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ASSISTANCE IN THE PRODUCTION OF  
VETERINARY DRUGS IN  
SADCC COUNTRIES

DP/RAF/86/012

ANGOLA

Technical report: The supply of veterinary drugs and vaccines  
in Angola\*

Prepared for the Government of the People's Republic of Angola  
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acting as executing agency for the United Nations Development Programme

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## INTRODUCTION

The People's Republic of Angola is situated in the southern region of Africa covering 1,246,700 km<sup>2</sup>. The country lays between the 4°23' S and 18°00' S and 11°50' E and 24° E latitudes. The Atlantic is its western boundary and the country borders in the North on the Republics of the Congo and Zaire, in the East on the Republics of Zambia and Zaire and in the South on Namibia.

The geography of the country is diverse, the coastal plains (width between 25-200 km) rising in stages towards the high inland plateau (altitude between 1200-1600 m), accounting for about two-thirds of the country.

The climate in the northern half of the central plateau is humid-tropical; in the high regions of the south is dry tropical. In the northern coastal plains the climate is humid - temperate, and in the central and southern parts the temperature is affected by the cool Benguela current.

The population of Angola at the last general census (1970) was estimated between 5.8 - 6.5 million. By 1985 it had increased to an estimated 8.0 million with a growth rate of 2.5% p.a. Most of the population is concentrated in the West - Central part of the coast between Benguela and Luanda and on the high plateau. Approximately 75% of people live in rural areas.

The economy of Angola is based on agriculture and on diamond export. Agriculture has great potential and the country had been almost self-sufficient in staple food production before independence in 1975. Due to continuous strife and the uncertain security situation, especially in the South, the country has become an importer of over 50% of its basic food requirements relying on donor contributions.

### 1. LIVESTOCK POPULATION AND PRODUCTION TRENDS. (Annex 1)

No reliable data exists for the livestock population of the country. The last livestock census was carried out in 1973. Prior to independence the annual growth rate of cattle (1964 to 1973) was between 4-7% in the commercial and 2.2% in the traditional sectors. After 1975 the number of commercial herds very sharply declined from just over 1.2 million down to 35,000 (from ca 37% to 1% of the national herd). In 1973 in the traditional sector there were a little over 3.2 million heads of cattle which increased to an estimated 3.5 million by 1987 representing at the present time 99% of the national herd. Primary production is therefore almost entirely in the hands of small private producers. There are some state operated and co-operative production units, but apart from egg production, they contribute very little to the output of the livestock industry. Small farmers and semi-nomadic pastoralists hold the vast majority of livestock, concerned in the main to satisfy their

own needs.

The number of goats, sheep, and pigs also declined in the country over the same period of time. It is estimated that the number of goats over the 14 years, declined by 28% (-2% p.a), sheep by 53% (-3.8% p.a) and of pigs by 38% (-2.7% p.a). Before independence there were 1.1 million layers and close on 5.0 million other poultry in the country. There were hatcheries for the production of day-old chicks. However, stock birds increasingly suffered from various diseases (coccidia, mycoplasma, salmonella) and were eliminated by 1984. At the present time there are some 0.6 million layers managed on a commercial scale. Stocks are replaced yearly with day-old chicks imported from Zimbabwe. There is no broiler production, nor is it envisaged in the near future. Luanda, Huambo, Benguela, Huila, and Malange are the centres for egg production. Expansion of egg production is hindered by the quality and the quantity of food and water. Little is known about the number of birds in the traditional sector. Every rural household would have some of them (5-15 birds). It is estimated that there may be some 5.0 million birds and their numbers are not expected to change much in the next few years.

Since 1975 a series of adverse factors have severely affected livestock of the country. The disruption of economic activity and of basic infrastructure as a consequence of the worsening security situation in the South (where 90% of cattle, 52% of goats, and 35% of pigs are), the drought of the 1970's and early 1980's, the increase of diseases, due to the decline in the quality and the extent of the veterinary services all contributed to the decline of the livestock sector.

Under these conditions any forecast of livestock production trends must be viewed with judicious caution. For planning purposes it is assumed by the Livestock Department (Departamento de Pecuaria / DEPEC) that no increase in the number of livestock may occur before 1990. On assumption that the security situation will have substantially improved by the last decade of the century it is thought that the annual growth rate of cattle may be between 2.0-2.5%, that of goats, sheep, and pigs 5%, 2%, and 3% respectively. Not much change is expected in poultry numbers in the traditional sector, perhaps an annual increase of 1%. However the number of commercial layers is expected to increase 10% p.a during the last 10 years of the century, taking their numbers from 0.6 million to 1.2 million birds (Annex 1).

It needs to be emphasised again that these forecasts are tentative. In the absence of a livestock census since 1973, the pilot project of the FAO, aiming to establish the actual number of livestock in the country by 1990, must rate as a high priority as soon as conditions permit. Rehabilitation of the basic infrastructure and extension of the veterinary services and resumption of peacetime economic activities are all crucially important for these forecasts to be meaningful.

## 2. NATIONAL DISEASE CONTROL STRATEGIES

### Animal Diseases-

#### 2.1 Trypanosomiasis (scheduled disease)

Angola lays in the Glossina infested part of Africa and ca.25% of its territory is affected by the vector of trypanosomiasis of man and his livestock. These territories are located North of the parallel 14° S and include Cabinda, Zaire, Uige, Bengo, Kwanza-Norte, parts of Kwanza-Sul, Malange, Luanda-Norte and Luanda-Sul (Annex 2). South of this limit there are two Glossina infested regions, one in Kuando-Kubango province and the other in Moxico. A considerable part of the infested areas would be excellent for agriculture and livestock production but for the presence of Glossina. In 1963 the "Trypanosomiasis Control Commission" was established. Its aim were 1) prophylaxis and treatment of human and livestock trypanosomiasis 2) Tsetse control and eradication and expansion of agriculture and livestock into areas freed from the fly. After 1975, following the departure of trained personnel, the shortcomings of financial support and the security situation in the countryside made the service ill prepared to cope with new outbreaks.

G. palpalis palpalis, G. fuscipes quanzensis and G. morbitans morbitans are the vectors of infection, the latest being the major vector of trypanosomiasis of animals, due to its marked zoophily. The trypanosomes more frequently found in livestock are T. vivax, T. congolensa and T. brucei. Some 90% of the cattle are kept in the southern provinces free of Glossina infestation leaving ca. 10% of cattle at risk. Although trypanosomiasis is not regarded as one of the most important loss-causing livestock diseases but it certainly is the most important barrier of expansion of livestock sector in the country. Control of the disease is attempted by chemoprophylaxis and chemotherapy (Berenil, Novidium). However, until such times when other measures of control (spraying, fly-traps, habitat destruction) may be re-established again an increase of trypanosomiasis is likely.

#### 2.2 Tick Born Diseases. (scheduled diseases)

These are especially important in areas of high rainfall, particularly in the North where they cause considerable losses. Anaplasmosis is the most important in this group of diseases. It is enzootic occurring in pockets. Babesiosis is regarded as the second most important tick born disease with sporadic occurrence, followed by Heartwater (caused by rickettsiae) in isolated pockets of infection and Corridor disease with low sporadic occurrence. East Coast Fever has not been recorded.

Control measures include control of the vector of protozoa or

rickettsia blood parasite by dipping or spraying with acaricides of cattle, sheep and goats at regular intervals. It is usually once a week in the rainy season (or when Amblyomma ticks are involved, carriers of rickettsiae causing Heartwater) and at longer intervals (2 weeks) when Anaplasmosis and Babesiosis are concerned, or even longer in the dry season (several weeks or even months) when development of ticks is slow. Babesiosis can be treated with a number of chemicals including Berenil and Anaplasmosis with tetracyclines.

Routine dipping is the Government recommendation for tick control and it is free of charge for the traditional sector. However 40-50% of the dip-tank and spray races are out of order, there is a shortage of auxiliary staff to operate and supervise the facility and there is a shortage of acaricides due to a lack of funds. For these reasons tick born diseases are thought to be on the increase.

### 2.3 Helminthiasis.

Climatic conditions in most parts of Angola are favourable for the survival of the free-living larval forms of various internal parasites requiring moist conditions. The epidemiology of these groups of diseases is complex and involves a balance between the rate of infection and the acquired resistance of the host. Young stock are the most susceptible until they too acquire resistance from field exposure. Exposure levels are highest during the rainy season when in the adult stock there is a rise in faecal egg output which can survive and develop under the moist conditions. Therefore calves and other livestock which are born at the beginning or during the rainy season are more prone to heavy exposure or even fatal challenge. If the challenge is not overwhelming resistance is developed. It is recognised that the largely untreated livestock in the traditional sector suffer an insidious but nevertheless very significant loss of productivity. Helminthiasis is regarded by some as perhaps economically the most significant disease in the country. Due to the widespread and insidious nature of endoparasitism no control measures have been instituted by the Government. Prevention or treatment is left to the discretion of individual livestock owner who does not really understand the importance of prophylactic measures. The recommendation of the Veterinary Department is to treat animals prophylactically a little before the rainy season and repeat treatment at the end of it. Whilst this is a reasonable measure, control should be primarily aimed at reducing parasitic burden in young animals, while at the same time encouraging acquisition and maintenance of resistance to subsequent challenges.

