

AGA-817(1993)

REPORT

Rome,
Italy,
22-26 November
1993

Expert Consultation on the Need for Information Systems to Strengthen Veterinary Services in Developing Countries



Food
and
Agriculture
Organization
of
the
United
Nations

**REPORT OF THE FAO EXPERT CONSULTATION
ON THE NEED FOR INFORMATION SYSTEMS TO STRENGTHEN
VETERINARY SERVICES IN DEVELOPING COUNTRIES**

Rome, Italy

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Forewords

Dr Hartwig de Haen, Assistant Director-General welcomed the participants of the Expert Consultation on behalf of the Director-General. He reminded the participants that their contribution should be made in their technical capacity rather than as national or regional representatives and drew their attention to FAO's Basic Text requiring the Organization to collect, analyze, interpret, and disseminate information relating to nutrition, food, and agriculture; this obviously includes animal production and health information. He reiterated that the Consultation is to produce recommendations which will serve as international guidelines for establishing animal health information systems.

Enhanced livestock productivity through selective breeding, appropriate feeding, and improved health relies to a large extent on effective information systems. Animal health information systems should be conceived in such a manner as to provide answers to questions such as: What diseases are present in a given area? What is their prevalence? How do they evolve (trends)? What is their economic impact? The answers in turn will help FAO define priority diseases, i.e. those that need our attention most urgently.

Dr de Haen asked the Consultation to imagine for a moment what would have been the results if, during the rinderpest epidemics which involved two continents in the 1920's, there had been an efficient and reliable information system; non-infected countries would have been alerted and enabled to prevent the entrance of infected animals and thus protect their livestock from the disease. Or to imagine what could have been the result if, during the African swine fever epidemic in the 1970's, there had not been an active animal disease information system in Brazil; it would not have been possible to adopt the optimal policy which served to eradicate the disease. Similarly it would have been unlikely that the eradication of the New World screwworm from Libya would have been possible had information systems in place not been reliable.

Thus the Consultation, should attempt to identify and find solutions to problems of input data gathering; define effective means of analyzing data, of transforming them into useful information and in disseminating the latter; and point the way to appropriate use of information in policy and decision making.

Finally, Dr de Haen stated that FAO specifically expected the Consultation to identify the existing needs and constraints regarding information systems as they relate to veterinary services in developing countries. Technical and practical solutions should then be formulated into recommendations for both FAO and its Member Countries.

After welcoming the participants on behalf of the Animal Production and Health Division, Dr A. Wahab Qureshi, Officer-in-Charge, informed the Consultation on the three existent information systems in the Division; they are: the animal health information system which revolves around the Animal Health Yearbook; the Consultation's input into the design of a system that would be beneficial to all users, particularly at the local level where the actual problems lie, would be valuable contribution. The tropical feeds information system which is a data base with textual information on the feeding values as well as recommendations for use in various rations; at present, tropical feeds information is published in the form of a diskette which is easy to use and is updated in a series of editions with up-to-date information

provided by a network of feed laboratories and participating animal nutritionists. The information system for conservation of domestic animal diversity an animal genetic resources data bank which consists of data on some 2,700 breeds of seven major species of domestic livestock; plans are to combine this with animal gene bank data and molecular data bank information, to form an integrated global information system for the conservation of domestic animal diversity.

In this information age, organizations appear to be using modern information technology to upgrade their image as well as their performance. However, one may ask the following questions with respect to the development of animal health information systems in developing countries: what information is needed? who are the users of this information? what is the benefit of this information to the users? what is the benefit-cost relationship? The users can be defined as the livestock owners, i.e. the target group; the veterinary services delivery system; the national policy and planning organization (d) the international collaboration and support organizations.

An information system designed and developed by any of these user groups will probably be of benefit to that particular group, but the current framework of agricultural development demands that the information needs and uses must be defined from the viewpoint of the livestock owners who are the "target beneficiaries". They are not represented at this Consultation, but as scientists and as professionals we can attempt to put ourselves in their shoes and give due consideration to these concerns.

Considering that the FAO/OIE/WHO Animal Health Yearbook has been of great value to chief veterinary officers in FAO Member Countries and to the three international organizations, FAO plans are to update its format in order to make it more readable and flexible and to allow member countries to have quick access to more veterinary information. This updating includes the use of an electronic questionnaire to facilitate prompt collection of data from member countries; the creation of a relational data base; the use of electronic mail to connect FAO headquarters with regional offices, governments of member countries and other international or regional organizations; and the production of the Yearbook in a readable diskette format.

These improvements are well within FAO means. But the question remains - how does it help a village which is struck by rinderpest, haemorrhagic septicaemia or foot-and-mouth disease? Other relevant questions are: what is the early warning system needed to prevent such potential disasters, and what information system is needed to improve preparedness to provide immediate assistance to this village?

This Consultation aims at strengthening veterinary services delivery systems through the improvement of information flow among all users. There are a number of issues to be considered while recommending a model information system or a networking structure with the use of appropriate information technology. Apart from defining the benefits and the beneficiaries, one needs to take into account the "networking culture" that could possibly be built within and among the various veterinary service units. This raises a number of additional questions: how does one develop a general understanding of the particular benefits envisaged? What are the requirements of the users? How can the individual tasks be defined and the required training be provided? What is the appropriate technology base

and how can it be creatively managed? These questions are relevant to the underlying theme of the last three topics of this Expert Consultation. FAO certainly looks forward to the conclusions and the recommendations of this Expert Consultation on these very practical questions.

Dr Roger Morris was elected chairman and main rapporteur. Dr Ian Dohoo and Dr Theresa Bernardo were elected co-rapporteurs for the Consultation.

1. Introduction

The world community has recognized increasingly in recent decades the power of information, and there has been a immense commitment of resources to development of information services to support both private and public sector activities, with information-related work representing the fastest area of employment growth in many countries over the last decade or more.

Information management technology confers a large competitive advantage on those who possess it and use it to the greatest benefit. Thus it is essential that developing countries have access to new information sources and means to control them. Information technology and resources are far more readily and cheaply transferable than most other technologies, so they offer an unusual opportunity for developing countries to gain equal access to a major world resource, and to use it to benefit their people.

Information technology and information systems are being applied more and more widely in animal health, although their use does not yet match that in many other fields. This Expert Consultation examines the technologies which are available, considers their potential value in animal health, and then describes how information systems appropriate to the needs of veterinary services and veterinarians can be implemented to improve their effectiveness and efficiency in improving world animal health.

The information revolution has proceeded so rapidly over the last decade that it is extremely difficult to predict when and how particular approaches will find a useful role in developing countries. The Consultation therefore sought to focus on immediate needs, while drawing attention to issues likely to need consideration in the longer term.

2. Objectives of the Consultation

The objectives of the Consultation were to consider information technologies and information management approaches which could potentially be adopted by developing country veterinary services, giving detailed attention to the next five years and more general consideration to the next fifteen years, and to advise on the following main areas:

- i. The functions in which information systems are of value, and the particular components of information systems which are most useful in various categories of animal health activities.
- ii. The ways in which information can be gathered, processed and disseminated, and how developing countries should design information systems for maximum effectiveness.
- iii. The strategies which developing countries should follow in designing and implementing animal health information systems matched to their needs and resources.
- iv. Recommendations to FAO and Member Governments on steps which would enhance the usefulness of information systems in their animal health activities.

3. Current approaches in information systems and decision support systems

3.1 Functions of information systems

Information systems are an under-used but essential tool in the strengthening of animal health services. In most developing countries, animal health and production information systems are operated principally by government services and this report deals primarily with this situation. In developed countries, the private sector is more often involved, particularly with systems aimed at optimizing productivity.

Information systems serve a wide variety of functions which are summarized in Table 1 and described in this section, together with their approximate priority in both developing and developed countries.

Table 1. The possible functions of an animal health and production information system and general estimates of their priorities in developed and developing countries. (Actual level of priority will vary from country to country).

