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# COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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### INTERGOVERNMENTAL TECHNICAL WORKING GROUP ON ANIMAL GENETIC RESOURCES FOR FOOD AND AGRICULTURE

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### DRAFT GUIDELINES FOR THE DEVELOPMENT OF INTEGRATED MULTIPURPOSE ANIMAL RECORDING SYSTEMS

The guidelines, after review by the Working Group and upon adoption by the Commission on Genetic Resources for Food and Agriculture, will be finalized and published as FAO Animal Production and Health guidelines. Therefore the formatting of the document already adheres to the format of FAO Animal Production and Health guidelines.

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DEVELOPMENT OF  
INTEGRATED MULTIPURPOSE  
ANIMAL RECORDING SYSTEMS

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## ACRONYMS

AHI	Animal health information
AI	Artificial insemination
APHIS	Animal Plant Health and Inspection Service ( <i>United States of America</i> )
AR	Animal recording
ASF	African Swine Fever
AT	Animal traceability
BSE	Bovine spongiform encephalopathy
BTS	Beef Traceability System ( <i>South Korea</i> )
CBPP	Contagious bovine pleuropneumonia
CTS	Cattle Tracing System ( <i>United Kingdom</i> )
DADF	Department of Animal Husbandry, Dairying and Fisheries ( <i>India</i> )
DEFRA	Department for Environment, Food and Rural Affairs ( <i>United Kingdom</i> )
DICOSE	Livestock Control Office ( <i>Argentina</i> )
EID	Electronic identification
ELISA	Enzyme-linked immunosorbent assay
EMPRES-i	The EMPRES Global Animal Disease Information System
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FMD	Foot-and-mouth disease
GDP	Gross domestic product
GIS	Geographical information system
GLiPHA	Global Livestock Production and Health Atlas
GPRS	General packet radio service
I&R	Identification and registration
ICAR	International Committee for Animal Recording
ID	Identification
INAPH	Information for Animal Productivity and Health
ISO	International Organization for Standardization
IT	Information technology
LIMS	Laboratory information management system
LITS	Livestock Identification and Traceability System ( <i>Botswana</i> )
MAPA	Ministry of Agriculture, Livestock and Supply ( <i>Brazil</i> )

MAPA	Ministry of Agriculture, Fisheries and Food (Argentina)
MISACO	Ministry of Health (Argentina)
MUN	Milk urea nitrogen
NAIS	National Animal Identification System ( <i>United States of America</i> )
NDDB	National Dairy Development Board ( <i>India</i> )
NLIS	National Livestock Identification System ( <i>Australia</i> )
NTB	Non-tariff barriers
OIE	World Organisation for Animal Health
OS	Operating system
PDA	Personal data assistant
PPR	Peste des petits ruminants
PR	Performance recording
RFID	Radio frequency identification device
RVF	Rift valley fever
SCC	Somatic cell count
SENASA	National Health and Agroalimentary Quality Service ( <i>Argentina</i> )
SGS	Animal Health Information System ( <i>Argentina</i> )
SIRA	Animal Identification and Registration System ( <i>Uruguay</i> )
SNA	Social network analysis
SOAP	Simple object access protocol
SOP	Standard operating procedure
SPS Agreement	Agreement on Sanitary and Phytosanitary Measures
SRS	Software requirement specifications
TBT Agreement	Agreement on Technical Barriers to Trade
UI	User interface
URS	User requirement specifications
USDA	United States Department of Agriculture ( <i>United States of America</i> )
UTM	Universal transverse mercator
VPN	Virtual private network
WAHIS	World Animal Health Information System
WTO	World Trade Organization

# Foreword

Animal identification and recording systems were historically developed by breed associations to maintain pedigree details of animals, by breeding organizations to implement genetic improvement programmes, for which performance recording is a prerequisite, by livestock improvement organizations to assist farmers in the management of their herds, and by veterinary health institutions and organizations to distinguish the health or vaccination status of herds or individuals animals. These programmes, however, were limited to participating farmers or to specific areas and did not always operate nationwide.

Past food and health scares, such as those caused by bovine spongiform encephalopathy (BSE), avian influenza and several chemical contaminations (dioxin, melamine, etc.), resulted in enormous losses and increased concerns about veterinary public health and food safety and quality. The need to trace animals and animal products has led many high-income countries to put in place nationwide animal identification and recording systems for complete traceability. Animal diseases have the potential to significantly affect international trade. For this reason, animal identification and traceability systems are becoming a requirement for access to specific regional or international markets. As a result, many countries worldwide, including countries with emerging economies, have put such systems in place. As a consequence, animal identification and recording for traceability are addressed by various international agreements and standards, including the World Trade Organization Agreements on the Application of Sanitary and Phytosanitary Measures and on Technical Barriers to Trade,<sup>1</sup> the OIE Terrestrial Animal Health Code,<sup>2</sup> and the Codex Alimentarius under the Joint FAO/WHO Food Standards Programme.<sup>3</sup> In addition, animal identification and recording systems are used in some countries to deter stock theft or facilitate subsidy payment and insurance schemes.

In 1998, FAO developed and published the *Secondary guidelines for development of national farm animal genetic resources management plans – animal recording for medium input production environment*.<sup>4</sup> These guidelines focus on performance recording schemes. However, as described above, several production and trade-related changes have occurred since the publication of these guidelines, particularly a surge in the importance of animal health and traceability, which in recent times have become the main drivers of animal identification and registration. It has been necessary to broaden the scope of animal recording and adopt a multipurpose approach that integrates animal identification and registration, live animal traceability, animal health information and performance recording. FAO, through its Technical Cooperation Programme, has supported several member countries in the development of animal identification and recording systems that are compliant with international standards, and continues to do so. These projects highlight the need to adopt a multipurpose approach.

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<sup>1</sup> See [http://www.wto.org/english/tratop\\_e/sps\\_e/spsagr\\_e.htm](http://www.wto.org/english/tratop_e/sps_e/spsagr_e.htm); and [http://www.wto.org/english/docs\\_e/legal\\_e/17-tbt\\_e.htm](http://www.wto.org/english/docs_e/legal_e/17-tbt_e.htm), respectively.

<sup>2</sup> See <http://www.oie.int/international-standard-setting/terrestrial-code/access-online/>

<sup>3</sup> See <http://www.codexalimentarius.org>

<sup>4</sup> See <http://www.fao.org/ag/againfo/programmes/en/lead/toolbox/indust/anim-rec.pdf>

The guidelines for development of integrated multipurpose animal recording system have been prepared with the objective of helping countries to design and implement such systems and to maximize the chances that they will be sustained. These guidelines aim to put performance recording in a more general context, and hence to complement rather than replace the previous FAO guidelines.

The Interlaken Conference<sup>5</sup> called on FAO to continue developing technical guidelines and technical assistance and to continue coordinating training programmes as a means of supporting countries in their efforts to implement the Global Plan of Action for Animal Genetic Resources. At its Fourteenth Regular Session, the Commission on Genetic Resources for Food and Agriculture requested FAO to continue developing technical guidelines on the development of integrated multipurpose animal recording systems.

Thirteen experts from ten countries, and colleagues from several FAO units at headquarters and in the decentralized offices, contributed to the preparation of the guidelines.

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<sup>5</sup> The International Technical Conference on Animal Genetic Resources for Food and Agriculture, held 3–7 September 2007, Interlaken, Switzerland  
(<http://www.fao.org/ag/againfo/programmes/en/genetics/angrvent2007.html>).

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The preparation of the guidelines began with an expert meeting held in October 2011 to discuss the draft outlines, which were developed in collaboration with the ICAR Developing Countries Working Group <sup>6</sup>. A second expert meeting was held in June 2013 to review the draft guidelines. A second version of the latter was subsequently discussed and revised in a third expert meeting held in June 2014. In total, 13 experts from 10 countries contributed to the preparation of the guidelines. Kamlesh Trivedi, Cuthbert Banga, Ole Klejs Hansen, Thomas Armbruster, Paolo Calistri, Gabriel Osorio, Daniel Trocmé and Graham Hamley have written and reviewed several sections of the guidelines. Hans Jürgen Schild, Erik Rehben, Mohammed Bahari, Japie van der Westhuizen and Omrane ben Jamaa have contributed in the discussions of the outlines of the guidelines and/or the review of the document. The document was extensively edited by Graham Hamley, Kamlesh Trivedi and Badi Besbes.

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<sup>6</sup> See [http://www.icar.org/pages/working\\_groups/wg\\_Developing\\_Countries.htm](http://www.icar.org/pages/working_groups/wg_Developing_Countries.htm)

## Preparation of the guidelines

FAO developed and published the guidelines on animal recording for medium-input production environments in 1998. The need to update these guidelines emerged during the preparation of the *Breeding Strategies for Sustainable Management of Animal Genetic Resources* (FAO, 2010). This has since been reiterated during several workshops and e-conferences organized by FAO and its partners to strengthen the national capacity of member countries on the management of animal genetic resources in general and animal identification and recording in particular.

Due to a number of food and health scares in the early 1990s (e.g. BSE, avian influenza and several chemical contaminations), animal traceability has become a major driver of the development of animal recording systems. Consequently, FAO receives an increasing number of requests from member countries for technical support to implement such systems. These projects also demonstrate the need for comprehensive, practical and straightforward guidelines on how to set up and implement a multipurpose animal recording system.

As it is described in Section I, such guidelines did not exist. FAO has therefore developed these guidelines to support decision-making and to address all the phases of the establishment of such a system, from the design phase to the field implementation, passing through the development of the legal framework and the cost-benefit analysis.

These guidelines focus primarily upon the process rather than the methods and the technology (e.g. details of the equipment and measurements), since the latter is sufficiently covered by other guidelines. Where necessary, efforts have been taken to adapt these guidelines to suit low or medium input production environments.

The preparation of the guidelines began with an expert meeting held in October 2011 to discuss the draft outlines. A second expert meeting was held in June 2013 to review the draft guidelines. A second version of the latter was subsequently discussed and revised in a third expert meeting held in June 2014.

Four workshops, held in Botswana, Tunisia, Chile and Morocco, attended by a total of 236 scientists, technicians, and policy-makers, from 57 countries, contributed to validate the outline, shape the conceptual approach and integrate the lessons learned from countries' experiences.

# Structure of the guidelines

The guidelines are divided into three parts: setting the scene, developing the concept, and putting the concept into practice. Each part contains a number of sections (see Figure 1).

The first part is divided into two sections that address the following objectives:

- providing background information on potential uses of animal recording systems, and explaining the rationale behind the development of these guidelines (Section I); and
- demonstrating the need for adopting a multipurpose approach, and translating the latter into an integrated multipurpose system (Section II).

The second part includes four sections that develop conceptual frameworks for:

- animal identification and registration (Section III);
- animal traceability (Section IV);
- animal health information (Section V); and
- performance recording (Section VI).

Each section contains an introduction of its rationale, its objective(s) and the respective conceptual framework, which describes the different options for the respective system and the requisite elements, and provides guidance for making the right choices for a given situation.

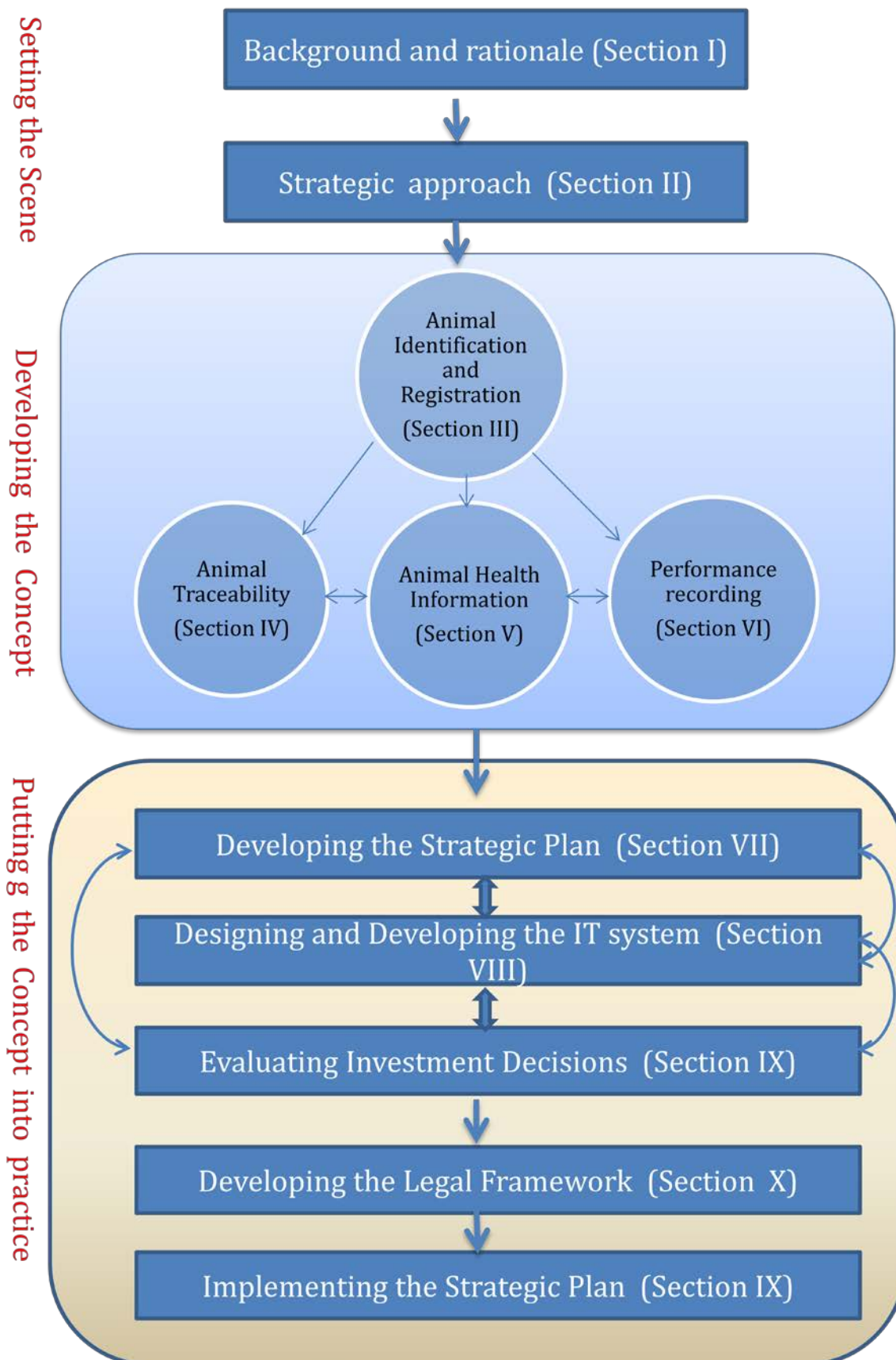
The third part is divided into five sections that address the following objectives and tasks:

- developing a strategic plan for establishing an animal recording system (Section VII);
- procuring or developing a software application for an animal recording system, and setting up the necessary computer hardware (Section VIII);
- evaluating the costs and benefits of an animal recording system, and identifying ways to make an equitable distribution of costs between the beneficiaries (Section IX);
- developing a legal framework for an animal recording system, and highlighting key policy and regulatory decisions to be made when implementing such a system (Section X); and
- implementing the animal recording system, based on the established strategic plan (Section XI).

These sections have much in common. It is, however, intended that each section be able to stand alone. Reading them in sequence will involve some unavoidable repetitions.

Each section contains an introduction of its rationale, its objective(s) and a set of tasks that needs to be carried out in order to achieve the desired outcome. These tasks are further broken down into a series of actions. Throughout these guidelines, acronyms are introduced in each section to maximize ease of reading, and are only used where necessary.





**Figure 1: The process for preparing and implementing an animal recording system**

# **PART 1: SETTING THE SCENE**

# **Section I. Background and rationale**

## **INTRODUCTION**

Animal recording systems are gaining worldwide interest both in high-income and in mid- and low-income countries. In high-income countries, animal recording systems were historically developed by breed associations to maintain pedigree details of animals, by breeding organizations to implement their genetic improvement programmes, by livestock improvement organizations to assist farmers in the management of their animals and by governments and veterinary health organizations to eradicate diseases such as brucellosis, tuberculosis and scrapie. However, these programmes were not always operated nationwide, often being limited to participating farmers or to areas in which certain disease risks existed. The recent outbreaks of bovine spongiform encephalopathy (BSE or mad cow disease), foot-and-mouth disease (FMD), classical swine fever, avian influenza and other diseases in some high-income countries have resulted in enormous losses in terms of the number of animals culled and destroyed and also loss of access to international markets. Consequently, many of these countries have been driven to implement nationwide animal recording systems that facilitate complete traceability of all animals and their products.

In most mid- and low-income countries, animal recording systems have not been implemented at national or even at local level. However, growing domestic and global demand for animal products and emerging opportunities for export of animal products have encouraged governments and livestock organizations in many mid- and low-income countries to invest in developing infrastructure and processes to improve the genetic potential of their animals, to control the prevalent infectious and parasitic diseases, to develop traceability systems to trace animals and their products, and to enhance the capacity of people to adopt new technologies and systems. As animal recording forms an essential element of these programmes, there has been an increased interest in establishing animal recording systems in these countries.

Previous and current experiences suggest, however, that animal recording systems developed in high-income countries are not directly applicable in mid- and low-income countries, primarily due to different socio-economic conditions, production environments, livestock service providers, veterinary institutions, capabilities of farmers and resource availability. Additionally, existing guidelines on animal recording focus upon, or are influenced by, the context and needs of high-income countries. This raises the question of whether these guidelines may be applied in the context of mid- and low-income countries, or whether there is a need to develop new guidelines for such countries. This section answers this question by giving the background and the rationale for the preparation of such guidelines. It starts by describing the benefits and beneficiaries of animal identification and recording systems. It then reviews the state of implementation of animal recording systems in high-, mid- and low-income countries and highlights several key points for consideration, learned from current and past experiences.

## **OBJECTIVES**

The key objectives of this section are twofold. Firstly, it aims to promote greater understanding of the various applications for which animal recording systems may be used,

and the benefits and beneficiaries of such systems. In support of this objective, it also provides examples of systems implemented in select countries with developed economies and countries with emerging economies, and offers several key points for consideration when developing an animal recording system. Secondly, this section provides an overview of existing guidelines relevant to animal recording systems, and explains the rationale behind the development of these guidelines.

## **BENEFITS AND BENEFICIARIES**

The primary purpose of animal recording systems is to provide information to stakeholders, including farmers, service providers and policy makers, to enable them to make informed decisions and to implement suitable plans. The benefits and beneficiaries of animal recording systems are summarized below.

### ***Animal traceability***

Animal traceability, which constitutes one potential component of animal recording systems, forms the basis of sanitary control systems in the production of food of animal origin. It constitutes the link between animal health, food safety and the organoleptic characteristics of food. Traceability serves many purposes, including the following:

**Food safety and quality control.** A properly developed animal traceability system is a risk mitigation tool that contributes to ensuring the safety and quality of food products of animal origin. It enables a food product to be traced back to its source and through all stages of production. This action may be taken promptly to prevent food contamination and to respond promptly and effectively to prevent contaminated or poor quality products from reaching the consumers in the event of an identified risk. It may also facilitate food recall in case of contamination in the value chain. It is important to note, however, that the scope of these guidelines is limited to the traceability of animals from birth to slaughter or death, and does not address the traceability of products along the value chain.

**Value addition to products.** Animal traceability can help to verify information about the attributes of a food product, such as whether it is organically produced, the specific breed type from which it is derived, whether good animal welfare practices have been followed, whether certain feeding practices have been applied, whether it is free from antibiotics and hormones, and whether it has been produced under environment-friendly conditions. The rationale is that such products usually attract higher prices in the marketplace. A traceability system providing such *ex ante* information will also benefit consumers as they will be protected from fraudulent claims about specific attributes.

