CHAPTER 4
Animal Disease Surveillance System

Monitoring and surveillance program for animal diseases is one of key components of DLD's mission. Surveillance programs and activities are aimed at ensuring rapid detection of, and early response to, animal disease threats, as well as development and application of new technologies for early and rapid disease detection. This chapter includes updates on the National Animal Disease Surveillance System (NADSS) in Thailand.

National Animal Disease Surveillance System (NADSS)

The Department of Livestock Development (DLD) initiated and implemented integrated animal health monitoring programs and surveillance activities into a national, comprehensive, and coordinated system. The NADSS is envisioned to be a national-level surveillance system for animal diseases that affect the economic well-being of the Thailand's livestock industry and trade markets, as well as animal diseases that are of significant risk to public health or wildlife species. The NADSS, comprised of monitoring programs and surveillance systems, will function to integrate the collection, collation, and analysis of animal health data and promptly disseminate animal health information, to those stakeholders responsible for maintaining animal health.

Thailand has conducted several animal disease surveillance programs to enhance the national capability for an early detection and notification of suspected cases or outbreaks of any endemic diseases, zoonotic or emerging diseases that pose threats to public health, animal health, and socioeconomics. Such activities are to support an implementation of appropriate animal disease control measures for an ultimate goal of eradication and proving freedom status of such disease or infection eventually. The disease surveillance and monitoring programs will provide not only safeguard measures to avoid risks of introduction into the domestic population or incursions of any exotic animal disease but also to facilitate domestic and international trade in animals and animal products. The programs effectively provide scientific information and creditability in certifying a sound zoo-sanitary health status for live animals and their products exported from Thailand. The risks or threats of animal disease pathogens that affect human health are regularly monitored in food of animal origins in order to build-up public confidence and to ensure consumer health such as avian influenza, BSE, salmonellosis, veterinary drug residues and etc.

The Terrestrial Animal Health Code of the World Oganisation for Animal Health or Office International des Epizooties (OIE) and relevant recommendations are fundamental basis in conducting animal disease surveillance activities in Thailand. DLD, by agencies under the Bureau of Disease Control and Veterinary Services and other relevant agencies, has undertaken both active and passive surveillance and monitoring programs for economic important diseases including exotics in large national-scale and small-scale on risk-based population. The Epidemiological Data Networking will provide support to the existing programs.

In general, there are disease surveillance and monitoring systems that most of livestock diseases have regularly been included in laboratory surveillance. Some specific active surveillance and monitoring programs were conducted such as Notifiable avian influenza (NAI), Newcastle

disease, Foot and mouth disease, Nipah encephalitis, Bovine spongiform encephalopathy, Brucellosis, Tuberculosis, Paratuberculosis, and etc (Table 4-1).

Table 4-1: Specific disease surveillance and monitoring programs implemented in 2011

Species	Specific disease surveillance and monitoring program	Duration
Cattle and buffalo	Foot and Mouth Disease (post-vaccination)	July-August
	Brucellosis	All the year round
	Tuberculosis	All the year round
	Paratuberculosis	All the year round
	Bovine spongiform encephalopathy	All the year round
Pig	Nipah Encephalitis	July-August
	Swine influenza	August-September
Sheep and goat	Brucellosis	All the year round
Poultry	Notifiable avian influenza and Newcastle disease	
	- Breeder and broiler farms	June and December
	- Backyard poultry	January-February and July-August
	- Areas and farms in compartment	June and December

1. Active surveillance system

1.1 Active clinical surveillance

The active clinical surveillance is a baseline and important component in disease surveillance that is conducted by the Provincial Livestock Officials, District Livestock Officials, Subdistrict Livestock Assistant and their livestock volunteers in the subdistrict and village level. Veterinary officers and para-veterinary officers have their routine practice or regular program to visit targeted villagers or farmers, at least once or twice a month. The purpose of the visit is to check general animal health and production status in those villages. In the meantime, the authority could develop a good relationship with farmers for cooperation on animal health and production. If any notifiable disease or animal health problem occurs in the village or its neighborhood, the authority will either be immediately informed during visit, or later at the PLO or DLO in order to conduct outbreak investigation. The obvious evidence is the active clinical surveillance program for highly pathogenic avian influenza that needs strong cooperation among farmers, villagers, livestock volunteers, village public health volunteers, Subdistrict Administration Organizations, all levels of public health authorities, Provincial and District Livestock officials.

In addition, the Provincial Livestock Office usually sets up mobile veterinary unit for delivery of veterinary service to the villagers such as treatment of sick animals, vaccination, castration, and consultation. This activity is conducted once a month. In addition, the mobile unit also involves with several issues on animal health, production, census or survey, training and public awareness. The mobile unit could be a large integrated agricultural unit of various authorities.