### 2.4 Bacterial and Viral Diseases.

Due to the deterioration of the diagnostic services after 1975, as a result of the departure of qualified personnel and the worsening security situation in the country, diagnosis and reporting suffered very significantly. For that reason the picture emerging from the reports of the diagnostic services

should be regarded as indicative of trends rather than reflecting the true extent of these diseases. The shortages of skilled personnel and of transport and the logistic difficulties arising from the security situation in the countryside are also very influential factors in the execution of the disease control measures.

In order of perceived economic importance the various bacterial and viral diseases may be enumerated as follows:

**Contagious Bovine Pleuropneumonia. ( CBPP, scheduled disease)**

CBPP is enzootic throughout the country, more particularly in regions between the Cunene and Cubango rivers. The disease was under reasonable control by regular vaccination before independence but it has flared up in recent years. Between 1980-1984 1267 outbreaks were recorded (315 outbreaks in 1980 alone), whilst from Jan. to Sept. 1987 162 outbreaks were reported by the Veterinary and Public Health sector of the Livestock Department

Control measures include:

- 1) isolation and quarantine of infected and carrier animals which, following treatment and recovery, are slaughtered,
- 2) movement control of animals in and around an outbreak,
- 3) free, annual, mandatory vaccination of up to 90% of cattle.

To these measures serological surveillance should be added for the recognition and elimination of carriers and subclinical cases when circumstances permit.

**Anthrax and Blackleg, (scheduled diseases).**

These diseases are enzootic in the country and diagnosed in cattle only, especially in the South. In pre-independence days both of these diseases were suppressed, in a large extent, by annual vaccination of cattle thought to be at high risk of infection. After 1975 these diseases become more significant and in 1981 139/144 and in 1982 124/113 outbreaks of Anthrax/Blackleg were reported respectively. Mass vaccination was resumed again and in 1986 and 1987 20 and 7 outbreaks were reported respectively.

**Bovine Tuberculosis and Brucellosis (both scheduled diseases)**

are very important especially from the veterinary public health point of view since they are communicable to man. Both of them are enzootic in the country more in dairy than beef cattle. Their economic significance is likely to increase with the expansion of the dairy sector, which had been well developed and organised in colonial times especially in the S-W. The proportion of infected animals in the country is not known in the absence of widespread testing with tuberculin and serological testing for brucella infection. Prior to 1983 IIVA (Veterinary Research Institute of Angola) produced tuberculin as well as antigens for rapid slide and tube agglutination



tests. Control measures include quarantine of known reactors and slaughter of infected animals. No vaccination is practiced at the present time nor is it envisaged in the near future. Slaughter policy certainly served its purpose in some of the eradication campaigns. However, identification of the most economical policy for the control and eradication of these diseases presumes knowledge of their true incidence, which in turn depends on the rehabilitation of the diagnostic services and expansion of their activities.

#### Foot and Mouth Disease (F M D; scheduled)

Despite lack of vaccination no outbreaks were recorded since 1975. Previously the virus strains SAT 1+2, O, A and C were identified. Infection of other species has never been recorded in Angola. No strategic reserve of the vaccine is kept in the country, but the large spare capacity of the Botswana Vaccine Institute enables it to respond to emergency orders from member states of SADCC.

#### African Swine Fever (A S F; scheduled)

This is the most serious disease affecting pigs in the country and a major barrier to the development of this sector of the livestock industry. Within the SADCC countries Angola has the greatest number of pigs with good potential for expansion due to its capacity for grain production, maize in particular. ASF is enzootic in the whole of the country and spread of the disease is enhanced by the prevalent practice of keeping pigs free around rural households. Between 1979-84, 152 outbreaks were officially reported 9 in 1986 and 4 between January-September 1987. Mortality is high and no vaccine is available for prophylaxis. Since this is a disease affecting several countries within the SADCC community there was a project proposal for the examination of the epidemiology and control of ASF, embracing Angola, Zambia, Malawi, Tanzania and Mozambique. Estimated cost of the project was \$ 6.72 mill. However, the proposal was withdrawn at the Ministers of Agriculture and Natural Resources meeting in Harare, (in Oct. 1987) when it was realised that "this disease is more of a managerial problem than anything else". In Angola the following measures have been taken for the control and eradication of the disease:

- 1) slaughter of all clinically suspected animals and destruction of carcasses,
- 2) slaughter of all in-contact animals with clinically suspected cases, sterilisation of their flesh which is processed into by-products,
- 3) disinfection of contaminated premises which must be kept free of swine for 6 months,
- 4) standstill order prohibiting movement of swine in, out and within the zone of infection for 5 months,
- 5) disinfection of means of transport which carried clinically suspected animals or feed,
- 6) disinfection of slaughter house where infected animals were

handled.

These are stringent measures and should yield good results provided they can be implemented, security situation permitting.

#### Rabies ( scheduled )

This is primarily a veterinary public health problem and in Angola it is more prevalent in urban centres. Infection cannot be treated either in man or animals but it can be prevented by the use of suitable vaccine. There is no evidence of increase of its incidence in the country. In 1979 there were 38 confirmed cases in dogs and cats, 27 cases in 1986 and 27 cases between Jan-Sept 1987. Control measures include:

- 1) annual compulsory vaccination of dogs ( free of charge).
- 2) registration and identification of vaccinated animals.
- 3) extermination of stray dogs
- 4) quarantine of suspected animals.
- 5) prohibition of dogs entering from a country known to have rabies.

These measures should keep the disease under control, although their implementation has suffered a great deal in recent years.

#### Poultry Diseases

The following diseases are recognised in the country: Newcastle disease, Fowl pox, Infectious bursitis (Gumboro), Infectious bronchitis, Fowl typhoid (*S.gallinarum*), Marek's disease, Mycoplasmosis (*M. gallisepticum*) and Pullorum disease (*S.pullorum*). Not much is known about the true incidence of most of these diseases in the traditional flocks although Newcastle disease is recognised as the most important and only notifiable poultry disease.

Vaccination is not practiced in the traditional flocks at the present time nor is it envisaged in the near future. If an outbreak of Newcastle disease occurs in a traditional flock, all the birds are destroyed. The 0.6 mill. layers kept in commercial system are vaccinated against Newcastle, Fowl pox, Gumboro and Infectious bursitis. All but the Fowl pox vaccines are administered in the drinking water because of a shortage of trained vaccinators. These prophylactic measures kept the disease under control, but *Coccidia* *Mycoplasma* and *Salmonella* do cause some problems. At the present time security situation and other factors preclude vaccination of traditional flocks. However, when conditions permit vaccination of traditional flocks should be considered unless a "stamping out" policy is deemed more economical in the light of better understanding of the incidence and economic significance of these diseases.

### 3 ORGANISATION OF VETERINARY SERVICES.

There are two key organisations involved in the diagnosis and control of animal diseases:

- 1) DNOPA (Gireccao Nacional de Organizacao de Producao

Agricola=National Directorate for Agricultural Production)

2) IIVA (Instituto de Investigacao Veterinaria de Angola - Veterinary Investigation Institute of Angola)

The current and new (from 1988) organisation of DNOPA and its provincial organ DPOPA are shown in Annexes 3 and 3/A and 4 and 4/A respectively.

DNOPA runs the field veterinary and extension services and is responsible for the vaccination campaigns and supervision of dipping complexes at municipal and communal levels via its provincial organ DPOPA. Below provincial level DPOPA is represented in each municipality and below that at communal level. The DPOPA stations at field level are known as "complexes". When organised as a unit it has cattle dip, vaccination crush, watering point, corrals, loading ramp, cattle weighbridge and clinic. The facilities of DPOPA at field level are not always organised in "complexes" but may be dispersed. The efficient operation of DPOPA at field level is crucial to both execution of the annual vaccination campaigns as well as the development of livestock sector and standards of its husbandry.

IIVA is the second key organisation in the veterinary services and is responsible not only for veterinary investigation and production of vaccines but also for research institutes (Annex 5). The five provincial veterinary diagnostic laboratories are under the supervision of IIVA (Annex 6) in terms of methodology finance and administration. IIVA has close links with the National Livestock Department (DEPEC) as do provincial diagnostic laboratories with the Provincial Livestock Department (DPL). Specimens for examination may come directly from livestock owners or via the Animal Health Sector and report goes back to owner as well as to the Animal Health Sector in case of notifiable diseases.

Currently IIVA is involved in a UNDP funded FAO executed project (ANG/80/051/E/01/12) which was approved late in 1984, revised in 1986 and is expected to complete its work by 1989. Project objectives include:

- 1) re-establishment of vaccine production at the Biological Production Division of IIVA at Huambo,
- 2) technical and operational support to the diagnostic laboratories in Huambo, Lubango and setting up of a similar laboratory facility in Luanda,
- 3) upgrading the skills of national staff thorough "on-the-job" training and fellowship studies abroad.

At the present time Huambo, Lubango and Benguela can render some diagnostic services but much below pre-independence level. In Luanda two laboratories are used temporarily at the University of Angola setting up facilities for the diagnosis of Newcastle and African Swine Fever diseases. Malange and Wako-Kungo can only provide very limited diagnostic services.

There is another project, under partial implementation, for veterinary assistance in the South West of Angola in Huila, Cunene, Namibe and Benguela provinces. Despite UNDP/FAO financial assistance (\$0.446 mill.) the project still requires an additional \$1.257 mill. to achieve project objectives. These

include:

- 1) rehabilitation of existing sanitary infrastructures (dip-tank cattle crush, water point etc.)
- 2) extend use of dip tanks,
- 3) expand annual vaccination campaigns and epidemiological enquires,
- 4) standardise reporting system and
- 5) train annually 100 technicians in basic and medium-grade animal husbandry.

