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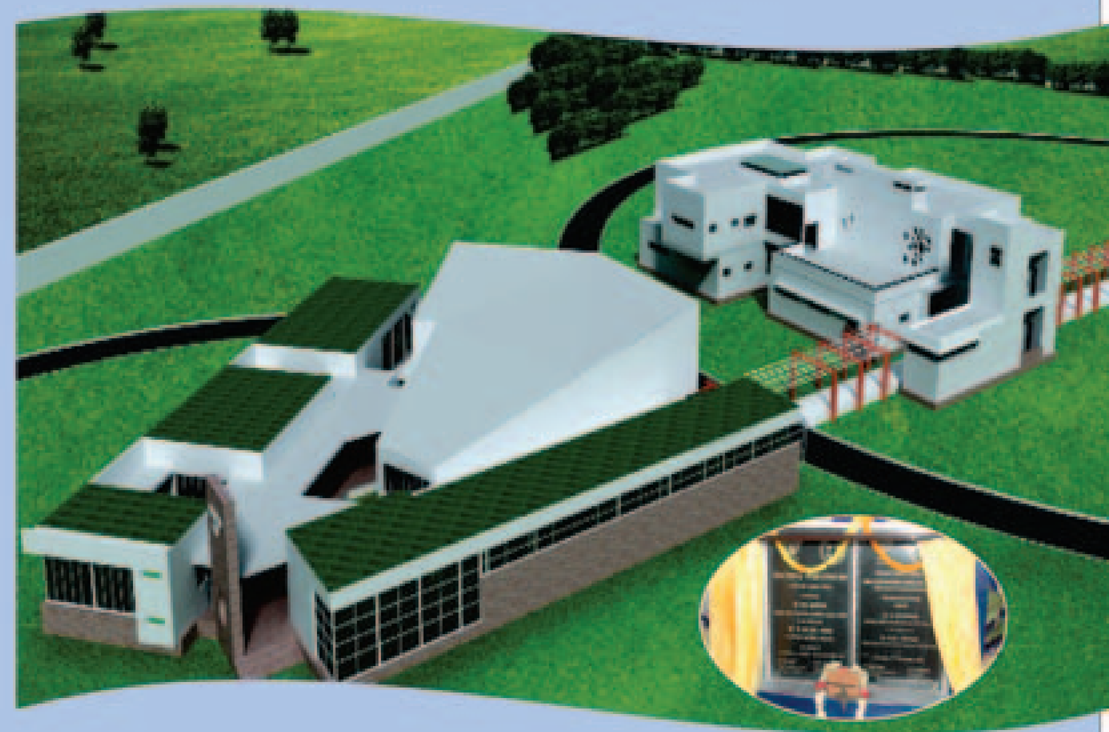
Vision 2030



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Printed : July 2011

Published By : **Dr. H. Rahman**
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& Surveillance, Hebbal, Bengaluru

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Printed at : Srinidhi Graphic Printers, Bengaluru

Foreword

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सचिव एवं महानिदेशक
Dr. S. AYYAPPAN
SECRETARY & DIRECTOR GENERAL

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
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FOREWORD

The diverse challenges and constraints as growing population, increasing food, feed and fodder needs, natural resource degradation, climate change, new parasites, slow growth in farm income and new global trade regulations demand a paradigm shift in formulating and implementing the agricultural research programmes. The emerging scenario necessitates the institutions of ICAR to have perspective vision which could be translated through proactive, novel and innovative research approach based on cutting edge science. In this endeavour, all of the institutions of ICAR, have revised and prepared respective Vision-2030 documents highlighting the issues and strategies relevant for the next twenty years.

Disease surveillance is central to animal health for better productivity. Accurate surveillance data facilitates understanding the true health status of animal populations and to guide the use of limited animal health resources before the disease becomes entrenched. The Project Directorate on Animal Disease Monitoring and Surveillance (PD-ADMAS), Bengaluru established in 7th Five Year Plan (1987) has been working tirelessly in providing valuable input to various governmental agencies for taking up disease control measures. The role of this Institute in the eradication of Rinderpest and Eradication and development of National Animal Disease Referral Expert System an interactive website for disease forecasting are noteworthy.

It is expected that the analytical approach and forward looking concepts presented in the '*Vision 2030*' document will prove useful for the researchers, policymakers, and stakeholders to address the future challenges for growth and development of the agricultural sector and ensure food and income security with a human touch.

(S. Ayyappan)

Dated the 6th July, 2011
New Delhi

Preface

"As the world becomes more integrated through the trade of goods and services and capital flows, it has become easier for diseases to spread through states, over borders and across oceans — and to do serious damage to vulnerable human and animal populations."

American RadioWorks and NPR News, 2001

The Project Directorate on Animal Disease Monitoring and Surveillance (PD_ADMAS) is a dedicated institute for veterinary epidemiology and disease informatics. The institute has played pivotal role in Rinderpest eradication in India. With changing national and international scenarios the animal health is a priority for nation's economy and human health.

The first vision document "Vision 2025" of the institute was developed keeping in view of the challenges and opportunities faced by the livestock health in India. Animal health for human health was also basis for the preparation of the document. The present document "Vision 2030" of PD_ADMAS expresses the strategies to overcome the future challenges in the field of animal health. The vision conceives and addresses the critical issues in the area of veterinary epidemiology making use of specialised tools like GIS, satellite imaging mathematical models and advanced computing techniques.

The comprehensive epidemiological data for a disease is possible with multi-sectional approach. Hence, more emphasis on disease ecology, field epidemiology and spatial epidemiology, will be given.

I wish to express my hearty thanks to Dr. S. Ayappan, Secretary, DARE and Director General, ICAR, Dr. K. M. L. Pathak, Deputy Director General (Animal Sciences), ICAR, Dr. Gaya Prasad, ADG (AH), ICAR for their valuable guidance. My thanks to all the peers in QRT, RAC, IMC, all the previous and present staff of the institute, who gave valuable inputs. I also appreciate the efforts of editors whose meticulous work helped in the development of the document "Vision 2030".

I am sure that PD_ADMAS Vision 2030 would provide a direction to work in depth on epidemiology of economically important livestock diseases, finally leading to control and eradication of the diseases for achieving high security to animal and human health in India.

Date : 6th July 2011
Place : Bengaluru

(H. Rahman)
Project Director
PD_ADMAS, Hebbal

Preamble

High quality national surveillance is the cornerstone of infectious disease prevention and control.

—World Health Organization, 2004

India has a fast growing livestock sector and it is taking steps to achieve self-sufficiency in production of animal products. India ranks first in the world in production of milk, seventh in production of egg and eighth in export of meat. It is projected that by 2020 meat, egg and milk production will increase by 50%, 35% and 25%, respectively.

Livestock sector plays a critical role in the welfare of India's rural population. It contributes nine percent to Gross Domestic Product and employs eight percent of the labour force. This sector is emerging as an important growth leverage of the Indian economy. As a component of agricultural sector, its share in gross domestic product has been rising gradually, while that of crop sector has been on the decline. In recent years, livestock output has grown at a rate of about 5 percent a year,

higher than the growth in agricultural sector. This enterprise provides a flow of' essential food products, draught power, manure, employment, income, and export earnings. Distribution of livestock wealth is more egalitarian, compared to land. Hence, from the equity and livelihood perspective it is considered an important component in poverty alleviation programmes.

With changing scenarios worldwide Indian livestock industry is facing many challenges both in terms of total produce and quality of the primary and secondary products. In order to compete in international market we need to improve the quality which intern demands safe animal health.

Animal disease status in India is encouraging for the facts that we could able to eradicate Rinderpest, the most dreaded livestock disease that vanished herds of cattle. But there are several other infectious diseases and non-infectious diseases, both old and new that are prevailing in the country causing huge economic loss annually. Control and eradication of the animal diseases needs a thorough understanding of the disease epidemiology. Project directorate on animal disease monitoring and surveillance is dedicated to nation to carry out the research activities in the area of veterinary epidemiology and disease informatics. With the eradication of RP successfully, India has proved its ability to face the challenges in spite of various challenges. Similar efforts are needed to control and eradicate the diseases like FMD, BT, HS etc which causes huge economic loss annually.

With "Vision 2030" we are envisioning the safe animal health, which is essential for safe human health. The document prepared will definitely guide us to achieve our goals both in time and space.

Contents

Livestock Disease Scenario in India

Livestock population in India is threatened by disease outbreaks, droughts, floods and other climatic anomalies. There are several diseases affecting livestock and poultry that can have devastating impact on animal productivity and production; trade in live animals, meat and other animal products; on human health and consequently on the overall process of economic development.

Animal disease scenario in India is encouraging for the fact that we could able to eradicate Rinderpest, the most dreaded livestock disease that vanished herds of cattle. But there are several other infectious and non-infectious diseases, both old and new, that are prevailing in the country causing huge economic loss annually. This chapter gives an insight into the present status of animal diseases in India focusing on important viral disease like FMD, BT, Pox, CSF, IBR and bacterial disease like HS, BQ, Anthrax, and Brucellosis. In poultry, the recent outbreak of avian influenza demands special mention.