1.2 Sero-monitoring program of vaccinated animals

The serological monitoring on vaccination practice in livestock has been conducted every year. As mass vaccination is one of the most effective measures for disease prevention and control, therefore, the herd immunity has been evaluated after vaccination program, usually 1 month

period. In general, serum samples are randomly collected and submitted for laboratory determination on antibody titre levels of foot-and-mouth disease (FMD) in livestock and Newcastle disease (ND) in poultry.

1.3 Active surveillance for specific diseases

Several specific animal disease surveillance programs have been undergoing at national level. At present, DLD has been conducting specific surveillance programs for Bovine spongioform encephalopathy (BSE) , Brucellosis, Foot and mouth disease, Nipah encephalitis, Notifiable avian influenza (NAI) , Paratuberculosis, and Tuberculosis. In general, the Bureau of Disease Control and Veterinary Services is responsible for planning, resource allocation and epidemiological analysis etc. The supportive veterinary laboratories for terrestrial animal disease surveillance are the National Institute of Animal Health (NIAH), the Foot and Mouth Disease Diagnostic Centre or Southeast Asia FMD Regional Reference Laboratory, and other 7 Regional Veterinary Research and Development Centres (RVRDCs) in Lampang, Pitsanuloke, Khonkean, Surin, Chonburi, Ratchaburi and Nakornsridhamaraj Provinces. The 9 Regional Livestock Offices supervise animal activities of the Provincial Livestock Offices in their responsible areas.

The national active surveillance programs have been carried out with several objectives and for many achievable advantages such as;

- To evaluate specific disease control program that DLD has conducted, such as a sero-surveillance in dairy cattle on annual basis for detecting sero-conversion animals on the premises or the prevalence of brucellosis, tuberculosis, and paratuberculosis in ruminant farms. These programs are very useful for general health monitoring and evaluation of disease freedom achievement, any problems or progress in eradication of certain diseases, in particular, farms or premises for further declaration or accreditation of a specific disease free status.
- To enhance veterinary capability in early disease detection and notification for preparedness to control and rapid alert or early warning of disease outbreaks. For instance, the national surveillance scheme for Notifiable Avian Influenza and Newcastle disease in native chicken surrounding the broiler exporting farms has been conducted twice a year. The method is an attempt to isolate Avian Influenza virus (AIV) and Newcastle disease virus (NDV) from sampled cloacal swabs.
- To prove freedom from certain diseases or to establish areas free status in Thailand in comply with the OIE international animal health codes. To date, Thailand has been conducting active surveillance schemes at national scale for Nipah encephalitis, Bovine spongiform encephalopathy (BSE), and etc.
- To screen transboundary animals in order to exclude animal diseases from those imported along the Thai borders. The serum samples will be collected for brucellosis screening test while they have been quarantined in an Animal Quarantine Station (AQS) at the border areas for a period of time.

Moreover, all the serum samples collected will be dispatched to a responsive RVDRC assigned for FMD infection testing by using the nonstructural protein antibody (NSP) test before issuing an Import Permit to release from such AQS to destination.

2. Passive Surveillance system

2.1 Notifiable Disease Reporting

An effective passive surveillance such as animal disease notification system helps us detect disease outbreak early before it spreads widely. District Livestock Office (DLO) must directly report notifiable diseases suspected or occurred in their area to the Provincial Livestock Office (PLO). The primary report may either be informed to DLO by villagers, livestock owners, or observed by themselves. The PLO will notify, in a line of command, to the Director-General of the DLD through the Bureau of Disease Control and Veterinary Services, and other local authorities concerned in the area.

DLD classifies notifiable diseases with respect to national animal disease reporting system. The terrestrial animal disease notification system has occasionally been reviewed and updated. A Manual of Disease Reporting and the Guidelines containing general knowledge of important diseases in Thailand have been distributed to all PLOs, DLOs, and other relevant stakeholders nationwide. The local veterinarians are able to preliminarily recognize any suspected disease and follow the instructions step by step immediately. Field veterinarians are responsible for primary disease investigation of the factors associated with disease outbreaks or animal health problem in affected areas.

The District livestock officials and subdistrict livestock assistants are the first DLD authority at the field level to report any suspected cases of notifiable diseases. The occurrence may be informed to their office, by owners, villagers, farmers, hatcheries or slaughterhouses, in their juristic area. The local veterinary staff has to conduct disease investigation and collect samples before completing reports and submit them to the provincial office within a specified period (Table 4-2). In case of any serious disease is confirmed, the district veterinary staff can undergo public awareness campaign through community radio station to educate farmers and villagers. The farmers or livestock volunteers in affected area are expected to report clinical signs of diseases to the authority as quickly as possible and be on alert.