**Export and certification.** Animal traceability helps exporting countries to achieve compliance with sanitary and phytosanitary standards set by importing countries, and can provide information that is required for the issuance of health certificates for export.

The benefits and beneficiaries of traceability will vary depending upon the scope and the comprehensiveness of the traceability system (i.e. how much of the supply chain is covered by the system, and how much detail is recorded).

Traceability systems may be mandatory and controlled by government authorities. Alternatively, they may be voluntary and controlled by the private sector for individual supply

chain initiatives. Mandatory traceability systems are primarily designed for the purpose of consumer protection. By protecting human and animal health and by reducing public costs associated with disease outbreaks, they benefit the country as a whole. Consumers benefit from improved food safety, and assurances of the accuracy of any claims made regarding the characteristics of the food they purchase and consume. Voluntary traceability systems benefit subsectors within the supply chain such as producers, processors, distributors and exporters. They also help to reduce exposure to risk and to minimize the costs and impact of crises related to food safety and quality.

### ***Animal health information***

Animal health information recording, another potential component of animal recording systems, is an essential tool for the prevention and control of diseases and the improvement of veterinary health management systems.

**Disease prevention and control.** A sound animal health information system provides information that enables animal health officials to define the health status of animal populations. The assessment of the population's health status is a pre-requisite for planning any surveillance and control strategy and for the application of zoning or compartmentalization policies. It is also essential to enable countries to fulfil their international obligations concerning animal diseases notification, and to facilitate early detection and rapid response in case of health emergencies. A timely response allows direct and indirect losses to be minimized and helps to restore consumer confidence. Finally, the existence of a comprehensive animal health information system facilitates the performance of risk assessment studies.

**Estimation of disease losses and management of veterinary health.** An animal health information system is a useful tool to estimate disease incidence and the impact of diseases upon animal performance and mortality. Through the systematic collection of data concerning veterinary treatment, laboratory data, diagnostic and health-related farm management practices and by making veterinary health information available to farmers and veterinarians, it is possible to reduce the incidence of disease and to decrease resultant animal losses.

### ***Performance recording***

The benefits and beneficiaries of performance recording depend upon the purpose and the scope of the recording system. Performance recording serves many purposes, including those listed below.

**Establishment of baseline animal performance levels.** It is important that a country is aware of the true productive capacity of its main livestock types in each of the major production environments and ecological zones. A nationwide animal recording system can generate livestock statistics. If the system also has a performance recording component, then it can generate useful data on production and productivity of livestock on a regional basis. Additionally, productivity can be linked to environmental constraints and to other limitations. The characterization of animal genetic resources does the same at the breed level. It allows the determination of the productive capacity of a breed in its production environment. Data generated provides valuable input to livestock organizations, public and private decision makers, and agricultural planners when developing strategies and programmes to enhance national food security and to increase livestock productivity.

**Evaluation of production system alternatives.** Information collected through performance recording provides important data for the advancement of production practices, including improved feeding strategies, better healthcare options, germplasm sources and housing alternatives. Benefits from research and development, based on performance recording, can contribute to improved food supplies, competitiveness in the global market, sustainable economic development, environmental conservation and social stability. Therefore, advancements in production practices do not just benefit the farmers who participate in the performance recording activity, but also the farming community as a whole and ultimately the consumer. For example, by applying improved production practices, it is possible to improve the quality of a product. This may in turn lead to access to new discerning markets, therefore benefitting the producer, and also providing consumers with new commodities. Box 1 shows how such benefits can even extend to the nation at large.

**Individual animal management.** Individual animal performance data assists farmers in managing day-to-day farm operations, in making culling decisions and in planning investments. Systematic use of information helps farmers to enhance the productivity of animals in terms of better growth, reproduction, production, nutrition and herd-health. However, the level of benefits realized by individual small-scale farmers will be modest and difficult to demonstrate objectively. For this reason, it is important that appropriate public institutions are able to provide support, in the form of financial capacity and knowledge building programmes, to allow such farmers to realize the full benefits of performance recording.

**Genetic improvement.** Performance recording for genetic improvement aims to identify and mate superior animals to produce superior herd replacements, or offspring for sale as breeding animals. It usually requires the maintenance of parentage records; this recording programme must be sustained over many animal generations in a rigorously consistent manner. The performance recording scheme benefits participating farmers, and the national livestock sector as a whole. However, annual rates of improvement are usually modest (less than three percent per year) compared with those delivered by management interventions such as a vaccination or feed supplementation. It is the cumulative nature of genetic changes that make them a powerful mechanism for development of livestock systems. Therefore, a support mechanism for the animal recording programme will be required, at least in the initial phase. This could be achieved by the provision of subsidized labour, equipment, or other production inputs, as necessary.

Performance recording can improve the efficiency of animal food production, which, when combined with a traceability system, can lead to increased income for farmers and safer food of animal origin for consumers. Raising awareness of the multiple benefits of performance recording among the different actors in the livestock sector can help secure their understanding, participation and contribution.

### **Box 1: Flow of performance recording benefits through the value chain: A dairy example**

The concentration of white blood cells in milk, known as somatic cell count (SCC), is an indicator of the hygienic quality of milk. Low SCC is desirable, as high SCC is a manifestation of udder infection (mastitis). Most milk processors penalize high SCC milk and pay a premium for low SCC. This is due to the fact that high SCC adversely affects product yield and quality. Individual cow SCC is widely recorded in dairy recording schemes worldwide. Farmers use individual cow SCC results to carry out herd improvement interventions (e.g. withholding milk from high SCC cows; culling cows with consistently high SCC; breeding replacement stock from genetically low SCC animals) that reduce the SCC of milk sold to processors.

This improves their revenue from the sale of milk, in addition to saving on costs related to high SCC such as discarded milk, veterinary fees, costs of antibiotics and other therapeutics. Selection against high somatic cells in milk usually also results in longer productive herd life of milking cows as udder infection is a main reason for non-voluntary culling. Processors buying milk will produce more and better quality dairy products with fewer residues, which consumers will be prepared to pay more for. Distributors of these products will be exposed to fewer quality-related risks and will improve their efficiency in marketing these products. Finally, consumers will enjoy better quality and safer products. Additionally, national food quality, and safety will be improved, resulting in better public health and global competitiveness. Reduced use of chemicals to treat infected cows will result in less environmental pollution, providing a benefit to the whole country. Lower udder infection also implies improved animal welfare.

Source: Cuthbert Banga

### ***Other benefits of animal recording systems***

Animal recording can also provide valuable statistical data on livestock numbers, production, productivity and marketing. This data may then be used in several ways, including deterring the theft of livestock and managing the payment of subsidies to prevent fraud. However, it is important to note that animal recording cannot replace the need for a livestock census.

**Authentication, preventing stock theft and locating and rescuing animals in disaster-struck areas.** Animal recording systems can be useful in resolving ownership disputes, mitigating stock theft, and can help to locate animals and to return them to their rightful owners in disaster-struck areas. Extension of such systems to include storing of biological samples could be helpful in resolving disputes through the use of molecular genetics techniques.

**Managing payment of subsidies and preventing fraud.** Correct payment of subsidies or taxes requires accurate data concerning animal numbers, holdings and owners. Since animal recording provides such data, it can support administration process and prevention of fraud in subsidy payment schemes.

**Animal insurance.** Through assigning unique identification codes to insured animals and their rightful owners, animal recording systems can ease the process of administering animal insurance schemes, and can mitigate instances of fraudulent insurance claims.



## STATE OF IMPLEMENTATION OF ANIMAL RECORDING SYSTEMS

Animal recording systems have been implemented in a significant number of high- and mid-income countries and have also been implemented in a few low-income countries. The specific reasons for implementing such systems may vary from country to country, but the main motives include ensuring food safety for consumers, controlling disease outbreaks, enabling genetic improvement, facilitating access to new global markets, preventing thefts of animals and managing the payment of subsidies. This subsection provides an overview of several animal recording systems that have been implemented in high-, mid- and low-income countries, and highlights the lessons to be learned from these experiences.

### *Countries with developed economies*

By enabling access to certain markets and by strengthening consumer confidence in their products, many high-income countries have implemented nationwide animal recording systems to safeguard the interests of farmers. Examples include:

- **European Union.** Prior to 2000, a number of European Union (EU) member states implemented animal recording schemes. In France, a national scheme was launched in 1969 to establish organized breeding programmes, and was updated in 1978 to require mandatory individual identification. The UK introduced a mandatory Cattle Tracing System (CTS) in 1998 to identify and trace all cattle in the country, primarily for the purpose of disease control, food safety and market access.<sup>7</sup> However, in 2000, the Council of the EU introduced Regulation (EC) No. 1760/2000, which sets out the elements of the European cattle identification and registration system that each member state must comply with. The primary purpose of this system is to facilitate the tracing of cattle in order to control the spread of infectious diseases, and to improve management of the subsidy payment scheme.<sup>8</sup> The EU's identification system for sheep and goats was implemented in 2004 and, since 2005, EU legislation also stipulates that meat must be identified, and the identification must link it to the animal or group of animals from which it is derived, and to the country and facility where it was processed.<sup>9</sup> The EU has also stipulated that third party countries wishing to export animals and products of animal origin to the EU must have in place effective animal recording systems in addition to other minimum SPS measures.
- **Canada.** In Canada, a voluntary animal recording system was introduced in 2001. A mandatory system commenced in 2002. This system is regulated by the Canadian Cattle Identification Agency, an industry-led organization that manages individual cattle identification and traceability until the slaughter or death of an animal. The primary purpose of this animal recording system is to facilitate traceability of animals to control infectious diseases and to enable market access.<sup>10</sup>
- **United States of America.** Since 2004, the United States of America has been implementing the National Animal Identification System (NAIS), which is built on an earlier programme by the Animal and Plant Health Inspection Service (APHIS) of the United States Department of Agriculture (USDA). The system is voluntary, and is based upon a partnership between state- and federal-level authorities, and industry.

<sup>7</sup> See <http://archive.defra.gov.uk/foodfarm/farmanimal/movements/cattle/cts.htm>

<sup>8</sup> See [http://ec.europa.eu/food/animal/identification/bovine/index\\_en.htm](http://ec.europa.eu/food/animal/identification/bovine/index_en.htm)

<sup>9</sup> Council Regulation (EC) 21/2004 (amended Regulation (EC) No. 933/2008); and Regulation EC/178/2002, respectively.

<sup>10</sup> See <http://www.canadaid.com>; and [www.inspection.gc.ca](http://www.inspection.gc.ca)



The primary purpose of the system is to enable the control of disease and the traceability of cattle, and to promote market access.<sup>11</sup> In addition to the NAIS, the USDA has also formulated a new Rule on Animal Disease Traceability, which became effective on 11<sup>th</sup> March 2013.<sup>12</sup> This Rule implements a mandatory system that requires animals to be identified prior to any interstate movement. This extends to cattle, sheep, swine, horses and poultry, which must be identified individually or in groups, depending upon the specific species. Under the federal system, individual states also remain free to implement more stringent systems if they so desire.

- **Australia.** In Australia, a mandatory system called the National Livestock Identification System (NLIS) has been in place since July 2005. This system, which is governed by Meat & Livestock Australia, facilitates the tracing of bovines until slaughter or death, for the purposes of controlling infectious diseases and enabling market access.<sup>13</sup> In 2008 an animal recording system was developed for sheep. Together with the concurrent cattle animal recording system, this is linked to an animal diseases surveillance and intelligence system that collects data from livestock markets, abattoirs, feedlots and saleyards.
- **Japan.** A mandatory animal identification and traceability system has been in place in Japan since 2004. This system traces animals from birth to slaughter; resultant animal products are traced from slaughterhouses through the distribution chain to the point at which they are purchased by consumers.<sup>14</sup>
- **South Korea.** Since 2004, South Korea has operated a mandatory system named the Beef Traceability System (BTS); each individual animal is traced from birth to the consumer. It is governed by the Ministry of Agriculture and Forestry for the purpose of controlling infectious diseases and food safety.<sup>15</sup>

Each of these countries has developed legal and regulatory frameworks to provide rules and regulations for implementing their animal recording systems. Further information on each of these systems can be found at the websites listed in the footnotes.

### *Countries with emerging economies*

Animal recording systems are uncommon in mid- and low-income countries, due to one of the following:

- Most of these countries have few surplus animal products to export, as most food products are produced and consumed locally.
- Distribution chains in these countries may be poorly developed.
- Generally, domestic consumers in these countries are unwilling to pay premium prices for animal products that are identified and traced.
- Animal productivity in these countries is low due to the low productivity of local breeds and to the challenging production conditions.

However, increasing demand for animal products worldwide has created opportunities for many mid and low-income countries, with large farm animal populations, to export their animal products. As meat exporters in these countries must provide certain minimum

<sup>11</sup> See <http://animalid.aphis.usda.gov/nais/naislibrary/documents/guidelines/NAIS-UserGuide.pdf>

<sup>12</sup> See [http://www.aphis.usda.gov/newsroom/2012/12/pdf/traceability\\_final\\_rule.pdf](http://www.aphis.usda.gov/newsroom/2012/12/pdf/traceability_final_rule.pdf)

<sup>13</sup> See <http://www.mla.com.au/meat-safety-and-traceability/National-Livestock-Identification-System>

<sup>14</sup> See <http://www.nlbc.go.jp/index.asp>

<sup>15</sup> See Lee, B.O. et al. 2011, Journal of Agricultural, Life and Environment Services, Vol 23 No.3, September 2011

information on the animals slaughtered in order to achieve compliance with importers' requirements, they are applying pressure upon governments to develop animal recording systems for animal identification, traceability, disease recording and disease surveillance. Increased demand for animal products, both domestically and globally, is also driving governments in these countries to invest in infrastructure to enhance the productivity of their animals, to promote genetic improvement and to protect their animals against disease. The growing awareness of the value of local breeds in many mid- and low-income countries is also pushing many governments to initiate systematic breed conservation and development programmes, of which animal recording systems form an essential element.

Examples of animal recording systems that have been developed in mid- and low-income countries are described below:

- **Botswana.** In 2004, Botswana developed and implemented an advanced livestock identification and traceability system (LITS) that satisfies EU export requirements.<sup>16</sup> The system incorporates stock branding in accordance with the Stock Brand Act and individual animal identification. For a long time, the Botswana computerized LITS used inserted rumen reticular boluses (RFID, see Section III of these guidelines). The system enabled the computerization of a number of activities, including the issuance of brand certificates, movement permits and change of ownership documentation. As of 2013, for various reasons, Botswana's LITS is moving towards the use of RFID ear tags instead of reticular rumen boluses. While the primary driver for the establishment of Botswana's LITS was to gain access to the EU market, its implementation has also reduced the incidence of stock theft, and has improved livestock marketing payment systems and abattoir operations.
- **Namibia.** In 1999 Namibia introduced the Fan Meat Scheme that is managed by the Meat Board of Namibia. Under this scheme, it is mandatory for commercial farms to identify each animal with an ear tag displaying a unique identification number. Recently, Namibia has moved from bar coded ear tags to double RFID ear tagging in both the commercial and the communal production environments. Prior to 2012, animals in the Northern Communal Area to the north of the FMD cordon fence were not covered with the animal recording system. Instead, they were using a branding system that used the same brand within a community. The Directorate of Veterinary Services is responsible for issuing ear tags and livestock movement permits. During the life-cycle of an animal each farmer is required to submit a number of documents, including an animal registration card after ear-tagging an animal and a livestock termination form in the event of the death or on-farm slaughter of an animal.<sup>17</sup> The underlying purpose for the development of this system was to satisfy the standards required to export meat to the EU and to South Africa. When animals arrive at a slaughterhouse, it must be indicated whether they have come from commercial farms or from communal farms. The meat is then labelled to indicate the owner, the date of slaughter, the abattoir at which the animals were killed and the carcass weights. This information is then used to trace back any meat that is sold either domestically or internationally.
- **India.** In India, the National Dairy Development Board (NDDB) has developed an integrated animal recording system, referred to as the Information Network for Animal Productivity and Health (INAPH).<sup>18</sup> This system, which includes animal identification and registration, has been developed primarily for the purpose of performance

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<sup>16</sup> See [ec.europa.eu/food/fvo/act\\_getPDF.cfm?PDF\\_ID=10380](http://ec.europa.eu/food/fvo/act_getPDF.cfm?PDF_ID=10380)

<sup>17</sup> See Fan Meat Standards for producers at [www.nammic.com.na/jdownloads/Manuals/fanmeatmanual.pdf](http://www.nammic.com.na/jdownloads/Manuals/fanmeatmanual.pdf)

<sup>18</sup> See [www.nddb.org/inaph/Pages/Inaph.aspx](http://www.nddb.org/inaph/Pages/Inaph.aspx)

recording (including artificial insemination, milk recording, progeny testing, ration balancing, veterinary treatment, diagnosis, testing and disease outbreaks). It can also be used for traceability of animals and control of infectious diseases. The NDDB maintains the central database, which receives data from the users of INAPH from across the country. Users also receive all necessary information from the system to enable to carry out their daily tasks.

- **Brazil.** In 2002, the Brazilian Ministry of Agriculture, Livestock and Supply (MAPA) created the Brazilian Bovine and Buffalo Identification and Certification System (SISBOV) for the identification and tracing of all cattle. Although it was initiated as a mandatory programme, it evolved into a voluntary programme that was restricted only to premises that supply animals to slaughterhouses that prepare meat for sale in foreign markets, and particularly the EU.<sup>19</sup>
- **Argentina.** In 2003, the Argentinean Government established Argentina's Animal Health Information System (SGS). This is operated by the Argentinean National Health and Agroalimentary Quality Service (SENASA), primarily for the purpose of achieving access to the EU beef market.<sup>20</sup> Under this system cattle often have been identified in groups. However, subsequent legislation introduced mandatory identification for all calves born after September 2007, through the use of an ear tag. It is anticipated that by 2017 all beef cattle will be individually identified and traced.
- **Uruguay.** Since 1974, Uruguay has operated a group traceability system. The Animal Identification and Registration System (SIRA) was implemented on 1<sup>st</sup> September 2006 with the approval of Law No. 17,997 of 2<sup>nd</sup> August 2006 and Decree 266/2008, which introduced mandatory individual cattle traceability requirements. SIRA is managed by the Livestock Control Office (DICOSE), under the Ministry of Livestock, Agriculture and Fishery (MGAP).<sup>21</sup>

## KEY POINTS FOR CONSIDERATION

Based on past and current experiences, key points for consideration when implementing animal recording systems are given below:

1. Animal recording systems that are used in high-income countries are not likely to work in mid-and in low-income countries due to differences in socio-economic conditions, production environments, livestock service provisions and veterinary institutions, varying levels of capability within both farmers and officials, limited communication networks and limited availability of resources (both in terms of manpower and finance). When developing a new animal recording system, it is essential to assess the prevailing conditions and to determine what is feasible in each given situation.
2. The development of an animal recording system should be undertaken in a phased manner; it should be extended progressively to new regions and/or species. It is not advisable to implement a new system that immediately extends to all regions and species. Likewise, it is essential that the system must be capable of being extended to cover new functions or activities incrementally.
3. The allocation of a unique identification number for individual animals or groups of animals, for premises and for owners within a country is a pre-requisite for operating

<sup>19</sup> See <http://www.agricultura.gov.br/animal/rastreabilidade/sisbov&prev=/search%3Fq%3Dsisbov%2Bbrasil%26newwindow%3D1>

<sup>20</sup> See <http://www.senasa.gov.ar>; [www.sgsgroup.com.ar](http://www.sgsgroup.com.ar)

<sup>21</sup> See [http://www.inac.gub.uy/innovaportal/file/5219/1/libro\\_trazabilidad\\_ingles.pdf](http://www.inac.gub.uy/innovaportal/file/5219/1/libro_trazabilidad_ingles.pdf)

any animal recording system. Specific methods of identification are addressed in Section III of these guidelines.