Function	Priority in Developed Countries	Priority in Developing Countries
a. Improve productivity - information for herd management and evaluation	Medium - High	High
b. Protection from risk - information to control spread of disease	High	Medium - High
c. Export markets - information to ensure access to export markets	High	Low - High
d. Consumer benefits - information to ensure security and safety of food supply	High	Low-Medium
e. Animal welfare concerns - information to protect animal welfare	High	Low
f. Environmental concerns - information on environmental impact and wildlife health	Medium - High	Low
g. Research and educational priorities - information to identify constraints to animal health and productivity	Medium	Medium
h. Other - information for non-livestock industries such as equine, companion animal, pharmaceutical	Medium	Low

In addition to the specific areas described below, an animal health and production information system will operate at several levels to enhance development policy decisions. Such

information will allow the determination of the economic impact of constraints to production, the monitoring of the efficacy of programs designed to eliminate those constraints and the incorporation of these and other data into systems which enhance decision quality.

a. Improve productivity

Animal health and productivity information systems and associated health care delivery systems potentially play an important role in improving both the average income and income stability of producers. The system should provide information to assist in the management of the livestock unit and to evaluate productivity in a variety of areas in order to identify key constraints to achieving optimal productivity. A "livestock unit" for the purposes of animal health and production services in developing countries is commonly a single smallholder herd, all animals within a single village which are managed communally, or a herd belonging to a family or larger group of nomadic or transhumant people. However in most developing countries there are intensive livestock industries comprising a small number of large commercial herds which are operating in parallel to the smallholder farmers. In developed countries improvement of health and productivity is more likely to be provided by private veterinary services and by producers themselves. While the majority of livestock in developed countries are owned by commercial farmers, there is a substantial and growing population of "lifestyle" producers who own small numbers of animals and present practical problems for disease control programs similar to those of smallholder farmers in developing countries.

b. Protection from risk

An information system should provide the information necessary to support risk assessment, in order to protect producers from the risk of new diseases arriving from other farms in the region, other regions in the country and other countries.

c. Export markets

Exporting countries must be able to supply sufficient evidence of freedom from pests, diseases and residues to convince importing countries of the safety of their livestock products.

d. Consumer benefits

An information system contributes to the welfare of human populations in two ways. First, it provides a mechanism to monitor potential health hazards and zoonotic diseases, and reduce health risks to the community. Second, by enhancing the efficiency of livestock production systems it contributes to lower prices, greater security of supply and improved quality of livestock products. As any improvement in animal health and productivity is adopted by a rising proportion of livestock owners, it progressively lowers prices and transfers a substantial proportion of the benefit of technical advances from the livestock producer to the urban consumer, who is therefore a major beneficiary of such advances. As a country develops, the priority of veterinary services tends to shift from supporting producers to protecting consumers from food-born hazards, and achieving the objectives listed below on this list.

e. Animal welfare considerations

Freedom from disease and the risk of mortality are fundamental to animal welfare. Animal welfare issues have high priority in developed countries and are increasing in importance in some developing countries.

f. Environmental considerations

An information systems should help monitor and evaluate the direct and indirect effects of livestock disease controls, particularly in terms of land-use changes and their effects on the natural resource base. In addition, wildlife health is important in sustaining the indigenous animal populations in an area and wildlife can act as reservoirs for some important endemic diseases of livestock. Wildlife may also serve as sentinel animals for diseases (including toxicoses) entering a region.

g. Research and educational priorities

An information system should be able to identify the important constraints to animal health and production in a region. This information should be used to direct research efforts and should contribute to the design of veterinary and agricultural curricula.

h. Other

A number of other sectors of society such as the racing (horses and dogs) industry and companion animal owners will be able to use for their own benefit technologies put in place to monitor livestock health and productivity. The veterinary pharmaceutical industry will benefit directly from better information on animal health in all sectors.

3.2 Components of Information Systems

There are four major components to an information system. These are: data collection; data management; information distribution and information utilization. This section briefly describes each of these components and briefly outlines some of the major issues of concern in each area. Table 2 specifically identifies the various elements which jointly comprise each of these components, and indicates whether they are relevant to information systems that apply at the 'within herd/village', 'within country' and international level.

a. Data Collection

Collection of data is the starting point for any animal health and productivity information system. However, this process is often very labour intensive and demanding in terms of resources. Some key considerations in the data collection process are as follows.

- i. Duplication of data collection and entry must be avoided. Some of the data required for an animal health and productivity information system may already be collected and entered into a computer by another user/agency. If collection of data is required, new technologies may, in carefully selected cases, simplify the

process and reduce the cost. In addition, the possible use of the data in multiple applications (including as an input to computer simulation for policy assessment) should be kept in mind.

- ii. Attention must be paid to the quality of the data collected. This involves initially defining the data precisely and then collecting it in a consistent manner.
- iii. The level of data collection (i.e. animal, herd, region) must be determined and appropriate sampling strategies employed. The ability to subsequently combine data collected at different levels must be borne in mind during the data collection phase.
- iv. When laboratory data is used for epidemiological purposes, the analyses tend to show up any excessive variability or deficiencies in repeatability of results from laboratories which do not maintain high levels of quality control. Recent research has helped to characterise the nature of problems which can occur. With this in mind, it is suggested that diagnostic laboratories in developing countries:
 - a. reduce the range of tests carried out to those which they have adequate resources to perform very well;
 - b. place strong emphasis on total quality management systems; and
 - c. routinely validate findings against field evidence using appropriate epidemiological techniques.
- v. More consideration should be given to accurate spatial referencing of disease and production data, both in collection and reporting. In doing so, environmental characteristics of the area (geography, rainfall etc) should be the prime basis for referencing, rather than administrative boundaries.

Table 2. Relevance of specific elements within the four major components of an animal health and productivity information system to systems operating at different levels. (+ = relevant, - = not relevant)

Element	Within Herd/Group	Within Country	Inter- national
a. Data Collection			
Farm event records	+	+	-
Production data	+	+	-
Pre-harvest food safety data	+	+	+
Laboratory diagnostic data	+	+	+
Product processing data	+	+	+
Disease specific monitoring	+	+	+
Commodity flows and prices	+	+	+

Element	Within Herd/Group	Within Country	Inter- national
Zoonotic disease surveillance	-	+	+
Animal movement data	-	+	+
Wildlife health data	-	+	+
Emerging and exotic disease data	-	+	+
b. Data Management			
Processing	+	+	+
Analysis	+	+	+
Interpretation	+	+	+
Synthesis	+	+	+
c. Information Distribution			
Herd health management reports	+	-	-
Health and productivity profiles	+	+	-
Routine disease reports	-	+	-
Program management reports	-	+	-
Specific disease reports	-	+	+
International disease reports	-	+	+
d. Utilization			
Feedback to data suppliers	+	+	-
Training	+	+	-
Monitoring use of information	+	+	-

b. Data Management

The rapid development of information technologies has led to a dramatic expansion in the possibilities of transforming data into useful information. There are four major steps in this process.

- i. *Processing* involves the computer entry, transmission, validation, integration and storage of the collected data. This stage of the process converts raw data into organized, usable data.
- ii. *Analysis* involves a number of components. Summarization of the data (i.e. descriptive statistics) and conversion into more useable forms (e.g. graphic presentation) are important steps. Identification of patterns in the data (spatial and

temporal) are now possible with new technologies. Finally identification of associations within the data (i.e. analytical studies) can be carried out in more depth and with greater ease given a wide array of new technologies. This stage of the process converts organized data into analytical results.

iii. *Interpretation* involves the evaluation of the results from the data analysis in light of other knowledge (e.g. experience, expert opinion, scientific literature) and conversion of those results into useful information.

iv. *Synthesis* involves the integration of interpreted results with other information in order to evaluate implications and identify future expectations. This

may lead to a comparison of scenarios and/or strategies through the use of simulation and optimization models and other economic techniques.

