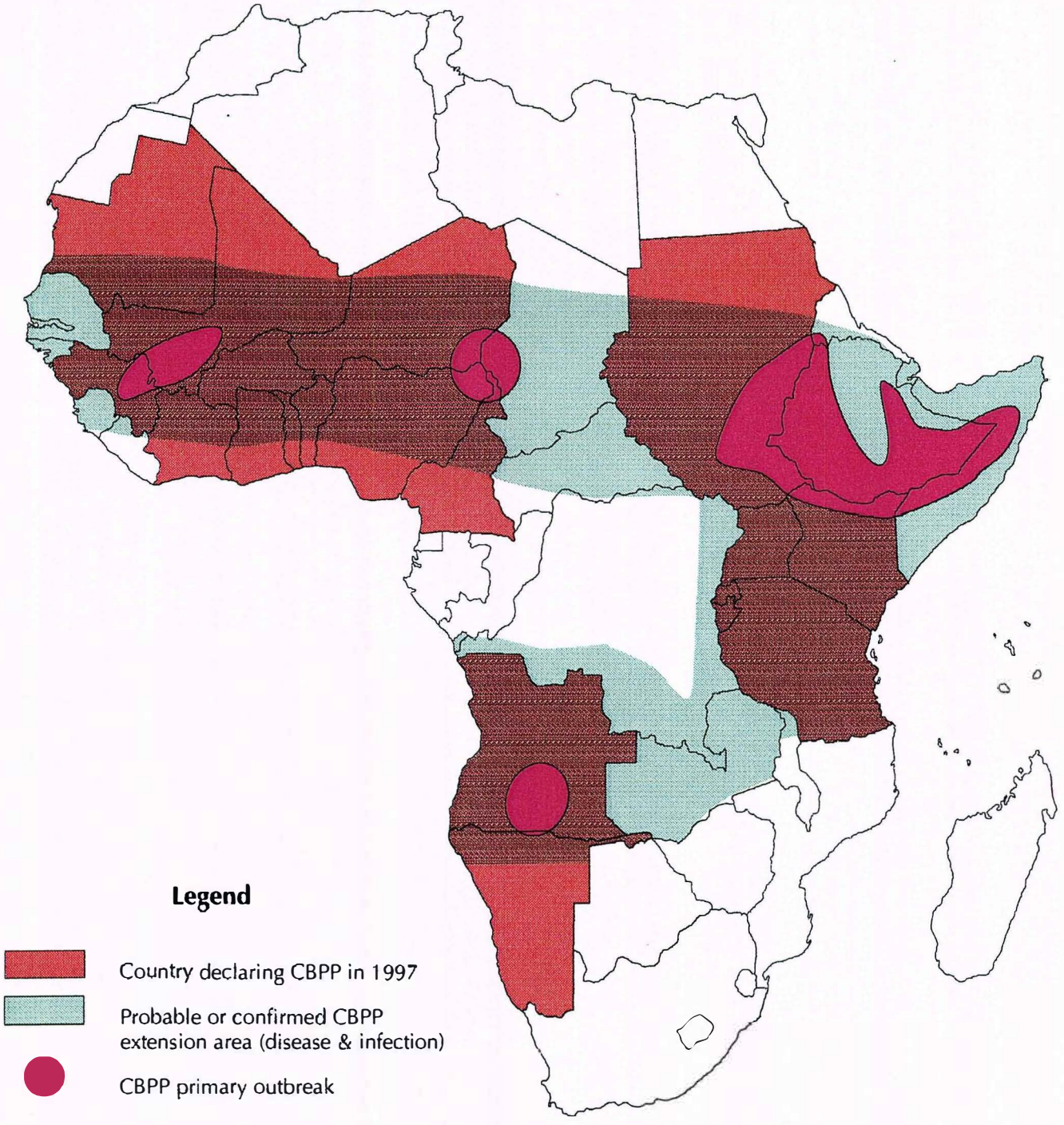
© CIRAD-EMVT avril 1998

Evolution of CBPP epidemiological situation in Africa (1980 - 1997)