4. An integrated animal recording system requires sophisticated software. A number of pre-designed commercial software packages are available for purchase. Alternatively, such software may be developed locally. It is important to note that pre-designed commercial software is unlikely to offer a sufficient degree of customizability to meet all requirements of a new animal recording system. However, developing custom software is a costly, time-consuming and complicated process. Nonetheless, if sufficient resources and capacity are available, then it is recommended that software be developed locally to meet specific needs.
5. The availability of regular training and education programmes for end users is vital to implement and sustain any animal recording system. It is equally important to provide online support to end users, through the establishment of troubleshooting support.
6. If complete identification and traceability of animals in the country is a primary objective for introducing an animal recording system, then extensive legal support is absolutely necessary.
7. Participation of stakeholders is likely to increase if they are able to clearly see benefits from doing so. It is therefore important that the benefits of participation and the disadvantages of non-participation in an animal recording system are clearly defined and communicated to all stakeholders.
8. The development of an integrated multi-purpose animal recording system is a complex process that requires the long term commitment of human and financial resources. Countries that wish to develop an integrated animal recording system often underestimate the resources required.
9. Whether it is a public or private sector initiative, animal traceability, control of infectious diseases and promotion of food safety should be regarded as public goods since they deliver benefits to farmers, food processors, food distributors, consumers, and the nation as a whole. By making local animal food producers and processors more competitive in global markets and by enhancing their export capabilities, traceability not only helps to develop individual businesses; it also contributes to national economic growth and development.
10. Before any decision is taken to introduce an animal recording system, it is important to carry out a detailed cost-benefit analysis of the project. Depending upon the results, this can help to communicate the benefits of the animal recording project to stakeholders including funding agencies. Ensuring stakeholder commitment from the outset, including national government, is essential for successful implementation of any animal recording project. While public funding is often essential at the outset of such projects, in order to ensure its long term sustainability, it is important that the system evolves to enable operating costs to be shared by all beneficiaries including farmers.

## **REVIEW OF EXISTING GUIDELINES**

Many international standards and guidelines have been developed to foster standardization of animal recording systems worldwide. These standards and guidelines are applied in the developed world where the animal recording systems have become more or less standardized. Due to the large number of small-scale producers and the low and medium input systems in which they operate, their implementation in mid- and low-income countries is a challenging task. This section reviews the existing guidelines and their applicability in these countries in general and in small-scale production environments in particular.

## **OIE guidelines on identification and traceability of live animals**

General principles on identification and traceability of live animals were adopted by the OIE Terrestrial Animal Health Standards Commission in 2007 as official OIE standards.<sup>22</sup> These guidelines present the main elements of an identification and traceability system for live animals as well as their outputs. They describe the essential elements of an identification and traceability system and the logical steps to be followed when developing such a system. However, they do not provide substantial guidance on how to implement these steps, nor do they include practical examples and information on the pros and cons of the different options.

## **ICAR standards, rules and guidelines**

The International Committee for Animal Recording (ICAR) is a worldwide not-for-profit organization that promotes the standardization of animal recording and productivity evaluation. Its aim is to promote the improvement of farm animal recording and evaluation through the formulation of definitions and standards by which to measure traits of economic importance. The ICAR International Agreement of Recording Practices, which contains voluntary standards, rules and guidelines concerning all aspects of animal recording, is available on the ICAR website.<sup>23</sup> This document sets out rules and standards for ICAR members and describes in detail the acceptable methods of animal identification and recording. These descriptions are referred to in the document as 'guidelines'.

The ICAR guidelines are primarily written by and for technicians who run highly developed state-of-the-art animal identification and performance recording systems. They provide good reference material on all aspects relating to performance recording, including methods of animal identification, measurement and calculation of traits and genetic evaluation. However, the ICAR guidelines do not provide direction for adapting the general principles to the conditions in mid- and low-income countries. For this reason, ICAR has established a Working Group for Developing Countries, for which one of the primary tasks is to simplify and adapt relevant sections of the ICAR guidelines to suit low- and medium-input production systems of these countries.

## **FAO secondary guidelines: Animal recording for medium input production environments**

In 1998, FAO developed and published the *Secondary Guidelines for Development of National Farm Animal Genetic Resources Management Plans - Animal Recording for Medium Input Production Environment* (hereinafter referred to as the FAO secondary guidelines), which are available on the FAO website.<sup>24</sup> They provide a comprehensive description of the benefits and beneficiaries of performance recording, the planning and conduct of performance recording schemes, providing step-wise and detailed guidance on institutional and operational organization of such schemes, and the utilisation of resulting information, with special focus on medium-input production systems.

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<sup>22</sup> See [http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre\\_1.4.1.htm](http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.4.1.htm).

<sup>23</sup> See [http://www.icar.org/pages/recording\\_guidelines.htm](http://www.icar.org/pages/recording_guidelines.htm)

<sup>24</sup> See [http://www.fao.org/AG/AGInfo/resources/en/pubs\\_gen.html](http://www.fao.org/AG/AGInfo/resources/en/pubs_gen.html)

However, since the publication of these guidelines, a number of developments have occurred relating to livestock production and trade. This includes a surge in the importance of animal health and traceability, which has become one of the main drivers for animal recording. Therefore, it became necessary to put the performance recording in more general context of national animal recording, establishing linkages with animal identification and registration, traceability and animal health information.

In conclusion, there is a need for new guidelines that support countries in the development of integrated multipurpose animal recording systems that integrates animal identification and registration, animal traceability, animal health information and performance recording. These guidelines should have a practical focus and be used to support decision-making when implementing sustainable animal recording systems, drawing on the lessons learned from past and current experiences. There is also a need that these guidelines afford greater consideration to low and medium-input production environments within low-income countries (the common characteristics of such production environments are summarized in Box 2).

## **Box 2: Adapting animal recording systems to low input production environments of developing countries**

When implementing animal identification and recording programmes in low input environments of developing countries, it is important to note that it is not advisable to simply apply the same standards and guidelines used in high input production environments of developed nations. The following factors, characteristic of low input production system of developing countries, should be considered when implementing animal recording technologies in this environment:

- i. Low external inputs.** Low input production systems are characterized by limited capitalization or purchasing of external inputs. Animal production is typically low cost and mainly dependent upon local animal genetic resources. The use of external inputs may be virtually non-existent (e.g. subsistence-based pastoral systems), which makes it difficult to implement costly technologies.
- ii. Limited access to resources.** Resources such as land, feed, water, finance and services in general are scarce in low input environments of developing countries. The situation with respect to feed supply is exacerbated by the fact that pasture, which is the primary source of feed in this environment, is continuously losing ground to cropland due to increasing demand for grain.
- iii. Inadequate infrastructure.** Any efforts to transfer technology developed for high input environments to the low input environment of developing countries must take cognizance of the general lack of infrastructure in the developing world. It is worth noting that facilities such as information communication technology systems, marketing services, transport systems, equipment and laboratories, which are vital for the proper functioning of animal recording systems, are commonly lacking in the developing world.
- iv. Low knowledge and literacy levels.** Illiteracy is a major problem in the developing world. According to the United Nations, 98 percent of non-literates live in developing countries, with high concentrations in South Asia, West Asia, and sub-Saharan Africa. In addition, knowledge pertinent to animal production and marketing is limited in these regions. This poses a serious challenge to the implementation of technologies such as animal identification and recording, which are highly dependent on good record keeping and interpretation of written information.
- v. Multiple uses of livestock.** Livestock generally serve a variety of purposes in developing countries. This has particular implications upon the type of data that needs to be recorded, the recording methods used and the utilization of such data in performance recording.

## **Section II. Strategic approach**

### **INTRODUCTION**

Section I outlined the potential benefits of an animal recording system and provided examples of animal recording systems that have been implemented in a number of countries. These examples and others demonstrate the need to broaden the scope of animal recording by adopting a multipurpose approach. This section introduces this approach, translates it into an integrated multipurpose system, and describes the step-by-step process that shall be followed to develop such a system. Subsequent sections provide detailed guidelines on each step to establish an effective animal recording system. The concepts and approach described here will be developed throughout the following sections. Finally, by providing a brief description of each of the following sections, this section provides an executive summary of these guidelines.

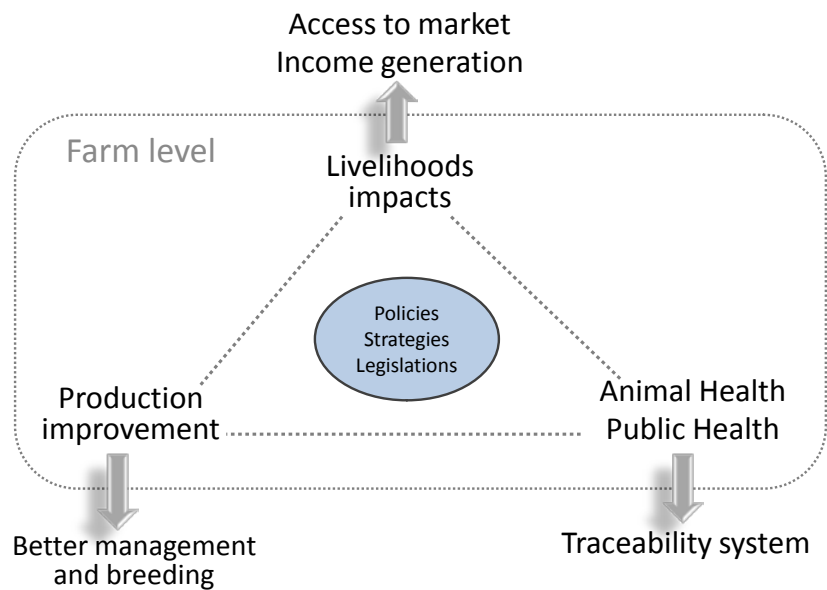
### **OBJECTIVE**

The objective of this section is to describe the strategic approach for developing an integrated multipurpose animal recording system.

### **THE CONCEPT OF A MULTIPURPOSE APPROACH**

As described in Figure 2, animal recording serves multiple purposes in a country's livestock sector. Animal recording forms the basis for improving animal productivity through better farm management. It provides information that allows producers to take action to improve the productivity and health of their animals, and to enhance the quality of their products. It is a prerequisite to establish and operate any genetic improvement programme. It also constitutes an essential component of traceability and disease control by making valuable health related information available to veterinarians and other health professionals, with which they can develop and implement disease prevention and control strategies. Traceability of animals and their products helps public health professionals to identify sources of risk quickly and to prevent contaminated or poor quality products reaching consumers. Through implementing systems for traceability, disease control and food safety, it is possible to enhance market access and to generate larger incomes for producers and other players in the value chain. Animal recording systems are therefore considered to be a powerful tool for livestock development and for addressing global demands for food security and poverty alleviation and not just an information system. However, to make animal recording systems effective in practice, they must be supported by appropriate public and private policies, and a legal and institutional framework.



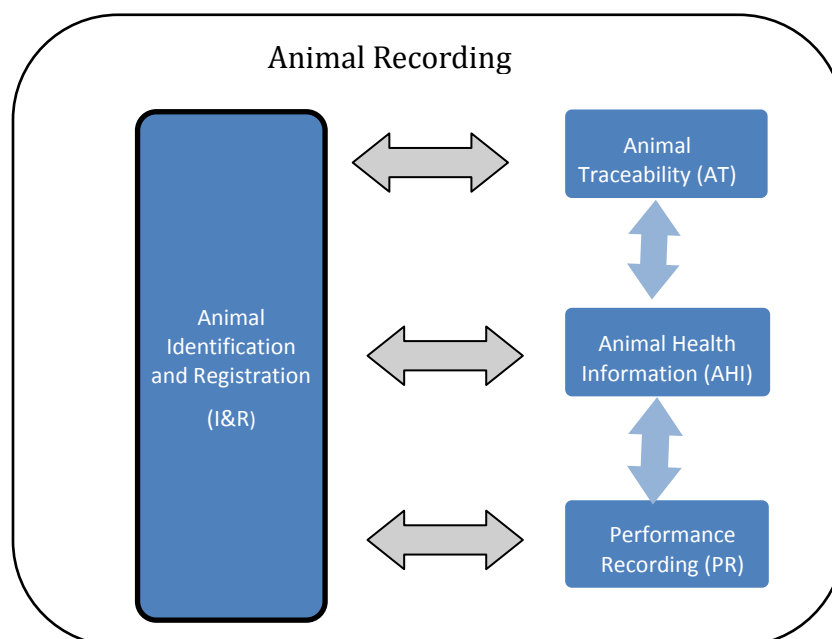


**Figure 2: Global approach for animal recording**

## MULTI-PURPOSE INTEGRATED SYSTEMS

### *Components of the multipurpose animal recording system*

In order to achieve the above purposes, the animal recording system should comprise four components. These are: (i) animal identification and registration (I&R); (ii) animal traceability (AT); (iii) animal health information (AHI); and (iv) performance recording (PR). The animal identification and registration component forms the core of the system, as it provides information to support the other components (see Figure 3).



**Figure 3: An integrated animal recording system with animal identification and registration as the core component**

### ***Integration and exchange among components***

As described above, an animal recording system is a combination of two or more components. For an animal recording system to be effective, each component must be developed on an individual basis, and all components must operate cohesively together. However, developing an animal recording system that encompasses all components from the beginning of its operation may not be feasible due to financial or other constraints. In such circumstances it may therefore be necessary to prioritize development and implementation of the components that are most critical taking account national requirements. Less critical components may then be developed at a later stage and integrated into the existing animal recording system.

In countries where little or no action has been taken to develop an animal recording system, it may then be preferable to develop a fully integrated system from the outset, depending upon available resources. In this case, it is recommended to design an integrated system that incorporates all components in one central database, even if the components are implemented in intervals. In this case the components are referred to as ‘modules’ of the animal recording system. The use of a single central database reduces the cost of implementing and maintaining such a system considerably and facilitates a rapid flow of communication that allows action to be taken quickly when necessary.

However, in practice in many countries, it is likely that a number of disconnected single or multipurpose information systems with corresponding databases in different locations, which are operated by different institutions, are already in place. It would often be costly and impractical to merge such systems. One possible solution in such circumstances is to establish linkages between different systems so that the databases and applications are able to: (i) export and import data elements through real time data exchange technology (see Section VIII), and (ii) generate information and carry out analysis by pulling required data from different databases where required. In this case, the different components with their respective databases form ‘subsystems’ of the animal recording system. It is important to recall that the animal identification and registration subsystem can enhance the utility of all other subsystems, which will use animal and premises codes allocated exclusively by the former subsystem. For example, veterinary data concerning vaccinations, treatments, testing, disease surveillance and herd health management can be linked to individual holdings and animals. However, this is possible only if the different subsystems are harmonized and can communicate with one-another. The development and integration of different animal recording subsystems should be undertaken in such a manner that data only needs to be collected and entered once, and enable all participating organizations using different subsystems to access the common data for their own purposes.

## **THE PROCESS FOR DEVELOPING AN ANIMAL RECORDING SYSTEM**

These guidelines have been prepared to provide the user with step-by-step guidance on how to develop and implement a strategic plan for an animal recording system (See Figure 1). The process is broadly divided into two parts:

1. Developing the concept
2. Putting the concept into practice

## ***Developing the concept***

There are different ways to set up each of the animal recording system components. To account for these differences, the guidelines first develop a conceptual framework for each component. Sections III, IV, V and VI develop the conceptual framework for animal identification and registration, animal traceability, animal health information and performance recording, respectively. They describe the consequences of the different options and provide a rationale for making the right choices for a given situation.

**Animal Identification and Registration.** Animal identification and registration refers to identification and registration of premises, keepers and owners, and animals. Section III presents these elements and describes the data that should be collected for each one. It describes the options that are available for the identification of animals and gives guidance for choosing the method of animal identification that fits the objective of the identification. The development of animal identification and registration system requires appropriate information technology, policy, legislation and institutional support. Their importance and role in evolving an effective animal identification and registration system are also highlighted.

**Animal traceability.** In these guidelines, animal traceability refers to the ability to access the history of an animal or a group of animals through all its life. In essence, this refers mainly to animal movement traceability. Section IV reviews the multiple objectives of an animal traceability system, describes the elements of such a system and the different options for tracing an animal or a group of animals, as well as the data that should be collected or provided in each case. This will help the user to decide on the type of animal traceability system and its elements, based on the set objectives.

**Animal health information.** Animal health information systems fulfil different objectives including the support for notification of animal diseases according to legislation and priorities of veterinary services. It supports monitoring of specific diseases and risk management of emerging and endemic diseases, which data can assist the development of prevention and disease control measures. Section V describes the main elements of an animal health information system, while simultaneously providing guidelines for correctly evaluating the elements characterizing each type of system. The section also provides key recommendations for developing an animal health information system.

**Performance recording.** Performance recording involves the objective and systematic measurement of various indicators of animal performance. Data such as animal physical characteristics, parentage and relevant events, may also be collected. The *FAO Secondary Guidelines for Development of National Farm Animal Genetic Resources Management Plans - Animal Recording for Medium Input Production Environment* provide a comprehensive description of the benefits and beneficiaries, the planning and conduct of performance recording schemes. Section VI does not intend to repeat what has already been presented in the above guidelines, but to put the performance recording in the more general context of national animal recording, highlighting the linkages between performance recording, animal identification and registration, traceability and animal health information. This section reviews the multiple objectives of performance recording, describes the different types of performance recording systems, and the elements of such systems, as well as the data that should be collected or provided in each case. Examples based mainly on dairy recording are given for illustration.

## ***Putting the concept into practice***

Based on the conceptual framework developed in the first and second parts of the guidelines, the third part provides guidance on how to prepare and implement an integrated multipurpose animal recording system. The related activities are divided into three steps:

1. Developing the strategy
2. Developing the legal framework
3. Implementing the animal recording system

### **1. Developing the strategy**

The development of the strategy goes through an iterative process that involves three steps: preparing the strategic plan, designing and developing the IT system, and evaluating investment decisions. If the cost estimates cross the availability of funds, the strategic plan and the IT system must be re-examined and modified, and the costs and benefits are to be reworked. This iterative process is to be continued until the cost of implementing the identified activities match the availability of funds (see Figure 1).

**Preparing the strategic plan.** A strategic plan should define the objectives and scope of the animal recording system; identify the participating stakeholders and their needs; decide upon the type of system and define its elements; specify the rules and procedures for data collection, storage, processing and reporting; and specify the IT requirements that are needed to develop the software application and build the IT infrastructure. It should also define the legal and institutional support required and present a detailed implementation plan. Finally, the strategic plan should specify human resource requirements, and prepare a budget and identify sources of funds. Section VII provides guidance on how to conduct an assessment of a country's situation and prepare such a strategic plan. The latter is common to all animal recording system components, but specificities are given as needed.

**Designing and developing the IT system.** The IT system enables users to capture, validate, process and store data, and to generate and transmit relevant information to the same or other users for decision making and planning. The IT system has two components: a software application and a hardware infrastructure. Section VIII provides guidance for procuring or developing a software application for an integrated multipurpose animal recording system and for setting up the required computer hardware. It focuses particularly on the preparation of the user requirement specifications, which impact heavily upon the success of the development process. It also gives guidance on how to call for tender IT companies and how to develop and test the software.

**Evaluating investment decisions.** Developing a national animal recording system requires large investments not only to develop and implement the system but also to maintain it. A cost-benefit analysis facilitates the decision making on such investment. The cost-benefit analysis involves: (i) estimation of costs, (ii) estimation of benefits, and (iii) evaluation of the costs-benefits relationship.

