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Report on the Norwegian-Mongolian mission NOR-MON-HEALTH

Veterinærinstituttet
Norwegian Veterinary Institute

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Index

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Abbreviations

CVO: Chief Veterinary Officer
FAO: Food and Agriculture Organization of the United Nations
FMD: Foot and Mouth Disease
GASI: General Agency for Specialized Investigation
GAVS: General Authority of Veterinary Services
IVM: Institute of Veterinary Medicine
M-FETP: Mongolian Field Epidemiology Training Program
MoFALI: Ministry of Food Agriculture and Light Industry
MULS: Mongolian University of Life Sciences
MVEA: Mongolian Veterinary Epidemiology Association
NCCD: National Centre for Communicable Diseases
NVI: Norwegian Veterinary Institute
OIE: World Organization for Animal Health
PVD: Provincial Veterinary Department
PVU: Private Veterinary Unit
SQCLVD: State Quality Control Laboratory for Veterinary Drugs
SVM: School of Veterinary Medicine
TAD: Transboundary Animal Disease
WHO: World Health Organization

Summary

The Norwegian Ministry of Agriculture and Food funded the Norwegian Veterinary Institute to carry out a scientific mission in Mongolia to map potential areas for collaboration. The main goal was to identify topics of common interest for Mongolia and Norway that can allow both countries to develop interventions/projects aimed at increasing capacity in both countries in preparedness for animal health, public health and food safety, following the ONE HEALTH approach: animals, humans, and environment.

The visit was conducted between June 17th and July 4th, 2019 during which time the NVI team visited Ulaanbaatar and its surroundings as well as Dornod province in the Eastern region of the country. Meetings and visits were held with Mongolia veterinary authorities, veterinary services at all levels, education and research institutions and the Food and Agriculture Organization of the United Nations.

The Norwegian team was impressed with the structure and standing of the veterinary services in Mongolia. A strong commitment was observed at government level to the newly implemented animal health law, and all levels of the veterinary services seem dedicated in their efforts to control and limit spread of transboundary animal diseases and serious zoonotic infections. However, many serious and transboundary animal diseases continue to be a reason for great concern in Mongolia. Brucellosis continues to be a major public health hazard, and also rabies has been difficult to control despite vaccination of livestock, due to a reservoir among wild animals. The Norwegian team also observed areas within veterinary services of Mongolia that lacked resources and competence to fully fulfill their mission. Mongolian colleagues clearly expressed the need for training and competence building within epidemiology, pathology and laboratory diagnostics, microbiology and parasitology. The use of antibiotics in animals is poorly controlled and untargeted, and remains a matter of great concern for the authorities. For NVI researchers this mission represented also a unique chance to come in contact with complex animal health problems with pathogens either for long eradicated from Norway or never identified. A close collaboration with institutions and colleagues that routinely handle these outbreaks and must conduct diagnostic and eradication programmes constitutes an added knowledge to ensure that the Norwegian competence in emergency and outbreak management remains at its highest level.

Based on observations during the visit to Mongolia, discussions with Mongolian colleagues in the veterinary services, and a careful evaluation of all collected information, the Norwegian Veterinary Institute propose four collaborative projects between the two countries aimed at increasing competence within ONE HEALTH:

1) Competence building in veterinary epidemiology

2) Training in primary diagnostic investigations

3) Strengthening of bacteriological diagnostics and testing of antimicrobial resistance

4) Training in working with cell cultures and a pilot study on oral rabies vaccination

Background

In August 2018, the Norwegian Veterinary Institute (NVI) partook in an official visit to Mongolia led by the Norwegian Ministry of Agriculture and Food. During this visit, authorities of both countries expressed interest in developing a stronger bilateral cooperation to increase capacity in both Norway and Mongolia on topics related to animal and human health as well as food safety.

The Norwegian Ministry of Agriculture and Food has subsequently decided to finance NVI to carry out a scientific mission to Mongolia aimed at mapping potential areas for scientific collaboration, with a focus on challenges related to animal health, food safety and zoonotic diseases. Furthermore, and in close collaboration with Mongolian colleagues, the mission should try and identify knowledge and best practice gaps related to animal husbandry, disease management and food safety that once jointly addressed can quickly be used to develop interventions and increase capacity and preparedness in both countries.

Finally, a stronger collaboration on animal health with Mongolia may open doors to increased trade between the countries and increased investment of Norwegian companies.

Members of NVIs mission:

- Hannah Joan Jørgensen, senior researcher/veterinarian (PhD)
- Petter Hopp, senior researcher/veterinarian (PhD)
- Torfinn Moldal, senior researcher/veterinarian (PhD)
- Carlos Gonçalo das Neves, Director of research and Internationalisation/veterinarian (PhD)

For a short CV on the mission members please refer to the appendix.

How the mission was carried out

The visit was conducted between June 17th and July 4th, 2019. The team visited Ulaanbaatar and its surroundings as well as Dornod province in the Eastern region of the country. Meetings and discussions were held with veterinary authorities of Mongolia including the Vice Minister of Food Agriculture and Light Industry (MoFALI), Madam Saulye Janiimkhan, and Director General, Chief Veterinary Officer (CVO) Mr. Tumendemberel. The team also met with the Governor of Dornod, Mr. Badamsuren.

Several governmental institutions were visited, including the Institute of Veterinary Medicine (IVM), the State Central Veterinary Laboratory (SCVL), the State Quality Control Laboratory for Veterinary Drugs (SQCLVD), Gene Fund, and Biokombinat. The team received information from the respective directors and their staff, and visited laboratory facilities. Meetings were also held with the Directors of Ulaanbaatar and Dornod Veterinary Departments, Mr. Abdilbish Medjargal and Mrs. Ayushmaa Chuluun, respectively. The team also had discussions with their staff, and visited the laboratory facilities.

A veterinary check point, four private veterinary units in two different provinces, four farms and herders (egg production, dairy and a mixed traditional herd), and a food market laboratory for food safety inspections and analyses were also visited. An abattoir for slaughtering of sheep and horses, that exports mutton to Iran, and a local slaughter market with traditional slaughter of sheep were also visited. In addition, meetings were held with local representatives for FAO, the Mongolian Field Epidemiology Training Programme (M-FETP) at the National Centre for Communicable Diseases (NCCD) and the deputy leader of the Mongolian Veterinary Epidemiology Association (MVEA).

The observations and conclusions reported here are based on these visits and discussions and organised as to identify/map challenges and problems related to different steps on the ONE HEALTH strategy as shown in Figure 1 (which applies to both infectious diseases, antimicrobial resistance, food safety aspects etc…). The possible interventions/projects suggested in this report are likewise based on the ONE HEALTH approach and related to these different steps.

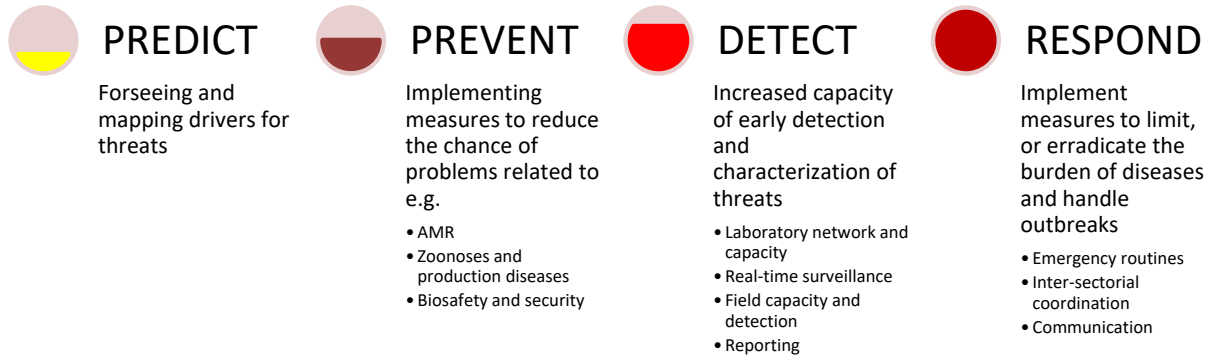

Figure 1. Possible areas of intervention/collaboration along the ONE HEALTH approach to health threats

Additionally some international and Mongolian reports/documents were also considered during the draft of this report, such as the WHO's Joint External Evaluation of International Health Regulations report from 2017. The World Organization for Animal Health (OIE) has carried out a Performance of Veterinary Services evaluation (PVS) as well as a PVS follow-up mission. Mongolia has not waived the confidentiality of these reports, and despite a request forwarded to the Mongolian CVO, it was not possible to obtain these in time for the conclusion of this report.

