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Assessing the Value of Additional Animal Health Information

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Abstract

The cost of collecting the information and assessing the benefits derived from better information about animal health are rarely examined. This chapter examines the private benefits of collecting animal health information within an economic framework, and demonstrates the need for such a framework to assess the economic value of collecting such information. Analysis carried out using Bayesian decision theory demonstrates there is not always a net gain from collecting additional animal health information. When the expected net gain from sampling at the optimal sample size is small, it is possible that the livestock producer would gain more by using the money elsewhere rather than by collecting additional information. In the case of vaccination against *Babesia bovis*, vaccine immunity is long lasting and the vaccine is relatively inexpensive in comparison to the cost of collecting additional information. Therefore, it is possible money may be spent more effectively on purchase of vaccine rather than on gathering additional information. Where vaccination must be carried out annually using a more expensive vaccine, the benefit from collecting information would be expected to be greater.

Introduction

Assessing the economic value of additional information forms an important but neglected part of the framework for economic analysis of animal health programs. Decisions are made in animal health programs under uncertainty with regard to many factors, including the incidence of a disease and immune status of the herd to that disease. Additional information can be collected to reduce uncertainty. While collecting information is regarded as an essential part of economic analysis, the economics of obtaining extra information are not usually assessed when designing animal health programs and information systems.

Quantitative information on the occurrence of disease, and the effects of disease control programs, is not available to support private decisions in animal health in Southeast Asia (or in much of Queensland). Information on disease occurrence available to livestock producers is limited and consists mainly of livestock producers' own experience and the experience of their advisers including neighbours, veterinarians, farm advisers, accountants and government officers. Therefore, livestock producers often make decisions on whether to vaccinate their animals to control a disease without specific information on the incidence of that disease or the likely benefits of vaccination. In general, livestock producers may have some knowledge of the incidence of a specific disease in their herd. However, in the face of uncertainty about the likely incidence of disease, livestock producers may elect to collect additional information on disease incidence.

One way of obtaining quantitative information on the disease status of a herd is use of serological sampling. However, before serological data can be used in decision making it must be interpreted to provide information on the incidence and severity of disease, i.e. the potential losses of a disease outbreak. If livestock producers decide that it may be worthwhile to collect more information by this method, they need to know that the value of obtaining the information does not exceed the expenditure to obtain the information. Further, it would be desirable to know the economically optimal number of serum specimens to collect.

The following section examines concepts important to the valuation of additional information including private use of animal health information and the relationship between the cost of collecting information and the value of information. A method to estimate the value of extra information to the individual livestock producer is then described and applied. The livestock producer's decision to collect information on the health status of the herd

using serological sampling is considered as part of the decision to vaccinate animals. Bayesian decision theory used in this chapter combines statistical and economic information to assist in identifying optimal management policies. This approach has been used in a number of situations in animal health decision making—for example, Williamson (1975), Fetrow et al. (1985), Elder and Morris (1986) and Parsons et al. (1986). A method to determine the optimal sample size is examined and applied.

This chapter considers the economic value of additional information for private purposes and does not take into account social and possible market consequences. Some market effects are examined in Ramsay et al. (Chapter 13) and social aspects in Tisdell et al. (1995).

Private Use of Animal Health Information

The effect of collecting additional information, or acquiring increased knowledge, can be to change the decision to vaccinate, decrease uncertainty in making the decision, or decrease the need for flexible policies. This section first examines the private use of animal health information; then the effects of increasing the level of knowledge are explored. Finally, the relationship between value of information and cost of gathering that information is investigated.

Animal health information provides support for private decision-makers. Any decision in livestock disease control involves uncertainty because of the need to predict what may occur in the absence of a disease control program as well as the effect that a disease control program may have on disease occurrence. Decisions are therefore made using the imperfect knowledge that is available to the decision maker. (In this case, knowledge is defined as the sum of available information.) However, perfect knowledge is not required for rational decision making and the most economic state for an individual usually involves imperfect knowledge and hence imperfect information (Baumol and Quandt 1964). This is discussed further in Tisdell (1996).

Collection of additional data, that is processed into information, is one way to decrease uncertainty. However, the production of knowledge requires the use of resources, and hence bears a cost. Because of this cost, it is often uneconomic to decrease uncertainty through the gathering of additional information. Alternatively, the effects of uncertain events can be reduced by maintaining flexible policies that enable a rapid response to change in the animal health status. Examples include (i) being prepared to vaccinate immediately if cases of a disease occur in the district, or (ii) reducing the

hazard by having a herd of disease-resistant *Bos indicus* cattle where there is a risk of disease caused by *Babesia bovis* infection. However, maintaining flexible policies may also bear a cost.

In Figure 1, the curve *ITK* describes a relationship between the amount of information and the expenditure incurred in obtaining that information. The benefit a livestock producer will gain from collecting additional information will depend on the livestock producer's current level of knowledge. If, using information currently available, the producer's level of knowledge is at a low point such as point *d* in Figure 1, then the collection of additional information will bring a large increase in knowledge for a relatively small expenditure. However, if the livestock producer's level of knowledge is at a higher point such as point *e*, the benefit from collecting additional information is much less per unit of expenditure. A livestock producer with a level of knowledge at point *e* would gain less benefit from the same expenditure on information collection than a livestock producer with a lower level of knowledge. A livestock producer with a level of knowledge at point *f* would gain little benefit from additional expenditure on information and the expenditure could exceed the value of the information. It will not be worthwhile for a producer to collect additional information on animal health unless the benefit gained from using that information exceeds the costs of collection.

If a livestock producer decides to gather additional information on the occurrence of disease on the farm, there are many ways of collecting that information. While some of these will not be feasible, or will be prohibitively expensive, the livestock producer will generally have a choice between methods. To select the method to be used, the livestock producer can compare the cost of the method and the value of the information likely to be produced. In most cases the method will not be an 'all-or-nothing' method and by increasing expenditure the livestock producer will obtain increasingly accurate information. However, the relationship between the cost of collecting information and the value of that information to a private decision-maker is almost certainly not a linear relationship and several possibilities exist for that relationship.

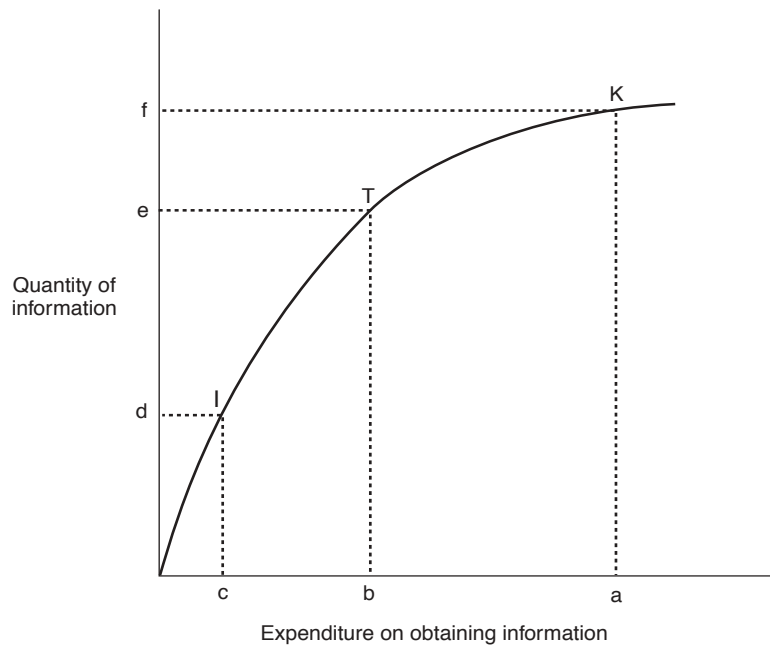


Figure 1. Quantity of information versus cost of animal health information.

Usually in the collection of information there is an initial start-up cost. Before samples are collected on a farm it is necessary that several things are done, including deciding on and obtaining a sampling frame and ensuring the tests needed to analyse the specimens are available. These must be done each time specimens are collected. In nearly all cases the start-up activities will not produce any information and this is the situation examined in this chapter. The relationship between the cost of collection and the value of the information obtained could be as depicted by curve *ARDF* in Figure 2.

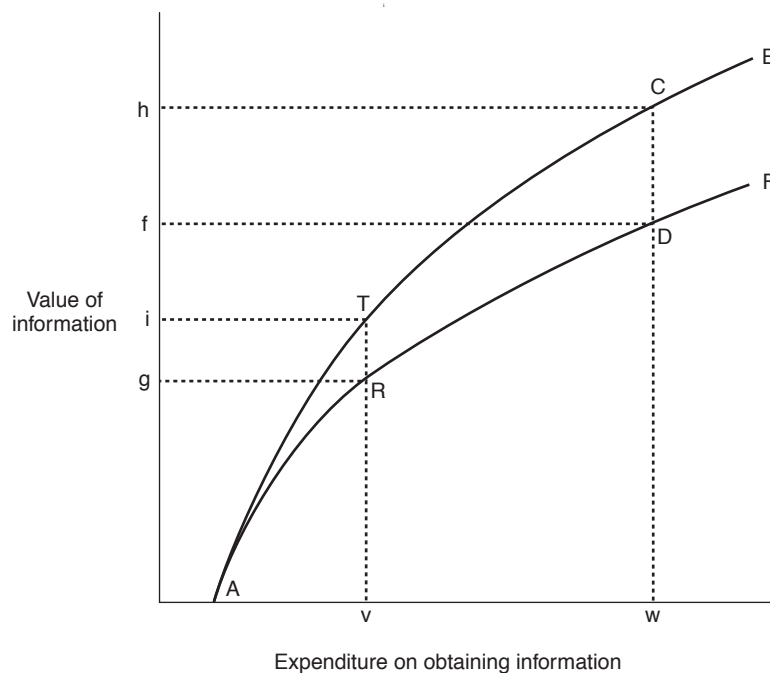


Figure 2. Collection expenditure versus value of additional animal health information, with allowance for start-up costs.

Where there is a start-up cost, the overall cost per specimen collected will decrease as the number of specimens collected increases. In addition, if it is possible to test for many diseases from the same specimen then the cost of specimen collection, per disease tested for, decreases as the number of tests carried out on each specimen increases. If each test carried out increases the value of the information, then the curve would be higher as illustrated by curve *ATCE* in Figure 2.

In Figure 3, the gross value of information curve is illustrated as curve *Aaa₁E* while the total cost of information is presented as curve *Caa₁F*. Quantity of information is now represented by the X-axis and expenditure and benefits by the Y-axis. The break-even expenditure can be determined as the points at which the gross value of the information equals the cost of collection. These points are demonstrated in Figure 3 as being where the cost curve *Caa₁F* crosses the value curve *Aaa₁E* at points *a* and *a₁*. The aim of the decision-maker collecting the information is to maximise the vertical difference between the two curves. This will occur when information is collected up to the point where marginal cost of collecting information equals its marginal gross value.

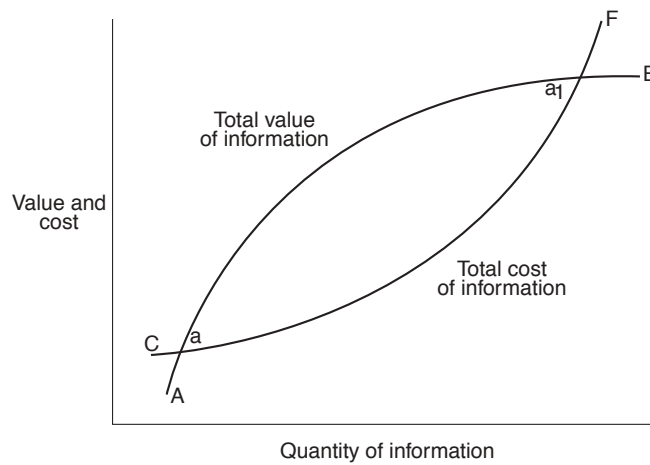


Figure 3. Total cost and gross value of information.

While the cost of collecting data and transforming it into information is relatively simple to determine, the value of that information is more difficult to estimate. The value of the information will depend on the uses to which it can and is put, as well as current disease control actions and level of disease occurring on the property.

The value of additional data collected on individual properties has rarely been estimated in relation to the better decisions that can be made using those additional data. Some attempt has been made in the analysis of herd health schemes which include, as part of the scheme, a health and production database on which the decisions to examine or treat animals are made (Williamson 1980).

The location of curves described in Figures 2 and 3 will vary from farm to farm and from year to year. Standard curves are not available to enable the livestock producer to determine the optimal level of expenditure on gathering information nor on the type of information that should be gathered. Therefore, while providing a useful framework to examine information gathering in relationship to expenditure, the curves do not provide the detail needed by livestock producers who are deciding whether they should gather more information before deciding on a disease control action.

Making Decisions on Gathering Animal Health Information

Currently the information available for private decisions on animal health in Southeast Asia (and even much of Queensland) is limited. If a livestock producer is deciding whether to vaccinate animals they can make the decision with the information available or decide to gather additional information to increase confidence that the action chosen is the most appropriate one. If the difference between the pay-offs for the alternatives is large, then it may be worthwhile for the livestock producer to spend money to learn more. This decision is outlined as a flow chart in Figure 4. The step of interest in this diagram is where the decision-maker determines whether additional information will be collected. In a Bayesian framework the prior information in step 1 consists of livestock producers' experience and that of their advisers. This prior information can be developed into prior, subjective probabilities. Subjective probabilities refer to the level of belief held by a person about the occurrence of possible events (Officer and Dillon 1968; Spetzler and Stael Von Holstein 1975). Because different livestock producers have had different experiences and interpret information and integrate new information into knowledge differently, they may have different subjective probabilities for the same event and therefore make different decisions.

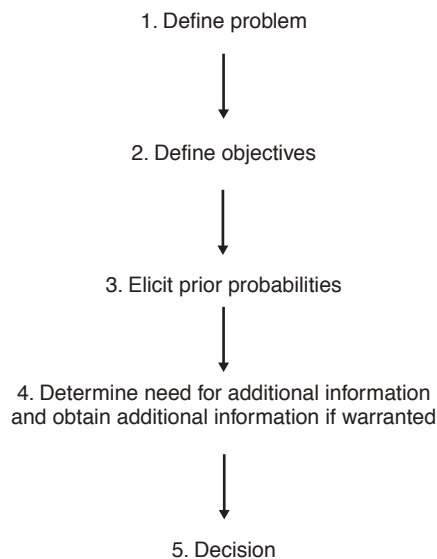


Figure 4. Decision framework for vaccination against *Babesia bovis* (adapted from Anderson et al. 1977)

As new information becomes available a rational livestock producer will use this additional information to modify the subjective probabilities of an event occurring. While this is not usually done in a formal manner, Bayes' Formula is used in this analysis to provide a logical framework for the combination of subjective probabilities, determined from the prior information, with the additional information collected by the decision-maker.

Determining the Value of Additional Information in a Bayesian Framework

The expected value of perfect information (EVPI), together with the cost of sampling (COS), can be used to estimate the maximum sample size worth considering. However, this does not determine the benefit received from a specific sample size nor does it estimate the optimal sample size. The optimal sample size can be determined with reference to the expected net gain from sampling (Harrison and Tamaschke 1984). Using these concepts, and a computer spreadsheet model discussed below, the value of additional information provided by serological sampling of a herd, and the optimal sample size for a livestock producer considering vaccination of his herd against *B. bovis*, can be determined.

In relation to the decision to vaccinate, the expected value of perfect information is the increase in expected value of returns from cattle production (EV) that would occur if the decision-maker could obtain completely accurate information concerning the event being faced, in this case disease incidence. That is, the livestock producer would always know the disease incidence that will occur and therefore always select the most appropriate strategy. To do this, it is necessary to calculate the expected value using the information currently available. The EV is calculated for each alternative action and the action with the highest EV is selected. The EV for a particular strategy A_j is defined as:

$$EV(A_j) = \sum_i P_i V_{ij} \quad (1)$$

where

P_i is the probability of the occurrence of state of nature i

V_{ij} is the pay-off of action j under state i

(Harrison and Tamaschke 1984; Ngategize et al. 1986).

The EVPI is then calculated as

$$EVPI = ERPI - ERCI \quad (2)$$

where:

ERPI is the expected revenue with perfect information

ERCI is expected revenue with current information.

In this case, because the information collected is not perfect, its cost of collection should be less than the expected monetary value of perfect information.

The method outlined provides a useful guideline for determining the maximum amount to be spent on information gathering. Williamson (1975) used it in decision analysis to evaluate use of heat mount detectors in dairy herds. Subsequently, use of decision analysis and calculation of EVPI has been undertaken by Elder and Morris (1986) and Galligan et al. (1987).

An upper limit on the sample size, the maximum sample size, can be set to ensure that $COS \leq EVPI$ where the COS for an individual property is approximated using the function:

$$COS = s + k_n n + k_t n + k_k d + k_m \quad (3)$$

where:

s is the start-up cost for data collection

k_n is the collection cost per specimen

k_t is the cost of laboratory testing per specimen

n is the number of specimens collected

k_k is the travel cost to the farm per kilometre

d is the number of kilometres travelled to collect the specimens and

k_m is the cost of mustering and handling the cattle for specimen collection.

Hence, the maximum sample size must satisfy:

$$s + k_n n + k_t n + k_k d + k_m \approx EVPI \quad (4)$$

That is:

$$n \approx (EVPI - (s + k_k d + k_m)) / (k_n + k_t) \quad (5)$$

The expected net gain from sampling (ENGs) is the difference between the expected value of sample information and the cost of sampling and is defined as:

$$ENGs = EVSI - COS \quad (6)$$

where EVSI is defined as the difference between the prior and posterior expected opportunity loss (EOL). That is:

$$EVSI = \text{prior EOL} - \text{posterior EOL} \quad (7)$$

The EOL of the optimal action is an alternative way to express the expected value of perfect information (that is, the benefit forgone from not collecting the information). The EOL provides an alternative way of expressing the expected value criterion which, in this case, is the action with the lowest EOL. The EOL for each action is defined as:

$$EOL(A_j) = \sum_i P_i L_{ij} \quad (8)$$

where L_{ij} is the opportunity loss of action j under disease state i .

The posterior EOL is an estimate of the EOL based on posterior probabilities such as might be calculated for the range of possible outcomes given a particular sampling (that is number of specimens collected). An EOL is calculated for each possible action for each possible outcome from the sampling strategy. The posterior EOL is calculated as the sum of the opportunity losses of selected strategies for each possible sample outcome weighted by the probabilities of the different outcomes.

The optimal sample size is defined as the sample size that will maximise the ENGs. A simple formula is not available to determine this value so the EOL, and from it the ENGs, must be calculated for each sample size so that the sample size that maximises the ENGs can be read from the tabulated results.

Determining the Value of Additional Information on Disease Caused by *Babesia bovis* in Central Queensland

Each of the steps outlined in the decision framework in Figure 4 are examined in this section. The method outlined above is then applied to examine the benefits from collecting serum samples by central Queensland beef producers seeking additional information on disease caused by *B. bovis*.

- Step 1. The problem in the present context is defined as determining whether a livestock producer should vaccinate animals against *B. bovis* using either of two vaccination programs (referred to as Vaccination 1 or Vaccination 2) or not vaccinate at all. With Vaccination 1, animals one year old are vaccinated while in Vaccination 2 all animals in the herd are vaccinated in the first year, with only animals one year old vaccinated in subsequent years.
- Step 2. It is assumed the livestock producer's objective is maximisation of the expected pay-off.
- Step 3. The prior information consists of the livestock producer's experience and that of their advisers. In the case examined, the event faced is the occurrence of disease in the herd measured as the risk of infection of cattle with *B. bovis* (determined from age specific seroprevalence at one year old). Age specific seroprevalence has been divided into five categories, namely very low, low, moderate, high and very high. Available information is gathered and analysed using the models developed in Ramsay (1997) so a pay-off is calculated for each state of disease incidence.
- Step 4. The livestock producer then faces the problem of whether it is desirable to gather more information and, if so, what is the maximum amount that should be spent. Preferably this might be expressed as the optimal sample size for serological sampling and the benefit that could be gained from gathering the additional information. In this step the method described previously is used.
- Step 5. An action is chosen that maximises the present value of expected net revenue, i.e. the ENGS.

In determining the sample size, the producer has derived personal probabilities for likely disease occurrence and has available estimates of the expected pay-off from each vaccination program under the different states of nature that could occur. Using the available information, the producer wishes

to determine if it is economic to collect additional information on disease incidence using serological sampling before making a decision on whether to vaccinate his herd.

A standard herd size and structure described in Table 1 is adopted. Two representative herds with different types of cattle are examined. The first herd consists of crossbred cattle (*Bos indicus* x *Bos taurus*) of intermediate disease resistance, while cattle in the second herd are disease-resistant *Bos indicus*.