#### **4. THE VETERINARY DRUG AND VACCINE MARKET (1986/87) AND ESTIMATED FUTURE REQUIREMENTS (1990-2000)**

##### **4.1. Registration, Licensing, Marketing and Distribution of Veterinary Drugs and Biologicals.**

**Registration.** All imported drugs and biologicals must be registered before use. The only exceptions are those products which are imported in the course of aid programs such as that of UNDP/FAO. Registration is implemented by the Veterinary Services Sector of the National Livestock Department (DEPEC) which has a section dealing with registration and control (Annex 3/A). Ten packs of each of three batches of the product must be submitted together with a copy of registration documents used in the country of origin, in addition to technical and scientific description of the product and any commercial literature. Samples and documentation may be sent to IIVA in Huambo for analysis and assessment or may be registered on the basis of documentation alone. For locally produced drugs and biologicals samples and application for product licence need not be submitted, these are registered on the basis of reputation of Manufacturer.

**Demands for veterinary drugs and biologicals** are collected at the provincial level (DPOPA) and passed onto the National Directorate (DNOPA) where they are assessed technically then sent to the Planning Cabinet of the Ministry of Agriculture. From there that part of the document which requires foreign exchange is passed onto the Ministry of Foreign Trade for

**Import Licence** The approved demand goes back to the Ministry of Planning which may be adjusted there, before returned to the Ministry of Agriculture.

**Foreign Exchange Control** Ministry of Agriculture applies for foreign exchange to the Central Bank. If approval is granted a licence for purchase is issued to the National Distribution Service of Supply of Materials (DINAMA) who is responsible for **Purchase and Distribution** of all technical veterinary inputs including veterinary drugs and biologicals, both imported and from local origin. There are no commercial channels other than DINAMA for supply and distribution of veterinary drugs and biologicals.

4.2. Recent Use (1985/87) and Estimated Requirements for Drugs (1990/2000.).(Annex 7)

Use of veterinary drugs at the present time suffers from a number of profound constraints. Although their consideration is very important, but since they equally apply to the use of veterinary vaccines these constraints will be considered in their own right.

Veterinary drugs in Angola are procured and distributed by DINAMA, the sole agent for this purpose. Details of use of these drugs for the last 3 years (1985/87) and projected demands for them for 1990 and year 2000 respectively, were provided by the Livestock Department (DEPEC) and are shown in Annex 7.

Use of ectoparasiticides for the last 3 years was relatively steady. The greater part of these originated from local formulation (Toxaphane by Agron and Shell). Recent use has been very modest and represents less than one third of the quantities which will be required by the end of the century.

The use of antiprotozoan drugs, Berenil (Hoechst) and Novidium (May and Baker), was declining during the least 3 years from just over 86000 doses in 1985 to ca. 43000 doses in 1987. This later quantity is ca. 20% of the 0,25 mill. doses, (which itself is a conservative estimate) envisaged for use by the end of the century.

There was a variety of anthelmintics in use. The most popular of these were Verban, a piperazine by Cynamid and thiobendasol derivatives by Merck, Sharp and Dome. The use of these anthelmintics was very modest, if steady, over the last 3 years, apart from the use of Bayer's Levamisol, which declined. It is envisaged, that the use of anthelmintics should more than treble by the end of the century.

Of the antibiotics Oxitetracyclins were by far the most popular, followed by Chloramphenical, Tilosin and a combination of Penicillin plus Streptomycin. It is thought that the use of these antibiotics should increase by 3-4 fold in the next decade or so.

Feed supplements (antibiotics plus vitamins) and even minerals, were used on a very modest scale during recent years but their use should increase by 2-3 fold, by the end of the century, foreign exchange conditions permitting.

Recent Use(1986/87) and Estimated Optimal Requirements for Vaccines (1990/2000). (Annex 8).

Vaccines in Angola may originate from two sources: 1) Central Veterinary Institute (IIVA) Huambo, where, since 1965 the most important veterinary vaccines and diagnostic reagents were produced. After independence vaccine production gradually declined due to a variety of difficulties and eventually stopped in 1983. Supplies of vaccines thereafter became heavily dependent on

2) Importation from abroad by DINAMA and paid for either by Government or international aid agencies.

Vaccination of livestock at the present time is confined to cattle and commercial poultry (some 0.6 mill. layers). Vaccination of cattle is organised on a campaign basis (beginning in February) and is executed by 40 vaccination brigades operating in 18 provinces. In the course of the campaign three vaccines (Contagious Bovine Pleuropneumonia, Anthrax and Blackleg) are administered to each animal. However, vaccination in some of the regions depends more on external circumstances, security in particular, than on veterinary requirements.

Data for the use of vaccines in 1986 and 1987 campaigns were available (Annex 8). The target in 1986 was the vaccination of 1.5 mill. cattle (ca. 40 % of the national herd). In that year 1.4 mill. doses of each of the three vaccines were available, 1.09 mill. doses were distributed and ca. 0.88 mill. doses were used, thus meeting 56% of the target. The remaining ca. 0.33 mill. doses were used in the 1987 campaign together with vaccines funded by UNDP and technically supported by FAO. In the 1987 campaign ca. 0.76 mill. doses of each of the three vaccines were used. For the 1988 campaign the use of 2.0 mill. doses of each of these vaccines is planned but as yet unfunded (\$ 0.316 mill., December 1987).

As for the use of these vaccines in the remaining years of this century the following considerations apply:

**Contagious Bovine Pleuropneumonia (CBPP)**

The use of efficacious live vaccine should provide serviceable protection for two to three years. Therefore annual vaccination of all cattle at risk, variously estimated to be 70-90% of the national herd, appears to be a very intensive campaign of vaccination. It is envisaged that by 1990 two thirds and by year 2000 three quarters of the national herd will be vaccinated. This calls for the use of 2.3 and 3.0 mill. doses of the vaccines respectively. Provided that intensive vaccination, together with other control measures in force can be executed, they should lead to a substantial reduction in the incidence of the disease. Then gradual introduction of slaughter policy may be implemented (instead of blanket vaccination) combined with extensive serological surveillance. At the present time production of 2.5 mill. doses of a live attenuated vaccine is

planned at IIVA, which should be sufficient for the vaccination of 70% of the national herd.

#### **Anthrax and Blackleg vaccines.**

These two vaccines may be considered together since their use as a bivalent vaccine become very popular not only in Angola but in other SADCC countries as well. Although judicious use of these two products is somewhat different, but the difference in cost of mono/bivalent products is not much, cost of administration is identical, therefore their simultaneous use is advantageous. The policy of the Government is to extend the use of all three vaccines, presently used in the campaign, so as to cover two third and three quarters of the national herd by 1990 and year 2000. This requires the use of 2.3 and 3.0 mill. doses of the vaccines respectively. Production of 2.5 mill. doses of each of these vaccines is planned at IIVA.

#### **Rabies vaccine.**

Although control measures adopted for this disease are adequate their execution, including annual vaccination of dogs, is very difficult. Thus in 1986, due to an acute shortage of vaccine, only 2500 doses were used and 42500 doses in 1987. The number of dogs is not known, but in a country of ca. 8.0 mill. people it is likely to exceed 0.25 mill. Therefore to give effect of declared Government policy of annual compulsory vaccination of dogs, substantially more vaccine, perhaps up to 0.25 mill. doses should be made available by the end of the century.

Prophylactic vaccination of poultry was confined to 0.6 mill. layers and none used in the traditional sector.

#### **Newcastle Disease vaccine.**

A little over 2.4 mill. doses were used for 0.6 mill. layers providing- on an average-four applications per bird. Under current management practice birds are kept for 18 months than replaced. During this time, (using a Hichner B1 and LaSota combination of the vaccine) 5-6 applications per bird would be more appropriate. Since prior to 1990 no increase in the number of layers is anticipated 3.0-3.6 mill. doses of the vaccine is called for. By the year 2000 the number of layers should double increasing the need for the vaccine proportionately to 6.0-7.2 mill. doses. Plans for vaccine production at IIVA include the production of 10.0 mill. doses of Newcastle vaccine. This should provide some vaccine for traditional flocks, where policy at the present time is destruction of infected flocks.

#### Marek's disease vaccine

All those chicks which become layers, or stock birds, should be vaccinated with this vaccine. This requirement was met in 1986. Since no increase in the number of layers is expected before 1990 the requirement remains 0.6 mill. doses. However, this should increase to 1.2 mill. doses by 2000 with an expected increase of 100 % of layers over the last 10 years of the century.

#### Infectious Bursitis (Gumboro) vaccine.

Because of a shortage of this vaccine 60,000 doses were used in 1986 and 400,000 doses in 1987, covering 10% and 66% of the birds which should have received it. The requirement for this vaccine is the same as that for Marek's vaccine.

#### Enterotoxaemia vaccine (bovine and ovine)

This is a vaccine which had been produced in earlier years and production of 0.2 mill. doses is planned by the UNDP/FAO project of rehabilitation of vaccine production at IIVA.

#### Brucella S19 vaccine.

A lyophilised S19 vaccine was produced and used in the country in earlier years, but its re-introduction is not envisaged in the near future. Following a survey of incidence of this disease in the national herd, a decision would become possible about adoption either of a vaccination or slaughter policy. Should the later option be deemed more economical, compensation should be considered to encourage owner cooperation.