Estimation of costs involves identifying all cost items and determining a unit cost for each cost item. The estimation of benefits involves identifying and quantifying the benefits. The analysis of the costs-benefit relationship should ideally be undertaken in economic terms. When this is not possible, alternative criteria should be worked out. Section IX provides a clear breakdown of costs and benefits of the animal recording system (particularly animal identification, registration and traceability system) and discusses the costs-benefit

relationship. It also identifies ways to reduce the costs and to distribute costs equitably between the main beneficiaries.

## **2. Developing the legal framework**

In order to implement an animal recording system, it must be supported by a suitable legal framework. To achieve this, it is first necessary to undertake detailed analysis of the existing relevant legal framework in the country, including its scope and the extent to which it is complied with. It is then necessary to either update existing legislation to support animal recording activity, or to develop new legislation for this purpose. During this process it is important to take into account a number of key considerations, including the desired scope of the animal recording system and whether compliance ought to be voluntary or mandatory. The latter will not only depend upon what is most desirable, but also upon whether the country in question has sufficient resources to operate a mandatory system. Section X provides guidance on developing the legal framework to support an animal recording system.

## **3. Implementing the animal recording system**

Before the AR system is rolled out in a larger area, it should be implemented in a small area as a pilot project to test its functionalities. The implementation activities, whether in the pilot area or in the extended area, can be divided in three phases: the preparatory phase, the implementation phase, and the maintenance phase. Once the system is in the maintenance phase, independent evaluations must be carried out at regular intervals to ensure compliance with the standard operating procedures. The main activities to be carried out in each phase are described in Section XI.

## **PART 2: DEVELOPING THE CONCEPT**

## **Section III.      Animal identification and registration**

### **INTRODUCTION**

Animal identification and registration (I&R)<sup>25</sup> forms the core component of any animal recording animal system (Figure 3). This section describes a conceptual framework for I&R, which focuses upon the identification and recording of premises, keepers and animals. The development and implementation of a strategic plan for building an I&R system is addressed in the third part of these guidelines, which describes how to put the conceptual framework into practice. The process for developing an I&R system is similar to that used for developing animal traceability, animal health information or performance recording systems. Therefore, these processes are addressed together later in these guidelines.

### **OBJECTIVE**

The objective of this section is to describe the elements of an I&R system and to provide guidance on how to choose the method of animal identification.

### **DEVELOPING THE CONCEPTUAL FRAMEWORK**

I&R refers to the identification and registration of premises (sometimes referred to as establishments or holdings), identification and registration of keepers and owners, and identification and registration of animals. This section considers these elements and describes the data that should be collected for each. It describes the options that are available for the identification of animals and states the criteria that should be considered when choosing a method of animal identification. The development of an I&R system requires information technology (IT), policy, legislation and institutional support.

#### ***1. Identification and registration of premises***

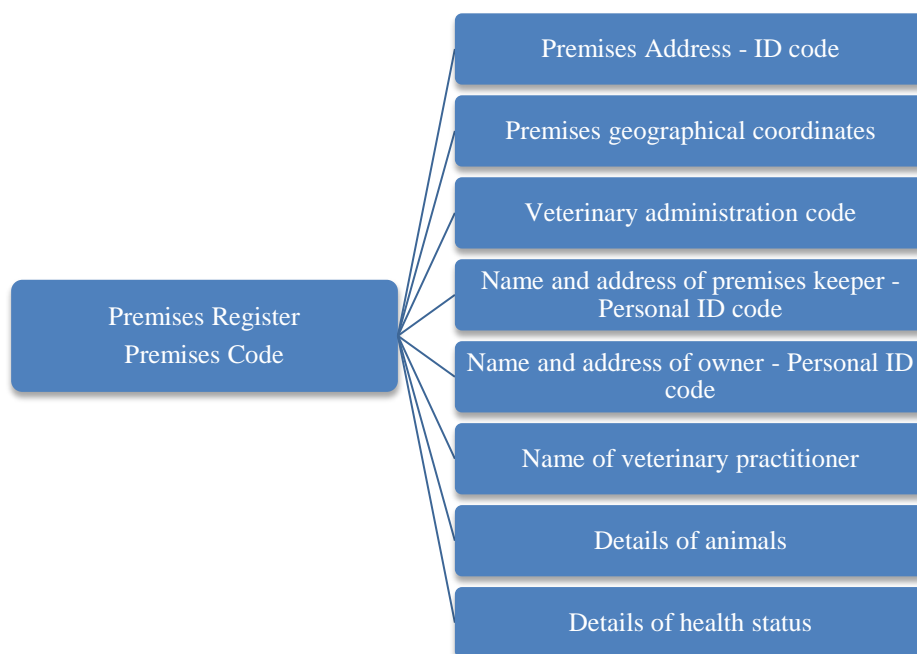
A premises is a geographical location where animals are permanently kept, such as a home, farm, feedlot, or a place where animals are temporary handled, such as a market, abattoir, test centre, dip tank, common shearing shed, and grazing pasture. A premises can also be mobile, such as a truck, train or ship. For current purposes, ‘premises’, ‘establishment’ and ‘holding’ are treated as synonymous. In order to establish geographical traceability, each premises should be identified by a unique premises code. The premises code remains assigned to a specific geographical location even when the herd, herd keeper or herd owner moves to another location. Therefore, the premises code identifies the geographical location and not the ownership. If the animal owner has more than one farm, each of the locations must have a unique premises code. Premises codes must be linked to animals, and to keepers and owners.

Each premises must have a premises register in the centralized database, which should contain the premises code, premises address with the location code, geographical coordinates of the premises, jurisdiction of veterinary administration code, name and address of the keeper with

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<sup>25</sup> to maximize ease of reading, only this acronym is used in this section

the personal ID code, name and address of the owner with the personal ID code, name of the veterinary practitioner, and a summary of animals kept on the premises (See Figure 4). The summary of animals includes details on animal species, production types (e.g. dairy or beef), defined groups (e.g. cows, heifers, bulls), information on animal arrivals and departures, births, and deaths.



**Figure 4: Schematic representation of a premises register**

When all animals of a particular species in a geographical location (such as a village) are kept in a manner that allows them to mix freely during daytime and often graze and drink in a common grazing area and watering source, they could be considered as one epidemiological unit coming from one premises, even if they return to individual households for milking in the evening and the animals are owned by different persons. In such circumstances, the premises code would be the same for all animals of that particular species in that particular geographical location.

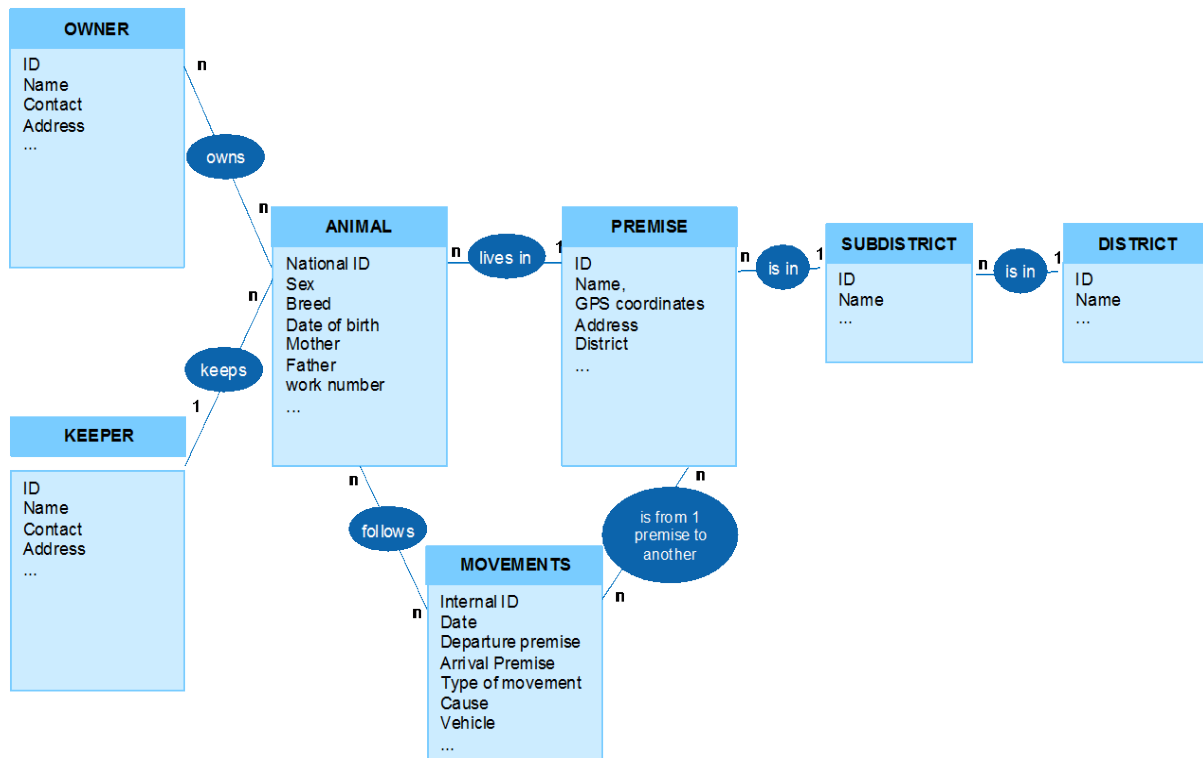
## ***2. Identification and registration of keepers and owners***

The keeper of the animals is the person responsible for the day-to-day management of animals on a particular premises. The owner is the legal owner of the animals, regardless of whether he/she owns the premises on which the animals are kept. In practice, the owner may also be the keeper. A keeper may be responsible for more than one herd (on more than one premises) belonging to one or more owners. Likewise, an owner might have more than one herd (on more than one premises), each having the same or different keepers. Identification and registration of both keepers and owners is essential. Dealers and transporters are a special case of temporary animal keepers, and therefore must also be registered.

A register that records the data on keepers and owners of the premises should be maintained in the database. This register should contain their names, addresses and other contact information to enable the authorities and other users of the database to quickly contact them if



necessary. When individuals or corporations are already registered in other public databases such as the national register of persons or any other existing register, their identification codes in such databases could also be utilized to identify them as animal keepers or owners in the register (See Figure 5).



**Figure 5: A schematic representation of relationships between keepers, owners and premises**

While creating both the premises register and the keepers and owners register, the following points need to be considered:

- The premises address could be made unique by using a unique village/location ID code.
- Keepers and owners could be made unique by using their unique personal ID codes.
- The person responsible for the animals at the premises is to be registered as the keeper, whether he is the owner or not.
- Even if the keeper and the owner is the same person both should be specified separately.

### **3. Identification and registration of animals**

Whether it is required to identify animals individually or by group, they need to be identified with a device and an identification code (ID code) that is appropriate both for the species and the purpose for which it is applied. For example, if the purpose were to demonstrate ownership of the community's animals, a brand may suffice. For some species, such as pigs and poultry, it may be sufficient to identify animals with a group code representing the premises of origin and to register all group movements. For others, such as cattle, a unique

lifetime identification code may be required for each animal to record its movement details or to control its performance.

The ID-code links the animal to the premises where it is kept (see Figure 5). While identifying an animal, certain data need to be collected and maintained at the premises and in the database. The options that are available for uniquely identifying animals and the minimum data that should be recorded while registering them are described below.

### **Developing a unique identification numbering system**

ID codes should preferably be numeric. In principle, ID codes should be kept as short as possible while remaining nationally unique for a turnover period of at least ten generations (approximately 50 years for cattle). In animal breeding, where pedigree information is recorded, a longer turnover period is required. Short and simple ID codes are easy to remember and to handle. However, animal ID codes often contain further information such as herd number and region. The inclusion of such extra codes as part of the animal ID code could provide useful information, such as the origin of an animal. However, although this makes such information easily and immediately available, it also makes the ID code longer and considerably reduces the number of possible ID code. It also makes the management of the ID codes more complex and expensive.

ISO 11784 is the established international standard on the structure of ID codes. It was developed for use in electronic identification worldwide, but the code structure is also applicable for non-electronic ID codes. The basic structure is an individual animal ID code of maximum 12 digits in combination with an ISO 3166 country code (a two-digit alpha code for visual tags and a three-digit numeric code for electronic tags). In this way, the format of identification devices is harmonized worldwide.

It is always advisable to include a check digit in a twelve-digit number, and this is usually included at the end. The check digit is a function of the preceding 11 digits, which helps to prevent entry of a false animal ID code. It works as follows: when the animal ID code is read, an algorithm is applied to calculate whether the check digit is correct. If any digit is incorrectly typed, then the check digit will not match the calculation and the software will prompt a message that the animal ID code is wrong. The correct ID code may then be entered to ensure that the correct data is applied to the correct animal (For an example, see Box 3).

#### **Box 3: Algorithm to calculate a check digit**

Let us assume a tag number is 29102465471, where 2 is the first digit, 9 is the second digit and 7 is the 11<sup>th</sup> digit. The last digit is the check digit; this is derived from the first 11 digits as follows:

The first digit is multiplied by 11, the second by 10 the third by 9 and finally the 11<sup>th</sup> digit by 1. The total sum of these numbers is then divided by 9. The remainder of this division is taken as the check digit.

For the above tag number, the check digit is 1, which is derived as follows:

$(2*11+9*10+1*9+0*8+2*7+4*6+6*5+5*4+4*3+8*2+7*1)/9 = 244/9 = 27$  and the remainder is 1.

If a country has a small population, it may decide to use less than 12 digits. If the country decides to have eight digits, then eight-digit numbers could be printed on the ear tags, but within the database the numbers should be stored as 12 digit numbers by preceding the eight digit ID code with four zeros.

### Identification devices

Depending on the code structure and the animal species, different identification devices such as tattoos, tags or electronic devices are used for identifying animals. It is important that the identification is easily visible. Typically, identification should be visible for the human eye. In some situations however, visible identification is supplemented by electronic identification (electronic ear tags, ruminal boluses, chips). In the case of animals identified individually with ear tags, it might be useful to use larger font for a number of digits (e.g. the last five digits) that can serve as a relevant working number for the animal.

Identification devices should be tamper-proof or at least tamper-evident. Tamper-proof means that the devices cannot be opened without destroying the locking mechanism in a way that they cannot be reused (Figure 6). Tamper-evident means that the devices cannot be opened and reused without clear indications, such as marks, or scratches, on their reuse. In addition, identification devices should not pose risks to animal welfare during the lifetime of the animal.



**Figure 6: An example of a tamper-proof test, showing reusable tags (left photo) and non-reusable tags (right) (Courtesy of Ole Klejs Hansen)**

Please note that the numbers on the tags presented in Figure 6 correspond to the test codes and not to animals ID codes.

A national system may use more than one type of identification devices. Identification devices that may be used are described below:

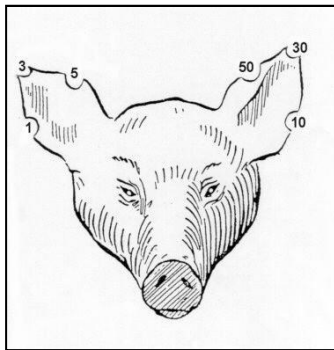
**Drawings, descriptions, photographs.** This method of identification is often used to identify stud animals of certain breeds. It can be used in breeds where individual animals have distinctive colours and markings. In countries where an animal identification system is absent, descriptions can be used to identify animals on most of the documentation that accompanies

them in the event of a sale or transfer of ownership. For example, an animal may be described as being red with a white blaze.

**Hot Branding (large stock).** This method of identification has been in use for centuries. One criticism of the use of hot iron branding is the issue of animal welfare. Additionally, under certain circumstances, it is possible to change characters in brands making them potentially unreliable. Identification based on fire-branding serves well against theft. However, since it cannot ensure individual animal identification, it is not a reliable tool for the implementation of precise movement recording and control systems.

**Freeze Branding.** A freeze brand can be applied through the use of liquid nitrogen ( $-196^{\circ}$  Celsius) or by placing the branding iron in a methylated spirits (alcohol) bath that is cooled down to  $-40^{\circ}$  Celsius by using solidified carbon dioxide. The frozen iron is then placed on the shaven skin and held in place for at least 30 seconds. Freeze branding is slower, more expensive and less reliable than hot branding. In addition, the supply of liquid Nitrogen to the field is limited in many places.

**Ear notching.** Ear notching is an identification method that is based on notches in the rim or holes in the animal's ear, which can be used as a code for identifying the animal.



There are several systems used, and the notches in different systems have different meanings. The example shown in the figure is a very simple system with six different values of notches whereby a maximum of three notches are needed to reach any total value until 99. The animal shown has an ID number of 99. In this system, a hole in the middle of the animal's left ear could denote 100 and a hole in the middle of the right ear could denote 200, and the system would be able to provide ID codes up to a maximum number of 399.

Because of the low number of combinations possible in any ear notch system, ear notching is not able to provide unique codes for national animal identification schemes, and in many cases it will not even be able to provide unique identification for all animals in a herd. In order to understand the notch-code, it is necessary to know which coding system was used at the time of identification.

**Tattoo.** Tattooing is a system where codes are tattooed on the animal's ears or body, so that they are easily visible.



Tattoos can provide unique identification for a larger number of animals than ear notching, and if the animal has one tattoo with the premises code and another tattoo with individual animal ID code within the premises of origin, this method might provide sufficient number of digits for national unique individual animal identification.

Tattoos are often considered to be an easy and cheap identification method. However, the technique has to be carried out with a high degree of accuracy to ensure that the tattoo can be easily read later. Using complicated codes or allowing persons without sufficient training to apply tattoos poses a significant risk to the effectiveness of an identification system.

Additionally, it can be difficult to read tattoos on animals with dark skin or thick hair, or animals that are covered in dirt. Often tattoos are not readable from a distance, which means that one must catch each animal to check its identity. Finally, the cost of character needle blocks is often underestimated. One needs as many sets of blocks as the number of digits in the ID code, adding considerably to the cost.

**Ear tags.** Ear tags are metal or plastic tags that are applied to an animal's ear. Plastic ear tags have the advantage to be very visible and easy to read at a distance, allowing them to hold sufficient digits for national unique ID codes. In official identification programmes, authorities must set requirements for durability, fraud resistance, readability and animal welfare. Internationally agreed test procedures for plastic tags quality are available from a number of sources, including the International Committee for Animal Recording (ICAR). Information about ICAR approved tags can be found on the ICAR website.<sup>26</sup>



Plastic tags are currently the most commonly used method of identification. They are cheap but may be lost; loss rate should not exceed five percent per year. The use of two identical plastic tags per animal, one in each ear enables an animal to be identified even if it loses one tag; the probability of losing both tags is extremely low.

I&R systems commonly use laser-printed plastic ear tags, but in some cases the ID code is written on the ear tag with a special marking pen. A one-dimension or matrix bar-code can be printed along with the number on the plastic tag, allowing the number to be read using an electronic scanner. This eliminates human error in reading and recording tags. However, in certain conditions, e.g. in extensive farming systems, particularly where the humidity is high, the bar-codes may become obscured by dirt and may not be able to be read by the scanner.

Ear tags can be removed and replaced easily. For this reason, it is important to control ear tag distribution and to ensure that only official ear tags are used (which must be easily authenticated). It is therefore important to distribute pre-printed ear tags displaying a special symbol, such as the logo of the competent authority, and to record the distribution and use of pre-printed ear tags in the central database.

Metal ear tags are generally smaller than plastic tags, and can often only be read at close range. It may also be necessary to clean tags before reading them, as the tags and any engraved figures can easily be obscured by dirt.

It is also important to consider that there may be circumstances in which ear tags or notching is not possible, as it is the case with earless animals or in areas where social conditions prohibit puncturing of ears.