Foot and Mouth Disease (FMD)

Foot and mouth disease is endemic in India since many centuries. It is present almost in all parts of the country and occurs round the year. Approximately 529 million domestic livestock are susceptible to FMD apart from the free-living and captive wild ungulates. Major incidence is reported in cattle and buffalo. Out of the possible seven, only four serotypes, e.g., 'O', 'A', 'C' and Asia 1 were ever recorded in India. Serotype 'C' too has not been recorded in the country since 1995. About 70-80% of outbreaks are due to 'O' followed by A and Asia-1. With the launching of intensive cattle development programmes through cross-breeding of indigenous cattle with exotic breeds, the incidence of FMD too has increased in India. Outbreaks occur throughout the year, but higher incidence observed in winter months and during pre-monsoon season.

Well-established Pan-Asian strain and its variants were responsible for outbreaks in two-third of the country since the year 2001-02. It has also been established that out of a possible ten genotypes of serotype 'A', only two, i.e., VI and VII are circulating in India for the last 20 years. In Asia 1 too, genotypes VIA and VIB are co-circulating in India.

The analysis of outbreak data for last ten years shows a decreasing trend of disease in recent past with the maximum outbreaks reported in the year 2002-03. Among the susceptible species severe outbreaks were observed in cattle and buffalo followed by goat, sheep, pig, camel and elephant.

Bluetongue (BT)

Bluetongue has become endemic in India. The first outbreak of BT in sheep and goats in the country was recorded in 1964 in Maharashtra State. Since then, the disease has been recorded in 11 states in India, either on the basis of virus isolation or by the detection of group-specific antibodies against the virus. Exotic sheep are more susceptible than indigenous and cross-bred sheep. A serological survey has indicated the presence of bluetongue virus (BTV) antibodies in cattle and buffalo in several states in India. However, clinical BT has not been observed in cattle or buffalo to date. Of the 24 known serotypes of BTV, 18 have been reported in India.

Culicoides spp. are the vectors of BTV. Of over 1400 species present worldwide, at least 39 have been reported to occur in India. Very few species of Culicoides have been demonstrated to be vectors for BTV, with the principal vectors varying geographically. Midges collected from Harayana, Punjab, Rajasthan and Himachal Pradesh were identified as *C. oxystoma*. BTV was isolated from midges, but vector speciation was not performed. *C. imicola* and *C. oxystoma* were found to be prevalent in Tamil Nadu. Details of vector species responsible for transmission of BTV in India are lacking. Virus-vector relationships also need to be analyzed critically.

The analysis of outbreak data from 15 co-ordinating units of PD_ADMAS, spread across different agro-climatic zones for the year 2010-11 shows the intensity of disease outbreak was sever in Karnataka (16) followed by Andrapradesh (08) and Tamil Nadu (02). The geographical distribution of the disease is confined more to peninsular India with unique climatic conditions and high sheep and goat population. The outbreak data collected for the last five years shows a decreasing trend in the disease outbreak. A severe outbreak of the disease was observed in the year 2007-08 subsequent to which a mild level of disease outbreak observed. Such observed pattern may be due to herd immunity attained by active infection.

Classical Swine Fever (CSF)

Classical swine fever (CSF) is a highly contagious, potentially fatal disease of pigs. The disease is currently endemic to India especially in intensive pig rearing units of north-eastern, nothern and southern states of India. The disease is associated with high mortality, abortion, mummification of the foetuses. In India, outbreaks of the disease have been reported from the states of Uttar Pradesh, Maharashtra, Tamil Nadu, and Punjab, and the north east Indian states of Arunachal Pradesh, Manipur, Mizoram, Nagaland, and West Bengal.

The mean prevalence of CSFV antibodies was 63.3% (376/594), whereas the viral antigen prevalence was 76.7% (220/287) from 594 samples collected from 12 states. The high prevalence of CSFV antibodies suggests that the disease is endemic in the country. The characterization of CSFV isolates from India lead to grouping of the virus in to two subgroups, viz., 1.1 and 2.2. Among the two subgroups 1.1 was predominant.

The analysis of disease outbreaks for last five years showed, a sharp fall in outbreaks from 2006-07 to 2007-08 and a steady rise from 2007 to 2010. The nature of outbreak was sporadic with outbreaks reported more from north-eastern (NE) states by virtue of high pig population followed by central and southern states. While the NE states are the epicentre of the infection and outbreak, the marketing channels link to different parts of the country there by spreading the infection. It was also hypothesized based on preliminary research data that illegal trade of animal across the national border may also be reason for finding the same subgroup of CSFV that is prevalent in China.

Swine Influenza

Influenza A viruses are the cause of considerable morbidity and mortality in humans and animals worldwide. Influenza virus infection is very common in pigs, and influenza viruses have been identified as one of the most commonly isolated pathogen from outbreaks of acute swine respiratory disease.

Swine influenza infection (H1N1, H2N2 and H3N2) is a common infection of pigs leading to very mild respiratory illness with self recovery within a short period. Infection from these viruses in pig population has been reported from many parts of the world and has also been detected in Indian native pigs from Tamil Nadu during the surveillance carried out by HSADL scientists during 2009-10 and two isolations of this virus strain have been made. This infection (swine influenza) is in no way connected to the pandemic H1N1 2009 and is neither a risk to human health nor a serious disease of pigs.

Pandemic influenza H1N1 2009 (WHO) is the name given by the international organizations to the virus that emerged in the form of pandemic in 2009 from Mexico that spread to US and then to the other parts of the world. There are no reports of morbidity or mortality in pig due to Swine influenza in India. But the new human variant, having more similarity with swine influenza type H1N1 has resulted in 10193 confirmed cases of with 1035 deaths as of 24 May 2010 in India.

Sheep and Goat Pox

Sheep and goat pox are two endemic capripox infections in India, which pose a significant economic threat to small ruminant productivity. In India, outbreak of capripox was reported as early as 1936 and since then, numerous outbreaks have been reported across the country.

Disease was found to show breed dependent severity, sheep of the Rambouillet breed were found to be most susceptible to infection with morbidity and mortality rates of 26.9% and 8.3%, respectively. Occasionally mortality in exotic breeds may reach 100%. The indigenous sheep and goats exhibit some natural immunity. Mortality in young animals can exceed 50%. In one of the studies in Jammu and Kashmir, morbidity and mortality rates in the entire flock were found to be 18.4% and 6.3%, respectively.

Trend analysis of capripox disease shows severe outbreak of the disease in the year 2006-07 and decreasing outbreaks in the later years.

Peste des Petits Ruminants (PPR)

PPR is an acute highly contagious viral disease of goats and sheep caused by *Morbillivirus* of the family, *Paramixoviridae*. Goats have been found more susceptible and suffer with more severe form than sheep. The first report of PPR outbreak in goats from Latur district of Maharashtra has been recorded. Subsequently, several outbreaks of PPR has been reported from Maharashtra, Karnataka, Andhra Pradesh, Tamil Nadu, West Bengal, Rajasthan, Orissa and Himachal Pradesh and the disease is now enzootic in several states of India. Outbreaks are relatively more common in goats than in sheep in northern states whereas in southern India outbreaks are more common in sheep.

PPR is a major constrain in the development of goat industry due to high morbidity (50-90%) and case fatality (50-85%) rates. Kids over four months and under one year of age are at highest risk. Finding suggested that frequency of disease outbreaks was greater between the month of March and June (51.7%) as compared to other periods of the year.

Infectious Bovine Rhinotracheitis (IBR)

Bovine herpes virus 1 (BoHV-1) is primarily associated with clinical syndromes such as rhinotracheitis, pustular vulvovaginitis and balanoposthitis, abortion, infertility, conjunctivitis and encephalitis in bovine species. The BoHV-1 virus can become latent following a primary infection with a field isolate or vaccination with an attenuated strain.

Sero-epidemiology of IBR in cattle and buffalo for the year 2009-10 showed that, the disease prevalence was highest in Tamilnadu with 67% prevalence and lowest was in Meghalaya. Overall disease prevalence was 34% in India with varying rates for different regions of the country: Eastern 17%, Western 24%, Northern 37%, North-Estern 39%, and Central 25%.

Haemorrhagic Septicaemia (HS)

Haemorrhagic septicaemia is an endemic disease in India. HS is the most important bacterial contagious disease in cattle and buffaloes. Buffaloes are more susceptible than cattle and that, in both species, young and young adult animals are more susceptible than older animals. Disease is widely distributed covering all the geographical regions of the country. In India, HS epidemics may occur as an alarming and devastating disease problem in cattle and buffaloes.

The disease is caused by *Pasteurella multocida*. The serotypes prevailing in India are B:2, A:1, A:1,3, A:3, A:4, A:3,4,12, F:3, D:1, D:3, F:1, F:4 and F:4, 12. The Indian B:2 serotype has also been associated with sporadic septicaemic disease in pigs.

