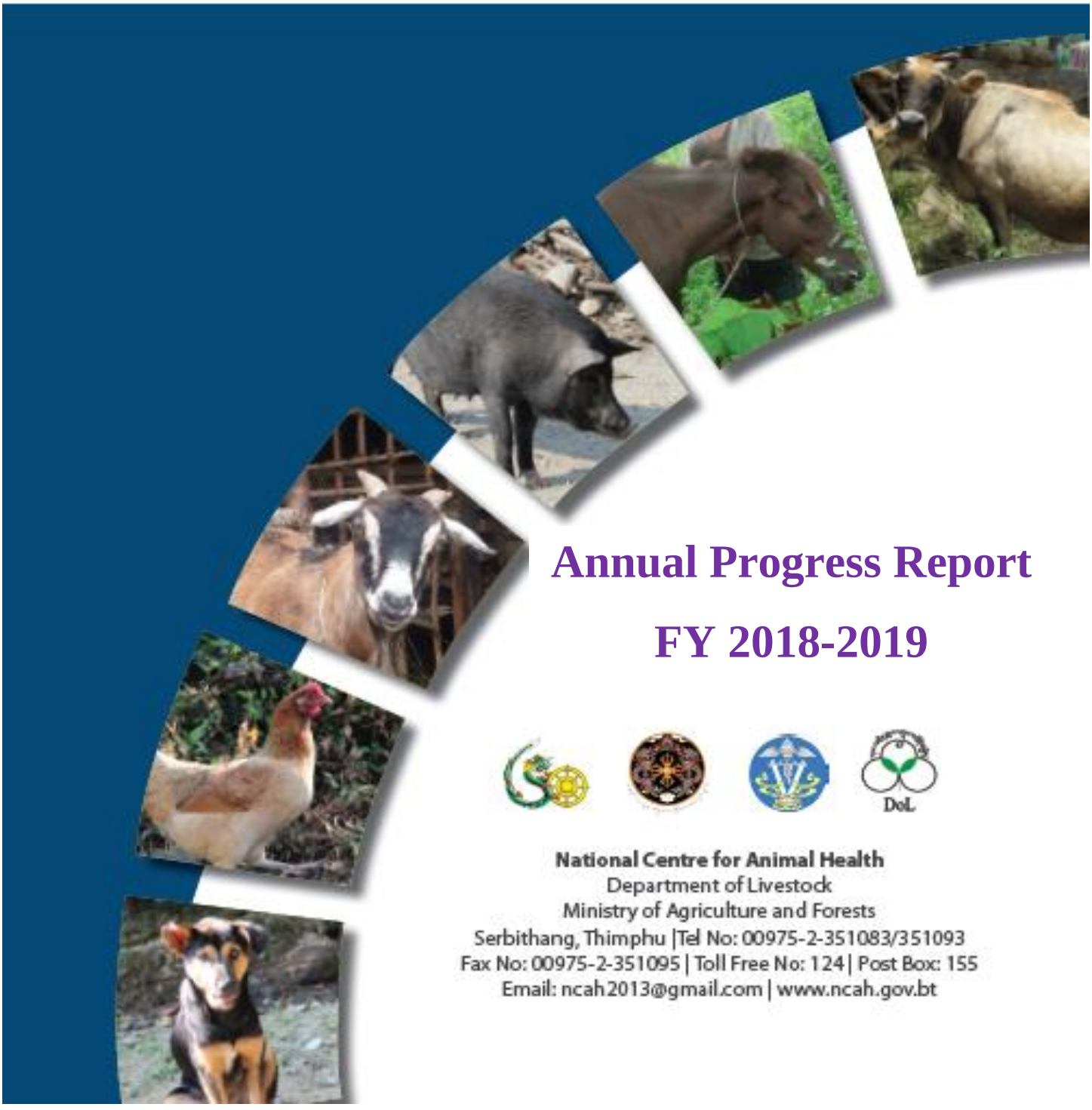
NATIONAL CENTRE for ANIMAL HEALTH



Annual Progress Report

FY 2018-2019

National Centre for Animal Health
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Ministry of Agriculture and Forests
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July 14, 2019

FOREWORD

The National Centre for Animal Health, Serbithang, Department of Livestock, Ministry of Agriculture and Forests is pleased to release the Centre's Annual Progress Report for the Financial Year 2018-2019. The report highlights the progress, achievements and experiences of the Centre while undertaking the mandate of animal health services in the country. As the national competent centre for animal health, the centre has a very crucial role to play in supporting the various commodity programmes under the livestock sector, with the ultimate objective of enhancing livestock production in the country.

I, on behalf of the management of National Centre for Animal health, Serbithang, would like to thank all the Unit Head and the staff at the Centre for their invaluable contributions in achieving the Centre's mandates and more importantly, for documenting all activities undertaken. I acknowledge their contribution and support in producing this annual report on time.

I would also like to express my sincere appreciation to all the Regional Directors of Regional Livestock Development Centres, the Programme Directors of various commodity centres, District Livestock Officers, Farm Managers of central farms, Veterinarians and Veterinary paraprofessionals for their continued support and successful implementation of animal health programmes in their respective jurisdictions. I extend my sincere appreciations to the relevant international partners for their technical and financial support provided for implementation of animal health activities in the country. I also extend appreciations to the Department of Public Health, Ministry of Health, and Bhutan Agriculture and Food Regulatory Authority for their continued support and cooperation in prevention and control of animal diseases.

I also thank the Director General and the Chiefs of various Divisions under Department of Livestock, for their continuous guidance and support to the Centre.

Lastly, I extend my appreciation to Disease Prevention and Control Unit of the Centre for coordinating to publish this document as an annual event.

Tashi Delek

Dr. RB Gurung
Offtg. Programme Director

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1. BACKGROUND

The National Centre for Animal Health (NCAH), Serbithang is located about 12 km away from Thimphu, the capital city of Bhutan. Initially, the centre started as a laboratory in 1978 at Chubachu, Thimphu. Later under the aegis of UNDP/FAO project, it was named as Royal Veterinary Diagnostic Laboratory (RVDL) and shifted to Serbithang in 1981. It was subsequently strengthened under EU assistance between 1991 and 1999 and was renamed as Royal Veterinary Epidemiology Centre (RVEC). The Centre is responsible for animal disease diagnosis and disease prevention and control programme, and providing technical backstopping to the Dzongkhags. In 2005, RVEC was renamed as National Centre for Animal Health (NCAH), and is one of the central programmes under the Department of Livestock, Ministry of Agriculture and Forests. The Centre has a campus area of 8.8259 acres and has 37 staff.

1.1 Main Mandates

- To function as national referral laboratory and competent centre for animal health;
- To ensure availability of quality veterinary drugs, vaccines and equipment; and
- To function as an institute for capacity development in animal health.

1.2 Functions

- Develop, implement and evaluate disease prevention and emergency response plans for livestock diseases and zoonoses;
- Support development of policies, strategies and plans for animal health;
- Coordinate, monitor and evaluate disease prevention and control programmes;
- Prioritize and conduct research on animal health;
- Liaise with national and international agencies for technical collaborations;
- Plan, coordinate and conduct animal health research in liaison with relevant agencies;
- Maintain and disseminate animal health and epidemiological information on regular basis;
- Provide referral services on laboratory diagnostic services;
- Support development of capacity in animal health programmes;
- Coordinate and implement antimicrobial resistance (AMR) studies in veterinary sector;
- Implement, monitor and evaluate management of veterinary drugs, vaccines and equipment at national level; and
- Conduct disease surveillance and control activities at national level.

2. FOUR MAJOR FUNCTIONAL UNITS OF NCAH

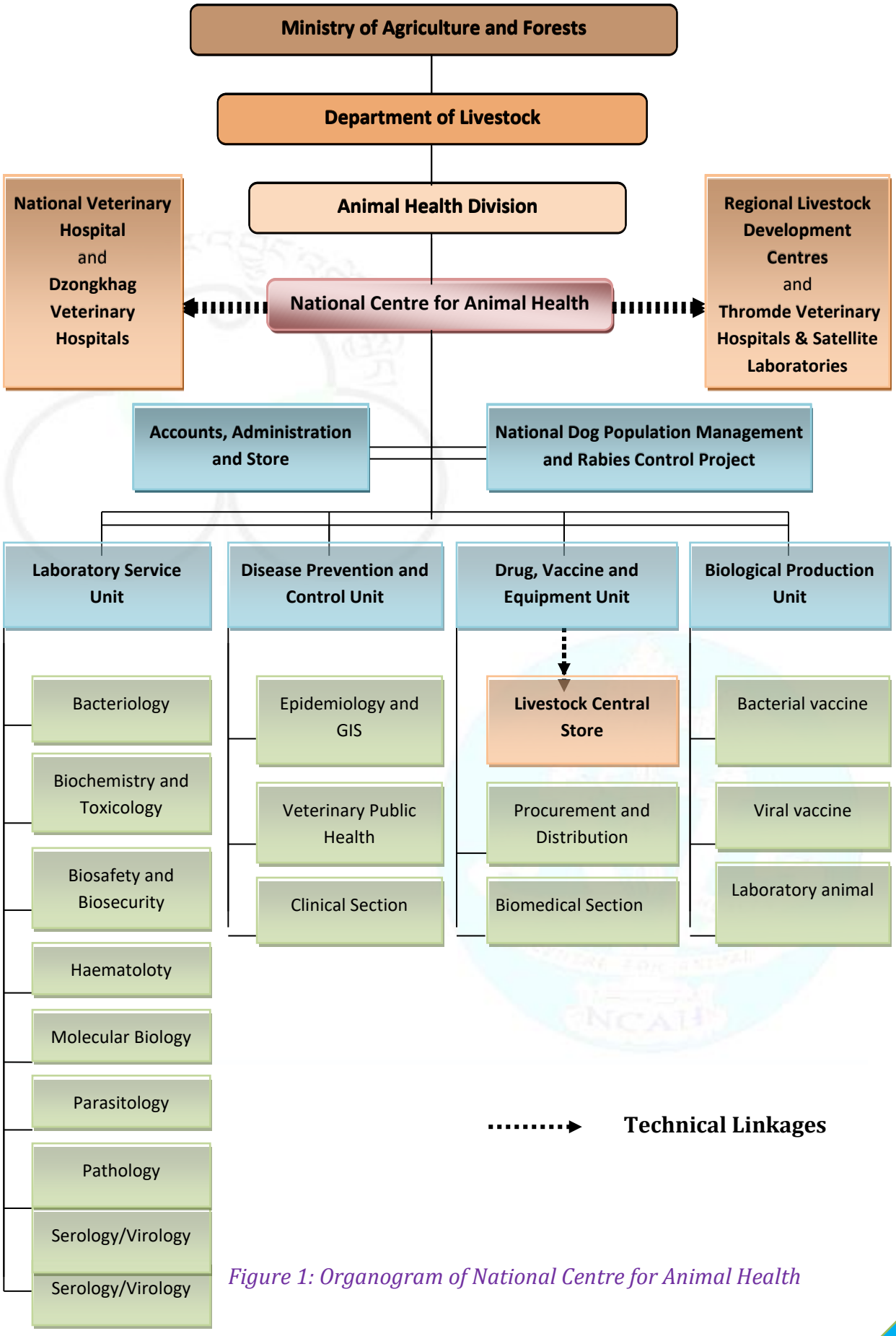


Figure 1: Organogram of National Centre for Animal Health

The Centre coordinates all national level animal health programmes in collaboration with the four Regional Livestock Development Centres (RLDCs) and the Dzongkhag livestock sectors. The main functional units are Disease Prevention and Control Unit (DPCU); Laboratory Services Unit (LSU); Drug, Vaccines, and Equipment Unit (DVEU); and Biological Production Unit (BPU) (see figure 1).

2.1 Disease Prevention and Control Unit (DPCU)

The Disease Prevention and Control Unit act as the focal unit for planning, implementation and monitoring of disease prevention and control programmes in the country. The unit has three sections: Epidemiology and Geographic Information System (GIS) section; Veterinary Public Health and Clinical section.

2.1.1 Human resources

During the FY 2018-2019, the unit was manned by following staff:

- Dr. Tenzin, PLHO (Head): now on EOL;
- Dr. Yoenten Phuentshok, Sr. Veterinary Officer: Voluntarily resigned;
- Dr. Pelden Wangchuk, Veterinary Officer;
- Mr. Kinzang Namgay, Sr. Livestock Health Supervisor;
- Ms. Karma Dekar, Data Manager/Administrative Assistant;
- Mr. Tenzinla of LSU, currently looking after the clinical section.

2.1.2 Main mandates

- To formulate, implement and monitor various nationally coordinated animal disease prevention and control programmes in the country;
- To formulate animal disease emergency response plans (contingency plans) for trans-boundary emerging animal diseases;
- To plan and implement zoonotic disease prevention and control programmes through One Health approach in collaboration with the Ministry of Health;
- To maintain the livestock diseases information in the country through the online *TADinfo* database system, analysis and reporting of the data;
- To maintain the animal health information in the country through Veterinary Information System (VIS) database, analysis and reporting;
- Catering of clinical services to the clients from around the Centre;
- To act as the focal agency for contact with international organizations like OIE (World Organization for Animal Health), FAO, WHO, APHCA (Animal Production and Health Commission for Asia Pacific) on all matters of animal health concerns.

2.2 Laboratory Services Unit (LSU)

The unit has the capacity to undertake rapid diagnosis and also advanced diagnostic tests such as Enzyme-linked immunosorbent assay(ELISA), Fluorescent antibody test (FAT) and molecular assays for emerging and re-emerging infectious disease like Foot and Mouth Disease (FMD), Highly Pathogenic Avian Influenza (HPAI), Classical Swine Fever (CSF), African Swine Fever (ASF), and Rabies. The laboratory is equipped with

real time Polymerase chain reaction (PCR) technology. The unit has Bio-safety level 2 plus for secure handling of high risk pathogens. The unit also functions as the National Referral Veterinary Laboratory. The unit is responsible for monitoring and evaluating Bio-safety in the veterinary laboratories in the country. The unit is also responsible for coordinating collaboration of advance level diagnostic research with international reference laboratories and institutes.

2.2.1 Human resources in LSU

The followings are the available human resource in the Laboratory Services Unit during the FY 2018-2019 (Table 1).

Table 1: Overall human resource capacity during the FY 2018-2019

Specialization	Sections	Number
Animal Health Specialist-I (Parasitologist)	Parasitology	1
Animal Health Specialist- III (Pathologist)	Pathology	1
Animal Health Specialist-III	Molecular biology, Microbiology, Immunology	1
Laboratory Officer	Bacteriology, Molecular biology, Bio-safety, Bio-security, Biochemistry and Toxicology	2
Sr. Laboratory Technician	Parasitology, Serology, Virology and Bacteriology	3
Assistant Laboratory Technician	Serology, Virology, Haematology, Bio-chemistry, Toxicology, Pathology and Post-mortem	6
Laboratory Attendant	General	1
Total		15

2.2.2 Main mandates

The main mandates of the Laboratory Services Unit are:

- Providing referral veterinary laboratory diagnostic services to the clients:

    - Provide routine veterinary laboratory diagnostic services, support clinical services, animal health programs and One-Health activities in the country;
    - Serve as the national referral laboratory for diagnosis of animal diseases in the country;
- Major Livestock Disease Surveillance/Survey:
    - Lead/coordinate and conduct laboratory-based animal health research activities in the country;
- Coordination and implementation of Bio-safety and Bio-security programmes:
    - Implement and monitor bio-safety measures and good laboratory practices in all veterinary laboratories in the country;
- Strengthening and enhancing laboratory diagnostic capacities:
    - To serve as focal laboratory for antimicrobial resistance monitoring in animals in the country;
    - To participate in regional proficiency testing for specific diagnostic methods;
    - To technically backstop regional, satellite and district laboratories in the country;
    - Introduction of new diagnostic tests/up-gradation of diagnostic tests for the emerging and re-emerging diseases in the country;
    - To liaise, collaborate and establish efficient laboratory networks with the outside agencies like Food Testing Laboratory, Bhutan Agriculture and Food Regulatory Authority; Clinical Laboratory, Jigme Dorji Wangchuck National Referral Hospital; Royal Centre for Disease Control, Department of Public Health; and Wildlife Clinic, Nature Conservation Division, Department of Forests and Park Services;
    - To liaise, collaborate and establish efficient laboratory networks with the international reference laboratories such as OIE and WHO Referral Laboratories;
- Laboratory skill enhancement:
    - To develop human resource capacity by conducting the diploma course in laboratory technology in collaboration with other relevant institutions;
    - Conduct refresher course and up-gradation courses for laboratory technicians.

2.2.3 Diagnostic capacities in LSU

The unit has six sections: Bacteriology, Serology/Virology/Molecular biology, Toxicology and Bio-chemistry, Parasitology, Post-mortem and Histo-pathology and Haematology Section. The different sections under the LSU are equipped with advanced diagnostic facilities. The summary of diagnostic tests and capacities available in each section are as follows:

2.2.3.1 Parasitology Section

The section provides routine diagnostic services for parasitic disease and recommends control guidelines and advisory services to the government livestock farms, dzongkhags and private livestock agencies. It also provides other professional backstopping to RLDCs, SVLs and DVHs/DVLs. Besides the routine activities, the section regularly conducts research and surveillance pertaining to parasitic diseases in collaboration with government farms, RLDCs and the dzongkhags. The section is also responsible to provide refresher/in-service courses for field staffs and trainings to the farmers with regard to parasitic diseases and control programs.

The Parasitology section is currently manned by the following staff:

- Ms. Tshewang Dema, Assistant Laboratory Technician

The following are the lists of diagnostic services that are being provided:

- Identification of parasites through direct technique;
- Identification of parasites through qualitative tests (Sedimentation and Floatation methods);
- Identification of parasites through quantitative tests (Stoll method);
- Urine sedimentation test for nematodes;
- Skin scraping examination using 10% KOH digestion method;
- Blood parasite examination;
- Pepsin digestion test;
- Faecal culture (simple tube method, culture tube method, Baermann's method);
- Tick identification (stereo-zoom method);
- Recovery of nematode larvae from soil, herbage and identification;
- Prepucial Trichomoniasis test and identification of *Trichomonas*;
- Post-mortem recovery of helminths, post mortem worm count;
- *Cryptosporidium* staining and identification (modified acid fast);
- *Microfilaria* identification from blood (modified Knott's method);
- Worm staining and preservation;
- Density estimation of flukes;
- ELISA for *Fasciola*.

2.2.3.2 Bacteriology Section

The section provides routine diagnostic services for microbial diseases (bacteria and fungi) in livestock through culture and identifications. The section also has capacity for second stage bio-chemical tests and identification of important bacterial pathogens like *Salmonella, Bacillus anthracis,* serotyping of *Escherichia coli*, etc.

The bacteriology section is manned by the following staff:

- Dr. RB Gurung, Specialist III, LSU;
- Ms. Puspa Maya Sharma, Laboratory Officer;

- Mr. Tenzinla, Sr. Laboratory Technician.

The section has the following diagnostic capacities:

- Bacterial culture and identification using sheep blood agar, MacConkey agar and other selective media and various bio-chemical tests;
- Fungal culture and identification using Sabouraud agar;
- Staining techniques - Grams, Giemsa, Methylene blue, Ziehl-Nielsen/Acid fast, Leishman, Lactophenol, Spore staining and Capsule staining;
- Species identification of important bacterial pathogens in Bhutan – *Salmonella* species, *E. coli, Staphylococcus* species, *Bacillus anthracis*, *Clostridium* species and *Streptococcus* species;
- Enumeration of bacteria - total aerobic count by pour plate technique and spread plate technique, total coli count by pour plate technique and spread plate technique, Most Probable Number (MPN) technique;
- Detection of *Mycobacterium* species by acid fast technique;
- Agglutination tests: Slide agglutination test (SAT), Tray agglutination test (TAT) and Micro-titre plate agglutination test (MAT);
- Detection of mastitis in milk samples through California mastitis test (CMT), Cell count and White side test (WST);
- Antimicrobial susceptibility test (AST);
- Intra-dermal test for bovine tuberculosis (TB) using purified protein derivatives (PPD).

2.2.3.3 Haematology Section

The section conducts the basic haematological tests to support clinical diagnosis in the animals (livestock, pets, birds and wildlife species).

The Haematology section is manned by the following staffs:

- Dr. NK Thapa, AHS-III,
- Ms. Tshewang Dema, Assistant Laboratory Technician.

The haematological parameters and tests commonly conducted in this section are:

- Haemoglobin estimation (Hb);
- Packed Cell Volume (PCV);
- Total Red Blood Cell Count (TRBCC);
- Total White Blood Cell Count (TWBCC);
- Differential Leukocyte Count (DLC);
- Erythrocyte Indices – Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC) and Mean Corpuscular Haemoglobin (MCH);
- Erythrocyte Sedimentation Rate (ESR);
- Wet film examination for blood parasites like *Microfilaria* and Trypanosome.

2.2.3.4 Bio-chemistry and Toxicology Section

The section conducts basic tests for clinical bio-chemistry in serum and also qualitative analysis of urine to support the clinical diagnosis. The section also conducts basic toxicological tests especially, screening of important Mycotoxin in animal feeds.

The Bio-chemistry and Toxicology section has the following staff:

- Dr. NK Thapa, AHS III;
- Ms. Dechen Wangmo, Laboratory Officer;
- Ms. Ugyen Pema, Asst. Laboratory Technician.

The following are the diagnostic capacities available in this section:

- Rapid tests for Aflatoxin in animal feed;
- Quantitative estimation of Mycotoxin (Aflatoxin, Ochratoxin, Fumonisin) in animal feeds;
- Mineral estimation for Ca, Mg and P in serum;
- Qualitative urine analysis;
- Qualitative and quantitative bio-chemistry.

2.2.3.5 Molecular biology, Serology and Virology Section

The section performs tests on both routine basis and also on the samples referred by the Regional/District/Satellite Laboratories in the country

This section is equipped with advanced diagnostic facilities such as real time PCR, ELISA and has the capacity to undertake rapid diagnosis of emerging diseases including the Highly Pathogenic Avian Influenza (HPAI), African Swine Fever (ASF), Infectious Bursal Disease (IBD), Newcastle disease (ND) and Rabies.

The Molecular biology, Serology and Virology sections are manned by:

- Dr. RB Gurung, AHS III;
- Ms. Puspa Maya Sharma, Laboratory Officer;
- Mr. Purna Bahadur Rai, Sr. Laboratory Technician;
- Mr. Dawa Tshering, Sr. Laboratory Technician;
- Ms. Kelzang Lhamo, Assistant Laboratory Technician.

The diagnostic capacities available in this section are:

- Rapid antigen detection tests for Avian Influenza type A, H5, Newcastle disease (ND) virus, Infectious Bursal Disease (IBD), Foot and Mouth Disease (FMD) and Rabies;
- FAT for Rabies;
- Antibody ELISA for FMD, Brucellosis, Rabies, ND, IBD, CSF, Infectious bovine rhinotracheitis (IBR), Leptospirosis, Contagious Bovine Pleuropneumonia (CBPP), Contagious Caprine Pleuropneumonia (CCPP), Porcine reproductive and

respiratory syndrome (PRRS), Johne's Disease (JD), Avian leucosis complex (ALC) and Peste des petits ruminants (PPR);
- Antigen ELISA for CSF and PPR;
- Typing ELISA (sandwich) for FMD;
- Conventional PCR for *Brucella*, FMD serotyping;
- Real time PCR for AI Type A, (H5, N1, H7, N8) FMD, CSF, ASF, Pigeon Paramyxovirus (PPMV) and ND;
- Agglutination tests - HA/HI for ND and H7N9;
- Slide agglutination test for *Salmonella* and *Mycoplasma*;
- Rose Bengal plate test (RBT) for *Brucella*.

2.2.3.6 Post-mortem and Pathology Section

The section has Post-mortem and Histo-pathology section which provides necropsy and histo-pathological diagnosis respectively.

The section has the man power as follows:
- Dr. NK Thapa, AHS-III;
- Ms. Passang Bida, Assistant Laboratory Technician;
- Ms. Ugyen Pema, Assistant Laboratory Technician.

The section is responsible for following diagnostic capacities:
- To conduct post-mortem examination and diagnosis in poultry, ruminants, canine, feline, equine, swine species and wild animals including reptiles and fish;
- To perform histo-pathological examination and diagnosis through processing and examination of slides (Hand E, Grams, ZN, pigment staining and pearls staining);
- To perform immuno-histochemistry.

2.2.3.7 Bio-safety and Bio-security section

The section is mandated to implement and monitor bio-safety measures and good laboratory practices (GLP) in all veterinary laboratories in the country. Thus, this section is an aide-de-section for all other sections.

The human resource in this section is as follows:
- Ms. Dechen Wangmo, Laboratory Officer

The section is responsible for the following:
- Planning coordination and implementation of Bio-safety and Bio-security plans;
- Technical support on Bio-safety and Bio-security measures;
- In-house training on bio-safety and bio-security;
- Reporting and monitoring;
- Samples referral to collaborating laboratories;

- Procurement of routine and research laboratory test kits, reagents, and consumables.

2.3 Drugs, Vaccines and Equipment Unit (DVEU)

2.3.1 Human Resources

As of 30th June 2019, the DVEU has 3 technical staffs to perform and carry out all the planned activities of the unit as below:

- Dr. Hiruka Mahat, Deputy Chief Veterinary Officer (Head of DVEU)
- Mr. Namgay Dorji, Sr. Livestock Health Supervisor
- Ms. Phuntsho Wangmo, Sr. Extension Supervisor

2.3.2 Main mandates

The main mandate of the DVEU is to coordinate implementation of overall management of Essential Veterinary Drug Program (EVDP) in the country. This mandate is implemented through various functions and activities such as:

- Timely procurement, distribution and storage of veterinary medicines, vaccines and equipment and non-drug items;
- Monitoring of drugs, vaccines and equipment supply, stock position, storage at Livestock central store (LCS) and field level;
- Maintenance of veterinary equipment and cold chain equipment;
- Audit quality control and quality assurance through testing of drugs at the Drug Regulatory Authority (DRA) approved laboratories;
- Ensure proper management of revolving fund;
- Coordinate/organize trainings/meetings related to EVDP;
- Organize/co-ordinate National Veterinary Medicine Committee (NVMC) meetings;
- Liaise with DRA and take follow-up action with regard to drug inspection reports;

2.4 Biological Production Unit (BPU)

2.4.1 Human resource

The unit is currently staffed with the following officials:

- Mr. Harka Bahadur Tamang, Sr. LHS ;
- Mr. Migma, Sr. Laboratory Technician;
- Ms. Karma Choki, Assistant. Laboratory Technician;
- Mr. Sangay Nidup, Laboratory Attendant.

2.4.2 Main mandates

The unit is primarily responsible for:

- Production of viral and bacterial vaccines and biologicals;
- Import/procurement of vaccines which are not produced within the country;

- Provision of technical support and monitor the cold chain facilities in the field to ensure the effective storage of vaccine and veterinary biologicals.

2.5 National Dog Population Management and Rabies Control Project (NDPM and RCP)

NDPM and RCP is a collaborative effort of Royal Government of Bhutan (Department of Livestock) and Humane Society International (HSI) with a 50-50 partnership, with the fund support in both cash and kind.

Phase I: September 2009 – June 2012

- 35,689 dogs were covered under Catch, Neuter, Vaccinate and Release (CNVR) programme.

Phase II: July 2012 to June 2015

- The Community Animal Birth Control (CABC) Programme was initiated in order to sustain dog population management (DPM) throughout Bhutan.

Phase III: November 2015 to June 2018

- After the end of Phase II, the project was further extended by three years, to streamline CABC and ensure on-going impact before the project can be entirely handed over to the RGOB by HSI.
- As per the MoU signed between DoL and HSI on 9th November 2015, the partnership was based on 65% contribution from RGoB in cash and 35% contribution from HSI, which were all in-kind.

After the end of phase-III in June 2018, the programme was supported by RGoB and has been coordinating and conducting high volume low cost spay neuter along with rabies control with limited budget which is the main mandate of the project.

The Project Management Unit (PMU) of NDPM and RCP is located in National Centre for Animal Health, Serbithang, with the following staff:

- Dr Hiruka Mahat, Project Coordinator
- Animal Welfare Officers (AWOs) on the basis of paid-when-working

3. KEY ACHIEVEMENTS OF NCAH FOR THE FY 2018-2019

The National Centre for Animal Health, Serbithang under the guidance of Animal Health Division, Department of Livestock and through the support of Regional Livestock Development Centres, Dzongkhag Livestock Sectors and other commodity programmes, achieved the following milestones during the FY 2018-2019:

3.1 Establishment and strengthening of laboratory diagnostic capacity

3.1.1 Laboratory quality assurance

- Technical backstopping missions conducted by Commonwealth Scientific and Industrial Research Organization (CSIRO) - Australian Animal Health Laboratory (AAHL), Geelong supported through FAO;
- Bio-safety equipment testing and certification by ESCO supported through FAO.

3.1.2 Proficiency testing

- Asia Pacific Inter-Laboratory Proficiency Testing scheme for Brucellosis (led by National Institute of Animal Health, Thailand):
    - Rose Bengal Test (RBT),
    - Enzyme-linked Immunosorbent Assay (ELISA).
- Asia Pacific Regional Proficiency Testing scheme for avian and swine panel (led by AAHL, Geelong, Australia):
    - Molecular test – PCR: Avian panel: HPAI, ND;
    - Molecular test – PCR: Swine panel: PRRS, CSF and ASF.
- National external quality assurance coordinated for four RLDCs for Brucellosis by LSU.

3.1.3 Introduction of new diagnostic technology

- New diagnostic technologies for important diseases established - molecular techniques:
    - Foot and Mouth Disease (FMD)-Loop mediated isothermal amplification (LAMP) test);
    - Porcine Reproductive Respiratory Syndrome (PRRS);
    - Erysipelas;
    - African Swine Fever (ASF);
- Cell culture technique established: human resource capacity built for cell culture;
- Bacterial identification for *Erysipelothrix rhusiopathiae.*

3.1.4 Samples collected/received and tested

- A total of 5,778 samples were referred or collected by the Centre and performed 13,069 tests to confirm various animal diseases.

3.1.5 Samples referred to international reference laboratories

- A total of 450 samples were referred to reference laboratories for disease diagnosis, confirmation and collaborative research.

3.1.6 Laboratory Information Management

To manage information generated for all veterinary laboratory activities in the country, the Centre initiated digitalization of online information through Laboratory Information Management System (LIMS) database, with the features to enter sample details, track the status of sample submitted, view diagnostic results and generate reports for various purposes.