Disclaimer Note

This report does not imply the expression of any opinion on the part of NVI concerning the legal or development status of Mongolia, its provinces, its veterinary services or its authorities. The mission had no inspection/evaluation goals and was designed exclusively to address possible fields for scientific collaboration between Norway and Mongolia, specifically between NVI and relevant Mongolian institutions working on animal health, food safety and public health.

While the report includes significant amounts of information provided by Mongolian colleagues, it has been written by NVI.

Mongolia – key facts relevant to this report

Mongolia borders China and the Russian Federation, covers 1 565 600 km^2, and has a population of approximately 3.2 million people, of which more than half lives in the capital Ulaanbaatar area (UN-DESA). Around 1 million people live in rural areas. Many of these are livestock herders who continue the ancient pastoralism traditions of move between lowland summer and highland winter pastures.

Geographically, Mongolia is divided into four regions (Western, Khangai, Central and Eastern), and administratively into 21 provinces (aimags) and the capital city Ulaanbaatar. Aimags are subdivided into soums (333), which again consist of bags (1664), the smallest administrative unit. Ulanbaataar is divided into nine districts, six of which have livestock.

Figure 2. Administrative map of Mongolia with its 21 provinces and capital municipality. NVI's mission visited in addition to the capital area the provinces of Dornod (easternmost in Mongolia) as well as Tov, Selenge and Darkhan-Uul.

After mining, the agriculture sector is the second most important contributor to Mongolia's economy, accounting for about 15 percent of GDP (http://www.fao.org/mongolia/fao-in-mongolia/mongolia-at-a-glance/en/). The livestock sector accounts for 87% of agricultural production, and employs one third of the population. Climatic conditions make agriculture difficult, and arable land accounts for less than 1% of the total land area. Extensive grazing covers 80% of the land area (Coslet, Palmeri, Sukhbaatar, Batjargal, Wadhwa, 2017).

Over the past years, the number of livestock has increased significantly in Mongolia, especially the small ruminants. This is associated with the transition to a free market system, the abolition of controlled herd sizes, and reduced meat prices. The total number of livestock in December 2017 was estimated to be 66.2 millions with sheep and goats as the main species. The increasing livestock counts have contributed to increased stocking rates and overgrazing. In 2017, FAO found more than 40% of pastureland to be moderately to heavily overgraze with rangeland degradation in 70% of the country (Coslet, Palmeri, Sukhbaatar, Batjargal, Wadhwa, 2017).

The climate in Mongolia varies widely with respect to temperature and precipitation, and the country is prone to weather related hazards. A "dzud" is a brutal natural disaster unique to Mongolia where vast numbers of livestock die from starvation or cold. It occurs in certain winter conditions, usually after a hot and dry summer. The frequency of dzuds has increased, and over-grazing exacerbates the problem. During the 2009/2010 dzud more than 10 million animals died (Coslet, Palmeri, Sukhbaatar, Batjargal, Wadhwa, 2017).

Mongolia has an over-production of meat for domestic consumption, and exports below its capacity. Several issues prohibit greater export, such as a lack of modern abattoirs and storage facilities as well as the occurrence of transboundary animal diseases such as Foot and Mouth Disease (FMD). The Government of Mongolia works to contain disease outbreaks in livestock, and western region is now considered as "disease-free" based on available surveillance results. This enables export of meat to certain countries, such as the Russian Federation. However, improvements in disease control and infrastructure are crucial to expand the country's export market.

Veterinary services, authorities and legislation

MoFALI is responsible for the veterinary services including legislation. A new animal health law was adopted by the Mongolian Parliament on 8th December 2017, and was implemented from 1st July 2018. This law is an important step towards compliance with international standards. The law ensures a vertical chain of command within the veterinary services, promotes science-based decision-making in the control of animal diseases, and reinforces animal identification and traceability.

The veterinary authorities have three levels, the national, the aimag (provincial) and the soum level. At the national level, the General Authority of Veterinary Services (GAVS) is the state administrative agency in charge of animal health. The GAVS is placed within the MoFALI, and the chair of GAVS is the CVO of Mongolia.

GAVS "shall ensure the protection of the livestock and animals health, ensure requirements of sanitation and hygiene requirements of animal derived food and non-food raw materials are met, and shall exercise the activities aimed at protecting public health from zoonotic diseases and controls" (Animal health law 28.2). GAVS "shall provide professional management and methodological/technical advice to all veterinary sector organizations, laboratories, veterinary units and veterinary service units" (Animal health law 28.4).

At the provincial/municipal level there are in total 22 veterinary departments covering 21 aimags and the municipality of Ulaanbaatar. The provincial veterinary authorities are divided into three divisions: Veterinary services, Laboratory and Administration. The veterinary services cover animal health, monitoring and risk assessment, and are responsible for designing, implementing and reporting data at the provincial level. They are also responsible for the vaccination, control and eradication programs including control and eradication of TADs, food safety and border control. Furthermore, they supervise the different veterinary agencies within the province (market laboratories, private veterinary units - PVUs, slaughterhouses/abattoirs, veterinary pharmacies and small animal clinics).

The laboratory division of the provincial veterinary authorities receives samples from surveillance programs or routine samples in relation to controls. The diagnostic capacity varies between different provincial laboratories. It has been decided that three regional laboratories will be established, but it has not yet been decided which provincial laboratories will get this position.

There are governmental veterinary services within all the 333 soums and in six of the nine districts in Ulaanbaatar. The offices are staffed with two veterinarians, a state veterinary inspector who is head of the office and a veterinary epidemiologist. The positions of epidemiologist in each soum have been established following the new animal health law. Recruitment is underway.

Within each soum and district there are PVUs that have the direct contact with the livestock and companion animal. A large proportion of their income is from government work such as vaccination, food inspection and diagnostic testing or sampling in surveillance programs.