Table 1. Standard herd size and structure for central Queensland.

Age and sex class	Proportion of sex	Number in herd
Females		
0–1 years	0.199	80
1–2 years	0.179	72
2–3 years	0.159	64
3–4 years	0.131	53
4–5 years	0.108	43
5–6 years	0.089	36
6–7 years	0.073	29
7–8 years	0.061	23
Castrated males		
0–1 years	0.325	84
1–2 years	0.313	81
2–3 years	0.245	63
3–4 years	0.115	30

Pay-off matrices for vaccination of cattle against *B.bovis* derived using models developed in Ramsay (1997) are presented in Tables 4 and 6. An analysis for crossbred cattle is presented first followed by analysis for the herd of *Bos indicus* cattle.

The cost of vaccine is taken as \$1.59 per dose and the cost of administering the vaccine as 50 cents per head. Mustering costs have been taken as zero because it is assumed that the animals have been mustered for another purpose, such as branding, when they are vaccinated. The parameters used in calculating the cost of sampling are set out in Table 2.

Table 2. Parameters used in determining the cost of sampling.

Variable	Cost per head
Collection cost (k_n)	\$5.00
Laboratory testing cost (k_t)	\$2.40
Travel cost per kilometre (k_k)	\$0.80
Distance travelled in kilometres (d)	100
Mustering costs (k_m)	\$0

The prior probabilities for the different states of nature used in this section have been devised in association with Mr Peter Black, a veterinary officer working in central Queensland, and Dr Bob Dalgliesh, an expert on disease caused by *B. bovis*. The probabilities have been devised to represent the variation in the incidence of *B. bovis* infection that can occur in central Queensland and the variation in the prior probabilities between different livestock producers in the region. The estimated prior probabilities are illustrated in Table 3. Here, producers 1 and 2 believe they have a high infection incidence, producers 3 and 4 believe they have a low infection incidence, and producers 5 and 6 fall in between these two extremes. With a very high or very low infection there will be little disease. These probabilities are relatively independent of breed, and Table 3 is taken to represent both breed groups.

Table 3. Estimated prior probabilities for different states of disease incidence for producers in different districts of central Queensland.

Incidence of infection	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	Producer 6
Very low	0.05	0.05	0.5	0.3	0.05	0.1
Low	0.1	0.1	0.2	0.3	0.15	0.2
Moderate	0.15	0.25	0.15	0.25	0.6	0.4
High	0.2	0.3	0.1	0.1	0.15	0.2
Very high	0.5	0.3	0.05	0.05	0.05	0.1

Sampling size considerations for a herd of cattle of intermediate disease resistance

At all levels of incidence of infection for cattle with intermediate disease resistance the predicted pay-off is positive for both vaccination programs as demonstrated in Table 4. The pay-off for Vaccination 2 is higher than for Vaccination 1 when the incidence of infection is very low, low and moderate.

Table 4. Pay-off matrix for disease control alternatives for a herd of intermediate disease resistance.

Incidence of infection	Payoff (dollars)	
	Vaccination 1	Vaccination 2
Very low	4 164	7 144
Low	22 919	26 396
Moderate	23 416	24 913
High	11 337	11 061
Very high	1 021	334

The EVPI and optimal sample size vary with the prior probabilities. The way in which these are derived is rather complex, and involves calculation of posterior probabilities using Bayes' formula, aggregating results for different sampling outcomes, and performing the analysis for various sample sizes. Further details are provided in Harrison and Tamaschke (1984) and Ramsay (1997). The maximum sample size is that for which the cost of sampling equals the expected value of perfect information.

As illustrated in Table 5, in almost all cases for the moderately disease-resistant cattle there is little, if any, net benefit to the producer from obtaining additional information via the collection of serum specimens. In almost all cases, Vaccination 2 is the most appropriate action. Where the ENGS is positive and the collection of specimens is expected to produce a net gain for the livestock producer, the optimal sample size is small (see Table 5) and the ENGS low.

Table 5. Estimated benefits from sampling for a herd of intermediate disease resistance with sampling costs of \$5 per sample.

Sample information	Producers with different prior probabilities					
	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	Producer 6
EVPI ^a (\$)	399	289	62	62	76	123
Maximum sample size	38	23	0	0	0	1
Optimal sample size	8	9	0	0	0	0
ENG ^b at optimal sample size (\$)	148	13	0	0	0	0

^a EVPI = the expected value of perfect information

^b ENG = the expected net gain from sampling

When tests for five different diseases are carried out on each specimen, the cost of collection decreases from \$5.00 to \$1.00 for each test. Again considering only the pay-off from *B. bovis* control, there is a small increase in the sample size identified as optimal (Table 6). The ENG at the optimal sample size increases due to the decreased cost of sampling. However, the method does not suggest a sample be collected in cases where sampling is not suggested with the higher cost of sampling.

Table 6. Estimated benefits from sampling for a herd of intermediate disease resistance with sampling costs of \$1 per sample.

Sample information	Producers with different prior probabilities					
	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	Producer 6
EVPI ^a (\$)	399	289	62	62	76	123
Maximum sample size	101	68	2	2	6	20
Optimal sample size	11	12	0	0	0	0
ENG ^b at optimal sample size (\$)	249	117	0	0	0	0

^a EVPI = the expected value of perfect information

^b ENG = the expected net gain from sampling

Sampling size considerations for a herd of disease-resistant cattle

The disease control option providing the highest pay-off for disease-resistant cattle varies with the incidence of infection as presented in Table 7.

Table 7. Pay-off matrix for disease control alternatives for a herd of disease-resistant cattle.

Incidence of infection	Payoff (dollars)	
	Vaccination 1	Vaccination 2
Very low	-1 866	-1 892
Low	2 351	2 368
Moderate	2 560	2 258
High	651	42
Very high	-1 035	-1 729

The optimal sample size and EVPI are sensitive to changes in the prior probabilities for the herd of disease-resistant cattle. The results for the collection of samples for a livestock producer with a herd of disease-resistant cattle are presented in Table 8. In some cases the ENGS would make the collection of specimens worthwhile.

Table 8. Estimated benefits from sampling for a disease-resistant herd with sampling costs of \$5 per sample.

Sample information	Producers with different prior probabilities					
	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	Producer 6
EVPI ^a (\$)	613	406	923	617	148	293
Maximum sample size	67	39	108	67	4	23
Optimal sample size	15	13	24	27	0	0
ENGS ^b at optimal sample size (\$)	223	33	414	103	0	0

^a EVPI = the expected value of perfect information

^b ENGS = the expected net gain from sampling

As in the case for the crossbred cattle, the optimal sample size increased with the reduction in the cost of sampling as a result of the increase in the number

of tests being carried out on each specimen (Table 9). The ENGS at optimal sample size also increased with reduced sampling costs; however, the collection of specimens still did not become attractive in cases where sampling was not suggested at the higher cost of sampling.

Table 9. Estimated benefits of sampling for a disease-resistant herd with sampling costs of \$1 per sample.

Sample information	Producers with different prior probabilities					
	Producer 1	Producer 2	Producer 3	Producer 4	Producer 5	Producer 6
EVPI ^a (\$)	613	406	923	617	148	293
Maximum sample size	164	103	255	165		
Optimal sample size	28	27	30	29	0	0
ENGS ^b at optimal sample size (\$)	394	188	590	279	0	0

^a EVPI = the expected value of perfect information

^b ENGS = the expected net gain from sampling

Application to Livestock Industries in Developing Countries

In developing countries many livestock producers operate on a small scale and recommendations on disease control are often made on a regional basis because small herds, where animals are grazed communally, can have similar disease incidence. The model developed in this chapter could therefore be considered for use in estimating the benefits of collecting information as part of an economic analysis to determine disease control strategies for small-scale livestock producers within a defined area. In the situation of small-scale livestock producers, benefits gained from improved decision making about animal health are not always financial. Improved family nutrition due to increased milk consumption would be an example. Therefore, it can be difficult to calculate and value the benefits obtained from collecting additional information. Additional analysis is needed to determine whether the method described here is suitable for use in developing countries.

Because resources in developing countries are often severely limited, it is particularly important that available funds are spent to provide the greatest benefit. An economic framework needs to provide a suitable method to determine areas in which funds spent will achieve the greatest gains. The

collection of animal health information should be examined within such a framework.

Discussion

The method outlined here could be used to assist an individual livestock producer, or groups of producers, examine their needs for additional animal health information. However, the collection of animal health information cannot be considered in isolation from decisions about disease control or eradication that are made using the information. The collection of animal health information should be integrated into animal health decisions in order to estimate the value of collecting additional information. Any assessment of the value of information needs to consider the benefits from decisions made using the information in comparison to those made without the information. In addition to considering the cost of collecting data, costs of processing data into information need to be included in the analysis.

In the example examined here, namely disease caused by *B. bovis* in central Queensland, the decision to sample and the optimal sample size are less sensitive to the prior probabilities of the decision-maker than to the pay-off from disease control programs, or the cost of sampling. Changes in the cost of sampling result in changes to the recommended sample size but not to the situations in which sampling is found to be financially attractive.

In the case examined, vaccination provides a positive pay-off at most levels of disease incidence. In such a case, the decision-maker may be better off vaccinating animals rather than collecting information on disease incidence.

Vaccination against *B. bovis* provides long lasting immunity. For some diseases, immunity is short lived and animals must be vaccinated annually. In such a situation the benefits from a single vaccination are likely to be smaller and sampling to determine disease incidence may become a more economic option, especially if the cost of vaccine is relatively high.

Conclusions

This analysis demonstrates the complexity of decisions involved with collecting additional information and the need to consider such decisions within an economic framework.

The Bayesian method outlined provides an economic framework to assess the collection of additional information on disease incidence as part of a decision to control a specific disease by vaccination. In doing so, use is made of current information, and the benefits to be gained from collecting additional information are assessed in comparison to the costs of collection. The method is applicable to large-scale individual livestock producers or to advisers to groups of small-scale livestock producers where the incidence of disease is considered to be consistent throughout the area. The method provides guidance for decision-makers about collection of additional information by augmenting the current knowledge of the decision-maker. The example demonstrated that there is not always a net benefit from the collection of additional information on disease incidence, and the cost of collecting information may exceed the benefits derived from collection.

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15

Modelling an Animal Health Information System: the LaoBase Project

*E. Sergeant
A.R. Cameron
C. Baldock
S. Vongthilath*

Abstract

This chapter describes an animal health information system developed for use in Lao People's Democratic Republic. Such a system is considered vital to improving livestock production through the reduction of disease; one of the priorities set by the Lao government. The system, named 'LaoBase', is simple to use, low cost, and requires only locally available technology. It has been designed to complement the current structure of the Lao Animal Health Department, reporting formats, information flow and priorities, and is compatible with geographical information systems which allow information to be mapped with ease. LaoBase has been designed in such a way that it can be easily modified to meet the needs of a number of other developing countries in the region.

Introduction

Animal health information systems for livestock disease surveillance and control purposes are many and varied throughout the world. They have largely been developed by government agencies to meet local needs and range from low-cost microcomputer-based, single-user systems with communication via the Internet to expensive file server applications with multiple user access over wide area and local area networks.

Historically, there have been two main approaches to the management of application development:

1. By information technology specialists with the business unit as the client.
2. By the relevant business unit, with information technology aspects contracted on an 'as needs' basis.

The former is the traditional approach for large applications which follow well understood models such as personnel, procurement, finance etc. The latter has proved to be far more effective and cost-efficient for specialised systems such as for animal health programs. Examples are the *ANEMIS* system for emergency disease management in Australia and the New Zealand *EpiMan* and National Livestock DataBase (NLDB) systems.

Animal health agencies often face several problems with regard to information systems, including the following.

- As complex systems approach obsolescence, obtaining funds for replacements is often difficult.
- Trade issues are driving the need for greater harmonisation of data structures among systems dealing with similar information.
- In some instances it would, overall, be more cost-effective to replace systems operating in different agencies by a single system but there are often no clear mechanisms to achieve this.
- In many cases, output report requirements have changed since the original systems were built, necessitating substantial redesign.

This chapter outlines how the 'business needs' of the Animal Health Division (AHD) in the Department of Livestock and Fisheries (DLF) within the Ministry of Agriculture and Forestry of the Lao People's Democratic Republic (PDR) were analysed and how an appropriate animal health information system

based on locally available technology was developed. 'Business needs' has been defined as technical business rather than administrative business of the AHD.

Information Systems and Databases

The difference between an information system and a database is not always clear. While a database is a component, an information system is more about understanding the critical information required for the business needs to be met, the uniform application of standardised definitions, the accuracy of input data, the flow of information among users, production of understandable and timely reports and the development of cost-effective solutions.

In animal health, especially in developing countries, 'cutting edge' information technology is frequently not the optimal means of finding an overall cost-effective solution for an information system. Unfortunately, this is not always clearly appreciated.

At present, there are examples of some relatively simple but effective systems being applied by different agencies throughout the world. Equally, there are examples of very expensive systems in operation, which are probably not cost-effective if examined in a strictly business sense, but there are lessons to be learnt from the approach taken to their development.

The Situation in Lao PDR

Approximately 85% of the 4.2 million people of the Lao PDR live in villages and are involved in agricultural production (58% of gross domestic product), largely at the subsistence level. Livestock production is an important source of cash income to villagers and comprises approximately 40% of the agricultural gross domestic product. One of the government's policies which aims to increase the standard of living of its people is to improve livestock productivity. Strategies to achieve this include reducing the impact of major infectious diseases delivered through programs of the DLF. However, the DLF is severely constrained by lack of resources and skills which are inhibiting its ability to achieve the objectives of its various programs.

It is known that many of the world's most serious infectious diseases are a major constraint to production in the smallholder livestock sector in Lao PDR. However, at present there is virtually no capability to obtain and

analyse representative quantitative data on the occurrence and impact of these diseases. Lao PDR has only the most basic information system to record and analyse animal health information. This means that decision-makers in the DLF are not in a position to make good judgments on priorities for use of scarce resources with regard to animal disease control.

Experience in other developing countries has clearly demonstrated the value of computerised animal health information systems in assisting with the management of disease control and surveillance programs. A similar system has previously been developed for use in Namibia (Hare and Biggs 1996) and provides an excellent example of the benefits of such a system in the management and reporting of disease information in a developing country.

The Lao PDR provides a unique opportunity to develop a low-cost animal health information system relevant to developing country needs, based on *Epi-Info* (Dean et al. 1997), a sophisticated relational database management program available in the public domain.

Assessing the 'business' needs

The initial stage in the development of a pilot animal health information system was the conduct of a needs assessment process with staff from the AHD of the Lao DLF to determine:

- the structure and reporting relationships of the AHD;
- the types, management and use of information presently collected; and
- priorities for information management.

The AHD (see Figure 1) is responsible for disease diagnosis and control; quarantine; the veterinary extension network; and vaccine production, distribution and use with partial cost recovery.

At the time of the needs assessment, the AHD was using a paper-based system of information management, recording various types of data, including village livestock statistics, disease occurrence, vaccination and officer activity reports. This system was hampered by the absence of standard report formats. Many records were aggregated at each level of administration and only summaries passed up the chain from district to province to head office. Thus, although a lot of detail was collected, a considerable proportion of the value was lost through aggregation. It also meant that errors which could have been detected at the local level were not detected in aggregated data.

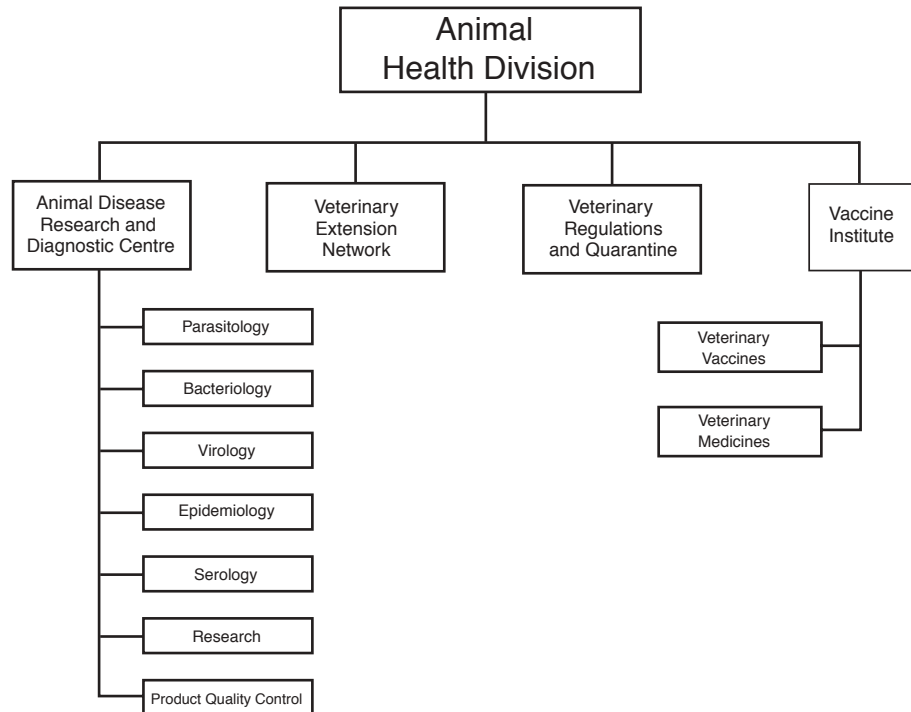


Figure 1. The organisational structure of the Lao Animal Health Department

One important activity to which the AHD is committed is the training and support of village veterinary workers (VVs). These people are smallholders who assist in animal health matters at the village level but receive no official salary. They are seen by the AHD as critical to the AHD's veterinary extension program. To date, approximately 6 400 VVs have been trained. While many of these actively participate in AHD animal health programs, an unknown number are inactive. The AHD has a goal of training at least one VV for each of the 12,000 villages in Lao PDR by the year 2000.

The initial assessment indicated that the key requirement of a computerised information management system was the ability to manage data on:

- livestock demographics;
- field reports of disease not supported by laboratory diagnoses;
- routine passive laboratory submission data;

- active surveillance data, derived from project surveys;
- management of vaccination program data;
- management of training and activities of veterinary extension workers in each village;
- meat inspection findings; and
- quarantine checkpoint activities.

Initial priorities for information management were for:

- collection of village demographic data;
- a system to track data on VVWs and their training;
- a disease reporting system; and
- a system to track vaccination production and delivery.

System Design

An outline of a basic information management system was designed, based on the structure of the AHD, information flows and priorities and is shown in Figure 2.

The system has been designed in such a way that it can be easily modified to meet the needs of a number of other developing countries in the region such as Vietnam, Cambodia, Myanmar and the Philippines. Also important in system design was that the system must be compatible with current geographical information systems (GISs) so that any data collected can be easily mapped.

It is envisaged that the system will eventually comprise seven major database modules:

1. **LAO-BASE**—the basic demographics required by AHD to undertake its responsibilities.

2. **EX-MAN**—an information management system to record the VVWs and their training.

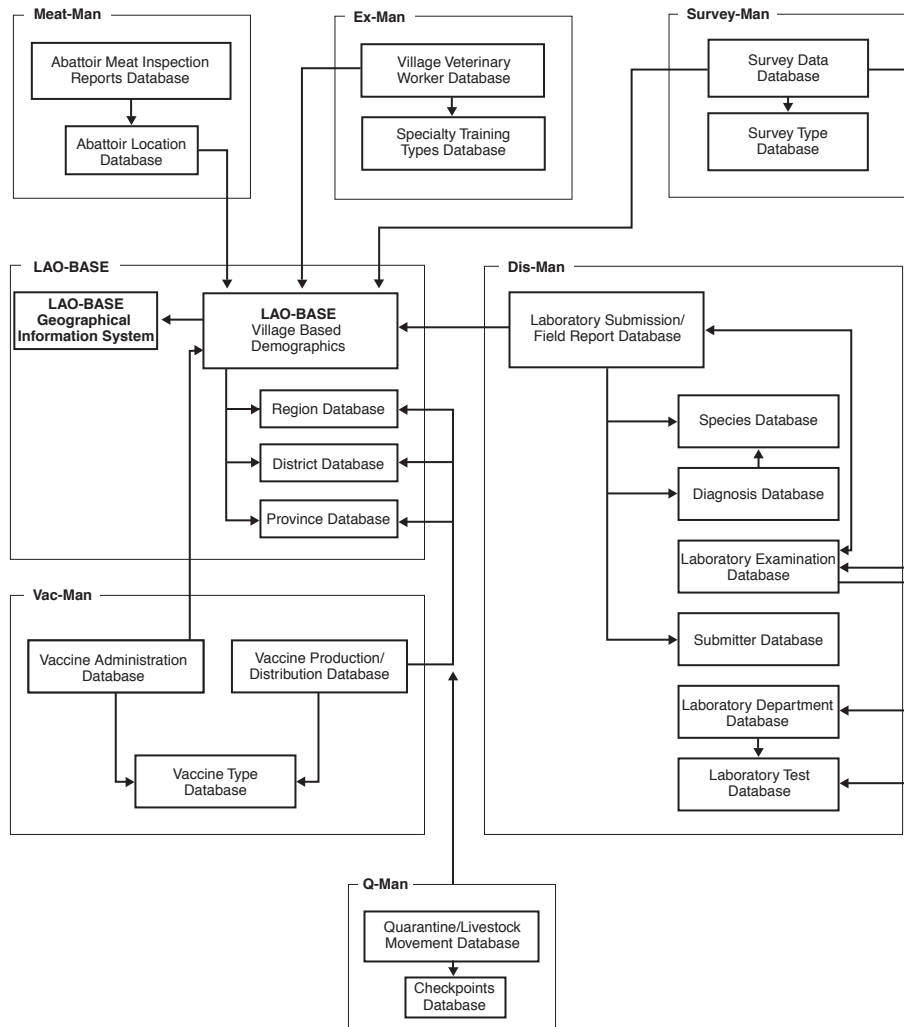


Figure 2. Conceptual model of the LaoBase information system showing main table relationships which reflect the ‘business’ of the Animal Health Division in terms of its organisational structure and main information flows.