3.2 Strengthened Disease Prevention and Control Programme in the country

3.2.1 Development and revision of National Disease Control Plans

The Centre, in coordination with other stakeholders developed and also revised the following national disease prevention and control plans to guide disease prevention and control programme in the country:

- National African Swine Fever (ASF) contingency plan – 2019, was developed in response to the on-going multiple outbreaks of ASF in pigs in South and Southeast Asia region;
- National Peste des petits ruminants (PPR) prevention and control plan, 2019, was developed to guide eradication of PPR in Bhutan, in line with the global movement to eradicate PPR by 2030;
- Developed an Emergency Brucellosis Prevention, Control and Eradication Plan, 2019, to eradicate brucellosis in the country;
- Coordinated revision of National Influenza Pandemic Preparedness Plan and Standard Operating Procedures 2014;
- A Generic Animal Disease Outbreak Management plan was drafted to guide prevention and control of new and emerging notifiable diseases in the country;
- Developed Strategic Plan for elimination of dog-mediated human rabies and rabies freedom by 2030, in line with the global target of reaching zero human deaths from canine-mediated rabies by 2030;
- Final draft of Risk-based Strategic Plan for Foot and Mouth Disease control in Bhutan in line to achieve stage 3 of FMD Progressive Control Pathway (PCP) by 2020.
-

3.2.2 Coordination of major disease outbreak investigations and containment

In coordination with other stakeholders, the Centre responded to rapid containment of following outbreaks in the country:

- Highly Pathogenic Avian Influenza (HPAI),
- Rabies,
- Foot and Mouth Disease (FMD) and
- Infectious Bursal Disease (IBD).

3.2.3 Strengthened animal disease information system

- Carried out TADinfo based data validation of notifiable animal disease outbreaks in the country, and submitted six-monthly and annual report to the World Organization for Animal Health (OIE) through WAHIS interface;

- Carried out real time update of notifiable animal disease outbreaks in the country, on Centre's web page;
- Following validation and analysis of notifiable diseases reported, the Centre published 'Status of notifiable animal diseases in Bhutan, 2018;
- Management and monitoring of animal health data reported via Veterinary Information System (VIS) database, carried out regularly.

3.2.4 Reduction of incidences of pandemic and epidemic diseases

There were reported outbreaks of 11 zoonotic and 30 non-zoonotic notifiable animal diseases in the country against excellent Annual Performance Agreement (APA) target of 30 and 63, respectively for the FY 2018-2019. The Centre was able to achieve well above the Excellent APA target set for 2018-19 in reducing the number of notifiable disease outbreaks in the country.

3.3 Strengthened vaccine procurement and distribution

For disease prevention and control programme in the country, the Centre:

- Procured 7,668,340 doses of vaccines of worth Nu. 5.55 M;
- Produced 10,880 doses of CSF vaccine and 1,600 doses of Anthrax vaccine.

3.4 Strengthened Veterinary medicine and equipment procurement and distribution system

- Initiated data base system in Government to Citizen (G2C) services for indenting and distribution of essential veterinary drugs in the country;
- Following write-off approval for expired medicines from the ministry, the Centre disposed drugs worth of Nu.1.15M, and processed for incineration at Penden Cement Authority Ltd (PCAL), Gomtu;
- To minimize the loss through expired veterinary medicines; in collaboration with essential veterinary drug programme (EVDP) focal persons, the Centre effectively mobilized all nearing-expiry medicines;
- Considering the storage of substantial volume of inflammable liquid at Livestock Central Store (LCS), installation of fire-fighting equipment and other necessities were completed to reduce or avert risk of fire hazard.

3.5 National Dog Population Management and Rabies Control Project (NDPM and RCP)

- Through community animal birth control (CABC) programmes, a total of 13,392 surgeries and vaccinations (ARV) were carried out both in dogs and cats in the field clinics;
- The second dog population survey and KAP survey was carried out for the entire country in July 2018;
- The project, in collaboration with Royal Society for Protection and Care of Animals, carried out education and advocacy programmes for dog population

management, in most of the schools of Haa, Paro, Wangdue Phodrang and Punakha;

- Mass anti-rabies vaccination campaigns were organized in Samdrup Jongkhar, Pemagatshel, Chukha, Samtse, Dagana and Sarpang Dzongkhags, vaccinating a total of 5,453 dogs;
- Due to impending elections last year, public gatherings were restricted. Nevertheless, the World Rabies Day with the theme "Share the message, Save a life "was observed, but only in the presence of technical officials from Ministry of Agriculture and Forests (DoL and Forestry officials involved in wildlife rescue and rehabilitation activities) and Ministry of Health of Samdrup Jongkhar, Gelephu, Sarpang, Phuentsholing, Samtse and Sipsu;
- Except for one human rabies case in 2016, no dog-mediated human rabies cases were reported since 2013. Therefore, Bhutan is well-on-track of achieving the global target of Zero-by-30, that is, freedom from canine-mediated human rabies by 2030.

3.6 Surveillance and Research

- Initiated collaborative studies on important zoonotic diseases: Anthrax, Rabies, Crimean-Congo Hemorrhagic Fever (CCHF), and bat derived zoonotic diseases;
- Completed collaborative studies on Salmonella, funded through WHO Advisory Group on Integrated Surveillance of Antimicrobial resistance (AGISAR) project;
- Completed nationwide Brucellosis sero-survey;
- Fleming Fund project for surveillance of Antimicrobial Resistance (AMR) initiated;
- Rodent sample collection and analysis for screening against Leishmaniosis, in collaboration with KGUMSB;
- Conducted surveillance of Rickettsia, in collaboration with Royal Centre for Disease Control (RCDC);
- HPAI H5N1 virus characterization, in collaboration with AAHL Geelong;
- FMD virus characterization, in collaboration with Pirbright Institute, UK;
- FMD vaccine efficacy study conducted at CRC Wangkha in collaboration with Pirbright Institute, UK;
- A manuscript on nationwide study on Taenia infection in dogs in collaboration with Institute of Parasitology, University of Zurich, Switzerland is completed;
- Completed IBR surveillance in CRC, Wangkha;
- Gid disease surveillance carried out in collaboration with Institute of Parasitology, University of Zurich, Switzerland;
- National street dog monitoring and evaluation survey and KAP survey jointly completed by DoL and HSI in July 2018; and
- A manuscript on Taeniid cyst in tiger is developed for submission to peer reviewed journal.

3.7 One Health and policy research

The Centre coordinated several one health activities in the country:

- Coordinated conduct of National One Health Conference in the country;
- Coordinated formation of Technical Working Group on One Health (TWG-OH) and revised the Bhutan One Health Strategy Plan (2019-2023) and also implemented National One Health Conference resolutions;
- Conducted training to the medical officers in the country on zoonotic disease case detection and management;
- Participated for other stakeholders workshop/meeting and developed the following plans:
    - Bhutan National Action Plan for Health Security (NAPHS);
    - Strategic Plan for Prevention and Control of Zoonotic diseases in the country;
    - National Influenza Pandemic Preparedness Plan for human;
    - Bhutan Wildlife Heath Strategic plan.

3.8 Capacity building

The Centre conducted various training/workshop to enhance the skills and expertise of the laboratory and animal health staffs in the country during the FY 2018-2019:

- Competent person training for sale of predetermined list of veterinary medicines;
- Provided training on GIS and scientific paper writing to the livestock staff;
- Coordinated conduct of training for the RNR field staff on special assignment to the department of livestock;
- Training of trainers on LIMS for NVL, NVH and 2 RLDCs;
- Two batches of animal health officers and laboratory personals were trained on animal disease investigation and LAMP-molecular test;
- Establishment of microbiological laboratory facilities at SVL, Phuentsholing and NVH, Motithang;
- Coordinated training for WHONET – a database for management of AMR data, for Veterinary Officer from four RLDCs.

3.9 Infrastructure development

Besides routine infrastructural development and maintenance, the centre carried out:

- Construction of ramp to make the office wheel-chair friendly, and
- Installation of water tank and plumbing works.

3.10 Financial achievement

From the approved budget of Nu 60.193 Million, the centre was able to utilize Nu. 58.820 Million. Budget utilization for the Centre in FY 2018-2019 was 97.71 percent.

4. ACHIEVEMENTS OF DISEASE PREVENTION AND CONTROL UNIT (DPCU)

4.1 Development and review of National animal diseases' prevention and control plan documents.

The Disease Prevention and Control Unit in coordination with other stakeholders developed and also revised the following plan documents, to guide and direct the field professionals to implement disease prevention and control program in the country:

- Developed National African Swine Fever (ASF) contingency plan, 2019;
- Developed National Peste des Petits Ruminants (PPR) prevention, control and eradication plan, 2019;
- Developed Emergency Brucellosis Prevention, Control and Eradication Plan, 2019;
- Developed Risk-based strategic plan for control of FMD in Bhutan, developed;
- Developed Strategic plan for elimination of dog-mediated human rabies and rabies freedom by 2030;
- Developed Drafted Generic Animal Disease Outbreak Management plan;
- Revised National Influenza Pandemic Preparedness Plan (NIPPP) and Standard Operating Procedures, 2014, to develop NIPPP 2019.

4.1.1 National African Swine Fever (ASF) Contingency Plan, 2019

Background

African swine fever (ASF), first described in the 1920s in Kenya, is a highly contagious hemorrhagic disease of wild and domestic suids with extremely high morbidity and mortality rates. It is a notifiable disease with the World Organization for Animal Health (OIE) due to its ability to spread rapidly and cause severe illness and economic losses. African Swine Fever does not pose risk to public health. African Swine Fever is unique, as it is the arthropod-borne disease caused by DNA virus. The disease is one of the most serious trans-boundary animal diseases because of its high lethality in pigs with high socio-economic consequences and its propensity for rapid and unanticipated international spread.

This contingency plan is applicable for prevention and emergency response in the event of African swine fever outbreak in Bhutan. The document is prepared after considering the factors for incursion of ASF outbreak in the country: recent outbreaks in neighbouring countries, pig farming and production in neighbouring Indian states, pig rearing system in the country, pork import figures, etc.

This ASF-CP is developed to ensure that all the required resources, expertise and services are mobilized and deployed rapidly to reduce the morbidity, mortality and social disruption to the minimum. It is also developed for rapid response teams for

responding to ASF pandemic and ASF outbreak in animals, and to avoid confusion and disagreement during implementation processes.

The main objectives of this ASF-CP are to:

- Prevent introduction of ASF virus into Bhutan;
- Immediately contain/control ASF virus circulating in pigs in Bhutan;
- Strengthen surveillance, early warning and response to ASF outbreak;
- Minimize morbidity, mortality and social disruption;
- Monitor and evaluate the response capacity.

4.1.2 National Peste des Petits Ruminants (PPR) Prevention, Control and Eradication plan, 2019

Background

Peste des Petits Ruminants (PPR) also known as 'goat plague' is a viral disease of goats and sheep characterized by fever, necrotic stomatitis, diarrhoea, pneumonia and death. It is considered a highly contagious trans-boundary disease that has serious socio-economic impact to the smallholder farmers and the government.

PPRV eradication is feasible because of favourable epidemiological features (absence of long term-carrier state in animals and no known reservoirs in wildlife or in the domestic animals other than small ruminants, life-long immunity after single dose vaccination) including growing political support following global eradication of Rinderpest. The control and eventual eradication of the disease will contribute significantly to achieving the sustainable development goals.

The Strategic Approach of the PPR eradication is based on four different Stages: The four stages correspond to a combination of decreasing levels of epidemiological risk and increasing levels of prevention and control.

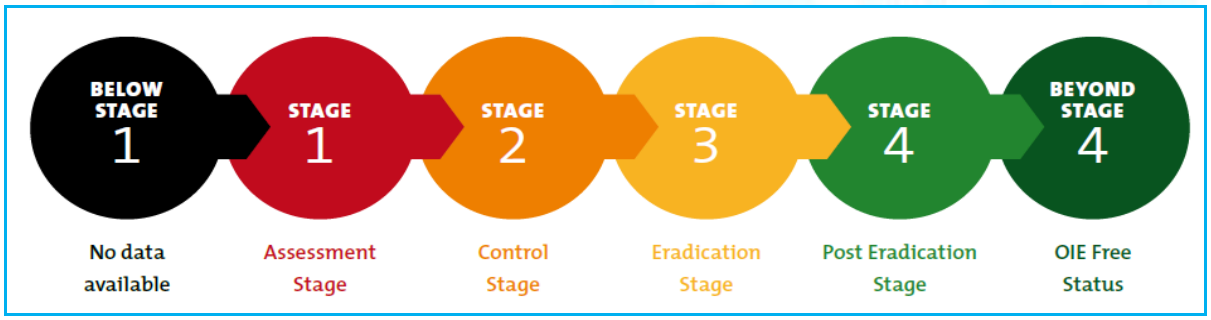


Figure 2: Step-wise approach for PPR Eradication

The usual progression of a **Step-wise approach** is to move from one Stage (n) to the Stage immediately after (n+1); this will be the case for most countries where PPR is endemic, notably in developing countries which may not have the resources to tackle the disease straight away on a national scale. However, for countries willing to eradicate PPR more rapidly, there is a fast-track procedure allowing them to move from Stage 1 to

Stage 3, Stage 2 to Stage 4 and Stage 1 to Stage 4. Whatever the path, Stage 1 is unavoidable to understand the situation and decide the relevant steps forward towards eradication.

Bhutan is in **Stage 2** of PPR-GCES Stages. This risk-based strategic plan is formulated to support the acceptance of the country into stage 3 and then to stage 4 while few typical items of stage 1 activity may still be continued. As such, this plan contains elements (most of them) typical of stage 2, 3 and 4.

The overall strategic approach of the plan is based on a preventive vaccination campaign targeting the small ruminant population in high risk and in targeted areas as well as rapid containment of outbreak. The vaccination of small number of goats has been conducted only in targeted areas but no post vaccination evaluation was conducted. We will implement risk-based strategic activities with an objective to make Bhutan free from PPR.

Bhutan shall implement various activities to achieve **'PPR Control Stage'** by 2019 and **'PPR Eradication Stage'** by 2020, and thereafter PPR freedom dossier shall be submitted to OIE for validation and verification.

4.1.3 Emergency Strategy for Prevention, Control and Eradication of Brucellosis in animals in Bhutan

Background

Brucellosis is a multi-species infectious and contagious disease of animals and humans, caused by bacteria of genus *Brucella.* Usually, brucellosis in cattle is caused by *Brucella abortus*; *Brucella suis* in swine; and *Brucella melitensis* in sheep and goats. Brucellosis causes abortion (but, most infected females give normal birth), the birth of weak or dead calves, and infertility.

Brucellosis poses serious public health risk when humans are infected. Human infection with *Brucella* organisms usually occurs through occupational contact with discharges from infected animals, particularly through calving, and also through slaughtering or ingestion of unpasteurised dairy products.

Currently, there are only sporadic cases of *Brucella* infection in cattle, with low prevalence in the country. Nevertheless, it can become a serious problem for both animal and humans in future if appropriate interventions are not made in time. Therefore, it is recommended to invest resources at this stage to combat the disease. This can be done through implementation of National Stepwise Approach towards Elimination and Eradication of Brucellosis.

This emergency strategic plan document is developed with the objectives:

- To eradicate brucellosis infection and reduce associated abortions and low production in cattle;

- To prevent human infection;
- To produce safe animal products for human consumption;
- To enhance trade of animal and animal products.

The current status

- In 2015, Brucellosis survey was conducted in all 8 government cattle farms in the country. Only 28 cattle from National Jersey Breeding Centre (NJBC) in Samtse (24.6%) tested positive to *Brucella* infection. All other farm animals tested negative to infection.
- In 2017, 42 of 110 cattle (38%) tested positive to Brucellosis at NJBC, Samtse and there is active infection in farm animals.
- In 2017, a risk-based sero-surveillance was conducted in 220 milk cooperatives in 20 Dzongkhags and collected 1,099 serum samples from 1,099 cattle. Of the 1,099 samples, 21 tested (2%) sero-positive to Brucellosis, from 10 Dzongkhags.
- In 2018, 22 of the 33 cattle tested sero-positive to Brucellosis (sample referred by RLDC Khangma) in Trashigang.

4.1.4 Risk-based strategic plan for control of Foot and mouth disease in Bhutan, 2018

Background

To prevent and control FMD outbreaks in the country, various measures were implemented as directed under National Foot and mouth disease prevention and control plan 2016 (Figure 3) developed in line with Progressive Control Pathway for the control of FMD **(PCP-FMD)**, shown in Figure 4, which forms the backbone of the FAO-OIE Global FMD Control Strategy.

Bhutan aims to achieve stage 3 of PCP-FMD by 2020 (Figure 5).

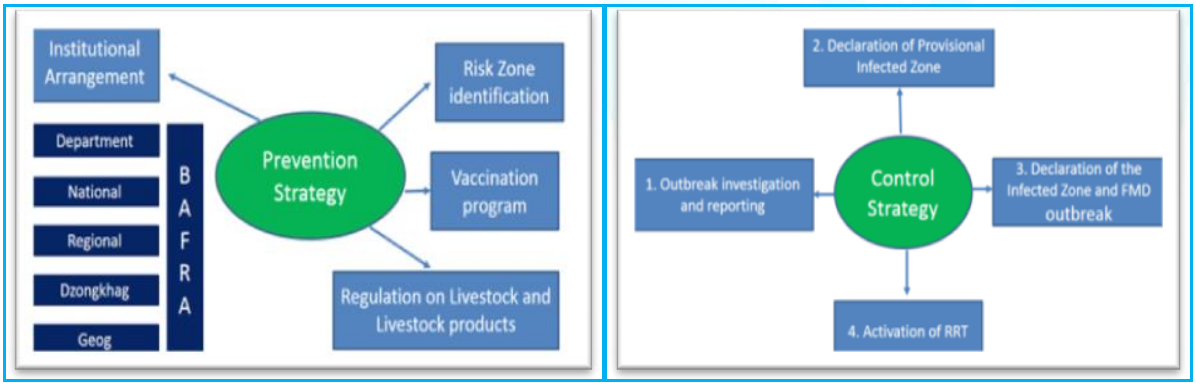


Figure 3: Existing Prevention and Control strategies

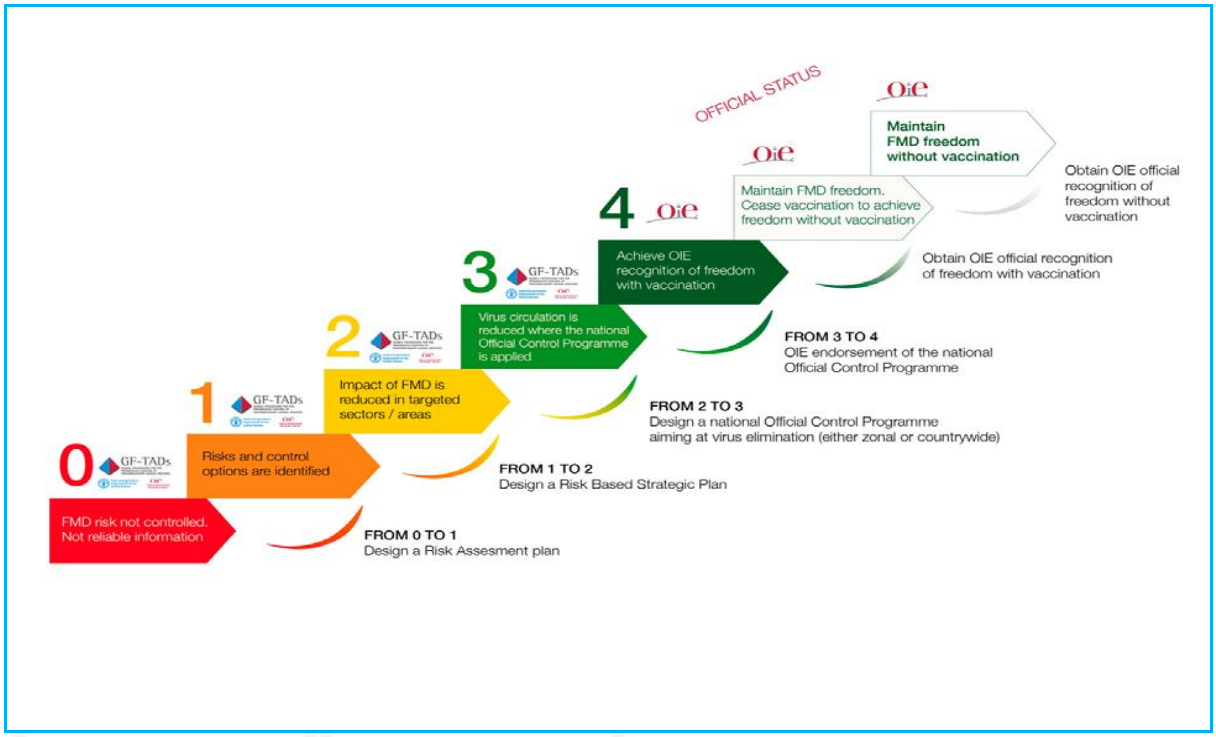


Figure 4: Stage progression in PCP-FMD

FMD Roadmap for South Asia

Country	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Afghanistan	1	1	1	1	1	2*	2	2	2	2	2	3	3	3	4
Bangladesh	1	1	1	1	1	1*									
Bhutan	1	1	1	1	1	1	2	2	2	3	3	3	3	3	3
India	3	3	3	3	OIE endorsed NCP							Zoning 'Free with Vx'			
Nepal	1	1	1	1	1	1	2	2	2	2	2	3	3	4	4
Pakistan	1	1	1	2	2	2	2	2	2	2	2	3	3	4	4
Sri Lanka	1	1	1	1	1	1									

FMD Roadmap for Bhutan

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
Stage of PCP	1	1	1	1	2	2	2	2	3

Figure 5: Regional and National FMD roadmap

In consultation with relevant stakeholders, the Risk-based strategic plan was drafted, with the incorporation of various component objectives, tactics and activities.

This risk-based strategic plan for control of Foot and mouth disease was drafted with the objectives to:

- Assess the current control plan;
- Better understand FMD epidemiology;
- Conduct risk analysis along the value chain and production system;
- Conduct socio-economic impact assessment of the disease;
- Strengthen surveillance and information system;
- Strengthen advocacy and awareness on FMD;
- Strengthen the FMD diagnostic system;

- Implement risk-based prevention and control measures;
- Ensure enabling environment for prevention and control measures.

4.1.5 Strategic plan for elimination of dog-mediated human rabies in Bhutan and rabies freedom by 2030

Background

Rabies is a notifiable disease in Bhutan. Rabies commonly occurs in the southern belt of Bhutan along the borders with India; however, isolated cases have been documented in the interior parts of the country, as a result of incursion from bordering areas. Therefore, it is important to control the disease at the source and prevent endemic transmission in the country. As part of the global effort to eliminate rabies by 2030, Bhutan has been actively implementing various strategies to control and eliminate dog-mediated rabies in the country through One Health approach. Bhutan aims to achieve zero dog-mediated human rabies death by 2030.

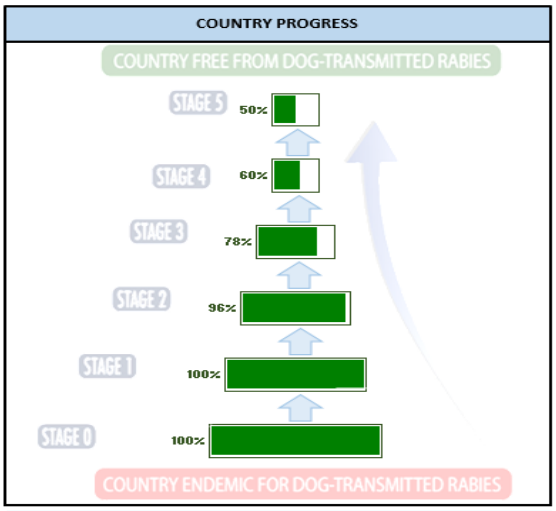


Figure 6: Summary of progress of National rabies prevention and control programme in Bhutan

Although cross-border rabies transmission is a challenge, dog-mediated human rabies elimination is feasible in the country. Bhutan has achieved drastic reduction of human rabies deaths over the decades to zero cases during 2017 and 2018. Self-assessment of national rabies prevention and control program was conducted through consultative workshop using Stepwise Approach towards Rabies Elimination (SARE) tool. The assessment indicated that Bhutan is in right track and is currently in Stage 3.5 (Figure 6) with much of the activities being achieved. Therefore, this make a good case for Bhutan to work towards elimination of dog mediated human rabies by 2030 as a part of 12thFive Year Plan program. However, the maintenance of rabies free status would require continuous implementation of various activities and enhance effective surveillance system to detect cases in both human and animals for early response. For instance, dog vaccination, rabies awareness and risk communication, making PEP accessible and building capacity for rabies diagnosis and surveillance are crucial, and are the common activities from the beginning and across all stages of the elimination program. This ***"Strategic plan for elimination of dog-mediated human rabies in Bhutan"*** provides both input and performance based indicator activities to be implemented to eliminate rabies deaths in humans in Bhutan.

This strategic plan is developed with the objectives:

- To enhance rabies prevention and control in dogs;

- To provide timely access to post exposure prophylaxis to all human following exposure to rabies;
- To reduce dog population at a manageable level and promote responsible pet ownership;
- To enhance community engagement on rabies prevention and control through community awareness and education;
- To institute coordination and collaboration mechanism through One Health approach at all levels.

Guiding principles of the Strategic framework**:**

- Dog bites are the primary source of human rabies. Human rabies prevention is possible through mass dog vaccination, promotion of responsible pet ownership and dog population control programmes with a partnership approach (One Health approach).
- Dog bites are a medical urgency and thorough cleaning of a bite wound is an important step which needs to be promoted at the community level through advocacy, awareness and education.
- Post-exposure rabies prophylaxis should be made easily accessible, affordable and available for those that require it.
- Enhanced surveillance is the key for monitoring the progress of the control program.

The following are the **key strategies** that will be implemented to achieve rabies elimination plan in Bhutan:

- Organizational setup of rabies control;
- Prevention and control of rabies in dogs;
- Prevention of rabies in humans;
- Strengthen and enhance surveillance;
- Strengthen disease outbreak response;
- Conduct and promote operational research;
- Advocacy, communication and social mobilization;
- Enhance partnerships and coordination;
- Cross-border control;
- Resource mobilization.

4.1.6 Generic Animal Disease Outbreak Management plan

Background

Over the years, the Department of Livestock in collaboration with Bhutan Agriculture and Food Regulatory Authority and Department of Public Health have developed several disease control guidelines including the Integrated National Influenza Pandemic Preparedness Plan (NIPPP). Recognizing increasing incidences of notifiable diseases in animals such as Foot and Mouth disease (FMD), Rabies, Anthrax, Peste des Petits Ruminants (PPR), Infectious Bursal Disease (IBD) including potential for introduction and spread of new zoonoses like Crimean Congo Haemorrhagic Fever (CCHF), Japanese

Encephalitis, Nipah virus, etc, it has become crucial to develop generic notifiable disease outbreaks management structure.

This document outlines the structure of the generic notifiable disease outbreak management with clear chain of command, decision making and roles and responsibilities of the different committees comprising of relevant agencies at different levels and fund mobilisation. The specific animal disease prevention and control plan including standard operating procedures are described in specific disease prevention and control plan, viz., National Influenza Pandemic Preparedness Plan 2014; National FMD Prevention and Control Plan 2016; National Rabies Prevention and Control Plan 2017; National Anthrax Prevention and Control Guidelines 2013; National PPR Guideline, 2017; and National Gid Disease Prevention and Control Plan 2016. This disease control command structures is aligned to the existing guidelines and control plans. This generic command structure applies to all notifiable diseases, and it should be followed in conjunction with the SOPs and guidelines of the specific diseases.

4.1.7 Revision of National Influenza Pandemic Preparedness Plan (NIPPP) and Standard Operating Procedures, 2014

Key updates/revisions in the revised NIPPP 2019 document are as follows:

- The composition of National Incident Command Committee (NICC) and Incident Operation Centre (IOC) have been reviewed and updated. The number of technical members in NICC was reduced with the formation of Technical Advisory Committee (TAC);
- The TAC shall Advice NICC and IOC on the scale of rapid containment activities including manpower requirement, timeline of containment and allocation of resources depending on the magnitude of disease outbreak;
- The roles and responsibilities of the National Incident Command Committee (NICC) have been defined for both normal (peace) times and during an outbreak;
- The incident command system has been updated in line with the Disaster Management Act of Bhutan 2013. The National Disaster Management Authority (NDMA) replaces the National Steering Committee as the highest authority on NIPPP. Linkages and coordination mechanisms have been built in the command system with the Disaster Management Committees at the National, District, Dungkhag and Geog level in order to maintain coherence for the implementation of response activities in line with the Disaster Management Act of Bhutan 2013;
- Protocol for information sharing and reporting has been included;
- The fund mobilization and release mechanisms have been explained clearly in line with the Disaster Management Act of Bhutan 2013;
- The Standard Operating Procedures (SOPs) have been updated based on latest scientific evidence/knowledge. New SOPs have been added on vehicle disinfection, movement of poultry/poultry products during outbreak time, surveillance on Avian Influenza (AI) H7N9;
- Based on the scientific evidence, AI H7N9, which was earlier recognized as LPAI, is now considered as HPAI and treated at par with H5N1 for outbreak response;

- Information on the historical outbreaks of HPAI H5N1 in Bhutan has been included along with the virus clades circulating in the country;
- A flow chart for budgeting and disbursement process for compensation has been developed for reference by the IOC/NICC;
- Dzongkhag Disaster Focal person has been included as a member of the compensation committee and IOC;
- New SOPs on antiviral prophylaxis by Health Control Team is incorporated to monitor compliance and ADR in risk group people;
- Compensation for turkey and egg trays are included; and
- Issues such as positive rapid test results, in species other than chicken (pigeon, ducks and other wild birds) are addressed to avoid confusion.