Cartographie CIRAD-EMVT, 1998

5.
CONCLUSION

Although Rinderpest remains current in East Africa and much technical, logistic and political difficulty is encountered in the field, ***overall, the PARC is a success.*** *The positive economic impact of health improvements on animal production leads the consultants to propose integrated technical and geographical strategies. The national systems of epidemiological surveillance, "pivots" of the future program of control of trans-boundary diseases in sub-Saharan Africa are mobilizing all the "livestock actors" around them.*

6.
AKNOWLEDGEMENTS

The consultants would like to thank Dr W. Masiga, Director of OAU/IBAR-PARC and his team for welcoming us and donating their time. We would also like to thank all the people we met during the course of these assignments.

7.
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8.
REMINDER of TERMS of REFERENCE

1. GENERAL CONTEXT OF THE ASSIGNMENT

The overall aim of the PARC program (Pan-African Rinderpest Campaign) is to improve the revenue achieved by African producers in the sub-sector of stockbreeding. The attempts to reach this goal occur by stimulating production through eradication of Rinderpest, and by improvements in services rendered to farmers and by the coordination on a pan-African scale of epizootic control.

The assignment will consist of technical support for the Coordination Unit of the PARC Program from the OAU/IBAR in Nairobi. The purpose is to help identify, then formulate an overall future program of intervention in relation to a fourth phase of the program. Then with a view to finance from Regional funds of the eighth European Development Fund the assignment will be subject to the FED committee.

The assignment will be conducted in close collaboration with the other support provided for IBAR for the preparation of the future program. The contracting party will ensure that the gathering of results from these supports is simplified in order to provide IBAR the facility to elaborate a consolidated proposal for presentation to the funds of the European Commission.

The assignment will be made up of two sections: one section "ANIMAL HEALTH" and one section FINANCE AND ADMINISTRATION.

2. OBJECTIVES AND EXECUTION METHODS OF THE ASSIGNMENT

2.1 ANIMAL HEALTH SECTION

General aims

Conforming to the recommendations of Stockbreeding specialists in the member countries of the European Union during their last meeting of 2-4 June 1997 in Brussels, the general aims of the support assignment will be to:

discuss and define with the Coordination Unit a global strategy of final eradication of Rinderpest in the continent, taking account of the current epidemiological situation of the disease and the results obtained its control since the creation of the PARC program

formulate, in particular, the operational recommendations concerning the actions to be taken:

concerning control and eradication, strictly speaking, in the zones where Rinderpest is still

endemic (East Africa), taking into account the recent developments of the disease;
concerning control and surveillance in the zones making up the "cordon sanitaire"
concerning epidemiological surveillance and epidemiological vigilance in the zones where the disease seems to have been eradicated (West Africa), with particular reference to the arrangements of the "OIE pathway of declaration of countries unaffected by Rinderpest";

evaluate, in addition, the appropriateness and the feasibility of control programs against other major trans-boundary epizootics and propose possible intervention synergies with existing or proposed systems of surveillance, epidemiological vigilance and coordination in the control of Rinderpest.

Specific tasks

The assignment sets out in particular to:

achieve a global assessment of on-going or planned actions at the level of countries visited, in particular concerning the setting up and running of epidemiological surveillance/epidemiological vigilance networks and the cordon sanitaire

study the suitability of the actions actually initiated or proposed in the countries visited with respect to the objectives set out above and the standard recommended methods of OIE for epidemiological surveillance of Rinderpest (OIE, June 1993);

evaluate the human resources and materials available for intensification in the surveillance and control of Rinderpest in each country visited including the cordon sanitiare on one hand and the requirements for potential control of other major diseases on the other hand; to do this the consultants will assess the strength available for intervention by:

the national veterinary services
the national and regional laboratories
the abattoirs
the private veterinarians
the farmers' organizations
the existing projects in the domain of animal health with multi- and/or bilateral funding (World Bank, PNUD European Union NGO inter state Cooperation) in particular concerning the existing epidemiological surveillance networks;

evaluate the need for research projects expressed by the national leaders and by the coordination unit of the technical committee of PARC.
study the possible links between the future national constituents of the PARC program and the projects relating to wild fauna financed by the European Union in relation to different African countries and to establish sub-regional classifications and types of intervention necessary in matters of eradication, control and /or surveillance of Rinderpest. This will be based on the existing documentation from OIE OUA/IBAR, the MD VIII and CIRAD-EMVT in addition to visits and the consultants' own knowledge.