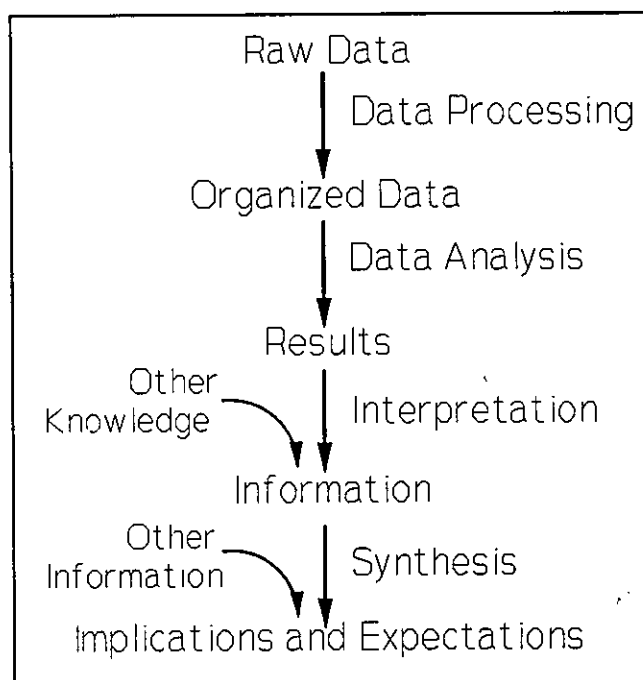


Figure 1. Stages in the data management process.

c. Information Distribution

While the data collection and management components of an information system determine the quality of the information generated, attention must be paid to where the information must go and how it should be distributed. New technologies such as electronic networks may make the distribution easier, more rapid and less expensive as well as making the information much more widely available.

Particular national and international effort should be directed towards local use of information systems by field staff in district offices, who generate most of the data used by higher levels, but frequently receive very limited benefits from participation in the system. In most countries there are substantial benefits which could be offered to field staff in the way of simple reports and aids to managing their field work. However, only a small effort has so far gone into designing reports for use at this level. Countries should focus greater effort at this level, and should exchange experience through FAO concerning both positive and negative experiences in delivering information to staff.

d. Information Utilization

Data, even if converted into useful information and presented in an efficient manner, are of no value unless used to make decisions and take action. In order to ensure their utilization, individuals receiving the data must be trained in the effective use of information in a decision-making capacity. An information system should include a component which monitors not only the delivery of information but also its use.

4. Current information management technologies and their use

Information management technology confers a comparative advantage to animal health services through improved data access, management and distribution. This merits exploitation by veterinary services in developing countries. However, it is important to select technologies which are appropriate to the situation and for which adequate support will be available. This is important when planning an information strategy in any country, but is particularly pertinent in developing countries where adequate support services may not yet be in place.

4.1 Uses and limitations of various types of information technologies

The following information technologies are being used in the field of animal health and production. Many new technologies are under development and some future requirements are identified where development of new methods is considered technically feasible. The list is illustrative rather than comprehensive, and some of the technologies listed will not be relevant to all animal health services.

a. Data collection

There are a variety of technologies used for data collection related to animal health and production.

i. Environmental characterization:

There is an increasing requirement to characterize the environments in which animals are kept, both at macro- and micro-levels of resolution. This is particularly important in predictive modelling of the distributions of diseases and their vectors, and in relating livestock productivity to environmental factors. New technologies can provide information in appropriate cases at lower cost than attempting to make equivalent measurements in the field using traditional methods, provided that validation is built into the data collection.

Examples include:

- digitization of mapped data;
- use of satellite-derived data to assess vegetation, habitat, etc;
- location determination using global positioning system (GPS) devices;
- climate characterization using data loggers.

ii. Animal and herd identification and characterization:

Identification systems for livestock have always been a major difficulty in disease control programs. Systems for creating unique herd identification codes with in-built error checking are now readily available, and substantially reduce errors during data collection and processing. Such systems are well suited for use in developing countries. Improved identification systems for individual animals (including miniaturized electronic devices for use as ear tags or subcutaneous implants) are becoming more readily available and more reliable. These supplement more traditional methods of animal identification and are more accurate. However due to cost they are not likely to find significant use in developing countries for many years.

Areas in which technologies do not currently exist, but are needed, include more precise animal age determination and genotype characterization. Precise age determination is required in the selection of young animals of specific ages (prior to the eruption of permanent incisors). Genotype characterization will in future aid the assessment of innate disease susceptibility.

iii. Sampling/gathering strategies including study design:

There are now software packages available which aid in the selection of an appropriate investigational method, determination of sample sizes to achieve different study objectives, and presentation of expected levels of precision of findings from such studies. However they require considerable skill in use and some prior evidence on which to base sample size estimates. These packages need to be enhanced to make them more appropriate for circumstances and production systems in developing countries.

iv. Diagnostic techniques:

Determination of the infection, disease, nutritional and physiological status of animals is becoming more precise through the increasing availability of diagnostic procedures such as antigen-specific ELISA tests, nucleic acid probes and polymerase chain reactions (PCRs). It is important that standardized techniques are available to validate new laboratory procedures, and that information system development take into account the potential for using such techniques to improve the accuracy of diagnostic laboratory results. In developing countries, it is often difficult to be confident that quality control is being successfully maintained on diagnostic techniques, and this can create substantial problems in the analysis of epidemiological data which relies on diagnostic test results. An important recent development has been the emergence of "molecular epidemiology". Various techniques have been developed which qualify for this label, such as the use of genetic markers in organisms to allow differentiation of otherwise identical strains of disease agents and hence evaluation of patterns of disease spread.

b. Data Management

i. Data Processing

In order to better relate information from different locations, there is a need to better characterize and classify world livestock production systems on the basis of a list of criteria such as their susceptibility to disease, their economic characteristics, their management characteristics, their products and other factors. Such a classification system would help greatly in making comparisons between production systems in different locations, but it has not proved easy to develop generally applicable but precise classification systems. Questions that remain to be answered are: 1) what data should be collected for this purpose; and 2) what are the categories for classification.

There are no specific technologies currently available to do this, but it is envisaged that geographical information systems (GISs) will contribute to this in the future. A GIS allows information of many different kinds to be entered into the computer program as "attribute data", which is stored in layers or "coverages" linked to the geographical distribution of particular features. This permits multiple attributes to be used in classifying the actual and potential geographical distribution of particular management systems, once requirements for maintaining a particular production system have been determined.

Technologies which enhance data entry into computers, in terms of speed and precision, are becoming increasingly available. These include voice recognition, digitization, bar codes and electronic scanning. Computer processing power is rapidly becoming greater and more cost-effective and is incorporating a wider variety of processing functions. Data storage devices can enhance electronic storage capacities considerably. These include tape drives, CD-ROM and removable hard disks.

New tools are coming into use for presentation of data. Word-processing packages now typically offer desk-top publishing capabilities. Graphic presentations have been facilitated through the use of spreadsheet and special graphics software programs which allow much greater scope for the appropriate and effective display and representation of data. Use of multi-media will offer even greater possibilities for the presentation of information and development of training materials for widespread use.

Data transfer between different software programs and different types of software is increasingly possible through enhanced importing and exporting capabilities of the software programs. Data transfer or sharing between computers over short and long distances is made possible through computer networks (eg. local area networks, wide area networks and telecommunication networks).

ii. Data Analysis

Data analysis techniques include descriptive methods, graphical methods and specific analytical methods (univariate and multivariate evaluation of causal relationships, time series analysis, spatial analysis, survival analysis, neural networks, etc). Graphical methods are particularly valuable because they allow the presentation of complex data in a visual form which is easily absorbed by most people. Over the last few years software for data analysis has been much improved, so that it is now easier to use and can produce powerful analyses quickly, easily and reliably. Data analysis methodologies and software implementations are now available for a far wider variety of analytical functions than was the case a few years ago, and supporting software is also available, such as programs which help choose the most appropriate form of analysis for particular types of data. Many analytical tools are incorporated into generic data management packages, particularly spreadsheet, while some more advanced methods are found in production system-specific software (eg. PigCHAMP, Monty). There is a need for appropriate analysis procedures in animal health and production evaluation software suitable for livestock systems in developing countries, because there are special difficulties which must be solved in analyzing data from smallholder livestock systems, especially in cases where the data is by its nature patchy in completeness and quality. Efforts are going on to identify the most useful techniques under such circumstances, and graphical methods, survival analysis and path analysis show particular promise.

iii. Interpretation of Results

This is an area for enhanced technical capacity in the future, to allow more precise and effective interpretation of the ever-widening range of data available to decision makers. Those currently available include knowledge-based (expert) systems which guide users in solving complex problems, graphical methods, simulation models, test interpretation software, and the development of multifactorial methods of classification for disease agents etc using comprehensive profiles of test characteristics (eg. numerical taxonomy, neural networks). Again, there is now software which makes these techniques much more accessible than they were in the past.

iv. Synthesis of Information

Data synthesis involves the integration of interpreted data, often from diverse sources, and their expression in terms and values that can be used by decision makers. Simulation models are commonly used to synthesize information from one or more sources. They range from simple spreadsheet models to disease models, production system models and models that integrate diseases and production systems. Other data synthesis technologies are risk assessment, knowledge-based (expert) systems, scenario analysis, decision analysis and classification methods.