4.2 Strengthening of Database Management and Disease Reporting System

- Validation of Animal health data for FY 2018-2019, entered into the Veterinary Information System (VIS) database by field veterinarians, veterinary paraprofessionals and data managers;
- Carried out regular updating and validation of notifiable animal disease outbreaks' data entered into the TADi*nfo* database, by field veterinarians and data managers;
- Two six-monthly and an annual reports on notifiable animal diseases were compiled and submitted to Office International des Epizootic (OIE), through World Animal Health Information System (WAHIS);
- Immediate notification to WAHIS submitted whenever there were outbreaks of any OIE reportable diseases in the country (e.g. Bird flu and PPR);
- To keep the field professionals and relevant stakeholders updated with the disease outbreaks happening around the country, DPCU regularly updated animal diseases outbreak's notification on the NCAH website;

- Carried out validation and analysis of notifiable animal diseases reported during the calendar year 2018, and produced a book, "Status of notifiable animal diseases in Bhutan, 2018", soft copy of which was uploaded onto the Centre's website and also shared with relevant stakeholders;

"Status of notifiable animal diseases in Bhutan, 2018"

During the year 2018, rabies was the major disease that occurred in Trashigang, Panbang, Samtse, Sarpang, Samdrup Jongkhar and Chukha dzongkhags as a result of incursion from the bordering town due to movement of rabid dogs.

A total of 12 separate outbreaks of rabies were reported from across the country during the calendar year.

Disease outbreaks reported (Figure 7) were as follows:

- Rabies,
- Foot and Mouth Disease,
- Classical Swine Fever,
- Infectious Bursal Disease, and
- Highly Pathogenic Avian Influenza.

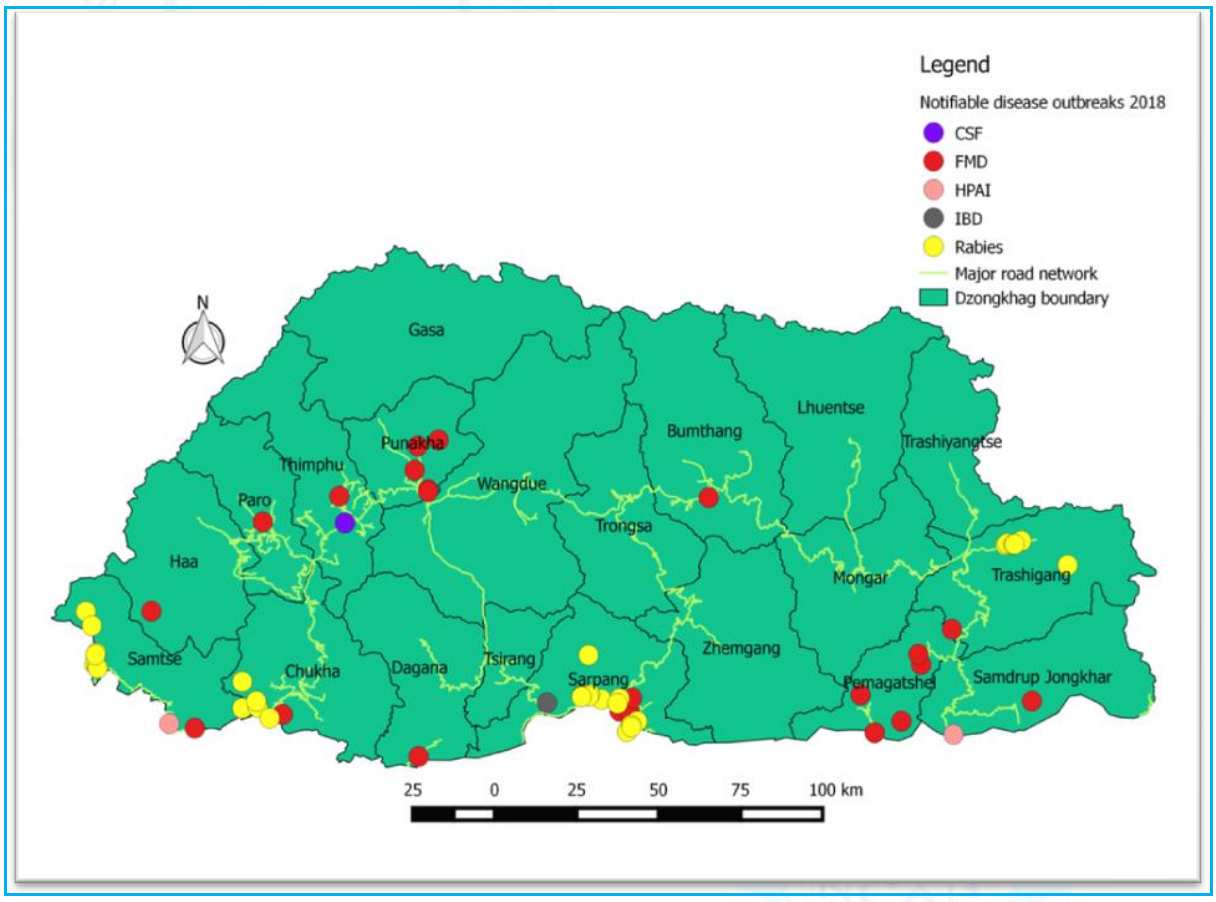


Figure 7: Distribution of reported notifiable animal diseases in Bhutan, 2018

4.3 Reduction in incidences of pandemic and epidemic diseases

There were reported outbreaks of 11 zoonotic (Figure 8) and 30 non-zoonotic (Figure 9) notifiable animal diseases in the country against excellent APA target of 30 and 63, respectively, for the FY 2018-2019.

During the FY 2018-2019, Foot and mouth disease was the major disease outbreak (20 separate outbreaks) reported, followed by 9 rabies' outbreaks.

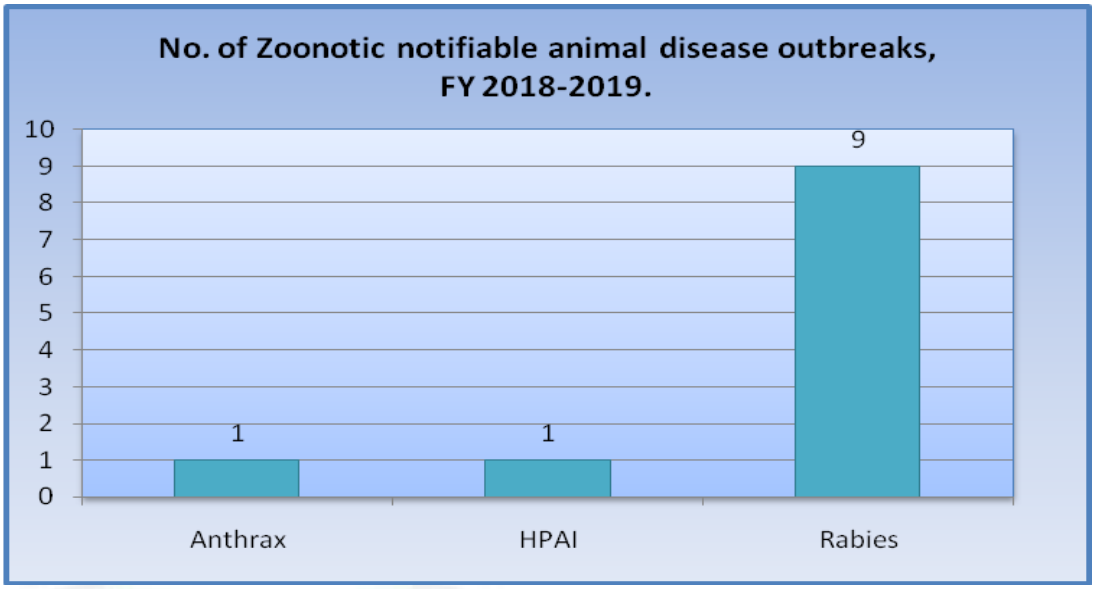


Figure 8: No. of outbreaks of zoonotic notifiable animal diseases, 2018-2019

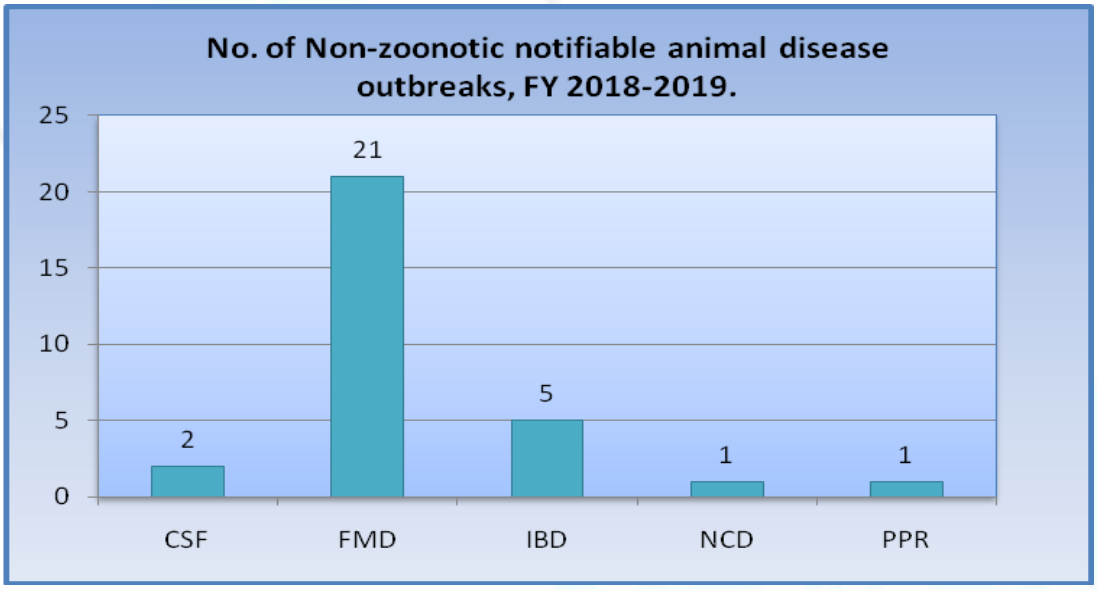


Figure 9: No. of outbreaks of Non-zoonotic notifiable animal diseases, 2018-2019

4.4 Disease outbreak investigation and containment

The DPCU, LSU and other technical units of NCAH, in collaboration with the RLDCs, Dzongkhag livestock sectors, and other relevant stakeholders, coordinated investigation and containment of following diseases' outbreak in the country:

- Highly Pathogenic Avian Influenza (HPAI),
- Rabies,
- Foot and Mouth Disease (FMD),
- Infectious Bursal Disease (IBD) and
- Swine Erysipelas.

Report on Swine Erysipelas outbreak at Regional Pig Breeding Centre, Yusipang

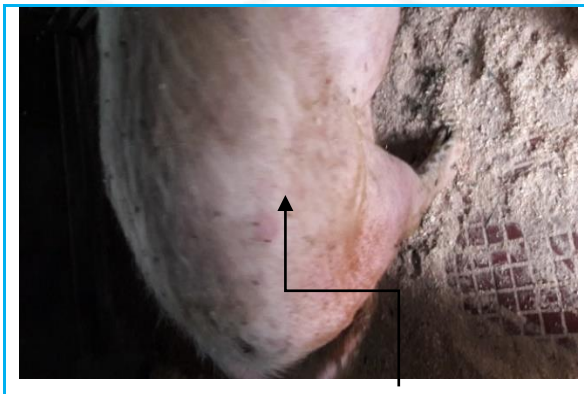
Dr. NK Thapa[1], Ms. Puspa Maya Sharma[1], Ms. Tshewang Dema[1], Ms. Menuka Rai[2] and Dr. RB Gurung[1]

[1]National Centre for Animal Health, Serbithang
[2]Regional Pig Breeding Centre, Yusipang

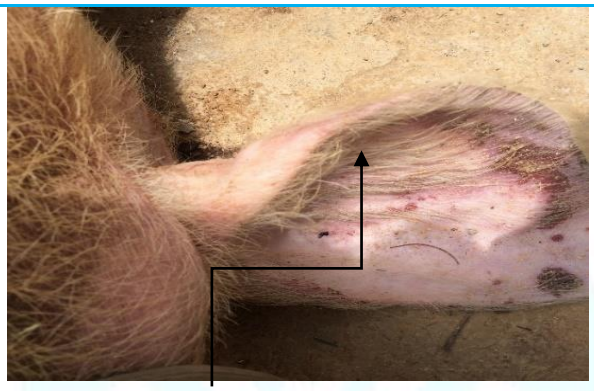
Summary

The outbreak of disease at the Great Grand Parent (GGP) shed at RPBC, Yusipang with the clinical signs of skin rashes on the body and ear tips, high fever, inappetance and swollen joints containing pus has been diagnosed as Erysipelas also known as "Diamond skin". The disease is caused by a bacterium, *Erysipelothrix rhusiopathiae* (syn, *insidiosa*) that is found in most of the pig farms. The bacteria were isolated from nasal swab/rectal swab and pus from joint of the affected animals, including the dead due to disease in the farm.

The disease is confirmed by isolation and identification of the organism in the laboratory. The clinical signs of the affected animals and the history of other events in the farm were also consistent with that of *Erysipelas*.



Fresh lesion on rump region



Lesion on ear tip

Swollen stifle joint

Pus in the joint

Figure 10: Lesions observed

In addition, *Salmonella* organism has also been isolated from the piglets with signs of diarrhoea. The bacteria were also of zoonotic importance. Hence, proper hygiene practices need to be implemented in the farm.

4.5 Coordination of One Health activities

The unit coordinated several one health activities in the country:

- Coordinated conduct of National One Health Conference in the country at Paro from 19-21 December 2019;
- Coordinated formation of Technical Working Group on One Health (TWG-OH) and revised the Bhutan One Health Strategy Plan (2019-2023) and also implemented National One Health Conference resolutions;
- Conducted training to the medical officers in the country (as resource person) on zoonotic disease case detection and management;
- Conducted SARE workshop to assess rabies prevention and control program in the country
- Develop study design for anthrax and rabies surveillance under NCAH-NIID-RCDC collaborative project
- Participated for other stakeholder's workshop/meeting and developed the following plans:
    - Bhutan National Action Plan for Health Security (NAPHS);
    - Strategic Plan for Prevention and Control of Zoonotic diseases in the country;
    - National Influenza Pandemic Preparedness Plan for human;
    - Bhutan Wildlife Heath Strategic plan.

4.6 Clinical services provided

Besides laboratory diagnostic services catered, Clinical section of the centre provides various clinical services (Table 2): deworming, vaccination, spaying/neutering and treatment, to the clients from around the centre, in supplementation to the veterinary clinical services provided by Dzongkhag Veterinary Hospital (DVH), Thimphu, and National Veterinary Hospital (NVH), Motithang,

A month-wise clinical services catered by the Centre are shown in the following table.

Table 2: Monthly clinical services provided by Clinical section, NCAH, 2018-2019

Months	Treatment	Deworming	Sterilization	Vaccination(ARV)
July	1	5		17
August	1878*	2		
September	6		1	6
October		1		2
November				4
December	7	5	1	6
January	151	3	3	4

February			3	1
March		2	8	2
April	3	5	8	6
May	8	3	11	6
June		1		1
Total	**2044**	**27**	**35**	**55**

**Therapeutic measures undertaken during disease outbreak in poultry farm*

Significant findings

Most commonly attended clinical cases/ services catered during the FY2018-2019 are as follows:

- Retention of placenta,
- Milk fever (Parturient paresis) and
- Vaccinations against Rabies, Black quarter and Hemorrhagic septicaemia.

4.7 Other works

- Coordinated review and work planning for NCAH.
- Coordinated development of Annual Performance Agreement and its implementation and participated in other policy issues.
- Coordinated preparation and compilation of the Centre's annual progress report.

5. ACHIEVEMENTS OF LABORATORY SERVICES UNIT (LSU)

A total of 5,758 various laboratory samples were received or collected and 13,145 various laboratory tests were performed for disease screening, surveillance and researches during the year (Table 3).

Table 3: Summary of samples received and tests performed during FY 2018-19

Section	No. of sample	No. of Tests
Parasitology	514	1777
Hematology	496	1593
Bio-chemistry and Toxicology	170	725
Bacteriology	634	3388
Serology/Virology /Molecular	2884	4094
Post-mortem	250	250
Histo-Pathology	810	868
International referral		450
Total	**5,758**	**13,145**

5.1 Achievements of individual sections under LSU

5.1.1 Histopathology, Post-mortem section

A total of 250 animal carcasses and 810 tissue samples were received and examined in the pathology section in Table 4.

Table 4: Samples and tests performed in Pathology section during the FY 2018-2019

Sample type	Number	Test type	Number
Tissue, organs	810	Histopathology- H and E Staining	868
Carcass	250	Post-mortem/Necropsy	250
Total	**1,060**		**1,118**

Significant findings

Histopathology: Common cases diagnosed were IBD, ALC, Respiratory infection, Pneumonia and septicaemia.

Post-mortem: Swine carcasses were received in highest numbers (206) and avian (34). Common findings were IBD, HPAI, IBD, ALC and trauma.

5.1.2 Parasitology section

In total of about 514 samples were received and 1,777 tests were performed by the section. The details of tests performed by this section are shown in Table 5.

Table 5: Sample and tests performed in Parasitology section, FY 2018-2019

Sample type	Number	Test type	Number
Faecal samples	514	Direct examination, Sedimentation, Stoll's dilution, Floatation	1777
Total	**514**		**1,777**

During the year, the section commonly detected parasitic infestations through the microscopic detection of eggs of *Strongyles*, *Coccidia* and *Ascaris*. All the detected cases were advised for deworming with appropriate anthelmintic medicines. Wherever the higher level endemicity of parasitism was observed, a periodical prophylaxis was also recommended. Besides the routine work, research on Taeniid infection in dogs is also being conducted.

5.1.3 Bacteriology Section

The details of number of samples, test types and numbers of tests performed in bacteriology section are as shown in Table 6.

Table 6: Samples and tests performed in Bacteriology section during 2018-2019

Types of specimen	Number	Types of tests	Number
Organs	12	Culture	655
Cloacal swab	299	Sub-culture	1310
Whole blood	15	Gram stain	78
Swab	47	Motility	74
Skin scraping	34	Biochemical test	1087
Caeca	36	Antimicrobial Sensitivity test	16
Feed	2	LCB Stain	34
Semen	5	Glycerol stock	80
Soil	16	Bacterial revival	54
Fermented milk	114		
Bacterial isolates	54		
Total	**634**	**Total**	**3,388**

Significant findings

During the year, besides other routine works of the laboratory, as a part of research activities, isolation and identification of *Salmonella* from poultry birds and *Erysipelothrix rhusiopathiae* from swine were carried out.

Antimicrobial susceptibility tests (AST) for important bacteria like *Salmonella*, *Staphylococcus* were conducted.

5.1.4 Bio-Chemistry/ Toxicology and Haematology sections

The Bio-Chemistry/Toxicology section performed Mycotoxin analysis in animal feeds and mineral estimation in serum sample. Minerals such as calcium, magnesium and inorganic phosphorous estimation were performed in the bio-chemistry section.

Details of samples and tests conducted in these sections are presented in Table 7.

Table 7: Sample type and the tests conducted in Bio-Chemistry/Toxicology section

Sample type	Number	Test type	Number
Feed	145	Aflatoxin	417
Serum	22	Fuminosin	108
Urine	3	Ochratoxin	126
		Calcium	44
		Urine biochemistry	30
Total	**170**	**Total**	**725**

Significant findings

Mycotoxin analysis detected about 46/145 (31.7%) of animal feeds contained aflatoxin above permissible level. Serum chemistry indicated 22/22 (1%) of the samples with low calcium in the submitted samples.

5.1.5 Hematology section

Basic haematological tests were also conducted to support the clinical diagnosis in animals. Details of samples and tests conducted in these sections are presented in Table 8.

Table 8: Sample type and the tests conducted in Haematology section

Sample type	Number	Test type	Number
Blood smear	19	PCV	331
Whole blod	477	Hb	331
		DLC	325
		TRCC	300
		TWCC	291
		Knott's test	15
Total	**496**	**Total**	**1,593**

5.1.6 Molecular Biology, Serology and Virology Section

The section performed tests such as rapid tests: Rose Bengal Test for *Brucella abortus* in bovine, Influenza A antigen, H5 antigen tests in birds, rabies antigen detection test, IBD, ND and Fluorescence Antibody Test (FAT) for rabies.

The other screening and confirmatory serological tests include Non-Structural Protein Enzyme Linked Immuno-Sorbent Assay (ELISA) for screening against FMD antibody, sandwich ELISA for FMD typing, antigen detection ELISA for CSF and Liquid Phase Blocking ELISA for FMD vaccine efficacy studies.

The molecular tests in this section include Multiplex conventional Polymerase Chain Reaction (PCR), real-time reverse transcriptase (RT) PCR for Influenza A, H5 and N1, N8 and Newcastle Disease Virus, Foot and mouth disease, Classical Swine Fever (CSF), PRRS EU, PRRS NA, ASF and *Erysipelas* diseases. Details of tests performed and samples are shown in Table 9.

Table 9: Sample and test performed in serology, virology and molecular section

Sample Type	Number	Type of Tests	Number
Serum	2361	RBT	847
		Brucella ELISA	842
		FMD ELISA	103
		FMD NSP(Rapid)	63
		FMD-Sero-typing (O, A, Asia-1)	150
		CSF ELISA	92
		PPR ELISA(Ag)	840
		Mycoplasma synoviae (rapid test)	21
		ALC ELISA	62
		Salmonella pullorum (rapid test)	21
		CDV ELISA	249
		IBR ELISA	96
Tissue/Epithelium/swab	507	PCR (AI,H5,N1)	222
		PCR NDV	32
		Rapid test (AI, H5, NDV, IBD)	56
		PCR FMDV	110
		PCR CSFV	134
		PCR PRRS	94
		PCR ASF	44
Brain	16	FAT	16
Total	**2884**		**4094**

Significant findings

A highly pathogenic avian influenza A (H5N1) virus was confirmed through PCR in the samples of poultry birds received from Dhamdara, Phuentsholing during April 2019. It was also further confirmed at AAHL, Geelong Australia clade Asian H5 clade 2.3.2.1a.

The molecular section also confirmed Classical swine fever and FMD, through real time PCR. Rabies was also confirmed by FAT at serology section from the samples received.

This section conducted international proficiency testing for highly pathogenic avian influenza (H5N1), Newcastle Disease, Classical swine fever, PRRS NA, PRRS EU, ASF and *Brucella.*

5.1.7 Bio-safety and Bio-security section

Bio-safety and bio-security section is mandated to facilitate and regulate strict compliance in performing laboratory activities. Thus, this section is an aide-de-section for all other sections.

Followings are the activities completed by this section:

- Routine Bio-safety works;
- Developed Laboratory Bio-safety manual version 2;
- Maintenance and repairing of equipment;
- Developed the incident report form, weekly equipment inspection form and also laboratory auditing checklist;
- Visit to NAH- Motithang for monitoring and evaluation of laboratory;
- Visit to CVH SL- Phuentsholing for monitoring and evaluation of laboratory;
- Maintained monthly temperature for fridges, incubators and deep freezers;
- Issued spill kits and first aid kits (one in BSL-2plus and one in reception in case of emergency);
- Issued new sharps disposal container for all the sections;
- Revised/developed new forms for auditing;
- The section successfully conducted internal auditing for the national laboratory to ensure good bio-safety and bio-security measures;
- Visited and technical auditing performed in some National and Satellite laboratories.

Bio-safety section has successfully evaluated and monitored two laboratories namely City Veterinary Hospital and Satellite Laboratory in Phuentsholing and National Veterinary Hospital in Thimphu. There were few drawbacks that were addressed which needed to be improved and also some feed backs were provided in order to maintain Bio-safety in the laboratory. Some brief presentations on Bio-safety measures were presented on how to handle samples and also familiarized on how to use proper safety gears and transportation of samples from field to the referral laboratory. The Bio-safety monitoring team has submitted the Bio-safety laboratory report to the head of the Centre with recommendation. In the conclusion it was seen that most of the laboratories in the country are not able to adhere strictly to Bio-safety and Bio-security protocol, mainly because of budgetary constraints and lack of proper awareness and trained laboratory personnel for Bio-safety measures. Some laboratory did not have Bio-safety focal person to coordinate and monitor their laboratory, therefore, the team had temporarily appointed Bio-safety focal person to monitor their laboratory on regular basis.

5.2 Introduction of new tests

During the financial year 2018-19, the following new diagnostic technologies for important diseases were established:

A. Molecular techniques
    1) Foot and Mouth Disease (FMD)-LAMP test),
    2) Porcine Reproductive Respiratory Syndrome (PRRS),
    3) Erysipelas, and
    4) African Swine Fever (ASF)

B. Cell culture technique established; human resource capacity built for cell culture.

C. Bacterial identification for *Erysipelothrix rhusiopathiae.*

5.3 Samples referred to international laboratories

Details of sample referred are given in table 10.

Table 10: Sample referred to international laboratories

Sl No.	Referring laboratories	Sample type and tests	Total Number
1	Armed force research institute of medical science, Bangkok, Thailand	Organs-Scrub Typhus	96
2	Massy university Manawatu campus, New Zealand	Fermented Milk- Bacterial culture	114
3	Pirbright, UK	Epithelial tissue- FMD	33
4	Pirbright, UK	Serum Sample- Vaccine efficacy study, FMD	117
5	Institute for Food Safety and Hygiene, University of Zurich, Switzerland	Bacterial isolates-Salmonella	54
6	AAHL, Geelong, Australia	Cloacal, tissue, fresh droppings-AIV	7
7	Dept of Veterinary medicine, University of Cambridge, UK	Whole blood, Tissue samples-Canine Transmissible tumour (CTVT)	29
	TOTAL		**450**

5.4 Laboratory quality assurance

5.4.1 Laboratory assessment, quality assurance audit and Technical backstopping

Technical Backstopping Missions conducted by Australian Animal Health *Laboratory – CSIRO supported through FAO.*

Technical Backstopping Missions to Participating Laboratories in Asia under project OSRO/RAP/402/USA

DATE: August, 2018

STAFF: Andrea Certoma, Australian Animal Health Laboratory-CSIRO

The visit was aimed to troubleshoot PCR assays and provide technical backstopping to molecular section. The expert reviewed, identified and resolved the underlying issues encountered during Asia Pacific Regional Proficiency Testing for Avian and Swine disease using Quant Studio 5 (QS5) real time PCR machine.

New molecular tests for the diagnosis of diseases such as African swine fever (ASF), PRRS was introduced and established at LSU. The section was provided with real time PCR reagents by the team for routine diagnosis and regular participation in PT.

5.4.2 Asia Pacific Regional Proficiency Testing

The avian diseases and Swine disease PCR panel for 2019 proficiency testing consisted of 15 and 18 gamma irradiated samples respectively, that were sent to each participating laboratory with instructions to test the samples using their standard diagnostic real-time PCR for Avian Influenza A (AIV matrix, MA), Avian influenza A H-type (H5/H7/H9) and Avian paramyxovirus-1 (APMV-1). Some laboratories also tested samples for N-type.

5.5 Molecular Diagnostics

The National Centre for Animal Health was provided with the Avian disease PT panel (Influenza A, H-type PCR and Avian paramyxovirus-1) and the Swine Disease PT panel (CSF, PRRS, ASF and SIV), for the South Asia and South East Asia 2019 PT programme. The laboratory reported results for Influenza A matrix, H5, N1, APMV-1, and CSF, PRSS NA, PRSS EU and ASF PCR.

5.6 Bio-safety and Bio-security Monitoring

5.6.1 Laboratory Auditing

Under Bio-safety monitoring and evaluation program, Bio-safety coordinator conducted auditing of its Centre on monthly basis and submitted the report to head of the Laboratory. As a part of monitoring and evaluation mechanism to be followed by the National Centre in terms of providing necessary feedback and helping in developing guidelines for the Regional levels, the unit had also made visit to City Veterinary

Hospital and Satellite Laboratory Building in Phuentsholing on 11th to 12th December, 2018, and National Veterinary Hospital in Thimphu on 7th May, 2019, to monitor the bio-safety practices followed.

Common observations:

- No proper signage pasted on the main entrance door to the laboratory section (Biohazard sign);
- No proper Guidelines available;
- No Proper sorting of hazardous and non-hazardous chemicals with labelling;
- No proper record keeping for test done and results;
- No close-toe shoe/slipper for the lab personnel;
- No different laboratory coats for workers working inside and outside lab;
- No proper register maintained for equipments and chemicals to check its functionality;
- Temperatures not maintained for any incubator and fridge;
- No biohazard signage pasted on fridge where positive samples are kept;
- No SOPs for some equipments;
- Laboratory did not have any prevention from insects or rodent;
- No eyewash available in laboratory;
- Not enough Personal protective equipments available (gloves, gowns, lab coat, mouth cover, goggles, etc);
- Need for Biological safety cabinet for those centres which deals with infectious samples;
- No proper waste management guidelines available;
- No Laboratory personnel and ESP properly trained on basic Bio-safety measures and protocols;
- No spill kits in case of accidents;
- No first-aid kits and fire extinguishers.

Recommendations

- Needs for the appointment of a Bio-safety coordinator/focal person in their centre;
- It was observed that the laboratory setup is not up to Bio-safety standard protocol but still there can be some adjustment done dividing the sections base on risk agents handled;
- The biohazard sign should be placed in the entrance door and also sign board displaying that “no eating, drinking and chewing in the lab”. Also add contact no. of the in charge or person concern in your biohazard sign in case needed in times of emergency;
- Simple operating procedures for all equipments are needed and also maintain equipment log chart to see whether the equipments are working and register to see who is operating the equipment;

- There is need of visitor form, temperature log chart, incubator log chart and autoclave log chart, incident/accident report form, which should be maintained every day;
- Every personnel working in laboratory should remove appropriate PPE before leaving the laboratory area and entering non-laboratory areas (lobby, administration offices, etc,).
- It is also recommended for proper storage of flammables and corrosives inside the closed shelf;
- The working desk should be maintained clean without any stationery or equipments crowded which will be inconvenient for laboratory personnel to properly clean the table after work is completed;
- Thermometer is needed for every fridge so that proper temperature for different test kits can be maintained as a result the quality of test kits will be maintained too;
- No separate disposal of laboratory waste and proper waste management guidelines;
- It is recommended that the laboratory personnel be issued a different coloured laboratory coat for working inside the laboratory and outside laboratory for other purpose which are washable;
- Develop the equipment SOPs;
- Develop equipment coding system, it is recommended to follow uniform coding system for the equipments, such as (Region,)/ (equipment code)/ (Number, to start with 01) to ensure traceability;
- Proper awareness training to the laboratory personnel and also to the ESPs about proper handling and disposal of waste;
- It is highly recommended to purchase the closed toe shoes, instead of the open toe shoes;
- It is recommended to use of 1-2% Virkon and bleaching (only) as disinfectant and to do away with any other phenolic disinfectant;
- Need for first-aid kits and spill kits and locate them in designated area.

