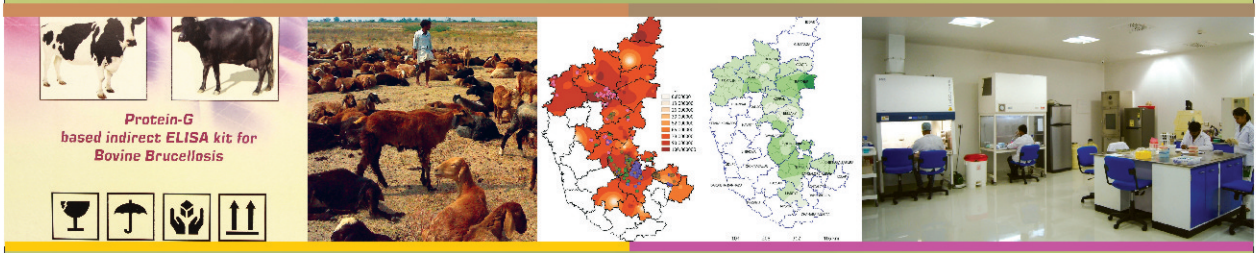
Vision 2050



National Institute of Veterinary Epidemiology and Disease Informatics
Indian Council of Agricultural Research

Vision 2050

National Institute of Veterinary Epidemiology and Disease Informatics
(Indian Council of Agricultural Research)
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Bengaluru

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संदेश

भारतीय सभ्यता कृषि विकास की एक आधार रही है और आज भी हमारे देश में एक सुदृढ़ कृषि व्यवस्था मौजूद है जिसका राष्ट्रीय सकल घरेलू उत्पाद और रोजगार में प्रमुख योगदान है। ग्रामीण युवाओं का बड़े पैमाने पर, विशेष रूप से शहरी क्षेत्रों में प्रवास होने के बावजूद, देश की लगभग दो-तिहाई आबादी के लिए आजीविका के साधन के रूप में, प्रत्यक्ष या अप्रत्यक्ष, कृषि की भूमिका में कई बदलाव होने की उम्मीद नहीं की जाती है। अत: खाद्य, पोषण, पर्यावरण आजीविका सुरक्षा के लिए तथा समावेशी विकास हासिल करने के लिए कृषि क्षेत्र में स्थायी विकास बहुत जरूरी है।

पिछले 50 वर्षों के दौरान हमारे कृषि अनुसंधान द्वारा सृजित की गई प्रौद्योगिकियों से भारतीय कृषि में बदलाव आया है। तथापि, भौतिक रूप से (मृदा, जल, जलवायु), बायोलोजिकल रूप से (जैव विविधता, हॉस्ट-परजीवि संबंध), अनुसंधान एवं शिक्षा में बदलाव के चलते तथा सूचना, ज्ञान और नीति एवं निवेश (जो कृषि उत्पादन को प्रभावित करने वाले कारक हैं) आज भी एक चुनौती बने हुए हैं। उत्पादन के परिवेश में बदलाव हमेशा ही होते आए हैं, परन्तु जिस गति से यह हो रहे हैं, वह एक चिंता का विषय है जो उपयुक्त प्रौद्योगिकी विकल्पों के आधार पर कृषि प्रणाली को और अधिक मजबूत करने की मांग करते हैं।

पिछली प्रवृत्तियों से सबक लेते हुए हम निश्चित रूप से भावी बेहतर कृषि परिदृश्य की कल्पना कर सकते हैं, जिसके लिए हमें विभिन्न तकनीकों और आकलनों के मॉडलों का उपयोग करना होगा तथा भविष्य के लिए एक ब्लूप्रिंट तैयार करना होगा। इसमें कोई संदेह नहीं है कि विज्ञान, प्रौद्योगिकी, सूचना, ज्ञान-जानकारी, सक्षम मानव संसाधन और निवेशों का बढ़ता प्रयोग भावी वृद्धि और विकास के प्रमुख निर्धारक होंगे।

इस संदर्भ में, भारतीय कृषि अनुसंधान परिषद के संस्थानों के लिए विजन-2050 की रूपरेखा तैयार की गई है। यह आशा की जाती है कि वर्तमान और उभरते परिदृश्य का बेहतर रूप से किया गया मूल्यांकन, मौजूदा नए अवसर और कृषि क्षेत्र की स्थायी वृद्धि और विकास के लिए आगामी दशकों हेतु प्रासंगिक अनुसंधान संबंधी मुद्दे तथा कार्यनीतिक फ्रेमवर्क काफी उपयोगी साबित होंगे।

(राधा मोहन सिंह)

Foreword

Indian Council of Agricultural Research, since inception in the year 1929, is spearheading national programmes on agricultural research, higher education and frontline extension through a network of Research Institutes, Agricultural Universities, All India Coordinated Research Projects and Krishi Vigyan Kendras to develop and demonstrate new technologies, as also to develop competent human resource for strengthening agriculture in all its dimensions, in the country. The science and technology-led development in agriculture has resulted in manifold enhancement in productivity and production of different crops and commodities to match the pace of growth in food demand.