The area of technology which most merits development and application to livestock production systems in developing countries is Integrated Decision Support Systems (IDSS). These have now progressed beyond research tools, and are increasingly finding application in animal disease control, as well as in other fields. They link a database with other components such as a geographical information system, knowledge-based systems, simulation models etc, to allow management of disease, problem solving and prediction of future effects of proposed disease control strategies, all in a tightly integrated manner so that the same core module gives access to all data and features. Current software design allows such integrated development to proceed far more easily than in the past.

c. Information Distribution

New knowledge which is not distributed to users is wasted, yet in many animal health activities inadequate resources are allocated to this phase of activity compared with gathering and analysis. Effective public information programs provide two way communication with the target audience rather than just "publicity" or "extension", and design of the dissemination and communication process needs just as much care as design of a field study.

The methods used cannot be covered here, but an effective program will use multiple strategies to reach target audiences, and will use both mass media approaches and local or more "face to face" techniques of various kinds.

Internal communication within animal health organizations and between such organizations and counterpart groups in various parts of the world is also vital, and information technology can add new opportunities to methods of communication. In recent years facsimile technology has dramatically changed patterns of communication, and facsimile devices (either stand-alone or preferably now within a computer) have become widely available. Exchange of digital information through telephone lines using modems on computers is now becoming widespread, and can speed up information transfer dramatically.

One of the most important developments in recent times in long distance information transfer has been the emergence of national and international electronic networks for distribution of electronic mail and information. These networks have now largely coalesced into a single international network called the Internet, on which a single communications protocol is followed so that computers can reliably communicate with each other. Because of the way in which the Internet operates and the more cost-effective technology used, there are currently no specific communications costs charged per message or file transfer. The Internet is available to almost all organizations in various ways, with a general acceptance that it is not to be used for commercial gain.

The Internet can be used for transmission of electronic mail, for transfer of computer files from one place to another, and as a way to find information on a wide variety of subjects through the use of searching software. The Internet can

have special value for developing countries, since it gives them immediate access to new information on the same terms as developed countries.

A promising method to disseminate analytical techniques and disease models which have been developed is through the sharing of new computer programs which are distributed either as "freeware" or "shareware". This could prevent duplication of effort and result in considerable savings in development costs. Resources could be used to modify or expand on the software development work that has already been completed, in order to adapt it to a new situation.

Differences in language and alphabet have historically been an impediment to information exchange, but computers can now handle most character-based languages as well as letter-based languages, and progress is now being made in computer-assisted translation which may facilitate language interchange in the future.

d. Utilization

The most significant constraint to the appropriate and effective use of information management technologies is their adoption into veterinary services and the use of the information outputs from such systems. This is an area where technologies themselves may not directly assist - rather, what is required is training in the operation and application of the different components of information systems, and the clear demonstration, through pilot exercises, of their comparative advantage in improving veterinary services. Investment in technology is not worthwhile unless sufficient time and financial resources are allocated to training users in the appropriate interpretation and use of the information.

5. Application of animal health information systems in developing countries

5.1 Information system components - current status and priorities

A variety of functions for information systems were identified in Section 3.1 (Table 1), of which three (improved productivity, protection from risk of disease outbreaks, improved access to export markets) were considered to be of highest priority for developing countries.

The objectives for information systems within any country will include one or more of these three core functions, plus others listed in Table 1. Each country must decide which among the full list of objectives deserve priority under their circumstances. For example, some developing countries depend heavily on export markets for their economic well-being while others do not.

For each of the stages involved in information gathering and processing and each data handling process within a stage, Table 3 shows in the first column an assessment of the priority given to each component at present in a "typical" developing country. The next three columns identify for each of the three major functions of an animal health information

system, which components should be given priority in future if progress is to be made in achieving that particular objective.

For example, if improving productivity is deemed to have top priority, then the critical elements of the information system to support this goal will be those identified in Table 3 below as high (H) or medium (M) within the 'Improving Productivity' column. Items left blank are not considered to require major emphasis for the particular category. The key activities to be undertaken in developing information systems to meet these three main functions are described in section 5.4 (Development Pathways).

It is recognized that there is considerable country to country variation, and the classification will not be appropriate for all countries.

Table 3. The current state of application, and proposed future emphasis to be given to each of the elements of animal health and productivity information systems in serving three principal functions of an animal health information system in developing countries. Cells left blank do not require emphasis for a particular element.

COMPONENTS	CURRENT STATUS	INFORMATION SYSTEM FUNCTION		
		IMPROVE PRODUCTIVITY	PROTECTION FROM RISK	EXPORT MARKETS
A. DATA COLLECTION				
FARM EVENT RECORDS	L	H		
PRODUCTION DATA	L	H		
PRE-HARVEST FOOD SAFETY DATA	L			
LABORATORY DIAGNOSTIC DATA	M	M	H	H
PRODUCT PROCESSING DATA	L	M	M	H
DISEASE SPECIFIC MONITORING	L-M		H	H
COMMODITY FLOWS AND PRICES	M-H		M-H	
ZOONOTIC DISEASE SURVEILLANCE	L-M			
ANIMAL MOVEMENT DATA	L-M		H	
WILDLIFE HEALTH DATA	L		M	
EMERGING AND EXOTIC DISEASE DATA	M		H	H
B. DATA MANAGEMENT				
PROCESSING	L	H	H	H
ANALYSIS	L	H	H	H

COMPONENTS	CURRENT STATUS	INFORMATION SYSTEM FUNCTION		
		IMPROVE PRODUCTIVITY	PROTECTION FROM RISK	EXPORT MARKETS
INTERPRETATION	L	H	H	H
SYNTHESIS	L	H	H	H
C. INFORMATION DISTRIBUTION				
HERD HEALTH MANAGEMENT REPORTS	L	H		
HEALTH AND PRODUCTIVITY PROFILES	L	H		
ROUTINE DISEASE REPORTS	M		M	
PROGRAM MANAGEMENT REPORTS	M			
SPECIFIC DISEASE REPORTS	M		H	H
INTERNATIONAL DISEASE REPORTS	H		H	H
D. UTILIZATION				
FEEDBACK TO DATA SUPPLIERS	L	H	H	
TRAINING	L	H	H	
MONITORING USE OF INFORMATION	L			

5.2 Information system methodologies

In order to achieve the objectives described earlier, it will typically be necessary to use a mixture of epidemiological and economic techniques. The uses and limitations of various specific techniques will be discussed, as a basis for outlining approaches to developing information system strategies.

5.2.1 Livestock demography and production systems

Information on the size and distribution of livestock populations is basic to planning any form of animal health program, as well as for broader planning of livestock development strategies. Methods for data collection and management in complete livestock censuses are well established in principle, and although they produce large quantities of data these are usually simple counts which do not present any special problems of analysis and presentation.

However in practice livestock census-taking presents a variety of difficulties, which must be taken into account. Firstly, it is very expensive to implement a national or regional livestock census separate from other similar activities (human population census, total agricultural census) using trained enumerators, and the information produced is in many cases far less reliable than might seem at first sight. For example, owners may provide false or

incomplete information if they fear that the data may be used for taxation purposes or as a basis for charges. Livestock census information is usually very limited with respect to production systems and production parameters. In some countries very detailed census data cannot be made available to livestock services because of confidentiality issues.