Several reporting forms were used namely DR.1- DR.5 (Table 4-2). A sample submission form and another 2 specific report forms for active clinical surveillance (CS.1 and CS. 2) of the highly pathogenic avian influenza (HPAI) disease, which were developed and revised since Thailand having HPAI outbreaks in January 2004 (Table 4-3).

The flowchart of disease notification reporting system (DR 1-5 forms) is shown in Figure 4-1.

2.2 Laboratory surveillance

The National Institute of Animal Health (NIAH) and 7 RVRDCs are responsible for conducting routine laboratory surveillance for any other animal disease in Group 3 and 4. However, rabies will be reported once suspected or output of the epidemiological data networking. The diagnostic results from all specimen or samples submitted to the NIAH and RVRDCs will be reported to the DLD's Director-General through Veterinary Epidemiology Development Center (VEDC) on monthly basis (Figure 4-2).

Table 4-2. Disease Reporting Forms (DRs) and the duration specified for submission the data to associated authorities

Reporting Form	Time period to submit report
- Preliminary Animal Disease Reporting Form (DR.1)	Within 24 hours after the disease has been noticed.
- Epidemiological Investigation Reporting Form (DR. 2)	Within 72 hours after the disease has been noticed.
- Disease Status Reporting Form (DR. 3)	Weekly report after the disease has been noticed.
- Vaccination Reporting Form (DR. 4)	After ring vaccination in surrounding area has completed
- (Designed plan/ Result) Ring Vaccination program (DR. 5)	***Designate plan*** Within 72 hours after the disease has been noticed. ***Vaccination result*** After ring vaccination in surrounding area has completed
- Progress Report of Disease Control (DR. 6)	Weekly report
- Sample Submitting Form	To accompany the sample submitted to the laboratory

Table 4-3. Specific Forms for HPAI Notification

Reporting Form	Specification and time for report submission
- Clinical Observation Reporting Form (CS. 1)	- Details by cases in village, sub-district & district - Within 24 hours after the disease has been noticed.
- Clinical Observation Reporting Form (CS. 2)	- All cases in a province, - Within 24 hours after the disease has been noticed.
- Epidemiological Investigation for HPAI Suspicion Reporting Form (July 2004)	- Within 48 hours after the disease has been noticed.

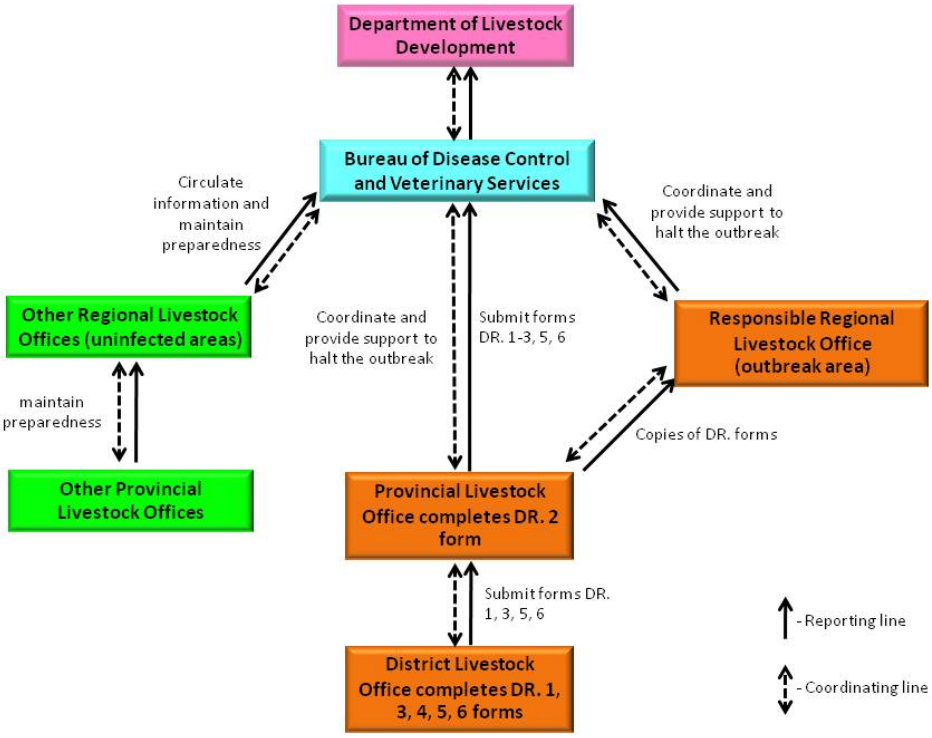

Figure 4-1. Flow chart of submission and coordination of the disease reporting system