Agricultural production environment, being a dynamic entity, has kept evolving continuously. The present phase of changes being encountered by the agricultural sector, such as reducing availability of quality water, nutrient deficiency in soils, climate change, farm energy availability, loss of biodiversity, emergence of new pest and diseases, fragmentation of farms, rural-urban migration, coupled with new IPRs and trade regulations, are some of the new challenges.

These changes impacting agriculture call for a paradigm shift in our research approach. We have to harness the potential of modern science, encourage innovations in technology generation, and provide for an enabling policy and investment support. Some of the critical areas as genomics, molecular breeding, diagnostics and vaccines, nanotechnology, secondary agriculture, farm mechanization, energy, and technology dissemination need to be given priority. Multi-disciplinary and multi-institutional research will be of paramount importance, given the fact that technology generation is increasingly getting knowledge and capital intensive. Our institutions of agricultural research and education must attain highest levels of excellence in development of technologies and competent human resource to effectively deal with the changing scenario.

Vision-2050 document of ICAR-National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI), Bengaluru has been prepared, based on a comprehensive assessment of past and present trends in factors that impact agriculture, to visualise scenario 35 years hence, towards science-led sustainable development of agriculture.

We are hopeful that in the years ahead, Vision-2050 would prove to be valuable in guiding our efforts in agricultural R&D and also for the young scientists who would shoulder the responsibility to generate farm technologies in future for food, nutrition, livelihood and environmental security of the billion plus population of the country, for all times to come.

(S. AYYAPPAN)
Secretary, Department of Agricultural Research & Education (DARE)
and Director-General, Indian Council of Agricultural Research (ICAR)
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Preface

The National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI) is a dedicated institute for veterinary epidemiology and disease informatics. The institute has played vital role in eradication and contain various livestock diseases 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 the challenges and opportunities faced by the livestock health in India. Animal health for public health has been the basis for the preparation of the document. The present "Vision 2050" document of NIVEDI expresses the strategies to overcome the future challenges in the field of animal health. The vision addresses the critical issues in the area of veterinary epidemiology highlighting the use of specialised tools like GIS, satellite imaging mathematical models and advanced computing software.

The comprehensive epidemiological data for a disease is possible with multi-sectoral approach. Hence, more emphasis on field epidemiology and spatial epidemiology, disease ecology and host-pathogen interaction shall be given.

I wish to express my hearty thanks to Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR, Dr. K. M. L. Pathak, Deputy Director General (Animal Sciences), ICAR, Dr. Gaya Prasad, ADG (AH), Dr. M. P. Yadav (Chairman, RAC) and Jyoti Misri, Principal Scientist, ICAR for their valuable guidance and suggestions. My appreciation and thanks to all the peers in QRT, RAC, IMC, previous and present staff of the institute for their valuable inputs. I also appreciate the efforts of Drs. Divakar Hemadri and B. Ganesh Kumar whose meticulous work helped in the development of the document "Vision 2050".

I am sure that NIVEDI Vision 2050 would provide a direction to work in depth on epidemiology of economically important livestock diseases, leading to control and eradication of the diseases for safe vis-a-vis animal health and public health in India.

(H. Rahman)
Director

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Context

Indian agrarian economy includes fast growing livestock sector. Livestock sector is achieving self-sufficiency in production of animal products by keeping pace with the growing population. It is projected that by 2020 meat, egg and milk production shall increase by 50%, 35% and 25%, respectively as per the public requirement.

Livestock sector also plays a critical role in the welfare of India's rural population. It contributes nine percent to gross domestic product (GDP) and employs eight percent of the labour force. As a component of agricultural sector, the contribution of livestock sector in gross domestic product has risen 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 as it is an important component in poverty alleviation programmes, continuous emphasis is laid for enhancing the quality of the primary and secondary products in international market, which in turn demands safe animal health for better products.

Livestock development programmes cannot succeed unless a well organized animal health service is built up and protection of livestock against diseases and pests particularly against the deadly infections is assured. Any programme of animal health care needs certain information before the programme is started for its ex-ante analysis, when the programme is already in operation for mid-term appraisal and when the programme is completed for ex-post analysis. This information on animal health care helps in taking decisions regarding the programme execution and evaluation.