**Electronic ID.** Visible identification is often supplemented by Electronic identification (EID), also referred to as Radio Frequency Identification (RFID). The electronic device, which can be programmed with an identification code, consists of a low frequency passive transponder that can be contained inside injected chips, built into ear tags or built into a ruminal bolus. The transponder can be read with an electronic reader.

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<sup>26</sup> See [http://www.icar.org/pages/approved\\_eartags.htm](http://www.icar.org/pages/approved_eartags.htm)



**Figure 7: Examples of electronic devices - From left to right: injected chip, ear tag and ruminal bolus**

The passive transponder must be activated by a radio-magnetic field, applied through the use of an electronic reader (scanner). Once activated, the transponder starts transmitting the unique ID code stored on the microchip. In addition to read-only EIDs, read-write EIDs are also available, which allows the user to include additional data in the EID, such as the animal's date of birth, dam ID, sire ID, birth weight, and the last calving date.

The main advantages of EIDs are that they minimize the effort and amount of physical handling required to record an animal, and reduce the risk of human error in reading the devices. The main disadvantage is the cost of purchasing the EIDs and reading devices. EIDs have mainly been used to identify pets and some horse breeds, but a growing number of countries are beginning to introduce the use of EIDs for farm animals.

**Implant/Chip.** The use of intra-muscular and subcutaneous microchips in farm animals poses a problem to the meat industry as the microchips can migrate in the body and in some instances the microchip implantation can cause abscesses.

**Bolus.** A bolus containing a microchip can be placed inside the rumen with a special introducer. This can only be used in ruminants that are more than three months old. However in contrast to implants, a bolus does not present a risk of migration or abscesses. The bolus is removed from the rumen at slaughter. Although it is theoretically possible to reuse boluses, there is the logistical problem of reallocating microchip numbers that have already been used.

EID devices should comply with international standards, and can be tested for performance and conformance through reference to ISO 24631 (see Box 4). Approved devices can be found on ICAR website.<sup>27</sup>

**Iris and Retina Scan, and Nose Prints.** The techniques consist of taking digitally codified scans or prints and analyzing them using special software. However, they are rarely used due to the cost and the difficulty to obtain scans or prints of an acceptable quality.

**DNA Analysis.** This is the third of the bio-identification methods by which the identity of a particular animal can be proven beyond any reasonable doubt. Unfortunately the testing procedure is expensive and it cannot be used as a national identification system.

<sup>27</sup> See at [www.icar.org](http://www.icar.org) or [http://www.service-icar.com/manufacture\\_codes/Manufacturers\\_DB/manufacture\\_codes\\_main.asp](http://www.service-icar.com/manufacture_codes/Manufacturers_DB/manufacture_codes_main.asp)



#### **Box 4: ISO standards for conformance and performance of electronic identification devices:**

**ISO 11785:** This international standard specifies how a transponder is activated and how stored information is transferred to a transceiver (scanner).

**ISO 24631:** This international standard has several parts that provide the means of evaluating the conformance and performance of ISO 11784/11785 transponders. Manufacturers should provide a copy of the original test report or the ICAR performance test certificate, so that national authorities and users can verify that minimum requirements are satisfied.

Minimum requirements for EID tags used in sheep and goats could be set in electrical units as follows (EU legislation):

Minimum activation field strength: max. 1.2 A/m

Modulation amplitude: min. 10 mV at field strength 1.2 A/m

Minimum requirements for EID tags used in cattle providing higher read distance than for the sheep and goat tags could be:

Minimum activation field strength: max. 0.6 A/m

Modulation amplitude: min. 10 mV at field strength 0.6 A/m

#### **Other ISO standards used to provide animal identification codes:**

**ISO 3166** prescribes codes for the names of countries, dependent territories, and special areas of geographical interest.

**ISO 11784** defines a code structure for country codes or manufacturer codes and animal ID codes. If the transponder has a country code, it is the responsibility of that specific country to ensure the uniqueness of the transponder identification code. If a transponder has a manufacturer code it is the manufacturer's responsibility to guarantee the uniqueness of the code.

#### **Important considerations for selecting an identification device**

An animal should have one unique ID code that is used for all animal recording systems including systems for animal traceability, animal health information and performance recording. This means that all organizations that use, or may wish to use I&R should be involved in the discussion.

Hot branding of large stock and tattooing of small stock remain a good method for achieving group identification and preventing theft. Laser printed ear tags with a controlled production and distribution system are most frequently used for individual identification and traceability. Where theft is a problem, boluses may present a good solution. However, the choice of identification method may be restricted by cost. While the cost of EIDs are decreasing, one still has to consider the reader cost, bearing in mind however that an electronic reader is not required for every animal keeper. The use of EIDs and visual ear tags can be combined. Table 1 summarizes the key issues regarding the use of various identification devices.

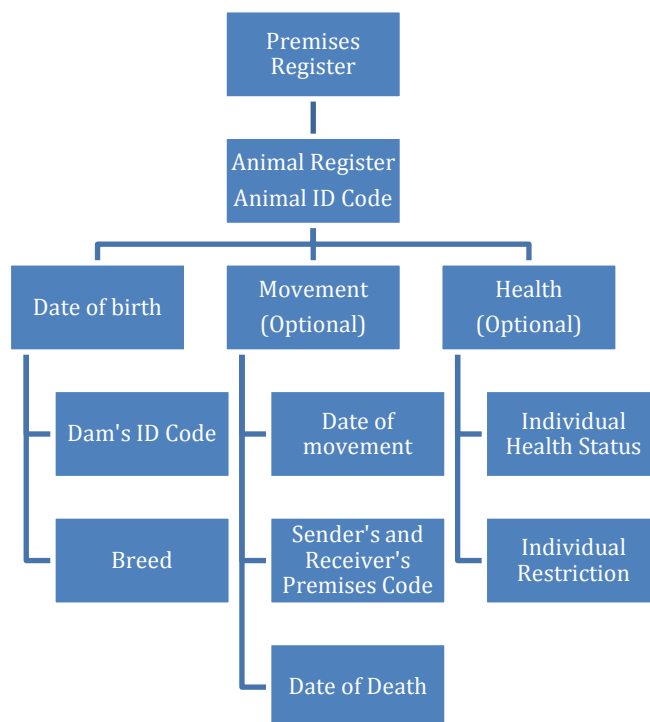
**Table 1: Advantages, challenges and costs of various animal identification types**

ID device type	Advantages	Challenges	Costs
Ear Notch	<ul style="list-style-type: none"> <li>• Easy application</li> <li>• Tamper evident</li> </ul>	<ul style="list-style-type: none"> <li>• No global standard for value of notches</li> <li>• Low number of ID-codes</li> <li>• Difficult to read from a distance on hairy animals</li> </ul>	<ul style="list-style-type: none"> <li>• Device is cheap</li> <li>• Labour cost for reading and registration is high</li> </ul>
Tattoo	<ul style="list-style-type: none"> <li>• Tamper evident</li> <li>• High number of ID codes</li> </ul>	<ul style="list-style-type: none"> <li>• Application must be done very carefully to ensure that the tattoo remains readable</li> <li>• Difficult to read from a distance on hairy, dark or dirty animals</li> </ul>	<ul style="list-style-type: none"> <li>• Medium cost device</li> <li>• Labour cost for reading and registration is high</li> </ul>
Metal ear tag	<ul style="list-style-type: none"> <li>• Easy application</li> <li>• Tamperproof</li> <li>• All ID-codes are possible</li> <li>• Low loss rate</li> </ul>	<ul style="list-style-type: none"> <li>• Difficult to read from a distance</li> <li>• Animal welfare issues can arise due to sharp edges</li> </ul>	<ul style="list-style-type: none"> <li>• Device is cheap</li> <li>• Labour cost for reading and registration is high</li> </ul>
Plastic ear tag	<ul style="list-style-type: none"> <li>• Easy application</li> <li>• Easily readable</li> <li>• All ID-codes are possible</li> <li>• Bar code possible</li> </ul>	<ul style="list-style-type: none"> <li>• Use only tags tested for fraud resistance, durability, readability, animal welfare</li> <li>• Loss rate may be a problem in rugged environments</li> </ul>	<ul style="list-style-type: none"> <li>• Device is relatively cheap</li> <li>• Labour cost for reading and registration is low</li> </ul>
Electronic plastic ear tags	See Plastic ear tags	<ul style="list-style-type: none"> <li>• See plastic ear tags</li> <li>• In addition, only use tags tested for electronic conformance and performance</li> </ul>	<ul style="list-style-type: none"> <li>• Device is more expensive</li> <li>• Enables automatic reading and hand-ling of animals</li> </ul>
EID boluses for ruminants (only possible with low frequency tags, ISO 11785)	<ul style="list-style-type: none"> <li>• All ID-codes are possible</li> <li>• Tamperproof</li> <li>• Loss rate is independent of environment</li> </ul>	<ul style="list-style-type: none"> <li>• Cannot be applied until the animal has reached a minimum age</li> <li>• No visual identification unless in combination with external ID device</li> </ul>	<ul style="list-style-type: none"> <li>• Device is more expensive</li> <li>• Enables automatic reading and hand-ling of animals</li> </ul>
Injectable chips (only possible with low frequency tags, ISO 11785)	<ul style="list-style-type: none"> <li>• All ID-codes are possible</li> <li>• Tamperproof</li> <li>• Loss rate is independent of environment</li> </ul>	<ul style="list-style-type: none"> <li>• Application is complicated</li> <li>• No standard for injection site</li> <li>• Low read distance</li> <li>• No visual identification unless in combination with external ID device</li> </ul>	Device is more expensive



## Registration of animals

The data that should be collected at the time of registering an individual animal include: ID Code, date of birth, dam ID, and breed. Certain additional data may be collected if I&R supports other animal recording system's components. For example, details of animal movements, including the date, are required for animal traceability systems; health status and individual restrictions are required for animal health information systems (See Figures 3, 5 and 8).



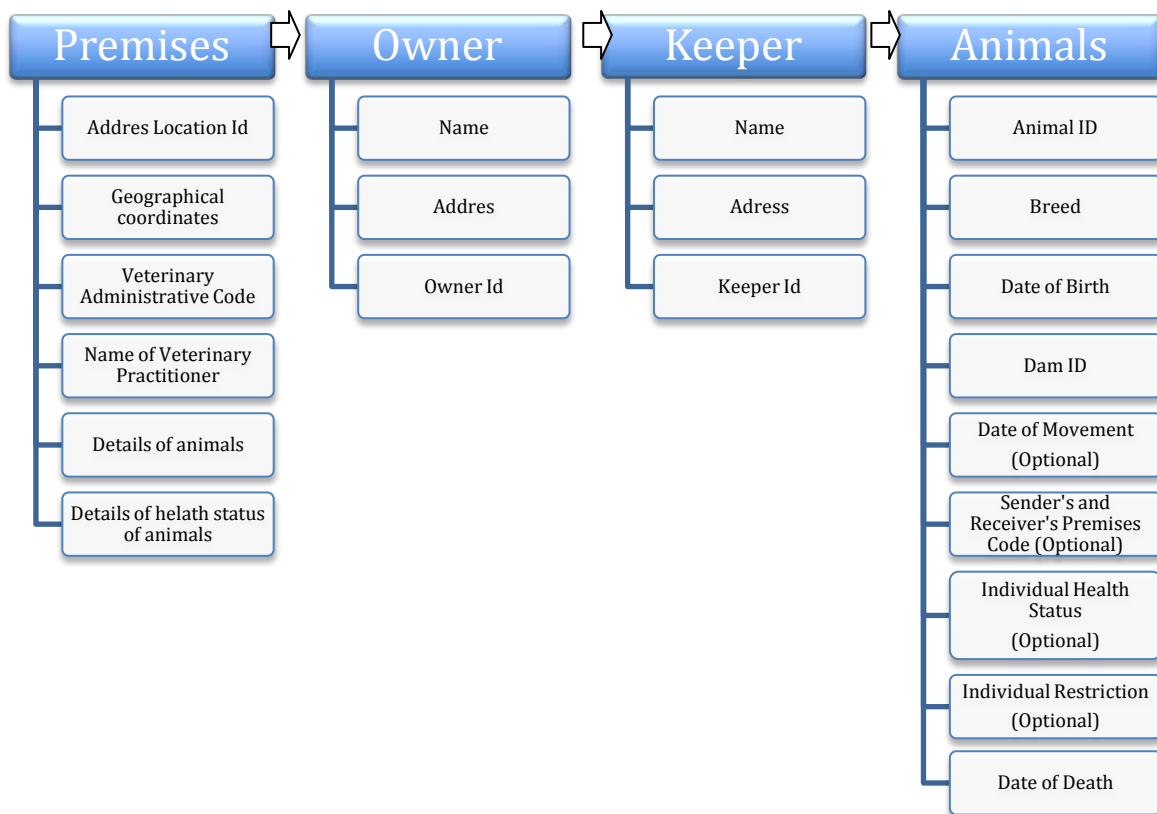
**Figure 8: Schematic presentation of an animal register (and its links to the premises register)**

A computer based system is necessary for I&R. It should have a built-in audit function that automatically checks for missing or inconsistent data and reports those to the responsible staff who will ensure that animal keepers, abattoirs and other relevant stakeholders comply with their record keeping requirements, and that reported errors are corrected.

A simple paper based system for the animal keeper is possible under the condition that reports are sent from the farm to the competent authority within a few days of a recordable event taking place. This data must then be entered into the centralized database as quickly as possible. All relevant events, such as animal movements, births or deaths, should be reported as soon as possible.

## An integrated view of I&R systems

The I&R process does not just consist of the identification and registration of animals, but also of premises, keepers and owners (See Figure 9).



**Figure 9: Animal identification and registration - an integrated view**

As explained in Section II, there are two main options when implementing an animal recording system. In option one, the I&R component forms a core module of a single central database of a fully integrated system, which includes the other modules – animal traceability, animal health information and/or performance recording. The second option would be that I&R forms a core subsystem for all other subsystems. In this case, one organization is responsible for maintaining the I&R database; all other organizations implementing specific animal recording subsystems extract data from the I&R database to their own database. In this way, linkages are established between the different systems such that the databases and applications are able to export and import data elements through XML files protocol. This is referred to as system interoperability.

## Section IV. Animal traceability

### INTRODUCTION

The development of animal traceability (AT)<sup>28</sup> systems has gained importance worldwide in the last two decades. The prime drivers for this have been protection of animal and public health, assurance of food safety and quality, and facilitation of market access and trade. These drivers and potential benefits of AT systems are extensively described in Section I of these guidelines. A summary is provided in Subsection 3, Paragraph 1 of this section, which reviews the objectives of an AT system. Countries that develop effective AT systems are not only better prepared to ensure safe and quality food to their consumers and guarantee public and animal health, but also have comparative advantage in enhancing their export of animal products. Those that have implemented an effective AT system often require countries that export animal products to their markets to establish an equivalent system. Sanitary and phytosanitary measures (SPS) along with AT requirements are increasingly becoming major non-tariff barriers (NTB) to international trade in animals and products of animal origin.

This section describes a conceptual framework for AT, with a main focus on animal movements. The development and implementation of a strategic plan for building an AT system is addressed in the third part of these guidelines, which describes how to put the conceptual framework into practice. The process for developing an AT system is similar to that for animal identification and registration, animal health information or performance recording systems. For this reason, these processes are addressed together later in these guidelines.

While delineating the conceptual framework, this section reviews the multiple objectives of an AT system, describes the elements of such a system and the different options for tracing an animal or a group of animals, and outlines the data that should be recorded in each case.

### OBJECTIVE

The objective of this section is to describe the types of AT systems and their requisite elements that should be developed, considering the local situation and the objectives for which it is being implemented.

### DEVELOP THE CONCEPTUAL FRAMEWORK

The International Organization for Standardization (ISO) defines traceability as "the aptitude to find the history, the use or the localization of an entity by means of recorded identifications".<sup>29</sup> In the context of *animal production*, traceability refers to the ability to access the history of an animal or a group of animals throughout the course of its life.<sup>30</sup> In the context of *animal health*, it refers to an animal's location and movements, its health status

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<sup>28</sup> to maximize ease of reading, only this acronym is used in this section

<sup>29</sup> ISO 8402:1994

<sup>30</sup> The Terrestrial Animal Health Code of the Office International des Epizooties (OIE) defines animal traceability as "the ability to follow an animal or group of animals during all stages(s) of its life".

(including its history of vaccinations and disease testing), and the ability to access the history of other animals that it has come into contact with during its life cycle. In the context of *food safety*, the aim is to prevent contaminated or poor quality products from reaching the consumer and to respond promptly and effectively in the event that they should do so.<sup>31</sup> In this case, traceability refers to the ability to trace animal products along the value chain. When developing an AT system, it is therefore essential to identify the desired objectives of such a system before defining its individual elements.

## ***1. Objectives of an animal traceability system***

An AT system can serve several objectives including, but not limited to, the following:

- **Enhancing risk management procedures** in order to:
  - enable risk managers to trace identified hazards (e.g. transmissible animal diseases and zoonoses, antimicrobial residuals) back to their source;
  - assess the potential spread of these hazards, therefore enabling effective control.
- **Protecting public health** in order to:
  - identify, trace and control animal movements, particularly concerning the possible spread of zoonoses;
  - identify, trace and recall unsafe foods (and feeds) at any stage of the food production and distribution chain.
- **Improving animal health services** in order to:
  - improve disease surveillance and control;
  - ensure inspection and certification of animal health.
- **Capturing trade opportunities (World Trade Organization Agreement on Sanitary and Phytosanitary Measures (WTO SPS Agreement))** in order to:
  - facilitate trade certification and access to markets with higher safety and quality standards.
- **Ensuring fair practices in food trade (World Trade Organization Agreement on Technical Barriers to Trade (WTO TBT Agreement))** in order to:
  - minimize the exercise of deceptive practices and fraud in the market place, and reduce the instance of unsubstantiated product claims (e.g. geographic indication, food quality, etc.).
- **Mitigating stock theft** where the aims are to:
  - facilitate identification of the rightful owner, resolve ownership disputes, and discourage livestock theft.
- **Facilitating the operationalization of animal insurance, subsidy and compensation payment schemes**

## ***2. Elements of an animal traceability system***

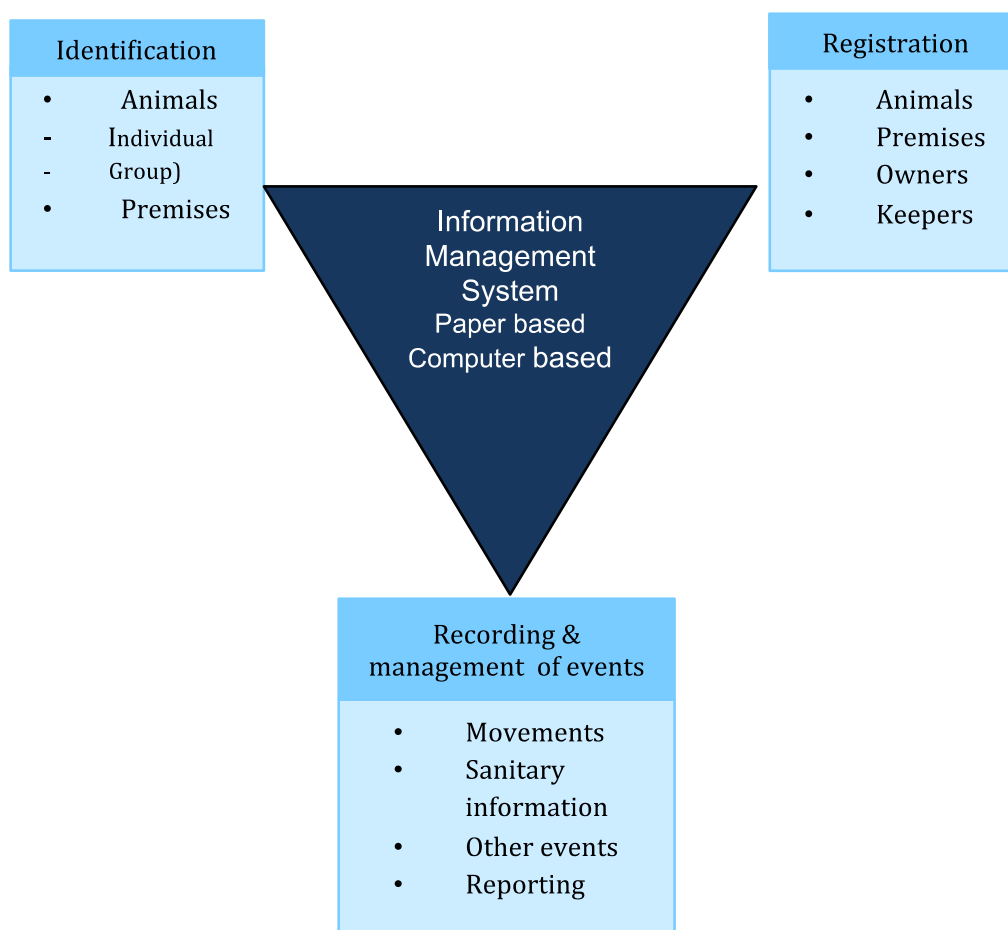
The key elements of an AT system are:

1. unique identification of individual animals or groups of animals and of the premises where animals are kept, reared, housed or gathered;
2. registration of identified animals, premises, owners and keepers;
3. detailed recording of key events including movement of animals between premises, and animal births or deaths;

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<sup>31</sup> The Codex Alimentarius Commission (CAC) guidelines CAC/GL 60-2006 define traceability as “the ability to follow the movement of a food through specified stage(s) of production, processing and distribution”.