The outbreak trend of the disease in India from year 2006 to 2010 shows a decreasing number of outbreaks which may be due to timely reporting and vaccination of the animals. In addition to buffalo, disease is also reported sporadically in goat, sheep and pig each with outbreak rate of 62, 102 and 5 respectively in the year 2007-2010.

Black Quarter (BQ)

It is an acute infectious and highly fatal, bacterial disease of cattle caused by *Clostridium chauvoei*. Buffaloes, sheep and goats are also affected. The disease is also sporadically reported in pigs. Young cattle between 6-24 months of age, in good body condition are mostly affected. It is a soil-borne infection, which generally occurs during rainy season. The disease is common in areas with moderate rainfall and where dry-crop cultivation is common. This disease is widespread amongst cattle in certain parts of India, particularly in Karnataka, Tamil Nadu, Andhra Pradesh and Maharashtra. Sporadic cases occur in the northern and eastern states of the country.

The maximum disease outbreaks in the year 2009-10 were recorded from West Bengal with total of 95 outbreaks, 293 attacks and 122 deaths followed by Maharashtra with 37 outbreaks, 128 attacks and 96 deaths. The other state like MP, J&K, Tamilnadu, have also reported sporadic outbreaks. Next to cattle the disease is reported from buffalo and sheep with outbreaks of 162 and 2 respectively since 2007. The outbreak trend of the disease shows a gradual decrease in the disease from 2006 to 2010.

Anthrax

Anthrax is an acute, infectious febrile disease of virtually all animals and man. **The most susceptible animals are cattle and sheep followed by horse and pig.** It is caused by *Bacillus anthracis*. It is a soil-borne infection. It usually occurs after major climatic change. The disease is enzootic in India. The disease is endemic in Tamil Nadu, Karnataka, Andhra Pradesh, Orissa, West Bengal, Maharashtra and J&K.

In India maximum disease outbreaks are reported in cattle followed by sheep/goat, buffalo, pig and elephant. The outbreak trend of the disease shows a sharp decrease in the year 2007-08 and almost steadily maintained in endemic areas with 60±10 outbreaks in subsequent years. The cumulative outbreak data of Bovines from 2002-10, shows highest outbreaks in West Bengal (142), with total of 631 attacks and 564 deaths. The outbreaks in small ruminants especially sheep are maximally recorded from AP and Karnataka which may be by virtue of high sheep population in those states and their migratory patterns.

Enterotoxemia (ET)

Enterotoxemia is severe disease of sheep and goats of all ages. It is caused by two strains of bacteria called *Clostridium perfringens* – the strains are termed types C and D. These bacteria are normally found in low numbers in the gastrointestinal tract of all sheep and goats.

The outbreak trend for last five years shows gradual decrease with 158 outbreaks recorded for the year 2010-1. The year 2006 has seen maximum number of outbreak with 457 outbreaks. Most of the outbreaks are reported from AP, Tamilnadu, Karnataka, Maharashtra and J&K. An estimated 12,929 sheeps and 619 goats have died due to ET since 2002. The effective vaccination strategy may be responsible for the decreasing trend of the outbreaks.

Brucellosis

Brucellosis is one of the five common bacterial zoonoses in the world. Bovine brucellosis is found worldwide, however, it has been eradicated from many countries; but, it is one of the most serious zoonotic diseases in India. The rates of infection vary greatly from one state to another within a country. In India, brucellosis was first recognized in 1942 and is now endemic throughout the country. Higher sero-prevalence was recorded in goats of Madhya Pradesh and Bihar and in sheep population of Karnataka and Rajasthan with overall disease prevalence of 8.85% and 6.23% in goat and sheep respectively.

The disease has been reported in cattle, buffaloes, sheep, goats, pigs, dogs and humans. But, the highest prevalence is seen in dairy cattle. Despite the advances made in the diagnosis and therapy, brucellosis is still wide spread and its prevalence in many developing countries is increasing. Screening of cattle and buffalo serum samples collected from various states (1994-2001) revealed that the disease is highly prevalent in union territory of Delhi followed by A & N islands, West Bengal, Tamilnadu, Kerala, Gujarat, Maharashtra and Punjab.

The seroprevalence studies carried out annually shows increasing trend of the disease. The representative samples from different regions of the country reveal that the prevalence rate has increased from 34.15% of the samples in 2006-07 to 67.28% in the year 2010-11.

Fascioliasis

Fascioliasis is caused by *Fasciola gigantica* and *F. Hepatica*. In India, *F. gigantica* is more common. The disease is most common and economically important disease of sheep.

The Prevalence rate of *Fasciola giagntica* in different geo-climatic zones (hills, tarai and plains) of north India was reported to be 10.79, 13.90, 2.78 and 2.35 percent in cattle, buffaloes, sheep and goats, respectively. Animals in the tarai had the highest prevalence of fasciolosis followed by those in the hills and plains, respectively. The prevalence of infection in cattle and buffaloes was highest during the winters (11.84% cattle, 15.57% buffaloes) followed by summers and rains, respectively. However, the seasonal trends in sheep and goats were reverse, with the peak prevalence during the rains (4.60% sheep, 2.71% goats). Abattoir studies revealed a higher prevalence in buffaloes (31.14%) than in sheep and goats. Screening of *Lymnaea auricularia* snails revealed that 5.48% of the snails harboured larval stages of *F. gigantica*. Also, the snails in the tarai had a higher prevalence (7.28%) of infection compared to those in the plains (1.57%).

Since 2002, maximum outbreaks of fasciola were reported from Orissa with 545 outbreaks, 4993 attacks and 34 deaths, followed by Haryana, Manipur, Mizoram and Bihar. Country wide Fascioliasis cumulative OB reports shows maximum outbreaks in Orissa followed by Bihar, Mizoram, Rajasthan, Haryana, Kerala, Karnataka, Maharashtra, Tamilnadu, Gujarat, etc.

Trypanosomiasis

Trypanosomiasis is caused by *Tryponosoma evansi* is an important haemoprotozoan disease of domesticated animals, pets and wild animals. It is commonly termed as Surra in all animal species and Tibersa in camels. Among the several species of trypanosomes, *Trypanosoma evansi* is the most commonly occurring species in India causing the disease. For non-prevalence other species, non-availability of the vector is the main cause. Surra disease results in anaemia, lowering down of milk yield and working capacity. Hence besides causing economic losses", it also causes high mortality in valuable animals.

In a country like India and state like Maharashtra, where all the factors are conducive for the disease and therefore it results in recording of endemic foci and sporadic cases of the disease. The livestock all over India particularly Rajasthan, Haryana, Punjab, Madhya Pradesh, Uttar Pradesh, Maharashtra, Tamil Nadu, Kerala, Andhra Pradesh is prone to disease". It occurs in all age groups of hosts". Most suitable season for occurrence of disease is during or after one and half to two months of rains" due to availability of rain water lodged ditches for breeding of the flies.The analysis of disease trend for last ten years shows decreasing pattern. Maximum outbreaks were recorded in the year 2001-02 whereas minimum outbreak in the year 2009-10.

Theileriosis

Bovine tropical theileriosis, an inapparent infection of indigenous cattle and buffaloes, has emerged as one of the fatal diseases of taurine cattle and their crosses since the early 1960s, due to large scale cross-breeding programmes. Theileriosis in Indian bovines is mainly caused by *Theileria annulata.*

Although systematic studies were not carried-out to study its incidence, out of 5454 blood smears of apparently normal CB cattle examined during the year 1989 at various centres of All India Coordinated Research Project (AICRP) of the Indian Council of Agricultural Research, 14.94 per cent had revealed *T. annulata*. Results of serological surveys conducted under the same project indicated that 30-60 per cent of the cross-bred cattle were positive for antibodies to *T. annulata piroplasms,* all over India, except in the Himalayan region, where climate is not favourable for tick activity.

The occurrence of tropical Theileriosis, *T annulata* is seasonal and coincides with the incidence of ticks on the host, which is very high in summer i.e., from May to October. The stress due to extreme of climate, transportation, concurrent disease, vaccination etc., may be contributory factors. The vector of *T. annulata* is generally *Hyalomma anatolicum anatolicum,* found in desert, semi desert and steppe. It is a three host tick and both immature and adult stages occur on cattle. The adults are active in late spring. The immature stage of *H. anatolicum* feed on most of the animals and larvae and nymphs can acquire infection by feeding on infected cattle and transmit infection after moulting, when they feed as nymphs or adults. The season of adult feeding and thus of disease incidence is widely spread from March to November, but, the nymphs have a more restricted season from July to September. The seasonal incidence of *T. annulata* is commonly in late spring and early summer.

The cumulative outbreak map clearly shows the maximum number of outbreaks from Orissa followed by Bihar, West Bengal, Jharkhand, Haryana, and rest of the states with outbreaks less than 60. The analysis of the disease trend for last five years shows varying outbreak trend with minimum outbreak recorded in 2008 whereas maximum in 2006.

Babesiosis

In India bovine babesiosis is mainly caused by two Babesia species, *Babesia bigemina* and *Babesia bovis*. The species are transmitted to host mostly by one host tick, *Boophilus microplus*. The transmission within the tick is by transvovarian. Once the adult female tick is infected it can transmit the infection for 32 generations.