If a livestock census useful for animal health planning can be carried out in the course of normal field operations, or if livestock owners in the country are able and willing to provide accurate census returns without the need for every owner to be visited by an enumerator, reliable information can often be obtained at a low cost. However if a livestock census cannot be implemented at very low incremental cost, a carefully considered decision needs to be made as to whether the resources would be more effectively allocated to sample-based estimation of production system characteristics, productivity of animals, and possibly some health indicators, as well as population distribution. In many circumstances it is possible to make better estimates of animal populations in developing countries by a detailed assessment of a well-structured sample distributed throughout the country, than through a more superficial country-wide census.

5.2.2 Livestock movement

Livestock movements are typically very influential on disease epidemiology in developing countries, and they tend to change rapidly in nature and extent as national development takes place. However information on such movements tends to be largely anecdotal and frequently some years out of date with regard to both the nature and the extent of movements. For infectious disease control purposes, improved and more current information on this issue is very important.

Where movement of animals is successfully regulated and the controls are universally enforced, infectious disease control will be much more effective and complete data on livestock movement is in principle available. However such restrictions on movement are only likely to be enforceable with the cooperation of livestock owners and traders. This is not practical in some countries, or at best may only be accepted by part of the population of an area.

Where movement control by permit operates, records should be analyzed periodically to identify patterns and trends, both over time and by geographical area. Where this data is not available, other (possibly qualitative) information on patterns and trends of movement should be sought. Sample-based studies of livestock movements between various locations (eg statistically selected sample farms or villages) have the potential to provide detailed information on movement patterns and the population dynamics of animal movement within the country, which could be extrapolated to the whole population.

5.2.3 Passive disease reporting

Most countries have lists of notifiable diseases, and operate disease reporting systems. These systems are essential for international trade and other obligations, but the information produced is of limited epidemiological value except for diseases which cause sufficient concern among livestock owners that they report a high proportion of all cases which occur. More commonly, only a proportion of all cases are reported, and the proportion varies over

time and between areas. Moreover diagnostic methods for many diseases through a reporting system may be of low sensitivity, and in some cases also of low specificity.

Therefore disease reporting is of value for detecting exceptions to the normal pattern of disease occurrence, but often does not reflect so accurately the "typical" epidemiological situation for a disease. While countries must maintain systems for the reporting of certain notifiable diseases, greater emphasis should be placed on the development of active monitoring and surveillance systems. Lists of notifiable diseases should be reviewed and updated periodically, as they tend to remain fixed for decades while the epidemiological situation changes substantially.

International disease reporting is primarily concerned with preventing expansion of the distribution of diseases through trade, and hence gives particular emphasis to exception reporting - new disease outbreaks, epidemiological changes, etc. Such reporting must be prompt, and the information must be made readily available for use in decisions on trading matters.

5.2.4 Animal and product processing and inspection

Some diseases and residues can be detected through the inspection of slaughter stock at abattoirs, and livestock products in processing centres. This information is of much greater value where animals and products are identified and can be traced back to their farm(s) of origin. Routine collation and analysis of inspection data is of limited value, as it does not include information on the source population. However, combined with on-farm studies, inspection data may be of much more use. By linking on-farm measurements to data collected from abattoirs, a far more comprehensive assessment of the field situation can be made, and approaches of this type should be considered in any case where abattoir data is going to be collected. Abattoirs do provide a low-cost location for obtaining samples if the information can be linked back to the source of the animals. The use of traceback to herd of origin is a powerful disease control tool if it can be carried out reliably. This has been achieved in a number of countries, commonly using tags attached to the tail, ear or body of the animal which last during travel from herd to abattoir. However it relies on the continuous cooperation of almost all livestock owners, which is often difficult to achieve in many developing countries.

It is often the case that a high proportion of offtake from livestock production systems does not pass through controlled abattoirs and processing plants. Even where a high proportion of national production is inspected, there may be a distinct sector of the livestock population which is not covered, and this may be of great importance to disease control programmes. Thus any system which uses inspection data must take account of the proportion of slaughtering which is not subject to inspection.

5.2.5 Sample-based observational studies

If instead of collecting data as opportunities arise, a study design is developed using statistical sampling based on epidemiologically sound criteria, then better answers can be obtained to disease control questions - often for lower costs.

As a first step, the objective of the study needs to be defined clearly in writing on the basis of discussions among those involved in the work, since this will determine the study method used. Standard epidemiological methods of this type include cross-sectional studies (a more accurate and informative term than the over-used word “survey”), longitudinal studies, case-control studies, cohort studies and intervention studies (again better than “field experiment”). Details of each of these techniques can be found in all textbooks on epidemiology, and they will not be described further despite their crucial importance.

Sample-based studies can provide reliable information on livestock demography, movement, production, health and disease risk factors, and may be extended to cover other agricultural enterprises and social factors. The analytical techniques available for structured studies of this kind are much more powerful and also more robust to statistical difficulties than those available for poorly structured data collection activities. Where statistical sampling techniques are used, the results derived from a relatively small but correctly selected sample can be considered genuinely representative of the total population from which the sample was drawn. It is nearly always necessary to stratify the livestock population on the basis of production system and geographical area (and in some cases on one or two other factors as well) before selecting the structured sample from within each of the sampling strata. Depending on the particular circumstances, cluster sampling may provide a cost-effective starting point for the sampling process, provided that its dangers are recognized in advance.

Despite their cost-effectiveness, sample-based studies have been under-used in the past. This may be attributed to lack of trust in sample-based information on the part of some decision-makers, a lack of guidelines and other background materials for the design of such studies, and the need for staff to be trained in the methodologies. The potential problem of livestock owners not agreeing to provide information has been over-emphasised. Experience has nearly always shown that a very high response rate, provided that the staff are well trained to deal with livestock owners and the study has been well designed and carried out.

Sample-based studies may involve a single visit to each sample unit or repeated visits. Programs based upon repeated visits may have to be based on a more restricted subset of the whole population because some livestock owners may not be accessible at all times, and because others will withdraw from the study for one reason or another. Therefore, single-visit studies are likely to produce results more representative of the whole population, but repeated visits produce more reliable information on the dynamics of production and health. Studies based on repeated visits are also more likely to cause livestock owners in the sample to make management changes as a result of contact with the investigators, which may directly or indirectly affect the variables of interest.

5.2.6 Continuous data collection

Monitoring and surveillance require continuous data collection, rather than special studies. Monitoring is defined as observation where no automatic action based on positive findings is envisaged. In disease surveillance, a control action based on positive findings is implied.

Surveillance is generally focused on disease, and limited to a few diseases perceived to represent a potential threat of dissemination through the population, rather than of present widespread economic importance. Disease surveillance has traditionally been unstructured

with respect to the host population, but there is a trend towards sample-frame selection. International trade requirements on disease status are progressively moving from disease reporting systems to clinical and serological (or similar) surveillance based on statistical samples.

Monitoring is normally related to the production system. Production and environmental variables, as well as disease factors, are usually observed in order to allow evaluation of determinants or effects of disease. Commercial producers in various circumstances operate their own production and health monitoring systems if they perceive that this will provide an economic benefit, but the data may not necessarily be available to other users. In other countries or production systems, monitoring may be carried out during visits by extension workers or other field staff. In this case, it is usually important to provide some feed-back of information of interest to the owners, so that they have an incentive to cooperate. This is an important facet of any such investigational approach.

5.2.7 Management of veterinary services and resources

Information is required for the management of veterinary services, and this is often a priority for senior staff whose main preoccupation may be with administrative matters. Systems are required for the management of drug, vaccine and other supplies, and for monitoring of vehicle usage, staff time and finance. These systems may be very difficult to establish and maintain as their operation requires a high level of commitment among staff of all levels. Systems providing feedback of information which assists staff in their work are more likely to be successful than those which solely increase workload.

The management of information in diagnostic laboratories presents particular problems, as some information is received with sample submissions, and additional information may be generated by various sections of the laboratory at different times. The complete information has to be assessed, and the results returned to the submitter of the material as quickly as possible.