4. recording of sanitary information for veterinary certification; and
5. collection and reporting of information.



**Figure 10: Breakdown of an AT system**

Figure 10 shows that an animal identification system is a prerequisite of a functional AT system, and that the latter cannot be developed until the former is in place (see also Figure 3). If the reader is unfamiliar with animal identification and registration, it is advisable to read Section III of these guidelines that provides detailed guidance on this topic, before proceeding with this section.

Depending upon the objectives and the scope of the AT system, the levels of its implementation (i.e. the depth, breadth and precision) are determined by the number, level of detail, frequency and clarity of the above data elements and the system functionalities.

### ***3. Types of traceability system***

AT systems can be categorized according to:

- **The extent of the value chain covered.** This can be divided as follows:
  1. An AT system refers to the traceability of the animal from the farm to the abattoir lairage; all animal movements and events during rearing, production, and marketing are recorded.

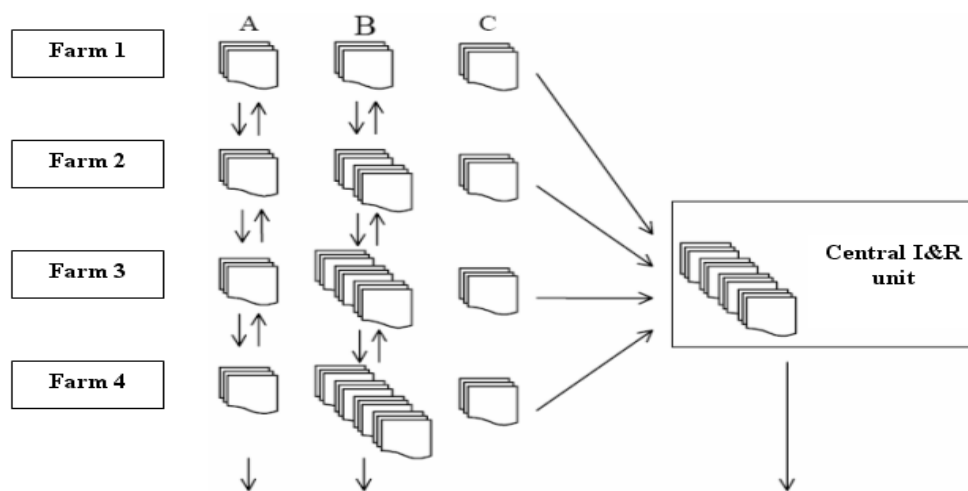
2. A product traceability system facilitates traceability from the abattoir or meat and dairy processing plant to the point at which the animal product is purchased by the consumer.
3. A full traceability system extends across both segments of the value chain and is generally referred to as “traceability from farm to fork”.

These guidelines address only (live) animal traceability.

- **The type of data management system.** An AT system may be paper based or computer based. A simple paper-based traceability system only supports single-tier traceability. It only addresses movement to and from the premises maintaining the record. The movement information is maintained locally on the farm or in a local extension, veterinary, police or administration office. In order to compile a complete record of movements for an animal or animals, it is necessary to trace each separate movement. This can be time consuming and may prevent a timely response in the event that a disease risk is detected. For chronic animal diseases that are not zoonotic, it may be considered appropriate that animals can be traced over a longer period. However, if the objective is to be able to trace susceptible animals within 24 to 48 hours (in order to manage highly contagious diseases such as foot and mouth disease (FMD) or avian influenza) a computer based AT system that is capable of capturing and mapping all recorded data elements and animal movements would be required. Box 5 summarizes the different systems for tracking movements between premises.
- **The type of the identification system.** Animals may be identified and traced individually or in groups, such as the herd or the specific geographical location (e.g. village) in which they are kept.

For all these AT systems, the amount of information and the level of detail that can be centrally available and retrieved depend upon the number and disaggregation of data elements of animals, premises and owners and keepers. A minimum traceability system would be based on the identification of the animals when they leave their premises (e.g. farm or village) and the recording of movement on paper. In this case, the database may only hold premises information (locality, animal keeper, and annual census).

### Box 5: Tracking movements between various premises



#### 1. Type A System

In system A, each link (premises) in the production chain gets the relevant information from the previous link from which the animal has been supplied. The advantage of this type of system is that the amount of information to be communicated remains small. This reduces the transaction costs. The disadvantage is that this system is largely based on trust. Each link has to trust the quantity and quality of the information passed on by the previous link. Furthermore, in case of an emergency, all links need a perfect administration for a fast response to be organized.

#### 2. Type B System

In system B, each link receives the relevant information about all previous links from the last one. Compared with the type A system, tracking and tracing can be achieved much faster in the event of an emergency. Moreover, because each link in the chain receives all previous information, the completeness of information can be controlled. Also the chain's transparency is better than with the type A system. A disadvantage is that the amount of information to be transferred increases with each link of the chain.

#### 3. Type C System

In the type C system, each link provides the relevant information to the central identification and registration unit that accumulates the information concerning all links in the considered production chain. This can address the matter of trust. Also, tracking and tracing can in principle be carried out rapidly. Moreover, since the organization is dedicated to the system, the danger that the system is not well maintained because of lack of time or resources is in principle minimized. On the other hand, total costs may be larger.

Source: Ferdinand Schmitt

### 4. Tracing animal movement

A movement occurs when an animal leaves one premises and enters into a new one. In several AT systems, especially for large ruminants, movement events are traced and controlled by issuing an individual movement ID card on which all animal movements are recorded. In the

European Union, an individual movement ID card is issued for a certain species (called an animal passport in the context of cattle, a sample of which is displayed in Figure 11). An individual animal movement ID card must at least contain the following:

- Animal ID;
- Colour(s);
- Sex;
- Year or date of birth, if known; and
- Premises ID of birth.

Depending upon the objective, additional requirements could be added, including the sire ID, dam ID (this is important for tracing vertically transmitted diseases such as bovine spongiform encephalopathy (BSE)), the health status and vaccination history of the animal and information concerning treatments.

Whenever the animal is moved, movement details are recorded in the movement ID card. Information that must be recorded at the time of movement includes the ID of the original premises, the date of departure, the ID of the new premises and the date of arrival. Additional information that may also be recorded includes the type of movement (for example leased in, leased out, sold, purchased, recovered from loss or theft, sent to slaughterhouse, exported, imported) and the vehicle ID. In some countries birth, slaughter and death are also registered as movements (in a movement register) because identification and registration, and traceability are in an integrated system.

A system based upon an individual movement ID card could be feasible for large animals (e.g. cattle and horses) and only when identification and registration is based on the individual animal identification. It is not practical for small animals, for which the number of individuals and the speed of population renewal frequently hamper the implementation of a comprehensive individual animal identification. In these cases, a group movement permission paper is often issued by the veterinary services. This can be useful in case of trace-back and trace-forward investigations.

In a traceability system based on an individual movement ID card, it is necessary to specify the maximum time within which a movement card should be issued for every newborn animal (e.g. within one month of birth). Similarly, the maximum timescale within which every movement should be recorded in the movement ID card must be specified (e.g. within three days of the movement). Each animal should travel with its movement ID card throughout its life. The movement ID card should be returned to the designated authority on animal's death or slaughter.

In case of animal imports, a record of the animal identification from the exporting country should be kept. This should be linked with the animal identification assigned in the importing country. Similarly, in case of animal exports, a record of the animal identification from the exporting country should be provided to the veterinary authority in the importing country.



**Cattle Passport**  
**Pasport Gwartheg**

British Cattle  
Movement Service  
Gwasanaeth Symud  
Llofnod

Ear tag / Tag clust:  
**UK123456400011**

Breed /Brid: **HOLSTEIN FRIESIAN**  
Sex /Rhyw: **MALE**  
Born /Ganwyd: **01 08 2011**  
Genetic Dam /Mam Eneftig: **UK123456700007**  
Sire /Tad: **UK123456300003**

Issue Date **09 08 2011** Version **01**  
Dyddiad cyhoeddi: Fersiwn:

Please check the details are correct, if not amend and return to BCMS. Gwiriwch fod y manylion yn gywir, ac os nad ydychwylt eu haddasu a'u dychwelyd at GSGP.

**Movement history / Hanes Symud**

Location Lleoliad	Address Cyfeiriad	Date on Dyddiad cyrraedd	Date off Dyddiad ymadael
01/234/5678-01	BOHS CURWEN ROAD, DERWENT HOWE, WORKINGTON, CUMBRIA, CA14 2DD	01 08 2011	

**To be completed by keeper on receipt of passport / I'w gwblhau gan geidwad ar dderbyn pasport**

Space for other information

Place your holding address label here  
Rhowch label cyfeiriad eich daliad yma

Signature  
Llofnod

Date of movement OFF holding / Dyddiad YMADAEL â'r daliad

Signature  
Llofnod

**Death details / Manylion y farwolaeth**

Reported electronically tick this box

Place your holding address label here  
Rhowch label cyfeiriad eich daliad yma

Signature  
Llofnod

Date of DEATH / Dyddiad y FARWOLAETH

Please remember to return the animal's passport to BCMS within seven days of the animal's death  
Cofiwch ddychwelyd pasport yr anifail i GSGP o fewn saith niwmod o farwolaeth yr anifail

British Cattle Movement Service  
Gwasanaeth Symud Gwartheg Prydain  
Curwen Road, Workington, Cumbria, CA14 2DD  
General helpline / Cyffwrdd: 0845 050 1234  
Cymraeg: 0845 050 3456  
Email / Cyfeiriad e-bost: bcms-enquiries@bcms.rpa.gsi.gov.uk

Report births, movements and deaths electronically using:  
Adrodd ar enedigaeithau, symudiadau ac marwolaethau yn electronig gan ddefnyddio:  
• CTS Online / SOG Ar-lein: [www.bcms.gov.uk](http://www.bcms.gov.uk)  
• CTS self service line: 0845 011 1212  
• Linell Human Wasanaeth SOG: 0845 011 1213  
• Or using a farm software package / Neu'n defnyddio pecyn meddalwedd ffarm

**For TSE use only / At ddefnydd TSE yn unig** **Born / Ganwyd**  
**01 08 2011** **UK123456400011**

**Figure 11: A sample of a cattle passport issued by the Government of the United Kingdom**

## 5. Control of animal movement

Animal movement control is the main reason for an animal traceability system. Movement reporting will increase if controls and incentives are implemented. Incentives (e.g. subsidies, drought season support) should benefit only herds that comply with all animal identification and traceability obligations. Controls should be performed at different stages: during

transportation by road police, in livestock markets and in slaughterhouses. Only animals that are in compliance should pass and be accepted. Control in livestock markets could be improved with adequate infrastructure (e.g. a fence, a single entrance, the presence of a market operator, veterinary inspections or authorized veterinarian).

The passage of animals through livestock market creates a large numbers of contact animals threatening the entire population in case of an outbreak of a contagious disease. Therefore, all existing livestock markets should be included in the animal identification and traceability system, regardless of their official state. To avoid conflicts with existing legal veterinary provisions, non-official livestock markets must either be officially approved or must be closed within a reasonable time period, otherwise, the central database would not mirror the reality. This issue is not easily solved however, as official approval requires appropriate sanitary conditions. Furthermore, severe controls may lead to the emergence of new informal markets elsewhere, preventing the commune from levying market taxes.

## ***6. IT infrastructure***

An AT system should operate as part of an integrated animal recording system, and cannot exist in isolation. Therefore an information technology (IT) system for AT must always contain information concerning animal identification, registration and events management, all of which are required to enable traceability. No traceability system can be effective unless it is supported by an efficient, integrated information system that captures data and provides information to all stakeholders in the shortest time possible. Section VIII provides detailed guidelines on establishing an IT infrastructure and developing a software application for an integrated information system covering all components of the animal recording system (animal identification and registration, AT, animal health information and performance recording).

The main resources for the required central infrastructure include: a database server to host data, a web server to host web-based applications, a data warehouse server to produce specific reports and high speed connectivity. The distributed IT network to capture data and generate information could take the following forms:

- collecting data on paper and entering data through desktops or laptops;
- entering data directly on smartphones/PDAs by field workers and synchronizing local database periodically with the central database; or
- a mixture of the above two, depending on the species and/or production system.

A suitable and user-friendly software application is necessary in an AT system for capturing, validating and retrieving data and reports through different platforms such as smartphones/PDAs, netbooks, tablets, laptops, desktops, etc. The installed application should support transmission of the required information to various users (e.g., governments, veterinary authorities, livestock producers, service providing organizations, livestock markets and slaughter houses) in various formats (e.g. as print output, email, PDF files, HTML pages, smartphones/PDAs and mobiles) and as various outputs (e.g. as alert messages, operational reports, review reports, graphs, analytical reports and statistical summary reports).

## Section V. Animal health information

### INTRODUCTION

The primary objective of any animal health information (AHI)<sup>32</sup> system is to collect, manage and systematically analyze data in order to generate appropriate information for various stakeholders along livestock food value chains. These data may be used to support the decision-making process in relation to diseases prevention, eradication or control and may support the design, development and management of surveillance programs.

A wide variety of disease drivers (e.g. increased intensification of livestock production, global trade, animal movement and climate change) are facilitating the emergence of new diseases and creating endemic problems. This poses new challenges for the prevention, control and eradication of animal diseases and makes the tasks of AHI systems more complex. On the other hand, the evolution and availability of new technologies, such as mobile devices, bioinformatics and geographical information systems have made the development of AHI systems a dynamic process that is being developed constantly to meet these challenges and the changing needs of users.

This section describes a conceptual framework for AHI systems. The development and implementation of a strategic plan for building an AHI system is addressed in the third part of these guidelines, which describes how to put the conceptual framework into practice. The process for developing an AHI system is similar to that used for developing animal identification and registration, animal traceability or performance recording systems. Therefore, these processes are addressed together later in these guidelines.

### OBJECTIVE

The objective of this section is to describe the elements of an AHI system and provide guidance on how they may be used and integrated with other relevant systems.

### DEVELOP THE CONCEPTUAL FRAMEWORK

#### *1. Objectives of animal health information systems*

AHI systems can be used to fulfil several different objectives including facilitating the identification and notification of animal diseases in accordance with legislation and the priorities of veterinary services. By collecting accurate data, AHI systems support the monitoring and management of emerging and endemic diseases and of other specific diseases. They may also be used to support the development of disease prevention and control measures. Considering the aim of these guidelines, this paragraph addresses four key objectives of AHI systems:

**To support official animal disease notification systems**, which are focussed on the collection of outbreak data for subsequent notification to other information systems (World

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<sup>32</sup> to maximize ease of reading, only this acronym is used in this section

Animal Health Information System (WAHIS) of the World Organisation for Animal Health – (OIE)), to fulfil international obligations.

**To support management of animal health emergency systems,** which provide information that facilitates rapid intervention in the event of a disease outbreak. Examples of utilities provided by such systems include:

- on-line queries to the animal identification and registration and traceability systems for retrieving and presenting connections between premises due to animal movements (see Figure 3);
- facilitating epidemiological inquiries (tracing-back and tracing-forward investigations) in confirmed disease outbreaks;
- defining buffer (e.g. protection and surveillance) zones around outbreaks; and
- providing the list of premises within such zones using web-based geographical information system (GIS) tools.

**To enhance animal disease surveillance and early warning information systems.** These systems combine data derived from:

- animal identification and registration systems;
- animal traceability systems;
- control and surveillance activities (e.g. vaccination data, herds or animals sampled and laboratory testing results); and
- other relevant systems, such as the incidence of human cases of zoonoses or the use of antimicrobials in food producing animals.

Surveillance and early warning information systems are essential for assessing the health status of animal populations, monitoring and improving the surveillance activities in place, supporting decision-makers in planning prevention, control or eradication strategies and framing zoning or compartmentalization policies. The assessment of the genetic resistance of animal populations to some diseases may be also one of the objectives of the surveillance systems (e.g. in the case of genetic selection programmes for scrapie). Surveillance information systems may also be used to demonstrate the absence of specific diseases, in order to achieve disease free status, in accordance with the requirements of competent institutions.

**To support risk assessment.**<sup>33</sup> This involves the collection of a wide range of data in order to facilitate a number of key actions, including the following:

- quantifying disease prevalence and incidence;
- estimating the probability of the spread of infection through the animal trade (disease import risk analysis) and other means (e.g. vectors dissemination for vector-borne diseases);
- identifying the presence of risk factors (for example, summer grazing on common pastures, use of common feed possibly contaminated, etc.); and
- estimating the magnitude of the possible consequences for the animal or human (in case of zoonoses) populations exposed to the infectious agent.