5.6.2 Equipment maintenance

Table 11: Details of equipment maintenance

SI No.	Name of equipment	Remarks
1	Two Incubators	Issues rectified
2	Freezer(R1-Parasitology)	Issues rectified
3	Freezer (R5, R15 andR16-Bacteriology)	Issues rectified
4	Freezer (R13-Clean room)	Issues rectified
5	Freezer (R10, R11 andR18)	Issues rectified
6	Deep Freezer (Old)	Issues rectified

5.6.3 Incidence Monitoring and Reporting

Table 12: Details of incidence monitoring and reporting

Date	Incident	Action
14.02.2019	A spill of rabies sample inside the eye of one laboratory personnel while opening the package	• He was immediately made to wash his eyes and rushed to hospital. He got vaccinated with rabies PEP. • Bio-safety officer issued a notification about the incident and advised all the lab personnel to comply by Bio-safety measures while dealing with high risk samples.
10.05.2019	While maintaining Bio-safety Cabinet II the service providers were not aware of the dismantling of Cabinet when they visited last time, one of them push the cabinet and fell upon him injuring his hand	• Reported the incident to the laboratory head and he was told to wash his hand with disinfectant (dettol) and apply antiseptic cream and bandaged the wound.

5.7 Laboratory Information Management System (LIMS)

Dr RB Gurung, National Centre for Animal Health, Serbithang

Introduction

Laboratory Information Management System is the online database system designed to efficiently manage the information of all the veterinary laboratory activities in the country. It has the features for online entry of sample details, test result, diagnosis and recommendation. The system helps the veterinary laboratories to track samples from submission to testing and reporting. This database enables real time tracking of sample testing status through a paperless system. Besides data storage and test result dissemination, customized analysis can also be performed to provide decisions required in policy interventions. This system is intended for all the laboratory facilities under the Department of Livestock (DoL) viz. National Centre for Animal Health (NCAH), Regional Livestock Development Centres (RLDCs), Satellite Veterinary Laboratories (SVLs) and Dzongkhag Veterinary Laboratories (DVLs). Once the system is live online it can be remotely accessed by any authorized personnel.

Rationale

Management of laboratory diagnostic activities, associated analysis and reporting is a time-consuming process often riddled with transcription error such as typing and optical character recognition (OCR) errors and more difficult in a manual system. Custom in-house solutions are developed by few individual laboratories, while some enterprising entities at the same time sought to develop a more commercial reporting solution in the form of special instrument-based systems. LIMSs are dynamic because the laboratory's requirements are rapidly evolving and different laboratories often have different needs.

In Bhutan, the veterinary laboratory network covers almost all dzongkhags with one laboratory in each district, four regional laboratories, four satellite laboratories and one national laboratory. On annual basis, these laboratories churn out large number of data from the number of samples submitted and test performed. Until now, all the laboratory networks in the country are maintaining this information on paper-based system. Storage and management of such large volume of data manually is a huge challenge with high degree of vulnerability to loss and damage. A web-based database system will immensely help in electronic storage, enhanced security, easy analysis and control on chain of custody.

The generic functionality of any LIMS database can roughly be divided into five laboratory processing phases:

1. Reception and log in of a sample and its associated customer data
2. Assignment, scheduling, and tracking of the sample and the associated analysis
3. Processing quality controls associated with the sample and equipment
4. Storage of data associated with the sample analysis
5. Inspection, approval and compilation of report or further analysis

The database (LIMS) was completed with several rounds of discussions. A training of trainers (ToT) was also carried out involving the representatives from RLDCs, SVLs and DVL. A month-long testing was conducted by hosting with the aim of getting feed backs and comments from the end users from regional and dzongkhag levels. The glitches were finally fixed and made ready for launching.

5.8 Fleming Fund Grant

Fleming fund grant was awarded to the Ministries of Health and Agriculture to strengthen Bhutan's capacity for dealing with the worldwide problem of antibiotic resistant diseases for strengthening AMR surveillance.

The UK Government's based Fleming Fund was granted to Ministry of Health and Agriculture and Forests to strengthen Bhutan's capacity for dealing with the worldwide problem of antibiotic resistant diseases for strengthening AMR surveillance. The reception was organized to mark the commencement during March 2019 and was hosted by Sir Dominic Asquith, KCMG, British High Commissioner to India and Michael Rutland, OBE, British Honorary Consul to Bhutan at hotel Tashi Taj, Thimphu.

The aim of the Fleming Fund is to address critical gaps in surveillance of antibiotic-resistant bacteria in low- and middle-income countries (LMICs) in Asia and Sub-Saharan Africa, which are set to bear the highest burden of antibiotic-resistant infections.

This is the first Fleming Fund Country Grant to be released in Bhutan. In preparation for this grant Mott MacDonald, carried out a Scoping Visit in January 2018 which was followed by Positioning Activities in March 2018 to refine the design of surveillance systems and conduct laboratory assessments, in order to better understand the priority areas to be supported through this request for proposal (RFP).

These activities culminated in identification of the major gaps and needs for strengthening AMR and AMU surveillance in humans and animals, and informed agreement with the Royal Government of Bhutan about grant objectives and outputs.

The focus of AMR surveillance in food animals supported by the first country grant will be on testing for resistance in enteric bacteria in healthy broilers and layer hens in Thimphu and Chukha and Trashigang. It will also include the National Food Testing Laboratory (NFTL) for resistance in bacteria on locally grown chicken in the Thimphu area.

The grant of about £1-1.5m is expected to be implemented for 18 months. Following the grant, the inception phase of six months (April to September 2019) was initiated with focus on strengthening the governance, that is, office set ups and infrastructure development. The project started with the kick-off meeting during April 2019 where the procurement of consumables, reagents, chemicals and media were discussed.

5.9 Fleming Fellowship-Chevening Scholarship Awards to Bhutan

One of the components of the Fleming fund is Fleming fellowship. The aim of the Fleming Fellowship Scheme is to advance the goals of the Fleming Fund by supporting the professional development of key practitioners and change-makers in selected countries.

The objectives are: to enhance investments made through Country and Regional Grants for improved AMR and Antimicrobial use (AMU), surveillance, encouraging peer-to-peer learning and joint problem-solving through participation in One Health communities of practice and contribute to the global dialogue on combating resistance.

Under this scheme, the management agent has funded three Fleming Fellowships in the animal health in the following areas:

- AMR Surveillance Fellowship
- AMR Laboratory Fellowship
- AMC/U Surveillance Fellowship

The above three fellows were selected through open advertisement during the period.

6. ACHIEVEMENTS OF DRUGS, VACCINES AND EQUIPMENT UNIT (DVEU)

6.1 Procurement of medicines, vaccines and equipment during FY 2018-19

- Fast track tendering and procurement for veterinary medicines and vaccines for the FY 2019-20 was completed by June 2019 as per the EVDP management cycle;
- Normal tendering and procurement of veterinary medicines and Vaccines was done and completed in August 2018;
- On-track tendering and procurement of veterinary equipment and non-drug items was done and completed on January 2019;
- Total tendered amount for medicines and vaccines for the FY 2018-19 was worth Nu. 27 million and the supply orders were given to the substantially responsive bidders;
- Total tendered amount for veterinary equipment for the FY 2018-19 was worth Nu. 2 million and the supply orders were given to the substantially responsive bidders;
- The Unit facilitated in getting approval for direct procurement of Veterinary hormones/ medicines and Aquatic medicines;
- The Unit spent Nu. 0.24 Million on Veterinary hormonal medicines (part payment) and Nu. 0.0451 Million on Aquatic medicines.

6.2 Verification and inspection of veterinary drugs and equipment

- A total of 10 verification/inspection visits were conducted by the verification team during the FY 2018-19, in order to inspect the newly arrived consignments of veterinary medicines, equipment and non-drug items in LCS, Phuentsholing and National Centre for Animal Health (NCAH), Serbithang;
- Verifications and inspections were carried out for RGoB funded medicines/equipment/non-drug items.

6.3 Distribution of Veterinary Medicines, Equipment and Non-drug Items

- As per the revised modality for distribution of veterinary medicines, equipment and non-drug items, the mass distribution was done two times in a financial year 2018-2019 (Table 13 and 14)
- Distribution was done up to the Dzongkhag Veterinary Hospital (DVH) point for Dzongkhags and till the respective Central Farms and Agencies' premises;
- Ad-hoc and emergency distribution of medicines and equipment were done throughout the year, as and when the requirements were submitted to DVEU by the respective centres.

Table 13: Summary of 1st lot, Mass distribution of Veterinary medicines, Equipment and Non-drug items for FY 2018-2019 (Date: 26th November – 15th December)

SL. No.	Name of the Agency	Total for medicines	Total for Equipment
1	Dzongkhags	16,914,678.31	15,300
2	Central Farms/Central Agencies	3,606,161.214	101,097.75
Grand Total		**20,520,839.52**	**116,397.75**

Figure 14: Summary of 2nd lot, Mass distribution of Veterinary medicines, Equipment and Non-drug items for FY 2018-2019 (Date: 18th June – 5th July, 2019)

SL. No.	Name of the Agency	Medicines		Total for medicines	Equipment and non-drug items		Total for Equipment
		Normal Distributed Drugs	Specialist/Emergency Drugs		Issued during 1st mass Distribution	Emergency Equipment	
1	Dzongkhags	3435577.04	1011889.82	4447466.86	1407805.98	453116.12	1860922.10
2	Central Farms/Central Agencies	696267.99	246366.70	942634.69	451444.57	45279.10	496723.67
3	Private Agency	1900.00	75889.30	77789.30	5870.11	3932.60	9802.71
Grand Total		**4,133,745.03**	**1,334,145.82**	**5,467,890.85**	**1,865,120.66**	**502,327.82**	**2,367,448.48**

6.4 Regularization of stock of medicines, equipment and non-drug items in LCS, Phuentsholing

- The physical, ledger and database stock verification of medicines, equipment and non-drug items was carried out in LCS, Phuentsholing. Accordingly, the ministerial approval was sought with valid justifications for differences and regularization of the stock differences.

6.5 Management of Expired and nearing-expiry medicines

6.5.1 Verification and inspection of veterinary drugs and equipment

- A total of 10 verification/inspection visits were conducted by the verification team during the FY 2018-19, in order to inspect the newly arrived consignments of veterinary medicines, equipment and non-drug items in LCS, Phuentsholing and NCAH, Serbithang.

6.5.2 Write-off and disposal of expired and damaged drugs in LCS, Phuentsholing

- Write-off approval for expired medicines in LCS, Phuentsholing was sought from Ministry of Agriculture and Forests (MoAF) and disposed drugs of worth Nu.1.15 Million.
- The expired and damaged drugs were processed for disposal at Penden Cement Authority Ltd (PCAL), Gomtu as per the pharmaceutical waste management guidelines.

6.5.3 Mobilization of nearing expiry medicines

- To minimize loss through expired medicines, the unit in collaboration with EVDP focal persons from four regions, mobilized all nearing-expiry veterinary medicines to various animal health centres throughout the country.

6.6 Store management

- Considering the storage of substantial volume of inflammable liquid at LCS, installation of fire-fighting equipment (10 nos.) and other necessities were completed to reduce or avert risk of fire hazard.

Figure 11: Fire extinguishing equipment installed at LCS

6.7 The 11th National Veterinary Medicine Committee (NVMC) Meeting

- The meeting was conducted on 5th and 6th March 2019 in TVH and SVL, Phuentsholing.
- 20 officials from DoL participated in the meeting.
- The meeting mainly focused on the key achievements of DVEU and the priority activities further strengthen the EVDP in the country.

Table 15: New NVMC Composition

1. Chief Veterinary Officer, AHD	*8. Representative from Piggery commodity centre*
2. Programme Director, NCAH	*9. Representative from fishery commodity centre*
3. Head, NVH	*10. Representative from NRDCAN (Feed and Fodder)*
4. Head, DVEU (Member secretary	*11. Representative from Wildlife*
5. Representative from RLDCs	*12. Representative from DVH*
6. Representative from Dairy commodity centre	*13. Representative from NVH/TVH*
7. Representative from poultry commodity centre	

6.7 Key Issues

- Some life-saving/essential drugs and equipments, not being quoted by the suppliers;
- Irrational indenting for veterinary equipment and non-drug items in accordance with the budget availability;
- Stocking of expired drugs in LCS and Regional Livestock Development Centres (RLDCs);
- Weak internal mobilization of nearing expiry drugs and acute drug shortage in some centres;
- Weak monitoring and reporting system for EVDP: 2-monthly and 4-monthly monitoring and reporting system for EVDP still not being implemented by the field units; and
- Lack of reliable database for EVDP: G2C database still at system enhancement phase.

7. ACHIEVEMENTS OF BIOLOGICAL PRODUCTION UNIT (BPU)

7.1 Vaccines production and procurement

- Produced 10,880 doses of Classical Swine Fever vaccine and 1,600 doses of Anthrax vaccines;
- Procured the vaccines worth Nu. 5.55m (Nu. 1.08M for poultry vaccines, Nu.4.47m for the rest)
- Initial approved budget of Nu.3.5M was not adequate, since around 5.0M is spent annually for the procurement of vaccines. Due to increasing demand for vaccines from the field, the unit had to procure additional vaccines worth Nu. 2.0 M from the revolving fund account.

Table 16: Details of vaccines procured during FY 2018-19

Vaccine type	No. of Doses procured
Gumboro (IBD) vaccine	2900000
ND B_1 vaccine	1900000
ND R_2B vaccine	950000
Fowl Pox vaccine	837000
Marek's vaccine	750000
FMD vaccine	225000
HS BQ combined vaccine	60000
Rabies vaccine	36140
PPR vaccine	10000
DHPPi + L vaccine	200
Total	**7,668,340**

7.2 Vaccine distribution

- The Biological Production Unit carried out the routine vaccine distribution once during the current financial year.
- The unit carried out the first quarter vaccine distribution in November 2018, starting from 6th Nov to 16th Nov, 2018.
- During the first quarter vaccine distribution, even the vaccine for the second quarter was clubbed due to the huge demand especially for poultry vaccines.
- Apart from the routine distribution, the ad-hoc and emergency distributions were done as and when there was requirement from Dzongkhag Veterinary Hospitals, Central Units including private poultry farms.
- During the distribution it was ensured that:

- The vaccines are delivered to the destination;
- The temperature of the refrigerated van is well maintained throughout the travel time using data logger;
- Monitoring of the cold chain equipments (Refrigerators) in all the DVHs (as per standard format) were done;
- Monitoring of the vaccine stock, usages, expiry, etc (as per standard format attached) were done;
- Issues if any were discussed with the In-Charge, DVH related to vaccines.

Details of vaccine distributed during the FY 2018-2019 is shown in the Annexure 10.

7.3 Temperature recording

- Temperature recording of refrigerator van and vaccine storage rooms are shown below in figure 12 and 13.
- It is evident from the graph below that the cold chain of vaccine is maintained within the recommended temperature of +2° to 8° C at all times.
- All the vaccines that are produced in-house as well as procured from outside are stored in the cool room on arrival until the final distribution.

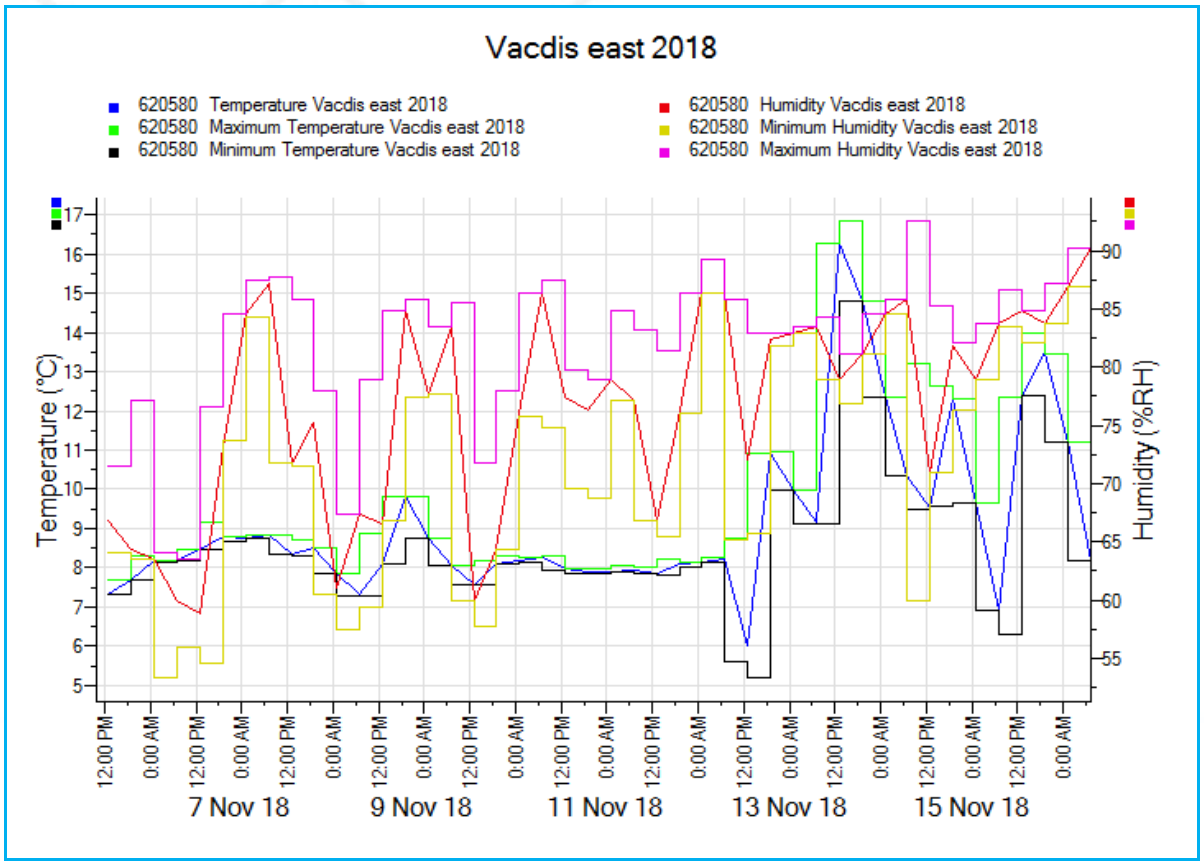


Figure 12: Graph indicating the maintenance of cold chain during the period of Vaccine distribution

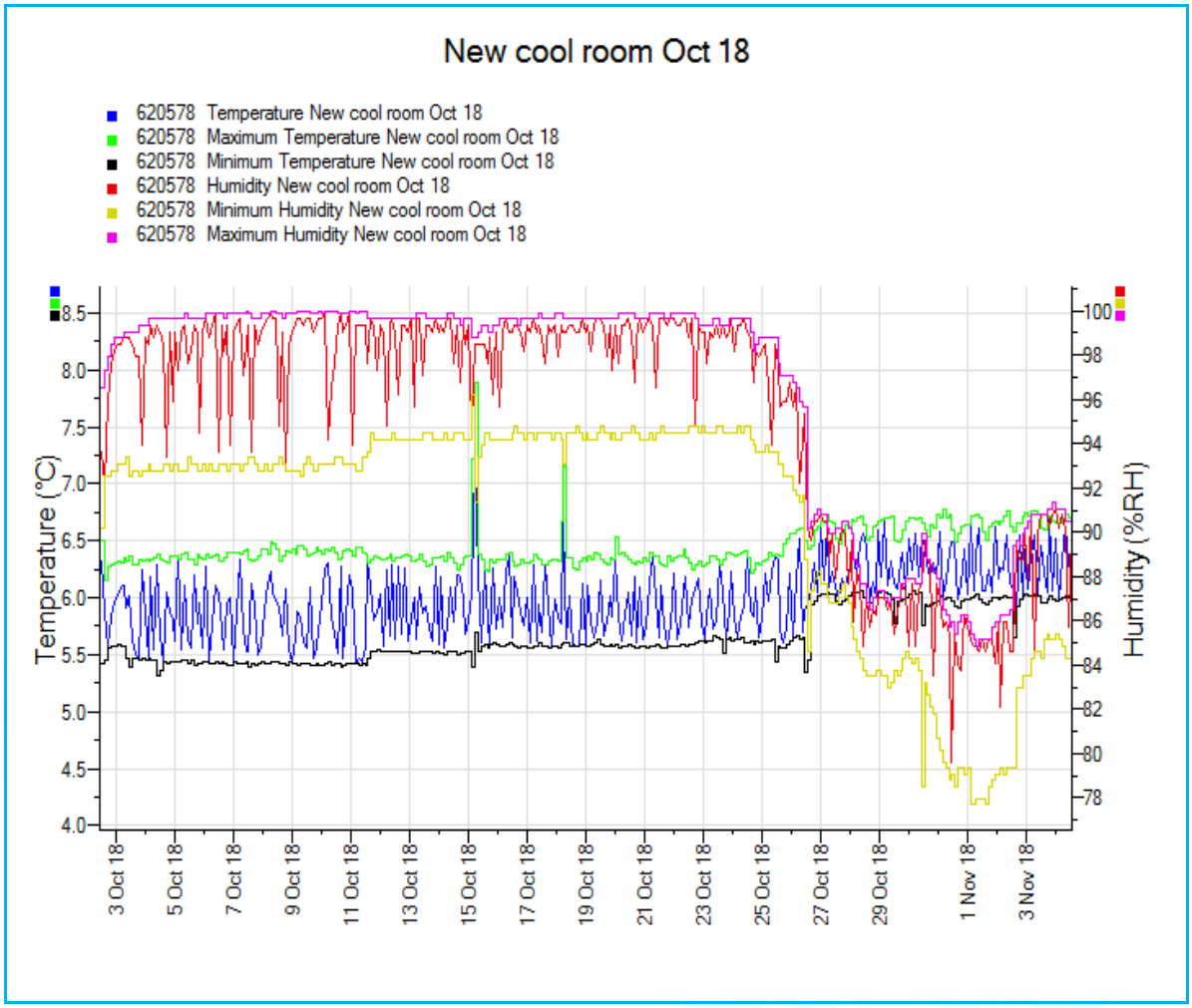


Figure 13: The temperature recordings of the vaccine storage room for the period from October 3, 2018 to November 3, 2018 prior to distribution.

8. ACHIEVEMENTS OF NATIONAL DOG POPULATION MANAGEMENT AND RABIES CONTROL PROJECT (NDPM-RCP)

Phase I: September 2009 – June 2012

- **35,689 dogs** were covered under Catch, Neuter, Vaccinate and Release (CNVR) programme.

Phase II: July 2012 to June 2015

- Approximately **25,128 dogs and cats** were sterilized and vaccinated.
- The Community Animal Birth Control (CABC) Programme was initiated in order to sustain dog population management (DPM) throughout Bhutan.
- As per the 2015 National Survey Conducted, the national coverage as of May 2015 stands at 64.1% in urban areas and 44.7% in rural areas.

Phase III: November 2015 to June 2018

- The project was further extended by three years, to streamline CABC and ensure on-going impact before the project can be entirely handed over to the RGOB by HSI.
- As per the MoU signed between DoL and HSI on 9th November 2015, the partnership was based on 65% contribution from RGoB in cash and 35% contribution from HSI, which were all in-kind.

During these 3 phases of the project, a total of **more than 92,000** dogs were sterilized and vaccinated.

After the end of phase-III in June 2018, project has been coordinating and conducting high volume low cost spay neuter along with rabies control with limited budget which is the main mandate of the project

8.1 Dog population management

- The second dog population survey and KAP survey were carried out for the entire country in July 2018, and the key findings are:
    - 40% of rural households own a pet dog;
    - 65-75% of dogs in Bhutan are sterilized and vaccinated; and
    - Canine transmissible venereal tumours were common among street dogs before the project started in 2009. In the 2018 survey, no dogs were found with CTVT in Thimphu.
- The project, in collaboration with Royal Society for Protection and Care of Animals, carried out education and advocacy programmes for dog population management, in most of the schools of Haa, Paro, Wangdue Phodrang and Punakha;
- Through community animal birth control (CABC) programmes, a total of **13,392** surgeries and vaccinations (ARV) were carried out both in dogs and cats in the field clinics, as detailed in the graph below:

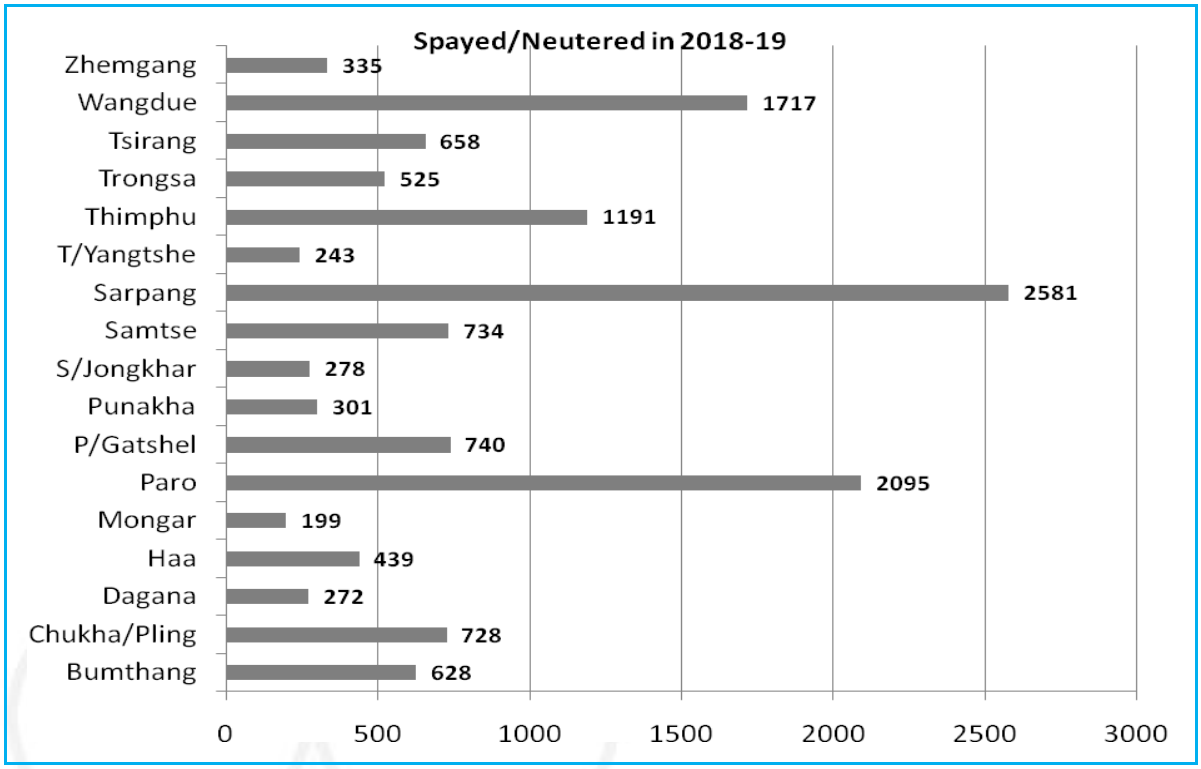


Figure 14: Dzongkhag-wise figure for sterilization carried out, FY 2018-2019

Figure 15: CABC and awareness team

8.2 Mass dog vaccination campaigns

Mass anti-rabies vaccination campaigns were organized in Samdrup Jongkhar, Pemagatshel, Chukha, Samtse, Dagana and Sarpang Dzongkhags, vaccinating a total of **5,453 dogs** (Figure 16);

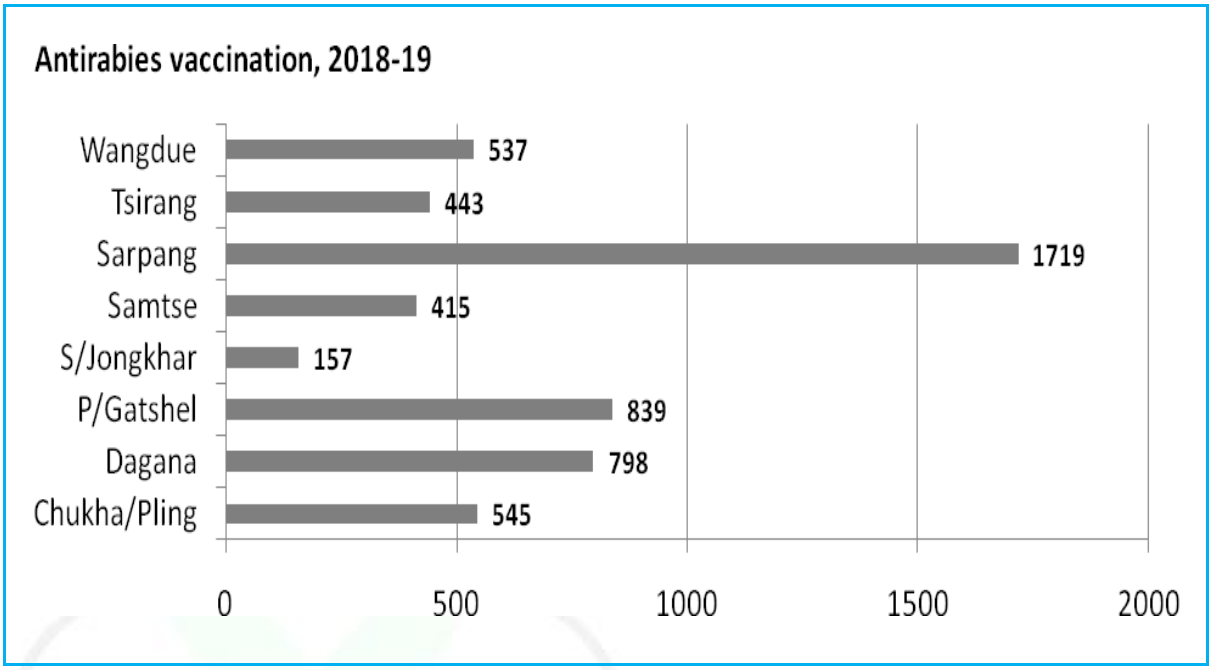


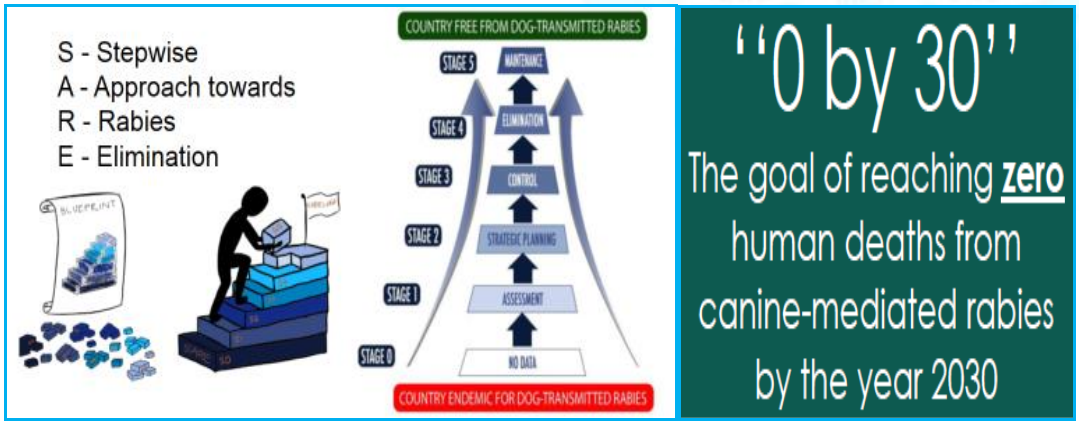
Figure 16: Mass anti-rabies vaccination in dogs for the year 2018-19

8.3 Observation of World Rabies Day: 28th September

Due to the impending elections last year, public gatherings were restricted. Nevertheless, the World Rabies Day with the theme ***"Share the message, Save a life "*** was observed, but only in the presence of technical officials from MoAF (DoL and Forestry officials involved in wildlife rescue and rehabilitation activities) and MoH, of Samdrup Jongkhar, Gelephu, Sarpang, Phuentsholing, Samtse and Sipsu.