India has achieved eradication of rinderpest (RP), CBPP, AHS and Dourine. However, there are several other infectious and non-infectious diseases prevailing in the country causing huge economic loss annually. Prevention, control and eradication of the animal diseases need a thorough understanding of the epidemiology as well their economic impact.

National Institute of Veterinary Epidemiology and Disease Informatics (NIVEDI) has the mandate to carry out 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 limitations. Similar efforts are needed to control and eradicate the diseases like FMD, PPR, Brucellosis, CSF, BT, HS etc, which cause huge economic loss annually to the livestock industry.

From a public perspective, policy makers seek an accurate assessment of losses due to animal diseases for planning and executing disease prevention and mitigation alternatives. Immediate impact of a disease outbreak includes reduction in the productive capacity of the animal and a subsequent reduction in the supply of livestock products. At the same time, disease outbreaks may reduce the demand for these products even from healthy animals in the infected area.

Challenges

The NIVEDI has made substantial technical achievements in developing an effective network and capacity building for epidemiological surveillance of nationally important animal diseases, standardizing and successfully applying diagnostic tests in population surveys, and for human resource development. Satisfactory efforts made by the NIVEDI have been recognized by various organizations. Presently, there is no veterinary institution in India that specializes in developing location specific livestock and poultry disease control and prevention strategies. Hence strong need was felt for elevation of NIVEDI to a National Institute status with a component of independent AICRP attached to it, to formulate strategies for disease control through application of epidemiological tools involving risk analysis, impact of economic losses and modern principles of management as well as development of disease forecasting model for important diseases.

The consequences of animal diseases in livestock and poultry include:

- Productivity losses for the livestock (e.g. production losses, cost of treatment, market disturbances)
- Loss of income from activities using animal resources (in such sectors as agriculture, transportation and tourism)
- Adverse effect on well-being of human (morbidity and even mortality rates, food availability, food safety and quality)
- Prevention or control costs (production costs, public expenditure)
- Suboptimal use of production potential (animal species, genetics, livestock practices)

Following challenges from disease perspective need to be taken care of:

Improvement in disease reporting

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 assessing the status of the disease in the region. Non-reporting, under reporting, delayed reporting are hindrances for any surveillance system and happen in most advanced countries. As expected, these area need highest priorities in countries like India.

Improvement in Data Quality

The passive collection of data involves the reporting of clinical or suspect cases to the animal health authorities by field veterinarians at their discretion. Therefore, success of this system solely depends on willingness and sincerity with which the field veterinarians work on a particular disease. The main limitation of passive data collection is inconsistency in the data collection for different diseases and among different administrative regions. Since quality animal healthcare depends on the availability of quality data at specified time, poor documentation, inaccurate data, and insufficient information can inhibit animal health information exchange and hinder epidemiological surveillance, disease prioritization and disease control initiatives. Under the given circumstances, every effort shall be made for conducting economic impact studies for taking policy decisions.

Laboratory diagnostic support to confirm diseases is pre-requisite for quality data collection. The recent initiative by the Department of Animal Husbandry, Dairying and Fisheries (DADF), Government of India to encourage disease reporting based on laboratory confirmation is laudable. The online system developed and put into use in data collection, recording, analyses for disease reporting will ensure uniformity and information dissemination among stake holders in real time.

Dissemination of Disease Information

Dissemination of disease information is important component of any surveillance system. Advances in mobile/internet technologies have the power to disseminate the disease data in quick time. DADF has provided some hopes by launching National Animal Disease Reporting System (NADRS), in which, establishment of dedicated computer network with linking of each taluk 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 undertaken. Through NADRS, the information available at the taluk would be electronically transmitted to the district veterinary office as well as the state office. Hope this will result in quick data transmission, data compilation, processing, and report generation in the future.

Veterinary Epidemiology and Disease Informatics

Developing quality man power in epidemiology research is a challenge which the country and NIVEDI in particular is currently facing. Though the scientists of NIVEDI are putting extra efforts to learn epidemiological tools and techniques, this is not sufficient to take

up sophisticated modelling, spatial and temporal analysis. In view of this, there is an urgent need to strengthen the human resource by undertaking appropriate capacity building programmes on disease epidemiology and livestock economics and statistics. Student enrolment in NIVEDI for master's and doctoral programme in epidemiology provides opportunities for both the teachers and students gain knowledge in this area.