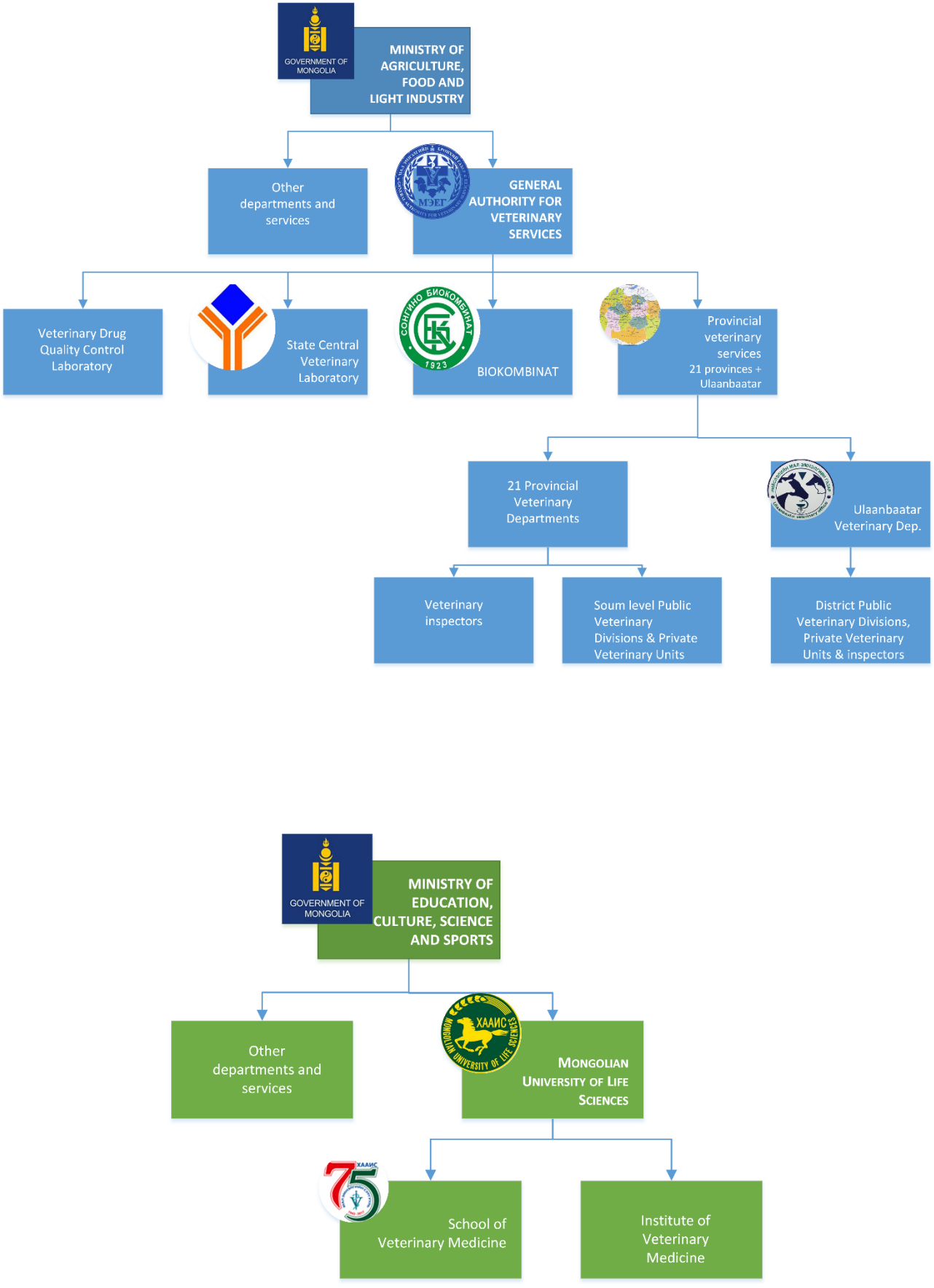

Figure 3. Organization of the Mongolia Veterinary services (in blue) and scientific/educational institutions (in green).

Visits to authorities, institutions and organizations

In the following chapter, a short summary is provided for the visits carried out to the different institutions and organizations. Table 1 shows the calendar of this visits.

Table 1. Calendar of visits.

Place	Date
Veterinary service in Ulaanbaatar	June 18th
The Chief Veterinary Officer*	June 18th
The School of Veterinary Medicine	June 18th
Biokombinat	June 19th
State quality control laboratory for veterinary drugs	June 19th
Veterinary inspection points / Sanitary check-points	June 19th
Veterinary service in Ulaanbaatar	June 20th
The Vice Minister of Food Agriculture and Light Industry*	June 20th
The Food and Agriculture Organization of the United Nations	June 20th
The National Centre for Livestock Gene Bank	June 21st
Laboratories at Ulaanbaatar Veterinary service	June 24th
Intensive production unit (layer farm)	June 24th
State Central Veterinary Laboratory	June 25th
Abattoir for slaughter of sheep, horses and cattle	June 25th
Slaughter market	June 25th
Private veterinary unit in Ulaanbaatar	June 25th
Intensive production unit (dairy farm)	June 25th
Institute of Veterinary Medicine	June 26th
Private veterinary unit in Ulaanbaatar	June 26th
Public Veterinary Division at district level (Ulaanbaatar)	June 26th
Private veterinary unit in Ulaanbaatar	June 27th
Food market laboratory	June 27th
Deputy leader of Mongolian Veterinary Epidemiology Association	June 28th
The Mongolian Field Epidemiology Training Programme at the NCCD	June 28th
Local authorities at soum level (Dornod)*	June 30th
Public Veterinary Division at soum level (Dornod)	June 30th
The Governor of Dornod*	July 1st
Veterinary department in Dornod province	July 1st
Provincial Laboratory in Dornod province	July 1st
Private veterinary unit in Dornod	July 1st
Wrap-up meeting with the Chief Veterinary Officer*	July 3rd

**These are not described in detailed ahead*

Veterinary service in Ulaanbaatar

The veterinary service in Ulaanbaatar is divided into Animal health, Administration, Monitoring and risk assessment and the Laboratory (visited June 24th). The obligations for the veterinary department is as stated above (see Veterinary services, authorities and legislation). Ulaanbaatar has nine districts, 6 of which have production animals. In these 6 districts there is a public veterinary office with two staff, a state veterinary inspector and an epidemiologist.

Approximately 50% of the inhabitants of Mongolia live in Ulaanbaatar. Therefore, food hygiene, which is the responsibility of General Agency for Specialized Inspection (GASI), is important. The veterinary service will implement a brucellosis surveillance programme in 2019. Testing of 35,000 cows is planned. The veterinary service also cooperates with the small animal clinics on programmes for control of echinococcosis and rabies.

The School of Veterinary Medicine - SVM

The School of Veterinary Medicine (SVM) is a part of the Mongolian University of Life Sciences (MULS) and is the only higher veterinary education institution in Mongolia. It is divided into four departments 1) Veterinary

basic sciences, 2) Microbiology and infectious diseases, 3) Public health and 4) Internal medicine. There are about 1000 students and four to five PhD-candidates each year. The faculty collaborates with institutions in South Korea and Japan. An evaluation by the European Association of Establishments for Veterinary Education (EAEVE) in 2012 pointed out that the funding of the faculty from the government was scarce and a need to strengthen facilities for and practical teaching in anatomy, pathology and clinical sciences (Wanner and Fodor, 2012).

Biokombinat

The state owned Biokombinat produces animal vaccines, totalling 50 million doses annually. With few exceptions, they produce all animal vaccines used in Mongolia, the main one being the *Brucella* vaccine. In addition, they manufacture some diagnostic kits and reagents. The institute has an animal research unit for phase 2 trials and safety testing of vaccines. Their research focusses on improving vaccine technology and development of pen-side diagnostic kits. SCVL performs some phase 3 vaccine testing for field efficacy.

With the increase in livestock numbers in the last years and several outbreaks of TADs, the demand for vaccines has increased. Until recently, all animal vaccines were state funded. However, with the new law on animal health, vaccines are divided into three categories; paid by the state, paid by the province and paid for by the herder.

Vaccine ordering varies and is influenced by GAVS policy and outbreak situations. The director expressed hope that the implementation of epidemiologists at soum level will improve the accuracy of vaccine ordering and thus the reliability of vaccine production. The institute faces some challenges with respect to their facilities and some ageing equipment. Research staff expressed a keen interest in capacity building within propagation of cell lines for culturing of virus. The ability to maintain and use cell culture could potentially improve the quality and efficiency of their vaccine production.

State quality control laboratory for veterinary drugs - SQCLVD

This government owned laboratory performs all purity and quality testing of drugs and bio-preparations intended for veterinary use, both domestically produced and imported. The laboratory performs quality- and potency testing of 250-300 batches of vaccines or diagnostic kits from Biokombinat annually, and 350-400 batches of imported drugs or drug components. Among other things, the laboratory has facilities for culturing and sterility testing, chromatography, mass spectrometry and ELISA tests, viral culture and animal testing for challenge trials and potency testing.