8.4 Reduction in incidences of dog-mediated human rabies

Except for one human rabies case in 2016, no dog-mediated human rabies cases were reported since 2013. Therefore, Bhutan is well-on-track of achieving the global target of ***Zero-by-30***, that is, freedom from canine-mediated human rabies by 2030.



Bhutan ➤

9. DISEASE SURVEILLANCE, SURVEYS AND RESEARCHES

9.1 Bhutan at the forefront of antimicrobial resistance prevention activities

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Abstract

The global concern of AMR is addressed by World Organisation for Animal Health, World Health Organization and the Food and Agriculture Organization. In line with the global strategy of AMR containment, the Department of Livestock under the Ministry of Agriculture and Forests in Bhutan has initiated prevention and containment activities for AMR in the country. We conducted a review to understand the status on containment activities in Bhutan with an aim to align/realign the activities with National Action Plan.

Multi drug resistant (MDR) Salmonella is common pathogen isolated in both imported and home-produced chicken and were found to be resistant to antibiotics like Gentamicin, Streptomycin, Ampicillin, Trimethoprim, Cephalexin, Ciprofloxacin Nalidixic acid and Amoxicillin. MDR ESBL producing Escherichia coli was isolated from the pigs, which are found resistant to Ampicillin, Cephalothin, Cefotaxime, Ciprofloxacin, Streptomycin, Chloramphenicol, Nalidixic acid, Sulphamethoxazole, Trimethoprim, Tetracycline and Kanamycin.

The Ministry of Health and Ministry of Agriculture and Forests developed National action plan jointly for prevention and containment of AMR. Public awareness is created by observing antibiotic awareness week and through mass media. The antibiotic use in both human and animal is being regulated by the Drug Regulatory Authority of Bhutan. Uses of antibiotics as growth promoters/additives in animal feeds are also restricted in the country.

Poster Presented at Second OIE global conference on antimicrobial resistance and prudent use of antimicrobial agents in animals: putting standards into practice, Marrakesh, Morocco, 29th to 31st October 2019.

9.2 Prevalence of Taeniid parasites and molecular characterization of *E. granulosus sensu stricto* in dogs, human and cattle in Bhutan

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Abstract

Introduction

Dogs belong to the first species to be domesticated contributing to hunting activities but also providing companion. In recent years an increase of the free-roaming community dog population has been observed with an estimate of 71,245 owned dogs and 48,379 free roaming community dogs from which 22,772 are in urban areas while 25,607 are in rural areas. A diverse range of zoonotic infections, including parasitic, bacterial, viral and fungal diseases, can be transmitted from dogs to human. Furthermore, dogs are known since decades as definitive host for *Taenia multiceps* causing coenurosis, commonly called as gid disease in yaks in Bhutan. Among various parasitic diseases, eggs of Taeniids *(Taenia* and *Echinococcus)* and *Toxocara species* have been found in dogs during routine faecal microscopy examination in Bhutan.

Although cystic Echinococcosis (CE) was documented in humans and livestock in Bhutan there is very little information regarding the molecular diversity of *E. Granulosus s.s* in animals. In this study, we characterized the Taeniid eggs from community, private owned, free-roaming dogs and yak dogs from all districts in Bhutan and also conducted a molecular characterization of the *Echinococcus* cysts collected from human patients over a period of two years (2015-2017).

Material and methods

A total of 953 faecal samples were collected from all the 20 districts of the country between May 2016 and April 2018. 670 community dog faecal samples and 283 yak dogs and field carnivore samples. 13 human cysts of varying sizes were collected between 2015 and 2017 from patients undergoing surgery at the Jigme Dorji

Wangchuck National Referral Hospital (JDWNRH), Thimphu. Furthermore, bovine cysts from lungs (Figure 17) and spleen (Figure 18) were collected from a carcass of a mithun [*Bos frontalis*] breeding bull.

Figure 17: Cysts in lungs (Mithun)

Figure 18: Cysts in spleen (Mithun)

Molecular analysis

Genomic DNA extraction was carried at the Institute for Parasitology. The positive samples were subjected to multiplex polymerase chain reaction [PCR] using mitochondrial DNA targets for identification of the morphologically indistinguishable eggs of Taeniid tapeworms. For human and bovine cyst samples, confirmation of the parasite species was accomplished by PCR of the cox1 gene (366bp).

Result

A total of 72 out of 953 (7.5%) dog faecal samples were positive for at least one cestodes species. 3.15% [30/953] were positive to *E. Granulosus s.s,* 0.84% [8/953] to *E. ortleppi* and 3.46% [33/953] to various other *Cestode* species. The highest prevalence of *E. granulosus s.s* was observed in Paro (10.17%) followed by Wangdue Phodrang (9.79%) and Trashigang (5.19%) districts. *T. multiceps* were recovered in dog fecal samples from three yak rearing districts in western Bhutan (Gasa, Thimphu and Haa).

Figure 19: Taeniid egg from dog faeces

Figure 20: Scolex from human cyst

Conclusion

This is the first nationwide detailed study conducted to understand the prevalence of various Taeniid, particularly *E. granulosus s.l.* in dogs, livestock and humans and also *T. multiceps*, the causing agent of coenurosis (gid disease) in yaks in Bhutan. Our study documents the presence of *E. granulosus s.s.* in dog faeces and also in human cysts in the same area/districts indicating transmission of *E. granulosus* s.s. from dogs to humans. Hence, regular deworming of community and private dogs that have access to viscera of potentially infected intermediate hosts and especially yak dogs should be implemented to control both, cystic echinococcosis in humans and gid disease in yaks.

9.3 Collaborative studies on Salmonella under WHO AGISAR project

Salmonella has been recognized as an important zoonotic pathogen of economic significance in animals and humans. Salmonellosis is most common and widely distributed food-borne disease and increasing antimicrobial resistance in non-typhoid *Salmonella* species has been a serious concern for public health worldwide. A recent study identified increasing resistance of *Salmonella* to drugs commonly used to treat severe *Salmonella* infections in adults and children. Outbreaks of multidrug resistant *Salmonella* strains have been recorded in various countries in the Indian subcontinent.
A study on prevalence of *Salmonella* in imported chicken carcasses in Bhutan showed 13% prevalence. *Salmonella enteritidis* dominated with a prevalence of 80.7% and 40 of the 42 isolates harboured two or more resistance determinants. Frequent outbreak of Salmonellosis has been reported in humans, either through the water sources or from the food items. A recent study concluded the prevalence of *Salmonella* at 20.3% and 27.1% in imported and locally produced beef and pork respectively. These isolates were not tested for antimicrobial resistance. Thus, the antibiotic susceptibility profile of these organisms is unknown.

Bhutan proposed a pilot study to develop antibiotic susceptibility profile of *Salmonella* isolates from human, animals and food products of animal origin. The antibiotic susceptibility test (ABST) profiling was a collaborative work between Ministry of Health, Department of Livestock and Bhutan Agriculture and Food Regulatory Authority. The ABST profile data from human samples were generated by Clinical Laboratory, Ministry of Health, while the National Centre for Animal Health generated for animals and National Food Testing Laboratory for all food products of animal origin. The main objectives of this collaborative study was to develop ABST profile for *Salmonella* isolates in Bhutan while enhancing national capacities for laboratory surveillance and antimicrobial resistance monitoring through One Health Approach. The findings are also aimed at rational management of antimicrobial use in human and animals.

A total of 54 isolates were collected from all three sectors: human, animal and food. All these isolates were collected using harmonized culture protocols, basic test and biochemical test. Samples were cultures at respective sector laboratories. All isolates

recovered and confirmed as *Salmonella* were referred to Institute of Hygiene and Food Sciences, University of Zurich for serotyping and detection of resistant determinant.

From the 54 isolates only 21 were identified as *Salmonella* of various species. Species level *Salmonella* confirmation was: *S. enteritidis* and *S. newport*- 23.8% each (5/21); S. Typhi, S. Weltevreder and S. Virchow – 14.3% each (3/21); and S. Kentucky – 5% (1/21). Phenotypically, all isolated of *S. enteritidis* were resistant to nalidixic acid and Nitrofurantoin. Additionally, one each isolate of *S. enteritidis* and S. Virchow were resistant to TE. A more detail studies at genetic level to determine resistance profile is required. The results of multi locus sequence typing (MLST) is expected to receive soon which may confirm the resistant determinant in these isolates.

9.4 HPAI H5N1 virus characterization in collaboration with AAHL Geelong

In 2019 April one outbreak of HPAI H5N1 was reported from Dhamdara, Phuentsholing. The swab samples were tested by real time RT-PCR at National Centre for Animal Health, Serbithang and confirmed the involvement of H5N1 subtype HPAI virus. H5 HA gene sequencing and amino acid motif: Complete HA gene nucleotide sequences from H5 positive samples showed sequence similarities to A/duck/Bangladesh/34283/2017(H5N1. The H5 HA amino acid sequence alignment" showed the presence of multiple basic amino acid residues (PQKERRRKR*GLF), arginine (R) and lysine (K), indicating highly pathogenic avian influenza (HPAI) viruses. Phylogenetic analysis: Bhutan H5N1 samples had 99% amino acid sequence similarities to A/duck/Bangladesh/34283/2017(H5N1)-like viruses. Phylogenetic analysis based on near complete HA gene sequences confirmed that the H5N1 viruses detected in Dhamdara, Phuentsholing in 2019 belong to Asian H5 clade 2.3.2.1a.

9.5 FMD vaccine efficacy study conducted at CRC, Wangkha

Tenzin Tenzin, Tenzinla, RB Gurung, Dawa Tshering, Minga, Anna Ludi

FMD is a highly contagious viral disease that affects all cloven-footed animals including cattle, yaks, sheep, goats, pigs and other wild ruminants. The disease is endemic in many parts of the world, particularly in developing countries of Asia, Africa, the Middle East, and some parts of Europe. FMD is endemic in all countries of South Asia. In FMD-endemic countries, FMD can have serious economic losses through reduced production in terms of milk, meat and draught power and deaths. FMD is the most important disease affecting livestock production in Bhutan and it is a notifiable disease as per the Livestock Rules and Regulations of Bhutan 2017. One of the control measures practiced in Bhutan is vaccination of animals using trivalent – O, A and Asia 1 serotype vaccine manufactured by Indian Immunologicals Ltd. India. Although vaccination is practiced on annual basis either biannual or annual depending on the endemicity of the disease Bhutan experienced sporadic outbreaks even in vaccinated herd. These outbreaks could be attributed to factors such as vaccine mismatch with wild type virus, cold chain failure or poor vaccination coverage. A study was designed to determine the protection level conferred by trivalent vaccine. Study was conducted at Regional Cattle Research

farm/Calf Rearing Centre, Wangkha. The Centre did not report FMD outbreaks for more than 10 years. Three groups of animals were identified: i) Booster group (n = 18), which received vaccine on 0-day, 28 days and 120 days; ii) Non-booster group (n = 18), which received vaccine only on 0 day and; iii) Control group (n = 5), which did not receive vaccine. All animals were bled on 0 day, 28 days and 120 day of the study. The serum samples were used for vaccine matching at Pirbright Institute, UK. The result showed that about 37% of the animals had high proportion of NSP antibodies at 30-day post vaccination. Vaccine matching test was performed by 2dmVNT with two each field isolates of Bhutan for serotype A and O. Sera used for serotype A were from A IRN/2005, A TUR 20/06, A/GVII and A22 IRQ/24/64. The sera used for serotype O were O 3039, O Manisa and OTUR 5/09. The highest 2dmVNR r_1 value for serotype A was against A/GVII and similarly the highest 2dmVNR r_1 for serotype O was against O TUR 5/09. All r_1 values for O3039, O Manisa and O TUR 5/09 were above 0.30 indicating close antigenic relationship between the field isolates and vaccine strain. However, it is not known at what point of time the r_1 value was determined.

9.6 Survey and Phylogenetic Analysis of Rodents and Important Rodent-Borne Zoonotic Pathogens in Gedu, Bhutan

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Abstract

Rodents are well-known reservoirs and vectors of many emerging and re-emerging infectious diseases, but little is known about their role in zoonotic disease transmission in Bhutan. In this study, a cross-sectional investigation of zoonotic disease pathogens in rodents was performed in Chukha district, Bhutan, where a high incidence of scrub typhus and cases of acute undifferentiated febrile illness had been reported in people during the preceding 4-6 months. Twelve rodents were trapped alive using wire-mesh

traps. Following euthanasia, liver and kidney tissues were removed and tested using PCR for *Orientia tsutsugamushi* and other bacterial and rickettsial pathogens causing bartonellosis, borreliosis, human monocytic ehrlichiosis, human granulocytic anaplasmosis, leptospirosis, and rickettsiosis. A phylogenetic analysis was performed on all rodent species captured and pathogens detected. Four out of the 12 rodents (33.3%) tested positive by PCR for zoonotic pathogens. *Anaplasma phagocytophilum, Bartonella grahamii*, and *B. queenslandensis* were identified for the first time in Bhutan. *Leptospira interrogans* was also detected for the first time from rodents in Bhutan. The findings (Table 17) demonstrate the presence of these zoonotic pathogens in rodents in Bhutan, which may pose a risk of disease transmission to humans.

Table 17: Pathogens detected from wild-caught rodents collected from Gedu, Bhutan

Rodent species	**No. of rodent**	**No. of positive**						
		Leptospira species	*Orientia tsutsugamushi*	*Rickettsia species*	*Anaplasma phagocytophilum*	*Ehrlichia chaffeensis*	*Bartonella species*	*Borrelia species*
Niviventer fulvescens	1	0	0	0	1	0	1	0
Mus species	2	0	0	0	0	0	0	0
Mus musculus	1	0	0	0	0	0	0	0
Rattus nitidus	4	1	0	0	0	0	1	0
Suncus murinus	4	0	0	0	1	0	1	0
No. of positives (%)	12	1 (8.3)	0	0	2 (16.7)	0	3 (25.0)	0

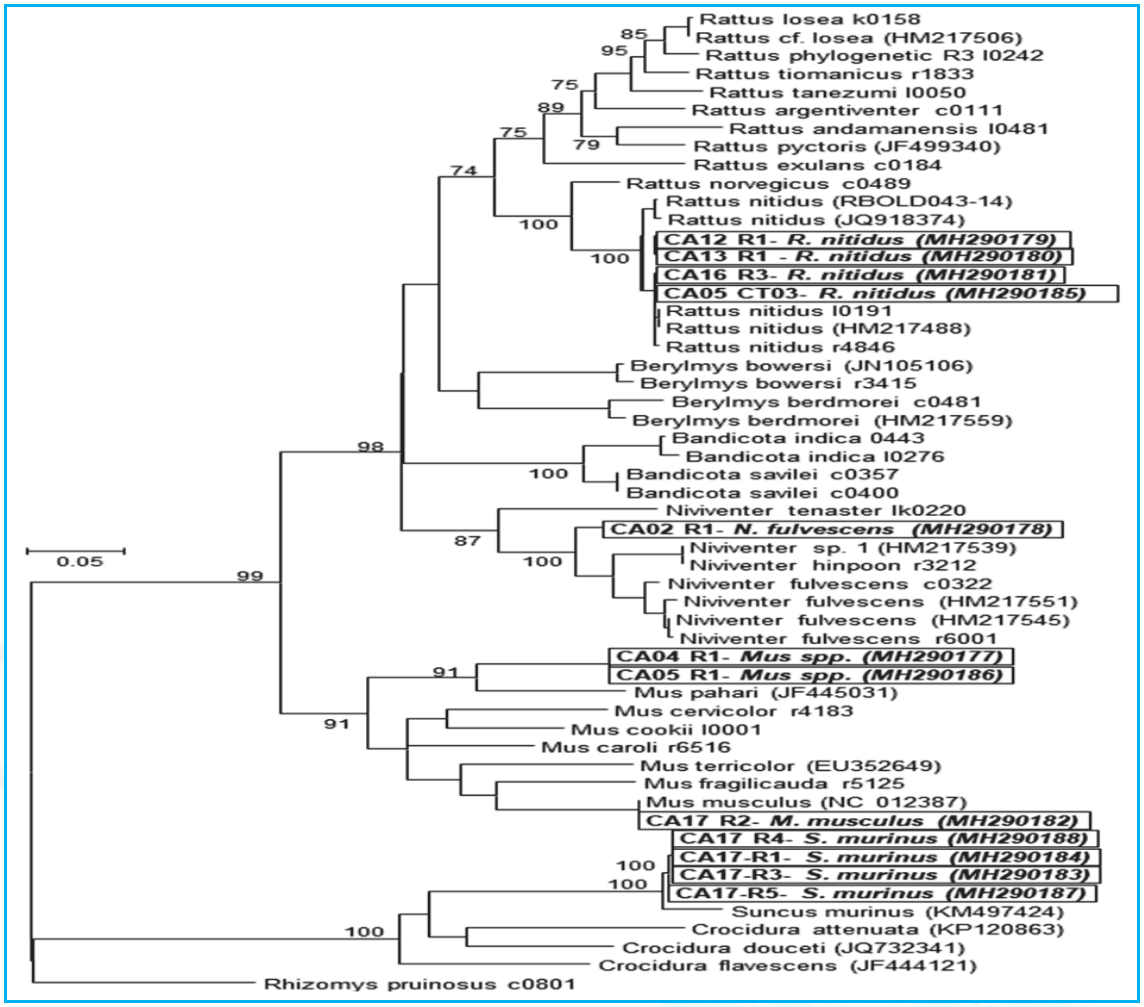

Figure 21: Phylogenetic tree of COI gene (541 bp) of rodents sampled in the study. GenBank accession numbers, sequences from CERoPath project and BOLD are noted after each sequence. Only bootstrap values of 70% or greater are shown. Scale bar represents substitutions per site.

9.7 Private and Street Dog Survey: Bhutan Project Monitoring and Evaluation

Abstract

Humane Society International, the global arm of The Humane Society of the United States, in partnership with the Department of Livestock, Royal Government of Bhutan has been implementing a humane dog population management and rabies control program since 2009. It is the first and longest humane program that has been implemented on a national level since its inauguration. The program has so far completed three phases, under which more than 92,000 dogs were sterilized and vaccinated against rabies. The third phase has ended in July 2018.

Monitoring and evaluation of the program has been a part of all three phases and to measure the impact of the sterilization program a nation-wide dog population survey was conducted in May 2015, which showed that very high sterilization rates have been achieved overall but especially in both Thimphu and Paro (which host the largest proportion of the national dog population). It also suggested that the continuous and

strategic sterilization programs in Thimphu and Paro have maintained the initially achieved sterilization coverage (>70%), however our monitoring survey in July 2018 suggested that despite high sterilization rates the dog population in some areas of the country has almost doubled in the last three years, specifically Thimphu and Paro. A KAP (knowledge, attitude and practices) survey revealed that human density, dog keeping practices and street dog feeding practices are governing the dog population dynamic significantly, directly and indirectly. Based on these findings HSI proposes a new focus for the fourth phase of the project – Dog friendly neighbourhoods and a pet welfare program, which manages the different dog communities (street and private dog communities) in partnership with the human communities they live with, while continuing the successful sterilization program.

Research result summary

In both districts Thimphu and Paro we recorded a significant increase of the dog density compared to 2015. In town areas for example we recorded 22.8% more dogs in Thimphu and 27.7% more dogs in Kabesa (Thimphu), however the highest dog density change was recorded in Paro (town) with a density increase of 76.8% of dogs per km. In chart below (Figure 22), we compare all Thimphu and Paro survey routes. While some have experienced decreased dog densities in the last three years the urban areas and some rural areas experienced an increase. Dogs per km street length is a tangible density measure how many dogs one would encounter along the survey route and provides a good indicator to assess dog population growths.

The ten-year program mainly focused on roaming dogs and did not target private dogs at all, however KAP survey results show that dog ownership was as high as 43.1% in rural areas (Thimphu and Paro combined) and 15% and 20.8% in urban areas of Thimphu and Paro respectively. We conducted both street dog surveys and household surveys (KAP and dog demographic) to explore the whole dog population and their relationship with the human communities they live with. The table below shows that ownership rates are high and sterilization rates low in some areas. Additionally, the age structure of the private dog population indicates there is a high turnover of dogs in all areas (skewed towards young dogs) but especially in the rural and semi urban areas. Based on the survey results we expect that rural and semi urban areas with high proportions of dog owning households and low sterilization rates must play a role in the influx of new dogs into urban areas, which generally show high sterilization rates of female street dogs.

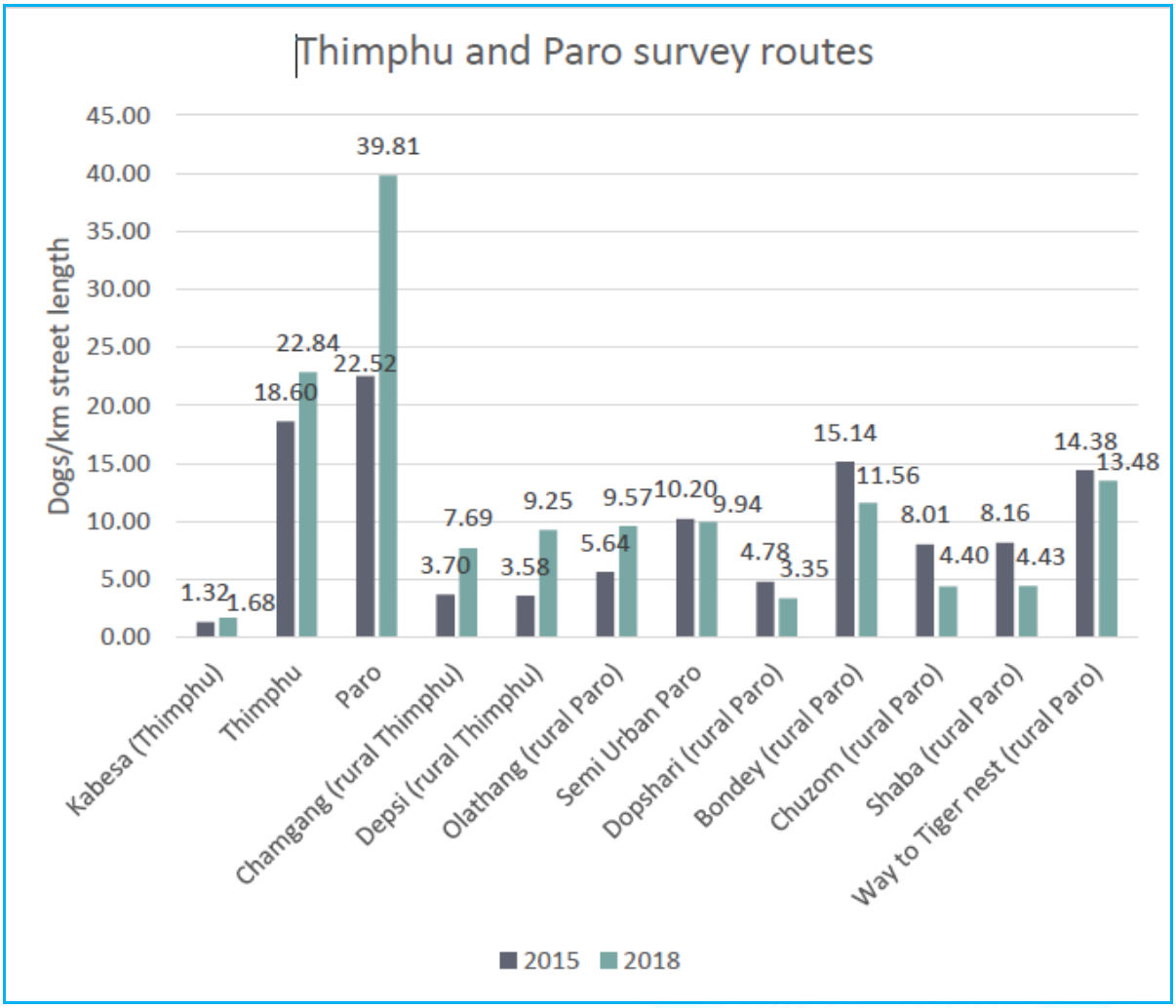

Figure 22: Survey routes

Table 18: Dog Ownership and Pvt. Dog sterilization rate

Area	Dog ownership rate	Private dog sterilization rates
Thimphu City	15.10%	32.95%
Paro City (B)	12.41%	56.52%
Paro suburban A	24.03%	36.36%
Paro suburban C	26.56%	52.27%
Thimphu and Paro rural	43.10%	37.62%

Table 19: Female street dog sterilization rates (2018)

Female street dog sterilization rates (2018)	
Urban area	**Percentage**
Thimphu Kabesa	83.3
Thimphu	70.9
Paro	81.16
Rural area	**Percentage**
Chamgang (Paro)	60
Depsi (Paro)	62.5
Chuzom (Paro)	46.15
Bondey (Paro)	56.25
Dopshari (Paro)	46.15
Olathang (Paro)	43.33
Semi Urban Paro	72.00
Shaba (Paro)	83.33
Way to Tiger nest (Paro)	42.86

There is a growing pool of evidence that dog populations and population dynamics are largely influenced by (dependent on) dog interactions and relationships with the local human community (e.g. Morters et al., 20141; Villatoro et al., 20162, and unpublished HSI data). Therefore, it is crucial to understand how the human-dog relationship and the quality of the interaction (positive vs negative) influence dog population dynamics as well as street dog behavior. Private ("owned") dog populations have long been ignored in discussions of street dog population management mainly because of two reasons:

1. There is a widely held assumption that there are relatively few private dogs where street dogs are common, and
2. It is assumed that private dogs and street dogs are two separate non-interacting populations (dog communities). As a result of several recent surveys in India, HSI now reports that dog demographic and KAP surveys show that not only should private and street dogs be considered as interacting communities (both are dependent on human behaviour, control and food/water provision) but should also be addressed as one dog community in a comprehensive dog management program to be sustainable.

This has multiple implications for sterilization and vaccination programs.
Private dogs need to be included in dog population management programs. They likely contribute to the street dog population because their litters are reared under relatively close human supervision and food provision, and because a large number (sometimes up to two-third) of them roam the streets with street dogs. The rate of abandonment of private dogs and pups from private dogs has not been determined but it is likely that street dogs are recruited from the private dog population. In Thimphu and Paro, in

particular, since sterilization efforts have maintained high proportions of sterilized street dogs.

The dog demographic and KAP survey in Thimphu and Paro (urban and Paro) resulted in the following key findings:

- Private dog sterilization rates were much lower than the street dog population's (overall sterilization rate was low with 39.7% sterilized compared to over 70% in the female street dog population in cities);
- Owned dogs were allowed to roam for at least part of a 24 hour day, especially in rural areas (up to 48% of the private dog population in rural areas and up to 39% in one area of Paro);
- Private puppy survival rate was relatively high in the last litter the households reared;
- People were most concerned about dog bites and aggressive dogs in their neighbourhood, both Paro as well as Thimphu urban areas report a 2.5 fold higher dog bite rate compared to the rural areas and other parts of Asia;
- Overall the combination of an increasing human population, available food (more meat shops and hotels), and unregulated breeding seem to be the most significant reasons recognized by the public for an increasing stray dog population. When asked why there are street dogs in Thimphu/Paro.

Besides the results of this survey, the authors' observations and conversations with Dr. Rinzin and Dr. Hiruka all suggest that street dog behaviour is very varied in both Thimphu and Paro, with some packs being easily agitated by human presents and other packs being very well adjusted to humans approaching them or passing by. Dog agglomerations were observed around the many meat shops. Dog packs around them where perceived as usually more aloof to even slightly aggressive in both urban areas, especially in the early morning hours.

9.8 National Street Dog Monitoring and Evaluation Survey and Knowledge, Attitude and Practices (KAP) survey

Background

With emerging methods to monitor and evaluate the impact of street dog programs, first ever street dog surveys in 2015 was conducted, designed and led by Dr. Lex Hiby (HSI consultant). This survey generated the first national evaluation of the sterilization rate across all Dzongkhags (districts) in the country as well as generated dog population estimates. Additionally, survey results in combination with clinic records and other monitoring surveys conducted by Dr. Karma Rinzin over time, were used to calculate the survival rates of sterilized dogs in order to distribute program efforts according to priority areas and areas with lower sterilization rates. The 2018 survey included a subset of the districts (eight Dzongkhags) but followed the below 2015 protocol, routes as well as start and end times. The results for the eight Dzongkhags surveys for both 2015 and 2018 are presented and discussed in this report.

Further a KAP (Knowledge, Attitude and Practices) survey was conducted to explore the relationship people have with their private and street dogs in urban and rural Paro and Thimphu.

There is a growing pool of evidence that dog populations and population dynamics are largely influenced by (dependent on) dog interactions and relationships with the local human community (e.g. Morters et al., 20141; Villatoro et al., 20162, and unpublished HSI data). Therefore, it is crucial to understand how the human-dog relationship and the quality of the interaction (positive vs negative) influence dog population dynamics as well as street dog behaviour. Private ("owned") dog populations have long been ignored in discussions of street dog population management. First, there is a widely held assumption that there are relatively few private dogs where street dogs are common. Second, it is assumed that private dogs and street dogs are two separate non-interacting populations (dog communities). As a result of several recent surveys in India, HSI now reports that dog demographic and KAP surveys show that not only should private and street dogs be considered as interacting communities (both are dependent on human behaviour, control and food/water provision) but should also be addressed in a comprehensive dog management program to be sustainable.