Infrastructure Facility for Research on Epidemiology

NIVEDI has developed an innovative India.admas Epitrak epidemiology software, which is 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 field veterinarians, and administrators, students and veterinary colleges. The outbreak data received from various states of the country are entered into the NADRES server, which is used for complex epidemiological analyses. The results of the analyses 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 places of outbreak for attention of policy makers. However, the success of future livestock health depends on real time disease monitoring/surveillance in both space and time, which require world class infrastructural facilities in terms of geo spatial infrastructure, computation, robust data etc for epidemiology research. ❑

Operating Environment

a. Disease Reporting

As recording of the disease incidence is essential, NIVEDI adopts the mechanisms for disease reporting.

i) Disease reporting by AICRP centers of NIVEDI

The AICRP centers of NIVEDI have been involved in investigation and reporting of endemic/emerging diseases of livestock and poultry. Serological surveys conducted by these centers have provided some active information on diseases like brucellosis and infectious bovine rhinotracheitis (IBR), however, information on status of other diseases have been largely elusive. The disease information gathered by AICRP centers from state animal husbandry departments has been useful in identifying endemic areas for each of the 15 priority diseases investigated.

ii) Disease reporting by State Animal Husbandry Departments

Animal diseases are primarily recorded by the veterinary officers working in government veterinary dispensaries/hospitals on the basis of clinical diagnosis. This information is passed to the district and state veterinary authorities. Disease information is also generated from the disease diagnostic laboratories at district, state or regional level. Finally, Department of Animal Husbandry and Veterinary Services collates this information and passes on to NIVEDI on monthly basis. Many diseases, however, remain either unreported or under reported due to delay in processing of data at various levels.

b. Disease Database

Two main sources of data on animal disease aspects are: (i) the places where the animals are reared and (ii) the places where the records relating to animal diseases are compiled. The two sources are actually called as prospective and retrospective sources, respectively. The prospective sources include herd/flock/farm household, slaughter houses and disposal centres/markets. The retrospective source includes veterinary clinic, diagnostic laboratories, artificial insemination centres, government departments and insurance organizations. As most of the livestock are

confined to rural area, the data from the households maintaining the livestock should be more reflective.

NIVEDI till now governed a network of 15 AICRP centres which essentially undertake the collection of information on animal disease outbreaks and send the biological samples (mostly serum) from the randomly chosen livestock population from respective states for sero-surveillance of animal diseases. Monthly livestock disease related information such as number of outbreaks, number of animals affected, and number of animals died from the main disease are entered in the database. By using this passive information, disease maps are created and livestock disease trends are studied (Fig. 1). The same network of AICRP on animal disease monitoring and surveillance along with the proposed 16 more additional centres in the XII Five Year plan envisages collecting the farm level data on livestock production and economics in sample diseased farms or sero-positive farms on a regular basis so as to develop a credible database.

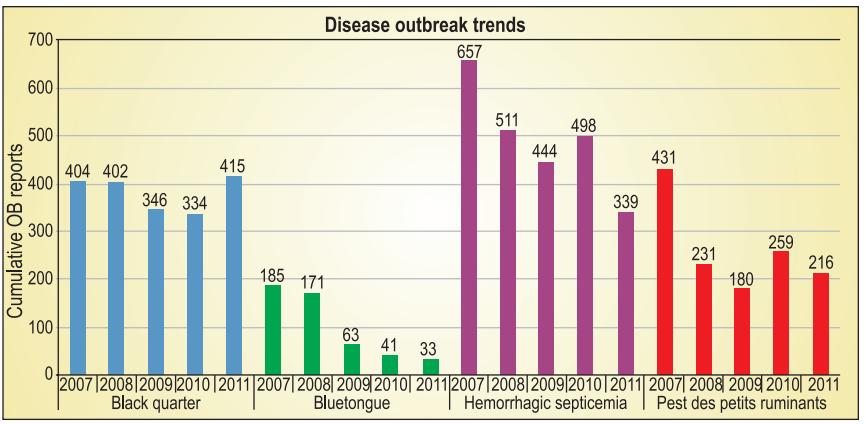

Fig. 1 Disease trends for some livestock diseases

c. Disease Forecasting

The institute has database on major livestock diseases of the country along with their associated risk factors. Using these databases, the software forecasts the probability of occurrence of disease outbreaks at the district level in advance. The results of the forecast can be seen as increasing or decreasing trend as depicted in the figures. The challenge before the scientists is to improve the resolution (district level to block level) and provide the information on real time basis by using advanced tools. Further, the forecasting model is to be improved by incorporating

parameters such as transmission probability, duration of infectiousness etc.

d. Prioritization of Diseases based on Economics

NIVEDI has identified priority diseases based on previous 10 year incidence patterns. Since this ranking is not based on economic losses, there is always doubt in the minds of policy makers whether to include these diseases in national control programmes, particularly if the disease is showing declining trend.