On these same bases, recommendations will also be established on the possibilities of joint control of major transboundary diseases for all the economically important animal species; this will also be taken into account apart from the large epizootics, the zoonosis and the spreading diseases;

finally, evaluate the various possibilities of external control that the coordination unit could rely on for monitoring and evaluation both for anti-Rinderpest vaccination campaigns and for epidemiological surveillance and epidemiological vigilance.

Expected results

The expected outcome of the assignment will notably be:

strategic, material and operational proposals concerning the aim of Rinderpest eradication based on the aptitudes of the "OIE pathway" and the epidemiological surveillance and epidemiological vigilance networks that already exist, or will be created, in the countries visited; these proposals will specify in particular;

the roles and responsibilities of different agents with respect to the existing or future structures of health defense

- *the role of private veterinarians and the farmers' co-operatives in the national networks*
- *the contribution and the specific role expected of the sections of Epidemiology, Communication, Socioeconomics and PANVAC*
- *the possible operational mode of cooperation with the external structures working for the same objective (FAO, reference laboratories, research units);*

a characterization of the health situation in a given country justifying intervention of one of the types proposed above; and on the basis of facts in the consultants possession, an attempt at classification from this characterization of member countries of OAU;

the adoption of coherent approaches to control of other major health constraints that have been identified, CBPP being in the front row; the control measures for this will have to take advantage of synergy with the actions aimed at eradication of Rinderpest from the continent;

according to this last complementary approach, and as much as is necessary, the assignment will propose a research section concerning, in particular, the diagnostic techniques, the epidemiology and immuno-protection vis-à-vis the major epizootics such as Rinderpest, CBPP PPR and CCPP: this section will give rise to a budgetary estimation and specific schedule;

a proposal relating to epidemiological information and its mode of transmission (type, timing, form) at the level of OAU/IBAR in order that this institution can adequately play its role of coordination with respect to OIE standards.

Methods of implementing the assignment

From a practical point of view, two preliminary consultation meetings are planned:

one in Brussels with the leaders concerned with the MD VIII and the team charged with the formulation of the proposed PARC IV project;

the other at Nairobi with the leaders of the coordination unit of PARC at OAU/IBAR.

Among other things, these meetings will be the chance to decide finally on the list of countries to visit;

the visits in a certain number of sub-Saharan Africa countries concerned by the PARC program:

not wishing to interfere with the search for information that the consultants may consider essential for their tasks, one could however envisage including amongst the countries to visit particularly:

in the endemic zone: Kenya, Tanzania, Uganda..
in the zone to consider as the cordon sanitiare: Cameron, Rwanda.;

in the zone where it is recommended to cease anti-Rinderpest vaccination: Niger, Mauritania for the Sahelian countries; Benin, Côte d'Ivoire for the coastal countries; to establish eventual coordination with the countries of the SADC and other Regional Organizations;

In addition, the preliminary consultation meetings will be an opportunity to establish the situation in Nigeria and Sudan within the framework of this assignment, in discussion with the leaders of OAU/IBAR and the European Union.

One meeting of restoration to OAU/IBAR in Nairobi to unite the team charged with the formulation of the PARC IV project and transmit a preliminary MEMO;
The discussion of a PRELIMINARY REPORT which must be transmitted before the end of November 1997 at the latest.

2.2 ADMINISTRATIVE AND FINANCIAL SECTION

Main objectives

During the overall evaluation of the PARC program carried out in July 1996 (Cf. "Assignment of overall evaluation of the pan-African campaign against Rinderpest" Definitive report March 1997), diverse problems related to the administrative and financial management of the program became evident. This was at the level of both the European Commission headquarters and its representatives in the countries and at the level of OAU/IBAR.