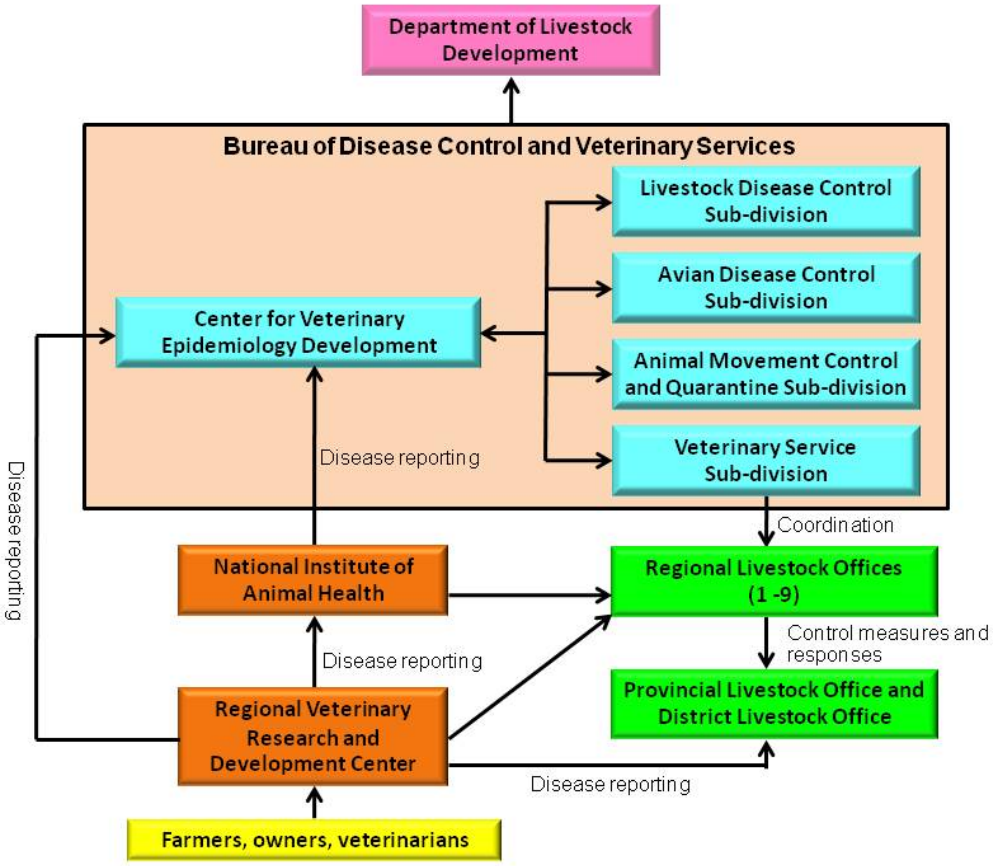

Figure 4-2. Laboratory surveillance system

3. Epidemiological Data Network

An effective epidemiological data network is necessary in disseminating and collecting surveillance data and information from/to relevant institutions in order to portray an accurate representation of animal health status of the country. The current epidemiological delivery system for animal disease reporting of the Department of Livestock Development (DLD) is shown in Figure 4-3.

Figure 4-4 shows the national animal disease response system when any outbreak or emergency occurs.