Following testing, SQCLVD issues permits for use for individual batches of the drugs and raw materials for drugs. The academic staff consists of veterinarians, pharmacists and chemists working in four laboratories.

Veterinary control points / Sanitary check

There are 11 veterinary control points situated within Mongolia, out of which, six are situated around Ulaanbaatar. These control points check the animal health certificates for transported animals and animal derived products like food and skin/hides. The control posts control the movement of all animals transport and products when moving between the west and the central and eastern regions, with the purpose of stopping the spread of TADs. Disinfection of vehicles during disease outbreak situations is also a task of the control points.

Food and Agriculture Organization of the United Nations - FAO

NVI's team met with Dr. Martin Heilmann, veterinarian and livestock systems officer at the FAO mission in Ulaanbaatar. FAO has been present in Mongolia working with local authorities in a broad range of topics for several years. A special focus was given to the Mongolian Agenda for Sustainable Livestock – MASL, which is currently under implementation with the support of FAO. Some aspects of MASL were considered extremely relevant for the NVI-Mongolia collaboration, especially under MASL objective 3 - To develop veterinary and

animal breeding services, and to improve food security and safety. Synergies could be easily established at least in the following topics:

- Establish a nationwide system on veterinary services, including activities on disease and early diagnosis
- Introduce appropriate medicine use for livestock, conduct training and disseminate information to the herders, take actions to reduce use of antibiotics, establish a unified database on veterinary pharmacy and drug sales
- Conduct frequent research on food security and safety, nutrition and market study of livestock products, support policy on production, and take actions to reduce trade barriers
- Develop standards of livestock products throughout its value chains, conduct feasibility research on standards, establish monitoring system on food security and quality

FAO referred to the Mongolian efforts to establish and develop their aquaculture production (inland lakes production). Here there is a considerable gap of knowledge in topics such as regulation, business model development, technical capacity, or laboratorial support to aquaculture health diagnostics.

Given FAO's long experience in the terrain and network within the country the possibility for direct collaboration between NVI-FAO-Mongolia partners in some of the projects/interventions were also discussed. All parties were positive to this possibility and such synergies are highlighted in the following.

The National Centre for Livestock Gene Bank

The center was established July 1st 2018 based on a state service organization from the 1950s. The breeding station is responsible for a gene bank with 66000 straws with frozen semen from ruminants, camelids and horses. About 60% of the semen is imported for crossbreeding, while semen from 47 breeds of Mongolian origin is stored at the station for preservation.

The staff consists of 19 persons, among them there are two veterinarians. The facility was large and modern with spacious stables and modern laboratory facilities for bacteriological, molecular and technical investigations. There was also a surgery unit. The station has its own flock of small ruminants, cattle and horses.

Laboratories at Ulaanbaatar Veterinary service

The laboratory in Ulaanbaatar is organized under the Ulaanbaatar veterinary service. The laboratory receives samples from the municipal territory. Most of the samples originate from surveillance programs or routine samples such as meat and milk hygiene and controls. The facilities included small laboratories for parasitology, bacteriology, serology, and food safety.

The parasitology laboratory receive approximately 1000 samples a year, mainly in a surveillance program for *Echinococcus multilocularis* and *E. granulosus*. The clinical bacteriology laboratory have reduced staff and the number of samples has been declining. The most common positive diagnoses are enterotoxaemia, pasteurellosis, and anthrax. The laboratory is now unified with the food bacteriology laboratory that prepare media and examines for 6 - 8 pathogens in food. The serology laboratory analyse approximately 50,000 samples annually of which 35,000 are in the surveillance program for brucellosis. There is a small PCR room, where 30 to 40 PCRs are run each year, mainly for verification of bacterial culture. The sanitation hygiene laboratory tested approximately 10,000 samples from animal derived products for freshness, biochemical test, pH etc. The laboratory had a small autopsy room in the same room as the autoclave. They have received less than ten animals a year for autopsy including dogs submitted with suspicion of rabies.

All samples and the results were registered in a laboratory management and information system (LIMS). It was not possible to register a herd ID in the system. The LIMS was common for all aimag laboratories, and SCVL is responsible for the system.

Intensive production units - layer farm and dairy farm

Most of the animal production in Mongolia is non-intensive and based on nomadic traditions. However, intensive animal production is encouraged and has increased in recent years. These production units include dairy-, broiler-, beef and egg- farms. The team was able to visit two different intensive production units, one bovine dairy farm and a farm with laying hens for egg production. The poultry farm was established in 2010. The manager of the egg-farm travelled internationally to learn and gain knowledge about poultry health, management, feed and biosecurity. She described a poor availability of veterinary support and guidance for her production system in Mongolia, but had nevertheless succeeded in establishing a profitable business. Biosecurity, however, was questionable.

The bovine dairy farm consisted of 100 milking cows and 165 in total with a mix of local breeds and Holstein cattle. The farmer had purchased straws of cattle semen, but in lack of inseminators the straws had been stored incorrectly and most likely destroyed. Cattle were milked twice daily but produced a mere total of 1000 litres of milk per day. Milking was performed in part by machine and in part by hand. Milk was delivered to a local dairy factory by the farmer. On several occasions the farmer had received a reduced price due to poor milk quality. He found veterinary- and management advice to be poorly available. Calves were of poor health due to respiratory infections, antibiotics were frequently administered, but no diagnoses had been made. The farmer did not evaluate udder health or perform testing for mastitis. It was clear to the Norwegian team that there was an unrealized production potential at the farm.

Abattoir for slaughter of sheep, horses and cattle

The team visited a large, modern abattoir for slaughter of sheep, horses and cattle. Sheep meat is exported to Iran, and horse meat to China, while cattle are for the domestic market. The abattoir was set up to slaughter 500-800 sheep per day, 100 horses and 120 cattle, and included facilities *ante mortem* and *post mortem*- inspections. Basic laboratory facilities for *Brucella* testing and basic hygiene testing were also available. The abattoir had full time veterinarians responsible for hygiene testing and meat inspection. The abattoir followed a quality control system.

Slaughter market

Together with staff from a PVU in Ulaanbaatar the team visited a traditional slaughter market. Herders bring their sheep and goats to the market for sale and display the animals in small pens. Private persons choose and buy their preferred animals, which are transported in wheelbarrows to a slaughter shed where they are slaughtered in traditional manner (manual tearing of the thoracic aorta). The slaughter markets have a veterinarian in charge of evaluating animal health by inspection of the pens.

State Central Veterinary Laboratory - SCVL

SCVL was established in 1947 and is a governmental institution with 80% state funding. The main tasks of the laboratory are:

- Diagnostics of animal diseases and implementation of control measures
- Veterinary sanitary expertise in export and import of foods and raw materials of animal origin
- Training of the staffs of provincial veterinary laboratories and distribution of instructions

The laboratory is responsible for diagnostics of TADs, surveillance and diagnostics of infectious and parasitic diseases and non-parasitic diseases and endemic diseases as well as testing of animal derived products for export and import purposes. SCVL has the only biosafety level 3 laboratory (BSL3) in Mongolia. The laboratory has 52 employees and is divided into six units:

- TADs (BSL3)
- Infectious and parasitic diseases

- Environment induced (non-infectious) diseases
- Epidemiology, monitoring and information
- Food hygiene and residue testing
- Administration

To facilities include laboratories for serology, clinical bacteriology, parasitology, food hygiene, residue testing, BSL3, pathology and diagnostics of bee diseases are established. The institute uses more than 400 diagnostics kits, and the BSL3 perform 52 different PCR assays for TADs.

SCVL has a high level of competence and the laboratories are quite well-equipped. The number of employees seems to be too low compared to the scale of their tasks. It was not clear to the delegation to what extent their role as reference laboratory is maintained as the number of samples submitted from provincial laboratories appears to be relatively low. The delegation also had the impression that there is an unfulfilled potential for SCVL to provide training and expertise to provincial level veterinary services.