However, financial implementation of different successive projects and commitments requires additional administrative approaches, notably concerning closure of commitments in order to cancel certain elements and release the balance of funds available.

With reference to the assessments carried out and the recommendations formulated on the occasion of the aforementioned evaluation, the assignment will have two main objectives:

together with services in charge of implementing the PARC program and the Commission, seeing to permanent up-dating of financial performance indicators drawn up on this occasion, closure of commitments and release of the balance of funds on the projects successively implemented up to now;

prepare a framework of administrative and financial evaluation of the program with a view to a possible fourth phase in the future that will permit assessment at the level of both the Commission and the Coordination Unit based at the OAU/IBAR in Nairobi.

Execution methods of the assignment

The assignment will be completed in two phases:

First, a financial specialist in collaboration with the services of the commission will have the task of:

up-dating the data on the financial engagements related to the program

ensuring the identification, initiation and assessment of procedures of closure of engagements as far as possible: the specialist will (if necessary and only with the prior agreement of the MD VIII/G/3, with visits from them) provide his support to this effect to the Commission representatives in the country.

With the appropriate services of the PARC program at OAU/IBAR and the EC representatives at Nairobi they will carry out the assessment:

to evaluate the needs and the capacities of a decentralized administrative and financial assessment which provides both the program leaders and the Representatives with a clear picture of changes during the end of the current funding and the planned intermediate phase of 24 months;

carry out to this effect the essential work of conception and setting up of performance indicators and training of personnel.

This first stage of activities will result in a PRELIMINARY REPORT submitted three months from the start of the assignment. In particular, it will be established what support is desirable at the level of the country as well as a classification of this in function of the criteria of urgency and costs concerned.

Secondly, the specialist will have to propose a management plan and financial overview for a possible fourth phase of the program to the Coordination Unit of the program and the services of the Commission. To this effect, the specialist will be involved more specifically with;

considering the recommendations of the financial appendix of the report for the aforementioned overall evaluation;
defining the requirements for information and the way to render it continually accessible at the different levels where it is required;
evaluate precise costs and funding of this assessment;
recommend an implementation procedure for this assessment and specify the decision levels and processes that are involved;
describe the posts and profiles of personnel needed for this assessment: as far as possible at this level the specialist will prioritize the training of on-site managers with respect to recruitment of new collaborators, and if necessary specify the further training desirable;
propose a timetable for implementation of management.

An INTERMEDIATE REPORT on this work will be submitted 6 months from the start of the assignment. Three months after the transmission of this intermediate report, the specialist will establish a DEFINITIVE REPORT depending on the remarks of OAU/IBAR and the services of the MD VIII. This report will contain in particular the final proposals concerning the assessment framework as well as a current version of the financial situation of the program.

NB. The MD VIII will provide the financial specialist with access to the necessary accounting data and in particular to the appropriate parts of the computing system. The necessary possibilities of international communication for the assignment will also be provided. Finally, he/she will see to appropriate requests from European Commission representatives in the country and its services as well as the responsible authority of PARC.

3. SKILLS REQUIRED

The assignment will be carried out by a team composed of:

Two specialists in epidemiology and tropical animal pathology for the ANIMAL HEALTH SECTION; one will be in charge of conducting the work in west and central Africa, the other for the countries of east Africa.

One financial specialist for the ADMINISTRATIVE AND FINANCIAL SECTION.

All of the work will be carried out in collaboration and permanent consultation with the leaders of the coordination unit in Nairobi and the team in charge of formulating the PARC project. In particular, the schedules for execution of activities and the supply of solicited reports for each of the sections will be coordinated, as closely as possible, with the team in charge of formulating the PARC IV project. The due date fixed for the presentation of this to the committee of FED (June 1998) will be taken into account.

The estimation of the duration of the different planned interventions, and all the work required for the realization of the present assignment concerning each of the two sections, will be carried out by the specialists on the basis of the general description formulated above and will be supplied in their initial proposal.