The objectives mentioned above are not mutually exclusive, and a certain degree of overlap may be observed in practice. One important component of any AHI system is herd health

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<sup>33</sup> For the definition of “risk assessment” and related arguments, please refer to OIE Terrestrial Animal Health Code: [http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre\\_1.2.1.htm](http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_1.2.1.htm)

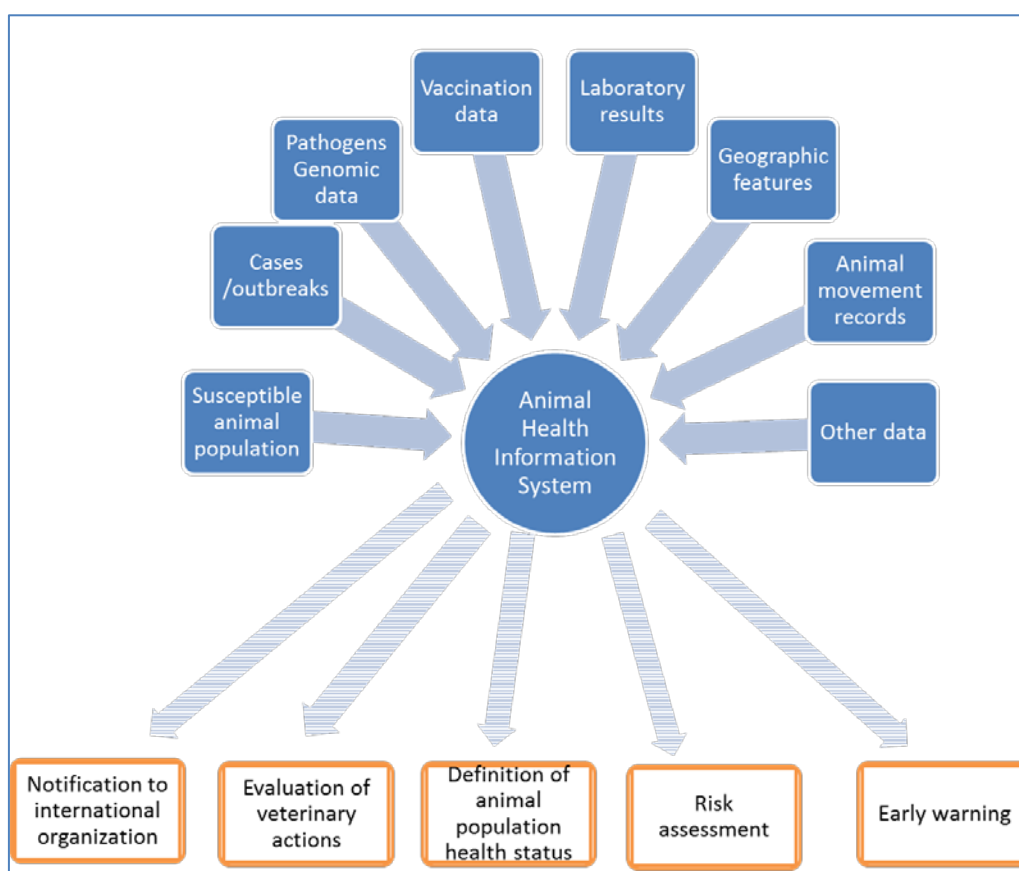
management, in which disease data is maintained both for individual animals and for the herd as a whole. Consequently, the data collected may be used not only to benefit diseased animals, but the whole herd. The details of herd health management are covered under performance recording in Section VI of these guidelines.

The EMPRES Global Animal Disease Information System (EMPRES-i) is an example of AHI system.<sup>34</sup> EMPRES-i is a web-based application that has been designed to support veterinary services and organizations by facilitating the collation, analysis of and access to animal disease information. It integrates several data layers, such as livestock density and the environmental variables from other FAO systems (e.g. from Global Livestock Production and Health Atlas - GLiPHA) and data on genetic characterization of pathogens (e.g. those deriving from the Openflu database).<sup>35</sup>

Although the internet has revolutionized and reduced the cost of the data collection and dissemination process, gathering and analysing data still constitutes a major expenditure when implementing any AHI system. As the sophistication of AHI systems has increased, so too has the need for hardware and skilled labour, thus further boosting associated costs.

## 2. Inputs and deliverables of animal health information systems

The data input and information deliverables of an AHI system are depicted in Figure 12 and are described briefly below.



**Figure 12: Inputs and deliverables of an AHI system**

<sup>34</sup> See <http://empres-i.fao.org/eipws3g/>

<sup>35</sup> See <http://openflu.vital-it.ch/about.php>

## 2.1 Input data

**Data on disease cases and outbreaks.** The collection of data on the occurrence of animal diseases requires a clear and unambiguous ‘case definition’ for each disease. The OIE Terrestrial Animal Health Code reports some case definitions for diseases for international trade purposes.<sup>36</sup> National legislation and regulations may also indicate case definition for many animal diseases, especially in relation to existing surveillance activities. Specific rules and diagnostic protocols have to be defined for cases confirmation, taking into account the characteristics of the diagnostic tests.<sup>37</sup> Sometimes a correct case definition may be difficult to obtain, particularly for asymptomatic infections in animals (e.g. for emergent diseases such as Influenza A infection in multiple species, Middle East Respiratory Syndrome, or Crimea Congo Haemorrhagic Fever) or when wildlife is involved.

In addition, case definition may be determined by the objectives of the surveillance system. For example, with vector-borne zoonotic diseases (e.g. Rift Valley fever, West Nile or Japanese Encephalitis) where the main aim is early detection of any circulating virus for prompt institution of public health protection measures, even the detection of viral genome by RT-PCR on mosquito pools may be included in the case definition.

For each suspected and confirmed case of disease the minimum data elements that must be collected include the following:

- the disease in question (sometimes the identification of the strain or the subtype/serotype can be fundamental);
- the location of the disease outbreak (the ID code of premises involved, with related geographic coordinates);
- the species of animals affected (demographic data on infected premises);
- the time and date on which the disease first occurred (date of first clinical signs, date of first suspicion, date of confirmation);
- how the infection has been detected, and what initially raised suspicion;
- which control measures have been put in place to limit the spread of the disease;
- the results of epidemiological investigations, both to identify the origin of the infection and any other premises that may have been exposed to the infection.

In general the geographic localization of an outbreak is demarcated by the epidemiology unit affected (farm, premises or village) where one or more cases of the disease have been confirmed. In practice, much of the data to be recorded in the event of an outbreak may be available through an animal identification and registration system. Special situations can be identified. For example, the disease may be detected in a geographical location where animals are brought together from numerous locations (e.g. in pastures or villages), or at the abattoir (e.g. contagious bovine pleuropneumonia (CBPP), bovine tuberculosis). In such situations, an effective AT system and a well-established animal identification and registration system play a crucial role in identifying the premises the animals came from, therefore enabling the source of the disease to be identified.

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<sup>36</sup> See <http://www.oie.int/international-standard-setting/terrestrial-code/access-online/>

<sup>37</sup> For the characteristics of the diagnostic tests and their use as confirmatory tests, at least for the international trade purposes, the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals must be considered. See <http://www.oie.int/international-standard-setting/terrestrial-manual/access-online/>



**Data on susceptible animal populations.** To identify susceptible animal populations, it is necessary to have data on the number of animals of susceptible species that are located in the proximity of outbreaks, animals that are within a certain radius of the outbreak area (e.g. in buffer zones or ecological areas) or that may otherwise have been exposed to the disease. Often these data may be retrieved from the animal identification and registration system. It is also important to gather data concerning the type of premises (e.g. breeding farms, fattening farms, collecting centres, or animal markets) as well as data on animal densities in the areas of concern. An animal identification and registration system may provide information on animals and animal numbers that is subdivided by category (e.g. fattening versus breeding animals), allowing more informed planning of control activities, such as vaccination campaigns or monitoring programmes.

**Data on animal movements.** Data concerning the number of animals of the susceptible species or other group that have been subject to movement may be retrieved from the animal traceability system. For practical purposes these data are often represented in AHI systems in the form of movement networks, using the social network analysis (SNA) method. Representing animal movement as a network of connections between premises has the advantage of promptly defining all possible infection routes in the event of an outbreak. In addition, the analysis of the animal movement network may highlight those premises that are at greatest risk of spreading infection (called “hub” or “super spreaders”) due to the number, intensity and complexity of their connections. The identification of potential “super spreaders” facilitates better planning of preventive measures, including more efficient resource allocation.<sup>38</sup>

The retrieval and analysis of data on animal movements is important not only in the case of direct or indirect contact (e.g. foot and mouth disease, peste des petits ruminants (PPR)) but also for vector-borne diseases (e.g. rift valley fever (RVF)) due to the possibility of infection being spread through the movement of viraemic animals. Systematic and timely recording of animal movement between premises is carried out by animal identification and registration and animal traceability systems. Additionally, an up-to-date herd register, reporting all animals entering or leaving the premises, is a key element of the animal identification and registration system.

**Data on geographic features.** The availability of geographical layers of detailed data on roads, mountains, rivers, lakes and other geographic barriers is important both for planning in-field interventions in health emergencies, and for risk assessment studies and surveillance purposes. This is especially important for vector-borne diseases, when preventive action, such as vaccination, has to be put in place. In the context of vector-borne diseases a range of other information, including climate conditions (e.g. temperatures, humidity and rainfall) and environmental factors (e.g. wind speed and direction, soil texture, land use, vegetation cover, vegetation indexes) is useful for identifying the zones that are more likely to be associated with disease spread or endemicity, thus facilitating the implementation of more targeted preventive action. Normally, basic geographical layers showing the administrative subdivision of the country (regions, provinces, governorates, prefectures, departments, etc.) are available in the animal identification and registration system together with the geographical coordinates of premises. If this is not the case, in order to support proper management of health emergencies, these must be included within the AHI system. These

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<sup>38</sup> see also: Calistri P., Conte A., Natale F., Possenti L., Savini L., Danzetta M.L., Iannetti S., Giovannini A. (2013). Systems for prevention and control of epidemic emergencies. *Veterinaria Italiana*, 49 (3), 255-261. doi: 10.12834/VeIt.1206.06. Available at [http://www.izs.it/vet\\_italiana/2013/49\\_3/255.htm](http://www.izs.it/vet_italiana/2013/49_3/255.htm)

data concerning geographic features complement those concerning the localization of farms and other places where animals are kept (e.g. pastures).

**Laboratory results.** The results of laboratory investigations are an essential part of any AHI system. The inclusion of these data requires the standardization of all information, such as the type of laboratory methods used and the format of results (qualitative versus quantitative values, definition of “negative” case). Particular attention should be paid when applying the concept of “sample” in coherence with the objectives of the AHI system (see Box 6). The inclusion of laboratory results could imply the development of an interface between the AHI system and one or more pre-existing laboratory information management systems (LIMS) where laboratory results are stored.

#### **Box 6: "Sample" definition**

The OIE Manual of diagnostic tests and vaccines for terrestrial animals defines a “sample” as the “material that is derived from a specimen and used for testing purposes”.<sup>39</sup>

This definition may be sufficient for laboratory quality systems. However, this definition may not be sufficient for the epidemiological objectives of an AHI system, which require information on the health status of animals (both as individual animals or groups of animals), premises or territories. Therefore, it must always be possible to link data from each sample to its source of origin (an individual animal, a group of animals, and/or premises). This may not be easy to achieve in certain conditions, for example in the case of pooled samples or when food is tested. When the animal identification and registration system is effectively implemented, it can support sample management by linking the animals from which samples have been collected (e.g. bar code or ear tag or RFID) and the sample material itself (e.g. barcode of the unique tube).

**Genomics data.** Genomics is a special aspect of laboratory testing. Today the genomic characterization of pathogens is becoming increasingly relevant, in the context of both animal health and food safety. The genomic characterization of pathogens may be useful to investigate the origin of outbreaks and to identify spatial and temporal clusters of infection possibly linked to common risk factors or sources of infection. It is important to underline that genomics data can provide additional material for epidemiological investigations, but it cannot replace the information retrieved from animal identification and registration and traceability systems, which is indispensable for tracing the source of an infection (based on the movement records of infected animals), and for identifying possible risk factors epidemiologically linked to the spread of the disease.

**Vaccination data.** Vaccination is one of the main control measures for many animal diseases. Therefore, the collection of data on vaccination activity may be essential for defining the health status of the animal population. The minimum data that should be recorded is the number of vaccinated animals within a given time period (e.g. a year, month, week, etc.) and the epidemiological unit of concern (ideally each premises). Nonetheless, information on vaccination may not be sufficient to precisely quantify the proportion of the immunized population, particularly when booster doses are required. Theoretically, only the registration and identification of each individual animal that has been vaccinated would enable accurate calculation of the number of animals that have been immunized correctly.

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<sup>39</sup> See [http://www.oie.int/fileadmin/Home/eng/Health\\_standards/tahm/0.04\\_GLOSSARY.pdf](http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/0.04_GLOSSARY.pdf)



Mass vaccination activities would enable veterinary services to enter a large number of premises and to cross-check the animal's identification and movement records. There are animal identification and recording schemes that are linked with specific vaccinations (e.g. foot-and-mouth disease (FMD) and brucellosis checks).

**Human cases.** In the case of zoonoses, the efficacy of the veterinary actions could be measured primarily on the basis of their impact upon public health. For this purpose the availability of updated human incidence data for these specific zoonoses, including their temporal and spatial distribution, is fundamental for evaluating the control measures in place and for developing new intervention strategies. Information on the demographics (age, gender and profession) of affected people would be necessary to properly evaluate the necessary veterinary action. For example, in case of brucellosis, the professional status of the patients can give an indication whether the source of infection is restricted to direct contact with infected animals during abortion or parturition (when the great majority of human cases are farmers or veterinarians) or whether a serious problem of food contamination may exist.

**Other data.** Many other types of data may be included in an AHI system, according to the purposes of the system. For example the collection of data on the use of antimicrobials in food producing animals or data on the type of feed used in the premises (e.g. for BSE or mycotoxins monitoring) may be added to the AHI system.

## 2.2 Deliverables of animal health information systems

**Animal disease notification to international organizations.** One of the main outcomes of an AHI system is the automatic production of those data that are required by regional or international organizations for the purpose of disease notification. In the field of animal health, each outbreak of a notifiable disease must be reported to the OIE-WAHIS. A specific set of data is required by OIE for immediate notification, for follow-up reports and for six-monthly and annual reports. The specific requirements of WAHIS and its dictionaries as well as the glossary of the Terrestrial Animal Health Code<sup>40</sup> (for the description of diseases, species, case, epidemiological unit, outbreak, slaughter/destruction, diagnostic and control methods, etc.), must be taken into consideration when developing an AHI system.

**Managing and assessing the efficacy of animal health interventions.** Data collected by an AHI system may be used to measure the efficacy of the measures implemented by veterinary services. The efficacy of and compliance with such measures may be assessed by comparing the actual figures (i.e. the number of suspected, investigated, and confirmed cases or the number of animals sampled, tested, slaughtered or vaccinated) with those that it was predicted that the measures would deliver. This supports the revision of existing measures and the formulation of proposals for additional interventions.

This information can also be useful for performing cost-benefit and cost-effectiveness analyses of actions. The periodical evaluation of veterinary actions is essential for re-planning and for modification of such actions.

**Definition of animal population health status.** An AHI system should be capable of producing indices and other outputs assessing the health status of the animal population within a country or within specific territories. Prevalence and incidence values are important

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<sup>40</sup> <http://www.oie.int/index.php?id=169&L=0&htmfile=glossaire.htm>

to quantify the frequency of animal infection (and/or disease, according to the case definition). The case-fatality, mortality, abortion rates and reproductive indices may assess the impact of the diseases. Each of these measurements must be spatially and temporally characterized in order to highlight possible geographical clusters or specific temporal trends. Further outcomes, for example the proportion of vaccinated or (estimated) immunized animals, may be of paramount importance to correctly define the health status of the population. Changes in the health status of the animal population may also indicate the efficacy or the impact of veterinary actions, in terms of variation of disease occurrence and/or the consequences.

When the objective of the AHI system is to support a “free status” request for a country or a zone, the outputs of the systems must adhere strictly to the criteria used for declaring the free status for that specific disease. The AHI system must provide all necessary data to fulfil the criteria, including the performances (i.e. sensitivity and specificity) of diagnostic tests used.

**Early warning.** One of the most valuable deliverables of an AHI system is the ability to generate accurate disease information quickly, which may then be used to alert veterinary and/or public health systems and networks (in the case of zoonoses) to take immediate actions to prevent and/or control the spread of disease. In order to accurately target surveillance actions to detect initial outbreaks, the implementation of an early warning surveillance system requires a thorough knowledge of the epidemiology of the disease in question. In the past, a sentinel system has been used for the early detection of animal diseases. This requires the selection and periodic testing of animals and the existence of an effective animal identification and registration system that supports individual animal identification. However, the probability of detecting a disease through a purely random sampling approach is low, especially when human and financial resources are limited. In light of this, the establishment of a risk-based surveillance may be the best approach. If non-disease data, such as associated productive parameters (e.g. dairy milk production, feed conversion rates, etc.) are also collected, the system can be used to anticipate potential problems relating to animal diseases.

**Risk assessment studies.** Data collected by AHI systems are inputs for routine risk assessment activities. In particular, data concerning the frequency of animal infection and the results of epidemiological investigations (including surveillance activities) can be used to assess the probability of disease incursion and spread, the magnitude of the possible consequences and the relative contribution of different risk factors. The requirement to generate the data and information that are necessary to support risk assessment should be borne in mind when developing an AHI system.

### ***3. Elements of animal health information systems***

An AHI system should contain the following elements:

#### **3.1 Data gathering**

Most systems are based on the use of reporting forms to record the data, and to transmit them to local or national centres for collation via paper, mobile devices, emails or through internet.

Data collection is performed through the use of specific reporting forms or templates. Each reporting form requires a specific analysis of the data set to be collected. A simple reporting form can include:

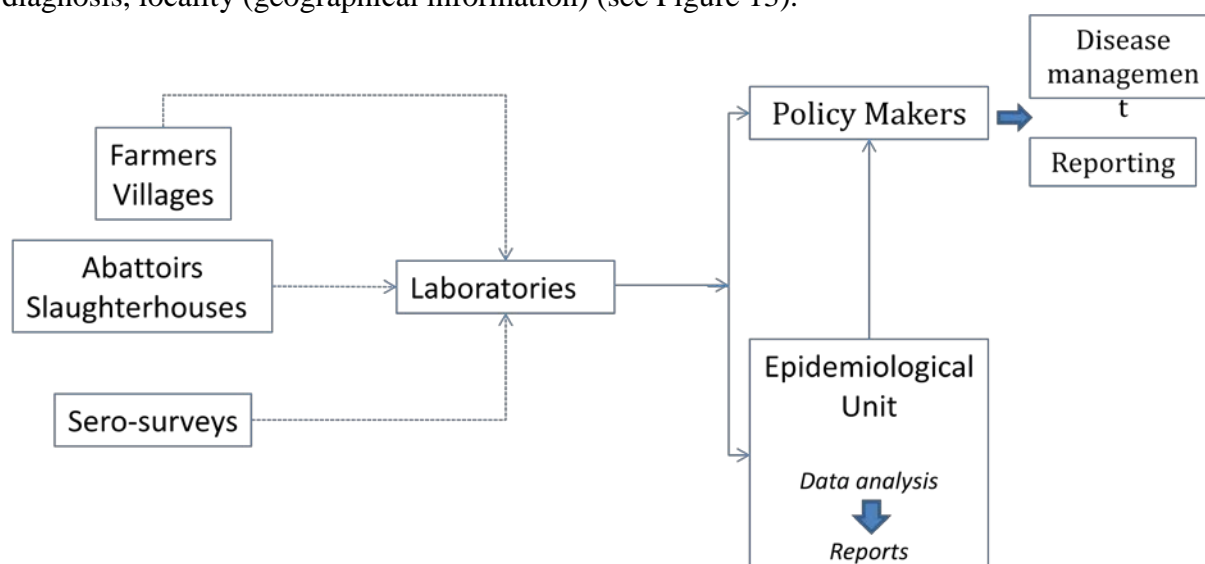
- geographical information related to premises location (latitude/longitude) and delimitations of administrative units. Geographical coordinates of establishments or epidemiological units where animal populations that are at risk should be captured when building or designing a national register of establishments for the purpose of animal recording;
- temporal information related to the time at which the information was recorded, and at which any health related activities (such as administration of vaccinations) took place;
- epidemiological information on species, farming system, number of animals at risk, cases, deaths, etc.;
- laboratory information: samples, species, date of collection, date of results; and
- action and control measures taken.

### 3.2 Data storage and manipulation

AHI systems should be able to handle a large amount of data and information. Paper-based systems are often inefficient and severely limited in the volume of information they can process. Computerized systems, based on database management systems, are more efficient and recommended, even in developing countries, due to their capabilities to store and effectively manage large amount of data for processing.