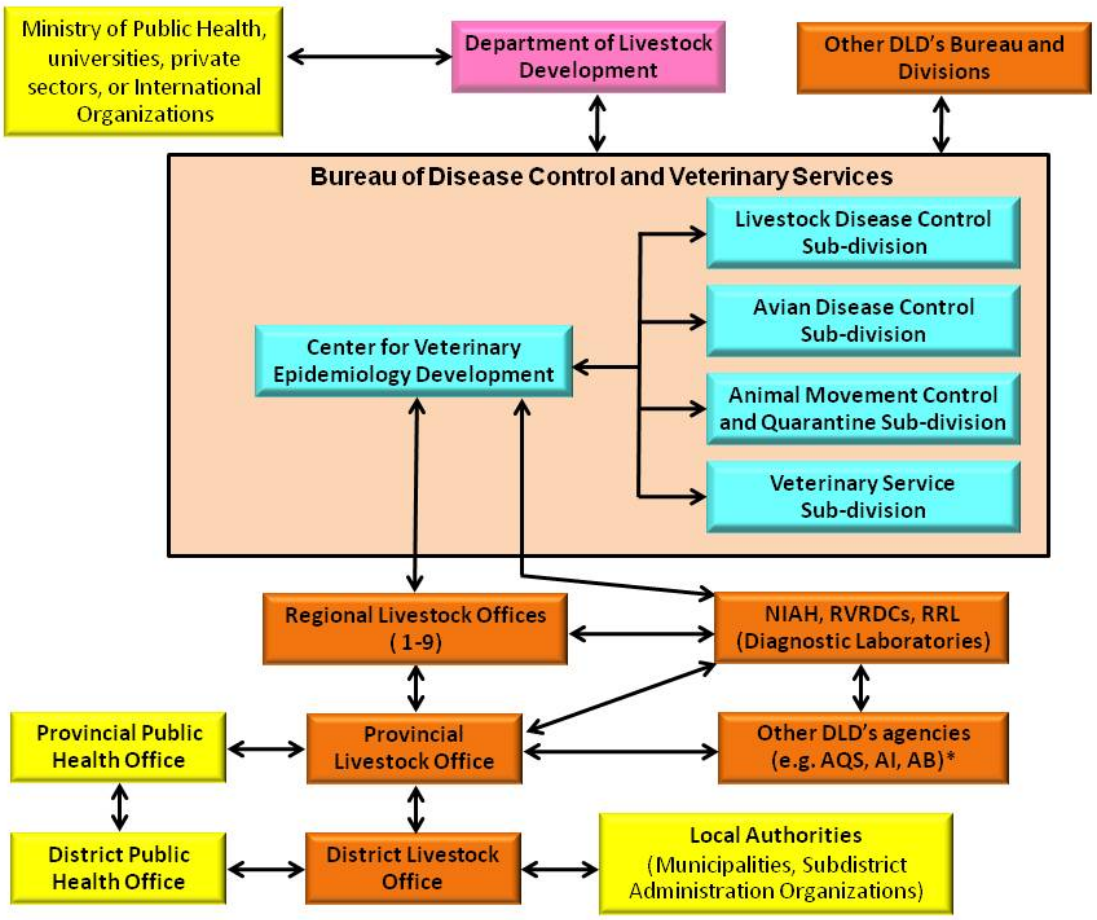

Figure 4-3. Epidemiological data delivery system

Remark: AQS = Animal quarantine Station, AB = animal Breeding and Research Center or Station, AI = Artificial Insemination and Research Center