## **5. CONSTRAINTS ON DRUG AND VACCINE USE AND PROPOSALS FOR INCREASED USE.**

The most important constraints and suggestions for their alleviation may be summarised as follows:

**1. Shortage of qualified personnel at all levels.**

There are 33 graduate veterinarians working in the country, 10 of which are at university or training institutes and 23 in central or local government administration. Some seven of the latter group do part-time field work. For operational field work 20 more veterinarians would be required.

There are also 205 animal health auxiliary personnel, including 42 animal health assistants and 165 field assistants also referred to as vaccinators. The number of the former group would need to be increased by ca. 50% whilst that of the latter by almost 100%.

Training requirements of new personnel could be met by one of the objectives of the SADCC project for Veterinary Assistance of the South-West of Angola, which is partly founded by UNDP/FAO but is still in need of funds amounting to \$1.257 mill.

**2. Security situation especially in the southern provinces of Cunene and Huila where about 50% of all cattle are kept. This cannot improve substantially before cessation of hostilities.**

**3. Deterioration of veterinary infrastructure, including the so called "complexes" at field level.**

Before 1975 there were 257 state and 869 private dip tanks in use in addition to 12 state and 85 private spray races. It is estimated that at least half of these are out of order together with many of the 1153 cattle crushes, weighing bridges and watering points. In 1986, 12 of the dip tanks and 29 cattle crushes were restored to use as part of the SADCC project partly founded by UNDP/FAO. However, this and other vitally important objectives of the project cannot be fulfilled unless additional funds are made available.

**4. Transport and spare parts are in very short supply.**

There are 22 four-wheel drive Jeeps (for vaccination teams) four 6-ton trucks (for water transport to dips) and four 5-ton trucks (for tents etc. for vaccination teams) in operation and 16, 9 and 5 more of each categories are required respectively. Acquisition of these vehicles is another objective of the SADCC project referred to in the preceding paragraph.

**5. Budgetary constraints for purchase of home-produced acaricides and shortage of foreign exchange for drugs and vaccines.**

At the present time acquisition of drugs and vaccines is very heavily dependant on donations or financial support by aid agencies. Rehabilitation of vaccine production at IIVA and expansion of the range of its products beyond the present

objectives of the UNDP/FAO project (ANG/80/51) would help to ease the situation leaving more funds for drugs..

6. Cold chain is also in need of rehabilitation. New cold stores, refrigerators and insulated transport boxes are required. In the course of the vaccination campaign vaccines are sent to Lubango and distributed to other provincial headquarters whence they are sent to municipalities then on to vaccination sites. Rehabilitation of the cold chain is in the planning phase at the present time with IFAD (International Food and Agricultural Development) and the Italian government.

7. Simplification of the system of procurement of drugs and vaccines so that orders are processed within the Ministry of Agriculture (and the Central Bank in respect of foreign exchange) within a given budget. To meet statistical requirements returns should be circulated to Ministry of Planning and Ministry of Foreign Trade.

## **6. CONSIDERATIONS FOR LOCAL MANUFACTURE.**

### **6.1 Pharmaceuticals.**

There are two pharmaceutical companies, Agran and Shell, who formulate ectoparasiticides from imported components. Their production capacity is considerably greater than is the takeoff and can readily supply all what Angola may require by the end of the century.

Manufacture of veterinary drugs, beyond the present scope and scale, is not envisaged, or indeed likely, until the security and economic situation will have improved.

### **6.2 Biologicals**

Institute of Veterinary Investigation (IIVA), Huambo.

#### **6.2.1 Location**

IIVA is located on the outskirts of the provincial capital, Huambo, some 5-6 km. from town centre and within one half hour drive from both airport and railway stations (presently not in operation). The all weather connecting roads are much in need of repairs. It shares a site of some 1200 hectares with the Central Veterinary Diagnostic Laboratory, the Faculty of Veterinary Science and also accommodates the first two year students of the Faculty of Agriculture. IIVA is responsible not only for veterinary investigation/diagnosis and for research

institutes but also for the production of veterinary biologicals and diagnostic substances (see Annex 5).

#### 6.2.2 Historical and prospectives.

The Institute was established in the 1920s for the diagnosis and control of Contagious Bovine Pleuropneumonia (CBPP), which had been recognised towards the end of the 19th century and was considered as a major disease of cattle. In the 1920s CBPP vaccine was imported from France and Senegal, but for various reasons it was decided to produce it at the Institute. In the 1940s diagnosis and vaccine production improved and at that time the Central Building was erected. In addition to the production of CBPP vaccine, Anthrax, Blackleg, Brucella S19, Bovine and Ovine Enterotoxaemia, Fowl typhoid, Newcastle vaccines, Brucella plate, milk ring and tube agglutination antigens and bovine and ovine PPD reagents were produced in the building.

In 1973 building work on the new Vaccine Production Facility started, but it has never been entirely completed. For that reason production of bacterial vaccines and reagents stayed in the Central Building until cessation of vaccine production in 1983. However, production of Newcastle Disease vaccine was transferred into one of the wings of the new Vaccine Production Facility as was media preparation, washing up and sterilisation. In addition to Newcastle vaccine, production of Fowl pox vaccine was also established with the help of foreign experts.

After independence (1975) vaccine production met with increasing difficulties, departure of Portuguese experts, uncertainty of supplies of materials, power, water and worsening security. As a result international experts left and vaccine production came to a temporary end in 1983.

In September of 1984 the Central Building was sabotaged and the Library and Accounting Department were destroyed. On March 16th of 1987 the same building as well as part of the Vaccine Production Facility were sabotaged. In the Central Building Departments of Pathology, Anatomical Pathology, Bacteriology, Virology, part of Toxicology, Animal Nutrition, the Conference room and Photographic section were destroyed.

In the early 1980s the Government developed a program to increase production of veterinary vaccines and to improve veterinary support services and the skills of national personnel employed in these fields. As part of this endeavour in December 1984 a UNDP-financed, FAO-executed project (ANG/80/51) was approved with \$ 1,393,200 contribution from UNDP and \$3,901,300 contribution by the Government. The project objectives included the following:

- 1) rehabilitation and expansion of diagnostic laboratory facilities in Huambo, Lubango and establish a similar laboratory in Luanda.

- 2) ordering and installation of equipment in these laboratories.

- 3) planning and implementation of programmes for increased

production of vaccines at IIVA.

4) technical advice in laboratory diagnosis and vaccine production.

5) establishment of an equipment maintenance system.

6) improvement of the technical skills of national staff by on-the-job training and by external fellowships.

In 1986 the project was revised and completion date was set from March of 1988 to September of 1989. Government contribution remained the same but UNDP contribution was increased to \$ 1,433 mill. including, in round figures \$ 779,000 for project personnel, \$ 191 000 for training and fellowships, \$ 413,000 for equipment and \$ 50,000 for miscellaneous expenses. These expenses cover the services of a Chief Technical Adviser, (36 months) a Maintenance Expert (24 months), consultants (5,6 months).

At the end of project activities IIVA will be capable of an annual production of 2.5 mill. doses of each of CBPP (lyophilised), Anthrax and Blackleg, 10.0 mill. doses of Newcastle and 0.2 mill. doses of Enterotoxaemia vaccines as well as complement fixing antigens for CBPP, tuberculin (bovine and ovine) and Brucella antigens for milk ring test and rapid slide agglutination tests.

#### 6.2.3. Site and services.

The 1,200 hectare site is bordered by perimeter fence of a few strands of barbed wires which is clearly inadequate for security. Within that perimeter fence, the Vaccine Production Facility is not segregated from other buildings, such as buildings of the Faculty, Diagnostic Centre or indeed large animal accommodation.

The site is flat, largely wooded, with a road network in need of repairs.

Water is supplied by the Local Authority and it is inadequate both in quality and quantity. To improve water supplies a bore well, complete with water tower, was established producing good quality water which is shared with the Faculty.

Electricity is supplied from the public grid, which has often suffered from unannounced cuts of uncertain duration. Without an alternative supply of electricity, vaccine production would be unsustainable.

An alternative supply of electricity is assured from two oil-fired emergency generators (Lister), 100 KW and 200 KW capacity respectively. They are both in good working order and are capable of serving the whole of the site. They are complete with a 10,000 L. underground fuel-storage tank. In addition there are two oil-fired generators, 90 KW capacity each, presently undergoing repairs.

Gas has been supplied from liquid nitrogen cylinders which proved to be adequate and simple.

Steam is supplied from a 15 year old oil-fired large boiler. Its make and capacity could not be established at the time of the visit but its capacity was said to be adequate. Nevertheless with the introduction of new equipment, requiring steam, its capacity to meet new demands should be revised.

Air compressor, which served vaccine production in the past, was damaged by the sabotage in April, but it is thought to be repairable.

The liquid nitrogen plant was also destroyed. It was capable of producing 25 L. of liquid nitrogen per hour, much more than was required on site, and also served other laboratories and artificial insemination centres. Its replacement is not regarded as top priority and may be replaced by the old machine (capacity 5 L. per hour) presently in Luanda.

Cold room (+4° C) is ca. 25 x 4 m. and is properly insulated. Its floor is waterproof cement and the walls are rendered. It is segregated to separate raw materials from products under test from those released. There is also a -40°C deep-freeze room of ca. 2 x 2 m. floor area, in working order.

Telephone communications were good in earlier years (20-30 lines) but due to acts of sabotage in the region there are only two lines serving the site now.

Telex facilities are available at the Faculty of Veterinary Science.

### 6.2.3. Buildings of the Vaccine Production Facility.

There are six blocks of buildings of equal size (390 m.<sup>2</sup> each, including corridors) connected by covered but not enclosed passageways and separated from each other by courtyards (10 x 30m). These buildings accommodate the following facilities:

Bld.No.1 washing, sterilisation, media production, chemical stores and walk-in incubator.