This has multiple implications for sterilization and vaccination programs.

Private dogs need to be included in dog population management programs. They likely contribute to the street dog population because their litters are reared under relatively close human supervision and food provision, and because a large number (sometimes up to two-third) of them roam the streets with street dogs. The rate of abandonment of private dogs and pups from private dogs has not been determined but it is likely that street dogs are recruited from the private dog population. In Thimphu and Paro, in particular, since sterilization efforts have been maintained high throughout the years. Dr. Tenzin, Paro veterinarian, reports 1500 to 2000 sterilizations per year with an overall sterilization rate of over 80%. Veterinarians and the knowledge of their Dzongkhag prove to be crucial. Dr. Tenzin, for instance, is aware of newly introduced dogs to the area and abandoned dogs around his sterilization clinic; however, the extent to which dogs are brought into the area as well as abandoned in the city remains unquantified at this point. Understanding more closely human directed movement of dogs as well as the role human play in the street dog population dynamics would not only help to improve the sterilization efforts of the program but provide an opportunity to create a human behaviour and community engagement campaign to sustainably address the problem and not only fix the symptoms (pun intended).

This survey and this report are an extension of a KAP survey conducted by Dr. Karma Rinzin and results will be compared across surveys in the second part of this report. What behaviors contribute to the problem and how they could be addressed in future efforts to take the program to the next phase, shall be explored.

Survey Design and Methodology – Street Dog Survey

Street dog surveys focus on the street dog population, which likely represents proportions of roaming private and truly unowned dogs of unknown ratio. Street counts

provide relative estimates of the roaming dog population and further provide a quantitative assessment of how many dogs residents encounter during their daily routines on the streets.

Street dog survey objectives:

- Generate a reliable estimate of the relative dog population per street kilometre;
- Estimate the proportion of sterilized dogs within the street dog population;
- Assess street dog welfare by tracking two indicators, body condition score and skin conditions as a proxy measure.

To generate an estimate of dogs per street kilometre, we created set routes, also called index or standard routes, in Google Maps along residential roads and highways but avoiding expressways (dogs tend to avoid these roads). A survey team, consisting of a driver and an observer in a car (or by foot), conducted the surveys early in the morning in towns or at any time in rural areas, following the start and end time from the 2015 survey. The observer used both the Google Maps app and the OSM Tracker app on a mobile phone. OSM tracker is an application that enables the observer to record a dog sighting and relevant specifics about a dog (female, male or unknown adult, sterile/notched female or sterile/notched male, pup, lactating) as well as record welfare indicators such as skin problems and body condition scores (BCS1 to BCS5), which are saved together with GPS coordinates of the sighted dog. OSM Tracker produces a track record of all sighted dogs and their specifics along the route which was followed during the survey. The data is subsequently downloaded and stored in an Access database for analysis. The survey route was surveyed on two consecutive days, by the same survey team, to measure the accuracy and power to detect change.

Results

Roaming Dog Abundance and density change in towns

Table 20 shows the count results for both surveys in 2015 as well as 2018 and the difference in dog numbers observed on the same track. The number of dogs encountered during the survey has decreased significantly in most urban areas of the districts, however Thimphu and Paro has experienced a significant increase in the number of street dogs. While 22.8% more dogs in Thimphu and 27.7% more dogs in Kabesa (Thimphu) was recorded, the highest dog density change in Paro was recorded with an increased density of 76.8%.

Table 20: Summary of the urban areas surveyed in 2015 compared to 2018 and the change in dog density per km surveyed.

Name of the Dzongkhag	Name of the Town	Survey Year	Track length	Number of Dogs Counted	Change in Number of Dogs	% Density Change	Dogs/km
Bhumthang	Bhumthang	2018	4.78	74.5	-12.5	-14.4%	15.59
		2015	4.78	87			18.20
Chukha	Tsimalakha (Chukha)	2018	6.51	75	-47	-38.5%	11.52
		2015	6.51	122			18.74
Chukha	Gedu (Chukha)	2018	8.89	59	-31.5	-34.8%	6.64
		2015	8.89	90.5			10.18
Chukha	Phuentsholing (Chukha)	2018	13.08	77	-47.5	-38.2%	5.89
		2015	13.08	124.5			9.52
Paro	Paro	2018	3.73	148.5	64.5	76.8%	39.81
		2015	3.73	84			22.52
Sarpang	Sarpang	2018	3.68	16	-69	-81.2%	4.35
		2015	3.68	85			23.10
Sarpang	Gelephu (Sarpang)	2018	7.25	53.0	-119.5	-69.3%	7.31
		2015	7.25	172.5			23.79
Samdrupjongkher	Samdrupjongkher	2018	4.9	40.0	-21	-34.4%	8.16
		2015	4.9	61.0			12.45
Samdrupjongkher	Deothang	2018	3.69	30.5	-10	-24.7%	8.27
		2015	3.69	40.5			10.98
Thimphu	Kabesa (Thimphu)	2018	17.82	30	6.5	27.7%	1.68
		2015	17.82	23.5			1.32
Thimphu	Thimphu	2018	22.07	504	93.5	22.8%	22.84
		2015	22.07	410.5			18.60
Trashigang	Trashigang	2018	3.5	33	-63	-65.6%	9.43
		2015	3.5	96			27.43
Samtse	Samtse	2018	1.47	31	-39	-55.7%	21.09
		2015	1.47	70			47.62

Roaming Dog Abundance and density change in rural areas

In Chhoker in Bhumthang, 87.5% more dogs were recorded compared to 2015. Olathang in Paro also showed an increased dog density of 69.7% as well as Zomlingthang in Sarpang (50% increase), Phuenshothang in Samdrup (16.7% increase) and both rural areas in Thimphu, Chamgang and Depsi, on which we recorded 107.7% and 153.3% more dogs in 2018. However, significant reductions in dog density were recorded across all districts, e.g. in Jigmeling in Sarpang, 81% fewer dogs were recorded compared to 2015.

In Table 21, the survey results per Dzongkhag were summarized. Overall it can be concluded that only Paro and Thimphu show an increased dog density, however, there are significant differences between areas within a district.

Table 21: Results of the street counts per Dzongkhag for 2015 and 2018

Name of the Dzongkhag	Survey Year	total track length	Number of Dogs Counted	Change in Number of Dogs	% Density Change	Dogs/km
Bhumthang	2018	21.19	176.5	-23.5	-11.8%	8.33
	2015	21.19	200			9.44
Chukha	2018	70.3	347	-193	-35.7%	4.94
	2015	70.3	540			7.68
Paro	2018	67.17	666.5	5.5	0.8%	9.92
	2015	67.17	661			9.84
Sarpang	2018	22.34	106	-296.5	-73.7%	4.74
	2015	22.34	402.5			18.02
Samdrupjongkher	2018	12.23	83.5	-68	-44.9%	6.83
	2015	12.23	151.5			12.39
Thimphu	2018	50.26	619	147	31.1%	12.32
	2015	50.26	472			9.39
Trashigang	2018	20.01	89	-90	-50.3%	4.45
	2015	20.01	179			8.95
Samtse	2018	15.94	132	-114	-46.3%	8.28
	2015	15.94	246			15.43

Impact of Sterilization

Average sterilization rates for the surveyed Dzongkhags are shown in figure 23. Overall sterilization rates are high within some areas (especially rural) with very low sterilization rates. Overall sterilization rates are important indicators; however, the authors believe that the proportion of sterilized female sis especially important when programs aim to reduce the density of dogs as the number of unsterilized females do not only represent the fertility of a population but also a few males (or one in fact) would be sufficient to sire pups with these females. However, male dogs can be sterilized much faster and programs need to make a specific effort to sterilize female dogs. (More details can be found in the appendix). Lowest and highest sterilization rates in females and overall for towns and rural areas are presented for all tracks that can be compared between 2015 and 2018, excluding the tracks that had significantly more rain.

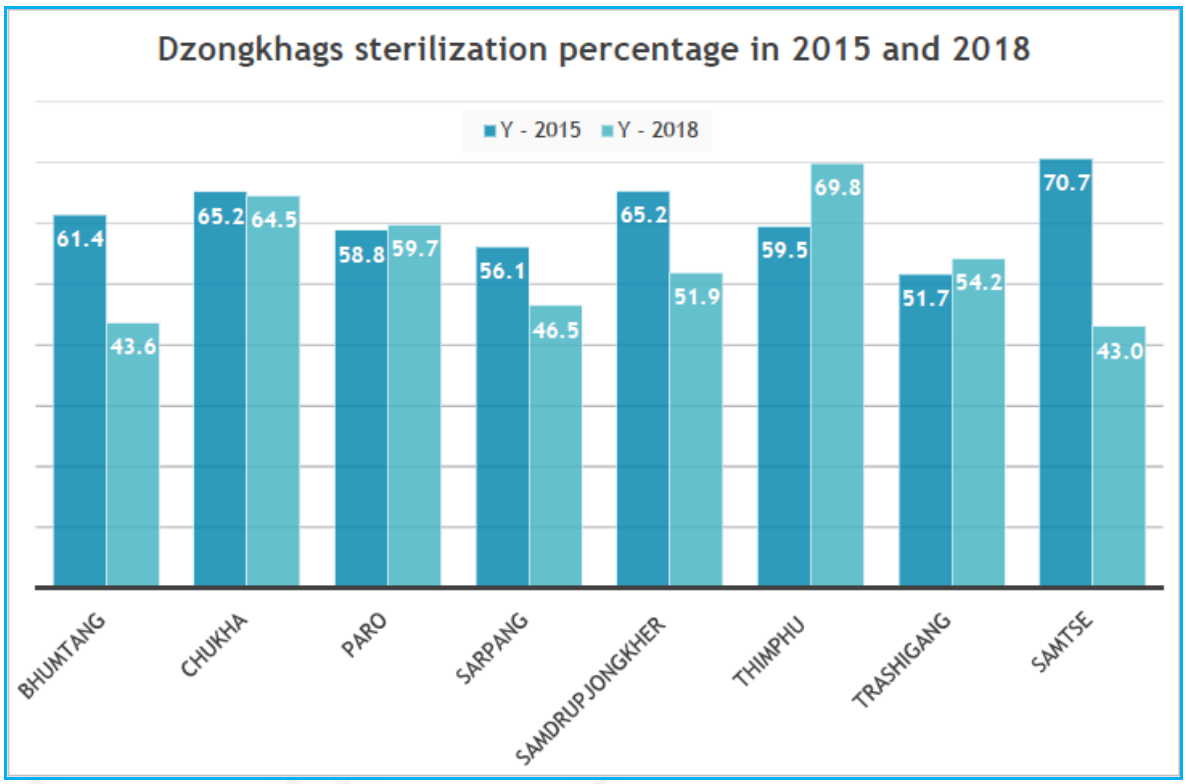

Figure 23: Average sterilization proportions by survey year and district

Impact of sterilization in town

In 2018, the lowest female sterilization rate in towns was recorded in Sarpang with 16.7% sterilized females and a total sterilization rate of 20%, a steep decrease compared to 2015 when we recorded 22% sterilized females and 49.7% total sterilized. The highest female sterilization rate in 2018 was recorded in Paro with 81.2% sterilized females and a total sterilization rate of 79.9%. Compared to 2015 the proportion of sterilized females was lower at 72.1% as well as the total sterilization rate with 73.8%, hence an increase in sterilized females and total sterilized dogs 9.1% and 6.1% respectively.

Impact of sterilization in rural areas

The lowest female sterilization rates were recorded in Jigmeling in Sarpang with 16.7% and a total sterilization rate of 16.7%. A steep decrease from 2015, when we recorded 20.6% sterilized females and 41.5% total sterilized dogs. High sterilization rates have been recorded in several places and some of the high proportions are due to a low number of recorded dogs

Survey Design and Methodology – KAP survey

Survey areas were chosen based on our street dog survey results and the knowledge that the largest proportion of dogs lives in Thimphu and Paro. The town areas are rapidly growing and with it the number of construction sites and human density. As a result, where human and housing density increases the roaming dog population will face decreased living space and a higher rate of contact with humans than previously.

Focusing this survey on the two main town areas in Bhutan will give a good insight on how this may have affected people in terms of how they keep their private dogs and how they perceive street dogs. Thimphu and Paro were divided in rural and urban areas. Paro urban was further divided into three areas A, B and C; Judging from Google Earth, only area B has high density housing, whereas areas A and B have lower housing densities.

Results

983 households were interviewed, of which 11 declined to participate (98.9% response rate). The households owned 300 dogs in total. About two thirds of all dogs were male dogs (62.5%, 187) and the remaining were female dogs (37.5%, 112). The sterilization rate was overall low with only 39.7% (119) of the dogs being sterilized and 58% (174) confirmed not sterilized and another 2.3% (7) not certainly sterilized.

To explore how observations and perception of the street dog population is compared to residents' perception; an open ended question was included in the survey. Responses for the question 'Why do you think there are street dogs in Thimphu/Paro?' were collated and trends were analyzed. The abandonment of dogs appears to be common in the region with people coming from rural areas to leave their dogs in the city, "People bring from other places and throw them on street in Thimphu city". When combined with an already large population of owned, unsterilized dogs, which are frequently allowed to roam, this leads to an increased population of street dogs. However, this does not explain why the population is able to persist in the area. The most frequent reasons given for the high number of street dogs related to food availability which is directly related to an increased human population in the region. As human populations have increased the number of food outlets such as meat shops, restaurants and hotels have increased significantly. Many surveyed individuals also suggested that there was poor waste management within the city and strays were "Scavenging garbage all around". In addition, the Buddhist faith of the area forbids the harm of dogs and leads to many residents actively feeding strays. Overall the combination of an increasing human population, available food, and unregulated breeding seem to be the most significant reasons recognized by the public for an increasing stray dog population.

Further we explored what breeds households owned in all survey areas. Most pure bred dogs were smaller breeds (Lhasa Apso and Pomeranian) apart from the Tibetan Mastiff (14, 14.9%) and German Shepherd (4, 4.3%).

9.9 Comparison of Antibody Responses after Vaccination with Two Inactivated Rabies Vaccines in Thimphu Dogs

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Abstract

We compared the antibody responses after vaccination with two commercially available inactivated rabies vaccines – Rabisin (Merial, France) and Raksharab (Indian Immunologicals) in dogs in Thimphu city, Bhutan. Fifty puppies were randomly assigned to two groups of 25 each and one group was subcutaneously vaccinated with a single dose of Rabisin and other group with Raksharab rabies vaccines as primary vaccination on day 0. Similarly, 50 adult dogs were also randomly assigned to two groups of 25 each and each group was subcutaneously vaccinated with a single dose of Rabisin and Raksharab vaccines as booster vaccination. Serum samples were collected on day 0 (prior to vaccination), 14 and 28 from all the dogs. Rabies antibodies were measured over a period of 28 days using SERELISA® Rabies Ab Mono Indirect enzyme-linked immunosorbent assay (ELISA).

A total of 198 blood samples from 66 dogs (3 samples each on day 0, 14 and 28) were collected and analyzed. Eight puppies (8/35; 22.86% belonging to Raksharab (n=7) and Rabisin vaccination group (n=1) demonstrated a minimum protective antibody titre (≥0.5 IU/ml) ranging from 0.6 to 2.75 IU/ml while the remaining puppies (n=27) demonstrated an antibody titre ranging from 0.1 to 0.45 IU/ml on day 0 (prior to primary vaccination). The antibody titre level increased after primary vaccination ranging from 0.21 to 4.78 IU/ml and 0.16 to 7.38 IU/ml under Rabisin group on day 14 and 28, respectively, and from 0.59 to 5.80 IU/ml and 1.19 to 6.76 IU/ml under Raksharab group on day 14 and 28, respectively.

In adult dogs under Rabisin booster vaccination group, 56% (9/16) of the dogs had ≥0.5 IU/ml of antibody titre (ranges: 0.25 to 6.45 IU/ml) on day 0 (before vaccination) and all dogs attained protective titre on day 14 (ranges: 1.07 to 6.46 IU/ml) and on day 28 (ranges: 2.22 to 10.26 IU/ml). Similarly, under Raksharab booster vaccination group, 56% (9/16) of the dogs had ≥0.5 IU/ml of antibody titre (ranges: 0.27 to 5.39 IU/ml) on day 0 (before vaccination). Excepting one adult male dog, all other dogs attained protective titre (≥0.5 IU/ml) on day 14 (ranges: 0.62 to 5.59 IU/ml) and on day 28 (ranges: 1.86 to 6.66 IU/ml). The findings showed that both the inactivated vaccines have elicited minimum threshold level for protection (≥0.50 IU/ml) responses as per the recommendation of the World Animal Health Organization (OIE) and World Health Organization (WHO), indicating that the vaccines used in Bhutan are potent and

efficient and thus, acceptable for primary and booster vaccination against rabies in dogs.

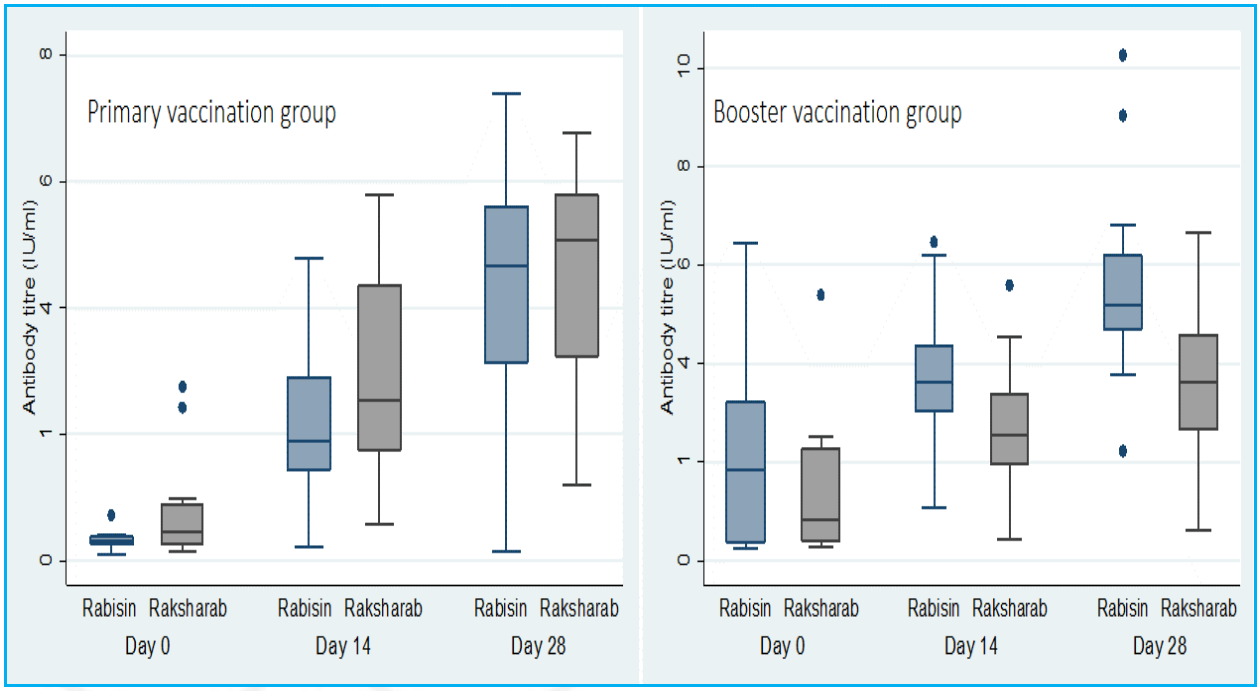

Figure 24: Comparison of antibody titre (IU/ml) between primary and booster vaccination group using Raksharab and Rabisin vaccine before vaccination (day 0) and after vaccination (day 14 and 28).

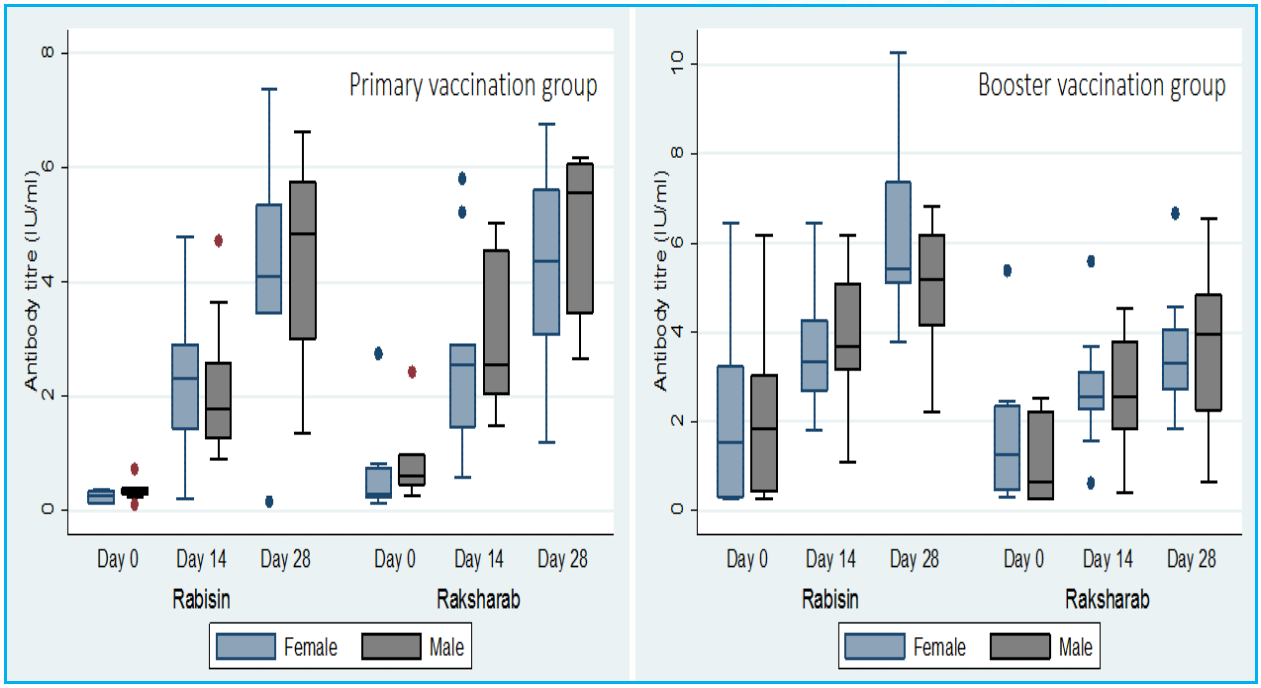

Figure 25: Rabies antibody titre of male and female dogs at day 0, 14 and 28 between primary (in puppies) and booster (in adult dogs) vaccination group using both Rabisin and Raksharab vaccine.

9.10 A community-based knowledge, attitude, and practice survey on rabies among cattle owners in selected areas of Bhutan

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Abstract

Rabies remains a disease of significant zoonotic and economic concern in rabies endemic areas of Bhutan. Rabies outbreaks in livestock threaten the livelihoods of subsistent farming communities and pose a potential public health threat. As a part of identifying approach to prevent rabies in cattle, a KAP survey was conducted among cattle owners in selected rural areas of the rabies high-risk southern zone and low risk zone in eastern Bhutan. Between March and April 2017, 562 cattle owners (281 in the east and 281 in the south) were interviewed using a questionnaire. Eighty-eight percent of the participants had heard of rabies but only 39% of the participants who had heard of rabies had adequate knowledge about rabies. Multivariable logistic regression analysis showed that residing in the south [OR = 9.25 (95% CI: 6.01–14.53)] and having seen a rabies case [OR = 2.46 (95% CI: 1.6–3.82)] were significantly associated with having adequate knowledge about rabies. Based on our scoring criteria, 65% of the total participants who had heard of rabies had a favorable attitude towards rabies control and prevention programs. The participants residing in the east were two times more likely to have a favourable attitude than their counterparts in the south [OR = 2.08 (95% CI: 1.43–3.05)]. More than 70% of the participants reported engaging in farm activities such as examining the oral cavity of sick cattle and assisting cattle during parturition. Only 25% of the participants reported using personal protective equipment while undertaking these activities. Despite a high level of rabies awareness, we observed that there is a lack of comprehensive knowledge about rabies regarding susceptible hosts, transmission routes, the health outcome of rabies infection in humans, and appropriate health-seeking behaviours. This study highlights the need to strengthen rabies education programs in rural communities to address the knowledge gaps that have been identified.

9.11 Rabies Prevention and Control Program in Bhutan: Self-assessment using SARE Tool

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Abstract

Free-roaming dogs and dog bites are a common public health problem in Bhutan. Several control measures were implemented during 1980s including mass killing of dogs by shooting and poisoning. Other control measures such as ad-hoc sterilization and vaccination against rabies, translocation and impounding of dogs were also implemented to reduce dog population and control rabies in the country. From 2009, catch-neuter-vaccinate-release program was initiated to manage dog population and control rabies in the country. Currently rabies outbreaks in animals are commonly reported in southern parts of the country with sporadic incursion into interior rabies free areas. However, no human rabies deaths were reported since 2017.

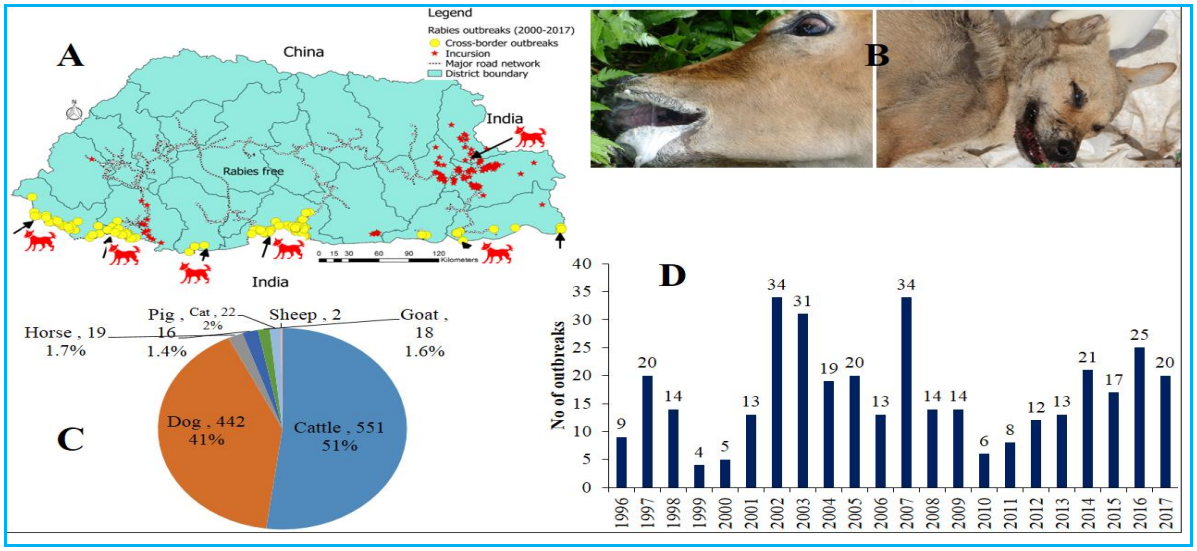

Figure 26: Geographic distribution of rabies in Bhutan [A]; Rabies cases in animals [B]; Distribution of rabies in animals [C] and Temporal distribution of rabies outbreaks in animals [# of outbreaks between 1996-2017] [D].

The country is on track to achieve its target to eliminate dog-mediated human rabies deaths by 2030 through One health approach. In this study, we reviewed rabies situation in Bhutan in terms of past and current control measures, gaps and future needs for rabies control using a "Stepwise Approach towards Rabies Elimination (SARE) tool". We highlighted the areas where more attention is required in order to eliminate rabies in Bhutan. The SARE output was used to develop a "Strategic plan for elimination of dog-mediated rabies in Bhutan by 2030" by incorporating all the agreed activities of Global framework for the elimination of dog-mediated human rabies.

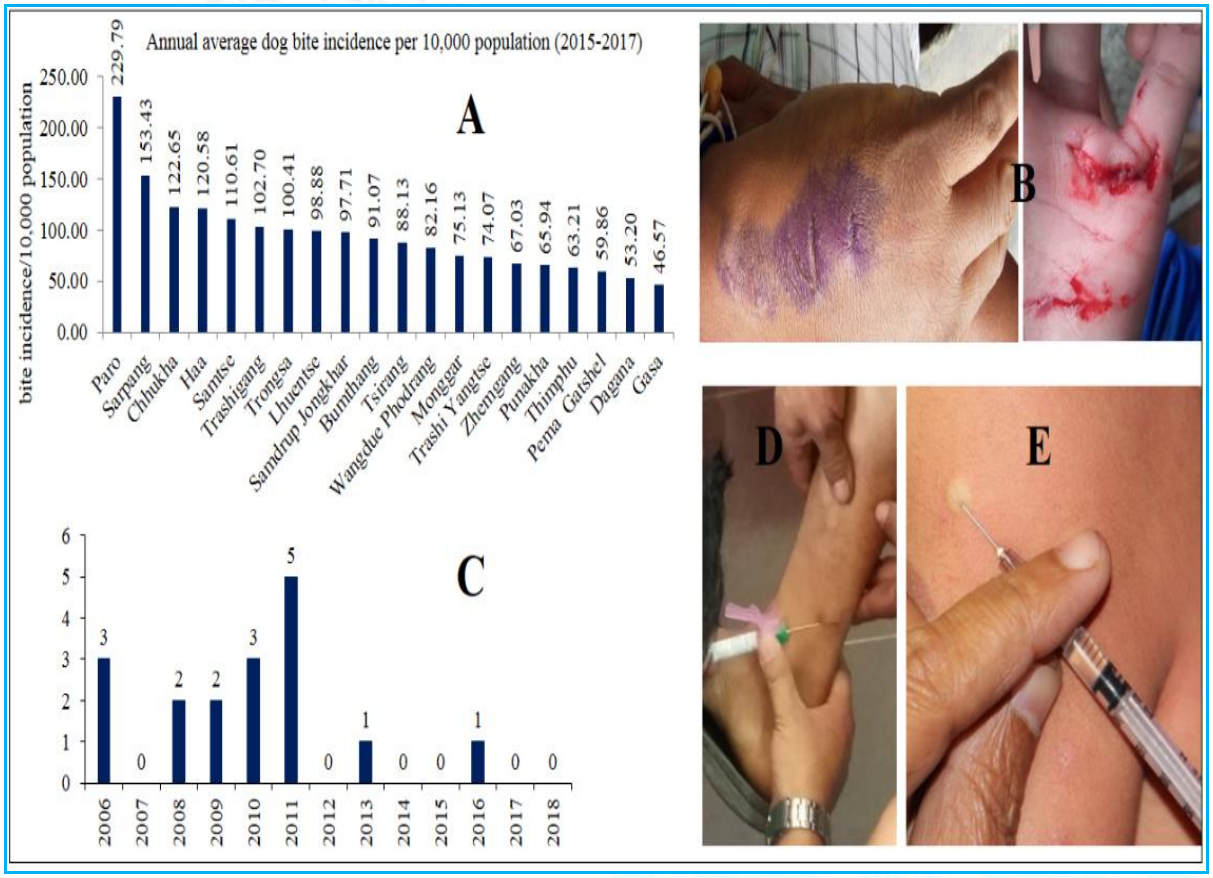

Figure 27: Average annual incidence of dog bites reported to different health centres in Bhutan [2015-2017] [A]; a case of confirmed rabid dog bites in human [B]; human rabies deaths in Bhutan [2006-2016] [C]; and human rabies immunoglobulin [D] and intra-dermal rabies vaccine being administered in rabies exposed people [E].