The economic losses due to diseases in livestock are broadly put into two main classes, viz. mortality and morbidity losses. The analysis of disease losses from different angles helps the farmers as well as policy makers and planners. The estimation of losses species-wise informs which species are more susceptible, age or herd size-wise estimate of losses suggest them at what age the animal is more susceptible. An analysis of losses due to many diseases at a time indicates which diseases are more deadly or damaging so that they can be managed accordingly. The disease loss information also help policy makers and planners to decide which disease ranks first in terms of losses so that they can get due importance in policy planning. It is also useful for persons dealing with livestock insurance in terms of deciding premiums for different species, age groups and size of animals.

The models used in evaluation of economic impact of livestock disease on production can be grouped under two headings namely statistical/epidemiological models and economic models. Statistical models are used to identify the factors that contribute to the development of disease conditions, the magnitude and direction of the contribution, and relationships between diseases. Common models in this category include regression analysis, path analysis, discriminant analysis and analysis of variance. The main step is to attach monetary value to the quantified impact.

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Opportunities & Strengths

The institute shall generate information on the epidemiology of all major animal diseases in the country by developing linkages. Suitable opportunities would be brought in place to forge partnerships and collaborations with both national and international organizations develop into a world class institution in veterinary epidemiology and disease informatics.

The institute has scientists of all major disciplines including animal health and social science, hence, there exists an opportunity to undertake inter-disciplinary research in the field of animal disease epidemiology and economics.

The institute is continuously getting adequate support in conducting its activities from ICAR. It would be possible to undertake bigger and ambitious programmes in future for addressing the needs of animal health sector in the country.

The major opportunities for NIVEDI in future include the following:

- Fostering linkages and collaboration with public and private, national and international organizations.
- Improving knowledge management system.
- Disease ecology in the backdrop of climate change and globalization.
- Adapting Strategies to improve data quality.
- Risk assessment for possible occurrence of disease
- Developing early warning system and disease modeling/forecasting.
- Integrating disease surveillance and monitoring and on-site diagnosis.
- Diagnosis and control of Zoonosis and emerging diseases.
- One health approach
- Consortium based research approach

Goals and Targets

The following activities would be taken up as goals/targets in the next three to four decades.

- Development of quality database on livestock diseases in India
- Use of big data opportunities in livestock disease surveillance
- Prioritization of diseases based on their economic impact
- Identification of risk factors for prioritized diseases
- Risk analysis and risk assessment studies
- Development of risk prediction models, disease spread models
- Development of spatially continuous risk maps which can be updated in real time
- Development of early warning system
- Farm level direct losses due to infectious diseases
- Investment analysis on modernization of livestock health measures in India
- Studies on impact of animal diseases on trade and livelihood of farmers
- Institutional innovations for safe international trade
- Public health and economic impact of zoonotic diseases
- Preparedness and inter-sectoral collaboration to reduce the risk of zoonotic diseases
- Studies on food safety vis-a-vis animal disease outbreaks
- KAP (Knowledge-Attitude-Practice) impact study for better targeting of intervention/control programme
- Economic impact of food-borne pathogens in the developing world, TADs and various central programmes.
- Traceability of animals and animal products
- Evaluating the impact of biotechnological intervention in animal health research
- Producer/Consumer awareness on the emerging animal diseases
- Impact of climate change on animal disease occurrence through modelling
- Impact of animal disease outbreaks on women and their empowerment

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Way Forward

Following strategy would be adopted to accomplish the vision and mission of NIVEDI.

Strengthening of AICRP by Establishing Coordinating Units in Each State

NIVEDI is currently having 15 coordinating units (Fig. 2) in various parts of the country. These units are mainly involved in epidemiological data collection of various diseases within the state they are located. However, in order to achieve meaningful results it is envisaged to have at least one centre in each State and Union Territory.