Bld.No.2 cold-rooms and goods-out on one side of corridor, freeze-drying (opposite cold-rooms) and goods-out on the other side.

Bld.No.3 anaerobic vaccine production, (presently occupied by Vet, Faculty.)

Bld.No.4 tissue culture (presently occupied by Vet. Faculty).

Bld.No.5 Aerobic vaccine production (presently occupied by Vet Faculty).

Bld.No.6 viral vaccine production.

In addition there is a services building, accommodating the boiler, liquid nitrogen plant (destroyed) compressor. (damaged) and raw materials.

### General conditions.

Buildings of the Vaccine Production Facility are ca. 12 years old and apart from the services building, which was badly damaged by the sabotage, are structurally in good condition. However, their design and layout do not meet present day requirements of buildings devoted to production of veterinary biologicals. Windows of single glazed panes in metal frames do not close tightly, nor do doors, connecting corridors to the open and to production areas. Floors are mostly built of 10x10 cm. blocks of stone which are densely corrugated with grooves of several mm. in depth and are most unsuitable in production areas. Walls are rendered and painted with non-washable paint. Pipeworks (water, electricity) are running externally on walls accumulating dirt. There is no air-filtration, or control of air-movement in any part of the production areas, not even air-locks, thus segregation of different departments, in order to prevent cross contamination, is not possible.

There is some control over effluents leaving the buildings, in as much as these are running into large underground cavities and dissipate into the soil.

In summary, it may be stated, that although these buildings do not conform to current requirements for vaccine production, but they could be modified and refurbished at considerable cost.

### Animal accommodation.

In the past laboratory animals were supplied from the breeding unit of the Institute. Rabbits and guinea-pigs were bred in small huts with open runs. These units were placed in rows along foot-path in a large fenced garden. The major problem with this system of breeding was the ready spread of infectious diseases, salmonellosis in particular. Due to problems with disease control, shortage of standard diet and eventually cessation of vaccine production, breeding came to an end. The animal house for testing was also inadequate in design and content. When breeding and testing are resumed, it would be desirable to replace these facilities with suitable ones, bearing in mind the need for containment of infectious agents not only within the buildings but within its sub-units.

There are also two poultry houses in a separate walled garden. Each house was sectioned into three parts accommodating up to 300 birds. Flocks were regarded as "clean" but not of SPF-standard and were certainly not maintained as such. The eggs were used for Newcastle and Fowl pox vaccine production as well as for testing. The houses have been out of use since 1982. This system is inadequate for keeping birds whose eggs are intended for egg-based poultry vaccine production and testing.

There is also accommodation for 45 cattle, 20 sheep and 8 horses housed in building and yards of general farming standards. For reasons of security, these are located too close to the Vaccine Production Facility and should be re-located before vaccine production is resumed.

#### 6.2.4. Production and Quality Control of Biologicals.

Rehabilitation of vaccine production is one of the objectives of the UNDP/FAO project (ANG/80/051). Production technologies and standards currently are subjects of discussions between FAO staff, foreign experts and national counterparts and therefore were not available. It was stated, however, that unlike in the past, production and quality control will be segregated and such technologies and standards introduced which are acceptable to FAO experts. It should be remembered, that design, construction and layout of production areas are much at variance with current requirements and present obstacles to production to internationally recognised standards. Similarly, use of embryonated eggs for poultry vaccine production, from flocks of birds else than of SPF-standards (as was the practice in the past) does not only preclude working to international standards, but it is also potentially hazardous and may lead to dissemination of egg-born diseases.

In the past difficulties were experienced in obtaining materials and chemicals for media production because of a shortage of foreign exchange. Continuity of supply of meat and liver was only assured if local supplies were augmented with supplies flown in from Luanda. This situation has not changed and beyond the provisions of the UNDP/FAO project, till the end of 1989, difficulties arising from shortage of foreign exchange will apply again

#### 6.2.5. List of more important laboratory equipment.

Some of these equipments are in-situ (ovens, autoclaves) others in store, yet others were recently purchased from UNDP funds and therefore could not be allocated to various departments. A list of the more valuable items are enumerated (Annex 9) and their condition noted.

#### 6.2.6. Staff, Management, Training.

In the absence of vaccine production the Vaccine Production Facility is not fully staffed, employing only three graduates and two technicians at the present time. It is envisaged, however, that there will be 3-4 graduates, 12 medium and junior grade technicians in addition to 30 auxiliary staff. The services of graduates and technicians will be shared between vaccine production and diagnostic services since the former activity is of a campaign nature.

There are four divisions in the Vaccine Production Facility (referred to as "Biological Products", Annex 5) including Bacterial and Viral Vaccines, Cell Culture and Quality Control. These are headed by the respective divisional heads in charge of 2-5 technicians (2 in Quality Control and Cell Culture and 4-5 in Vaccine Production) and some of the 30 auxiliary staff divided between the divisions.

Technical education, following four years of primary and secondary education, involves three years study at an

agricultural, veterinary or zoo-technical institute. Specialised, technical training is on-the-job. Although the UNDP/FAO project (ANG/80/051) provides, for graduate staff, 72 months fellowship abroad, (more than half of which has already been utilised), medium grade technical staff is not exposed to technical experience outside their place of work.

## **7. DISCUSSION AND RECOMMENDATIONS.**

### **7.1. Discussion.**

Any forecast of future requirements of veterinary drugs and vaccines should be based on reliable livestock statistics and on reasonable disease control measures. Due to the poor security situation in the South of Angola, where most of the livestock, especially cattle are, no livestock census has been carried out since 1973. Therefore statistical data available on livestock are estimates, which may be substantially erroneous. Although disease control measures adopted are basically sound, their execution has been much compromised by the very great difficulties facing the Veterinary Services. Under these conditions forecasts of livestock population trends and of future requirements for drugs and vaccines should be viewed with caution.

To improve the situation FAO aims to carry out a pilot scale livestock census by 1990 and is also instrumental in rehabilitation of aspects of the Veterinary Services. The UNDP/FAO project (ANG/80/051/E/01/12), - which aims to re-establish vaccine production at IIVA and rehabilitate diagnostic laboratories in Huambo, Lubango and set up laboratory in Luanda-is fully financed, if a little behind original schedule. However, the project for "Veterinary assistance in the South-West of the People's Republic of Angola"- aiming to rehabilitate sanitary infrastructures, expand vaccination campaigns and epidemiological enquires, in addition to training technicians and improve reporting systems- is only partly funded by UNDP/FAO and is still in need of \$ 1,703 mill. to meet project objectives.



7.2 Recommendations.

- 7.2.1 Carry out livestock census as soon as conditions permit.
- 7.2.2. Find additional funds of \$ 1,703 mill. for UNDP/FAO project for the " Veterinary assistance in the South-West of the People's Republic of Angola".
- 7.2.3. Expand activity of 7.2.2. on its completion to other regions.
- 7.2.4. Simplify procurement of veterinary drugs and vaccines.
- 7.2.5. Carry out feasibility study for the structural updating of vaccine Production Facility in Huambo.
- 7.2.6. Reconsider production of egg-origin viral vaccines for poultry, in the absence of eggs from SPA flock of birds, and abandon it,
- 7.2.7. New animal facility for breeding and testing, capable of containing pathogenic organisms, should be provided.
- 7.2.8. Additional provisions to be made for promising middle-grade technical staff to gain experience in vaccine-production in Establishments of good reputation.

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NUMBER OF LIVESTOCK AND PROJECTED INCREASES

(1973 - 2000\*)