Table 22: Summary of the SARE result in Bhutan

Stepwise Approach towards Rabies Elimination - Bhutan , 2017

STAGE 3.5

ACTIVITY SUMMARY

COMPONENTS	PENDING ACTIVITIES	ACCOMPLISHED ACTIVITIES
Data collection and analysis *Total number of activities = 22*	1	21
Prevention and Control *Total number of activities = 26*	3	23
Laboratory diagnosis *Total number of activities = 13*	1	12
Dog population related issues *Total number of activities = 13*	2	11
Information, Education, Communication *Total number of activities = 21*	4	17
Cross-cutting issues *Total number of activities = 12*	2	10
Legislation *Total number of activities = 13*	0	13

STAGE SUMMARY

STAGE*		PENDING ACTIVITIES	ACCOMPLISHED ACTIVITIES	STAGE COMPLETED?
0	Total number of activities = 6	0	6	COMPLETED
0.5				COMPLETED
1	Total number of activities = 44	0	44	COMPLETED
1.5				COMPLETED
2	Total number of activities = 31	1	30	COMPLETED
2.5				COMPLETED
3	Total number of activities = 23	5	18	COMPLETED
3.5				PENDING
4	Total number of activities = 10	4	6	COMPLETED
4.5				PENDING
5	Total number of activities = 6	3	3	PENDING

* Scores in increments of 0.5 show progress along a particular stage.

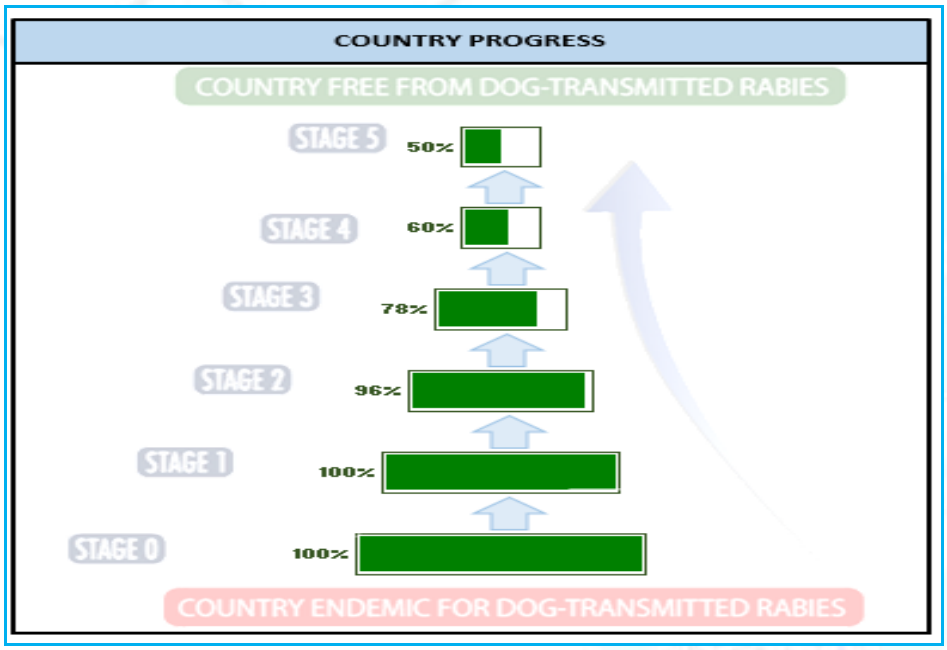

Figure 28: Summary of the five stages of SARE scores in Bhutan.

9.12 The potential effect of improved provision of rabies post-exposure prophylaxis in Gavi-eligible countries: a modelling study

Hampson and Trotter et al., 2018, WHO Rabies Modelling Consortium (Tenzin Tenzin is a co-author of this article).*

Published in Lancet Infect Dis 2019;19: 102–11

Abstract

Background: Tens of thousands of people die from dog-mediated rabies annually. Deaths can be prevented through post-exposure prophylaxis for people who have been bitten, and the disease eliminated through dog vaccination. Current post-exposure prophylaxis use saves many lives, but availability remains poor in many rabies-endemic countries due to high costs, poor access, and supply.

Methods: We developed epidemiological and economic models to investigate the effect of an investment in post-exposure prophylaxis by Gavi, the Vaccine Alliance. We modelled post-exposure prophylaxis use according to the status quo, with improved access using WHO-recommended intra-dermal vaccination, with and without rabies immunoglobulin, and with and without dog vaccination. We took the health provider perspective, including only direct costs.

Findings

We predict more than 1 million deaths will occur in the 67 rabies-endemic countries considered from 2020 to2035, under the status quo. Current post-exposure prophylaxis use prevents approximately 56 000 deaths annually. Expanded access to, and free provision of, post-exposure prophylaxis would prevent an additional 489 000 deaths between 2020 and 2035. Under this switch to efficient intra-dermal post-exposure prophylaxis regimens, total projected vaccine needs remain similar (about 73 million vials) yet 17·4 million more people are vaccinated, making this an extremely cost-effective method, with costs of US$635 per death averted and $33 per disability-adjusted life-years averted. Scaling up dog vaccination programmes could eliminate dog-mediated rabies over this time period; improved post-exposure prophylaxis access remains cost-effective under this scenario, especially in combination with patient risk assessments to reduce unnecessary post-exposure prophylaxis use.

Interpretation: Investing in post-exposure vaccines would be an extremely cost-effective intervention that could substantially reduce disease burden and catalyse dog vaccination efforts to eliminate dog-mediated rabies.

9.13 Determinants of health seeking behaviour of animal bite victims in rabies endemic South Bhutan: a community-based contact tracing survey

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Published in BMC Public Health (2019) 19:237

Abstract

Background: Dog bites are the main source of rabies infection and death in humans, contributing up to 99% of all cases. We conducted a contact-tracing study to evaluate the health seeking and treatment compliance behaviors of people following potential exposure to rabies in rabies endemic south Bhutan.

Methods: Using information from the rabies post exposure prophylaxis (PEP) register, animal-exposed victims who had visited five hospitals in south Bhutan between January and March 2017 were traced and further data were collected from them using a structured questionnaire. A snowballing technique was used to identify victims who did not seek PEP. The survey was conducted between April and June 2017. Logistic regression was performed to assess factors associated with PEP-seeking and compliance behaviour by the victims.

Results

Amongst 630 who reported to hospitals, 70% (444) of people could be traced and additional 8% (39) who did not seek PEP was identified through contact tracing. Therefore, a total of 483 people were interviewed. Seventy-one percent (344/483) of exposure were due to animal bites of which 80% (365/455) were considered to be provoked incidents. Common reasons for not seeking health care included assumptions that risk of infection were minor if bitten by an owned or vaccinated dog. The victims who are male (OR: 0.36; 95% CI: 0.16–0.77) and educated (OR: 0.41; 95% CI: 0.17–0.96) were less likely to seek PEP, while those that experienced unprovoked bite (OR: 5.10; 95% CI: 1.20–21.77) were more likely to seek PEP in the hospitals. Overall, 82% of the victims sought PEP from the hospitals within 24 h after exposure. Eighty-three percent completed the PEP course prescribed by the physician. The respondents living in urban areas (OR: 2.67; 95% CI: 1.34–5.30) were more likely to complete the prescribed PEP course than rural dwellers.

Conclusions

There is high risk of rabies infection in southern Bhutan. It is critical to bridge knowledge gaps and dispel existing myths which will help to improve PEP seeking and

compliance behaviour of people exposed to rabies infection from animals. A risk-based advocacy program is necessary to prevent dog-mediated human rabies deaths.

9.14 Roaming behaviour of pet dogs in the periphery of protected area in west Bhutan

Tshering Dorji[1,2], Tenzin Tenzin[3], Karma Rinzin[4], Waraphon Phimpraphai[1], Michel de Garine-Wichatitsky[1,5, 6]

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[2]Dzongkhag Veterinary Hospital, Department of Livestock, Gasa, Bhutan
[3]National Centre for Animal Health, Department of Livestock, Thimphu, Bhutan
[4]Animal Health Division, Department of Livestock, Thimphu, Bhutan
[5]CIRAD, UMR ASTRE, Montpellier, France, 6ASTRE, Univ Montpellier, CIRAD, INRA, Bangkok, Thailand

Abstract

To understand the roaming behaviour of pet dogs, we used commercial TK-STAR© GPS collars designed for tracking pet dogs and fitted the devices on the neck of 34 dogs in Haa. These dogs were tracked over one week at the periphery of protected area Jigme Khesar Strict Nature Reserve (JKSNR). As the actual length of the sessions varied due to varying battery life span of the device, we standardized dog movement statistics over 24-hour activity data for the analysis. On average, the distance travelled by the 34 dogs in 24 hours was 259 meters (+/-8 meters) and the maximum distance travelled was 9,472 meters. Most long distance movements occurred along the major motorable roads/highway. The average daily activity range was less than 150m^2. Housing was a significant factor determining the roaming behaviour of pet dogs in our study areas. None of the dogs tracked in the study sites actually entered the protected boundary during the survey, although there is potential for such intrusion given the distance and direction travelled by some of the dogs. This study is limited by the short duration (24-hour activity data) of the data collected and analysed. Further studies are required to quantify the movement patterns of the dogs, including stray and feral dogs, possibly including the protected areas.

9.15 Community perceptions of free-roaming dogs and management practices in villages at periphery of a Nature Reserve in Bhutan

Tshering Dorji[1,2], Tenzin Tenzin[3], Karma Rinzin[4], Waraphon Phimpraphai[1], Michel de Garine-Wichatitsky[1,5, 6]

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[2]Dzongkhag Veterinary Hospital, Department of Livestock, Gasa, Bhutan
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Submitted for publication

Abstract

In Bhutan, free-roaming dogs pose health hazards to human, livestock, and wildlife. Understanding the perceptions and practices of local communities regarding free-roaming dogs is important to mitigate negative impacts. A cross-sectional community-based study was conducted in the buffer zone of Strict Nature Reserve, western Bhutan. The study was conducted in February-October 2018 using a household questionnaire survey, "free-listing" of dog diseases, group discussions and key-informant interviews. A total of 140 households from Katsho and Uesu geogs (sub-districts) - were interviewed. People classify dogs under three categories: "Gokhi"/pet dog, "Changkhi"/stray dog, and "Shakhi"/feral dog. A higher proportion of rural people owned dogs, which considered important to guard crops and livestock from wildlife, protect and guard households' properties. Owning a dog also contributed significantly non-material well-being of the respondents from both sites, especially the rural villages, as dog owners indicated their level of happiness would sharply decrease if their pet dog was removed from them. In contrast to the perceived positive impacts of pet dogs, (81%) of the respondents considered stray and feral dogs a problem in the community. The threats were attacks/bites by free-roaming dogs to humans, livestock and also wildlife. Rabies was the most frequently (69.7%) mentioned dog diseases with the highest rank (1.46) in the list, followed by scabies (49.5%), ranked (1.52). The majority (56%) of the respondents indicated that stray and feral dogs originate from abandoned pet dogs. This study calls for a cross-sectoral/one health approach to mitigate the threats posed by free-roaming dogs and more detailed ecological and epidemiological studies are required to control their impacts.

9.16 Prevalence of *Taenia multiceps* in yak and stray dogs in Bhutan

Puspa M Sharma[a], Tenzin Tenzin[a], Pema Tshomo[a], TshewangDema[a], Cristian Alvarez[b], Frencesca Gorib Tshering Norbu[c], LhatruLhatru[d], Phurpa Namgay[e], Chimi Jamtsho[f], Nirmal K Thapa[a], Ratna B Gurung[a], Kinzang Drukpa[a], Yoenten Phuentshok[a] , and Peter Deplazes[b]

[a]-National Centre for Animal Health, Department of Livestock, Ministry of Agriculture and Forests, Serbithang, Thimphu, Bhutan,
[b]Institute of Parasitology, University of Zurich, Winterthurerstrasse, Zurich, Switzerland,
-Livestock Extension Centre, Sakteng, Trashigang,
[d]Livestock Extension Centre, Merak, Trashigang,
[e]Livestock Extension Centre, Thangbi, Choekhor, Bumthang,
[f]-District Veterinary Hospital, Trashiyangts.e

Abstract

The objective of this study was to find out the presence-absence of *Taenia multiceps* in dogs faeces in the yak grazing/pasture areas that cause Coenurosis [Gid disease] in yaks in Bhutan. Currently, Gid disease is being reported in yaks from Haa, Paro, Thimphu, Gasa and Bumthang districts and no Gid disease has been reported in the yaks at Merak-Sakteng in Trashigang, Bumdeling (Pemaling) in Trashiyangtse and Singye dzong yak herding area in Lhuentse in the eastern region. In addition, Gangtey, Phobji and Sephu yak rearing areas under Wangdue Phodrang previously reported Gid disease in yaks but were controlled since 2008 and no cases were reported so far. Two hundred eighty-two environmental dog faecal samples were collected from yak grazing areas (pastures) located above 3000 metres above sea level. The samples were initially analysed at the NCAH laboratory and those positive to Taeniid eggs were further referred to Institute for Parasitology, University of Zurich, Switzerland and conducted molecular characterization. In this study, *Taenia multiceps* were recovered in dog faecal samples from three yak rearing districts in western Bhutan (Gasa, Thimphu and Haa) that have clinical Gid disease in Yaks. No *Taenia multiceps* were recovered from dog faecal samples from Merak-Sakteng [Trashigang] and Bumdeling [Trashiyangtse] yak rearing areas that had no recorded history of Gid disease in yaks. Similarly, no *Taenia multiceps* were also recovered from dog faecal samples collected from Wangdue Phodrang district that was previously reporting Gid disease in yaks but had controlled in 2008.Our study demonstrates that no *Taenia multiceps* were recovered from dog faecal samples collected and examined from the above mentioned yak rearing areas thus confirming the historical absence of Gid disease in these areas. However, our study has some limitation since we could not collect representative faecal samples directly from yak dogs due to logistical constraints and remoteness of the yak herds.

9.17 Serological Evidence of *Rickettsia, Orientia*, and *Coxiella* in Domestic Animals from Bhutan: Preliminary Findings

Tshokey Tshokey[1-3] John Stenos[2] Tenzin Tenzin[4] Kinzang Drukpa[4] Ratna Bahadur Gurung[4] and Stephen R. Graves[1,2]

[1]Faculty of Health and Medicine, University of Newcastle, Newcastle, Australia.
[2]Australian Rickettsial Reference Laboratory, University Hospital Geelong, Geelong, Australia.
[3]Department of Laboratory Medicine, Jigme DorjiWangchuck National Referral Hospital (JDWNRH), Thimphu, Bhutan.
[4]Department of Livestock, National Centre for Animal Health (NCAH), Thimphu,Bhutan.

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Abstract

There is no information on Rickettsial diseases in domestic animals in Bhutan. This study provides preliminary serological data on exposure of domestic animals to *Rickettsia*, *Orientia,* and *Coxiella*. Animal sera were collected opportunistically from Bhutan and tested in the Australian Rickettsial Reference Laboratory for IgG antibodies against spotted fever group (SFG) and typhus group (TG) *Rickettsia*, scrub typhus group (STG), and Q fever (QF). Of the 294 animals tested, 136 (46%) showed serological evidence of past exposure to one or more Rickettsiae: 106 (36%), 62 (21%), 45 (15%), and 11 (4%) being positive against SFG *Rickettsia, Orientia*, TG *Rickettsia,* and *Coxiella*, respectively. Dogs appeared to exhibit the highest sero-positivity against SFG (55%) and TG *Rickettsia* (45%), horses against STG (91%), while goats were mostly positive for *Coxiella* (9%).Dogs also appeared to have high risk of being exposed to SFG *Rickettsia* (odd ratios [OR] 5.71, 95% confidence interval [CI] 3.02–10.80, $p < 0.001$), TG *Rickettsia* (OR 48.74, 95% CI 11.29–210.32, $p < 0.001$), and STG (OR 6.80, 95% CI 3.32–13.95, $p < 0.001$), but not against QF (OR 1.95, 95% CI 0.42–8.95, $p = 0.390$). Differences in sero-positivity rates between animal species may have been significant for SFG, TG, and STG, but not for QF. The differences in the sero-positivity rates of the four infections between districts appeared to be significant for TG and STG, but not for SFG and QF. The sero-positivity rates of domestic animals to the four Rickettsial infections were consistent with similar studies on the human population in the same areas and appear to demonstrate a high prevalence of exposure to Rickettsiae in Bhutan. These preliminary findings constitute baseline data for Bhutan. The findings of this study call for an increased human-livestock sector collaboration in Rickettsial diseases research aimed at developing diagnostic and therapeutic guidelines and formulating preventive and control measures through a One Health approach.

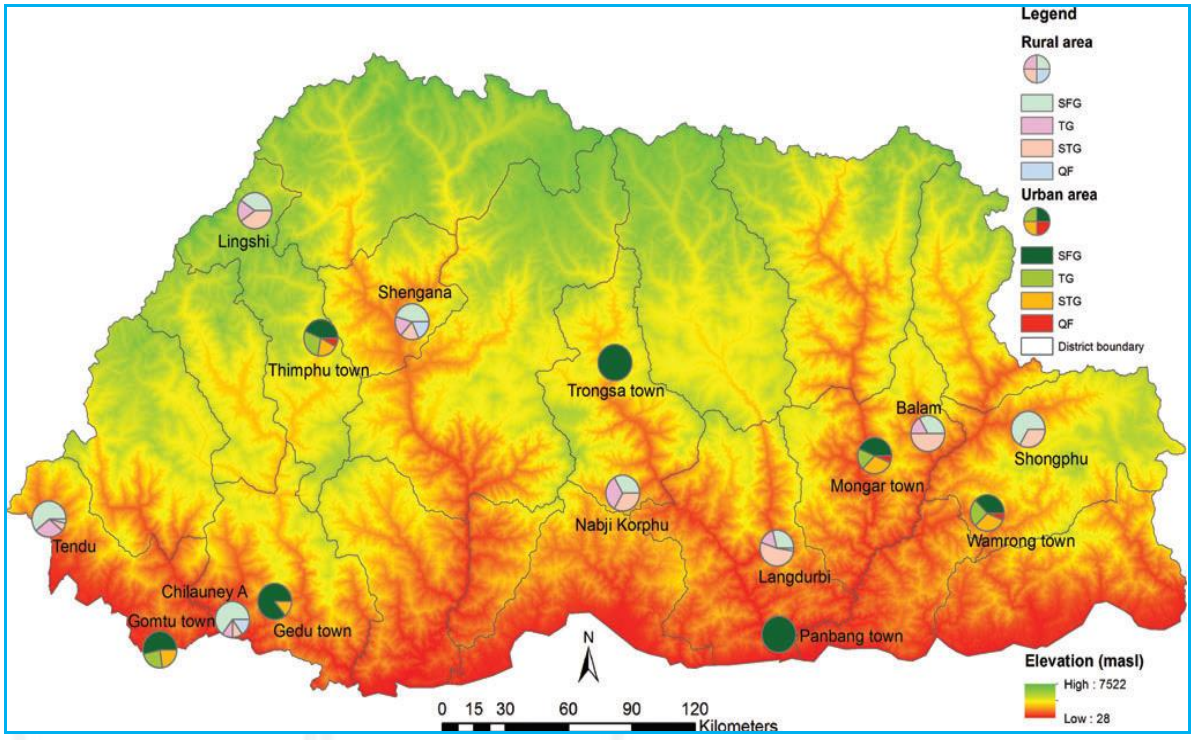


Figure 29: Map of Bhutan showing pie charts demonstrating proportion of animals sero-positive against SFG, STG, TG, and QF in each urban and rural sampling area. Sero-negative animals are not shown on the map. Pie chart location provides an approximate location of sampling sites. QF, Q fever; SFG, spotted fever group; STG, scrub typhus group; TG, typhus group.

Table 23: Comparison of Sero-positivity Rates against Four Rickettsiae among Human and Animal Population in the Study Sites/Districts

	SFG positive (%)		*STG positive (%)*		*TG positive (%)*		*QF positive (%)*	
Districts	*Animal*	*Human*	*Animal*	*Human*	*Animal*	*Human*	*Animal*	*Human*
Mongar	9 (31.0)	13 (12.0)	8 (27.6)	13 (12.0)	4 (13.8)	2 (1.9)	1 (3.4)	13 (12.0)
Urban	7 (36.8)	3 (9.4)	5 (26.3)	2 (6.3)	3 (15.8)	1 (3.1)	1 (5.3)	5 (15.6)
Rural	2 (20.0)	10 (13.2)	3 (30.0)	11 (14.5)	1 (10.0)	1 (1.3)	0 (0.0)	8 (10.5)
Punakha	5 (20.8)	18 (16.7)	2 (8.3)	10 (9.3)	2 (8.3)	10 (9.3)	2 (8.3)	3 (2.8)
Urban	0 (0.0)	4 (12.5)	0 (0.0)	3 (9.4)	0 (0.0)	1 (3.1)	0 (0.0)	0 (0.0)
Rural	5 (20.8)	14 (18.4)	2 (8.3)	7 (9.2)	2 (8.3)	9 (11.8)	2 (8.3)	3 (4.0)
Samtse	24 (42.9)	22 (20.4)	5 (8.9)	25 (23.2)	11 (19.6)	2 (1.9)	1 (1.8)	2 (1.9)
Urban	7 (24.1)	5 (15.6)	3 (10.3)	5 (15.6)	3 (10.3)	0 (0.0)	0 (0.0)	1 (3.1)
Rural	17 (63.0)	17 (22.4)	2 (7.4)	20 (26.3)	8 (29.6)	2 (2.6)	1 (3.7)	1 (1.3)
Trashigang	10 (40.0)	18 (16.7)	7 (28.0)	19 (17.6)	4 (16.0)	5 (4.6)	1 (4.0)	6 (5.6)
Urban	6 (54.5)	5 (15.6)	5 (45.5)	3 (9.4)	4 (36.4)	0 (0.0)	1 (9.1)	1 (3.1)
Rural	4 (28.6)	13 (17.1)	2 (14.3)	16 (21.1)	0 (0.0)	5 (6.6)	0 (0.0)	5 (6.6)
Chukha	19 (31.7)	29 (26.9)	3 (5.0)	32 (29.6)	2 (3.3)	0 (0.0)	3 (5.0)	9 (8.3)
Urban	6 (19.4)	6 (18.8)	1 (3.2)	4 (12.5)	0 (0.0)	6 (7.9)	0 (0.0)	1 (3.1)
Rural	13 (44.8)	23 (30.3)	2 (6.9)	28 (36.8)	2 (6.9)	6 (5.6)	3 (10.3)	8 (10.5)
Trongsa	9 (45.0)	14 (13.0)	6 (30.0)	46 (42.6)	6 (30.0)	2 (1.9)	0 (0.0)	8 (7.4)
Urban	3 (30.0)	1 (3.1)	0 (0.0)	4 (12.5)	0 (0.0)	0 (0.0)	0 (0.0)	4 (12.5)
Rural	6 (60.0)	13 (17.1)	6 (60.0)	42 (55.3)	6 (60.0)	2 (2.6)	0 (0.0)	4 (5.3)
Zhemgang	13 (32.5)	14 (13.0)	20 (50.0)	45 (41.7)	6 (15.0)	0 (0.0)	1 (2.5)	7 (6.5)
Urban	2 (20.0)	4 (12.5)	0 (0.0)	11 (34.4)	0 (0.0)	0 (0.0)	0 (0.0)	4 (12.1)
Rural	11 (36.7)	10 (13.2)	20 (66.7)	34 (44.7)	6 (20.0)	0 (0.0)	1 (33.3)	3 (4.0)
Thimphu	17 (42.5)	8 (7.4)	11 (27.5)	5 (4.6)	10 (25.0)	3 (2.8)	2 (5.0)	12 (11.1)
Urban	11 (55.0)	2 (6.3)	5 (25.0)	4 (12.5)	7 (35.0)	2 (6.3)	2 (10.0)	3 (9.4)
Rural	6 (30.0)	6 (7.9)	6 (30.0)	1 (1.3)	3 (15.0)	1 (1.3)	0 (0.0)	9 (11.9)
Overall	106 (36.1)	136 (15.7)	62 (21.1)	195 (22.6)	45 (15.3)	30 (3.5)	11 (3.7)	60 (6.9)
Urban	42 (32.3)	30 (11.7)	19 (14.6)	36 (14.1)	17 (13.1)	4 (1.6)	4 (3.1)	19 (7.4)
Rural	64 (39.0)	106 (17.4)	43 (26.2)	159 (26.2)	28 (17.1)	26 (4.3)	7 (4.3)	41 (6.7)

Human data from Tshokey et al. (2017).
QF, Q fever.

10. ANIMAL HEALTH SURVEILLANCE/RESEARCHES – ON GOING

Initiated collaborative studies on important zoonotic disease like, Anthrax, Rabies, Crimean-Congo haemorrhagic fever (CCHF), and bat mediated zoonotic diseases

A collaborative research studies on anthrax, rabies, brucellosis, Crimean-Congo Haemorrhagic Fever (CCHF) and bat derived zoonoses was initiated between three institutions: National Institute of Infectious Diseases, Japan; Royal Centre for Disease Control, Department of Public Health, Ministry of Health and National Centre for Animal Health, Department of Livestock, Ministry of Agriculture and Forests. This collaboration was established between these three institutes for the purpose of improving health of the people and animals in the two countries based on the practical implementation of the "One Health Concept". To initiate this collaborative research and as per planned activity two batches of Bhutanese laboratory staff were trained at National Institute of Infectious Diseases, Japan on culture and identification of anthrax organism, culture and identification of *Brucella* organism, immuno-fluorescence assay for CCHF and serum neutralization test (SNT) for rabies. The SNT technology included hands-on training on cell culture that included maintenance of cell lines, cell passage and virus titration. Similarly, two batches of Japanese team from National Institute of Infectious Diseases and National Institute of Animal Health visited the National Centre for Animal Health, Serbithang to establish diagnostic facility for anthrax, *Brucella*, CCHF and rabies. The bat derived zoonoses component of the collaboration will be initiated soon with the visit of Japanese team to identify bat habitat, collect samples and refer to Japan for detection of any zoonotic agent in Bhutanese bats.

11. HUMAN RESOURCE AND CAPACITY DEVELOPMENT

The Centre conducted various training/workshop to enhance the skills and expertise of the laboratory and animal health staffs in the country during the FY 2018-2019.

- Competent person training for sale of predetermined list of veterinary medicines;
- Provided training on GIS and scientific paper writing to the livestock staff;
- Coordinated conduct of training for the RNR field staff on special assignment to the department of livestock;
- Training of trainers on LIMS for NVL, NVH and 2 RLDCs;
- Two batches of animal health officers and laboratory personals were trained on Animal Disease Investigation and Molecular technique (LAMP-molecular test) in disease diagnosis.
- Establishment of microbiological laboratory facilities at SVL, Phuentsholing and NVH, Motithang;
- Coordinated training for WHONET for Veterinary Officers from four RLDCs;
- Discuss, Review, Quality Assurance techniques of Laboratory;
- AMR Review and Analysis Workshop;

- Collaborative research on Zoonotic diseases, with NIID and NIAH Japan;
- One Health Workshops;
- Workshop: OIE Performance of Veterinary Services (PVS) for South Asia;
- Write shop for NAIP;
- Workshop on Zoonotic Salmonella and SOP.

12. FINANCIAL ACHIEVEMENTS

97.71 percent (58.820M) of the total approved budget (60.193M) was utilized during the FY 2018-2019 (Table 24).
Details of budget expenditure during the FY 2018-2019 is given in the annexure 11.

Table 24: Financial achievement in Brief, for the FY 2018-19

Sl no	Unit	Approved Budget (M)	Expenditure (M)	Utilization (%)
1	Direction services	19.004	18.359	96.6
2	DPCU	2.054	2.034	99
3	LSU	3.221	3.175	98.57
4	DVEU	29.800	29.139	97.78
5	BPU	3.950	3.950	100
6	NDPM and RCP	2.164	2.163	100
	Total	**60.193**	**58.820**	**97.71**

13. ACHIEVEMENTS OF ADMINISTRATIVE SECTION

- Completed auditing for the FY 2016-2017and 2017-2018;
- Carried out coordination of various workshops and trainings;
- Construction of wheel chair ramp, costing Nu. 96,098.55;
- Installation of water tank and plumbing works, costing Nu.1,39,606.00;
- Procurement of stationeries and printer cartridge of worth Nu. 89,593.00;
- Purchase of LCD Projector, costing Nu: 44,500.00;
- Procurement of Extension kits of Technical staff and ESP, costing Nu. 1,10,200.00;
- Printing of laboratory SOPs/booklets of worth Nu. 48,208.00; and
- Carried out processing of Visa and permit for:
    - PVS Workshop: 17 heads
    - NIID and NIAH Japan: 4 heads
    - AAHL and Biosiences Research Australia: 4 heads
    - Andrea Fabiana: 1 head

14. EX-COUNTRY TRAINING/WORKSHOP/MEETING DURING FY 2018-2019

List of NCAH staffs who have attended ex-country training/workshop/meeting during FY 2018-2019, are given in annexure 1.