3. **DIS-MAN**—a disease information management system capable of handling both field and laboratory diagnoses.

4. **VAC-MAN**—information about production, distribution and delivery of vaccines produced by the AHD.

5. **SURVEY-MAN**—results from specific surveys.

6. **Q-MAN**—information on animal movements through quarantine checkpoints.

7. **MEAT-MAN**—information on slaughtering and meat inspection results at abattoirs.

In the initial development phase of the project the focus was on the first four modules, as these were the main priorities identified by the AHD.

Implementation

The system has been designed to allow operation initially as a single centralised system but with the capability of being distributed as a number of independent provincial systems with data being merged into a central database for national analysis.

A pilot system has been developed for the first four modules which has been tested and is now in use in Lao PDR. The main features of the system include:

- fully menu-driven, integrated data entry and reporting systems;
- use of standard code and term lists to ensure consistency and accuracy during data entry;
- standard codes and terms, maintained in separate data files and protected by password access for security and maintenance;
- fully relational database structure to ensure linkage between related information;
- GIS compatibility has been assured by including provision for recording of geographic coordinates of all villages and the use of standard hierarchical codes for village, district and province identification;
- the DIS-MAN module, which includes provision for both field and laboratory reports and maintains relational links between the two;
- provision for recording multiple laboratory tests and their results, all linked to a single laboratory accession and field report;
- a comprehensive range of reporting capabilities including lists, summary tables, Office International des Epizooties (OIE) summary reports and automated maps (both thematic and point); and

access to the full analytical and reporting capabilities of *Epi-Info* for customised reporting.

There are now more than 12,000 villages in the demographics database, most with latitude and longitude coordinates for simple disease mapping. The system is linked to computerised maps of Lao PDR which permits data to be automatically mapped through the *Epi Map* program.

In developing the information system, existing forms and information flows were also reviewed. Some forms were redesigned to reflect the needs of the AHD and to simplify and standardise data collection and entry into the database. The standard disease report form that was designed is shown in the appendix. The main opening screen for LaoBase is shown in Figure 3. It is based on the familiar format of having a toolbar at the top with a series of drop-down menus in a logical order. The *Epi-Info* menus are included on the toolbar for easy access to statistical programs for analysing the data without having to export to other programs.



Figure 3. The main opening screen of LaoBase showing the tool-bar at the top with a series of drop-down menus which cascade to the various sub-menus.

Data entry screens have been designed to show both Lao and English script as the majority of users have a good understanding of Lao but limited English. Figure 4 shows how a typical data entry screen appears to the user.

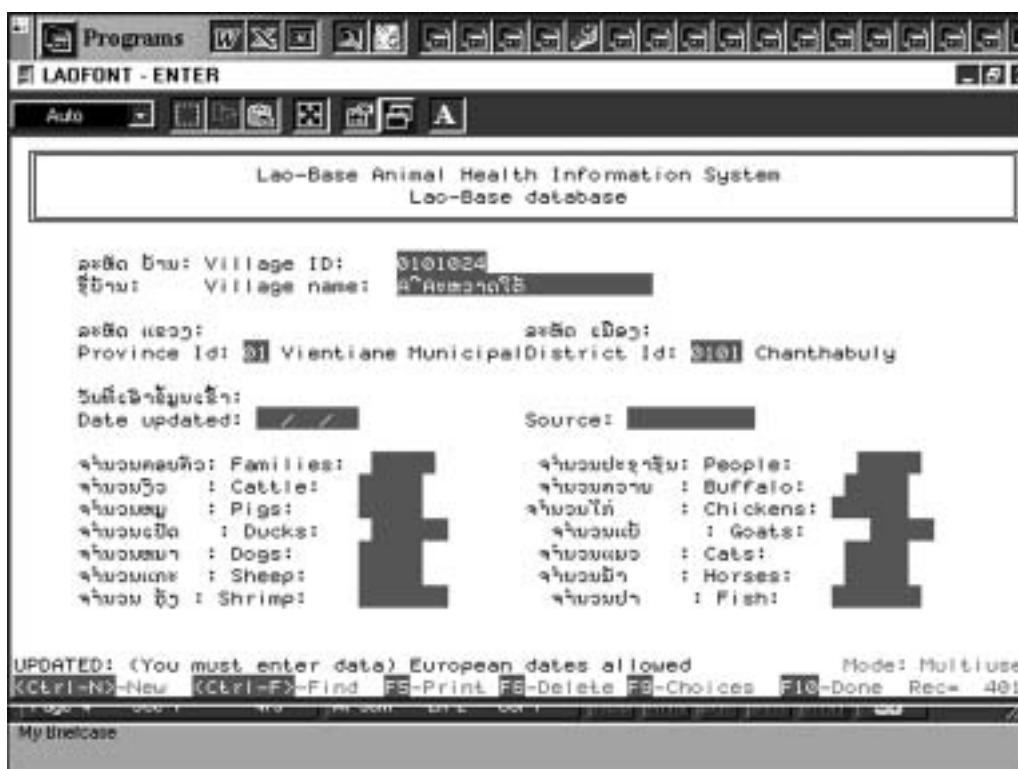


Figure 4. Data entry screen for entering demographic data into LaoBase.

LaoBase has been developed with 30 standard output formats covering most routine reporting needs. Reports are created directly from the database by following user prompts on the screen for such details as time period of report, species and so on. Reports can be saved to a file or printed directly. Figure 5 shows the different reports available to the user for the disease database. The options include OIE reports in the prescribed format as well as thematic and point maps which have a number of special features to permit the user to 'drill-down' from the province to district level as well as view the details of the data which produced the map.



Figure 5. LaoBase screen showing choices available to the user through the disease report sub-menu.

Reports are automatically formatted and can be printed directly from the system or sent to a file for transmission as an email attachment or for editing in another program such as a word processor. Figure 6 shows a standard OIE report generated directly from data in the system.

The mapping capabilities within LaoBase are quite powerful and the system uses accurately geo-coded point files for village locations and boundary files for districts and provinces. When location maps for diseases are required, the system sizes and colour codes the points representing villages in accordance with the number of disease records for each village. Figures 7 and 8 show maps automatically generated from the database using the reporting functions in LaoBase. Figure 7 shows provincial boundaries while Figure 8 shows the result from 'drilling down' to a particular province by the familiar 'point and click' technique to highlight disease distribution within districts. The map reports also have a facility to permit the user to display lists of the data used to generate the particular map. This can be used to check various things such as the names of villages, specific dates of laboratory submissions and so on.

OIECODE	DISEASE	SPECIES	OUTBREAKS	CASES	ATRISK
B101	Anaplasmosis	.	1	4	25
B051	Anthrax	.	1	100	100
B051	Anthrax	buf	2	1	2
B304	Duck hepatitis	avi	1	1	1
B306	Fowl cholera	avi	1	200	1100
A150	Fowl plague	avi	1	600	2700
A130	Hog cholera	sui	2	7	45
A160	Newcastle disease	avi	3	17	155
B058	Rabies	can	103	169	563
C619	Intestinal Salmonella infectio	avi	1	30	2000
B159	Salmonellosis (S. abortus-ovis)	avi	1	70	2000

Figure 6. Standard Office International des Epizooties (OIE) report generated by LaoBase from records in the Dis-Man tables.

Discussion

A simple and low-cost, yet powerful national animal health information system has been developed in *Epi-Info* to facilitate ease and speed of development. As a public domain, DOS-based program, *Epi-Info* also has the advantage of being suitable for use on a wide range of computers including older, non-windows machines that are still commonly used in developing countries, thus facilitating the future transfer of the system to other countries in the region. The pilot system also makes use of a Lao font manager, allowing the use of Lao script for screen prompts and data entry.

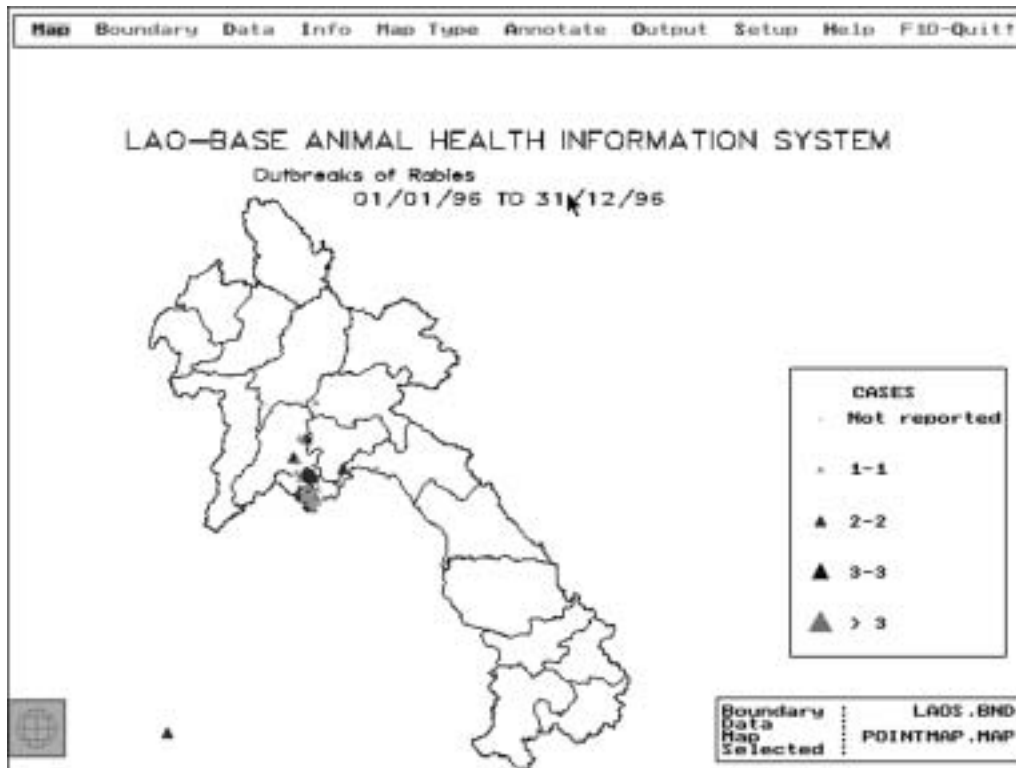


Figure 7. Map report from LaoBase showing village locations as triangles from which laboratory submissions for rabies diagnoses in dogs have been made. The triangles differ in size and colour depending on the number of submissions received from the particular village. The triangle in the bottom left which is outside the borders of Lao PDR is an artifact resulting from lack of coordinate data for some villages. Clicking the computer mouse on the boxed circle in the lower left of the screen toggles the map between provincial and district boundaries.

It is hoped that this system will be a model for the further development of more comprehensive animal health information systems in Lao PDR and other countries in the region. The simplicity and flexibility of design will ensure the collection of important disease surveillance and related data in a consistent and reliable manner, providing accurate and reliable information on which disease management decisions can be based.

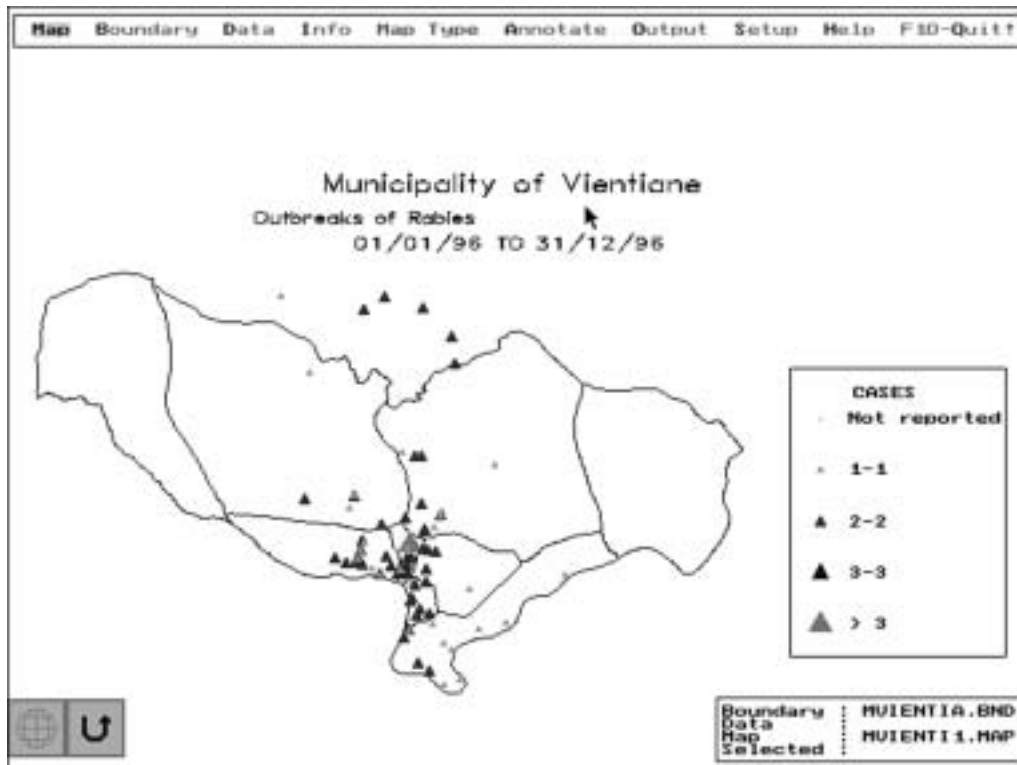


Figure 8. Map of Vientiane Municipality showing district boundaries generated by the 'point and click' technique from the map shown in Figure 7. Clicking the computer mouse on the U-shaped arrow in the bottom left of the screen returns the user to the map shown in Figure 7.

Presently, the system can be linked to *Epi Map* (Dean et al. 1995) for mapping distributions of variables of interest, but the facility also exists for linkage to more sophisticated GIS software packages as the need arises.

Acknowledgments

We wish to thank the Australian Centre for International Agricultural Research for providing funding through project AS1/96/83, *Development of field survey and information management techniques for animal health priority setting in Lao PDR*. We are most grateful to our Lao colleagues for their contributions to the development of the system.

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Appendix

Disease report form which was designed to standardise data collection and entry into LaoBase.

Instructions:

Complete all sections of Part 1 and Part 2. Complete Part 3 only if submitting a sample for laboratory examination. Completed forms may be mailed or faxed to the Animal Health Division, or sent to the Provincial Livestock and Fisheries office to be forwarded to Vientiane. Disease reports may be made by telephone direct to the Animal Health Division. If reporting by telephone, please provide all the information in Parts 1 and 2.

Form D1801

Lao People's Democratic Republic

Peace Independence Democracy Unity Prosperity

LAOBASE ANIMAL HEALTH INFORMATION SYSTEM

DISEASE REPORT FORM

Animal Health Division Department of Livestock and Fisheries Ministry of Agriculture and Forestry	Ben Khunte, Vientiane Telephone (021) 216380 Fax: (021) 216380
Report date	Report number

Part 1: Submission information

Location	Reason	Form completed by:	Disease reported by:
Village	<input type="checkbox"/> Disease Report <input type="checkbox"/> Diagnostic <input type="checkbox"/> Surveillance <input type="checkbox"/> Export	Name: Address:	Name:
District	<input type="checkbox"/> Accreditation <input type="checkbox"/> Research		
Province	<input type="checkbox"/> Regulatory <input type="checkbox"/> Disease Control <input type="checkbox"/> Eradication		
Owner		<input type="checkbox"/> District Officer	<input type="checkbox"/> Owner
Name		<input type="checkbox"/> Provincial Officer <input type="checkbox"/> Central Officer	<input type="checkbox"/> VVW <input type="checkbox"/> District Officer
Address		<input type="checkbox"/> VVW <input type="checkbox"/> Owner <input type="checkbox"/> Either	<input type="checkbox"/> Provincial Officer <input type="checkbox"/> Central Officer <input type="checkbox"/> Other

Previous report ID

Part 2: Animal information

Species	Sex	Number of animals		
		Sick	Dead	Total in village
<input type="checkbox"/> Cattle	<input type="checkbox"/> Male			
<input type="checkbox"/> Buffalo	<input type="checkbox"/> Female			
<input type="checkbox"/> Pig	<input type="checkbox"/> Castrated male			
<input type="checkbox"/> Chicken	<input type="checkbox"/> Speyed female			
<input type="checkbox"/> Duck	<input type="checkbox"/> Mixed			
<input type="checkbox"/> Goat	<input type="checkbox"/> Unknown			
<input type="checkbox"/> Sheep	Age	History and clinical signs		
<input type="checkbox"/> Horse	<input type="checkbox"/> Days			
<input type="checkbox"/> Shrimp	<input type="checkbox"/> Weeks			
<input type="checkbox"/> Fish	<input type="checkbox"/> Months			
<input type="checkbox"/> Cat	<input type="checkbox"/> Years			
<input type="checkbox"/> Dog				

Presumptive diagnosis

Part 3: Specimen information — Laboratory use only

Specimens	No.	Lab tests		
<input type="checkbox"/> Blood		<input type="checkbox"/> Serology		
<input type="checkbox"/> Serum		<input type="checkbox"/> Bacteriology		
<input type="checkbox"/> Faeces		<input type="checkbox"/> Histology		
<input type="checkbox"/> Fresh tissue		<input type="checkbox"/> Virology		
<input type="checkbox"/> Fixed tissue		<input type="checkbox"/> Parasitology		
<input type="checkbox"/> Swab		<input type="checkbox"/> Haematology		

Lao-Australian Animal Health Project

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16

Progress Towards National Animal Health Information Systems in Southeast Asia

Abstract

All countries in Southeast Asia have animal health programs at least in the form of basic veterinary services. Most have recognised the need for relevant information for decision making and development of national programs. Some have made considerable progress towards national collection of animal health information. This chapter contains revised versions of papers presented at a regional workshop held in Vientiane (June 1996). A country-by-country stocktake of the progress towards national animal health information systems was the main objective of the regional workshop. Reports are provided for the Kingdom of Cambodia, Indonesia, Lao People's Democratic Republic, Peninsular Malaysia, the Philippines, Thailand and Vietnam. Each account covers a summary of the geography, political divisions and major agricultural products of the country, the structure of the livestock-related organisations, sources of information used by these groups, the management of animal health information, and the constraints and problems faced. It was clear that most countries would like to subscribe to the principles underlying the computerised systems of the type developed in Thailand as part of this research project. However, while achieving these principles remains an objective, considerable work still has to be done on the basic fundamentals of animal health data collection in most countries.

Kingdom of Cambodia

C. Sandan

C. Barmey

Introduction

The Kingdom of Cambodia shares common borders with Vietnam in the east and south, Lao People's Democratic Republic (PDR) in the north and Thailand in the west. The country is divided administratively into 19 provinces and three cities.

Agriculture plays an important role in the national economy. About 80% of the total active population is engaged in agriculture, mainly in the production of foodstuffs and animal husbandry. Food production includes rice cultivation, industrial crop cultivation and second crop cultivation.

Rice cultivation is considered the first priority however animal husbandry is being recognised as an increasingly important agricultural activity. Livestock play a vital role in food cultivation with cattle and buffalo still being used to plough approximately 85–90% of farm land under cultivation. In many places in the country, farmers sell animals when faced with serious hardship caused by drought and floods, and so have come to rely on livestock in several important ways.

Structure of the Livestock-related Organisations

The hierarchy of livestock-related organisations is shown in Figure 1. The Department of Animal Health and Production is a department of the Ministry of Agriculture and is responsible for livestock production and animal health activities. This Department is divided into a number of other offices—Administration, Personnel, Animal Production and Animal Health. There are provincial and district level Animal Health and Production Offices throughout the country. In addition, the Department is responsible for Animal Breeding Stations for pigs, poultry and cattle.