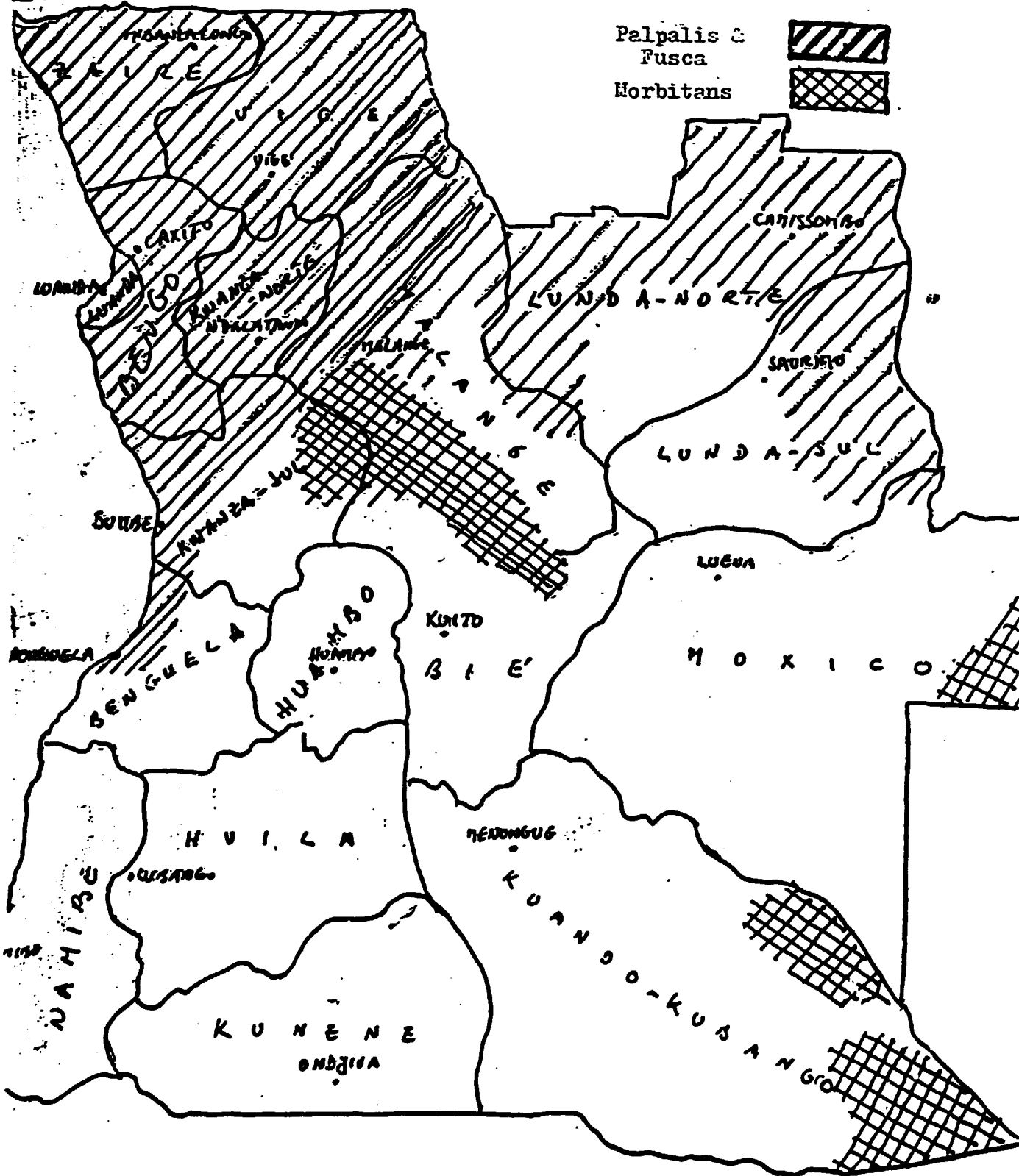
		Numbers (X 000)		Animal Changes		Projected Increases (X 000)	
		1973	1987	Past	+Projected	1990	2000
CATTLE	Traditional	3229	3465	0.5	-	3465	-
	Commercial	1202	35	-6.9	-	35	-
	TOTAL	4431	3500	0.1	2.5	3500	4375
GOATS		2088	1500	-2.0	5.0	1500	2250
SHEEP		385	180	-3.8	2.0	180	216
PIGS		1299	800	-2.7	3.0	800	1040
POULTRY	Traditional	4900	5000	0.1	1.0	5000	5500
	Commercial	1100	600*	X 3.2	10.0	600	1200
	TOTAL	6000	5600	-0.5	2.0	5600	6700

\* Source: National Livestock Department

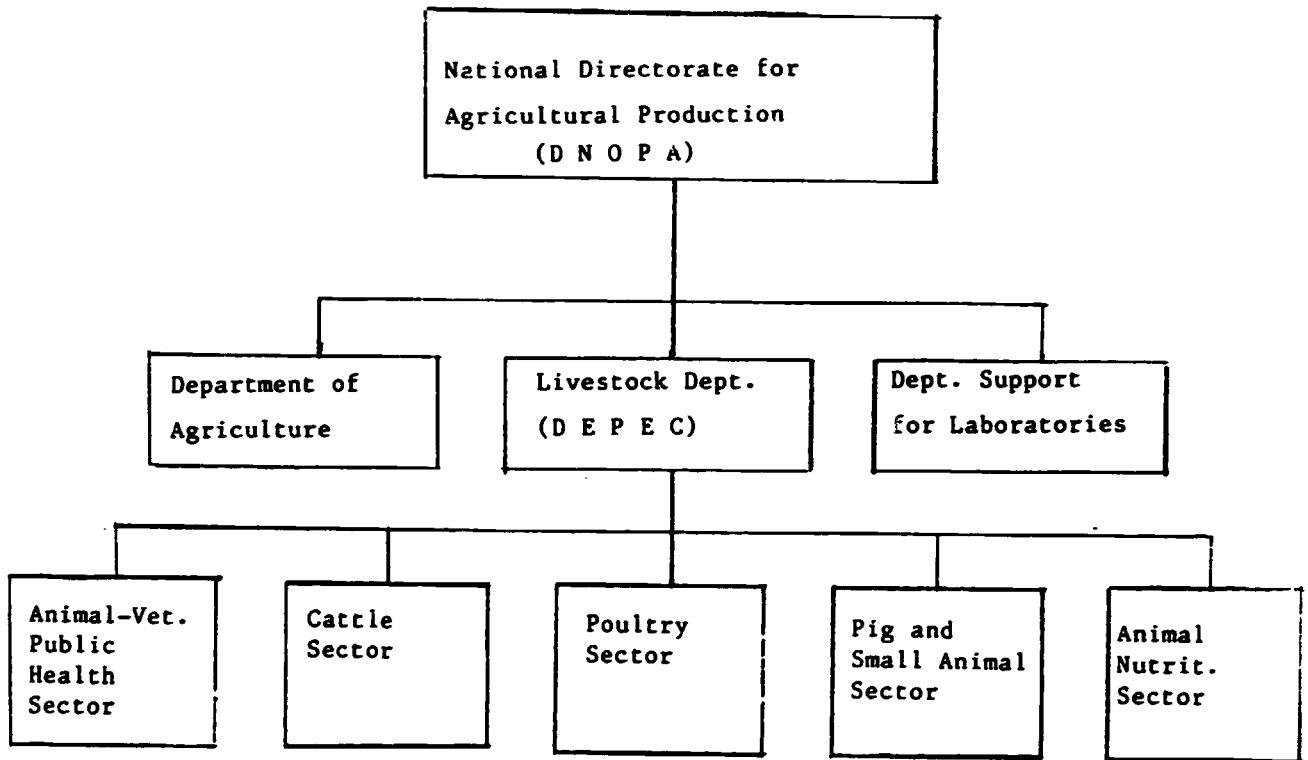
X No change till 1990: change apply between 1990-2000

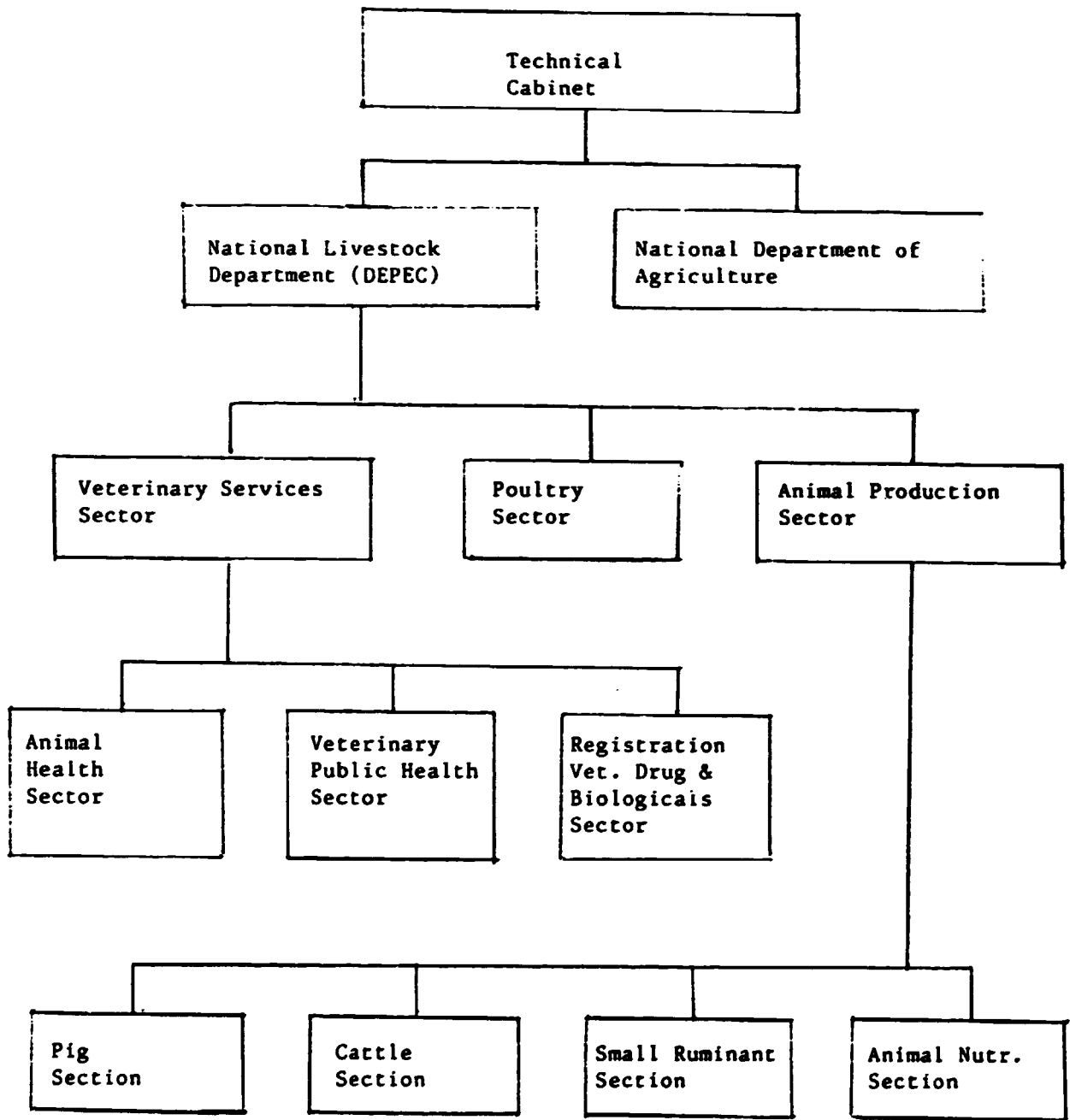
\*\* All layers

DISTRIBUTION OF GLOSSINA IN ANGOLA.