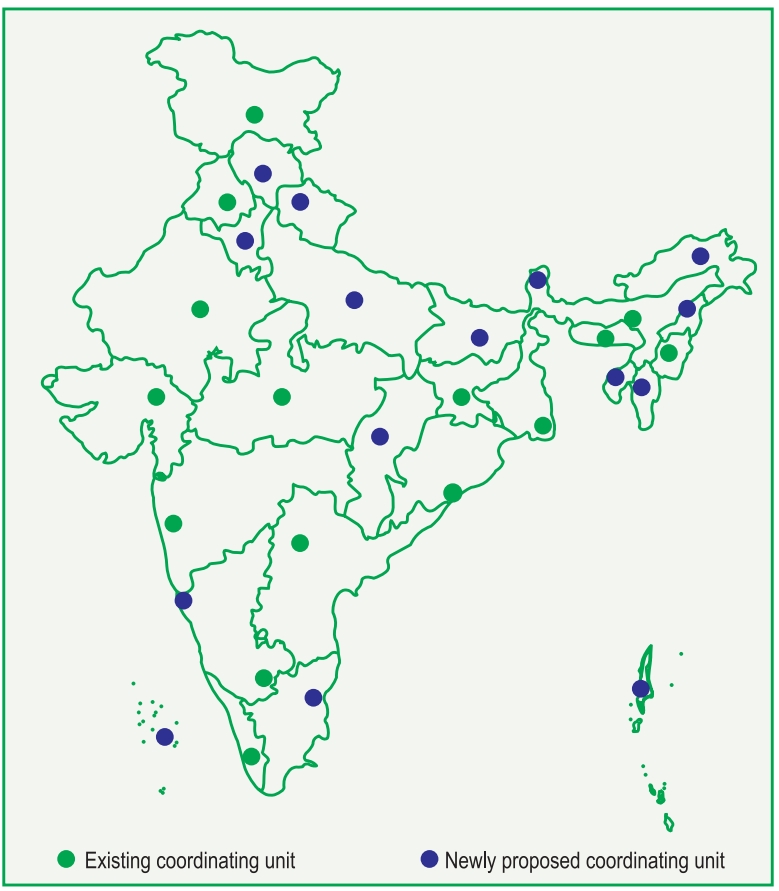
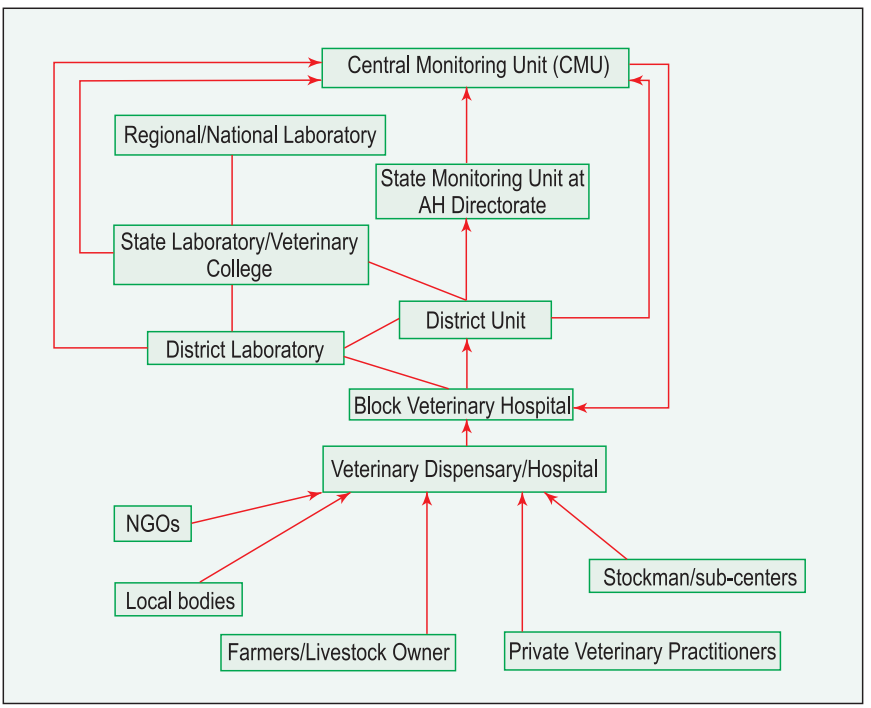


Fig. 2 Location of AICRP Centres

Linkages with National Animal Disease Reporting System (NADRS)

In National Animal Disease Reporting System (NADRS) establishment of dedicated computer network with linking of each taluk 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 enabled. The information available at the Taluk would be electronically transmitted to the district veterinary office as well as to the state office (Fig 3). This will result in quick transmission, data compilation as well as report generation. Data or information on disease incidence/outbreak, number of animals attacked and died, losses incurred due to death and treatment costs would be communicated by all the state departments of veterinary and animal husbandry services/AICRP centres on a real-time basis. It is envisioned that by having such a disease communication system in the country, the emergency preparedness and the response capacity of our animal health care system would attain the level of excellence at par with those achieved and in place in developed countries. NIVEDI envisages utilizing this system for developing disease simulation and forecasting modules.