The Animal Health Office is responsible for vaccine production, a small animal clinic, animal movement control and the National Veterinary Diagnostic Laboratory (NVDL).

The NVDL comprises seven sections including Administration, Serology, Epidemiology, Haematology, Pathology, Parasitology and Bacteriology. At present there are 26 staff at NVDL. Among them, two have a PhD degree in Veterinary Sciences, eight have Bachelor's degrees, 11 have medium level diplomas and three have a short training course certificate.

Sources of Information

Disease

Laboratory

Information from laboratory investigations is derived from research and diagnostic activities of the NVDL. Staff in the Epidemiology Section are responsible for collecting samples in the event of a disease outbreak. The samples are then processed by the laboratory. Care is taken when transporting samples back to the laboratory to ensure the quality and usefulness of the samples but local conditions sometimes make this very difficult. Data are collected on clinical and laboratory diagnoses.

The recent introduction of enzyme-linked immunosorbent assay (ELISA) tests has allowed the laboratory to conduct foot-and-mouth disease (FMD) typing tests and evaluations of herd immunity.

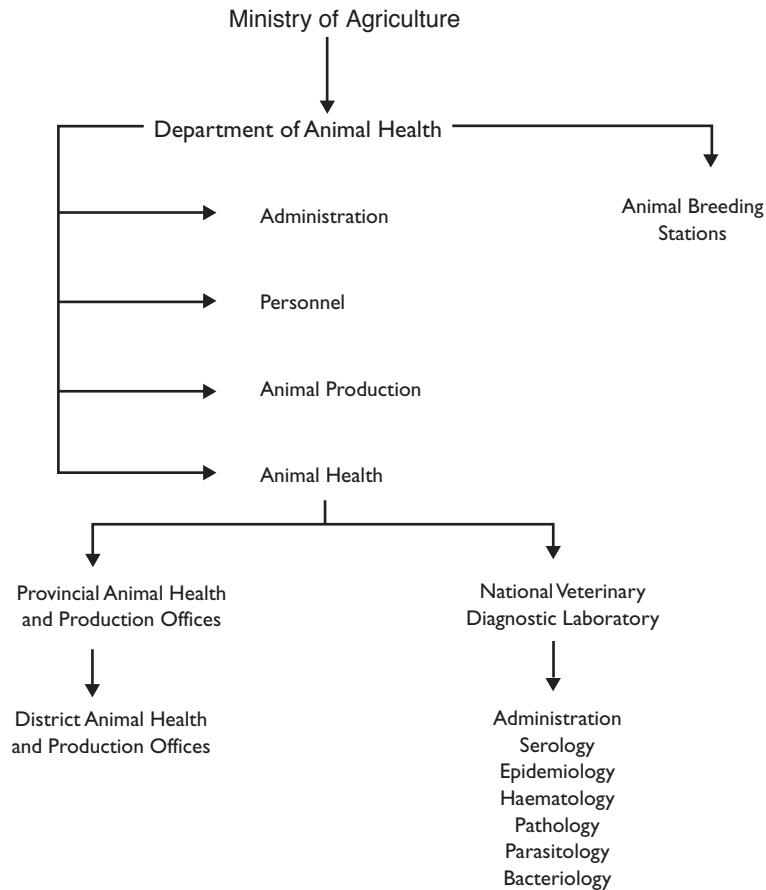


Figure 1. Structure of the livestock-related organisations in the Kingdom of Cambodia.

The Epidemiology Section is responsible for compiling the monthly reports to the Office International des Epizooties (OIE) on FMD status in Cambodia and the quarterly report on animal disease using the data collected through laboratory activities. In addition, staff in this section offer feed back on the results of laboratory tests and advice for treatment and prevention of animal diseases.

Field

Officers from the Epidemiology Section collect samples from animals involved in outbreaks. Submission forms are completed at the time a sample is taken by staff. These are then used by laboratory staff in the collation of disease data.

Surveillance

Staff in the Epidemiology Section of the NVDL are also responsible for active surveillance and disease surveys as well as other epidemiological activities. Local conditions and lack of available funds make survey work very difficult.

Livestock demographics

Population

Livestock statistics have been very difficult to collect and to maintain accurately because of internal political conflicts, poorly developed infrastructure, widespread dislocation of farmers and Government priorities. Those figures which are available largely originate from small surveys conducted with foreign donor assistance. For example, no national data are available of baseline population (species, age group), livestock production or production parameters (calving, abortion, mortalities).

Most cattle and buffalo are kept in the main rice production areas in the centre of the country as they provide the primary means of ploughing. The number of animals is much smaller in the forested areas of the northeast and southwest. Farmers in these regions tend to raise their cattle in semi-wild conditions where animals are set free in the forest in January–February and not attended to again until May–June. This type of cattle raising is not uncommon in other parts of the region but invariably makes data collection and disease control and prevention work more difficult.

Livestock movement

Animal movement as well as trading of animal products to and from the neighbouring countries is considerable.

Cattle and buffalo movement is occurring in large numbers from Cambodia to Thailand, Vietnam and Lao PDR (and thence to Thailand). Cattle and buffalo are being transported to Thailand in different ways. Small numbers of stock are carried through the border gate at Poi Pet while the majority are driven through the forest roads. This stock is always escorted by armed groups. Export of animals and meat products also occurs by sea.

As the price of pigs, and especially piglets, is lower in Vietnam and Thailand, hundreds of piglets are transported by truck to Cambodia from Thailand via Poi Pet. These imported piglets (and chickens) are being sold in Banteay Meanchey, Battambang, Pursat and Kandal provinces.

Very little of the Cambodian border is controlled by the Government and the lack of adequate internal movement checks makes accurate livestock movement data difficult to obtain. It is thought that many animals are being exported from the more heavily stocked provinces in the centre of the country to the border provinces and thence to Thailand and Vietnam.

Control program monitoring

Vaccine production and distribution

No vaccines are currently produced in Cambodia. All vaccines are imported from Europe and other countries through foreign donor assistance. The vaccines are stored in the National Animal Health Office and then distributed to provinces. Most provincial offices have refrigeration facilities. District veterinarians collect the vaccines and use them in villages specified. FMD vaccination campaigns have mainly been restricted to areas surrounding disease affected areas in order to avoid further spread of disease.

Management of Animal Health Information

Very little management of data collected is undertaken due to the lack of facilities, trained staff, resources and equipment.

Constraints and Problems

The country has suffered great difficulties through war, civil conflict, widespread dislocation, population loss and severe restraints on development over many years. As a result services of all kinds have suffered major setbacks and remain poorly developed. The country is very reliant on assistance from foreign donors.

Veterinary services in general are still weak although recent assistance has enabled some useful and valuable work to take place. The following areas have been identified as particularly in need of strengthening:

- abattoirs;
- meat inspection services;
- livestock movement control;
- animal husbandry (nutrition, breeding, animal raising);

- animal health information management, equipment and facilities;
- capacity building for animal health personnel; and
- cooperation with neighbouring countries.

Summary

Table 1 summarises the information collection and storage systems discussed above.

Table 1. Summary of livestock-related data and the means of record keeping in the Kingdom of Cambodia.

Activities	Format of records maintained
Laboratory submission	Paper records. Data collected on submission forms. Regular compiled reports created manually. Quarterly reports to the Office International des Epizooties (OIE) are compiled manually using laboratory data.
Field disease reports	Paper records. Data collected on investigation report forms. Data collated to manually produce disease summary reports.
Livestock movement	Minimal data able to be collected.
Livestock population	Minimal data able to be collected.
Vaccine production and use	Minimal data able to be collected.
Central computer system	Very few computers are available to support extensive computerisation of collected data and staff are not familiar with information technology.

Indonesia

N. Wodowati

Tri Saya Putri N Hutabarat

Introduction

Indonesia comprises more than 17 508 islands, ranging from humid to dry tropics, with some elevated areas which have a subtropical climate. Agriculture represents approximately 20% of the gross domestic product; livestock represents approximately 10.5% of the agriculture sector, thus contributing about 2% to the gross domestic product.

Most livestock are owned by smallholders, apart from a small number of government and private farms. For smallholders, livestock act as a financial reserve and source of income. Sheep and goats are also extensively used in religious and cultural ceremonies. Some livestock such as cattle and buffalo also act as a source of draft power for cropping and transport. However, this function is progressively declining in areas such as Java, where beef production is becoming an important income source for smallholders. Draft power remains vital to agriculture in many other islands and provides framers with extra income or bartered services in return for hiring their animals out.

Directorate of Animal Production—improving livestock productivity; improving livestock breed, forage and concentrate resources; and implementing the appropriate technologies.

Directorate of Animal Health—developing and implementing animal health programs and services; providing technical guidance and supervision on disease surveillance, animal product safety, quarantine policies and veterinary drug control.

Directorate of Livestock Breeding—improving quality of livestock breeds and providing technical guidance and supervision on appropriate breeding technology.

Directorate of Livestock Distribution and Development—providing technical guidance on the identification and development of potential livestock areas and livestock distribution programs.

Directorate of Livestock Industry—providing technical guidance and services for the development of livestock industries and smallholders, and providing supervisory guidance on livestock business and marketing.

The national animal health policies are determined by the Director General of Livestock Services on the advice of the Director of Animal Health. The Directorate of Animal Health (DAH) runs through five operational groups which carry out the following functions: disease surveillance, disease prevention and control, veterinary public health, animal quarantine and veterinary drug control. The animal health development policies in the second long term development plan have been shifted from an 'animal disease approach' into an 'animal health approach'. The animal health approach involves an integrated role of public health, animal food supply and agricultural development. Even though in principle the five functions of DAH remain in operation, the restructuring of DAH organisation has been linked to the new approach. The subdirectorates which carry out the five functions are called animal health services, farming environment protection, animal product safety, animal protection and animal drug control.

Although the overall animal health policies are determined by headquarters, the responsibilities for the actual physical implementation of animal health programs and the provision of inputs rest with Provincial Livestock Services (PLS). The details of their activities are then reported to DGLS in a series of routine implementation reports.

The 27 PLS offices are administratively under the jurisdiction of the Governor or Head of each of the respective provinces, but receive technical guidance from DGLS. The organisational structure of the provincial offices varies between provinces, but normally it has five or six divisions following DGLS structure. The divisions are livestock programming, animal health, livestock production, livestock distribution and development, livestock extension and livestock economics.

DGLS has a number of technical implementation units which include seven Disease Investigation Centres (DIC), two Artificial Insemination Centres, nine Centres for Breeding and Forage Production, one Centre for Veterinary Pharmaceuticals and one Veterinary Drug Assay Laboratory. Two other units which are presently still under preparation and construction are Feed Assay Laboratory and Centre for Livestock Biotechnology (for embryo transfer). PLS has also a technical implementation unit which is the type B (provincial level—see below) laboratory.

In order to control both veterinary biological and pharmaceutical products in the country, the government has formed several commissions such as the Veterinary Drug Commission, the Veterinary Drug Assessment Commission and Veterinary Drug Inspectors. For the purposes of inspection of products of animal origin for human consumption, usually there is cooperation with the Ministry of Health or the local authority/municipality. In the case of control of zoonotic diseases such as rabies, there is cooperation between three Government ministries—the Ministry of Agriculture/DGLS, the Ministry of Home Affairs and the Ministry of Health.

Over the last decade, DGLS has also implemented large-scale livestock distribution programs with soft loan assistance from several international donor bodies such as the World Bank and the Asian Development Bank. The aim of these programs is to address rural smallholder poverty through the concept of integrated area development. The performance of the livestock distribution scheme is monitored through special computerised project activities which are administratively reported to DGLS. The monitoring activities have given most of the project staff valuable experience, but there have been some difficulties experienced, particularly in coordinating a large number of diverse components and implementing agencies over a wide area and within a short time frame.

Sources of Information

Disease

Indonesia has operated a national livestock disease reporting and surveillance system for many years. However, as in other developing countries, Indonesia's livestock services share a lack of accurate data on animal disease and productivity. At present, eleven diseases categorised as 'national strategic diseases' must be reported to DAH in the form of monthly reports by laboratory and provincial livestock services.

Laboratory

A good laboratory service is one of the important factors used to determine the effectiveness of animal health and production services. The Indonesian government has established a well-structured network of laboratory support which consists of a Disease Investigation Centre (DIC or type A laboratory) at regional level, type B laboratory at provincial level and type C laboratory at district level. There are seven DICs, 24 type B and 42 type C laboratories throughout the country. DICs are responsible for providing comprehensive diagnostic services, and implementing disease surveillance and investigation. The type B laboratories offer a restricted set of diagnostic services usually for parasitic and bacterial diseases, whereas the type C laboratories offer service for parasitic diseases only. Samples which could be not examined at a type C site will be forwarded to type B laboratory or DIC.

During the past twenty years, the Government has been trying to provide sufficient physical facilities, equipment and manpower, either through governmental budget or donor country funding. It is hoped that decentralising the laboratory system can bring the service closer to the farmers. Realising that the laboratory network is an essential component of the national surveillance system, the government has made substantial efforts in the last ten years to improve the epidemiological capabilities of the laboratory staff through short courses and workshops.

All animal health laboratories in Indonesia are free-for-service, with the predominant clientele being subsistence farmers who cannot afford to pay for the service. The role of diagnostic laboratories in almost all of the developed countries is usually a passive one. In contrast, the role of DICs is mostly active—not restricted to providing on-demand services only, but also responsible for providing information and making recommendations related to problem identification, as well as supporting disease control and eradication strategies on a regional or national basis.

Since 1989 all DICs have been using a *Panacea*-based software program called *DIAG*. This program allows DICs to collect and analyse data which is obtained either from surveillance, field activities or submitted directly to the laboratories. Outputs produced automatically are based on diagnostic results and laboratory activities. Monthly reports are sent directly to DAH.

The laboratories are constrained by a number of factors such as lack of operating funds, lack of a reliable and continuous source of essential chemicals, supplies, spare equipment parts and lack of technical training. The most significant problem for the laboratories seems to be the inappropriate, poor quality specimens received from the field.

Field

The overall effectiveness of field veterinary services in Indonesia is handicapped by: inadequate transportation facilities; inadequate funds for running costs and maintenance; poor means of communication; lack of drugs and vaccines; inadequate funds for supplies required for collecting, transporting and examining samples; insufficient trained manpower at both the professional and support levels; and inadequate funds for monitoring programs. On the other hand, the success of veterinary services delivery is also dependent on the interaction between field staff and farmers. In Indonesia, extension programs have been successfully implemented by bringing farmers into groups. Each of the groups has a farmer leader.

Although the government over the past 10 years has established about 359 Animal Health Posts (AHP) at the subdistrict level, the availability of the field veterinary services is still unequally distributed. AHP are small, government-subsidised clinics manned by a veterinarian and some paravets. The AHP establishment policy is meant to help livestock owners with basic animal health care and to support the expanding distribution of livestock throughout the country. Some AHP are not functioning because the government has failed to recruit veterinarians (particularly new graduates, who are not interested in working in the rural areas). In general, non-functioning of AHP is a result of transportation problems, a lack of equipment, medication or adequately trained staff.

The direction of the overall policy of the Indonesian government over the last five years has substantially changed from provision of government services into a more privatised or semi-privatised service. However, other constraints to AHP activities include a very small case load because of farmers' lack of awareness of the existence of AHP services, and veterinarians' lack of

confidence or skill in actively promoting or selling veterinary services. This has led to difficulties in achieving the goal of self-sustainability.

Owing to these problems, the Government now plans to transfer (in the near future) some of the responsibility of running the AHP to private practitioners on the basis that the construction cost for the AHP will be given as a credit to the veterinarians. Another problem associated with AHP is the high cost of veterinary equipment relative to the farmers' ability to pay, and the veterinarian's low income. At present, in provinces such as Jawa Timur, Nusa Tenggara Barat and Nusa Tenggara Timur, some of the AHP are run by individual or groups of private veterinarians. The AHP system where farmers are encouraged to pay for the services provided seems to be worked quite satisfactorily in these three provinces, bearing in mind that the service has been formally regulated by the local governments.

At present, a pilot project assisting in the computerisation of field reports is designed for four provinces in the eastern part of Indonesia with Australian Government assistance. The design of the database is based on the *Epi-Info* program, but specifically developed for AHP reports.

Data at the provincial level is collected by district veterinarians and stored both manually and on computers. At this level, problems obstructing the flow of information include delays in submitting appropriate reports, incomplete or improperly compiled report formats, and the lack of trained veterinarians. Data collected at the provincial level is sent to DAH which analyses the data and then uses the results for policy planning purposes.

Currently, DAH is developing the National Animal Health Information System (NAHIS) which will involve all subsystems in the national animal health system. The information network overseen by NAHIS comprises all the central, regional, provincial and district databases.

Surveillance

Surveillance is conducted periodically by DICs using stratified sampling methods. At present, most diseases targeted for surveillance are those included in the national strategic disease list and listed in Office International des Epizooties (OIE) Lists A and B. Surveillance of Newcastle disease has obtained post-vaccination data while surveillance of rabies has meant both pre- and post-vaccination data have been collected. The findings of all surveillance activities is sent to DGLS for further action.

Livestock demographics

Population

The Directorate of Livestock Programming at the national level is responsible for providing livestock statistical data such as population, meat, egg and milk production and consumption, volume and value of import and export of live animals and animal products and so on. The data usually are collected in cooperation with the Central Bureau of Statistics which has branch statistics offices throughout the country. It is also collected administratively from the local governments (village, subdistrict, district etc.). The livestock censuses which are carried out every five years, in conjunction with the overall agricultural census, provide some baseline livestock data such as structure of farm and livestock holdings, livestock growth rate and so on. The subdirectorates of livestock statistics is presently developing a model for projecting the livestock population and production as well as the consumption of meat, eggs and milk using a special computer program. The data for this model has been supplied by each of the Provincial Livestock Services.

Livestock movement

DGLS applies quarantine measures to control livestock movement. The quarantine offices are distributed throughout the country and are referred to as Animal Quarantine Centres at a regional level, Animal Quarantine Posts at the provincial level and checkpoints at a district level. Information required in the control of animal movement includes animal health status, a vaccination history, livestock origin and movement permit licence from the local Office of Livestock Services.

Quarantine data are usually collected by quarantine officers at the quarantine stations or checkpoints. The data include any records related to the control of import and export of live animals and products of animal origin—such as meat, eggs, milk, bones, hides, leather, horns and biological products (vaccines, sera etc.). Reports from quarantine services are of great importance in preventing entry of highly infectious or exotic animal diseases or prohibited products of animal origin into the country. The quarantine offices are also working in coordination with laboratory services for testing imported animals during the quarantine period. The data are collated and compiled manually at the national level.

Administrative confusion sometimes occurs as the quarantine office is the responsibility of the Secretary General of the Ministry of Agriculture and therefore reports to the Secretary General as opposed to DAH.

Control program monitoring

The national control program monitors 11 strategic diseases through vaccination and control of livestock movement. Starting in PELITA VI (sixth five year plan), DGLS has established eradication programs for three diseases, namely brucellosis, rabies and hog cholera.

Vaccine production and distribution

Many vaccines have been produced in-country such as vaccines for Newcastle disease, haemorrhagic septicaemia, anthrax, rabies and brucellosis. These vaccines are produced by the Centre for Biological Products, located in East Java province. Due to financial difficulties, the Centre is not able to produce sufficient vaccine and the government allows the importation of some vaccines. All vaccines are examined at the Veterinary Drug Assay Laboratory, located in West Java, before they are distributed to the market.

Distribution of vaccine is decided by DAH, based on provincial requirements and depending on the priorities of disease control in certain provinces. The Centre also has a stock of vaccines available for emergency outbreaks.

Reports on vaccine production and distribution, including details of type, number, designated area and so on are sent annually by the Centre to DAH. Vaccination in the field is recorded by local Livestock Services officers at subdistrict to provincial level and reported monthly to DAH.

Other activities and administration information

There is much information which has been recorded which is not directly related to livestock diseases or control programs. However, most data are recorded manually and has not been entered into a computer. Some data are held in a computer database at DAH and managed by the Secretariat Section. Data on residues, milk and meat inspection, livestock movement, livestock and livestock products exported and imported are still managed using a semi-manual system throughout all levels.

Abattoir data are usually recorded by meat inspectors on a monthly basis. A standard report format is used for meat inspection, particularly for collecting data on fascioliasis, livers condemned, number of livestock slaughtered and number of breeding cattle slaughtered. The data are collated and compiled manually and/or entered into computer using the *Panacea* database management program at the national level. However it has often been irregular and incomplete. As mentioned earlier, because the data are

unwieldy to collate, it is not a useful abattoir disease monitoring database. Other food inspection data, such as for milk and egg products, are not available because inspection is not under the direct control of the Government.