Institute of Veterinary Medicine - IVM

IVM is a part of MULS and is the most important research institute working on veterinary science (wildlife, food safety, zoonosis, infectious disease and development of diagnostic kits and vaccines) in Mongolia. The institute also provides advices to the authorities. The institute was established in 1961 and has 88 employees. Of these, 75 are researchers, and about one third of them hold a PhD. Funding from the Government via the Ministry of Education, Culture, Science and Sports covers the running costs, salary for permanent positions and insurance. In addition, the institute applies for grants, and have obtained 28 governmental grants so far this year as well as funding through ten international projects.

The on-going projects are related to infectious diseases, non-infectious diseases, environmental changes and anti-microbial resistance. Ongoing studies of strain variation of rabies virus has resulted in development of a rapid test in collaboration with Japanese researchers. No other lyssavirus than lyssavirus genotype 1 (RABV) is detected within the country. A recent project also revealed a lack of capability both among medical and veterinary laboratories to perform adequate antimicrobial resistance testing of bacterial isolates.

The institute points out certain areas of interest for collaboration:

- Zoonotic diseases that requires work in BSL3
- Antimicrobial resistance in a One health-perspective
- Capacity building in epidemiology
- Wildlife diseases (deer and reindeer)
- Rabies

The institute has competent and dedicated employees and relatively modern laboratory facilities, but lacks biosafety laboratory level 3 (BSL3).

Public Veterinary Division at district level (Ulaanbaatar) and soum level (Dornod) - PVDs

There are Public Veterinary Divisions (PVDs) within all the 330 soums in the country and in six of the nine districts in Ulaanbaatar. The offices are staffed with two veterinarians, a state veterinary inspector who is head of the office and a veterinary epidemiologist. This structure is still in the process of being implemented following the new animal health law.

The inspector inspects slaughterhouses, assess PVUs, issues animal health certificates, inspect control quarantine measures and animal movement, veterinary drug use and disinfection for biosecurity measures. The main task of the epidemiologist is to report the epidemiological situation on a regular basis to the

provincial level, assess disease dynamics, study infectious and non-infectious diseases, plan and combine all data on vaccination, TAD outbreak, and plan preventive measures.

The team visited several PVDs at soum level. The recent establishment, following the new animal health law, of veterinary epidemiologists at soum level requires training of staff within practical field epidemiology, clinical diagnostics and reporting. The epidemiological situation was reported as described, but the team is uncertain whether the staff were able to evaluate the information and perform simple descriptive analysis that could enlighten trends and changes in disease situation.

Private Veterinary Units – Ulaanbaatar and Dornod - PVUs

The team visited four different PVUs, three in and around the capital and one in Dornod province. Each PVU had between three and five veterinarians. Their main tasks include vaccinations, meat- and milk inspections, health certificates before animal transport and slaughter, *Brucella* testing and sale of drugs for veterinary use. Most of the veterinarians reported to have more than 80% of their income from government funded work (vaccinations, health certificates, surveillance, food safety checks etc). A relatively smaller part of their activities relate to diagnostics and treatment of diseases in animals. Access to diagnostics for common production diseases was very limited. There appeared to be a lack of competence within herd animal health, common parasitic diseases and common infectious diseases that are not under management by the authorities.

Food market laboratory

A food market laboratory was visited. The laboratory was independent, i.e. it did not belong to the market. The laboratory had eight employees, and their role was to perform hygiene inspections of meat, milk and food products, check certificates of animal health and transport, as well as perform targeted and random testing for zoonotic animal disease. Visual inspection was used in combination with basic laboratory testing.

Mongolian Veterinary Epidemiology Association - MVEA

MVEA has currently nine members. The association is open for membership. The association has organized two training seminars in the Western region in cooperation with wildlife people. The subjects were 1) Participatory epidemiology and 2) Wildlife – Livestock interface focusing on Peste des Petit Ruminants. The association has also translated the book Epidemiology for Field Veterinarians: An introduction by E. Sergeant and N. Perkins into Mongolian and are planning development of a curriculum in epidemiology for soum and aimag level. The association is dependent on collaborators and support to fulfill their ambitious plans.

The Mongolian Field Epidemiology Training Programme at the Nation Center for Communicable Diseases – M-FETP

The M-FETP is organized within NCCD and was established in 2009. The organization is a member of the global "Training programs for Field Epidemiology Networks" (TEPHINET) to which the European EPIET program (European Program for Intervention Epidemiology Training) run by the European Centre of Communicable Diseases (ECDEC) also belongs. M-FETP shall strengthen the public health system through training well-qualified professionals in applied epidemiology. The training is given over one year and is organised as a part time study and includes field work. Since 2013, applicants from the veterinary sector have been accepted into the programme. So far five veterinarians have graduated from the course and all of them have gone back to their positions in the governmental veterinary services.

In 2018, M-FETP started offering two month training programme: Frontline – FETP. This programme is organised with two week-long modules in Ulaanbaatar and six weeks of field work at the students´ work place. The course was not arranged in 2019 due to lack of funding. The M-FETP courses are well organised and maintain a high academic level with international collaborations. The five veterinary graduates are a great resource to the veterinary services.

Veterinary Department in Dornod province

The veterinary services is divided into the Veterinary department, administration and the laboratory (see below). The obligations for the veterinary department is as stated above (see Veterinary services, authorities and legislation). The veterinary department reports of a good cooperation with GAVS, GASI and PVUs. Dornod province has approximately 2.3 million livestock that is served by 70 veterinarians in 41 PVUs. Altogether there are 170-200 veterinarians working in Dornod. At this time of the year most of the veterinarians are in the field performing surveillance and vaccination.

Provincial Laboratory in Dornod province

The provincial laboratory in Dornod is organized under the Dornod veterinary service. There are five staff, four veterinarians and one technician. The laboratory receives samples from the province. Most of the samples originate from surveillance programs or routine samples such as meat and milk hygiene and controls. The laboratory in Dornod has a small autopsy room and laboratories for bacteriology, serology, PCR and food hygiene.

For autopsy, they receive 2-3 rabies cases annually. At the food hygiene laboratory they receive samples every day from slaughter houses, kindergartens etc. At the bacteriology laboratory they receive animal samples like milk, organs and blood for bacteriology. For PCR, they have approximately 14 assays, but analyse no more than 7-8 samples annually.

Overall assessment/impressions from the mission

The Norwegian team was impressed with the structure and standing of the veterinary services in Mongolia. With a high number of animals and a dependency on animal derived food products, the authorities of Mongolia prioritize prevention, surveillance, treatment and control of animal diseases and food safety. A strong commitment was observed at government level to the newly implemented animal health law, and all levels of the veterinary services seem dedicated in their efforts to control and limit spread of TADs and serious zoonotic infections. However, the team also observed obstacles with respect to resources and competence within veterinary medicine in Mongolia. There was an expressed need at all levels of the veterinary services for training and competence building within epidemiology, microbiology, parasitology, pathology and laboratory diagnostics.

Many serious and transboundary infectious diseases remain a reason for great concern in Mongolia. Brucellosis continues to be a major public health hazard, and also rabies has been difficult to control despite vaccination of livestock due to a reservoir among wild animals. Tools to improve disease surveillance are being introduced, including animal registration and ear tagging and digital tools for reporting.

Compared to the high number of animals in the country, the number of practicing veterinarians and capacities of veterinary specialist and laboratory services is somewhat limited. Great attention is paid to surveillance and control of selected infections (eg. *Brucella*) and to government initiated vaccination campaigns, but diagnostics and disease specific follow ups of common production related diseases in animals are lacking. Field veterinarians and veterinary inspectors receive relatively little diagnostic and advisory support from local and regional veterinary laboratories. For example, the use of antibiotics in animals is poorly controlled and untargeted. A strengthening of general diagnostics and advisory support to veterinarians could help improve this situation in the medium-long term.