15. VISITORS TO NCAH DURING THE FY 2018-2019

Table 25: Following officials visited NCAH during the FY2018-2019, for various purposes

SI No.	Date	Visitor's Name	Purpose of visit
1	3.7.2018	Allison Litre John, Tim Seal	Fleming fund scoping study
2	9.7.2018	Ganga and the 9th batch of RNR-PDP	Institutional visit
3	24.7.2018	Martin Gicbert	Tiger Health Research
4	22.8.2018	Dr. Dheerasata Pipatpongsopon	DLD, Thailand
5	4.9.2018	Esther Van Wegen, Dr. Sithar Dorjee	Visit to understand the procurement system of MOAF
6		John Allen and Team	AAHL r AGK-BIO
7	15.9.2018	PK Prusty Vaishro	To know the lab disease diagnosis of equine
8	22.11.2018	Lyonpo (MOAF) and team	Facility visit
9	1.3.2018	Glenn Browning, Helen Crabb, James Gil Kerson	Visit for fleming fund fellowship
10	10.4.2019	Dr. shekhar Chettri and team	CNR trainee's

ANNEXURE

Annexure 1: List of NCAH staffs who have attended ex-country training/workshop/meeting during FY 2018-2019

Name	EID. No	Position Title	Course title	Institute	Country	Start Date	End Date	Duration (days)	Funding Agency
Dr. Ratna Bdr. Gurung	9603028	Specialist III	Lab-TAG and ISWAVL	Hotel Empress	Thailand	18/06/2019	22/06/2019	5 days	FAO
Dr. Ratna Bdr. Gurung	9603028	Specialist III	AMR and AST	Chulalongkorn University	Thailand	28/05/2019	31/05/2019	4 days	OIE
Dr. Ratna Bdr. Gurung	9603028	Specialist III	Zoonotic infections	NIID	Japan	18/02/2019	22/02/2019	5 days	NVAL and NIAH
Dr. Nirmal Kumar Thapa	9302007	Specialist III	Intercountry meeting to review implementation of National Action Plans on AMR	Bangkok	Thailand	23-07-2018	25-07-2018	3 days	WHO
Dr. Nirmal Kumar Thapa	9302007	Specialist III	Second oie global conference on antimicrobial resistance and prudent use of antimicrobial agents in	Marrakesh	Morocco	29-09-2018	31-07-2018	3 days	OIE

			animals: *putting standards into practice*						
Dr. Nirmal Kumar Thapa	9302007	Specialist III	Regional Meeting on Fleming Fund regional Grant	Kathmandu	Nepal	17-06-2019	18-06-2019	2 days	International vaccine Institute, S. Korea
Puspa Maya Sharma	2014030185	Laboratory officer	Rabies cell culture and CCHF	NIID	Japan	18-2-2019	22-2-2019	5 days	NIID, Japan
Ms. Dechen Wangmo	20150105019	Laboratory officer	Regional worshop on Biological safety cabinet Technology		Thailand	26 Novembr,2018	28 November,2018	3 days	Department of Medical science, Ministry of public health in collaboration with the Department of Livestock Development
Ms. Dechen Wangmo	20150105019	Laboratory officer	"Laboratory sustainability at the heart of Bio-safety and Bio-security" And ISWALD 2019.	OIE in collaboration with	Thailand	17June, 2019	21 june,2019	5 days	OIE in support from kingdom of Thailand and ministry of Agriculture of the People's Republic of China
Tshewang Dema	20040736 0	Laboratory Technician	Regional worshop on Biological safety		Thailand	26 Novemb	28 November,2	3 days	Department of Medical science,

		I	cabinet Technology			r,2018	018		Ministry of public health in collaboration with the Department of Livestock Development
Kelzang Lhamo	2003100 13	Laboratory Technician I	Rabies cell culture and CCHF	NIID	Japan	18-2-2019	22-2-2019	5 days	NIID, Japan
Pasang Bida		Sr. Laboratory Technician III	Laboratory Training in Feeding and Animal Health	Maejo University, Chiangmai	Thailand	15/10/ 2018	28/10/2018	3 days	EU-TCP

Annexure 2: List of Staff at NCAH, during the FY 2018-2019

Sl. No.	Name	Position Title	EID No.	Position Level	Remarks
Veterinary Doctors					
1	Dr. Kinzang Dukpa	**Program Director**	9603005	P1	**EOL**
2	Dr. R B Gurung	Specialist III (Animal Health) **Offtg. Program Director**	9603028	ES III	
3	Dr. N.K. Thapa	Specialist III (Animal Health)	9302007	ES III	
4	Dr. Vijay Raika Monger	Specialist III (Animal Health)	9411039	ES III	**Transferred**
5	Dr. Tenzin	Principal Livestock Health Officer	2001032	P1 A	**EOL**
6	Dr. Hiruka Mahat	Dy. Chief Veterinary Officer	200501113	P2 A	
7	Dr. Yoenten Phuentshok	Sr.Veterinary Officer	201201031	P3 A	**Resigned**
8	Dr. Pelden Wangchuk	Sr. Veterinary Officer	20140103307	P4 A	
Technical Staff					
1	Puspa Maya Sharma	Sr. Laboratory Officer	20140103185	P3 A	
2	Dechen Wangmo	Laboratory Officer	20150105019	P4A	
3	Purna Bdr. Rai	Sr. Laboratory Technician II	8806138	SS3 A	
4	HarkaBdr. Tamang	Sr. Livestock Health Supervisor II	8307007	SS3 A	
5	Kinzang Namgay	Sr. Livestock Health Supervisor	8604131	S1 A	
6	Namgay Dorji	Sr. Livestock Health Supervisor II	200208011	SS3 A	
7	Phuntsho Wangmo	Sr. Extension Supervisor II	200308065	SS3 A	
8	Migma	Sr. Laboratory Technician II	9801103	SS3 A	
9	Tenzinla	Sr. Laboratory Technician II	9901013	SS3 A	
10	Dawa Tshering	Sr. Laboratory Technician II	9901014	SS3 A	
11	Ugyen Pema	Asstt. Laboratory Technician I	2109009	S2 A	
12	Kelzang Lhamo	Asstt. Laboratory Technician I	200310013	S2 A	
13	Tshewang Dema	Asstt. Laboratory Technician I	200407360	S2 A	
14	Karma Choki	Asstt. Laboratory Technician I	2108008	S2 A	

15	Pasang Bida	Asstt. Laboratory Technician I	2109008	S2 A	
Administrative Section					
1	Tshewang Dakpa	Accounts Assistant III	8712024	SS4 A	
2	Pari Chhetri	Accounts Assistant II	9709069	SS3 A	
3	Karma Dekar	Sr. Administrative Assistant IV	9507009	S1 A	
4	Rinzin Dorji	Store Keeper	9910107	S4 A	
5	Phuntsho Choden	Administrative Asst II	200712003	S4 A	
6	Pemo	Sr. Telephone Operator II	9904051	O1 A	
Drivers					
1	Penjor	Driver	9906003	O1 A	
2	Tashi Gayleg	Driver	2006039	O1 A	
3	Pema Wangdi	Driver	2106032	O1 A	
4	Sangay Tshering	Driver	9902017	O1 A	
5	Tshewang Rinzin	Driver II	201108012	O3 A	
6	Tandin Wangchuk	Driver II	20120300163	O3 A	
ESP staff					
1	Karna Kumar Tamang	Sweeper		ESP	
2	Sangay Nidup	Helper (Lab Utility)		ESP	
3	Man Bir Lama	Laboratory Attendant		ESP	
4	Tshering Dolkar	Night Guard		ESP	
5	Kencho Dema	Helper (Lab Utility)		ESP	
				Total Staff Strength:	**40 staff**

Annexure 3: Staff transferred/resigned/superannuation to and from NCAH

1. Dr. Phuntsho Wangdi, Specialist I (Superannuated)
2. Dr. Vijay Raika Monger, Specialist II (transferred out)
3. Dr. Yoenten Phuentshok, Sr. Veterinary Officer (Voluntarily resigned)
4. Dr. Pelden Wangchuk, Veterinary Officer (transferred in)

Annexure 4: Essential Service Personnel (ESP) records

1. Sonam, Night Guard (Superannuated)
2. Chimi Wangmo, ESP (Voluntarily resigned)
3. Tshering Dolkar, Night Guard (Newly appointed)
4. Kencho Dema, Helper (Newly appointed)

Annexure 5: Promotion acquired during the FY 2018-2019

1. Puspa Maya Sharma, Sr. Laboratory Officer, P3A
2. Pari Chhetri, Accounts Assistant I, SS2 A

Annexure 6: Details of infrastructure

Sl. No	Class of Building	No. of Unit
1	Office building (Administrative Block)	1
2	Laboratory	2
3	Vaccine Production building	1
4	Old Laboratory building (Store)	1
5	Generator House	1
6	Refrigerator Workshop	1
7	Small animal house	1
8	Sheep shed	1
9	Garage	1
10	Animal potency test	1
11	Guard house	1
12	Res. Quarter, Class II	3
13	Res. Quarter, Class III	1
14	Res. quarter, Class IV	4
15	Drivers quarter	2
16	Res. quarter, old hostel	5

Annexure 7: Detail of Vehicles

Sl.	Type of vehicle/	Make/Model	Date of	Registration.	Stationed	Present
No.	Machinery		Purchase	No.	At	Condition
1	Eicher Bus	Indian/2010	2009	BG-1-A0612	NCAH	Running
2	Scorpio Pick up	Indian/2008	2008	BG-1-A1601	NCAH	Running
	(Double cabin)					
3	Bolero Pick up	Indian/2008	2008	BG-1-A1602	NCAH	Running
4	(Single cabin)					
	Scorpio Pick up	Indian/2008	2008	BG-1-A1603	NCAH	Running

5	(Double cabin)					
	Bike (Bajaj pulsar)	Bajaj Co.2008	2008	BG-2-A0217	NCAH	Running
6	Toyota Hilux (Refrigerator Van)	Japan/2010	2010	BG-1-A1887	NCAH	Running
7	Toyota Hilux	Bangkok	2013	BG-1-A2290	HSI Project	Running
	(Virgo)					
8	Toyota Hilux	Bangkok	2013	BG-1-A2291	HSI Project	Running
	(Virgo)					
9	Bolero	Mahindra, India	2011	BG-1-A1952	HSI Project	Running
10.	Air Force Ambulance	Mahindra, India	2009	BG-1-A1812	HSI Project	Off Road

Annexure 8: Vehicle expenditure for maintenance and spare parts

Sl. No	Vehicle No.	Funding	Cost (Nu.)
1	BG-1-A1601	RGoB	Nu. 77,230.00
2	BG-1-A1602	RGoB	Nu. 29,055.00
3	BG-1-A1887	RGoB	Nu. 32,650.00
4	BG-1-A0612	RGoB	Nu. 80,700.00
5 **6** **7** **8**	BG-1-A2291 BG-1-A2290 BG-1-A3076 BG-1-A1952	HSI Project HSI Project HSI Project HSI Project	Nu. 77,227.00 Nu. 64,330.00 Nu. 31,560.00 Nu. 22,775.00
Total Amount:			**Nu. 4,15,527.00**

Annexure 9: Construction and renovation works

Sl. No.	Name of work	Funding	Cost, Nu.
1. **2.**	**Construction of wheel chair ramp** **Installation of water tank and plumbing works**	RGoB RGoB	Nu. 201,000.55 Nu.1,39,606.00

Annexure 10: Details of vaccines (Produced and Imported) distributed during the FY2018-2019

Sl.No.	Dzongkhags/ Central Units	Locally Produced		Imported									
		Anthrax	SF	FMD Oil	HSBQ	IBD	Fowl Pox	NDB_1	R_2B	Marek's	Rabisin	DHPPi + L	PPR
	Dzongkhags												
1	Bumthang			5000	2700						800		
2	Chhukha		200	8000	540	118600	10000	63600	17000		1500		500
3	Dagana			7000	5400	8000	1000	13400			50		
4	Gasa			800	600						30	2	
5	Haa			2000	450	9000	6000		6000		1250		
6	Lhuentse			10000	6000	7000		2000	9000		300	2	
7	Mongar			11900	8880	108000			31000		1000	3	
8	Paro		50	16500	600	92400	34000	24000	16000		2000	79	
9	Pemagatshel			5000	3000	40000	5000		17000	2500	700		200
10	Punakha			10500	1020	50000	17000	26000	27000		1500		
11	Samdrup Jongkhar			10000	9000	20000	5000		10000	10000	1000		
12	Samtse		300	40000	3000	155000	35000	150000	17000		2800		3000
13	Sarpang		1700	32000	11490	528000	320000	226000	280000		2000		
14	Thimphu			7800	3510	60800	29500	27200	16400		230		
15	Trashigang			5000	4500	40000			20000		1350		
16	Trashiyangtse			6000	6000	6000	5000	4000	5000	5000	1000		
17	Trongsa			6500	4500	6800	8000	1000	4000		1000		

18	Tsirang		1250	8200	1200	355000	155000	293000	110000		1100	20	
19	Wangdue Phodrang			18000		6000		4000	1000		1600	50	
20	Zhemgang	500		6000	4050	11000		7000	37000		1400		
	Central Units												
21	NDDC, Yusipang			100	120								
22	BSF, Bumthang			300	120								
23	NJBC, Samtse	400		600	420								
24	NNBF, Trashiyangphu			500	480						20		
25	NPoDC, Sarpang					43200	30000	16400	29800	257500			
26	NPBC, Yusipang		1470	1350									
27	NSBC, Bumthang			1000	900						20		
28	NPiDC, Gelephu		2000	1850									
29	Calf Rearing Centre, Wangkha			350	330								
30	RPPBC, Lingmethang		1400	800		10600	7000	3600	3500	124000			
31	RMBF, Arong			200	180						20		
32	RMBF, Wangdigang												
33	RPBC, Paro					10800	4000	3600	3500	100500			
34	National Animal Hospital										3500		
35	Private Poultry Farm					19400	1000	14600	8800	105000			
36	BLDC, Sarpang/Samrang			150	150	148400	86000	92200	95500	12000			100
37	RLDC Wangdue												
38	RLDC Tsimasham										3500	50	800
39	RLDC Zhemgang										500		

40	RLDC Kanglung			100		17600		11000	11500		3600	3	
41	NDPM and RCP (HSI)										500		
42	Local CNR, Lobeysa					1800	1000	1200			60		
43	Sertsham Farm, Lhuentse			150	150	400	1000	400	400	500			
44	Nature Conservation Division				30								
	Total doses distributed	**900**	**8370**	**223650**	**79320**	**1873800**	**760500**	**984200**	**776400**	**617000**	**34330**	**209**	**4600**

Annexure 11: Approved Budget and Expenditure statement for NCAH, for FY 2018-2019

ACT CODE	S ACT CODE	FIN. ITEM CODE	OBJECT CODE	TITLE	Approved Budget	Expdture	Balance
001.00				DIRECTION SERVICES (NCAH)			
	001.01			PERSONNEL EMOLUMENTS			
		0001		RGOB Financing			
			01.01	Pay and Allowances	11.454	11.076	0.378
			02.01	Other Personnel Emoluments	0.448	0.427	0.021
			24.03	Contributions - Provident Fund	1.122	0.962	0.160
				TOTAL SUB-ACTIVITY 001.01	**13.024**	**12.465**	**0.559**
	001.02			OPERATION and MANAGEMENT SERVICES			
		0001		RGOB Financing			
			11.01	Travel - Incountry	1.600	1.600	0.000
			12.01	Utilities -Telephones, Telex, Fax, E-mail, Internet	0.345	0.345	0.000
			12.02	Utilities -Telegram, Wireless Transmission, Postage	0.002	0.002	0.000
			12.03	Utilities - Electricity, Water, Sewerage	0.391	0.390	0.001
			12.05	Utilities - Fuelwood	0.031	0.031	0.000
			14.01	S and M - Office Supplies, Printing, Publications	0.200	0.200	0.000
			14.06	S and M - Uniforms, Extension Kits, Linens	0.058	0.058	0.000

			15.01	Maintenance of Property - Buildings	0.201	0.201	0.000
			15.02	Maintenance of Property - Vehicles	0.793	0.793	0.000
			15.09	Maintenance of Property - Water supply, Sewerage, Playfield	0.010	0.010	0.000
			17.01	Op. Exp. - Advertising	0.070	0.045	0.025
			17.02	Op. Exp. - Taxes, Duties, Royalties, Fees, Handling Charges, Bank Charges	0.149	0.148	0.001
			18.01	Hospitality and Entertainment	0.030	0.030	0.000
			25.01	Retirement Benefits	2.100	2.041	0.059
				TOTAL SUB-ACTIVITY 001.02	**5.980**	**5.894**	**0.086**
				TOTAL ACTIVITY 001.00	**19.004**	**18.359**	**0.645**
002.00				DRUGS, VACCINES AND EQUIPMENT UNIT (DVEU)			
	002.01			PROCUREMENT, DISTRIBUTION AND MANAGEMENT OF VETERINARY MEDICINES, VACCINES and EQUIPMENT			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.300	0.298	0.002
			14.02	S and M - Medicines and Laboratory Consumables	27.000	26.369	0.631
			17.01	Op. Exp. - Advertising	0.100	0.096	0.004
			17.0	Op. Exp. -	0.150	0.128	0.022

			3	Transportation			
			52.07	Plant and Equipt. - Hospital/Lab. Equipment	2.000	1.999	0.001
				TOTAL SUB-ACTIVITY 002.01	**29.550**	**28.890**	**0.660**
	002.02			STRENGTHENING and ENHANCEMENT OF DRUGS, VACCINES AND EQUIPMENT DELIVERY SERVICES			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.150	0.150	0.000
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.100	0.100	0.000
				TOTAL SUB-ACTIVITY 002.02	**0.250**	**0.250**	**0.000**
				TOTAL ACTIVITY 002.00	**29.800**	**29.140**	**0.660**
003.00				LABORATORY SERVICE UNIT			
	003.01			TEST KITS VALIDATION AND TEST STANDARDIZATION FOR SEROLOGY AND MOLECULAR			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.130	0.130	0.000
			14.02	S and M - Medicines and Laboratory Consumables	0.050	0.050	0.000
				TOTAL SUB-ACTIVITY 003.01	**0.180**	**0.180**	**0.000**
	003.02			EMERGENCY FIELD VISITS AND SAMPLE COLLECTION			
		0001		RGOB Financing			

			11.01	Travel - Incountry	0.125	0.125	0.000
			14.06	S and M - Uniforms, Extension Kits, Linens	0.050	0.050	0.000
				TOTAL SUB-ACTIVITY 003.02	**0.175**	**0.175**	**0.000**
	003.03			PROVIDING REFERRAL LABORATORY DIAGNOSTIC SERVICES TO CLIENTS			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.380	0.380	0.000
			14.02	S and M - Medicines and Laboratory Consumables	0.410	0.410	0.000
				TOTAL SUB-ACTIVITY 003.03	**0.790**	**0.790**	**0.000**
	003.04			STRENGTHENING AND ENHANCEMENT OF LABORATORY DIAGNOSTIC CAPACITIES			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.305	0.297	0.008
			14.01	S and M - Office Supplies, Printing, Publications	0.050	0.008	0.042
			14.02	S and M - Medicines and Laboratory Consumables	0.250	0.250	0.000
				TOTAL SUB-ACTIVITY 003.04	**0.605**	**0.555**	**0.050**
	003.05			MAJOR LIVESTOCK DISEASE SURVEILLANCE/SURVEY			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.280	0.279	0.001

			14.01	S and M - Office Supplies, Printing, Publications	-0.050		-0.050
			14.02	S and M - Medicines and Laboratory Consumables	0.134	0.134	0.000
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.120	0.120	0.000
				TOTAL SUB-ACTIVITY 003.05	**0.484**	**0.533**	**-0.049**
	003.06			LABORATORY COORDINATION and SKILL ENHANCEMENT			
		0001		RGOB Financing			
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.250	0.250	0.000
				TOTAL SUB-ACTIVITY 003.06	**0.250**	**0.250**	**0.000**
	003.07			COORDINATION AND IMPLEMENTATION OF BIO-SAFETY AND BIO-SECURITY PROGRAMMES			
		0001		RGOB Financing			
			14.02	S and M - Medicines and Laboratory Consumables	0.100	0.080	0.020
			15.05	Maintenance of Property - Equipment	0.100	0.100	0.000
				TOTAL SUB-ACTIVITY 003.07	**0.200**	**0.180**	**0.020**
	003.08			MONITORING AND REPORTING			
		0001		RGOB Financing			
			12.02	Utilities -Telegram, Wireless Transmission, Postage	0.030	0.005	0.025
			17.02	Op. Exp. - Taxes, Duties, Royalties, Fees, Handling Charges,	0.020	0.020	0.000

				Bank Charges			
				TOTAL SUB-ACTIVITY 003.08	**0.050**	**0.025**	**0.025**
	3.10			**ONE HEALTH APPROACH TO DETERMINE ANTIBIOTIC SUSCEPTIBILITY PROFILE OF SALMONELLA**			
		2977		**Communicable Disease**			
			11.01	Travel - Incountry	0.205	0.205	0.000
			17.02	Op. Exp. - Taxes, Duties, Royalties, Fees, Handling Charges, Bank Charges	0.004	0.004	0.000
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.278	0.277	0.001
				TOTAL SUB-ACTIVITY 003.10	**0.487**	**0.486**	**0.001**
				TOTAL ACTIVITY 003.00	**3.221**	**3.174**	**0.047**
004.00				DISEASE PREVENTION AND CONTROL UNIT			
	004.01			NATIONAL FOOT AND MOUTH DISEASE PREVENTION and CONTROL			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.143	0.143	0.000
			14.06	S and M - Uniforms, Extension Kits, Linens	0.050	0.034	0.016
			17.01	Op. Exp. - Advertising	0.002	0.002	0.000
			17.09	Op. Exp. - Survey/Census	0.080	0.080	0.000
				TOTAL SUB-ACTIVITY 004.01	**0.275**	**0.259**	**0.016**

	004.02			NATIONAL AVIAN INFLUENZA (BIRD FLU) PREVENTION and CONTROL			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.115	0.115	0.000
				TOTAL SUB-ACTIVITY 004.02	**0.115**	**0.115**	**0.000**
	004.03			NATIONAL GID DISEASE PREVENTION and CONTROL			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.115	0.115	0.000
			14.02	S and M - Medicines and Laboratory Consumables	0.050	0.050	0.000
			17.09	Op. Exp. - Survey/Census	0.050	0.050	0.000
				TOTAL SUB-ACTIVITY 004.03	**0.215**	**0.215**	**0.000**
	004.04			NATIONAL RABIES PREVENTION and CONTROL			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.090	0.090	0.000
			17.09	Op. Exp. - Survey/Census	0.090	0.090	0.000
				TOTAL SUB-ACTIVITY 004.04	**0.180**	**0.180**	**0.000**
	004.05			ANIMAL HEALTH RESEARCH ON ZOONOTIC DISEASES			
		0001		RGOB Financing			
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.040	0.040	0.000
			17.09	Op. Exp. - Survey/Census	0.100	0.100	0.000
				TOTAL SUB-	**0.140**	**0.140**	**0.000**

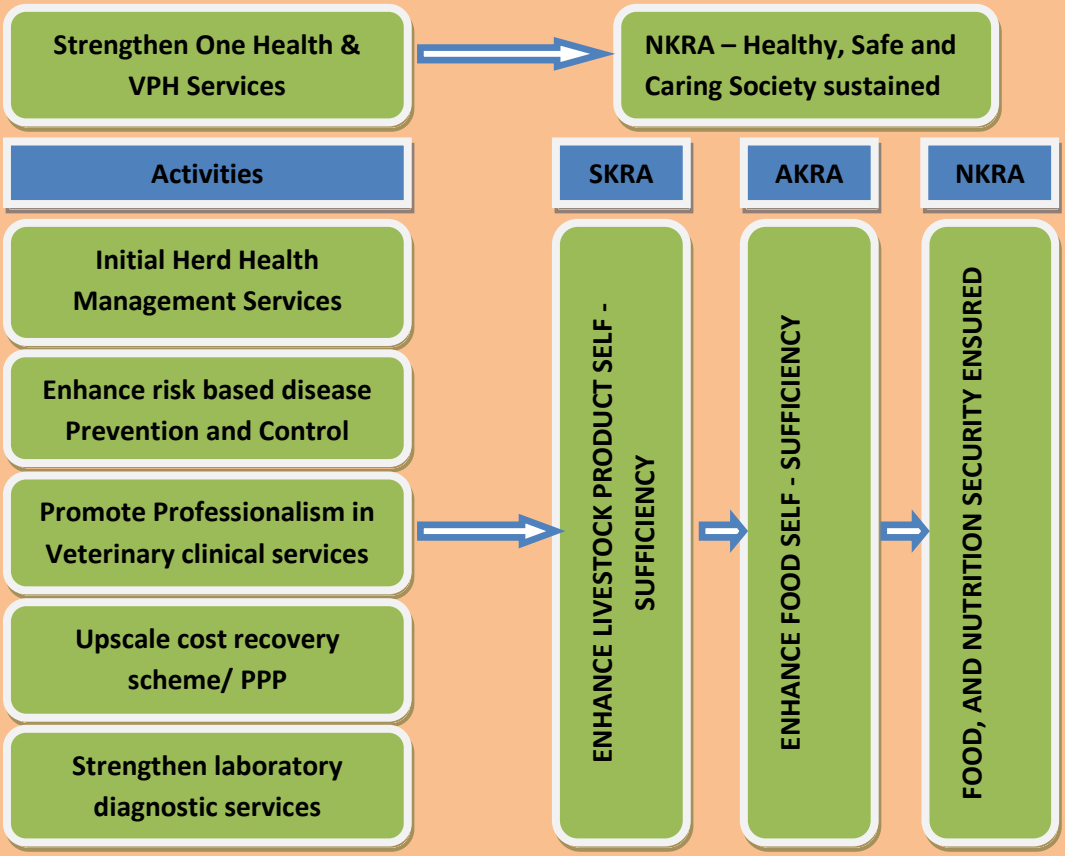
				ACTIVITY 004.05			
	004.06			ANIMAL HEALTH INFORMATION SYSTEM			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.075	0.075	0.000
			15.07	Maintenance of Property - Computers	0.010	0.009	0.001
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.050	0.050	0.000
				TOTAL SUB-ACTIVITY 004.06	**0.135**	**0.134**	**0.001**
	004.07			NATIONAL PESTICIDES RUMINENTS PREVENTION and COUNTROL			
		0001		RGOB Financing			
			17.09	Op. Exp. - Survey/Census	0.070	0.07	0.000
				TOTAL SUB-ACTIVITY 004.07	**0.070**	**0.070**	**0.000**
	004.08			NATIONAL BRUCELLOSIS PREVENTION and COUNTROL			
		0001		RGOB Financing			
			17.09	Op. Exp. - Survey/Census	0.070	0.069	0.001
				TOTAL SUB-ACTIVITY 004.08	**0.070**	**0.069**	**0.001**
	4.09			PREVALENCE OF GID IN YAK FROM ENDEMIC AND NON-ENDEMIC DISTRICTS OF BHUTAN			
		1650		Adhoc Assistance for Individual Donors			
			17.09	Op. Exp. - Survey/Census	0.540	0.540	0.000

			54.02	Office Equipment	0.187	0.187	0.000
			54.03	Computers and Peripherals	0.127	0.127	0.000
				TOTAL SUB-ACTIVITY 004.09	**0.854**	**0.854**	**0.000**
				TOTAL ACTIVITY 004.00	**2.054**	**2.036**	**0.018**
005.00				BIOLOGICAL PRODUCTION UNIT			
	005.01			PRODUCTION OF ANIMAL VACCINES			
		0001		RGOB Financing			
			14.02	S and M - Medicines and Laboratory Consumables	0.371	0.371	0.000
				TOTAL SUB-ACTIVITY 005.01	**0.371**	**0.371**	**0.000**
	005.02			PROCUREMENT OF ANIMAL VACCINES			
		0001		RGOB Financing			
			14.02	S and M - Medicines and Laboratory Consumables	2.802	2.802	0.000
				TOTAL SUB-ACTIVITY 005.02	**2.802**	**2.802**	**0.000**
	005.03			PROCUREMENT OF POULTRY VACCINES			
		0001		RGOB Financing			
			14.02	S and M - Medicines and Laboratory Consumables	0.677	0.677	0.000
				TOTAL SUB-ACTIVITY 005.03	**0.677**	**0.677**	**0.000**
	005.04			DISTRIBUTION OF VACCINES			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.100	0.100	0.000
				TOTAL SUB-ACTIVITY 005.04	**0.100**	**0.100**	**0.000**
				TOTAL ACTIVITY	**3.950**	**3.950**	**0.000**

				005.00			
006.00				NATIONAL DOG POPULATION MANAGEMENT and RABIES COUNTROL PROGRAM			
	006.01			OPERATIONAL AND MANAGEMENT SERVICE			
		0001		RGOB Financing			
			15.02	Maintenance of Property - Vehicles	0.384	0.384	0.000
				TOTAL FINANCING ITEM CODE 0001	**0.384**	**0.384**	**0.000**
		0002		RGOB Contribution			
			15.02	Maintenance of Property - Vehicles	0.793	0.793	0.000
				TOTAL FINANCING ITEM CODE 0002	**0.793**	**0.793**	**0.000**
				TOTAL SUB-ACTIVITY 006.01			
	006.02			MASS RABIES VACCINATION CAMPAIGN			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.050	0.050	0.000
			14.02	S and M - Medicines and Laboratory Consumables	0.050	0.050	0.000
			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.100	0.100	0.000
				TOTAL SUB-ACTIVITY 006.02	**0.200**	**0.200**	**0.000**
	006.03			OBSERVATION OF WORLD RABIES DAY AND AWARENESS CAMPAIGN			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.072	0.072	0.000

			17.08	Op. Exp. - Incountry Meetings and Celebrations	0.103	0.103	0.000
				TOTAL SUB-ACTIVITY 006.03	**0.175**	**0.175**	**0.000**
	006.04			IMPLEMENTATION OF CABC			
		0001		RGOB Financing			
			11.01	Travel - Incountry	0.348	0.348	0.000
			17.03	Op. Exp. - Transportation	0.064	0.064	0.000
				TOTAL SUB-ACTIVITY 006.04	**0.412**	**0.412**	**0.000**
	006.05			KAP SURVEY AND MandE FOR CNVR			
		0001		RGOB Financing			
			17.09	Op. Exp. - Survey/Census	0.200	0.200	0.000
				TOTAL SUB-ACTIVITY 006.05	**0.200**	**0.200**	**0.000**
				TOTAL ACTIVITY 006.00	**1.780**	**1.780**	**0.000**
				TOTAL OUTPUT 027	**59.809**	**58.439**	**1.370**

CANOPY view of ANIMAL HEALTH STRATEGIES in the 12th FYP



TASHI DELEK