With the increased awareness of residue problems in food in the last five years, particularly in meat and milk, the government has recently started a residue monitoring and surveillance program to obtain a general picture on types and levels of residues in the country. The program is carried out by DICs and the data will be collated and compiled at the national level.

Management of Animal Health Information

Each unit in DAH is responsible for the management of specific data. The overall management of animal health information system is under the Director of Animal Health.

Subdistrict level

The reports from the 'grassroots' level are an essential component of the national disease reporting system. However, they are characterised by a number of weaknesses including inaccurate, incomplete and unrealistic reporting. Many of these problems are due to incorrect diagnoses and occasional guessing rather than reporting fact.

At this level, most of the data are collected by paravets or field veterinary assistants (FVA) directly from farmers and village offices. Most of the FVA are faced with the problem of being unable to make an accurate clinical or post-mortem diagnosis because of lack of diagnostic skills and lack of equipment for making a proper clinical examination. This situation has influenced the ability of FVA to gather and submit adequate and reliable data to the higher level. It is taken for granted that in Indonesia there is under-reporting because most of cases remain undiagnosed.

Some other reasons which contribute to the problem are (i) limited number of FVA compared to the area covered, which means the whole subdistrict area could not be served intensively; (ii) insufficient transport and mobility of field veterinary service staff which means that FVA could only serve a limited area; (iii) lack of trained FVA which adversely affects the accuracy and reliability of disease reporting; and (iv) limited guidance or advice from their supervisors which means their feedback about the reported problem is sometimes delayed or the problem remains unsolved. Prompt action

regarding disease confirmation would have to rely on increasing the FVA' ability to solve disease problems and be able to get a clearer picture of the disease situation in the area.

In addition, there are other obvious problems which constrain the FVA in making a good report such as lack of incentives and low motivation. The ability of the field extension workers to gather adequate and reliable data is usually hindered by a number of weaknesses such as lack of incentives, lack of transport, and lack of supervision and monitoring by higher authorities. The establishment of the Animal Health Post network throughout the country would act as a good foundation for disease surveillance if it could be made to operate effectively.

District level

Data are mostly collected by veterinarians and animal scientists in their respective district areas, and combined with data that they receive from the subdistrict level. Other sources of data include Animal Health Posts, abattoirs, livestock markets, artificial insemination posts, type C laboratories and checkpoints for animal movement. A number of shortcomings also characterise the flow of data and information at this point, such as: (i) lack of or inefficient transport systems between villages, subdistricts and districts which mean that some of the reported disease problems can not be checked or evaluated; (ii) lack of trained veterinarians and animal scientists which leads to lack of awareness of the importance of information needs of both farmers and village extension workers on one side, and the provincial and national levels on the other side; (iii) in many cases, data from lower levels (i.e. village or subdistrict levels) are not edited at this level, which in some respects could make the reports contradictory to the natural history of the disease.

It can be seen that district reports contain highly aggregated information for transmission to the higher level. However, information received at this level is frequently not interpreted and utilised by the local staff for solving immediate problems or making policies. The government has made an effort in the last five years to encourage decentralisation and delegation of planning to the district level, which should lead towards a more decentralised system of data storage, processing and analysis. This would enable the local staff to have the opportunity to analyse data and interpret results to assist both farmers and village extension workers with a clearer picture of the disease situation and production performance.

Provincial level

Sources of data for this level are numerous and include districts, abattoirs, livestock markets, type B laboratories, milk processing plants, quarantine stations, private companies and other institutions such as the statistics office. To some extent the non-government organisations such as the dairy cooperatives and other livestock commodity organisations are also included as sources of data. The data are collected by veterinarians and animal scientists from different divisions at the provincial level.

Similar shortcomings to those mentioned above also characterise the flow of data and information at this level, such as: (i) delays in submission of appropriate reports; (ii) incomplete or improperly compiled report formats; (iii) lack of adequately trained veterinarians and animal scientists, which creates difficulties in solving problems encountered in the course of implementing policies at the provincial level; (iv) lack of data quality checks, and non-editing of reports from various sources (which occasionally leads to false reports); and (v) the fact that most of the data is simply compiled as raw data without proper analysis.

National level

The policy-makers at DGLS/DAH require information on the general situation of major animal diseases in the country (especially the notifiable diseases) in order to determine overall animal health policies. They need to know whenever there is a change in the virulence of endemic diseases, or when any new or emerging disease appears in the country, in order to take the necessary action for controlling the disease. The reporting system from the 'grassroots' level up to the national level should be workable enough to supply the necessary data to provide up-to-date disease awareness in the country. However, to support better decisions on animal health and production, policy-makers need comprehensive information systems which include a wide range of information on livestock statistics, farming systems, public health, livestock distribution, livestock movement, livestock marketing, prices, value of draught power, farm incomes, animal product hygiene and so on.

In general, the collection, management and reporting of disease and production data at national level is characterised by a number of shortfalls including: (i) incomplete reporting and non-collection of important disease data; (ii) persistent gaps in time series of data on diseases and production parameters; (iii) unnecessary aggregation in the reporting systems resulting in problems of interpretation and dissemination; and (iv) weaknesses in

dissemination of processed information to field staff and other interested institutions. In addition, most of the managers are burdened with administrative commitments which leave little time for utilising the available information for planning and decision making.

The present disease reporting system is focused on selected diseases but cannot give estimates of prevalence or incidence as the total populations of animals at risk are usually unknown. On the other hand, lack of baseline data on productivity of the affected population makes it difficult to obtain estimates of the economic effect and extent of disease outbreaks. This limits the quality of analysis which in turn affects the usefulness of information for decision making and planning. However, the value of routine disease data may increase if they are integrated with secondary data from various sources. In an attempt to capitalise on the potential value of these data, DGLS should explore the possibility of integrating data from various sources into one common system. The national disease information system would then be a core system that allows multiple systems to be integrated and accessed to provide a nearly complete information system for animal health planning.

The national disease reporting and surveillance systems have been operating for many years. The old disease reporting formats and flow of information has been improved progressively since 1976 to meet the need for epidemiological surveillance. DGLS has taken the initial step by introducing the most recent changes to the system through short courses and workshops for national, regional and provincial staff. This step was then followed through by Provincial Livestock Services staff through training at the district and subdistrict levels.

The surveillance data are mainly coming from two sources—reports generated by DICs and Provincial Livestock Services. Responsibility for collecting data is placed at all levels from subdistrict level (as the ground level) up to the national level. Each level collects data and submits them to the next higher stage in the form of monthly, quarterly and annual reports together with emergency reports in the case of a suspected disease outbreak.

A standard format for reporting has been set up to be used by each level. This report format uses Forms E1 to E30. There are 296 districts, 3 625 subdistricts and 67 033 villages throughout the country. Any suspected outbreak cases should be reported within 24 hours to DAH by any means of communication that can reach headquarters as quickly as possible—such as telephone or telegram. To confirm the outbreak occurrence, another report should follow using a particular outbreak report format (in red colour). The

data are then summarised and tabulated by DAH to be published in the Epidemiological Surveillance Bulletin which is disseminated to regional, provincial and district offices as well as to other related institutions so that there is a feedback of information to the field.

The central government took a further initiative to improve the disease reporting system and surveillance by running a workshop in 1987 with the assistance of the British Overseas Development Administration Animal Health Project. The present disease reporting format was then revised and simplified in order to reduce the number of diseases to be reported to the national level. The 13 notifiable diseases are only the major diseases for which control responsibility is placed on the national authority. Other diseases should be reported to the national level on an annual basis.

The computerisation of the national surveillance data started in 1988. A program called *In-menu* has been developed to enter and collate the two main data sources, i.e. laboratory and clinical data. The *In-menu* program is written in *Panacea*, a database management package (PAN Livestock Services Ltd., Reading, United Kingdom). The reports generated by this program produce a breakdown of the distribution and occurrence of the 13 notifiable diseases in Indonesia by district and by species. A second workshop in 1990 was organised by the central government, also in cooperation with the British Animal Health Project. The main aims of the workshop were to identify information needs for different levels and different institutions and to determine weaknesses in the dissemination of processed information to different levels and other related institutions.

The outputs of the disease reporting system are also used for reporting to international agencies such as the OIE and the Food and Agriculture Organization of the United Nations (FAO). All diseases in OIE Lists A and B which have occurred in the country annually are recorded in the OIE annual *Animal Health* publication and in the FAO/World Health Organisation/OIE *Animal Health Yearbook*. The obligation as a member of OIE is to provide notification within 24 hours of any occurrence, recurrence, or epidemiologically significant development pertaining to List A diseases. For diseases not in List A, similar reports should be sent where findings are of exceptional epidemiological significance to other countries. The OIE format for reporting the disease notification is through the OIE form SR-1, followed by a weekly report SR-2 and a subsequent monthly report SR-3.

Constraints and Problems

During the implementation of the National Animal Health Information System the following constraints and problems have been experienced most widely.

- Disease cases reported by Livestock Services might not reflect the true situation in the field and may be significantly under-reported.
- Reports from the field are often received too late, sometimes with a delay of 3–4 months. Output is very difficult to manage if this is a common feature.
- There is no reliable mechanism for data validation so data accuracy and validity cannot be examined adequately.
- Staff have limited knowledge of basic data collection and analysis.

Summary

Table 2 summarises the information collection and storage systems discussed above.

Table 2. Summary of livestock-related data collection and means of record keeping in Indonesia.

Activity	Format of records maintained
Laboratory submissions	<p>Disease Investigation Centres (DICs) collect and report on diagnostic and other laboratory activities monthly to the Directorate of Animal Health (DAH) using computers and <i>Panacea</i>-based software <i>DIAG</i>. Soon to be updated to <i>MS Access</i>-based.</p> <p>Type B and C laboratories send manual reports to DAH monthly.</p>
Field disease reports	<p>Manual collection and management of data at subdistrict and district levels. Little data handled by computer. All data sent up one level, collated then finally sent from provincial level and sent to DAH for analysis.</p> <p>Animal Health Post database, based on <i>Epi-Info</i> program.</p> <p>District, provincial and central level database uses <i>MS Access</i>.</p>

Table 2. (cont'd) Summary of livestock-related data collection and means of record keeping in Indonesia.

Livestock movement	Data maintained on detail of animals, history etc. at checkpoints and quarantine centres or posts. Reports are sent to Secretary General of Ministry of Agriculture.
Livestock population	Village level data collected by untrained staff and needs careful validation. Census conducted every five years.
Vaccine production and use	DAH maintains records on vaccine production and distribution. Local Livestock Services report vaccination of animals to district, then to province and then to DAH.
Management of animal health information	Overall management of information is the responsibility of DAH by means of manual and some computerised databases of records. Monthly Office International des Epizooties (OIE) reports submitted.

Lao People's Democratic Republic (PDR)

S. Vongthilath

Introduction

Livestock production is an important component of the existing farming systems and is considered by the Government to be an important alternative to the prevailing subsistence agricultural practices. Livestock production offers one of the most promising opportunities for Lao farmers to commercialise by meeting the domestic consumption demands and, to some extent, future export markets. The Government of Lao PDR recognises the important role of livestock in rural development programs.

The Ministry of Agriculture and Forestry has a mandate to implement six priority government programs: food security; the promotion of commercial production; shifting slash and burn cultivation; irrigation system development; rural development; and human resources development. The main priorities are food security and the promotion of commercial production to meet the demands of a growing population—including the urban population and tourists as well as prospective future exports.

Government support for animal health and production services still focuses on the control of the major epidemic diseases. The disease control program should also involve, directly and indirectly, livestock owners as well as livestock traders. The major constraint faced in achieving the objectives of these programs has been the high incidence of diseases causing significant morbidity and mortality. Serious livestock diseases such as haemorrhagic septicaemia, anthrax, foot-and-mouth disease (FMD), blackleg, classical swine fever (CSF), Newcastle disease (ND), fowl cholera and duck plague are endemic in Lao PDR. These diseases lower production, decrease income security and severely limit access to export markets. Disease control measures are currently insufficient due because of shortcomings in the current information systems. The Lao Government places strong emphasis on progressively improving livestock and poultry production by reducing mortality and morbidity through the strengthening of disease control measures against major diseases.

The Government aims to address the problem by strengthening animal disease control programs by producing and supplying sufficient quality vaccines in useable condition throughout the country and strengthening the veterinary extension network. Also seen as important activities are the upgrading of the animal disease control and diagnostic structure, strengthening the epidemiological services, and improving the network of spot quarantine stations.

Structure of the Livestock-related Organisations

The hierarchy of livestock-related organisations is shown in Figure 3. The Department of Livestock and Fisheries (DLF) of the Ministry of Agriculture and Forestry is divided into two sections and three divisions. The Administrative Section is responsible for personnel, administration, finance and welfare. The Technical Section undertakes planning, international cooperation, investment and technical support.

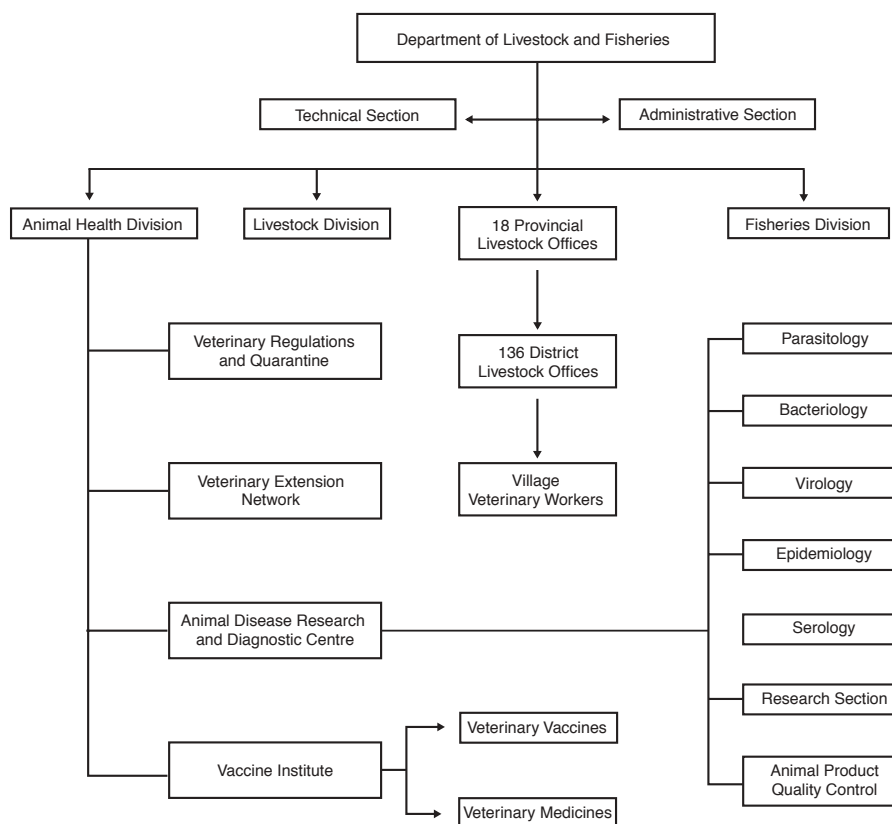


Figure 3. Structure of the livestock-related organisations in Lao People's Democratic Republic.

The Livestock Production Development Division manages the country's animal production and breeding programs. Fisheries development including fish health and disease diagnosis is conducted by the Fisheries Production Development Division.

The Animal Health Division (AHD) is responsible for the wide Veterinary Extension Network, vaccine distribution and use, training and extension work and for a cost recovery system. Part of the AHD—the Vaccine Institute—oversees the production of veterinary vaccines and medicines.

The Animal Disease Control and Research Laboratory situated in the capital, Vientiane, is the focal point of the epidemiology and diagnosis network. Staff in six provinces play an important role in this Veterinary Extension Network.

The AHD is largely responsible for the regulation, hygiene and control of animal movement and livestock products, assisting in the formulation of veterinary legislation, the meat inspection network and the Animal Spot Quarantine network.

The AHD acts to strengthen the veterinary network down to the village level and to promote the participation of private enterprise and the community in urban areas. The aim of the Division is to increase the vaccination coverage, improve the management and distribution of vaccines, and increase the adoption of a cost recovery system. It also hopes to promote greater participation in its programs and encourage self-reliance.

The AHD plans to establish a new National Diagnostic Laboratory—thereby strengthening epidemiological centres—and commence a forceful promotion of field diagnosis tests. Also planned is the strengthening of existing spot quarantine stations and the establishment of further stations at the borders where necessary in order to meet the need for the control of animal movement as well as the food of animal origin. An assessment of the possibility of establishing international quarantine stations where it is deemed necessary will also be made.

Sources of Information

Disease

Laboratory

The Animal Disease Control and Diagnostic Center in Vientiane Municipality is the largest diagnostic centre in the country. This centre has seven different units. The Diagnostic Center is still in a developmental stage with regard to diagnostic laboratory techniques. At present the laboratory can provide identification of bacterial species but not the identification of type or serotype. In the past year much effort has been made in the development of a diagnostic network to reach target provinces through the training of

approximately 20 local staff operating in six provinces, namely Luang Prabang, Xiengkhouang, Borikhamxay, Savannakhet, Saravane, and Champassack.

In addition, some equipment and chemicals have been provided through overseas development assistance which has allowed basic diagnosis of some parasitic and bacterial diseases including haemorrhagic septicaemia and anthrax to be made.

In most cases, samples are received from livestock centres or stations, private farms, smallholders, model farmers, markets, slaughterhouses or animal products for export. Sometimes samples are collected from field work for laboratory diagnosis in the area where there is occurrence of epizootic diseases. To this point in time, standardised submission forms have not been used. Instead, sample information is manually entered into notebooks. Some samples received from the provincial network—which have been transported inappropriately or with insufficient accompanying case history information—can prove to be less useful.

Field

Currently, there are no standardised reporting forms for the field disease reporting. Previously, in the event of a disease outbreak, the village veterinary workers (VVs) contacted the district livestock and fisheries officers (DLFOs) and the provincial livestock and fisheries officers (PLFOs) by letter, telephone or in person. Depending on the situation, the PLFO reported usually by fax, letter or phone to the AHD or in some cases directly to the DLF.

Surveillance

Support through an Australian Centre for International Agricultural Research (ACIAR) project during 1997 and 1998 has encouraged the use of new methodologies for active disease surveillance. Vientiane Municipality was the chosen to first implement these methodologies for disease control. At present 600 serum samples from 35 villages have been collected. Following evaluation of the methodologies employed in this project, the processes will be extended to other provinces and ultimately all of Lao PDR.

Livestock demographics

Population

The VVW is the person responsible for the collection of the animal population information at the village level in collaboration with the chief of

the village. The information is collected once annually. The absence of formal information forms required a short training course of 3–5 days for the VVW. A summary of the village information (number of different species of animal only) is sent to the DLFO. The DLFO summarises all the village information and sends the overall village information to the PLFO. The AHD has the detailed population information to the district level only.

Livestock movement

In 1995 the demand for meat in Vientiane Municipality was estimated at 12 000 t/year, but the meat supply was only 7 000 t. The deficit of about 5 000 t/year was made up from other sources in Sayabouly, Luang Prabang, Houaphanh, Xiengkhouang, and Vientiane provinces and from the northern part of the country. About 9 000 head were imported from Vietnam to Vientiane Municipality. Approximately 10 000 head were imported from Vietnam to the central and southern provinces namely, Borikhamxay, Khammouane, Savannakhet, and Champassack. In addition, some animals were imported unofficially from Cambodia and Thailand, with only the animals from Thailand being used for breeding and milk production. In 1996, the movement of large animals (pigs excepted) changed direction. This was confirmed from Sepone Animal Checkpoint in 1995, where some animals from Lao PDR were exported to Vietnam. In the central and southern regions of the country, animals were transported on Road no.9 (Savannakhet province) and no.8 (Borikhamxay province) and along road no.13 from Vietnam. From Cambodia the animals were also transported along Road no.13. The smuggling of animals across those borders is one of the major causes of the spread of disease. In general the movement of animals cannot be controlled.

AHD wish to strengthen and establish additional spot quarantine stations at the borders in order to meet the need for the control of movement of animals and animal products. Furthermore the need for the establishment of international quarantine stations should be investigated. At the end of 1996, 15 of the proposed 26 spot quarantine stations had been established as well as the upgrading of personnel capabilities and equipment. These stations are already cooperating with those in the neighbouring countries.

Animals being transported within the country must be accompanied by a vaccination certificate which is issued by a VVW and certified by a DLFO. An identification card and health certificate, both issued by DLFO, as well as a movement permission form, issued by DLFO certified by District Agriculture and Forestry Office, are also required.

For the export of animals an identification card—issued by a DLFO or PLFO, a vaccination certificate—issued by a VVW and certified by a DLFO, and health certification—issued by a PLFO or the AHD, must be provided at the inspection points. An export permission document, issued by a DLFO and certified by the Province Agriculture and Forestry Office or DLF, must also accompany any animal being exported from the country.