The analysis of the disease status for last ten years shows maximum outbreaks in the year 2001, whereas minimum in the year, 2008-09. The spatial analysis of the disease shows the maximum outbreaks recorded from Orissa followed by Assam, Haryana, Jharkhand, Bihar, MP, Rajasthan, and HP.

Emerging Diseases

There have been several outbreaks of new and emerging diseases like, Bovine Spongiform Encephalopathy (BSE), Paramyxovirus infection in horses (Hendra) and pigs (Nipah) and Zoonotic H5Nl avian influenza. Fortunately, India has remained free from these diseases. Also, old diseases re-emerge in new guises that enable them to evade current control measures. These agents might have undergone subtle genetic changes or could be recombinants with other viral or cellular genes. Immunological pressure could also be responsible for such genetic changes. These organisms may also turn out to be really new, hitherto undiscovered agents. Of particular concern is the ability of new multi-drug resistant bacteria with a pathogenic potential for human via food chain like *Salmonella enterica*, *Campylobactor, Entrerococcus spp* etc. The recent reports of H5Nl avian influenza virus crossing the species barriers and infecting humans, pigs, cats and tigers have caused alarming situation world-wide. This is especially true for pigs that have strong genetic similarity to humans.

Exotic Diseases

There has been always a risk of introduction of new diseases/pathogenic organisms into a country causing serious animal health problems in terms of mortality and morbidity. Exotic (non native) pathogens, once introduced into a country, can escalate into an epidemic due to the absence of vaccine or effective drugs, lack of resistance in host animals and limited resources to diagnose and restrict the spread of these pathogens. Hence, there is a need to take extra precaution in import of animals infected with pathogens. The WTO has permitted countries to exercise their sovereign rights to protect their livestock industry from such diseases.

Conclusion

Present status of the animal diseases in India needs a serious attention, in terms of research and funding especially in the area of epidemiology. Unless a valid research data in regards to disease epidemiology is made available, planning of disease control measures would be difficult and eradication would be impossible. Animal diseases are not only threat to national economy but also to human health. In the recent past, most of the emerging infectious diseases in human are of animal origin. Hence, it is animal health for human health.

Project Directorate on ADMAS

Achievements

Despite being the highest producer of the milk, India still experiences major losses due to infectious diseases. For any efficient livestock production system, availability of quality diagnostics, vaccines and effective surveillance programmes are a must. In a way, disease surveillance is central to animal health for better productivity. Precise diagnostics are supplementary to the disease surveillance and monitoring. Animal disease surveillance, monitoring and production of quality diagnostics are the strong pillars of the Project Directorate on Animal Disease Monitoring and Surveillance (PD_ADMAS), which is serving the country on animal health issues, there by indirectly augmenting the productivity. Presently under different programmes, institute has various projects that support in understanding the etiology of the disease and interaction of etiological agent with the host, epidemiology, surveillance, monitoring, forecasting, forewarning, estimation of economic losses and impacts. The external funded projects on bovine mastitis, outreach programmes on zoonotic diseases and blue tongue have added feathers to the PD_ADMAS cap. A new contract research project initiated under public private partnership mode on IBR and Leptospirosis is also noteworthy. The salient achievements made under various projects are given in the ensuing paragraphs.

The interactive web-based software for the forecasting of the 15 major livestock diseases was launched in the X plan has a large number of databases covering a period from 1987 to 2010. These databases are updated regularly and are collated to suit the requirement of GIS software. Currently the software is operated on MySQL platform with the web address as NADRES.RES.IN using ERNET facilities. The unit analyses the data for spatial and temporal epidemiology and also works out the trends of the diseases at national and regional level. The database has over 79,000 scientifically documented disease outbreak data linked to 609 districts of the country from 1987 to 2010. The analysis of the data enables the policy makers to prioritize the control strategies. A logistic regression analysis for 15 economically important livestock diseases utilizing the NADRES module, predicts the probability of occurrence of the disease two months in advance at district level. Based on the predicted values forecast maps were prepared for the 12 calendar months. Utilizing the database, the spatial distribution of the diseases in the country at district level have been analyzed. The data has also been utilized for mapping out the pathozones (Mild, Moderate, High and Very High) in the country to the major livestock diseases. The zones have been linked to the risk factors and ecopathozones of the livestock diseases have been identified. Maps have been prepared using EpiInfo© software of CDC Atlanta, USA, which has been standardized to suit the need.

Research on zoonotic diseases such as brucellosis, leptospirosis are being carried out at PDADMAS right from inception of the institute. Brucellosis in animals is characterized by abortion, retained placenta and orchitis. The disease in humans is serious public health problem. Conventionally, the diagnosis of this disease is done using a battery of tests such as Milk ring test, Rose Bengal Plate Test, Standard tube agglutination test, etc. Development of ELISA kits (250 and 450 test format) for the detection of antibodies against *Brucella abortus* in cattle, *B. melitensis* in sheep and goats, *B. suis* in pigs and a common conjugate ELISA for detection of anti-brucella antibodies in various species of animals and humans is the highlight of Brucella Research at PD_ADMAS during the last plan (2007-12). Countrywide sero-surveillance carried out using the indirect ELISA indicated that 8.85% of goat, 6.23% sheep and 22.11% of swine serum samples are positive for anti-*Brucella* antibodies. Similarly ELISA screening of 499 risk group-human serum samples showed that 17.3% are positive anti-*Brucella* antibodies. In addition to ELISAs, few PCR protocols have been optimized for detecting (BRUCE ladder PCR) *Brucella* organisms and differentiating (AMOS PCR: Abortus, Melitensis, Ovis, Suis) various *Brucella* species.

Characterization of stock cultures of suspected leptospira species began only recently at PD_ADMAS and between 2009-11, one hundred ninety one stock cultures from different livestock and human hosts [Bovine-93 (cattle-82; Buffalo-11)]; Canine 16; Horse-8; Human-31; Goat-11 Elephant-1; Rodent-25; and water body source-6], were subjected to *Leptospira* genus specific PCR and pathogenic *leptospira* specific PCR [*secY* (translocase) and 16s rRNA genes based PCRs] for identification of *leptospira* organisms. The identified pathogenic *leptospira* organisms (n=52) were later subjected to *rpoB* gene specific PCR for species identification. Phylogenetic analysis of isolates based on *rpoB* gene sequences revealed that 14 isolates belong to *L. borgpetersenii* serovar Hardjo, 8 isolates to *L. kirschneri* serovar Grippotyphosa, 16 isolates to *L. interrogans* species with major serovar Australis/Bratislava, Tarassovi and Icterohaemorrahagie and 14 isolates belong to *L. inadai* species subgroup. The overall percentage prevalence of leptospira species in livestock and human are *L.borgpetersenni, L. interrogans, L. inadai and L. Krischneri* 27, 31, 27,15, respectively were observed.

Besides zoonotic pathogens, research work on food-borne pathogen, *Listeria monocytogenes* was undertaken. *L. monocytogenes,* which is an opportunistic and a facultative intracellular pathogen, causes life threatening infections in animals and humans. There are 13 serotypes of *L. monocytogenes.* Out of these serotypes, only 1/2a (CC7), 1/2b (CC3 & 5), 1/2c and 4b (CC 1, 2 & 4) are pathogenic to human and but all the above except 1/2c (CC9) are pathogenic to animals. The population structure of *L. monocytogenes* consists of three distinct phylogenetic lineages: Lineage I include isolates of serotypes 1/2b, 4b; Lineage II includes isolates of serotypes 1/2a, 1/2c; Lineage III includes isolates of serotypes 4a & 4c. Some subtyping procedures including serotyping, multilocus enzyme electrophoresis (MLEE), pulsedfield gel electrophoresis (PFGE), ribotyping and DNA sequencing-based subtyping techniques like multilocus sequence typing (MLST) have been developed to track individual strains involved in listeriosis outbreaks, and to examine the epidemiology and population genetics of these bacteria. A total of 10 *Listeria monocytogenes* isolates were to study the sequence diversity of seven (*bglA*, abcZ, *ldh, cat, dap*E, *dat, lhk*A) housekeeping genes (MLST) of *L. monocytogenes,* to assign and correlate serotypes, sequence types and clone/lineage and to develop a multi-virulencelocus sequence typing (MVLST) scheme for studying the local epidemiology and to generate informative sequence data for studying the virulence of *L. monocytogenes.* The relatedness of isolates was analyzed using the Sequence Type Analysis and Recombinational Test (START). Sequence types (ST) were clustered into clonal complexes or lineages. From the sequences of the seven housekeeping loci for each isolate, allelic profiles were assigned from MLST database. For each locus the number of alleles ranged between 2 and 3. In the present study, eight out of ten isolates are of 1/2a serotype, of which six isolates of the food origin are of Sequence type-ST 7, whereas, the other two clinical isolates fall under equence type-ST 12 because of six nucleotide insertions noticed in ldh gene. Similarly, two out of ten isolates (L62T07 and LZPL907) are of serotype 1/2b. The percentage of nucleotide polymorphisms in the housekeeping genes ranged from 2.506 to 12.101% against 3.629 to 14.062% in virulence genes. Though the allelic profiles of both housekeeping and virulence loci showed three major clusters, the grouping was different.