Veterinary laboratories are present in all regions and provinces of Mongolia and are reasonably well equipped. However, competence and training varied between the visited laboratories and persons. Staff had limited access to courses, seminars and practical training, and each laboratory seemed to develop their own procedures. For example, several laboratories had PCR equipment, but the technique was mostly used for verification of bacteriological cultures and not for clinical samples. Often, there were very few samples per year that needed verification by PCR, and the delegation questioned whether this was adequate to maintain staff competence. Relatively few samples were received by reference laboratories, and referral of samples should probably be encouraged. IVMe recently evaluated the capacity for antimicrobial resistance testing in some medical and veterinary laboratories, with results pointing to unsatisfactory competence and skills. It might be an advantage to standardize protocols and diagnostic activities between the laboratories, and to strengthen reference laboratories.

The implementation of the new law on animal health is likely to facilitated efforts to improve animal health and safety of animal derived food products in Mongolia. A strengthening of veterinary services at soum level, with a veterinary inspector and veterinary epidemiologist in each soum is clearly a positive development. However, without sufficient training and duty descriptions, the veterinary epidemiologists and inspectors cannot fulfil their potential. We found the ongoing collaboration between Mongolian veterinary authorities and FAO very interesting and productive and we believe some of the projects proposed by this mission can align very well with the Mongolian Agenda for Sustainable Livestock (currently under development and implementation).

In particular, IVM has dedicated staff with high competence, well-equipped laboratories, a broad international network and on-going research projects with high relevance for the Mongolian situation. Likewise, the Norwegian delegation was impressed by the strong commitment that was demonstrated by the staff at the Ulaanbaatar and Dornod Veterinary Departments. We believe that this forms an extremely good basis for cooperation between Norway and Mongolia within the veterinary sector, and a guarantee for the feasibility and success of the interventions/projects proposed in this report.

Suggested areas for cooperation

Ahead we propose four different projects covering different areas (presented in no specific priority ranking), where there was recognized mutual interest and relevance for future collaboration. Each of the proposed projects was designed under the following premises:

- To have a direct impact on different levels of preparedness related to animal and public health
- To provide a measurable benefit for both Norway and Mongolia
- To be based on both infrastructure/logistic development and capacity building
- To link different Mongolian institutions in a common project (central government, provincial, management or research)
- To be limited to a 1 to 2 years period and feasible/executable by itself (not dependent on the remaining proposed projects)

P1 - Competence building in veterinary epidemiology

Background: There lies great potential in the new structure with epidemiologists at soum level, but it requires appropriate training of staff. We propose training courses within practical field epidemiology at the province and soum levels. There is also a need for extended training of key veterinary epidemiologists.

Aim: Increase competence in epidemiology at provincial and soum level. Assist in developing curse material for epidemiology training courses to be run by national resources in the future.

Implementation: The team proposes building on existing courses organised by NCCD and the M-FETP in Mongolia, They offer a year-long (M-FETP) and a two month long course (frontline-FETP) within field epidemiology in human health. Veterinarians have been accepted for the course since 2013 and five veterinarians have completed the long course. We propose to run an adaptation of the frontline-FETP for veterinary field epidemiology. We estimate that the course can be offered to approximately 10 veterinarians, and veterinarians at the provincial level should be prioritised.

In Mongolia, veterinarians are obliged to partake in approved courses every fifth year to keep their license. The MVEA (nine members) have plans but not resources for developing such courses. We suggest to develop curriculum for one to three different courses in epidemiological subjects that can be included in the approved courses for keeping the veterinary license. This could be done in cooperation with MVEA, the Mongolian Veterinary Medical Association and SVM. Such courses will be aimed at veterinarians at the soum and province level, both governmental and private employed veterinarians.

Benefit for Mongolia: The epidemiology training has not been included in the curriculum at SVM until recently. Increased competence in epidemiology is needed and asked for at all levels in the veterinary field, both in public and private sector. There is need for both courses in more advanced epidemiological methods for key personnel and courses in field epidemiology for soum veterinarians and private practitioners. By involving SVM, this may benefit the veterinary education as parts of the course material may also be relevant in the undergraduate education.

Benefit for Norway: By partaking in development in courses and in the education Norwegian epidemiologist will get valuable information on epidemiology of TADs. Students will be expected to perform small research projects. By partaking in the mentoring of these student projects, Norwegian scientists will gain valuable knowledge that may also be relevant for pursuing further research.

Resources and duration: 1,000,000 NOK during one year. Includes the funding of a frontline-FETP course in Ulaanbaatar for 10 veterinarians, with Norwegian epidemiologist assisting in adapting the course for the veterinary sector and partake in training and supervising field work. In addition, a Norwegian epidemiologist assisting in the development of the curriculum of one to three courses in epidemiology for soum and field veterinarians.

P2 - Training in primary diagnostic investigations

Background: Performing necropsies of livestock and relevant sampling for further laboratory investigations are crucial for setting a herd diagnosis and initiating proper treatment or other measures in case of disease outbreaks. We have received a suggestion from IVM to support the running courses for training field veterinarians in necropsy and sampling. This would include techniques to determine cause of death as well as extent of disease and taking adequate samples. Another suggestion is to support training in histopathological investigations for some bacterial, viral, parasitic and prion diseases. Mongolian colleagues have emphasised that strengthening diagnostics of parasitic diseases mainly at province level should be a prioritised project and have suggested strengthening aspects within ecto- and endo-parasites of ruminants, tick borne diseases and diagnosis of equine piroplasmosis and trypanosomosis. An additional suggestion has been to study parasites of reindeer in Mongolia.

Aim: Strengthening skills in performing necropsies and sampling as well as histopathological investigations and diagnostics of bacteria and parasites (focus on veterinarians at provincial labs in close coordination with SCVL and IVM).

Implementation: Both Norwegian and Mongolian partners have already run similar courses for training field veterinarians in necropsy and sampling for veterinarians and would be interested in collaborating in such a project. The courses could either be organised in Mongolia with experts from Norway, or a limited number of colleagues from Mongolia could visit Norway for intensive training. As a minimum, we suggest that three pathologist and one technician from NVI (Section for Pathology in Ås and the National Competence Centre on Preparedness that has its main site in Sandnes) take part in the training. Ideally, the team should also include a parasitologist and a bacteriologist. The latter could be combined with training in the diagnostics of parasitic and bacterial diseases respectively.

Up to five veterinary pathologists from the reference laboratories in Mongolia could take part in the necropsy routine at the Section for Pathology at NVI and evaluate selected slides under supervision of the pathologists. Training in classical techniques for detection of bacteria and parasites could also be performed at NVI or SCVL/IVM. The inclusion of private farms in Mongolia might represent an added value for field training.

Benefit for Mongolia: Increased competence in primary diagnostic investigations is crucial to ensure proper treatment for better animal welfare, reduction of economic losses and prevention of treatment resistance.

Benefit for Norway: Increased competence in recognising exotic diseases is beneficial for the preparedness.

Resources and duration: 2,000,000 NOK during one year (the courses in necropsies and sampling should take one week, while the training in histopathological investigations and diagnostics of parasites should take two weeks).

P3 - Strengthening of bacteriological diagnostics and testing of antimicrobial resistance

Background: There is an expressed need for strengthening bacteriological diagnostics and antimicrobial resistance testing relevant to animal health and food safety in the Mongolian veterinary services. This competence can contribute to reducing and improve antibiotic usage in Mongolia. The Norwegian team observed weaknesses both within general bacterial diagnostics and antimicrobial resistance testing in most of the laboratories visited. One example is the analyses of milk for diagnosis of udder infections (mastitis) and bacterial quality and safety of milk. Mastitis is an important reason for antibiotic usage, reduced milk -quality, -quantity and -safety worldwide. Milk from cows with mastitis may contain a large number of pathogenic bacteria, and when such milk is consumed raw, as is common in Mongolia, it can constitute a significant public health hazard. In Mongolia, despite variable quality and safety of milk, there is little information about the most common bacterial causes of mastitis in cattle and appropriate treatment and management of this disease. There is also little information about which pathogens are present in raw milk that is for sale, and what the resistance profiles these bacteria have. Milk safety can only be properly assessed through bacteriological testing and antimicrobial resistance testing.