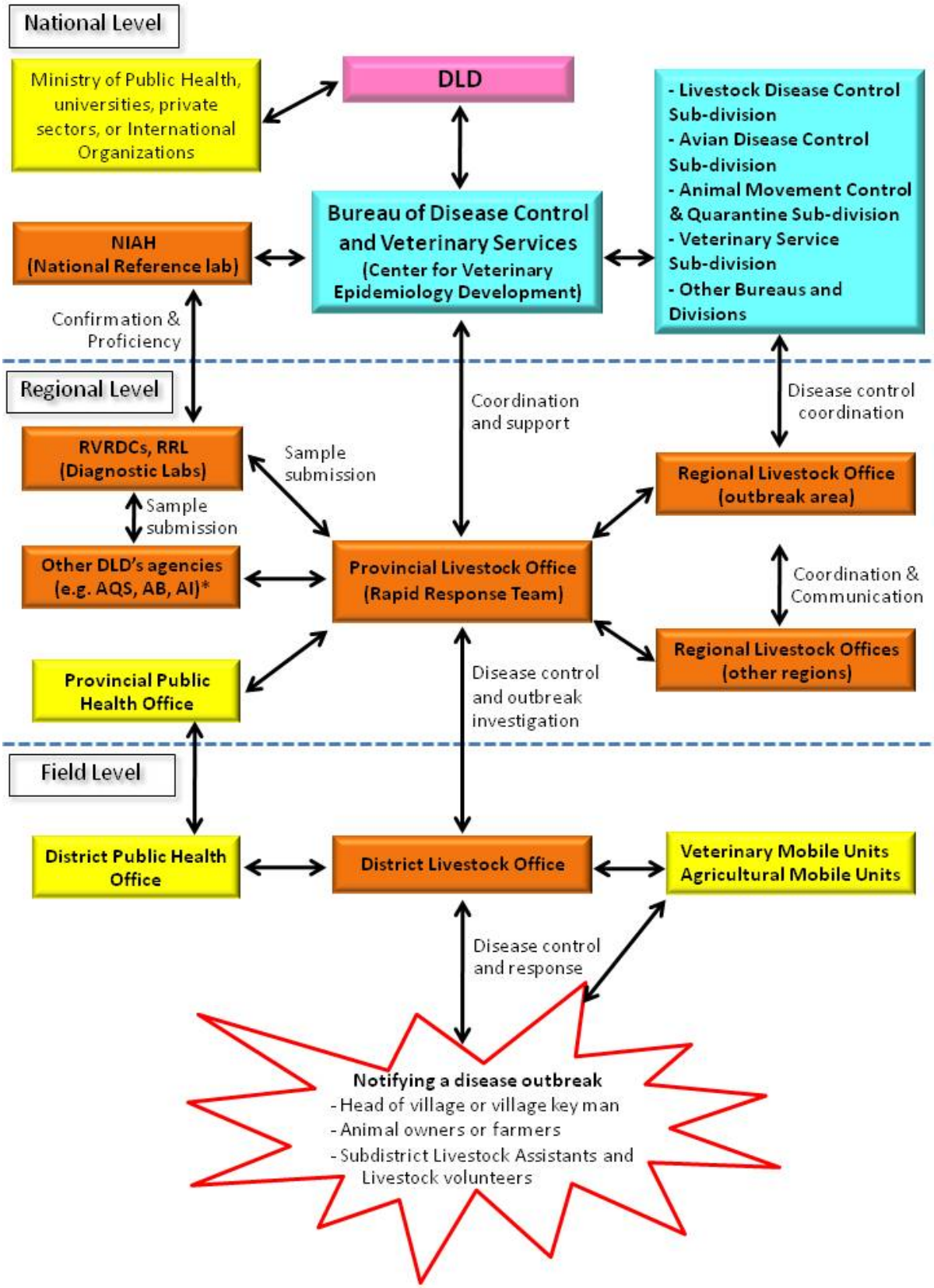

Figure 4-4. National Animal Disease Response System

Remark: AQS = Animal quarantine Station, AB = animal Breeding and Research Center or Station, AI = Artificial Insemination and Research Center

Specific Surveillance Programs in 2011

Bovine Spongiform Encephalopathy (BSE)

DLD has conducted surveillance program of BSE since 2001 onwards by continuous sampling of brain obex. No positive samples have been detected. Samples from animals at risk were likely to find BSE sent to the National Institute of Animal Health. Animals at risk were divide into 4 groups according to recommendations of the OIE.

Group 1: cattle older than 2 years old and showing clinical signs according to BSE such as behavior change, excitement and fear to motivate during milking time, be frightened when close up the door or fence, and cattle showing neurological symptoms without symptoms of infection.

Group 2: cattle older than 2 years old and showing clinical signs of the balance such as fall sleep at any time, unable to walk or balance, get yourself down and unable to get up, as well as cattle older than two years was carving in an emergency or leaving during screening examination before carve animals.

Group 3: cattle older than two years old and died by unknown causes or died during transport from farms to slaughterhouses.

Group 4: cattle sent to slaughterhouses as usual

During 2001-2011, 7,725 samples were collected and tested at National Institute of Animal Health (Table 4-1).

Table 4-1. Number of samples submitted to laboratory during 2001-2011

Year	Number of samples	Cumulative number of samples	Laboratory results
2001	457	457	Negative
2002	515	972	Negative
2003	873	1,845	Negative
2004	664	2,509	Negative
2005	855	3,364	Negative
2006	983	4,347	Negative
2007	1,018	5,365	Negative
2008	1,056	6,421	Negative
2009	1,025	7,446	Negative
2010	257	7,703	Negative
2011	22	7,725	Negative

Nipah Encephalitis

After the outbreaks of Nipah encephalitis in Malaysia in 1998, DLD has conducted the surveillance program for Nipah encephalitis. The target areas for surveillance were both adjacent areas to Malaysia (Region 8 and 9) and high density of pig population (Region 2 and 7).

Sampling frame was designed with the purpose of detecting Nipah virus infection evidence with the 95 percent probability of detection if it is present in 1% of herds (farms or villages) in a stratum (4 regions). The sample size needed to give a 95% probability of detecting Nipah virus infection if the disease is present in 1% of herds in a stratum is to randomly select at least 300 herds.

The number of samples collected in each herd was calculated by estimating the disease prevalence of the disease within farms (20%) with 95% confidence level. As a result, thirty provinces were selected from all provinces in region 2, 7, 8, and 9. Twelve pig farms or villages and 15 samples per farm or village were collected blood samples to detect antibody against Nipah viruses by ELISA (follow the instructions of the FAO-RAP Manual on the Diagnosis of the Nipah Virus Infection in Animals No. 2002/01).

Table 4-3 shows the results of active surveillance program during 2003-2011 and Table 4-4 describes the results of laboratory surveillance from pigs showing lesions of interstitial pneumonia during 1998-2011 and. All samples were not found the antibody against Nipah virus.

Table 4-3. Number of serum samples of pigs collected and tested during active surveillance program from 2003 to 2011

Year	Number of samples	Laboratory technique	Results
2003	14,737	ELISA (indirect)	Negative
2004	3,794	Modified ELISA (direct)	Negative
2005	4,762	Modified ELISA (direct)	Negative
2006	4,202	Modified ELISA (direct)	Negative
2007	4,566	Modified ELISA (direct)	Negative
2008	3,666	Modified ELISA (direct)	Negative
2009	4,900	Modified ELISA (direct)	Negative
2010	3,031	Modified ELISA (direct)	Negative
2011	3,352	Modified ELISA (direct)	Negative
Total	**47,010**		**All negative**

Table 4-4. Number of samples from pigs showing lesions of interstitial pneumonia during 1998-2011 as part of laboratory surveillance

Year	Number of samples	Cumulative number of samples	Results
1998	58	58	Negative
1999	169	227	Negative
2000	112	339	Negative
2001	56	395	Negative
2002	16	411	Negative
2003	82	493	Negative
2004	154	647	Negative
2005	404	1051	Negative
2006	246	1,297	Negative
2007	116	1,413	Negative
2008	150	1,563	Negative
2009	161	1,724	Negative
2010	75	1,799	Negative
2011	255	2,054	Negative
Total	**2,054**	**13,471**	**All negative**

Swine Influenza

According to the epidemic of Pandemic (H1N1) 2009 Influenza, Department of Livestock Development (DLD) launched the monitoring and surveillance program of new type of influenza strain A (H1N1), which was divided into 2 components.