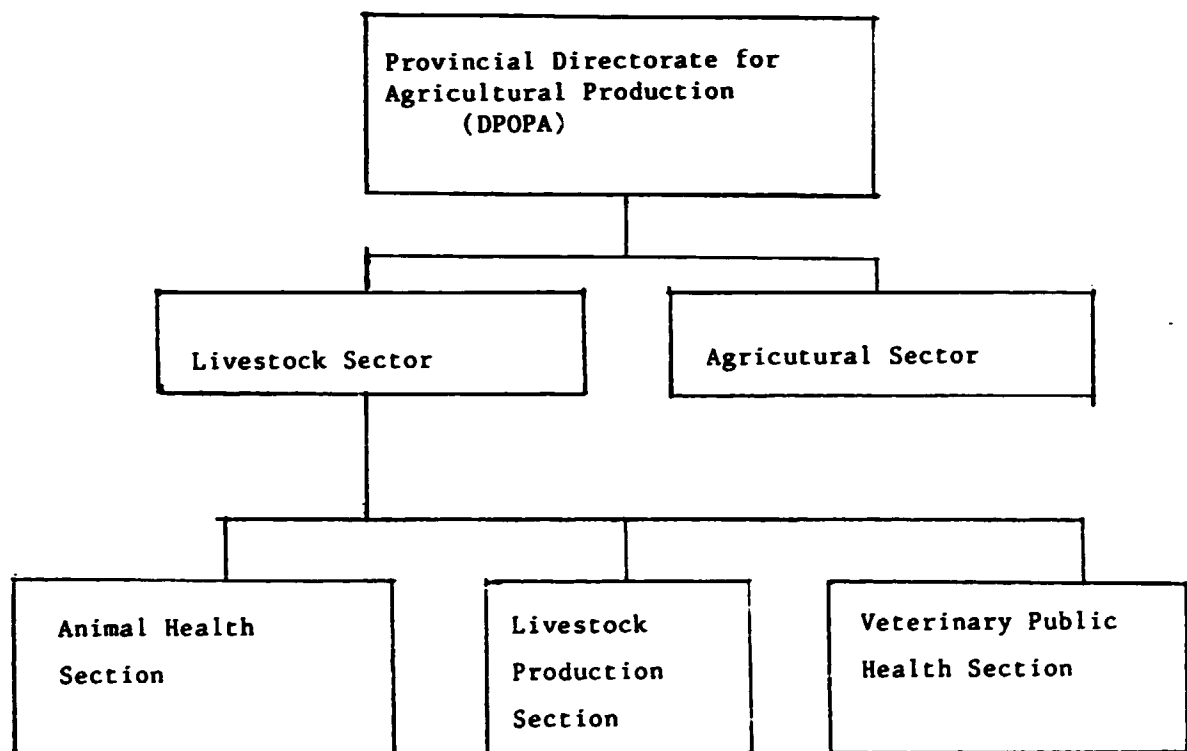


Organisation (1987) of National Directorate  
for Agricultural Production (D N O P A)

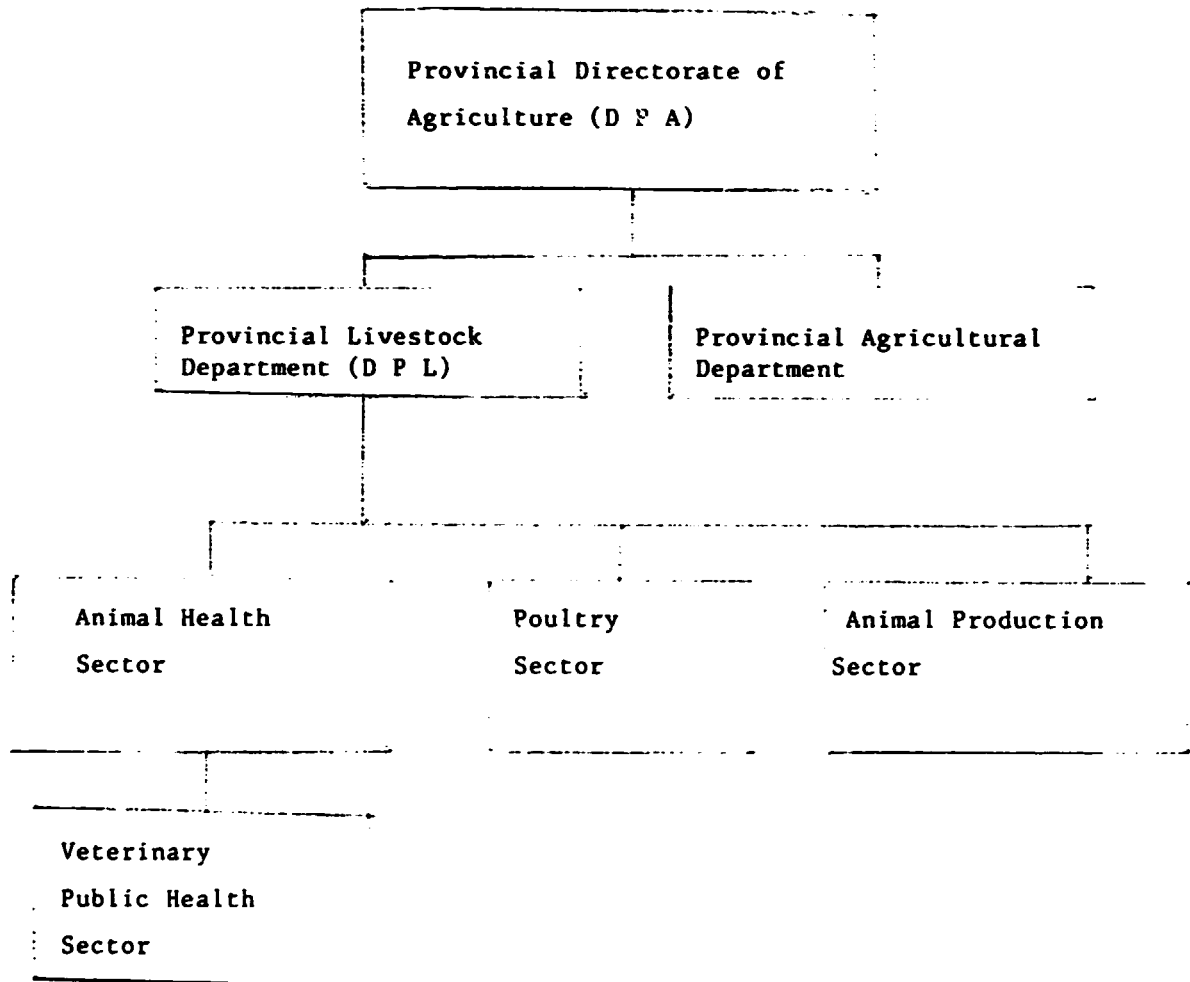




Organisation (1987) of Provincial Directorate  
for Agricultural Production (D P O P A)