Classical swine fever (CSF) is ranked the top most among the pig diseases and is one of the OIE listed diseases. The CSF or hog cholera is an economical and highly contagious viral disease of domestic pigs associated with high mortality, abortion, mummification of fetuses. It is of great concern in areas, where the pig population is in high density. Classical swine fever virus (CSFV) has been divided into three groups with three or four subgroups: 1.1 and 1.2 and 1.3; 2.1 and 2.2 and 2.3; 3.1 and 3.2 and 3.3 and 3.4. The global distribution of these subgroups varies depending on the geographic region. Keeping in view of the importance of the disease and no information on the prevalence various subgroups of CSFV, a research project was undertaken to study the various CSFV genetic groups prevalent in India. Towards this end, CSFV suspected clinical samples/isolates were nucleotide sequenced at 5' UTR and NS5B genomic region and molecular epidemiological analysis was carried out. The results of the 5' UTR analysis revealed the presence of at least two genetic subgroups (subgroup 1.1 & 2.2) in India. On the phylogenetic tree, the Indian isolates are placed separately from other members of the subgroup 1.1 from Europe, South East Asia and China. The study also could indicate that there are at least two populations of subgroup 1.1-viruses involved in the outbreaks during 2006-08 in the country. The study also revealed that viruses of subgroup 1.1 are the most dominant group involved in CSFV outbreaks in India during 2006-08. Phylogentic analysis of NS5B gene was carried out to determine the possible origins subgroup 2.2 in India. The analysis revealed that the said subgroup may have had its origins in China. The study also revealed presence of this subgroup not only in north-eastern states but also in other parts of India including the southern state of Karnataka and Northern state of Uttar Pradesh. In addition to above molecular epidemiological study, sero surveillance of eight hundred and twenty seven pig serum samples collected from three (3) states viz., Andhra Pradesh(377), Karnataka (294) , and Kerala (156) indicated that 205 (25%) samples were positive for antibodies against CSFV.

Peste des petits ruminants (PPR) is one of the highly contagious and economically important viral diseases of small ruminants, especially goats and sheep, with morbidity and mortality rates as high as 100% and 90%, respectively. Economic losses due to PPR have been estimated to be 1,800 million Indian Rupees (US$ 39 million) annually. However, the pattern of PPRV infection and its seroprevalence in small ruminants and other species in India has not been systematically studied to date except few reports, which dealt only on sheep and goats. PD-ADMAS has undertaken a systematic study on the epidemiology of PPR in sheep, goats and cattle including wild ruminants and the project is proposed with an objective of generating the baseline data on prevalence of the PPR in India in collaboration with Indian Veterinary Research Institute, Mukteswar. Serum samples were collected from unvaccinated sheep, goats and cattle from different places of Karnataka to study the seroprevalence of PPR. A total of 723 serum samples (Goat-32; Sheep-149; cattle-542) were screened for PPRV antibodies by using PPR C-ELISA kit, the percentage prevalence of 14.7, 56.2 and 4.42, were observed in sheep, goat and cattle, respectively. None of the clinical samples were found positive for PPRV antigen, when tested by PPR S-ELISA kit.

Among *alpha herpesviruses* infecting ruminants, the bovine herpes virus 1 (BoHV-1) is a important pathogen of cattle, which has worldwide distribution. Based on antigenic and genomic characteristics, BoHV-1 has been further subdivided in two distinct yet closely related subtypes: 1 (BoHV-1.1) and 2 (BoHV-1.2). It has also been proposed that such subtypes may be associated to distinct clinical manifestations of disease in cattle: subtype 1 causes respiratory tract infections known as infectious bovine rhinotracheitis (IBR),while, the subtype 2 has been associated to genital diseases known as "infectious pustular vulvovaginitis" (IPV) or balanoposthitis (IPB) as well as other forms of reproductive failure. Since, different types and subtypes of bovine herpesvirus 1 have been shown to be associated to different clinical conditions of cattle differentiation of type/subtype becomes essential for understanding the pathogenesis and epidemiology of BoHV infections. Eleven IBR/IPV suspected clinical samples (nasal, conjunctival, vaginal and prepucial swabs) collected from cattle/buffaloes were nucleotide sequenced for molecular epidemiological studies. The strains of BoHV-1 have grouped in two different nodes; one related to BoHV-1.1 and another to BoHV-1.2. All the Indian strains used in the study belonged to subtype 1.1 irrespective of animal species, clinical manifestations. The phylogenetic analysis indicated that BoHV1.1 is the predominant subtype prevalent in India. Cumulative study (1995-2010) encompassing 57009 serum samples from different parts of the country were tested by AB-ELISA during these years and 36% samples were found positive.

Trypanosomiasis or Surra, a chronic disease caused by *Trypansoma evansi*, clinically characterized by severe anaemia, hypoglycemia, weight loss, reduced reproductivity, infertility and abortion with death occurring in some animals having the acute phase of the disease. Recovered animals exhibit low levels of fluctuating parasitaemia for years and serve as a carrier for the disease. Detection of clinical disease, however being done by conventional and serological tests, identifying the carrier status/

latent infection is an important criterion in controlling the disease. In order to detect carrier animals, a set of primers were indigenously prepared and PCR was optimised evaluated for its performance. The results indicated that PCR is capable of detecting 0.5 tryps/ml. Parallelly expression of truncated gene of VSG in prokaryotic system was carried out and its immunological reactivity was analysed with immune and hyperimmune sera with an objective to develop recombinant antigen based diagnostics for *T. evansi.*

A Seroprevalence study of bovine neosporosis was conducted among 1927 dairy cattle and 341 water buffaloes from Karnataka and Andhra Pradesh states of southern peninsular India by employing competitive ELISA (c-ELISA). Overall 12.61 and 9.97% serum samples were found positive for the presence of *Neospora caninum* antibody among cattle and water buffaloes respectively. Out of 1927 sera from cattle, 912 and 1015 sera were collected from unorganized and organized herds, respectively. Significantly ($p<0.05$) higher prevalence was found in the cattle in unorganized herds (11.90%) in comparison to organized herds (8.96%). A sero-prevalence study on caprine neosporosis was conducted among 3975 randomly selected healthy goats from four different geographical areas including 9 states of India by employing c-ELISA. Over all 7.93% goats were found to be positive for the presence of *Neospora caninum* antibody. There was no significant difference in the apparent prevalence of four different geographical areas of India ($p>0.05$).

The NAIP sub-project on "Bovine Mastitis: Unraveling molecular details of host-microbe interaction and development of molecular diagnostic methods" aimed at understanding the molecular diversity of three major bacterial pathogens viz, *E. coli, Streptococcus sp, Staphylococcus sp* and development of molecular diagnostics for subclinical mastitis. The project is also studying the host-microbe interactions at cellular and molecular level using mouse model. The salient achievements of the project till now are summarized below,

Fourteen spa types of *S. aureus* viz. t359, t267, t6877, t3992, t1200, t2104, t2478, t2770, t2802, t5109, t2915 and eleven new *spa* types were identified. The chromatograms of these new types were submitted to Ridom GmbH, Germany and the spa types were designated as t7286, t7287, t7288, t7680, t7681, t7682, t7683, t7684, t7867, t7695 and t7696. *S. aureus* of spa-type t359 and t267 identified in our laboratory has also been reported in *S. aureus* isolates from bovine mastitis in Brazil and England respectively, thereby signifying their global epidemiological importance. The other spa types identified in this study have not yet been reported in *S. aureus* associated with bovine mastitis.

The MLST analysis of *S. agalactiae* led to the identification of a unique allele of *atr* gene (atr_56) and a new Sequence Type 483, reported for the first time in the world. MLST analysis of *S. uberis* led to the identification of 10 new alleles and 3 unique STs which were designated as ST-439, ST-474 and ST-475 by the curator and were submitted to the *S. uberis* MLST database. MLST analysis of *S. epidermidis* isolates revealed the presence of 5 new alleles.

A multiplex PCR was developed for identification of *E. coli* simultaneously differentiating from *Shigella sp.* and other members of *Enterobacteriaceae* family. A multiplex PCR (two tube format) was developed for sensitive, specific and simultaneous detection of 10 mastitic pathogens including S. *aureus, S. agalactiae, S. dysgalactiae, S. uberis, E. coli, S. chromogenes, S. epidermidis, S. sciuri, S. haemolyticus* and *S. simulans*. Multiplex PCR for the simultaneous detection of five most prevalent Staphylococcal species: *S. aureus, S. chromogenes, S. epidermidis, S. sciuri* and *S. haemolyticus* was developed and important Streptococcal species: *S. agalactiae, S. dysgalactiae* and *S. uberis* were developed. This molecular method satisfies the need of a rapid and specific tool for identification.