Aim: to improve bacterial analyses of milk and resistance testing in selected key laboratories in Mongolia.

Implementation: Together with IVM and selected Provincial veterinary laboratories, scientists will implement a project to strengthen bacteriological diagnostics and AMR-testing in the food chain using milk as a model (from cow to market). The project would be organized as a small surveillance project at province and central levels, with a strong involvement also of dairy factories and their veterinary staff. The project would encompass training in topics such as correct sampling, sample transport, choice of and production of culture media, bacterial culturing techniques, AMR testing and finally, interpretation of results. In order for the training to be valuable at production level, reporting and guidance to veterinarians and herders will also be included. The project does not require specialized equipment.

Benefit for Mongolia: By using a practical approach this project will improve competence and methodology within bacterial diagnostics and antimicrobial resistance testing in key Mongolian laboratories. By choosing milk as a matrix and base training around a small surveillance project valuable data will also be generated in addition to competence. The competence gained will provide laboratory staff with important practical and theoretical skills that can easily be adapted to other types of samples. Ultimately the project will fill in gaps on mastitis and milk safely that can benefit animal health, efficiency of milk production and milk safety. Importantly it will improve diagnostic capacity, which is fundamental to decision making in animal production and targeted and correct antibiotic treatment.

Benefit for Norway: Organizing and running this project will provide Norwegian researches and laboratory staff the opportunity to work with pathogens that we need preparedness for in Norway. The project can provide a foundation for future collaborative research projects, particularly within AMR and as part of a global effort to reach sustainability goals by contributing to reduced and improved usage of antibiotics.

Resources: 2,000,000 NOK during one year. Includes planning, followed by three steps of training, practice and implementation: 1) Training: a short course in bacteriology and antimicrobial resistance testing will be held in Norway by researchers with broad competences 2) Practice: further training and practice in laboratory techniques and advisory functions in Mongolia, 3) Implementation: performance of a small surveillance project in Mongolia and reporting of results.

P4- Training in working with cell cultures and a pilot study on oral rabies vaccination

Background: Cell cultures are crucial for isolation and characterisation of certain pathogens (especially viruses) as well as propagation for vaccine production. Rabies is one the most feared zoonotic diseases worldwide and is prevalent in wild animals as red foxes and wolves in Mongolia with spill-over both to livestock, dogs and humans (Odontsetseg, Uuganbayar, Tserendorj, Adiyasuren, 2009). The Word Organization for Animal Health (OIE) among others have an aim to eradicate dog-associated rabies within year 2030. Campaigns for vaccination of dogs are put in place in Mongolia, but reduction in the prevalence of rabies in wild animals will reduce the risk for spill-over to dogs, livestock and humans. The use of baits distributed by planes and helicopters for oral vaccination of wild non-flying mammals (mainly foxes) has been a very successful measure for prevention of rabies in member countries of the European Union (Müller, Freuling, Wysocki, Roumiantzeff, Freney, Mettenleiter, Vos, 2015), and rabies in non-flying mammals are now only detected sporadically within the Union.

Aim: Strengthening the skills in working with cell cultures for the purpose of isolation, characterisation and propagation of viruses and reducing the prevalence of rabies in wild animals and eventually the spill-over to guard dogs, livestock and humans.

Implementation: Training in establishment of primary cell cultures as well as maintenance of cell cultures, inoculation, propagation, harvesting, titration and identification of viruses by immunofluorescent antibodies of cell cultures can be provided by NVI with up to five participants from Mongolia. The production of baits for oral vaccination should be performed by Biokombinat, while a pilot study on oral vaccination of foxes in a small area (in a province to be discusses) shall be carried out by Biokombinat, IVM, local authorities and researchers from the NVI in collaboration with institutions in the European Union. The economic aspects of implementing these baits for oral vaccination should also be accessed.

Benefit for Mongolia: Increased competence in working with cell cultures will be beneficial for both the isolation and characterisation of pathogens as well as production of vaccines, while a successful vaccination campaign for preventing rabies will be in the interest for both the animal health and the human health.

Benefit for Norway: Competence in carrying out vaccination campaigns is relevant in the case of disease outbreaks in mainland Norway or Svalbard.

Resources and duration: 2,000,000 NOK during two years (the training in working with cell cultures will take one to two week(s), while the pilot study on oral rabies vaccination will require a period of planning before execution and evaluation).

UNs SDGs and proposed projects/interventions

Mongolia was one of the first countries to adopt the Sustainable Development Goals, with the national Parliament approving the Mongolia's Sustainable Development Vision 2030, just 6 months after the international launching of the SDGs. Mongolia has a sound foundation for ensuring future sustainable development. The country's past economic growth and its Human Development Index values are strong arguments for a successful implementation of this agenda.

An agriculture-based, livestock-dominated economy is unfortunately not strongly resilient to natural disasters, climate change, disease outbreaks, fluctuations off the markets, etc. These vulnerabilities have had social, economic and environmental consequences, and present challenges to sustainable development.

All projects proposed in this report were designed not only to strengthen the collaboration between both countries and mutual capacity related to animal and public health, but also to embody the UNs Sustainable Development Goals. We believe that the 4 projects/interventions described in this report will contribute significantly to help Mongolia achieve several of these goals as summarized briefly in Figure 4.