(*Source:* DADF, GOI)

Fig. 3 Schematic diagram of NADRS networking

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

GIS offers visualization and spatial analyses 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 can be monitored and visualized for probable interventions. With the availability of disease spread models, the contagious process may be

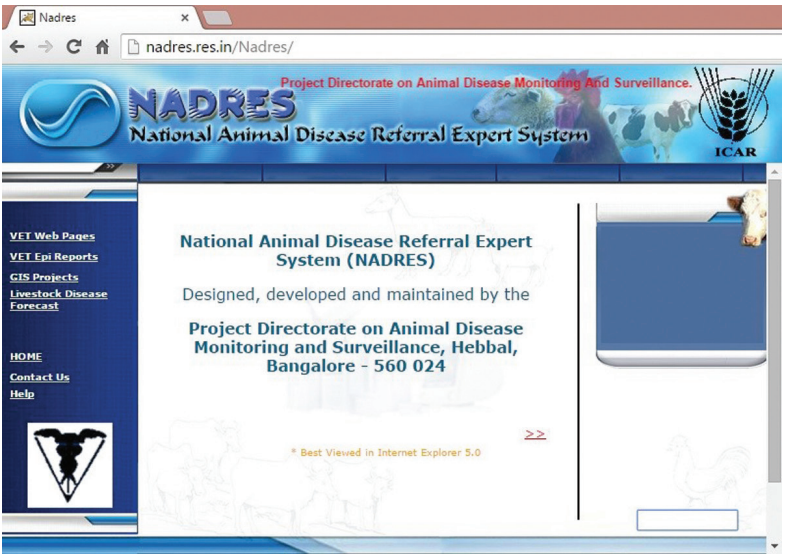


Fig. 4 Screen-shot of NADRES website

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 behaviour of a disease may be uncovered. The use of GIS technologies along with remote sensed data from satellites in epidemic disease modelling and prevention will not only promote mutual developments in epidemiology and geographic information science, but has significant theoretical and practical values especially as global concern over communicable diseases.

Molecular Epidemiology/Phylogeography

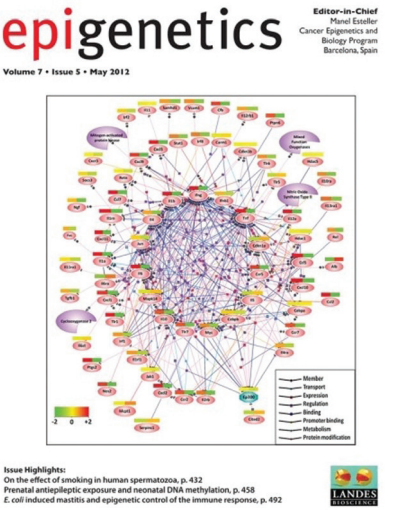


Fig. 5 Network analysis of mastitic pathogen infection

Molecular epidemiological methods shall be used for the surveillance of infectious diseases to identify etiology, physical sources, and routes of disease transmission. Through molecular epidemiology, use of the natural genetic variability of microorganisms would be teased out for molecular subtype matches or mismatches in surveillance data sets for regulatory action. Advanced molecular epidemiological tools shall help in detection of clusters through pathogen surveillance, when a common source is suspected between two or more spatially or temporally separated outbreaks, especially when the agent is the primary linking element. Linking of molecular epidemiologic technique with population genetics and spatial epidemiological techniques help in inferring most likely places of origin, migration patterns and locally-varying rates of evolution.

Harnessing the Power of Information Technology and Big Data

Major 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 shall be strengthened. Novel online data sources, such as social media, combined with epidemiologically relevant environmental information are valuable new data sources that can assist the "real-time" updating of spatial maps. Advances in machine learning and the use of crowd sourcing opens up the possibility of developing a continually updated atlas of infectious diseases.

Development of An Early Warning System

Early warning of outbreaks and the capacity for prediction of spread to new areas is an essential pre-requisite for the effective containment and control of epidemic animal diseases. Early warning is based on the concept that dealing with a disease epidemic in its early stages is easier and more economical than having to deal with it once it is widespread. An early warning system with search capability to scan through reports/

information available (in all Indian languages) in the internet including electronic media and provision for collating official and non official outbreak information (such as email, sms) shall be used in alerting the disease outbreaks after verification. This system shall be backed up by GIS and statistics based prediction models for depiction, determining the pattern of spread, effective containment and control of epidemic animal diseases.

Futuristic Technologies in Disease Diagnosis, Monitoring and Surveillance

Early detection of disease 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. Futuristic technologies such as nanotechnology, nano biosensors, may enhance disease screening by improving sensitivity, selectivity, time taken for 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 behaviour of a cell is required for precise and timely diagnosis. Access to Technology capable of measuring single binding events or interactions on between the pathogen and the host on nano scale would be a great asset in this regard.