A swiss-albino mouse model was developed for understanding the host microbe interaction in mastitis. The expression of genes associated with immune response mechanism to mastitis were analyzed in tissues collected from the experimental mice model infected with prototype organism (*S. aureus, E. coli and S. agalactiae*) and sacrificed in time course manner. The quantification of relative expression of IL-2, IL-4, IL-6, IL-12, TNF-α, IFN-γ, GMCSF, TLR-2, TLR-4, TLR-9, TLR-11, TLR-12, TLR-13, CD14, IL-1β, RANTES, lactoferrin, Cxcl-1, Cxcl-5, C3 and SAA3 were carried out.

PD_ADMAs was included as a non funded unit within All India Network on Bluetongue from July 2009 and was given the responsibility of spatial epidemiology and clinical sample based molecular epidemiology of BTV for Karnataka state. During this period, outbreaks databse and digital taluk level map for Karnataka state was created. Preliminary molecular epidemiological analysis based on clinical samples indicated that involvement of serotypes 1 and 2 in Raichur and serotype 1 in Bagalkot outbreaks.

PD_ADMAS is one of the twelve centres which have been actively involved in working on zoonotic diseases under Outreach Programme on Zoonotic Diseases (OPZD) by Indian Council of Agricultural Research (ICAR) since November, 2009. Under the outreach programme on zoonotic diseases, epidemiology of brucellosis, leptospirosis and listeriosis in addition to their zoonotic relevance were studied. The burden of these agents in livestock and their products is documented. Interestingly, among pig samples 51.2%, 74.35% and 20.51% were positive for brucellosis by RBPT, ELISA and PCR, respectively indicating the higher prevalence of both antibody and antigen in pig samples. Different livestock species including 11 tiger and equine samples were screened for *Leptospira* spp both by PCR and isolation methods. Four out of 10 cattle and 11 out of 16 goat serum samples were positive. Zoonotic potential of brucellosis, leptospirosis and listeriosis in samples from human were collected from risk group (veterinarians, para veterinarians, farmers/workers associated with the animals) and persons showing clinical signs were assessed.

“Incidence of Infection due to Infectious Bovine Rhinotracheitis and Leptospira in Indian Dairy Farms”under PPP mode that was conceptualized, approved and launched during December, 2009. This is a unique and exhaustive study that included 11 organized dairy farms covering six states of India viz., Pondicherry, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra and Chattisgarh. It is a comprehensive study inclusive of cattle, buffaloes maintained both by government and private sectors. It is evident from the study that the overall incidence of IBR and leptospirosis in Indian dairy farms was 42% and 20%, respectively. The outcome of the study has revealed that the incidence of IBR and leptospirosis in animals having reproductive issues was 54% and 22%, respectively. It is noteworthy to mention that the apparently healthy animals showed overall incidence of IBR and leptospirosis as 34% and 19%, respectively. The findings also revealed the overall incidence of IBR and leptospirosis in buffaloes as 31% and 20%, respectively and the single largest group of pathogenic leptospires isolated was Leptospira Hardjo. The economic impact and carrier status of IBR/leptospirosis is well discussed and is a matter of concern to animal and public health.

Consequent to the eradication of RP from the country, the sera samples received at the Institute were preserved for retrospective studies. This was the beginning of the Serum Bank at the Institute. The cataloguing process of the bank has been streamlined with alphanumeric labeling of each sample received at the Bank and assigning a barcode. A system has been introduced to collect the serum from various parts of the country based on stratified random sampling method.

Impact Assessment

Disease forecasting and forewarning, disease trends

The advances in information technology provide adequate computing techniques to develop a national livestock disease information system, which is the prime need of the day. To this end , PD_ADMAS has developed an innovative india.admas *Epitrak* epidemiology software which is a dynamic and interactive livestock disease relational database supported by Geographic Information System (GIS). The online NADRES server addresses the needs of data collection, retrieval, analysis and critical reporting of disease events as and when they occur and is useful for students and vet colleges, field veterinarians, administrators. The outbreak data received from various states of the country are entered into the NADRES server, which is used for complex epidemiological analysis. The results of the analysis are provided in the form of GIS maps and also for forecasting of livestock diseases. Demarcating the country into disease specific Eco-Patho-Zones has helped in identifying likely region/places of outbreak and there by drawing the attention of epidemiologists to the disease prone zones. Further, the NADRES appraises current livestock disease status in the country to the administrators, planners, researchers and field workers through periodical epi-reports. This has provided to the nation a reliable, cost-effective and user-friendly, national animal health information system, which is capable of generating, storing, transmitting and retrieving of the animal health information for compilation and analysis of not only the active and passive data but also the animal health related data required for identifying the disease precipitating factors.

Providing sampling frame and technical consultancy for FMD-CP/PPR-CP/AINP-BT etc.

PD_ADMAS has provided critical inputs to national FMD control programme by providing the list of villages from each districts of various states for conducting sero-sampling. Besides this PD_ADMAS has provided technical help in disease data analysis for All India Network Programmes such as AINP-BT.

Development ELISAs for sero-surveillance IBR, Brucellosis, CSFV

Besides the avidin-biotin ELISA developed for diagnosis of IBR and bovine brucellosis, the research efforts over the year on this disease has resulted in the development of ELISAs for the detection of antibodies against *B. abortus* in cattle, *B. melitensis* in sheep & goats, *B. suis* in pigs and a common conjugate ELISA for detection of anti-*brucella* antibodies in humans and various species of animals. The development of ELISA for the detection of anti-CSFV antibodies is a significant step in sero-surveillance of this disease.

Training

Another important and significant contribution was in the area of human resource development at national, regional, state and district level by offering both hands-on training. Through various training programmes PD_ADMAS has been able to make an impact on the professional development and performance of scientists due to new knowledge gained and the skills acquired by them. These scientists, working in the coordinating centers, veterinary hospitals/dispensaries are now better equipped to carryout sampling/epidemiological analysis.

SWOT Analysis

Self-introspection is essential for any organization to realize its targets and potential. The SWOT analysis critically scrutinizes the various facets of the institution or programme or an activity, based on real experiences, feedback, peer observations, etc. It further helps in visualizing future opportunities in the emerging scenario with the backdrop of possible threats. Following section gives a brief sketch of SWOT analysis of PD_ADMAS. It takes into consideration such factors as training, research, policy and consultancy.

Strengths	**Weakness**	**Opportunities**	**Threats**
• Prioritization of diseases for launching control measures • Availability of National databases on livestock demography, agro ecological, climatological parameters • Availability of National Animal Disease Referral Expert System an interactive website for disease forecasting / epimapping etc. • Availability of economic analysis modules	• Lack of sufficient number of trained personnel in Epidemiology. • Lack of trained technical support. • Lack of Physical infrastructure and space. • Lack of sufficient number of coordinating units • Gross under reporting of diseases. • Lack of non availability of economical diagnostics.	• Scope for becoming the regional centre for countries in the SAARC region. • Scope for Refinements of NADRES software • Scope for International linkages on livestock disease surveillance.	• Downsizing of coordinating units and personnel due to policy decisions • Creation/competition of/from parallel disease reporting / monitoring structure. • Misconstrued perception of the role of PD_ADMAS may mar its further utility and growth owing to role ambiguity and duplication.

PD_ADMAS 2030

The project directorate on animal disease monitoring and surveillance is progressing ahead with experiences gained in the process of successful RP eradication to face the challenges of various other economically important diseases of livestock. The efforts would be to become the influential organization in the area of animal health and human health in the country.

Vision

Freedom from diseases, food safety and income security through sustainable livestock health and economics.

Mission

Utilizing power of epidemiological tools to promote livestock health.

Focus

To accomplish the vision and the mission of the Project Directorate on ADMAS, it gives highest priority to animal disease monitoring and surveillance by focussing on following key areas by:

- Promoting innovations and improving human resource capacity.
- Fostering linkages and collaborations with public and private, national and international organizations.
- Improving knowledge management system.
- Designing the studies to understand livestock disease economics.
- Understanding of the disease ecology in the back ground of climate change and globalization.
- Adapting Strategies to improve data quality.
- Risk assessment for possible disease occurrence with few disease determinants defined.
- Developing early warning system and disease modelling / forecasting.
- Integrating disease surveillance and monitoring and onsite diagnosis.

Harnessing Technological Advances

Developments in molecular biology, biotechnology, nanotechnology, information technology and geo-spatial technology are expected to provide significant new opportunities for animal disease monitoring and surveillance.