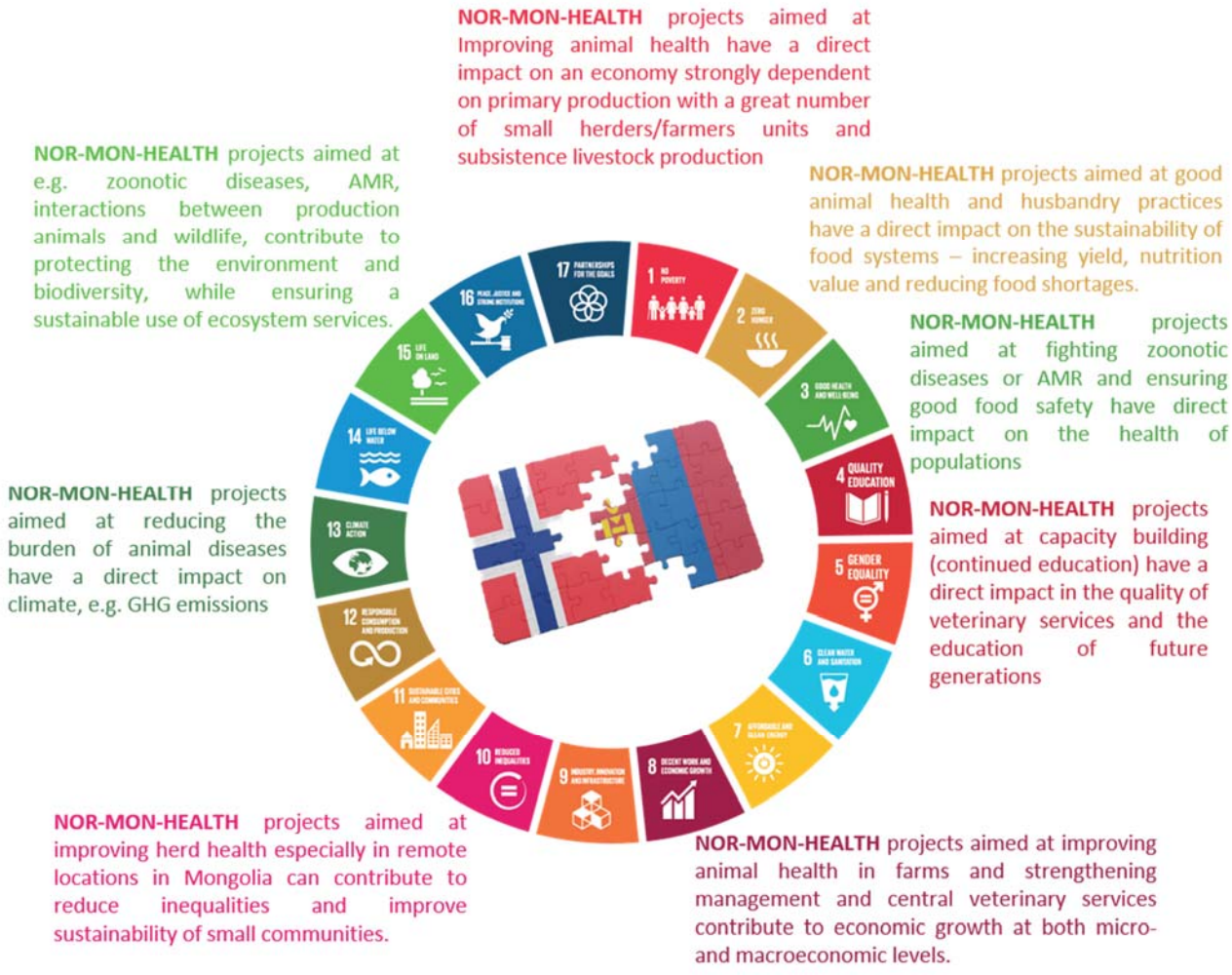

Figure 4. Contribution of NOR-MON-HEALTH projects towards the UN's Sustainable Development Goals.

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When visiting a country where language can represent a barrier, a skilled translator is an essential asset. We would like to thank our translator and veterinarian colleague Dr. Odontsetseg for her invaluable help both during and after the mission. Having a translator who is also scientifically highly qualified in veterinary medicine decisively contributed to the success of this mission.

A word of thanks also to the Mongolian Embassy in Stockholm for their help with logistics and support during the entire mission.

And a final acknowledgment to the Royal Norwegian Ministry for Agriculture and Food for funding this mission and for focusing and supporting NVIs efforts for ONE HEALTH both in Norway and abroad.

Appendix

Curricula of the members of NVI's mission to Mongolia

HANNAH JOAN JØRGENSEN graduated as a veterinarian from the Norwegian School of Veterinary Sciences in 1998. She worked in clinical veterinary practice for two years before starting her PhD project within food bacteriology, which she completed in 2005.

From 2005 to 2014, she worked within research, diagnostics, and outbreak investigations in the fields of food safety, and infectious bacterial diseases in terrestrial animals with emphasis on bovine mastitis and ovine footrot.

From 2014 to 2017 she worked at the Norwegian Public Health Institute on diagnostics and vaccines against meningococcal diseases in humans, and was responsible for running a surveillance project for meningococcal disease in Ethiopia.

After 2017, Hannah J. Jørgensen has been responsible for coordinating activities within diagnostics, surveillance, and reporting on zoonotic infections at the Norwegian Veterinary Institute. She coordinates support to the authorities on questions relating to zoonoses, leads surveillance- and research projects, and is also involved in the handling outbreaks of infectious diseases in animals with zoonotic potential.

Hannah has a broad scientific background, and her main interests lie within bacteriology, zoonotic diseases and control of infectious disease. She also has a keen interest in international work, and is particularly interested in finding practical solutions for laboratory diagnostics and disease surveillance in low income settings.

PETTER HOPP graduated from the Norwegian School of Veterinary Sciences in 1986. From 1986 to 1994 he worked on fish diseases at the Norwegian Veterinary Institute's regional laboratories.

Since 1995 he has worked at Section for Epidemiology and his main field of interest are surveillance programmes on infectious diseases of animals and epidemiology of infectious diseases in ruminants. His obtained his PhD in 2007 on Epidemiological studies of scrapie in the Norwegian sheep population.

His main scientific interest is surveillance for infectious diseases, in particular for control, early detection and proving freedom of disease. He has always been interested in using register data in governmental and industry registers as well as in information in the laboratory information system at the Norwegian Veterinary Institute.

TORFINN MOLDAL graduated from the Norwegian School of Veterinary Sciences in 1999 and has worked at the Norwegian Veterinary Institute since 2000.

He worked at the Section for Pathology mainly performing autopsies of mammals and poultry till 2014, and has since 2014 been working at the Section for Virology and later Section for Molecular Biology dealing with diagnostics, surveillance and preparedness of viral diseases including avian flu, african swine fever and rabies.

He has also been involved in the surveillance and diagnostics of prion diseases since 2001. He has defended his PhD in 2019 focusing on certain aspects of the intestinal health of Atlantic salmon. Other scientific publications are related to viral and prion diseases.

CARLOS GONÇALO DAS NEVES graduated in Veterinary Medicine, from the Technical University of Lisbon in 2004, and obtained his doctorate (PhD) in veterinary science, specialty Virology in 2009 from the Norwegian School of Veterinary Sciences.

With scientific papers published in international scientific journals and extensive experience of scientific project coordination Dr. Carlos das Neves is currently the Director of Research and Internationalization at the Norwegian Veterinary Institute in Oslo, responsible for coordination of research staff of more than 150 researchers working in more than 20 different disciplines.

He served previously for 3 years as Head of Virology and 2 years as Head of Emerging Threats. He holds a joint position on ONE HEALTH and wildlife at the Faculty of Medical Sciences at the University of Tromsø and has been promoted to research professor in 2018.

Dr. das Neves has developed his scientific research in the field of virology in wildlife species and accumulated over these years extensive experience of fieldwork across the Arctic. We works today with topics related to ONE HEALTH and emerging threats, especially viral zoonoses and antimicrobial resistance with a focus also on LMICs.

In 2013 he obtained the diploma of specialist of the European College of Zoological Medicine in the area of Wildlife Population Health and was appointed by the Norwegian Government in 2014 as an expert in animal welfare and health of the National Food Safety Committee.

Dr. Carlos das Neves is the current President of the Wildlife Disease Association and has also served as Honorary Consul of Portugal in Norway between 2010 and 2017.

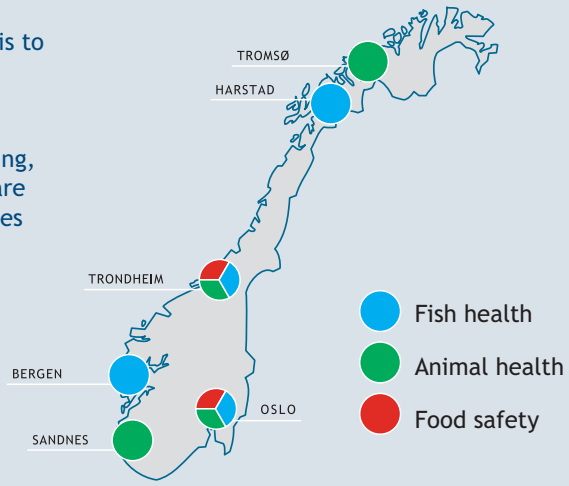
Scientifically ambitious, forward-looking and cooperatively oriented – for integrated health

The Norwegian Veterinary Institute is a national research institute that operates in the fields of animal and fish health, food safety and feed hygiene; its primary task is to provide the authorities with independently generated knowledge.

Emergency preparedness, diagnostic services, monitoring, reference functions, consulting, and risk assessments are all important areas of activity. Our products and services include research results and reports, analyses and diagnoses, studies and advice.

The Norwegian Veterinary Institute's central laboratory and administration lie in Oslo, and we operate regional laboratories in Sandnes, Bergen, Trondheim, Harstad and Tromsø.

The Norwegian Veterinary Institute collaborates with a large number of national and international institutions.



Fish health

Animal health

Food safety

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