Animal products being transported must be accompanied by an invoice issued by the organisation or enterprise of origin, a packing list issued by the organisation or enterprise of origin, a sanitary certificate issued by a DLFO, and a movement permission document which is issued by a DLFO and certified by the District Agriculture and Forestry Office.

At the checkpoint, officers will check the required documents and record in the checkpoint notebook the owner's name, the origin of the animals, the number of animals, sex, age, color, weight (animal products), means of transport, registration number of the trucks and destination of the goods. The checkpoint will summarise only the number of animals, origin and destination in monthly reports to the DLFO and six-monthly reports to the PLFO. The PLFO reports the number of animals moved internally and numbers imported and exported to the AHD, usually once or twice per year. Until now, all data have been recorded in books with no standardised format or computerisation.

Control program monitoring

Vaccine production and distribution

The Vaccine Production Institute was established in 1980 and further supported by several United Nations Development Programme/Food and Agriculture Organization of the United Nations (UNDP/FAO) projects. The Institute produces 11 types of vaccines, of which four are for bacterial agents (haemorrhagic septicaemia, blackleg, anthrax and fowl cholera) and seven for viral agents (CSF, ND, FMD, infectious bronchitis, fowl pox, duck plague and rabies). Initial production capacity was 10 million doses a year. The annual demand from provincial areas directs the Institute in the priorities for vaccine production. In 1995, 6.4 million doses of vaccine were produced, mainly ND vaccine (65%), fowl cholera (11%) and haemorrhagic septicaemia (9%). The average level of subsidy is 36%.

Following an order of vaccine, the vaccines are distributed to the provinces by air, truck or boat. All provinces have vaccine storage and distribution facilities for final dispatch to districts. Districts have their own cold storage facilities in the form of mechanical, solar or petrol refrigerators. The VVWs

receive vaccines from the district office in small amounts only as there are no cold storage facilities in the villages.

Vaccine distribution information is recorded manually in books. As yet there is no computerisation or use of standardised forms. The production numbers, number of doses distributed, destination and storage for different types of vaccines is recorded daily and monthly, and summarised every six months.

Other activities and administration information

Veterinary extension network

The veterinary extension network is the first priority activity of the AHD. The main responsibilities of this network are vaccine distribution and use, the management of a cost recovery system and training.

The VVWs are the key personnel within the network who liaise between the farmers, smallholders and with the different level officers (DLFOs, PLFOs, AHD). About 6 400 VVW in 11,500 villages have been trained to date.

Reporting

The VVWs report to DLFOs, mainly when there is an outbreak of disease. The DLFO should report to the PLFO every three months on activities, planning, and the diseases situation (outbreaks). They also produce a six-monthly report, which is a compilation of the three-monthly reports without additional information. Every six months, there is also a meeting of all DLFOs. Reporting is irregular and there are no standard forms. The PLFOs report to the AHD on a three-, six- and 12-monthly basis. Two reports are produced: one for the Provincial Agriculture and Forestry Office and one—with more detailed data on livestock—for the AHD (DLF). The veterinary authorities are informed of emergencies in particular districts by mail, radio or telephone.

Training databases

Four different types of training have been conducted—specialist subject matter, 'train the trainer' classes, management training and VVW training. The names and personal and professional details of all those attending courses have been recorded. Participants receive a training certificate upon completion of their course which is issued by the director of the AHD and the Director General of DLF.

Meat inspection

Only 10 provinces have a slaughterhouse and network of meat inspectors in all districts. In other provinces, especially in the north, the meat inspector will be confined to the provincial capital. Some VVWs act as meat inspectors or commonly as advisers. Only basic data is recorded in the meat inspector's handbook including name of owner, number of certain breeds and the result of inspection. The meat inspector will submit a summary once a month to the DLFO or PLFO reporting the number of animals inspected and how many animals were found to be infected.

Quality control

A meat, milk and vaccine quality control unit was established this year and therefore no data are recorded are yet.

Management of animal health information

In collaboration with the technical section of DLF, the AHD has become centre of all veterinary information collection at the national level. A report is received by the AHD twice a year from the provinces and recorded in a notebook. The amount and accuracy of information available at central level is very limited and reporting is presently a major constraint for adequate planning, monitoring and control.

Phase I of the ACIAR project (No. 9438, started July 1996) is geographically limited to three districts of Vientiane Municipality. A computerised animal health information system has been implemented as well as staff training and collection of serum samples. During phase II (expected start from June 1997), sample collection will continue, coupled with the analysis of samples and the expansion of the surveillance system to the entire Vientiane Municipality and other provinces. An ACIAR project (No. 9204) has already implemented such a system in northern Thailand by adapting the World Health Organisation software, *Epi-Info*, and including additional software components.

The AHD send an annual summary report to the DLF, National Statistics Centre, and also a monthly report (OIE recording forms) of infectious diseases (FMD, anthrax, haemorrhagic septicaemia) to the OIE.

Constraints and Problems

The following have been identified as major constraints to the development of a sound animal health information system in Lao PDR:

- weakness in reliable disease monitoring and livestock movement control systems in the country;
- insufficient information available on the incidence of serious epizootic diseases in the country, hindering the effective control of these major diseases;
- lack of technical facilities, standard submission forms and limited financial resources to support information system programs; and
- insufficient international technical assistance.

Being one of the least developed countries in this region and still paving the way for a new economic mechanism, the DLF—in charge of promoting animal health and animal production services—has a strong need for cooperation with non-government organisations (NGOs), international organisations, donor countries and specifically with close neighbouring countries. Previous exchange experiences through training and study tours were mostly granted by Vietnam and Thailand. Past technical assistance and grants were mostly donated by UNDP/FAO and to some extent by NGOs including Quakers, CIDSE (Cooperation Internationale pour le Développement et la Solidarité) and Heifer & Mennonite. ACIAR is currently undertaking a small research project (No. 9683) for the development of field survey and information management techniques for animal health priority setting in smallholder livestock production systems in Lao PDR.

Future technical assistance for the development of skilled manpower through training for upgrading the technical know-how, management and policy considerations are strongly needed. External grants and private cost-sharing will also be important in supplementing the performance of animal health and production services including the control of animal movement in Lao PDR.

Summary

Table 3 summarises the information collection and storage systems discussed above.

Table 3. Summary of livestock-related data collection and means of record keeping in Lao People's Democratic Republic.

Activities	Format of records maintained
Laboratory submission	Paper records—detailed records kept at provincial laboratory network. Six-monthly summary sent to central office. Farmer, private owner, smallholder submit samples in person, the details of which are recorded.
Field disease report	When the outbreak occurs, the village veterinary workers (VVs) contact the District Livestock and Fisheries Officer (DLFO). Summary paper sent to the Provincial Livestock and Fisheries Officer (PLFO) and the Animal Health Division (AHD).
Livestock movement	Paper records. Detailed records kept at checkpoint network. Six-monthly summary sent to the PLFO and central office.
Livestock population	Village totals for each species maintained on paper records at district offices, district summary report sent to provincial office. Provincial summaries held on computer in central office.
Vaccine production and use	Vaccine production, supply and storage for each type maintained on paper records monthly. Six-monthly summary sent to central office.
Veterinary extension network	The VVs report (irregularly) to DLFOs, mainly outbreaks of diseases. DLFOs should report to the PLFO every three months on activities, planning, diseases situation (outbreaks). They also produce reports (but there are no standard forms) which are sent to the AHD on a three-, six- and 12-monthly basis.
Meat inspection	Paper records. Detailed records kept by meat inspector and slaughterhouse. Six-monthly summary sent to the PLFO and central office.
Central computer system	A computerised animal health information system has been implemented.

Peninsular Malaysia

Nor Aidah Bt Abdul Rahim
S. Johar

Introduction

Malaysia shares a common border with Thailand in the north, Singapore in the south, and with Indonesia and Brunei in the east. The country is divided administratively into 13 states and one federal territory (Kuala Lumpur). Eleven of the states and Kuala Lumpur form Peninsular Malaysia and are the subject of this report. The other two states are Sarawak and Sabah on the island of Borneo. Malaysia is a net exporter of poultry, eggs and swine, but imports slaughter cattle, sheep and goats.

Structure of the Livestock-related Organisations

Livestock-related affairs are the responsibility of the Department of Veterinary Services (DVS). The structure of this Department is shown in Figure 4 and the role of each division discussed below.

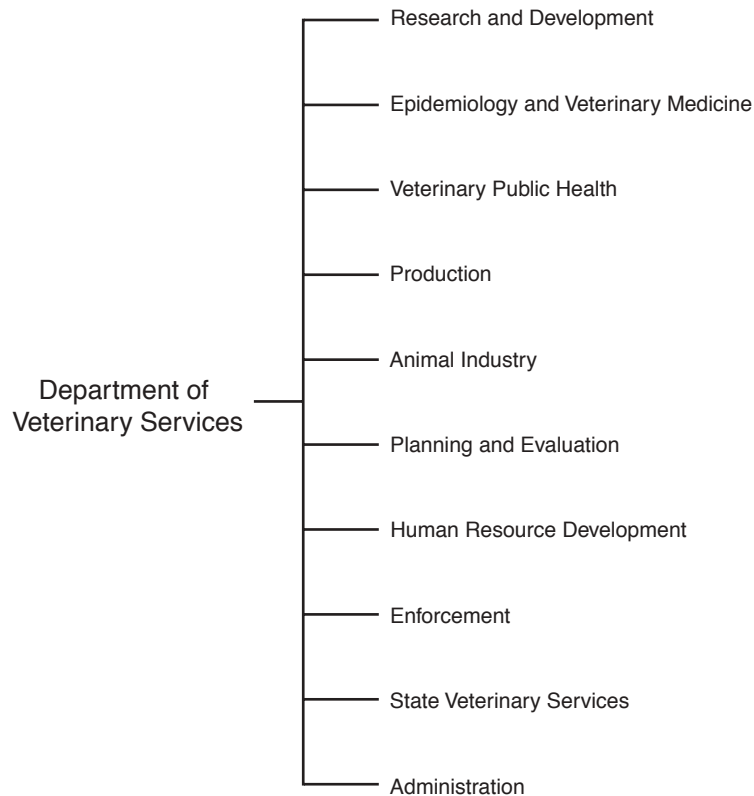


Figure 4. Structure of livestock-related organisation in Peninsular Malaysia.

Research and Development

This division was formed after the reorganisation of the DVS in 1996 with the purpose of coordinating all research activities of the Department. Funds for research are provided for by the National Science Council under the Intensive Research in Priority Areas Program.

The Veterinary Research Institute (VRI) is the only government animal or veterinary research institution in the country. Research is mainly in animal health with special emphasis on diseases of economic importance. Some of

the research projects involve collaboration with local universities and other institutions. Studies and research on local raw materials and plants for animal feed are conducted in government farms in Peninsular Malaysia. The National Animal Biotechnology Institute carries out research on artificial breeding and genetic engineering.

Epidemiology and Veterinary Medicine Division

This division (formerly known as the Animal Health Division) deals with matters pertaining to animal health. There are three units in the division, each with specific functions as described below.

Disease control programs, which include surveillance of specific diseases, are determined by the Disease Control, Veterinary Medicine and Biologics Section. National disease control programs such as the control of foot-and-mouth disease (FMD), brucellosis, tuberculosis, Johnes disease, swine fever, salmonellosis and haemorrhagic septicaemia are determined and undertaken by this unit. Field health services make up most of the activities, and personnel are deployed to all states to carry out herd health programs in the districts. The introduction and importation of vaccines and other biologicals are also monitored by this section.

The Animal Quarantine, Import and Export Unit provides quarantine as well as inspection and clearance services for live animals, birds and animal products imported into and exported from Peninsular Malaysia. These imports are controlled by the Animals Ordinance 1953, the Animals Importation Order 1962 and Animal Rules 1962. In the case of Sabah and Sarawak, they are subject to the Sabah Animals Ordinance 1962 and the Public Health Ordinance 1962, respectively.

There are six Regional Veterinary Laboratories servicing Peninsular Malaysia. In addition, there are two other veterinary laboratories, one in Sarawak and another in Sabah. This unit monitors and coordinates all the laboratories in Peninsular Malaysia. Monthly reports of the laboratories findings are compiled and diseases in the Office International des Epizooties (OIE) List A and B highlighted. Each laboratory has facilities for bacteriology, virology, pathology, and parasitology. In addition all the laboratories in Peninsular Malaysia have Public Health and Diseases of Aquatic Animals Units. The primary role of the laboratories is to provide support services to the field veterinary health activities in the prevention, treatment, control and eradication of diseases.

Veterinary Public Health Services Division

The activities of this division were previously included in the Animal Health Division. In October 1996, the Government approved the establishment of this separate division upon recognition of the need to expand activities based on demands for food safety.

Activities of the division encompass meat inspection, the establishment of new abattoirs, accreditation of processing plants, monitoring of zoonoses and activities under the Codex Alimentarius.

The Veterinary Public Health Laboratory provides support services in Veterinary Public Health programs of the DVS. It also provides laboratory service to various agencies and the private sector on request. The services provided are aimed at raising the level of quality, wholesomeness and safe production of foods of animal origin. There is a central laboratory in Petaling Jaya and branches in the regional veterinary laboratories in the Peninsula. Samples tested are those from poultry and meat processing plants, abattoirs, milk collecting centres, imported meat and meat products.

Abattoirs which belong to the DVS are managed and monitored by the unit which includes determination of standards and requirements for new abattoirs. In the past, the main inspection activity was meat inspection at slaughter houses which consisted of ante-mortem and post-mortem inspections. With the increase in international trade and the requests for importing food from establishments new to the DVS, inspections of processing plants and abattoirs both local and overseas are now undertaken.

Production Division

This division now maintains genetic stock of cattle, sheep, goats, deer, rabbits, quails and ostriches in the government farms. Apart from providing genetic material to farmers, studies on feeding, production and other related areas are also coordinated by the division.

The Development and Management of Farms Unit oversees the management and development of all the DVS farms. The policies and directions which the farms should follow are determined by the unit. Research in breeding and genetic engineering of cattle is conducted in the National Animal Biotechnology Institute.

Animal Industry Development Services Division

The role of this division is to provide support to the growth and development of the various commodities in the livestock industry. Production of livestock, which was a major function of the DVS, is replaced by activities which enhance private sector participation in the industry.

Planning and Evaluation Division

The development of all the federal projects throughout Peninsular Malaysia is handled by this division. The five-year Malaysia Plans are monitored by the division and evaluation and reviews are made by division staff.

Apart from its responsibilities in planning and evaluation, this unit is responsible for the computerisation of the DVS. Programs are developed by evaluating the needs of all the divisions and units in the DVS. The headquarters, VRI, and some of the states have a local area network (LAN). E-mail facilities are available in all the laboratories, some of the states, headquarters and the VRI. Eventually it is planned that all agencies under the Ministry of Agriculture will be linked via the *AGROLINK*.

Human Resource Development Division

This division is responsible for the career development of all categories of staff. Training needs and areas of expertise required by the DVS are the responsibilities of this division.

Postgraduate education and scholarship needs are determined by the unit. Eligible staff for further education up to masters and doctorate levels are identified annually and scholarships secured for successful candidates. Short term or long term courses in the country or overseas are also identified. Opportunities for training are not limited to Department staff only but also offers government staff in developing countries training in various veterinary fields under the Malaysian Technical Cooperation Program.

There are three institutions where in-service training is provided for the staff in veterinary management and field training in animal husbandry.

Enforcement Division

Enforcement units are placed in all the states. They act upon operations that are against the laws of the states such as illegal slaughter of animals and movement of animals without permits.

State Veterinary Services

The State Veterinary Services are independent of the federal government in terms of financial support. However, the policies and general orders of the federal government form the guidelines under which the states operate. The district staff form the frontline in the veterinary field services.

Administrative Division

The division deals with finance and service matters of all the staff under the federal government.

Sources of Information

Disease

Laboratory

Laboratory reports form the main source of information on diseases. Standard submission and reply forms are used by all laboratories. There are specific forms for mammals, avian, serology, biochemistry, inter laboratory (referral cases). Forms are completed by DVS staff, private veterinarians or farmers. Specimens are transported to the laboratory by road, rail or air. All cases are registered daily and results reported as soon as they are obtained.

Records on diseases are stored at laboratories, the VRI and the districts. Different modules have been developed for the storage and retrieval of information. In the laboratory for instance, the animal disease information system (ADIS) was developed for data storage and retrieval. Monthly reports are generated by all the laboratories using standard formats which in turn are compiled at the headquarters. Significant findings are reported to the Director General during the monthly senior officers' meeting.

At the VRI, each unit has its own module which is interlinked to others by the local area network. In the Regional Veterinary Laboratories, however, the units are not interlinked but the same module is used for recording and reporting. Monthly laboratory reports are sent to the Veterinary Laboratory Services Unit at headquarters for compilation.

Field

Data on diseases investigated in the field are stored in a program called *GEISHA* which was developed especially for this purpose. This software is used extensively by the herd health group which conducts surveillance on

specific diseases. The district staff also record cases of disease occurrence during the course of their extension services. Field cases are recorded at the districts of each state. Data are coordinated by the Disease Control, Veterinary Medicine and Biologics Unit at headquarters.

Surveillance

Surveillance for diseases such as brucellosis, tuberculosis, Johnes disease, FMD and salmonellosis (*Salmonella pullorum* and *S. enteritidis*) is carried out routinely. In addition, bulls used for breeding are checked for campylobacteriosis and trichomoniasis.

Livestock demographics

Population

Census on livestock is not carried out systematically but data on animal populations are collected by district personnel throughout the year. Population data are collected while on visits to farms for treatment or health programs.

Livestock movement

Movement of animals between states requires a movement permit for the exporting state, issued by the exporting state; a health certificate, which is also issued by the exporting state; and an import permit which is issued by the receiving state. These documents are issued by the State Veterinary Services (headquarters). For movement within the state, the district office will issue the movement permit.

There are six entry points with quarantine facilities in Peninsular Malaysia. Quarantine of animals is dependent upon the country of origin. All animals entering the country must be accompanied by appropriate documents, i.e. a health certificate and an import permit.

Control program monitoring

Monitoring of disease control programs is the responsibility of the Disease Control and Veterinary Medicine and Biologics Unit. Funds for the compensation of animals culled for brucellosis, tuberculosis and Johnes disease are provided for by the unit. Guidelines and procedures for disease control program are generated from this unit.

Vaccine production and distribution

Vaccine production for Newcastle disease, fowl pox and swine fever has been privatised to a local Malaysian-owned company. However, the VRI still produces haemorrhagic septicaemia vaccine for the whole country and fowl cholera vaccine for ducks and chickens on request. Research on the development of vaccines using local strains is the responsibility of the VRI. The production of such vaccines may be privatised.

Vaccines produced by the VRI are sold to private practitioners and state veterinary services for sale to farmers. Records of sales are kept at the VRI. Imported vaccines on the other hand are imported by companies identified as sole agents by the producers. Permits for importation are issued by the headquarters and records are stored there. Data on the volume of imported vaccines are collected but data on the actual location and distribution to farmers are not known.

Management of animal health information

Animal Health Information is part of the Veterinary Information System (VEINS). The Epidemiology and Veterinary Medicine Division is responsible for the management of the information. Each unit under the division manages the information collected for compilation and further action. Various software packages for the laboratory, field, quarantine and abattoirs have been developed but all are at different stages of use.

OIE SR-3 forms for diseases of Lists A and B are completed by the laboratories every month and are submitted to the headquarters for compilation and then forwarded to the OIE every quarter.

Each unit produces an annual report which is the source of information for the DVS annual report.

Constraints and Problems

The use of information as a management tool is not yet in place. This may be due to the different stages of utilisation of the computerised systems that have been developed. To overcome this weakness, managers need to encourage the field staff to use the information that they have already stored. Analysis of data is yet to become a routine exercise. In line with the Government's campaign for the use of information technology in daily operations, a more efficient animal health information system is foreseen.

Summary

Table 4 summarises the information collection and storage systems discussed above.

Table 4. Summary of livestock-related data collection and means of record keeping in Peninsular Malaysia.

Activities	Format of records maintained
Laboratory submission	<p>Standard forms completed by Department of Veterinary Services (DVS) staff, veterinarians or farmers and registered on computer upon receipt.</p> <p>Computerised data storage and retrieval system at each laboratory—animal disease information system (ADIS).</p> <p>Monthly lab reports sent to headquarters for compilation.</p> <p>Office International des Epizooties (OIE) forms are submitted by labs monthly then compiled into quarterly report by headquarters.</p>
Field disease reports	<p>Field cases are recorded at districts on <i>GEISHA</i> software.</p> <p>Data is coordinated at headquarters.</p>
Livestock movement	Data is collected at all checkpoints.
Livestock population	Not systematically collected.
Vaccine production and use	<p>Records of locally produced vaccine sales to private vets and state veterinary services are kept at VRI.</p> <p>Data on imported vaccine volumes but not distribution.</p>

Table 4. (cont'd) Summary of livestock-related data collection and means of record keeping in Peninsular Malaysia.