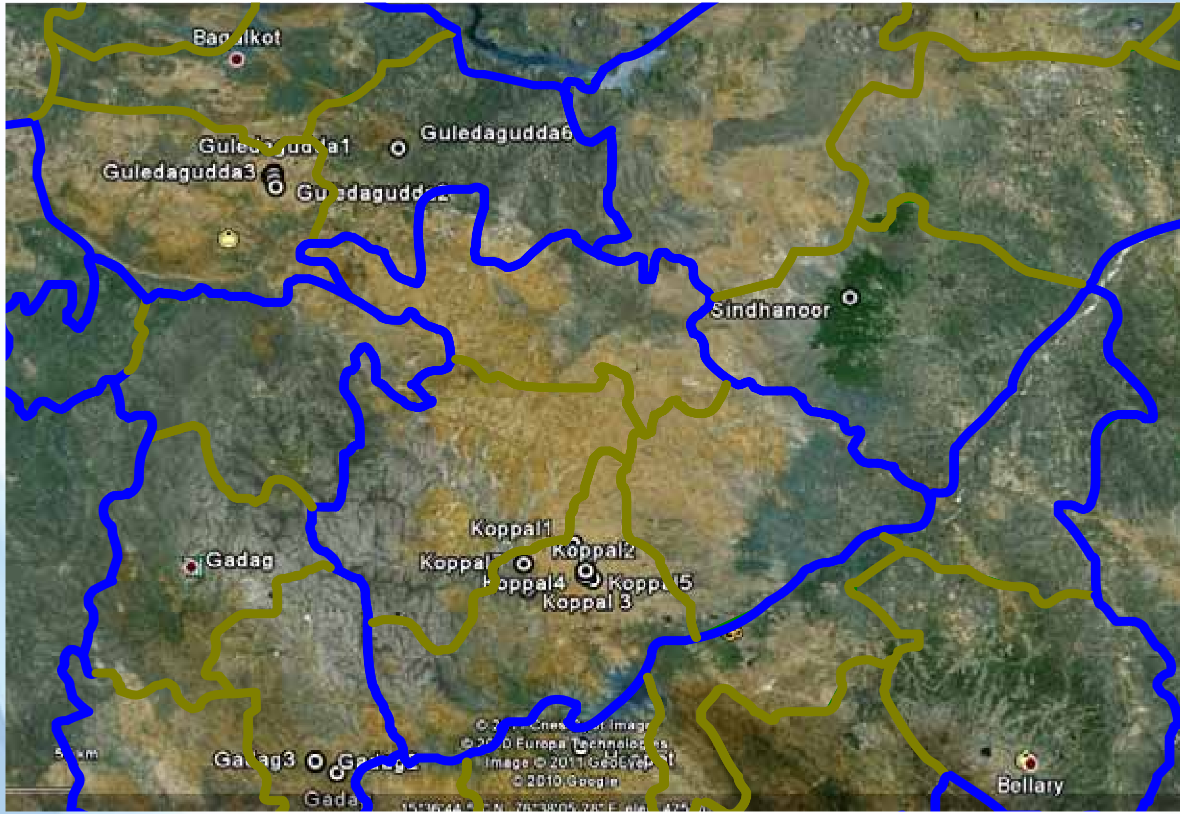
Harnessing power of information technology

Disease reporting concerns the communication of information about disease outbreaks to appropriate bodies in order to inform and activate appropriate responses at the national and international level. There has been a sea change in disease reporting techniques with information and communications technology developments – particularly mobile phones, email and the internet – becoming more effectively integrated in the process of disease monitoring. This has resulted in the establishment of National animal disease reporting system, a department of animal husbandry, dairying and fisheries, GOI, very recently. Developments in the plotting of disease data onto digital maps, enabling graphical illustration of disease outbreaks, the automation of disease reporting processes and data collation, online mapping allow real-time data on disease outbreaks and will assist in the determination and targeting of more effective responses to disease outbreaks.

Remote sensing and GIS in disease surveillance

Geographic information systems (GIS) and aerial and satellite imagery ("remotely sensed" imagery) are contributing new tools to the surveillance for many types of infectious diseases. With the arrival of GIS, and especially GIS for non-GIS specialists, at long last "where" becomes an equal partner with the other three parts of the epidemiologic investigational quartet: the others are "who," "what," and "when." GIS helps to answer the questions: Are there clusters of cases? Where are the clusters? Is the center of disease transmission moving in time and space?

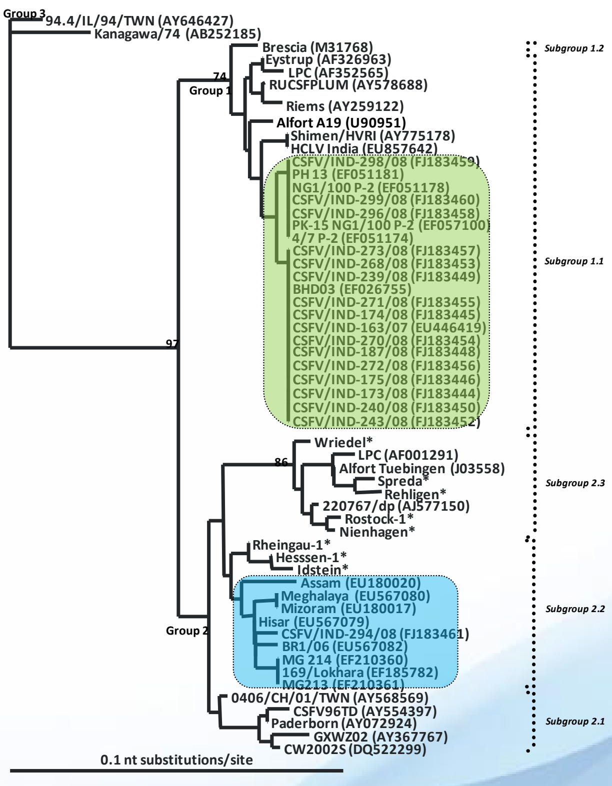
Along with advances in GIS technology and the increased availability of spatial data, has been the increasing application of remote sensing to infectious disease surveillance. Remote sensing potentially can offer an efficient way to assess disease risk over large geographic areas where human and economic resources and infrastructure do not exist to support traditional disease reporting surveillance systems. Remote sensing is particularly well-suited to monitor diseases that are strongly tied to environmental determinants.



Geographical locations from where the Bluetongue suspected samples were collected by ADMAS team 2009-10

Molecular Epidemiology

Molecular epidemiology is the application of nucleic acid-based detection and analytic methods to the study of diseases in populations. Molecular epidemiological methods are used in the surveillance of infectious diseases to identify etiology, physical sources, and routes of disease transmission. In addition, these methods can be used to define the molecular basis for characteristics relevant to disease control and prevention, including virulence, antibiotic resistance, and antigenicity. Molecular methods will influence surveillance systems at multiple levels. An important application of molecular epidemiology is the use of the natural genetic variability of microorganisms to tease out recent epidemiological events or trends. Interpretation of molecular subtype matches or mismatches in surveillance data sets can impact whether or not investigations are initiated, can drive health and regulatory action or inaction. Molecular epidemiology helps in detection of clusters through pathogen surveillance, when a common source is suspected between two or more spatially or temporally separated outbreaks (however detected), especially when the agent is the primary linking element.



Phylogenetic analysis of 5'UTR region of Indian CSFV isolates

Use of futuristic technologies in disease diagnosis, monitoring and surveillance

The key to success in handling animal disease epidemics is early detection. If a disease can be detected very early in the phase of epidemic development, the possibility exists that it can be arrested and eliminated before it actually inflicts damage. Early detection presupposes that there is a surveillance system in place that will bring infection to light when it is first seen. The country's veterinary authorities are then placed in the position of being able to manage the problem before it becomes uncontrollable, thus protecting the local livestock industry and ensuring food security for those closely dependent upon livestock. Futuristic technologies such as nanotechnology may enhance disease screening by improving sensitivity, selectivity, time to diagnosis, and the availability of testing equipment. Often, the differences between healthy and diseased or pre-disease states are very small, and the ability to detect single molecules or small changes in the behavior of a cell is required for diagnosis. Technology capable of measuring single binding events or interactions on the nanoscale would be a great asset.

Economics of livestock diseases

Animal health economics is a discipline, which does not belong to the core of veterinary science but is becoming more and more important as an aid to decision making on animal health interventions at various levels. The growing importance of animal health economics can be explained by the dramatic changes, which have occurred in the global socio-economic environment over the past two decades. Key changes affecting decisions on animal health measures have been the following:

- The importance of agriculture in the national economy declines as countries develop, resulting in stronger completion for funds by different sectors.
- More and more responsibilities are being transferred from the public to private sector, which is more concerned with visible returns on the investment.

As a result of these developments , it has become increasingly important to provide sound economic justification for any proposed action to improve or safeguard animal health to those expected to finance the proposed intervention.

Strategy and Frame Work

Following strategy would be adapted to accomplish the vision and mission of PD_ ADMAS.

Strengthening of AICRP by establishing coordinating units in each state

Project Directorate on ADMAS currently runs with 15 coordinating units. These units are mainly involved in epidemiological data collection of various diseases within the state they are located. However, in order to achieve a meaningful results it is envisaged have at least one coordinating unit in each state and union territories.