Component 1 (Swine Influenza)

1. Active laboratory surveillance

To conduct sampling secretions in the nasal cavity of pigs (nasal swab) on the farm and carcasses of pigs in abattoirs around the country since May 4, 2009 to June 30, 2009 with the goal of 24,300 samples. The result showed that 18,654 samples (76.77%) were collected and submitted to laboratory with no swine influenza virus.

2. Passive clinical surveillance

To conduct clinical surveillance since April 27, 2009 to June 30, 2009 using a network of monitoring avian influenza in the area monitoring the sick pig that follows the definition is fever, depress, weight loss, dyspnea, cough, sneeze more than 50 percent of the herd. The results showed no suspected swine flu was found during the period.

Component 2 (Pandemic H1N1 influenza)

The situations of outbreaks of influenza in people in Thailand which infected patients spread across the country and the beginning of the expansion of H1N1 from urban to rural, Department of Livestock Development has conducted monitoring and surveillance of Influenza type A (H1N1) in swine with the purpose in order to assess the situation of such diseases of pigs in Thailand. Owing to Thailand not having influenza type A (H1N1) in pigs, the monitoring plan was set up by following the FAO Guidelines for surveillance of pandemic H1N1/2009 and other influenza viruses in swine populations.

1. Active laboratory surveillance

Based on the calculation of 1 percent of prevalence and 95 percents of confidence, 460 pig farms in 38 provinces were collected nasal swab samples during September to December 2009. The pigs in large scale of farms were collected 60 samples and in small-scale farms were collected all.

The results showed that 20,278 samples were submitted and tested in laboratories**.** 51 samples from 20,278 samples were positive for Influenza A H1N1 with Virus Hemagglutination Inhibition Test. The positive samples were sent to confirm at the National Institute of Animal Health for sequencing which the result showed a sample of the 51 samples of a new influenza strain H1N1 2009.

2. Passive clinical surveillance

The definition of suspected swine flu in pig farms were divided into 2 groups comprising the clinical signs in human contacting pig farms and the clinical signs in pig.

2.1 In case of finding the human showing clinical signs of influenza type A and contacting the pig farm, the surveillance was conducted as follows

2.1.1 If a pig were showing symptoms of respiratory tract, 20 pigs would be collected nasal swab samples or lung biopsy or carcass.

2.1.2 If no pig were showing symptoms, the monitoring would be conducted within 2 weeks by checking symptoms at least once a week.

2.2 In case of finding the suspected cases of swine influenza type A (H1N1) in pig comprising fever, depress, weight loss, dyspnea, cough, sneeze more than 50 percent of the herd, nasal swabs or lung biopsy, or carcass of 20 pigs would be collected and submitted to laboratories.

The result showed that no suspected case of influenza type A in human and pig has been found during the surveillance period.

Brucellosis, Tuberculosis, and Paratuberculosis in cattle

DLD has conducted the surveillance for brucellosis, tuberculosis, and paratuberculosis in dairy cattle, beef cattle for breeding, and buffalo for breeding with the purpose in order to establish the disease-free status of the farm.

The cattle and buffalo older than a year were collected blood sample in order to directly test brucellosis by Rapid Plate Agglutination Test and to test paratuberculosis by submitting the blood samples to laboratories. Those animals were tested tuberculosis by single intradermal test.

Brucellosis in goat and sheep

DLD also conducted the surveillance of brucellosis in goat and sheep with the purpose in order to establish the disease-free status of the farm. The goat and sheep older than 6 months were collected blood sample and submitted to laboratories

Notifiable Avian Influenza

In compliance with the OIE recommendation on surveillance for avian influenza, the intensive active surveillance, so-called "X-ray survey", is carried out every six months in completion to the routine surveillance protocols. The same surveillance protocol may be additionally undertaken upon the necessary situation. Two major activities during the X-ray survey include:

1. Intensive active clinical surveillance

Door-to-door visits to survey and interview villagers for any sick poultry or dead birds during the last 30 days in every household, in all villages of the risk areas, is carried out by livestock volunteers to strengthen daily routine active clinical surveillance. During the X-ray campaign each volunteer will visit 10-15 houses in his or her responsibility every day. If any AI suspected case is found, the volunteers will immediately report to local DLD officers for further investigation and sampling for laboratory submission as soon as possible.