5.2.8 Evaluation of Options and Prediction of Future Outcomes

A rapidly growing area of activity is the evaluation of alternatives before important decisions are made. These may range from economic evaluation of options for carrying out disease control programs, to analyses of the risk of introducing a disease with a particular import policy on a product.

The techniques used have grown greatly in sophistication in recent years, both in the basic techniques and in their capacity to cope with expected variation in assumptions (riskiness). Analysis using electronic spreadsheet (often with in-built consideration of risk issues), simulation and optimisation models, risk analyses and many other techniques as described in part 4 of this report, all have a place.

Some of the same techniques are used to make predictions of likely future trends in disease occurrence or productivity based on historical results, which is an important requirement for decision-making.

Knowledge-based systems are increasingly finding a place in providing reliable and prompt evaluation of information, where the same choices are faced repeatedly and consistent and logical decisions must be made. In the long term (10-15 years) developing countries are likely to find such systems very valuable in overcoming shortages of skilled manpower. In the meantime, it is recommended that countries should seek to take advantage of such technologies in very specific cases where the technology would offer a major benefit in animal health programs.

In general, whereas analytical techniques have reached the point in their development where software can be used by most people with some training in this area, the same is not true of evaluation and prediction procedures, especially for application in developing countries. This is an important area for development in coming years.

5.3 Constraints to the development of effective information systems

It is essential that the major constraints to the development of effective information systems be identified in order that appropriate mechanisms for overcoming the problems can be identified. There are three general areas in which constraints exist: infrastructure and organization; human resource skills, and the information systems themselves. This section describes the major constraints in each of these areas and identifies mechanisms to deal with them. The following section will identify additional constraints specific to the high priority functional areas of information systems.

5.3.1 Infrastructure and organization constraints

A fundamental constraint to the development of effective information systems in some countries is a lack of commitment amongst senior policy decision makers to epidemiologically sound approaches to information system design. Allocation of resources to the task becomes difficult without this commitment. One problem related to resource allocation in many developing country institutions is the high proportion of budgets assigned for salaries and wages after lengthy periods of progressive reduction in funding, with very little left to cover operating expenses. This largely precludes undertaking structured studies and may even interfere with the appropriate management of routinely collected data. Inability to undertake useful work due to inadequate high-level support or operating resources may lead skilled staff to seek more satisfying opportunities elsewhere.

Within the public sector, an additional constraint may be the lack of incentive to ensure that appropriate decisions are made and resultant action is taken. All too commonly, there are also no adverse repercussions on individuals who fail to fulfil their responsibilities to obtain information, evaluate that information, and take action. As long as individuals can get away with making decisions based on inadequate information, there is little incentive to ensure that the appropriate information is sought. Regrettably, in many situations it is not possible to adequately reward individuals who do make a serious effort to ensure that the appropriate information is used in the decision making process.

Thus the development of improved information systems must include the development of procedures which motivate participants to produce and use sound information, and detect and discourage those who fail to meet this basic obligation.

In order for information systems to be truly effective, a cohesive working arrangement must exist among the contributing groups - between veterinarians (private and public) and producers, within the veterinary service, between the service and other veterinary groups, and between veterinarians and people in other relevant disciplines. A lack of cohesion may negatively affect data quality, result in the duplication of data collection efforts, result in an inability to integrate information from a variety of sources and ultimately reduce decision making capabilities.

A final limitation in this area may result from legislation which requires the expenditure of considerable resources on outdated and ineffective information systems. All too often there are requirements that certain forms be completed and filed, despite the fact that the collected data are never used.

For exporting countries, methods to set standards for veterinary services and objectively evaluate them against such standards and other factors which influence access to international trade must be developed and refined. This is one of the steps which must be taken before risk assessment techniques can be used most effectively.

5.3.2 Possible solutions to infrastructure and organization constraints

Generating a serious commitment to animal health and production information systems among senior administrators will require the successful development of systems designed to meet specific key objectives. For countries that depend on exporting livestock products, the incentive to develop such systems may come from international requirements to develop surveillance based information systems. For other countries, the systems will have to focus on areas of national priority.

Privatization or introduction of cost-recovery mechanisms may introduce greater incentives to generate and use appropriate information in decision making processes. In addition, this will generate additional revenues to help cover the operating expenses of the information system. Budget constraints will almost certainly require organizations to reduce the number of staff over time while evolving needs will require the modification of job descriptions and the upgrading of the skills of those who remain.

5.3.3 Human resource skill constraints

There are a number of specific areas in which individuals in developing countries may not yet possess sufficient expertise. The following areas deserve special consideration. First, there may be a general problem with the orientation of the animal health services towards dealing with specific diseases instead of looking at production systems and constraints affecting those systems. Second, decision makers may not recognize the need, or have the ability, to specify with sufficient precision the objectives of the information system. Third, the use of structured investigations as part of an information system is a relatively new technique and individuals involved in the system may not have expertise in the design and conduct of such studies. Fourth, the same lack of expertise often applies to the data processing and analysis components of the information system. Fifth, skills in the area of interpreting the information generated and synthesizing final conclusions through the

evaluation of various scenarios may be very limited. Finally, individuals in developing countries may lack experience in the management of information system.

5.3.4 Possible solutions to human resource skill constraints

The only way to overcome the problem of lack of skilled personnel and appropriate expertise is to provide educational and training opportunities to individuals who can contribute to the information system. These opportunities should be made available in a number of formats and at various levels. In order to do this effectively, the following items need to be considered.

1. High level training (PhD or equivalent) in veterinary epidemiology and economics should be provided to a small number of select individuals who will guide the development of information systems and provide additional training and support within the developing country or region. Unlike many of the basic sciences, the technology to use advanced epidemiologic and economic techniques does exist in many developing countries. In many cases, this consists of little more than a microcomputer and appropriate software which are now available at relatively low cost. Consequently, the advantages of high level training can be effectively used by the developing country.
2. Training in data management methods to the MSc (or equivalent) level should be provided to a small group of support personnel.
3. A number of veterinarians who will ultimately manage the field components (i.e. data collection and information distribution) should receive training in epidemiology and economics at the MSc (or equivalent) level.
4. A variety of short courses in selected aspects of epidemiology and economics should be provided to field and laboratory personnel. Field personnel will primarily require training in data collection and processing methods while diagnostic laboratory personnel will require an understanding in test result interpretation. It should be possible to have this training provided by individuals trained at a higher level.
5. In order to meet these educational requirements, opportunities for post-graduate training in epidemiology and economics must be expanded, offered in a variety of formats (e.g. varying duration, level and location) and made more accessible to individuals from developing countries. Research projects carried out in these programs should deal with issues of relevance to developing countries.
6. Veterinary curricula should place greater emphasis on the disciplines relevant to structured studies (e.g. epidemiology, statistics, economics).

5.3.5 Information system constraints

Many information systems do not present results in a manner that make it possible for users without extensive skills and experience to get the maximum benefit from the information

available. Systems built in developed countries may not be appropriate for the production systems used in developing countries. Systems have often been developed without adequate attention to the methods of analysis of the data and presentation of the results. In many cases, the system is not even available in the common language of the developing country. Finally, systems often lack the ability to effectively exchange data with, or be integrated with other computer programs.

5.3.6 Possible solutions to information system constraints

Information system constraints can be overcome by the selective application of new computer software techniques and the continued development of new programs within the developed world. However, making these applicable to developing countries will require a mechanism for the translation and modification of these programs.

The primary need for developing countries is the adaptation of existing tools and techniques to make them accessible and easy to use. One important component of this is the translation of systems into a variety of languages which will only be feasible if software is developed in a language-independent form.

While it is recognized that the development of new techniques is not the primary requirement for developing countries research in the areas of risk assessment methods, forecasting techniques and decision support systems will help in the implementation of information systems. The area in the earliest stage of development and requiring the most effort is the development of easily used risk assessment methods and their adaptation to developing countries. It is also recognized that research is required into the application of new global information technologies, such as satellite-derived data, to the improved predictive modelling of the distribution and dynamics of livestock, production systems, diseases and their vectors.