● Existing coordinating unit ● Newly proposed coordinating unit

Improving efficiency of human and financial resources and effective utilization of infrastructure

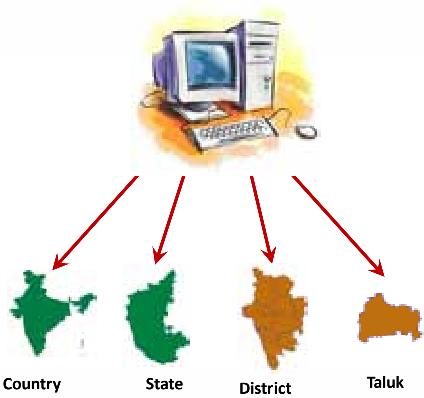
Proper and efficient utilization of human and financial resources is of utmost importance for successful culmination of any programmes. In this regard PD_ADMAS envisages to improve efficiency by

- Developing a futuristic human resource development programme in epidemiology.
- Formulating network based target-oriented research and technology development programmes.
- Prioritizing demand-driven and resource-based research.

Forging link with with National Animal Disease Reporting System

Disease Reporting is of utmost importance. Prompt reporting of any epidemic is essential not only for undertaking immediate control measures to prevent the further spread of the disease, but also for formulating long term disease control strategy in the country or region. Recording the incidence of diseases is essential for estimating the economic loss, conducting risk analysis and also for obtaining disease free status of the country.

In National Animal Disease Reporting System (NADRS) establishment of dedicated computer network with linking of each taluka of the district to the district head quarter, each district of the state to the state headquarter, and each state to the country's central unit has been envisaged. Here, the information available at the Taluka would be electronically transmitted to the district veterinary office as well as the state office. This will result in quick data transmission, data compilation as well as report generation. As the envisaged system reduces paper work involved it may be encouraging for all those involved in disease reporting. This real time disease system is may become fully functional by the end 2012. PD_ADMAS envisages to utilize this system for developing disease simulation and forecasting modules.



Strengthening of Web-based GIS Platform (NADRES) to Support Surveillance and Control of Livestock Diseases

GIS is a technology to deal with spatial and temporal data. It offers visualization and spatial analysis tools to monitor the spread of an epidemic disease. It is suitable for the development of a disease tracking and prevention system given its spatial data acquisition and processing abilities, as well as its powerful spatial analysis functions. The origin and subsequent spread of epidemic diseases have a close relation with time and geographic locations. If disease data are captured in space/location and time and they contain essential disease attributes, the spatial distribution and temporal characteristics of the disease spread may be monitored and visualized for probable intervention. With the availability of disease spread models, the contagious process may be dynamically simulated and visualized in two or three dimensional spatial scales. Consequently, high-risk population groups may be identified and visually located while the spatial distributional patterns and spreading behaviors of a disease may be uncovered. More effective prevention decisions may be made by the government and public health institutions through better allocation of medical resources by using the network analysis models of a GIS. The use of GIS technologies in epidemic disease modelling and prevention will not only promote mutual developments in epidemiology and geographic information science, but will also promote the formation and development of spatial epidemiology, which has significant theoretical and practical values given an increased global concern over communicable diseases GIS provides powerful tools for visualizing and linking data in public health surveillance.

Establishing linkages with national/international institutions

Because the infectious diseases respect no national boundaries and very transboundary nature of many livestock diseases is forging international linkage or alliances. It has become mandatory in the regime of free trade to have international monitoring of the diseases. A strong linkage need to be established among the different stake holders in the field of animal health viz., HSADL, disease diagnostic laboratories both central and state, Veterinary institutions and Colleges in the country and international organization like FAO, WHO and OIE outside the country. It is quite essential to have good links with immediate neighbouring countries and collective efforts are needed to control and eradicate the diseases.

One world, one health approach

The convergence of people, animals, and our environment has created a new dynamic in which the health of each group is inextricably interconnected. The challenges associated with this dynamic are demanding, profound, and unprecedented. While the demand for animal-based protein is expected to increase by 50% by 2020, the number of diseases transmitted from animals to human is also expected to raise. Of the 1,461 diseases now recognized in humans, approximately 60% are due to multi-host pathogens characterized by their movement across species lines. And, over the last three decades, approximately 75% of new emerging human infectious diseases have been zoonotic. Our increasing interdependence with animals and their products may well be the single most critical risk factor to our health and well-being with regard to infectious diseases. Thus pathogens circulating in animal populations can threaten both animal and human health, and thus both the animal and human heath sectors have a stake in, and responsibility for, their control. Pathogens – viruses, bacteria or parasites – have evolved and perfected their life cycles in an environment that is more and more favorable to them and ensures their continuity through time by replicating and moving from diseased host to a susceptible new host. Project Directorate on Animal disease monitoring envisages strengthening partnerships with animal and human health institutions within the country to manage existing and novel diseases that will be of public health, agricultural, social and economic importance in the future.

Epilogue

Project Directorate on ADMAS is a unique institution in the country that deals with livestock disease monitoring and surveillance. As a national institute, the mandate of PD_ADMAS is to provide information on nationwide livestock disease profile and status to the policy makers and to the state government agencies to undertake control measures/programmes. In addition to the above, disease epidemiology, economics and forecasting and forewarning are some of the important works assigned to PD_ADMAS. To this end the institute is committed to realizing in its mission of promoting livestock health in the country.

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Annexure

Yearwise expenditure (₹ in Lakhs)

Approved XI Plan, PD-ADMAS				Year wise Expenditure							
Heads	Earlier approved allocation	Revised allocation	Difference	2007-08	2008-09	2009-10	2010-11	2011-12 (Available)	Total 2007-08 to 2010-11)	AS Per BE 2011-12	Total Plan Exp
A. Recurring											
Pay & Allowances	10.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA	134.00	50.55	83.45	5.63	7.29	6.00	6.52	25.11	25.44	12.00	37.44
HRD	18.00	9.36	8.64	3.00	0.79	0.57	0.24	4.76	4.60	2.00	6.60
Contingency	800.00	643.43	156.57	208.18	175.32	138.95	0.00	120.98	522.45	116.98	639.43
Total (A)	***962.00***	***703.34***	***258.66***	***216.81***	***183.40***	***145.52***	***6.76***	***150.85***	***552.49***	***130.98***	***683.47***
B. Non Recurring											
Equipment	500.00	272.12	227.88	61.50	2.66	112.96	21.68	73.32	198.80	73.32	272.12
Works	1517.00	963.51	553.49	0.00	0.00	3.51	260.00	700.00	263.51	700.00	963.51
Library Books & Journals	30.00	0.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Livestock	5.00	0.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Vehicles	8.00	0.00	8.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Other/Furniture/Fixtures	87.00	1.13	85.87	0.00	1.13	0.00	0.00	0.00	1.13		1.13
Tribal (TSP)	0.00	140.00	-140.00	0.00	0.00	0.00	0.00	140.00	0.00	140.00	140.00
Total (B)	***2147.00***	***1376.76***	***770.24***	***61.50***	***3.79***	***116.47***	***281.68***	***913.32***	***463.44***	***913.32***	***1376.76***
Grand Total (A+B)	**3109.00**	**2080.10**	**1028.90**	**278.31**	**187.19**	**261.99**	**288.44**	**1064.17**	**1015.93**	**1044.30**	**2060.23**
AICRP Details	Allocation										
TA	91.00	55.00	36.00	17.00	10.49	7.14	4.32	16.05	38.95	15.00	53.95
Contingencies	324.50	322.00	2.50	137.00	70.61	37.37	26.10	50.92	271.08	40.70	311.78
Equipments	10.00	10.00	0.00			10.00		0.00	10.00	0.00	10.00
Furniture & Fixtures	24.00	3.50	20.50			3.50		0.00	3.50	0.00	3.50
Total	***449.50***	***390.50***	***59.00***	***154.00***	***81.10***	***58.01***	***30.42***	***66.97***	***323.53***	***55.70***	***379.23***
Grand Total	**3558.50**	**2470.60**	**1087.90**	**432.31**	**268.29**	**320.00**	**318.86**	**1131.14**	**1339.46**	**1100.00**	**2439.46**

Financial proposal for xii plan (2012-13 to 2016-17)

(₹ in Lakhs)

Sl. No.	Heads	PD ADMAS	AICRP	Total
A	**Recurring Contingencies**			
1	Establishment Charges	875.00		875.00
2	Travelling Allowance	125.00	310.00	435.00
3	HRD	30.00		30.00
4	Other Charges (Contingencies)	1745.00	1565.00	3310.00
	Sub Total A	***2775.00***	***1875.00***	***4650.00***
B	**Non Recurring Contingencies**			
5	Equipments	500.00	700.00	1200.00
6	Furniture & Fixtures	500.00		500.00
7	Works	3060.00		3060.00
8	Vehicles	38.00		38.00
9	Library Books & Journals	82.00		82.00
10	Live stock	5.00		5.00
11	Information Technology	50.00		50.00
	Sub Total B	***4235.00***	***700.00***	***4935.00***
	Grand Total (A+B)	**7010.00**	**2575.00**	**9585.00**

₹ 310.00 lakh TA under AICRP @ ₹ 2 Lakhs for 31 centres for five years

₹ 1550.00 lakh Other Charges (Contingencies) under AICRP @ ₹ 10 Lakhs for 31 centres for five years