The information on sick or dead poultry or normal situation will be daily summarized by the DLD provincial veterinary officers before reporting to the AI website of the DLD by 4.00 P.M.

2. Active laboratory surveillance (or sampling to a standard protocol)

The most recent epidemiological situation in considerable risk areas and surroundings is taken into account for selecting targeted areas for sampling. Samples are collected according to the designed sampling protocol appropriate to the current status by the local DLD officers and submitted to either the National Institute of Animal Health (NIAH) or other 7 Regional Veterinary Diagnostic and Research Centres for virus detection. Active laboratory surveillance significantly contributes to evaluate the status during the most vulnerable months.

Sampling standard protocol

DLD has conducted a standard protocol for cloacal swab samplings from backyard poultry, grazing ducks or sick poultry and/or their carcass submission to a laboratory as follows:
At the confidence level of 95 % and prevalence of 10-20%.

- Backyard poultry: collect 5 cloacal swabs per household for 4 households in a village for all villages located in the sub-district of risk areas e.g. duck grazing area, habitat of migratory birds etc.
- Grazing duck flock: collect 20 cloacal swabs per grazing duck flock of all flocks
- Submit 2-5 sick or dead birds

Swab samples were placed in tubes, containing virus transfer medium with usually five swabs pooled per tube.
The surveillance results of the X-ray campaign from 2004 to 2011 are shown in Table 4-5.

Table 4-5. Results of intensive active laboratory surveillance (X-ray survey) during 2004-2011

Time/Year	Duration	Number of samples submitted*
1/2004	1-31 October 2004	150,648
1/2005	1-28 February 2005	66,588
2/2005	1-31 July 2005	87,721
3/2005	17 October–31 December 2005	99,651
1/2006	1-28 February 2006	57,461
2/2006	1 June – 31 July 2006	86,274
1/2007	3 January–5 March 2007	58,471
2/2007	17 June-31 July 2007	51,428
1/2008	1-29 February 2008	45,882
2/2008	1-31 July 2008	44,891
1/2009	1-28 February 2009	61,052
2/2009	1-31 July 2009	54,083

Time/Year	Duration	Number of samples submitted*
1/2010	February 2010	26,060
2/2010	July 2010	56,454
1/2011	February 2011	49,199
2/2011	July 2011	16,609 (cloacal swab) 12,326 (serum samples)

Remark: *One sample is pooled cloacal swabs from 5 birds.
Data excluded samples for export and pre-movement testing.

Foot and Mouth Disease (FMD)

DLD has attempted over the years in order to establish a FMD free zone in Region 2, the eastern part of Thailand, to comply with OIE international animal health codes. FMD surveillance in Region 2 has been conducted with 3 objectives: 1) FMD early detection, 2) Assessing protective immunity through the titer analysis of FMD vaccination, and 3) Evaluating the FMD status.

Geographic Information System (GIS) has been used to identify locations of villages and farms. Additionally, the standardized questionnaires are used to interview farmers on their attitude, knowledge about FMD and their behaviors in disease prevention and control. All documents were returned BDCVS for further analysis for determine the basic knowledge in FMD and possible risk factor may be introduced into their farms.

In passive surveillance, all farmers are obligated by law to notify to veterinary authority of their sick or clinical signs of FMD. Any suspicions are further investigated by DLD Officers and appropriate samples are collected for laboratory diagnosis at the Eastern Regional Veterinary Research and Development Centre and confirmation by the FMD Regional Reference Laboratory (RRL) in Pakchong, Nakhonratchasima province, Thailand.

A serological surveillance was conducted to estimate FMD prevalence in FMD free zone, i.e., the control and buffer zones. The prevalence will be estimated in 2 sub-population groups including the pig accredited farms and ruminants in that area. The two-stage sampling was used in selecting villages and/or farms, which is the primary unit, and randomizing the animals, which is the secondary unit, for serum sample collecting and testing for the evidence of FMD infection. The sampling plan is distributed to each provincial livestock office to proceed accordingly.

All serum samples from pigs in accredited farms and other livestock in buffer and control zones were collected with animals' history and were submitted to the Eastern Regional Veterinary Research and Development Centre (RVRDC) in Chonburi province. The Eastern RVRDC conducted tests for any FMD evidence on sero-conversion by detection of the Non-structural Protein (NSP) and determining FMD titer by the Liquid phase (LP)-ELISA. All serum samples are stocked in the Serum Bank at National Institute of Animal Health (NIAH), Bangkok. The RRL later selects samples randomly from the serum bank for NSP and FMD titer of type O, A, and Asia1 testing for comparison.