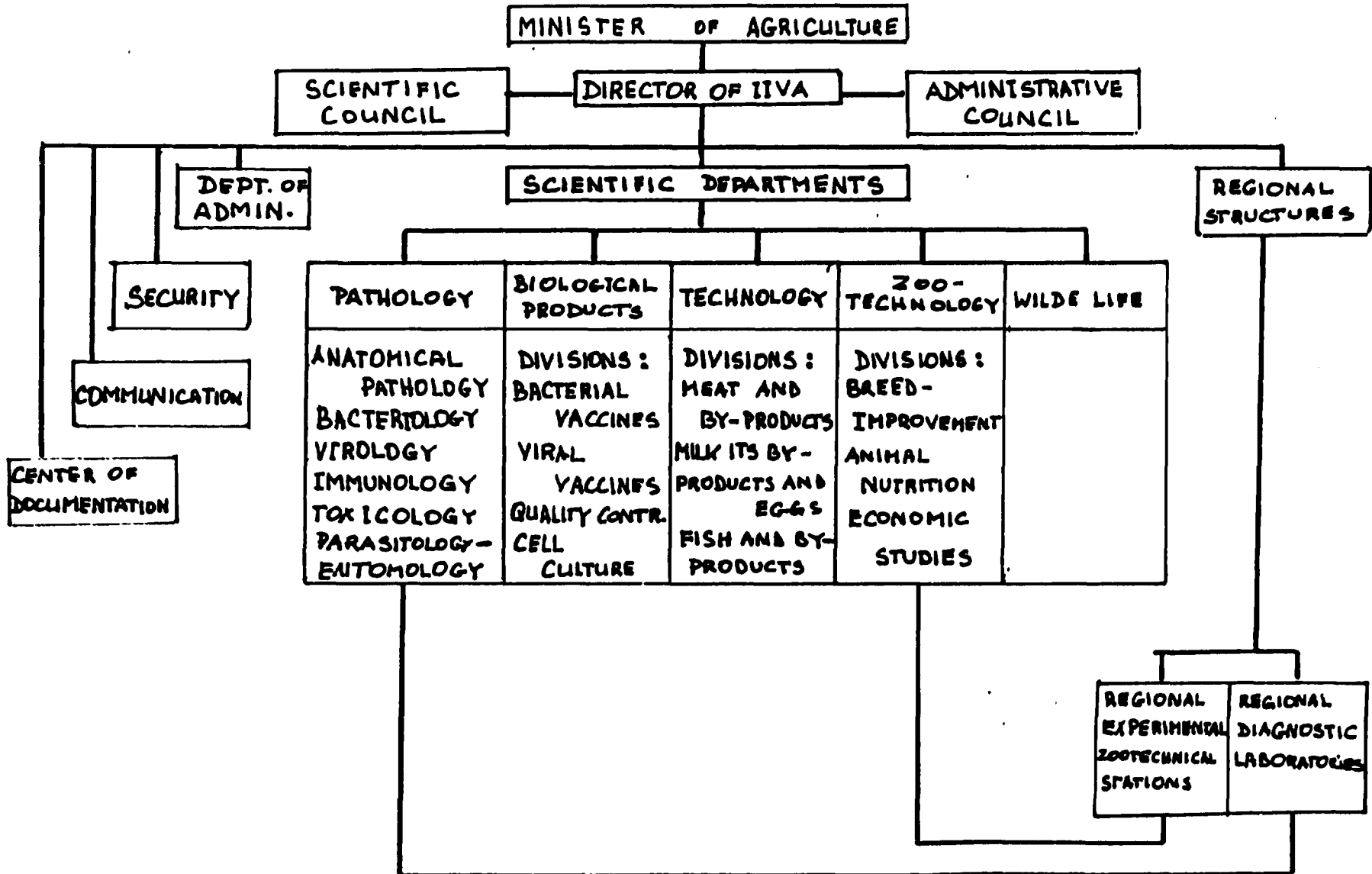


Future (1988) Organization of Provincial  
Directorate of Agriculture (D P A)



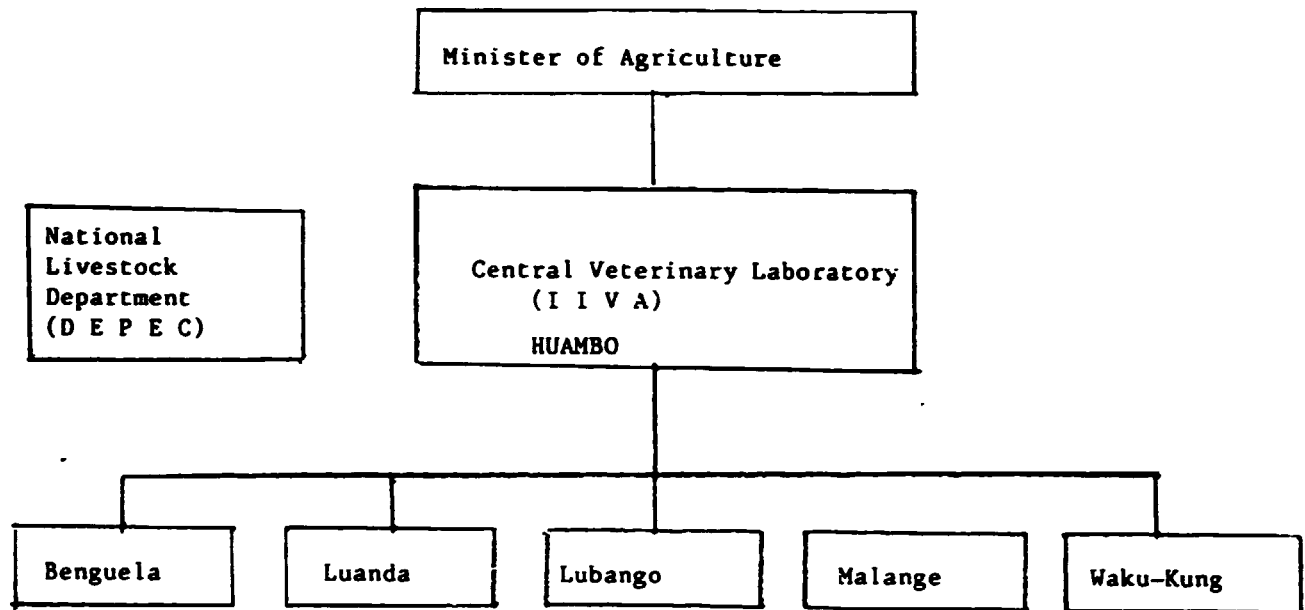
**ORGANOGRAM OF INSTITUTE OF VETERINARY INVESTIGATION.  
(IIVA)**

ANNEX 5.





Organization of Veterinary Diagnostic Laboratories



Recent Use (1985/87) and Estimated Requirements for Veterinary Drugs (1990/2000)

V E T E R I N A R Y D R U G S			Y E A R S					
COMMERCIAL	TECHNICAL	MANUFACTURE	QUANT.	1985	1986	1987	1990	2000
<b>1. <u>ECTOPARASITICIDES</u></b>								
Toxagran 75	Toxaphenic	Agran & Shell	Lts	10000	10000	10000	20000	35000
Asuntol 50	Organo-phosphorus	Bayer	Kg	2000	2000	2000	5000	6000
Neguvon Powder	- do -	-do-	Kg	2000	2000	2000	5000	6000
<b>2. <u>ANTIPROTOZOANS</u></b>								
Berenil	Dimanazenaceturate	Hoechst	Kg	63	26	0	126	180
Novidium	Homidium	May & Baker	doses	43000	43000	43000	86600	133000
Moranil	Suramin Sodium	Specia	Gr.	1250	1250	1750	0	0
<b>3. <u>ANTIHELMINTICS</u></b>								
Bonizole	Thiabendazole	M.S. Dome	Lts	990	990	990	2500	3500
Ranizole	- do ->Ratoxamide	- do -	Lts	990	990	990	1300	2500
Citarin-L 100	Levamisole	Bayer	Lts	250	80	45	450	750
Lopatul 100	Nitros Canate	CIBA	Tablets	0	0	330	700	1000
Lopatul 500	- do -	CIBA	-do-	1000	1000	1000	1800	2500
Droncit	Draziquantel	Bayer	-do-	300	300	300	700	1000
Mansonil	Miclosamide	Bayer	Kg	200	200	200	600	1000
Verban	Piperazine	Cynamide	Kg	1952	1952	1952	4000	6000

<b>4. ANTIBIOTICS</b>								
Terramycin powder	Oxitettracyclin	Pfizer	Ltr	52	52	52	130	200
Terramycin Q - 100	- do -	-do-	Ltr	280	280	280	500	1000
Reyerin Susp.	Rolitetracyclin	Hoechst	Kg	300	300	300	700	2000
Omnamycin Susp.	Penic. + Srepto.	- do -	Lts	50	50	50	150	300
Taylan Sol.	Tylosin	Elanco	Lts	150	150	150	300	600
Trelacon 200	- do -	- dO -	Lts	1000	1000	1000	2000	4000
Leukomycin 20%	Cloranphenicol	Bayer						
Cloranphenical 20%	- dO -	- do -						
<b>5. FEED SUPPLEMENTS</b>								
Minerals			Kg	64200	0	0	100000	200000
Betical - B+C		Prozoo	Kg	3000	3000	3000	4500	8000
Floxaïd		M.S.D	Kg	3300	3300	3300	5000	10000
Farmistress	Antibiotics &	Furminter	Kg	0	0	950	1200	2000
Vit. Adec	Vitamines	- do -	Lts	3000	3000	3000	4500	8000
Vit. Adec Injection		Pfizer	Lts	150	150	0	300	800
Vit K-3		Prozoo	Kg	60	60	60	100	200

Recent (1986/87) use and Estimated Optimal  
Requirements for Priority Vaccines (1990/2000)

VACCINES	USED (X 000) DOSES		ESTIMATED REQUIRES. (X 000 DOSES)	
	1986	1987	1990	2000
Anthrax	885	765	2400	3000
Blackleg	885	765	2400	3000
CBPP*	885	765	2400	3000
Rabies	2	45	250	250
Newcastle	2450	1200	3600	7250
Fowl Fox	305	400	600	1200
Marek's	600	0	600	1200
Gumborg**	60	400	600	1200
Av. Infect. Bronchitis	522	800	800	1600

\* CBPP: Contageous bovine pleuropneumonia.

\*\* GUMBORO: Infectious bursitis

List of More Important Laboratory Equipment

- 5 1000 l. each vertical electrically operated old autoclaves in working order.
- 3 2000-3000 l. each horizontal, old autoclaves, steam-fed from boiler house; in working order.
- 2 2.5 m. each "Kotterman" hot air ovens, fairly new and in good working order.
- 1 "Hereus" (U.K) hot air oven, in working order, capacity ca. 0.3 m.
- 2 "Virtis" (USA) lyophiliser, 13 l. and 15 l. respectively, one new, the other also in good working order.
- 5 Oil immersion research/routine microscopes (Olympus and Opton), mostly new and in working order.
- 2 Stereo microscopes, both of them new.
- 2 "Tropical" (Philips of Denmark) -40 C deep-freezer, combined capacity ca. 1.5-2.0 m, in working order.
- 1 "Frica" TT80 -80 C deep-freezer, capacity is ca. 0.5 m.
- 4 "Brasaire" (U.K) Laminar flow cabinet, working area is ca. 200 x 60 cm.
- 4 4-10 C assorted, old domestic refrigerators in working order, combined capacity ca. 4m.
- 3 Assorted, old bench incubators, in working order, total capacity is ca. 2m.