Activities	Format of records maintained
Central computer system	<p>Headquarters, VRI and some states have a local area network (LAN).</p> <p>E-mail facilities available in all laboratories, some states, headquarters and the VRI.</p> <p>Planned for all agencies of Ministry of Agriculture to be linked to <i>AGROLINK</i>.</p> <p>Various software programs have been developed for laboratory, field, quarantine and abattoirs but at different stages of use.</p>

Philippines

R.C. Abila

Ma. L.M. Joco

Introduction

The Philippines is an archipelago made up of approximately 7 100 islands and islets. This geographical subdivision is grouped around three major islands: Luzon, Visayas and Mindanao. The human population is currently about 76 million. There are 13 political subdivisions: regions 1 to 12 and the Cordillera Autonomous Region in the north. The regions are further divided into 78 provinces.

The Philippines is basically an agricultural country, highly dependent on crop production, livestock and fisheries/marine production. Rice is produced as a staple crop while corn is cultivated primarily for use as animal feed. Livestock production shares equal importance, not only for its food value, but also for draft purposes.

Structure of the Livestock-related Organisations

The structure of the Philippine Department of Agriculture is shown in Figure 5. The Bureau of Animal Industry is a section of this Department and its hierarchy is shown in Figure 6.

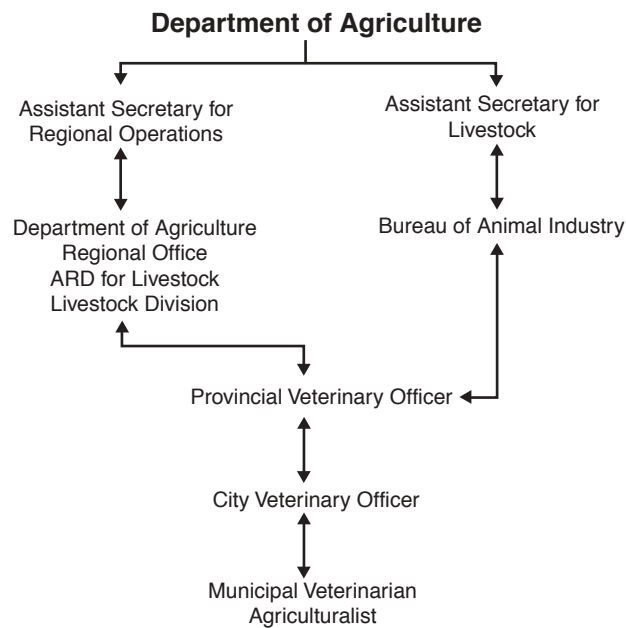


Figure 5. Structure of the Department of Agriculture of The Philippines.

The Planning and International Desk Office coordinates the plans of all units of the Bureau of Animal Industry, monitors and evaluates programs, projects and activities, produces routine accomplishment reports, and coordinates special and foreign-assisted projects.

The Animal Feeds Standards Division monitors and regulates quality of feeds.

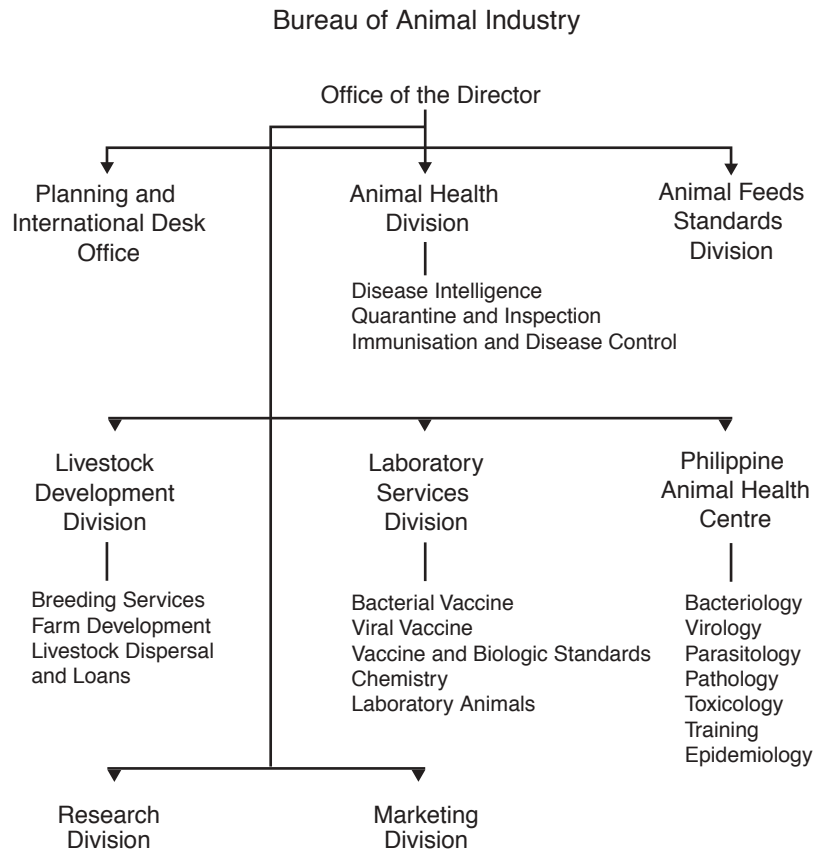


Figure 6. The structure of the Bureau of Animal Industry within the Philippine Department of Agriculture

The Animal Health Division is divided into three sections. The Disease Intelligence Section collates and analyses disease data and transforms these into presentable information. The Quarantine and Inspection Section regulates the movement of animals, animal products and by-products. The Immunisation and Disease Control Section is responsible for the distribution of vaccines and the coordination of vaccination campaigns.

The Laboratory Services Division comprises five sections. The Bacterial Vaccine Section is responsible for the production of vaccines against haemorrhagic septicemia, anthrax, swine plague, leptospira and brucella antigen. The Viral Vaccine Section oversees the production of vaccines against Newcastle disease, fowl pox, hog cholera, and viral antigens for diagnostic tests. Quality control of Government-produced and commercial

vaccines and biologics is the primary responsibility of the Vaccine and Biologics Standards Section. The Chemistry Section conducts the chemical analysis of feeds and feed supplements.

The Philippine Animal Health Centre is a national reference centre for diagnosis and research of animal diseases. The Centre's Epidemiology Section conducts disease outbreak investigation and epidemiological studies of priority diseases. The Bacteriology and Virology Sections are responsible for the diagnosis of and research studies on bacterial and viral diseases respectively. Necropsy and histopathological examination is conducted by the Pathology Section. The Toxicology Section is primarily involved in the diagnosis and research of aflatoxin and other mycotoxins.

The Livestock Development Division comprises three sections. The Breeding Services Section oversees the upgrading of local breeds through artificial insemination and infusion of imported breeds while the Farm Development Section is responsible for the management of government livestock farms. The Division takes responsibility for a livestock dispersal program through credit, a program conducted by the Livestock Dispersal and Loan Section.

Research on livestock production, breeding, development of pasture and forage, non-conventional feeds and biogas is largely the responsibility of the Research Division.

The Marketing Division is responsible for the development of auction markets and for monitoring of prices of animals and animal products throughout the country.

Sources of Information

Disease

Laboratory

There are 12 regional animal disease diagnostic laboratories (RADDL). The Philippine Animal Health Centre (PAHC) serves as the national reference center for these RADDL. It conducts routine diagnostic procedures and research on animal diseases. Cases diagnosed at the PAHC and RADDL are summarised every month using the Animal Disease Diagnostic Laboratory Report form. These reports are forwarded to the Epidemiology section of PAHC for collation and analysis. Collated data are presented in a table form indicating the date and place of occurrence, species affected, morbidity and mortality, diagnosis and diagnostic tests used.

Field

Field Reports form the main source of disease data and are based on the clinical diagnosis of the Agricultural Technologists.

At the time of a disease outbreak, a formal outbreak investigation takes place. An Initial Disease Outbreak Report form is used. The form allows the submitter to describe in detail the clinical features, signs observed, lesions found during necropsy, exact location of the outbreak down to farm level, exact date and—if possible—the time of the start of the outbreak and other observations regarding the behaviour of the disease. In the final follow-up investigation a Final Disease Outbreak Report form is completed. This report contains information regarding additional findings about the outbreak and the daily incidence of the disease. It attempts to establish the source of the first infection, the introduction of the disease and the transmission of the etiologic agent.

Surveillance

Specific disease surveillance is undertaken for foot-and-mouth disease (FMD) and rabies. FMD is based on weekly submission of field reports, results from outbreak investigations and samples tested at the laboratory. Rabies surveillance is mainly based on laboratory diagnosis.

The Bureau of Animal Industry undertakes some special surveys and epidemiological investigations. The Bureau also conducts research on the prevalence of some diseases. The Philippine Animal Health Centre is taking the lead in these studies. Some of the completed studies include serological prevalence of pseudorabies in swine, pasteurellosis in pigs and ruminants, and swollen head syndrome in selected commercial poultry farms. Studies on the distribution of anthrax and the different serotypes of FMD are priorities. In depth investigations on the epidemiology of diseases are also being conducted.

The Farm-Integrated Animal Health and Production Project, being supported by The German Agency for Technical Aid (Deutsche Gesellschaft für Technische Zusammenarbeit—GTZ), is conducting a routine collection of data on health and productivity of livestock in smallholder farms. Data collected include the date and the type of action taken (e.g. artificial insemination, vaccination, treatment and pregnancy testing) and observations on animal activity (e.g. farrowing/calving, abortion and sickness). Data from cattle and carabao are entered into a desktop computer using *DAIRYCHAMP*. Other data are entered in an *MS Excel* spreadsheet.

Livestock demographics

Population

Livestock statistics are collected by the Bureau of Agricultural Statistics (BAS) and the Local Government Units (LGU). The BAS collects every quarter information from representative household samples for backyard farms and complete enumeration for the commercial farms annually. The LGU collects information annually from all barangays (villages) through the Barangay official data of backyard farm demographics.

Data collected are merely number of animals per species. No classification is made in terms of age group, sex or breed. Livestock population figures from BAS are divided into backyard and commercial farms.

Livestock movement

More than 50% of the livestock produced in the country are shipped to MetroManila for consumption. Local quarantine checkpoints are located in every province. At the checkpoints, the number/quantity of animals/animal products, species, type of vehicle carrying, owner, source and destination are recorded. A shipping permit and a veterinary health certificate are required for all animals to be shipped. There are also international quarantine checkpoints in major airports and seaports

Control program monitoring

Vaccine production and distribution

The Laboratory Services Division of the Bureau of Animal Industry produces vaccines for haemorrhagic septicemia, anthrax, Newcastle disease, fowl pox and hog cholera. FMD, hog cholera and rabies vaccine are procured from private sources. Distribution of vaccines is the responsibility of the Animal Health Division. Vaccines are distributed to the regions, provinces, sometimes directly to the cities and municipalities. Records are kept including details of the type of vaccine, batch number, brand, number of doses, date released and destination. Information is also collected at the time of vaccination, including the date of vaccination, barangay (village), type of vaccine, species, and number of animals vaccinated.

Management of Animal Health Information

The Disease Intelligence Section of Animal Health Division (DIS-AHD) is the unit responsible for the collation and analysis of all animal health information. The Epidemiology Section of the Philippine Animal Health

Centre collates and analyses data from diagnostic/laboratory reports and submits them to DIS–AHD. All reports produced by DIS–AHD are submitted to the Planning Office of the Bureau of Animal Industry. All data are computerised using spreadsheets and reports are in the form of summary tables, graphs and maps. Weekly reports for rabies and FMD are produced but usually other diseases are only reported monthly. The DIS prepare reports to OIE.

Constraints and Problems

Constraints and problems which have been encountered include:

- doubtful validity of disease diagnoses from field reports;
- small number of samples examined at regional laboratories;
- delay/non-submission of reports;
- epidemiological analysis not able to be done due to absence of some information (e.g. population at risk);
- lack of trained personnel at the regions/provinces in managing the animal health information system; and
- lack of equipment (such as computers) to handle voluminous data.

Summary

Table 5 summarises the information collection and storage systems discussed above.

Table 5. Summary of livestock-related data collection and means of record-keeping in The Philippines.

Activities	Format of records maintained
Laboratory submission	Table format. Monthly summaries on standard report form sent from regional labs to central office for compilation.
Field disease reports	Standardised outbreak forms used.
Surveillance reports	Weekly submission of field reports on foot-and-mouth disease collated with lab reports and outbreak investigations. Specific survey projects use <i>DAIRYCHAMP</i> and spreadsheets to record and analyse collected data.
Livestock movement	Data are recorded.
Livestock population	Data are collected.
Vaccine production and use	Records are collected on production and distribution. Data also collected at time of vaccination.
Central computer system	All data from submitted laboratory summary reports are recorded on computer spreadsheets, tables, graphs and maps.

Thailand

Y. Meephuch

Thailand covers an area of 513 000 square kilometres with an approximate human population of about 62 million. The country borders Myanmar in the north and northwest, Lao People's Democratic Republic (PDR) in the northeast, Cambodia in the northeast and east and Malaysia in the south. The country is administratively divided into four areas (central, northern, northeastern and southern) and nine livestock development regions, each of which comprises eight or nine provinces. There are 76 provinces in Thailand. Agriculture contributes about 10% of the country's gross domestic product and occupies over half of the population.

Structure of the Livestock-related Organisation

The Department of Livestock Development (DLD) of the Royal Thai Government is responsible for the animal health services and the promotion of animal production in Thailand. The present organisation of the DLD is shown in Figure 7.

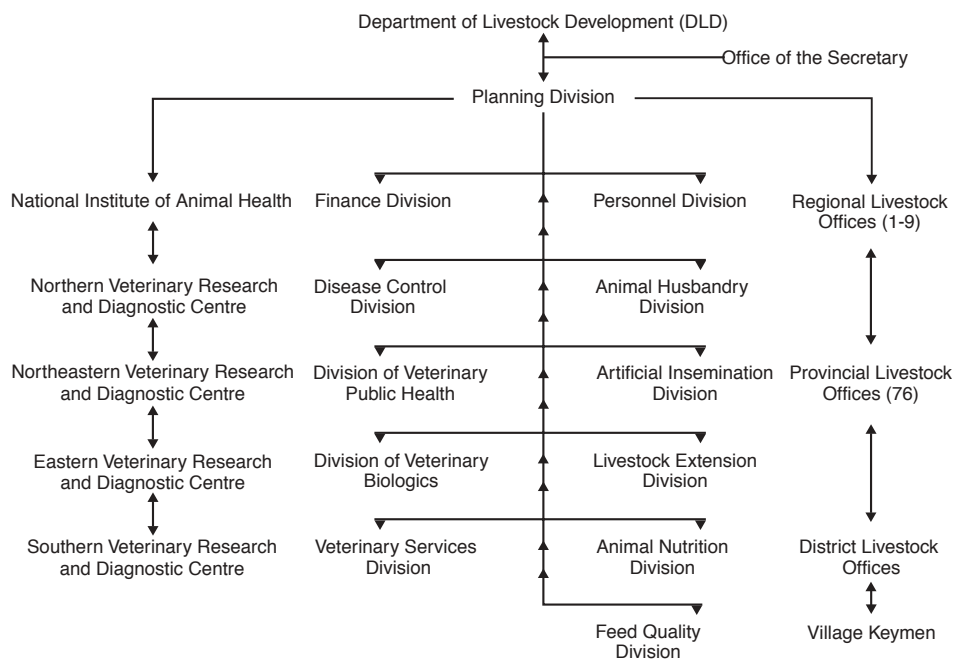


Figure 7. Structure of the Thai Department of Livestock Development.

The Planning Division collects administrative and technical information from every division within DLD in the form of monthly reports in order to allocate budget and personnel and to make policy for the animal health services system.

The Disease Control Division is responsible for the control, prevention and eradication of major contagious diseases such as foot-and-mouth disease (FMD), haemorrhagic septicaemia, rinderpest, brucellosis, anthrax, tuberculosis, Newcastle disease, swine fever and Aujeszky's disease. The Epidemiology Section and FMD Information Centre are the main units of the Division which deals with the analysis of field data and active surveillance in order to develop strategies for the disease control and eradication program.

The National Institute of Animal Health (NIAH) was established in 1986 by the Japanese International Cooperative Agency under NIAH Project Phase I (1986–1993). Its main function is to conduct research and diagnosis on animal disease and health problems. Epidemiological survey and research activities on the major economic loss-causing animal diseases such as brucellosis, tuberculosis, paratuberculosis, swine fever and arthropod-borne diseases are the main objectives of the NIAH Project Phase II (1993–1998).

A Laboratory Information System based on data from diagnosis, survey and research has been established among NIAH and Regional Veterinary Research and Diagnostic Centres. At present there are four such Regional Veterinary Research and Diagnostic Centers (RVRDCs) namely Northern VRDC in Region 5 in Lampang province; Northeastern VRDC in Region 4 in Khon Kaen province; Southern VRDC in Region 8 in Nakhonsrithammarat province and the new, Eastern VRDC in Region 2 in Chonburi province. These centres are in charge of animal health research and diagnosis in their respective regions. They also support each other as a network of both laboratory and field surveillance systems.

The Division of Veterinary Public Health is responsible for the control and prevention of zoonosis. The Veterinary Service Division is responsible for the treatment of animal diseases. Meat inspection, as well as the quality control of meat processing plants and slaughter houses, is also conducted by this division.

The Artificial Insemination Division provides insemination services in cattle and pig for farmers. The Division also conducts research on the improvement of techniques and productivity.

The Division of Veterinary Biologics produces biological products such as FMD vaccine, swine fever vaccine, Newcastle disease vaccine, rinderpest vaccine, brucella antigen and pullorum antigen.

Sources of Information

Disease

Laboratory

The NIAH and the four RVRDCs are the diagnostic laboratories responsible for disease diagnosis in the whole country. All have a standardised submission form that records details of epidemiological data concerning the sick animal or samples submitted to the laboratories. The submission form is

completed by a paraveterinarian or veterinarian from the epidemiology section of the laboratory. Upon arrival at the laboratories, information is entered into a standardised computer database. Data is sent from the laboratories to a central database on a regular basis.

Field

When a disease outbreak occurs, the District Livestock Officer in the locality conducts field investigations and completes the report form, EP12. In this form, information about the location of the outbreak, number of animals affected and at risk, possible risk factors, nearest village, vaccination history, suspected sources of infection, symptoms seen, samples sent to laboratory and control actions taken are recorded. This report is sent to the Provincial Livestock Officer and Regional Livestock Officer and then reaches DLD headquarters.

In the event of an FMD outbreak, specimens and basic information of the outbreak are sent to the Foot and Mouth Disease Centre in Pak Chong, Nakhon Ratchasima province or to the Northern Veterinary Research and Diagnostic Center (NVRDC) in Hang Chat, Lampang province for confirmation and typing of the virus.

After submitting the EP12 form, the District Livestock Officer conducts a weekly outbreak follow-up investigation and completes another report form (EP13). The distribution channel of this form is the same for EP12. This form collects weekly update information during the outbreak and for four weeks after the outbreak is over. Information on the form includes cumulative totals of animals sick, recovered, died and at risk up to the previous week.

A monthly Summary Report is produced by districts and represents collected information about all disease outbreaks in the district during the past month. Information collected includes diagnosis, location of outbreak, demographic data about animals affected, key dates (e.g. date of onset, date of first report etc.) and control measures used.

Routine vaccination reports are compiled and contain details about locality at village level, population of animals, number of animals vaccinated and type of vaccine used. These are entered in a report form called EP14 by the District Livestock Officer and are used to monitor the utilisation of FMD vaccine. Ultimately, it will link to outbreak reports in order to monitor the efficacy of the vaccination campaign.

Surveillance

Epidemiological surveys of disease prevalence or incidence and research activities on the major economic-loss animal diseases as brucellosis, tuberculosis, paratuberculosis, swine fever and arthropod-borne diseases are the main objectives of the NIAH Project Phase II (1993–1998).

The Newcastle Disease Free Zone Project is implemented by the Veterinary Service Division. Random sampling of serum and cloacal swabs from chickens in Regions 1, 2, 3, 6 and 7 are collected for examination before and after vaccination.

The FMD Control and Eradication Project in Region 2 comprises an FMD vaccination campaign program in cattle, buffalo and pigs conducted at four-monthly intervals throughout the region. Serological surveillance for antibody titre and immune status of the vaccinated animals is undertaken one month after vaccination by random sampling of the serum.