5.4 Development pathways

When identifying the appropriate pathways to follow in the development of information systems, there are a number of basic principles to be considered. The specific objectives for the system must be defined with considerable precision and the decision-making process which will use the generated information should be identified before development starts. In general, systems should be kept as 'low-tech' as possible but specific advanced technologies may be required to overcome specific obstacles. The end user of the system should be integrated into the development process as early as possible and the process of providing education in information use and decision making techniques should be carried out in parallel with the system development.

If the system is in the public sector, the development of complementary skills in the private sector which will contribute to the success of the system should be encouraged and supported, as should the involvement of related disciplines outside the veterinary service. Finally, once developed, systems should be continuously upgraded and maintained.

Three major functions of information systems of potentially high priority to developing countries were identified in Section 3.1. Authorities in each country can determine the balance of emphasis between improving productivity, protection from risk, and securing access to export markets, based on their relative importance within that country. Policy

formulation should be linked directly to information management, and should also be varied in emphasis to reflect country priorities.

There is an identified need for better use and application of information systems and technologies in supporting the formulation of animal health and disease control policies at all levels (farm, national and donor levels), using valid data-sets collected using the methods described, which have been analyzed and presented in an appropriate and useful form. It is also necessary to have clear identification of decision-making authority in order for the policies to be implemented successfully.

Decision support systems (DSS) are required to help establish development, research and training priorities and policies. However, limited access to methods for development of DSSs and the skills to use them effectively may be constraining factors. If DSS are to be effective, it is important that the eventual users contribute to their development.

Effective communication within and beyond the veterinary service will be necessary to gather information from different sources which may be relevant to policy formulation. It will be necessary to balance and measure conflicting objectives (eg. producer versus consumer, importer versus producer, different ministries) in formulating policy.

The following section indicates which actions are necessary to strengthen each of the major functions of animal health information systems and lists these actions in order of priority. General constraints to improving animal health information systems were discussed in the previous section. Constraints which are specific to an action are included under that action.

a. Improving Productivity

i. Increased producer involvement

There will be a requirement to increasingly involve farmers and producers in animal health information systems, and they will likely play an increasing role in driving the requirements for and development of such systems. In order to encourage their participation it will be necessary to sensitize them to the potential benefits of their involvement such as increased profit and additional veterinary services.

ii. Orienting disease reporting to livestock production systems.

The lack of definitions for production systems and the need to change the orientation/culture in veterinary services concerning disease reporting systems are constraints particular to this development. There is also a need for long-term data collection to produce accurate figures of production parameters and for greater farmer/producer involvement in the reporting system. Finally, enhanced skills are necessary to identify disease in a livestock production system context.

iii. Increased use of structured sample-based studies.

- iv. The need to record a wider range of parameters.

A more effective understanding of the relationship between disease and productivity effects will require the recording of a wider range of parameters. This will require an understanding of the producer of the additional benefits to be gained through the use of this data to monitor production performance.

- v. Emphasis on active monitoring and surveillance

In general, a change of emphasis from passive disease surveillance to active disease surveillance and monitoring in target production systems should occur. It will be necessary to improve and evaluate diagnostic precision to support this activity.

- vi. Prediction Capacity

It is perceived that with the improvement in disease and other information systems, and the reduction in centralized government veterinary services there will be an increasing need and capacity for prediction of livestock population size, distribution, disease distribution, dynamics and productivity effects. The availability of appropriate methods and skills in their use could be constraining factors.

b. Protection from Risk and c. Export Markets

Below are outlined measures which will enhance capacity to protect countries from the risk of diseases, both indigenous and imported, and to support livestock export markets. It is important to note that the diseases of interest will differ to varying extent between items b and c, between countries and over time.

- i. Efficient national & international communications systems

The technologies required for these are available in most developed countries, but their application in developing countries is constrained by lack of appropriate infrastructure and support systems, and in some cases by the lack of knowledge of the benefits and cost-savings which some of these technologies can impart.

- ii. Development of Risk Analysis Capacity

As a result of decisions made in the Uruguay Round of GATT, sanitary barriers will now be the only legitimate remaining non-tariff trade barrier. Risk analysis is being promoted as a transparent and science-based method for making import decisions. With the adoption of risk analysis techniques national authorities will increasingly be asked to provide data to verify the disease status of their country. This data can be obtained most effectively and efficiently through active and structured sample-based studies.

a. Risk analysis

There is a need for training in risk analysis methodologies and for further development of techniques for quantitative risk assessments.

b. Risk management

Disease/species/commodity guidelines and legislation must be available at the national level to provide a rational and legal basis for decision-making to protect national agriculture. It is also necessary to have the operational and resource capacity for response in case of a disease outbreak.

iii. Emphasis on active monitoring/surveillance

iv. Structured sample-based studies

5.5 Organizational Arrangements

A number of countries (e.g. U.S.A., Great Britain) have chosen to establish epidemiology units concerned with *strategic* issues in locations away from the headquarters of the government animal health service while staff concerned with *tactical short-term* epidemiological issues are usually located in veterinary headquarters. The strategic investigational group may be located in a government institution or a university. This arrangement has proven to be successful in keeping a dedicated cadre of people together and focused on the longer term tasks required to develop a national animal health information system. This separation of functions is considered to have considerable merit.

6. Conclusions

It is recognized that many countries currently collect much data which is not adequately analyzed and used in the decision making process. In many situations the data are not sufficiently complete or valid or in a form suitable for analysis to allow their effective use. Consequently, it is concluded that countries should only collect data which they have the capability to analyze and effectively use. This may require a reduction in the total amount of data collected in order to reallocate resources from routine data collection into analysis and interpretation.

It is also essential that the decision making process and the information required for that process be clearly defined in order to ensure that the appropriate data are collected and relevant analyses conducted. This requires that more specific objectives be set for the animal health and production information system

Information systems technology has advanced greatly in recent years, but the problem of adapting the technology to meet the specific needs of developing countries for animal health and production support and then ensuring that the information generated is effectively used remains. This report sets out a strategy for achieving this, and seeks to balance the benefits of adopting new approaches against the need to maintain a practical and realistic approach,

in order to develop animal health information systems which meet the real needs of the developing countries of the world.

7. Recommendations

7.1 On Information Technologies

The following recommendations are made on matters covered in part 4 of the report:

To FAO

- * Since developing countries have in the past been disadvantaged by poor access to information services, FAO should develop information systems strategy planning guidelines which would advise countries how to plan and implement cost-effective information systems within the country.

The components to be covered under such an information systems planning process would include:

- (i) Low cost methods of enhancing flow of information into the country which could assist the veterinary services;
- (ii) Cost-effective two-way movement of information between headquarters and the field infrastructure, including the private as well as the public sector where appropriate;
- (iii) Improved methods of achieving two way flow of action-directed information between veterinary services and animal owners, which would ensure that animal owners were kept up to date with information they need, while the veterinary service was made more frequently aware of the priorities and perspectives of the animal owning population;
- (iv) Public communications mechanisms for information which needs to reach the widest possible audience.

This information systems planning strategy should guide countries on how to achieve a balance between adopting the use of newer information technologies (which offer much more efficient ways of transmitting information and hence overcome historical limitations of existing information flow mechanisms), and the danger that the technology itself will be given greater emphasis than the messages it is designed to transmit. While achieving this balance is a challenge and there is no perfect solution, developing countries do have an opportunity to gain the benefit of recent world experience (both good and bad), and develop effective information infrastructure at remarkably low cost in historic terms, given the reductions which have occurred in recent years in the cost of information equipment and services.

- * FAO should give consideration to the desirability and feasibility of providing a service whereby countries could make their import requirements available to other countries through an electronic exchange system, possibly through a common system with plant protection services.

- * In view of the central role of FAO in the dissemination of information on world agriculture, it should become an Internet node with full Internet services, and should use this capacity to help countries gain maximum benefit from the available services. To help achieve this goal, FAO should prepare and distribute to veterinary services information about the value of Internet services and a brief outline of the mechanism of establishing an Internet connection within a country.