Credible Information on Economics of Livestock Diseases

Research in this field primarily deals with three interrelated aspects, viz.

(i) Quantifying the economic impact of animal disease;
(ii) Developing methods for optimizing decisions when individual animals, herds or populations are affected; and
(iii) Determining the economic merit of specific disease control and health management programmes.

An accurate assessment of losses due to animal disease is useful for policy makers, who may weigh these potential losses against the costs of disease prevention and mitigation. Hence, the models that provide the most comprehensive assessment of potential losses are most useful to decision makers.

For an appropriate model for wide variety of animal disease impacts, a system of economic relationships is needed that accounts for the interdependencies and degree of response (elasticity) among various production, marketing and consumer sectors of the economy for animal health impact.

The distribution of losses, policy costs and programme benefits becomes particularly important for policy makers to explore and implement best suited strategies for the control of animal diseases.

Attainment of Disease Free Status with Respect to Major Endemic Diseases by 2050

Since last 10-15 years, there has been an increased awareness and realization at all levels of animal health care management system, starting from field veterinarians to the policy makers that having a disease free animal population is a must for ensuring high productivity and profitability of domestic livestock production system. Attaining disease free status is also important for having hassle free trade of livestock and livestock products with the prospective importing countries. NIVEDI would strive to help the country in attaining the disease free status from major endemic diseases of livestock and poultry by 2050. It would be very much a reality because in the years to come, the NIVEDI shall develop a robust animal health research facility and referral system by continuously and sincerely implementing and pursuing the goals and targets set to achieve the mandates of the institute in the coming three and half decades.

Improving Efficiency of Human and Financial Resources and Effective Utilization of Infrastructure

NIVEDI envisages further improved efficiency by

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

Establishing Linkages with National/international Institutions

Strong linkages shall be established with different stake holders in the field of animal health viz., NIHSAD, disease diagnostic laboratories of states, veterinary universities, institutions and colleges. Linkages shall also be established with NIC, ISRO, NBSS_LUP, CMMACS, IMD etc in the country, and international organization like SAARC secretariat, FAO, WHO, CDC, PIADC, USDA, Pirbright Institute, and OIE outside the country. It is also essential to have good links with immediate neighbouring countries as collective efforts are needed to control and eradicate infectious diseases.

"One World One Health," Approach

The convergence of people, animals, and environment has created a new dynamics, in which, the health of each group is inextricably interconnected. The challenges associated with this approach are demanding, profound, and unprecedented. The demand for animal-based protein is expected to increase by 50% by 2020. On top of that, of the 1,461 diseases now recognized in humans, approximately 60% are due to multi-host pathogens, characterized by their movement across species lines. Over the last three decades, approximately 75% of new emerging human infectious diseases are of zoonotic in nature. 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. Project Directorate on Animal disease monitoring envisages strengthening partnerships with animal and human health institutions within the country to manage existing and novel diseases of public health, plant associated and of economic importance in the future.

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ANNEXURE

Plan-wise proposed targets and expected outcome

Targets	Time frame	Outcome
Strengthening of AICRP	2012-17	Better disease information generation, and liaison with state animal health authorities, effective sero-surveillance etc.
Proper linkages with National Animal Disease Reporting System	2012-17	Real time disease information
Strengthening of Web-based GIS Platform to Support Surveillance and Control of Livestock Diseases	2012-2022	Improved outbreak simulation and disease prediction. Disease mapping and availability of information for control and mitigation of disease outbreaks
Development of an early warning system	2012-2022	Availability of text mining software for gathering information in electronic media, internet etc.
Molecular Epidemiology	2012-2050	Improved knowledge on infectious agents involved in disease outbreaks and movement of pathogens.
Harnessing the power of information technology	2012-2050	Effectively utilize the information technology tools for better tracking of diseases for their control.
Use of futuristic technologies in disease diagnosis, monitoring and surveillance	2012-2050	Early detection of existing as well as any new emerging pathogen for timely control measures thus indirectly reducing the disease spread
Generating credible information on Economics of livestock diseases	2012-2022	Understanding the disease impact, setting up priorities for diseases control, impact assessment of disease control programme.
Helping relevant agencies to attain disease free status	2012-2050	Better trade opportunities for livestock products and by-products thereby better foreign exchange influx.
Improving efficiency of human and financial resources	2012-2050	Increased output
Establishing linkages with National/ international institutions	2012-2050	Improved data dissemination and knowledge exchange,
One World One Health, approach	2012-2022	Improved information on zoonotic diseases, human and animal interface. Measures to control zoonotic and Trans-boundary diseases.