Surveillance of FMD antibody titre in cattle along the Thai–Myanmar border is also undertaken by the Epidemiology Section of the NVRDC routinely as a follow-on from the Australian Centre for International Agricultural Research project.

Livestock demographics

Population

At present a village livestock population census is not regularly or routinely collected. Some years it is collected by either the National Statistics Office or Thammasat University under a specific project. The information is collected by sending temporary personnel out to all villages to interview using questionnaires. The information collected is stored and compiled using microcomputers. Normally the animal population census is conducted at the same time as a human population census with details of socioeconomic information being also of interest. Village livestock population estimates are maintained in the district veterinary offices, and summary figures are collated at the provincial level.

Livestock movement

There are 28 international quarantine checkpoints and 16 inland quarantine checkpoints throughout the country. Thailand shares long borders with Myanmar in the west and north, Lao PDR in the northeast, Cambodia in the east and Malaysia in the south {See also Chapter 6, Figure 3.}

All animals moving into the country through international quarantine checkpoints are examined for signs of infectious diseases and vaccinated with trivalent FMD vaccine by quarantine officers. Serum from some of these animals is randomly collected for laboratory examination. After examination and vaccination the quarantine officer will stick an ear tag with identification and certification numbers onto the animal.

All animals moving to the inland quarantine checkpoints have to be cleared for identification and certification before being allowed to pass.

Information on breed, sex, place of origin, destination, physical examination, date of arrival, date of vaccination, owner's name and address, disease found or suspected at the checkpoint and purpose of the movement is recorded. Monthly summary reports on the information are produced by quarantine officers and sent to the Disease Control Division .

Control program monitoring

Twice a year, FMD campaign programs are implemented throughout the country by District Livestock Officers. A haemorrhagic septicaemia vaccine campaign program is conducted once a year. An EP14 report form is completed with details of vaccination such as owner's name, address, district, province, kind of animal, type of vaccine, date of vaccination, vaccine lot number, number of animals vaccinated, name or identification number of the animal, sex, age, and name of vaccinator. These reports are sent to the Disease Control Division through the Provincial Livestock Office and Regional Livestock Office after every vaccination.

Vaccine production and distribution

The Division of Veterinary Biologics produces several varieties of vaccines including those for trivalent, bivalent and monovalent FMD, haemorrhagic septicaemia, anthrax spore, rinderpest, swine fever, fowl cholera, Newcastle disease, infectious bronchitis and infectious laryngotracheitis. These are produced for in-country use by the DLD and farmers. There are some imported vaccines used by commercial companies.

Some of the vaccine produced is provided to the Veterinary Service Division to be distributed to Regional Livestock Offices, Disease Control Division and other organisations of the DLD, the remainder is made available for farmers to purchase.

Other activities and administration information

Veterinary extension network

A network of volunteer village cooperators or 'keymen' has been established. These people receive a small amount of basic training in animal health, and act as the link between the village livestock owners and the government veterinary services.

A *dairy herd information system* for collecting data such as herd health records, individual cow records, milk yields, somatic cell counts and farm event data record is being established through a joint project between the Livestock Extension Division, Artificial Insemination Division, Division of Veterinary Public Health, Regional Livestock Offices and Dairy Cooperatives.

Management of Animal Health Information

Laboratory surveillance system

All Epidemiology Sections of the RVRDCs and NIAH are responsible for the collection of data such as pathology, bacteriology, virology, immunology, serology, parasitology, toxicology and biochemical data from diagnostic laboratories. A network of laboratory surveillance has been established among the Epidemiology Sections of NIAH and RVRDCs. They had developed a computerised database program called the Animal Health and Production Information System (AHPIS) in order to standardise the format of their data collection, analysis and reports. Data and information from RVRDCs are submitted in form of paper reports and database files recorded on diskettes to the NIAH, which is the centre for the network. In this way, the NIAH is able to collect laboratory diagnostic information from all RVRDCs and analyse the data easily and efficiently. Monthly or annual reports of disease diagnoses, analysis of disease outbreaks, some specific disease surveys and laboratory diagnostic activities can be produced by this AHPIS. The reports are submitted to the Planning Division for policy making and budget allocation and to the Disease Control Division for in implementing control measures, providing warnings to officers in charge and for international reporting requirements such as Office International des Epizooties (OIE) reports.

Field surveillance system

The Disease Control Division is responsible for the field disease outbreak reporting system including the FMD Information System. In the case of the FMD Information System, information from EP12, EP13 and EP14 forms, and FMD laboratory confirmed reports is recorded and processed by a program

which was developed from the *Foxbase* application. This program is capable of recording and reporting FMD outbreaks in terms of FMD type, number of animals affected, and other details of the circumstances of the outbreaks. Information of FMD vaccine coverage in the outbreak village is reported along with an outbreak analysis. The report can be produced weekly, monthly, yearly or in any time period as requested.

Constraints and Problems

To ensure the development of an optimal animal health information system (AHIS) in Thailand a number of features could be enhanced. An increase in the capabilities of the system analysts by way of input from visiting expert consultants, training courses and postgraduate education, along with the further development of a nationally linked data network, would see an improvement in the use of the AHIS as a management tool.

Summary

Table 6 summarises the information collection and storage systems discussed above.

Table 6. Summary of livestock-related data collection and means of record keeping in Thailand.

Activities	Format of records maintained
Laboratory submission	<p>Standard submission form completed by paravet or veterinary from epidemiology section of laboratory.</p> <p>Paper and database files sent from regional laboratories to the National Institute of Animal Health (NIAH).</p> <p>Computerised database (AHPIS) standardises format of data collection, analysis and reports.</p> <p>Reports and analysis automatically computer generated.</p>

Table 6. (cont'd) Summary of livestock-related data collection and means of record keeping in Thailand.

Field disease report	<p>Standard forms for outbreaks.</p> <p>Forms sent to Provincial and Regional Livestock Officers then to Department of Livestock Development headquarters.</p> <p>Standard follow up investigation forms.</p> <p>Monthly summary reports compiled by District Livestock Officer.</p> <p>Paper and database files sent from regional laboratories to central NIAH.</p> <p>Computerised database (AHPIS) standardises format of data collection, analysis and reports.</p> <p>Reports and analysis automatically computer generated.</p>
Surveillance report	<p>Standard foot-and-mouth (FMD) outbreak forms used and entered on computer-based FMD Information System (FoxBase application).</p> <p>Reports and analysis on FMD status automatically computer generated.</p>
Livestock movement	<p>Detailed information maintained.</p> <p>Monthly reports produced by quarantine officers and sent to the Disease Control Division.</p>
Livestock population	<p>Not routinely collected.</p> <p>Maintained on spreadsheets.</p>
Vaccine production and use	<p>Routine vaccination reports are compiled by District Livestock Officer.</p>
Dairy Herd Information System	<p>Data recorded on computer database.</p> <p>Reports and analysis automatically computer generated.</p>
Central computer system	<p>A computerised Animal Health and Production Information System (AHPIS) has been implemented.</p>

Vietnam

Lai Thi Kim Lan

Thai Thi Thuy Phuong

Introduction

Vietnam has long borders with Lao People's Democratic Republic (PDR) and Cambodia as well as China. Agriculture contributes approximately 30% of the gross domestic product and livestock play an important role. Crop production has been steadily increasing in the fertile delta areas, along with livestock production. Livestock contribute about 28% of the agricultural gross domestic product. The country is divided into 50 provinces.

Structure of the Livestock-related Organisations

After the Veterinary Ordinance was promulgated by the Government in 1993, the organisational structure of veterinary services were established from national to village level, as indicated in Figure 8.

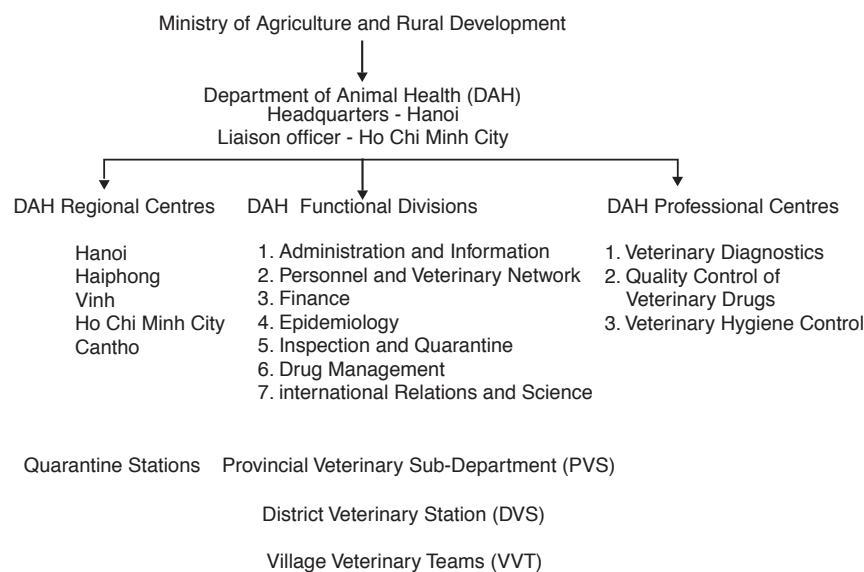


Figure 8. Organisational structure of veterinary services in Vietnam.

The Department of Animal Health (DAH) is under the direct management of the Ministry of Agriculture and Rural Development (MARD) with the responsibility of the overall control of veterinary services in the whole country. The Department's headquarters office is located in Hanoi City with a liaison office in Ho Chi Minh City.

To assist MARD in the management of all active aspects of veterinary services, seven Functional Divisions, three Professional Centres, six Regional Veterinary Centres and six International Quarantine Stations which belong to DAH were established by MARD.

DAH Functional Divisions are responsible for Animal Disease Control, Animal Quarantine, Meat Inspection and Food Hygiene, Veterinary Drug Quality Control and Management. They provide advice to the Government and in regard to the issuance and promulgation of regulations and legislation relating to all veterinary service matters.

The National Centre for Veterinary Diagnosis is responsible for testing samples sent by Provincial Laboratories, sending staff to outbreak areas to collect samples and carrying out disease investigation within the State breeding farms. The Centre is also involved in providing training for field officers.

National Centres for Quality Control of Veterinary Drug and Bio-Products are responsible for the sampling and testing of veterinary drugs, as well as storing and strengthening the strains of virus and bacteria required to produce vaccines.

National Centres for Veterinary Sanitary Inspection take responsibility for food hygiene inspection, controlling sanitary conditions at veterinary drugs manufacturing plants, food processing and producing establishments, slaughterhouses, veterinary drug outlets, food stores and animal feed enterprises.

Regional Veterinary Centres act on behalf of DAH to manage all activities of veterinary services in the regions.

DAH Animal Health Inspection Stations are responsible for sanitary inspection of animals, animal products and other objects along the borders with China, Lao PDR and Cambodia and at international airports and harbours throughout Vietnam.

Sources of Information

Disease

Laboratory

Information from laboratory investigations is collected from the research and diagnostic activities of the National Centre for Diagnostic and Regional Veterinary Centres.

At present, the system of Animal Disease Diagnostic Laboratories in Vietnam is divided into three different levels—provincial, regional and national. Provincial Veterinary Laboratories which belong to the Provincial Veterinary Sub-Departments have facilities for diagnosing certain parasitic and bacterial diseases. DAH Regional Veterinary Diagnostic Laboratories are equipped with facilities for animal disease diagnosis such as viral diseases, serological tests and pathological study. The National Veterinary Diagnostic Centre is equipped with modern diagnostic facilities and advanced diagnostic technologies. Apart from the diagnostic abilities of the Laboratory,

toxicological and biochemical characteristics of the diseases also may be characterised.

Recently, DAH has received assistance from the International Atomic Energy Agency and a Food and Agriculture Organization of the United Nations project (TCP/RAS/6611[A]) to supply the equipment required for foot-and-mouth diseases (FMD) diagnosis by enzyme-linked immunosorbent assay (ELISA) tests in Regional Veterinary Centres in Ho Chi Minh City and the National Veterinary Diagnostic Centre.

Samples which are sent to any laboratory must be attached to a case report on the disease situation. The report form is issued by DAH following a standardised format. Field Veterinary authorities are responsible for completing the form before sending it to the laboratory with the samples. The samples are maintained under cold conditions and transported to the laboratory in person.

Field

Standardised reporting forms have been established by DAH requiring details such as number of disease outbreaks, mortality, morbidity, clinical signs and measures of treatment. All the disease information except urgent reports are reported monthly, quarterly and yearly to the Epidemiology Division by mail, fax or sometimes in person.

Epidemiological information of animal disease status and distributions derived from field disease reports are collected and analysed by the Epidemiology Division of DAH.

Aside from routine monthly reports, whenever a disease outbreak occurs or any suspected outbreak is notified, urgent reports are sent directly to the Provincial Veterinary Sub-Departments, Regional Veterinary Centres and DAH by telephone or fax on the day of discovery and followed by weekly monitoring reports until the disease outbreak has ceased.

Livestock demographics

Population

There are two flows of livestock demographic information. One source is the mass vaccination campaigns but the data collected are generally not accurate. Population data can also be sourced from the General Department of Statistics which is a department of the Ministry of Investment and Planning.

The livestock population census is conducted twice a year, in April and October by census-takers. The animal population figures are recorded and the animal species are also identified.

Livestock movement

There are six Regional Veterinary Centres of DAH and twenty Animal Sanitary Inspection Stations at international airports, harbours and on the borders between China, Lao PDR and Cambodia.

These Centres and Stations control animal movement for import and export. There are 45 Inland Sanitary Inspection Stations at important transport points along the main roads. These checkpoints belong to Provincial Veterinary Sub-Departments and act on behalf of Provincial Authorities to inspect animals transported to the other provinces.

As well as some required procedures at all the Stations and checkpoints, other documents are required for animals, namely a Health Certificate, Certificate of Vaccination, and Laboratory test results for animals being imported and exported. The Certificate of Animal Health for import and export is issued by DAH and the Certificate for animal movement is issued by the Provincial Veterinary Sub-Department. At the checkpoints, the information on the time and date of animal movement, animal species, number of animals, health status of animals, sanitary condition, place of departure and arrival are recorded. The reported information follows a standardised format which is stipulated by DAH.

The most important reported information are animal species, number of moving animals and number of animals which do not meet requirements of inspection and measures of treatment. At present, most of the stations are not equipped with computers so data are only recorded on paper. There is also scope for improving the quality of data collected on imported animals.

Control program monitoring

Vietnam has implemented many animal disease control programs which mainly aim to control some infectious diseases of livestock such as rinderpest, FMD, anthrax, erysipelas, rabies and classical swine fever.

DAH has also developed programs on national or regional scales to establish animal disease-free zones for animal product exportation in some provinces of the Red River Delta and the Mekong River Delta, for example. At present, Vietnam is implementing a national animal disease control program which consists of three sub-programs to control and eradicate anthrax, FMD and rabies.

The animal health information system has been improved in recent years allowing animal disease control programs to be monitored closely from the central to local levels.

Vaccine production and distribution

There are three vaccine manufacturers in Vietnam. Vaccine production is largely based on the vaccination plan which is devised by DAH annually. This plan is dependent on the current animal disease situation and the availability and use of imported vaccine.

The Ministry of Agriculture and Rural Development entrusted the task of distributing vaccine to National Veterinary Drug Company No I & II with the agreement that the companies will follow the DAH vaccination plan. Provincial Veterinary Sub-Departments are responsible for the management and distribution of vaccine under the terms of the official vaccination plan.

At the central level, the DAH Division of Veterinary Drugs Control and Management, National Centre for Quality Control of Veterinary Drugs and Bio-products and National Centre for Veterinary Sanitary Control are responsible for the management of imported vaccine registration and vaccine production, as well as managing the types of circulated vaccine. Vaccine quality control, storage, strengthening strains of virus and bacteria to produce vaccine, and the control of sanitary conditions of vaccine manufacture and storage are also conducted by these agencies.

The Provincial Veterinary Sub-Department is responsible for management and distribution of vaccine at the provincial level.

Other activities and administration information

Veterinary extension network

At the base level, there are over 2 000 field veterinarians and private practitioners, approximately 10 000 veterinary technicians and 25 000 vaccinators who are working at district, village and street levels. They serve the small producers directly for their income and receive a small allowance during the mass vaccination campaigns. Their knowledge of veterinary services management, epidemiology and diagnostic work is still weak and this is a major obstacle to controlling animal diseases. Funds for training courses are very limited and the materials and technical capacity of district veterinary stations is very basic. As a result the stations do not meet the requirements of the contact and training database.

Meat inspection

Meat inspection is carried out at abattoirs or slaughterhouses. In the case of private slaughtering carried out by families, veterinary authorities cannot carry out meat inspection before meat is distributed to the markets because many families do not notify inspectors before slaughtering in order to avoid paying slaughter taxes.

Quality control

The meat quality control standards are only able to be applied to meat being exported. Meat samples are examined for drug residues and on sensory, physical, chemical, microbiological and toxicological characteristics at Regional Veterinary Centres which belong to DAH.

Management of animal health information

To meet animal health information requirements of the country, DAH decided to establish an animal health information system from central to field level. This is still in an early stage of development and constrained by limited finances, technical skills, and computer equipment, with systems only available in some DAH Functional Divisions, the Professional Centres and Regional Veterinary Centres. Almost all Provincial Veterinary Sub-Departments and District Veterinary Centres are still without computers.

An Animal Health Information Management Section was established by DAH. It is responsible for data collection and analysis, and the processing and storage of reports sent by DAH functional divisions, the Professional Centres, the Regional Veterinary Centres and Provincial Veterinary Sub-Departments etc. As well as preparing DAH annual reports, animal disease reports and Office International des Epizooties (OIE) reports are compiled by DAH Division of Epidemiology.

At present, there is only one computer connected to the Ministry of Agriculture and Rural Development information network to exchange information. The methods of collecting, analysing and processing data are still conducted manually. Computers are almost solely used for recording and storing data.

Constraints and Problems

Although the animal health information system has been in operation for some years, it has not been equipped adequately with computers and networking equipment.

The animal health disease reporting system has been standardised and now follows a uniform reporting form, but manual methods are still used to compile and analyse data.

The computerised information network has not been applied widely in the management of veterinary services in the whole country.

The basic knowledge of data collection, analysis, processing and storage by computer is very limited amongst staff.

The monthly reports from the field are often submitted too late and are usually scanty and inaccurate and so might not reflect the true disease situation in the field. Sometimes the output is difficult to update. This is a main reason that DAH can not submit animal disease country reports to OIE on time.

The DAH Animal Health Information System of Vietnam needs to be improved in order to provide qualified and accurate information for animal disease control programs and other veterinary activities and, especially, to keep up with the rapid changes of advanced information technology utilised by Association of Southeast Asian Nations (ASEAN) countries.

In coming years, the DAH priority in the area of animal health information system development will be to establish a computerised information network for the DAH. This will require adequate financial investment in the development of a central database system as well as purchasing computers and networking equipment to set up local area network (LAN) and wide area network (WAN) for the Animal Health Information System; enhancing the ability of staff to use computers for data collection, processing, analysis, and storage; and in further developing international cooperation in ASEAN countries in the animal health information field.

In order to strengthen the capabilities of the Animal Health Information System, DAH would like to have assistance from ASEAN to enhance the knowledge of advanced information technologies amongst DAH staff and in the development of computerised management of veterinary services and an effective animal disease reporting system.

Summary

Table 7 summarises the information collection and storage systems discussed above.

Table 7. Summary of livestock-related data collection and means of record keeping in Vietnam.

Activities	Format of records maintained
Laboratory submissions	<p>Paper records.</p> <p>Samples and standard forms completed by field veterinarians and delivered to laboratory in person.</p>
Field disease report	<p>Paper records.</p> <p>Standard forms for disease outbreaks.</p> <p>Outbreak reports treated urgently and sent to provincial, regional and national offices on day of notification then weekly monitoring reports until outbreak controlled.</p> <p>Disease data reported monthly, quarterly and annually to Epidemiology Division.</p>
Livestock movement	<p>Paper records.</p> <p>Detailed information collected at checkpoints on standard forms.</p>
Livestock population	<p>Inaccurate records from mass vaccination campaigns.</p> <p>Livestock population census twice a year.</p>
Vaccine production and use	<p>Department of Animal Health (DAH) holds data on production, storage etc.</p> <p>Provincial Veterinary Sub-Departments hold data on distribution of vaccine.</p>
Meat inspection and Quality control	<p>Data on export meat samples collected.</p> <p>Data maintained at Regional Veterinary Centres.</p>
Management of animal health information	<p>Only a few computers within DAH divisions, the Professional Centres and the Regional Veterinary Centres.</p> <p>Province and District Veterinary Centres are not computerised.</p> <p>One computer connected to the Ministry of Agriculture and Rural Development information network to exchange information.</p> <p>Computers used for storage of data, not analysis.</p>