To Countries

- * Countries which have appropriate expertise should initiate the formation of a veterinary epidemiology and informatics discussion forum on the Internet which could help countries become familiar with the technology and gain assistance with problems, and provide a technical forum for discussion of issues covered in this report, as well as wider matters in veterinary epidemiology. It may be appropriate to establish a link between such a group and the International Society for Veterinary Epidemiology and Economics, and countries or individuals may wish to take appropriate steps to achieve this.
- * Countries which have not yet developed information systems should consider beginning the process through the use of programs such as Epi-Info and EpiMap, which are distributed free of charge by WHO and the Communicable Disease Centers in the USA. These two programs have been developed specifically for surveillance and epidemiological investigations, and new enhanced versions of the software are regularly being released. They should satisfy the requirements of many countries for surveillance software and allow rapid establishment of useful systems.

7.2 On the Use of Specific Methods

To FAO

- * FAO should play a major role in supporting the epidemiological approach to exotic disease prevention and control preparedness.

In the area of facilitating international trade, the FAO and the Office International des Epizooties (OIE) could assist developing countries by developing a system for the rapid and inexpensive distribution of information about animal diseases. It is therefore recommended:

- * That one international disease reporting system based on HandiSTATUS and operated by the OIE in consultation with FAO (and WHO where appropriate) be created. This will allow FAO to phase out the publication of the Animal Health Yearbook.
- * That FAO, in collaboration with OIE (and WHO where appropriate) should take special responsibility for the training required for the operation of this international system and the development of national surveillance systems which will supply the necessary data. When appropriate techniques for risk analysis of imports and exports are available, the FAO should assist in the dissemination of these techniques as well.

To Countries

- * If census (i.e. complete population) based information cannot be gathered at very low incremental cost, resources should be used for sample based estimation of health and production parameters.
- * Unstructured collection of routinely available data have often not met animal health and production information needs so it is recommended that much greater use be made of specific structured investigations. New techniques such as computer simulations may be used to better identify factors to be included in such investigations.
- * There is a need to raise the confidence of administrators in the results of structured, sample-based investigations by improving their familiarity and appreciation of these techniques through education, proper application of the techniques and demonstration of their benefits.
- * A variety of new analytical techniques are available for use in information systems. Methods to identify risk factors for diseases are well established and need wider application. Techniques to process and analyze spatial data (e.g. disease location data) are emerging and offer great potential for use in animal health and production information systems. New procedures are also available for the analysis of long term temporal pattern (e.g. distribution over extended time periods). However, the length of time required to obtain the necessary data and the variability of the data over time make extensive use of these techniques less appropriate.
- * Longitudinal study designs (i.e. following a sample of the population over some period of time) should be used more widely to investigate animal health and productivity. While it is recognized that the study may induce changes in the population during the study period, the advantages in terms of information generated by such studies usually outweigh this disadvantage.
- * Newer approaches such as knowledge-based systems and (economic) simulation modelling techniques should be adapted for use in the decision support process in developing countries, since current ways of carrying out these techniques tend to require considerable expertise for their use.
- * The input from a wide variety of specialists (e.g. epidemiologists, economists, production system specialists) should be considered in the design and conduct of structured investigations.
- * Routine monitoring systems should be based on the premise that they monitor a production system instead of monitoring only for specific diseases .

7.3 Concerning Removal of Current Constraints to Progress

To FAO

- * That FAO play a central role in identifying collaborating centres in epidemiology and economics and assist countries in structuring their training programs.

7.4 Concerning Development Pathways

To FAO

- * That the FAO should be active in carrying out feasibility studies and pilot projects in animal health and production information systems in various regions of the world.

7.5 Concerning Organizational Structure

To FAO

- * Manuals and guides that cover all aspects of developing, implementing and using an animal health information system should be developed by the FAO and made available to developing countries.
- * FAO should investigate methods of ensuring that information systems are compatible with increasing privatization of veterinary services.

To Countries

- * That countries create a group within the veterinary service specifically responsible for development of policy and strategy using epidemiological methods and information systems techniques
- * That countries give careful consideration to the location of such a group bearing in mind specific national factors, but that efforts be made to avoid such groups being diverted to urgent tasks and therefore being unable to complete important strategic tasks.
- * Regardless of location of the unit, adequate resources to support all aspects of the data management and analysis component of the information system should be provided to allow data collection to produce useful information.
- * Countries which lack the resources to initiate the development of an animal health and production information system should seek support from the FAO for such endeavour.

AGENDA

Monday, 22 November 1993

Opening and Introduction

08:30 Registration

09:30 Opening address - Dr Hartwig de Haen, FAO

09:45 Introductory statement - Dr A.W. Qureshi, FAO

10:00 Coffee break

10:15 Introduction of participants
Election of Chairperson and vice-Chairperson
Nomination of Rapporteur and Recorder
Adoption of the Agenda and Timetable

Topic one Current approaches in information systems and decision support systems

10:45 Presentation of Topic Paper: Dr Roger S. Morris

11:15 Discussion by the Experts

11:35 Presentation of Topic Paper: Dr Aalt Dijhuizen

12:05 Discussion by the Experts

12:25 Lunch break

14:00 Presentation of Topic Paper: Dr Will Hueston (Dr R. Morris)

14:15 Small group discussion (two groups)

- Why do countries need information systems?

14:45 Plenary discussion

15:00 Coffee break

15:20 Small group discussion (two groups)

- What components within information systems do developed and developing countries need?

16:15 Plenary discussion

16:45 Conclusion and recommendation

17:30 End of Session

Tuesday, 23 November 1993

Topic two Information management technology - an appraisal of the systems available and their uses in developing countries

08:30 Presentation of Topic Paper: Dr Theresa Bernardo

09:00 Discussion and value assessment by the Experts

09:20 Presentation of Topic Paper: Dr Brian D. Perry

09:50 Discussion and value assessment by the Experts

10:10 Coffee break

10:30 Selection of issues to be discussed in small groups

10:45 Small group rotational discussion to identify uses and limitations of various types of information technology

12:30 Lunch break

14:00 Plenary discussion and formulation of recommendations

15:00 Coffee break

15:20 Plenary discussion and formulation of recommendations (contd.) and demonstration by Experts of information technology

17:00 End of Session

17:30 Wine and cheese tasting

Wednesday, 24 November 1993

Topic three Applications of animal health information systems in developing countries

08:30 Presentation of Topic Paper: Dr Vicente Astudillo

09:00 Discussion by the Experts

09:20 Presentation of Topic Paper: Dr Tri Satya (Tata) Hutabarat

09:50 Discussion by the Experts

10:10 Coffee break

10:30 Issues to be discussed in small groups

- What is currently happening? (two groups)
- What is not happening but should be? (two groups)

12:30 Lunch break

14:00 Plenary discussion and formulation of recommendations

15:00 Coffee break

15:20 Plenary discussion and formulation of recommendations (contd.)

17:00 End of Session

Thursday, 25 November 1993

Topic four Information management needs of animal health services in developing countries.

08:30 Presentation of Topic Paper: Dr Tito Livio Machado Jr

09:00 Discussion and constraints identification by the Experts

Topic five Practical issues in Applying Information Systems

09:20 Presentation of Topic Paper: Dr Ian Dohoo

09:50 Discussion and constraints identification by the Experts

10:10 Coffee break

10:30 Presentation of Topic Paper: Dr Andrew James

11:00 Discussion and constraints identification by the Experts

11:20 Selection of constraints to be discussed in small groups

11:45 Small group rotational discussion to find solutions to constraints

12:30 Lunch break

14:00 Small group discussion (two groups)

- What development pathway should countries follow with information systems?

15:00 Coffee break

15:20 Plenary discussion and formulation of recommendations

17:00 End of Session

Friday, 26 November 1993

08:30 Drafting report

09:50 Coffee break

10.00 Initial review of recommendations

12:30 Lunch break

14:00 Review and final formulation of recommendations with coffee break at 15:00 hrs
Summary: Chairperson

16:45 Closing remarks: Dr. Yves Cheneau, Chief, AGAH

17:00 End of the Consultation

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