### 3.3 Data flow and analysis

In-field data can be originated by veterinarians, technicians, farmers, and other stakeholders, working in farms or slaughterhouses, abattoirs or laboratories. This makes the data flow a critical aspect of AHI systems. The restricted access of specific users to sensitive data needs to be taken into account when the flow of disease data is included in an AHI system. Disease data need to be recorded and integrated following a logical sequence of steps until validation and integration in the databases before dissemination. Cases or animal health events can be recorded following for instance the name of the disease, suspected cases, confirmed, diagnosis, locality (geographical information) (see Figure 13).



**Figure 13: Data flow in a complex system collecting disease information**

Data analysis is required to convert data into information, which is used to assist animal health decision making. Data analysis may range from the simple calculation of totals and

rates, such as mortality, incidence, prevalence, to the determination of complicated statistical associations and the use of epidemiological risk models to predict the outcomes of interventions. In the latter cases well-skilled epidemiologists are needed.

### **3.4 Outputs/reporting**

Once data are analyzed, the results must be made available to those who need them for decision making. The information has value at many different levels – potential users include livestock owners, owner groups, co-operatives, or enterprise industry bodies, private veterinary services, agricultural product manufacturers, local, provincial and national government veterinary authorities, legislators, university and research organizations, trading partners, regional or international organizations.

## ***4. Key considerations for the development of an animal health information system***

A well-designed, functional AHI system should be based on clear rules and procedures. These procedures must specify the responsibilities and duties of the different institutions and actors (both public and private) within the system, in order to establish an effective and efficient data quality verification system. As a general rule, data should be validated by those who generate it (since they have all the necessary information available to undertake validation). The organizational structure of the institutions involved must be respected when the data flows (inputs and outputs) are developed. Particular attention should be paid to these aspects when the information system has to collect and manage data deriving from several competent authorities. It is crucial to ensure that the system respects data ownership and confidentiality, and that all data is stored securely.

Special consideration must be given to the role of veterinary practitioners, who often constitute the most crucial sentinel for diseases detection. Therefore, in order to improve their ability to recognize clinical signs of disease, private veterinarians working on the farms should be the targets of training activities and communication campaigns. Furthermore, in many countries the execution of preventive actions (e.g. vaccination) is often assigned to private veterinarians or to community animal health workers.

Abattoirs and animal markets may also collect relevant epidemiological data within an AHI system. In many instances these premises represent the sole feasible sampling point, where monitoring programmes can be put in place. Moreover, in some countries the LIMS are the first nucleus of any AHI system and the laboratories are the first centres for data collection and storage. This is especially relevant when a widespread informatics infrastructure is not in place.

It is also necessary to enable correct integration of different aspects (i.e. the varying types and sources of data) of animal health information systems to avoid multiple entries of the same data. Significant effort is required to standardize data and procedures in order to allow such integration. In relation to data standardization and the establishment of common dictionaries, it is necessary to implement a common coding system (to keep track of the source and type of data). This represents a significant challenge for any institution. The complexity of these systems and the need for feasible, flexible and easy-to-use tools, poses particular difficulties

when developing such systems. To address this issue, a collaborative approach, involving management experts and veterinary professionals is necessary.

For the abovementioned reasons, it is advisable to adopt a progressive and incremental approach when developing an AHI system, starting with the basic functionalities (like the notification and registration of disease cases) and progressively adding new ones. An AHI system should be integrated gradually with other existing systems (e.g. Integration with a LIMS could start with the exchange of simple data files). The integration of two or more pre-existing information systems that have been developed for different purposes requires complex analysis of the data generation process and revision of data management procedures.

## Section VI. Performance recording

### INTRODUCTION

The *FAO Secondary Guidelines for Development of National Farm Animal Genetic Resources Management Plans - Animal Recording for Medium Input Production Environment* (FAO, 1998) - subsequently referred to as the 'FAO secondary guidelines' in this section - provide a detailed description of the benefits and beneficiaries of performance recording (PR)<sup>41</sup>, and of the planning and conduct of PR schemes. The secondary guidelines provide step-wise and detailed guidance on the institutional and operational organization of such schemes, and on the utilization of resulting information. In particular, these focus upon medium-input production systems.

The purpose of this section is to provide a conceptual framework for PR. Key questions such as what to measure, how to measure, how to process data and how to use the results are addressed. It is not intended to repeat detail that has already been presented in the FAO secondary guidelines. Instead, PR is addressed in the more general context of national animal recording, highlighting the linkages between PR, animal identification and registration, animal traceability and animal health information (see Figure 3).

A strategic plan for building a PR system and its implementation are presented in the third part of these guidelines, which describes how to put the conceptual framework into practice. This is so because the process to be followed to develop a PR system is similar to that of animal identification and registration, animal traceability and animal health information systems.

While delineating the conceptual framework, this section reviews the multiple objectives of PR, describes the different types of PR systems, and the elements of such systems, as well as the data that should be collected or provided in each case. Examples, based mainly on dairy recording, are given for illustration.

### OBJECTIVES

The objective of this section is to highlight the potential uses and the main elements of a PR system, its potential linkages with animal identification and registration, animal traceability and animal health information, as well as key considerations when implementing such a system. This includes the integration of a PR system into other existing animal recording components, with a particular focus upon a national animal identification and recording system.

### DEVELOPING THE CONCEPTUAL FRAMEWORK

PR involves the objective and systematic measurement of various indicators of animal performance. Data such as animal physical characteristics, parentage and relevant events may also be collected. All data is recorded, securely stored and processed for use by various

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<sup>41</sup> to maximize ease of reading, only this acronym is used in this section

stakeholders to support decision-making, according to their objectives. These stakeholders and their needs, as well as the objectives and scope of the PR system are described below.

### **1. *Potential stakeholders and their needs***

The primarily stakeholders in any PR system are the producers. But there are many others who potentially benefit from the PR system. These are listed in Table 2. Each stakeholder has specific information needs, with specific frequency and content for each of their information needs. As an illustration, probable information needs of stakeholders in the dairy sector have been listed in Annex I of these guidelines. Many of these needs are also applicable for other sectors.

**Table 2: Potential stakeholders interested in PR systems**

Stakeholders	Cattle and Buffaloes		Sheep and Goats			Poultry	Pig
	Dairy	Beef	Dairy	Meat	Fibre		
Producers	X	X	X	X	X	X	X
Artificial Insemination Service Providers	X	X					
Breeding Companies	X	X	X	X	X	X	X
Milk Component Laboratories	X		X				
Breed Associations	X	X	X	X	X		
Feed suppliers	X	X	X	X	X	X	X
Feed Testing Laboratories	X	X	X	X	X	X	X
Provincial Health Authorities	X	X	X	X	X	X	X
Disease Testing Laboratories	X	X	X	X	X	X	X
Private Veterinarians	X	X	X	X	X	X	X
Farm Consultants	X	X	X	X	X	X	X
Processors	Milk Processors	Slaughter Houses	Slaughter Houses	Slaughter Houses	Slaughter Houses/ Wool Companies	Slaughter Houses/ egg processing plants	Slaughter houses
Policy makers	X	X	X	X	X	X	X

## 2. *Objectives of a PR system*

PR serves a variety of purposes. It helps to build a knowledge base such as baseline animal performance levels, best production practices, and best breeding strategies. The purposes of PR are described in Section I and summarized below:

- **Establishment of baseline animal performance levels.** In any country, it is necessary to know the productive capacity of the main livestock types and breeds in each of the major production systems and ecological zones. This information, along with other statistics related to number and distribution of animals and holdings, is required for planning and investment decisions.
- **Evaluation of production system alternatives.** In cases where production efficiency and outputs do not conform to the optimum norms or baselines, PR can support the investigation and establishment of management alternatives. For example, it can be used to compare specific feeding strategies, health care options, germplasm sources, housing alternatives or other management variables.
- **Individual animal management.** PR can provide farmers with the necessary information to make decisions and take action to improve the productivity and the health of their animals, to enhance the quality of their products, and to increase the overall profit of their farm operations. This continues to be the main objective for developing a PR system.
- **Genetic improvement.** Data collected through a PR system is used by breeders (farmers) and breeding organizations, governmental institutions and other agencies for the evaluation and selection of replacement stock (young animals) as future parents and the achievement of genetic progress in the target population.

## 3. *Scope of a PR system*

The scope defines the level of coverage of the PR system. This involves several factors, including:

- **Species.** Farmers keep a variety of livestock species (cattle, buffaloes, sheep, goats, poultry, pigs, etc.), but in most countries PR systems have been initiated for cattle.
- **Traits.** There are many economically important traits that could be included in a PR system. Table 3 classifies these traits into three categories: essential to start with, desirable, and those that could be added later.
- **Spread.** The geographical area to be covered by the PR system - the whole country, a province, a region or a group of farms.
- **Production Systems.** The type of herds (small, medium or large) and production systems (intensive, extensive or livestock-crop mixed farming) to be included.
- **Coverage.** Restricted to only farms or other institutions such as laboratories (feed testing, milk component analysis, disease testing, etc.), slaughterhouses, processing plants, etc., are also included.

The decision on which option to choose depends on the objectives and the available resources (infrastructure, financial and human), as well as the farmer involvement.

## 4. *Types of PR systems*

The FAO secondary guidelines defined four broad types of PR system according to the above objectives:

- PR systems to establish baseline animal performance levels;



- PR systems to compare specific production system alternatives;
- PR systems for individual animal management; and
- PR systems for genetic improvement.

The main features of these types of PR systems are summarized in Table 3. The common goal of all these systems is to facilitate better understanding and control of the production process in order to increase production, enhance efficiency and sustainability of resource use, and to identify opportunities to improve management. However, they differ with regards to the beneficiaries, structural requirements, and organizational requirements.

The first two types of PR system listed above are essentially field survey or research activities designed to address specific questions in limited periods of time. They record information on an appropriate sample of animals. Usually, their costs are covered with public funds. In contrast, the two latter types are continuous activities (at least for several production cycles or animal generations), which seek to utilize objective performance data at the individual animal level. Usually, their costs are borne by the farmers, but public support is also required, at least in the initial phase.

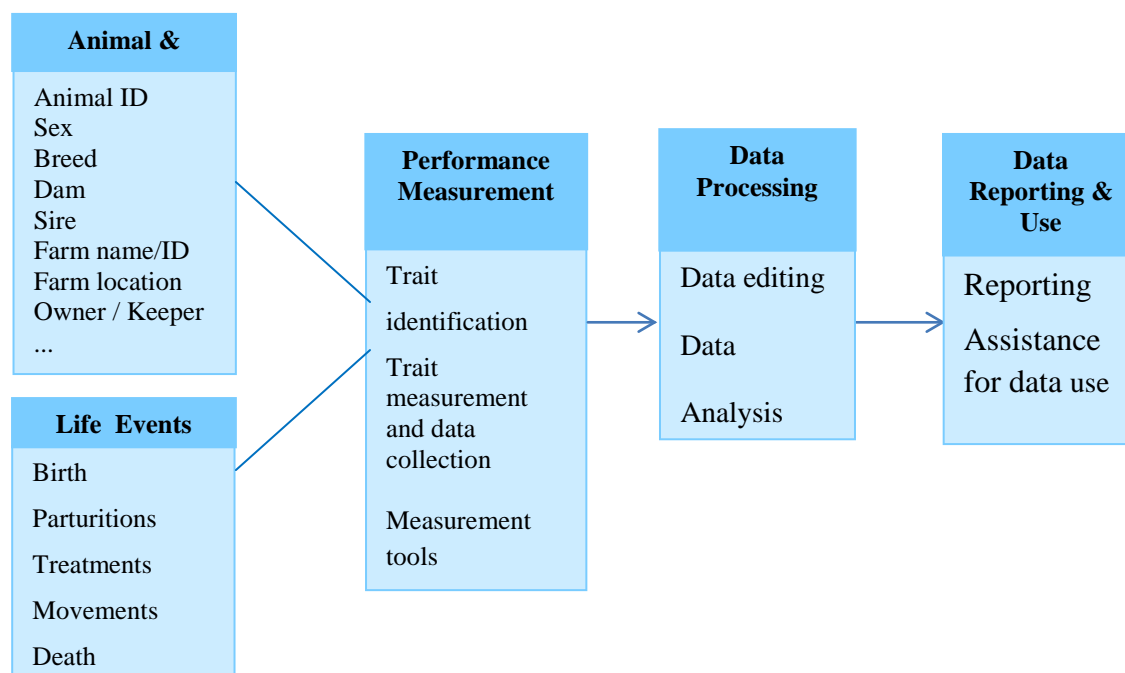
A PR system for genetic improvement has much in common with a PR system for animal management, but there are a few key differences. Firstly, the former focuses upon the breed as a whole, whereas the latter focuses upon the individual herd. Secondly, the former includes pedigree information of each recorded animal unlike the latter, and this information must be sustained over time (many animal generations). In both cases, records must be maintained in a rigorously consistent manner.

This section focuses only upon PR systems for individual animal management and genetic improvement.

**Table 3: Types of PR systems and their general characteristics (Adapted from FAO secondary guidelines)**

<b>Characteristic</b>	<b>PR systems to establish baseline performance</b>	<b>PR systems to compare production alternatives</b>	<b>PR systems for animal management</b>	<b>PR systems for genetic improvement</b>
Primary Uses	Identify development opportunities and challenges; help better strategic planning	Identify best management practices; farmer education.	Improve day-to-day farm management; farmer education	Identify best breeding Animals; improve farmer organization; farmer education
Main beneficiaries	Government and the nation as a whole	All farmers; consumers	Participating farmers; consumers; rural communities	Participating farmers; commercial farmers; consumers; rural communities
Participants	A broad sample of farmers	A few carefully selected farmers	Initially a few farmers, with numbers to increase progressively	A number of farmers (breeders); eventually, farmers outside the nucleus to validate
Duration	Short-term (1-5 year)	Usually a single production cycle	Continuous, across multiple production cycles	Continuous, across animal generations
Who will take the measurements?	Technical staff / field technicians	Farmers, technical staff / field technicians	Farmers, technical staff / field technicians	Farmers, technical staff / field technicians
Animal Identification	None or temporary	Temporary individual or group animal identification, usually for a single production cycle	Permanent individual animal identification	Permanent individual animal identification; pedigree information
Traits to be measured	Many simple measures	Measures of animal response to production alternatives	Measured traits associated with individual animal productivity and economic return	Easily measured traits associated with the breeding goal
Data analyses	Summaries of averages and measures of variability	Appropriate comparative statistical analyses	Easily interpreted individual animal and herd summaries; benchmarking; Provision of assistance and advice to interpret the results	Prediction of genetic merit; individual animal summaries; provision of assistance and advice to interpret the results

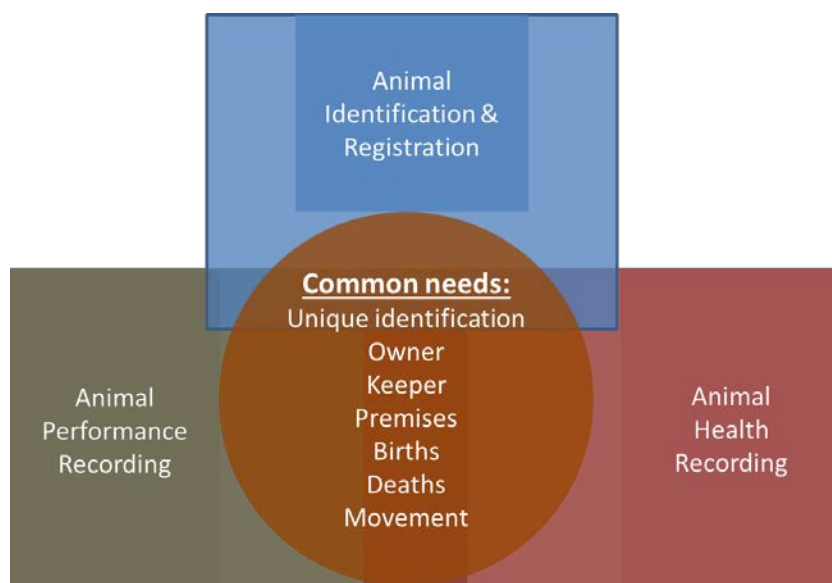
## 5. *Elements of PR systems*



**Figure 14: Elements of a PR system**

Figure 14 shows that information recorded in an animal identification and registration system (including animal, farm, keeper and owner information) will automatically be utilized by any PR system. Similarly some events, such as animal movement and treatments, which are recorded in animal traceability and animal health information systems will also be used. Animal identification and registration, animal traceability and animal health information systems are described in detail in Sections III, IV and V of these guidelines respectively. Only passing references are made to them in this section.

A PR system can exist as an independent system. However, it functions better when it is part of a comprehensive animal recording system (see Figure 3) in a country. Since the different components share information (see Figure 15), this reduces duplication and therefore results in lower incremental costs. Information must only be collected once at the animal, herd and/or farm level.



**Figure 15: Sharing of information within an animal recording system**

## 5.1 Animal identification

As indicated earlier in this section, animal identification is necessary for most types of PR systems. However, the choice of the identification method (i.e. group or individual identification), identification devices, and the duration (i.e. temporary or permanent) depends upon the specific objectives of the PR system. It is also necessary to relate the recorded animal to its premises (farm) in order to link performance to the environment where the animal is raised, hence the linkage to the animal identification and registration system.

## 5.2. Performance measurement

In order to measure performance, it is necessary to define and identify the traits to be measured, also to define the measurement and collection procedures, and to choose the appropriate measurement tools.

### *Trait identification*

When selecting traits, it is important to choose those that support the objective of the PR system and that feasibly can be measured on the farm. In many cases, important traits cannot be measured easily. For example, resistance to infectious diseases may be an important trait, but this trait can be measured directly only by exposing the animals to the disease. This is impractical. Therefore, it is instead necessary to rely upon correlated or indicator traits that are relatively easy to measure and provide less expensive or timely information on the traits of interest. Table 4 presents a list of measurable traits as well as other important information to be collected by a PR system.

Life history data that defines the critical events in an animal's productive life are important for all types of PR systems. Such data is generally temporal in nature, such as dates of birth,

weaning, mating, parturitions, sale, medical treatments, end of lactation and death. The measurement of this data often cannot be scheduled and therefore must be recorded by the farmers as the events occur. If the PR system is integrated with an animal identification and registration system, much of this data can be retrieved from the latter.

**Table 4: A list of measurable traits (non-exhaustive)**

Species or Production System	Traits and properties to be recorded		
	Essential	Desirable	Additional
<b>All systems &amp; species</b>  <b>(Basis for all other production systems to follow)</b>	Unique identification Sex Owner Keeper Treatment group Culling and Death Birth date (at least estimated)	Breed Premises Birth date (exact) Dam Sire Birth status (single, twin, etc.) Wean status (raised as single, twin) Calving / lambing ease Culling reason Pregnancy diagnosis Mating information (AI / Natural)	Functional (linear) traits & body measurements Body condition (scores) Sickness diagnoses Fertility tests and diagnoses Health treatment Vaccinations Parasite counts or scores Parasite impact indicators (e.g. FAMACHA scores) Recorder (technician/farmer) Inseminator Diagnostic & Analysis laboratory Feed intake
<b>Dairy Production</b> Cattle Buffalo Dairy Goats Dairy Sheep	Test day milk yield Dry off date	Fat percentage Protein percentage Somatic Cells per ml Milking times / intervals	Milk Urea Nitrogen Lactose percentage Mastitis diagnosis Locomotion Body weights (calves and production animals) Metabolic disorders Temperament and likability Milking speed / ease of milking Individual or group feed intake
<b>Meat Production (ruminants)</b> Cattle Sheep Goats	Weight at weaning Weaning date	Birth weight or Girth circumference measure Post weaning weights Dam weight at weaning of calf Pre-slaughter weight Scrotum circumference	Pre-weaning weight Dam weight after calf birth Post weaning growth test weights Body measurements Shoulder/hip height, Body length, Pelvic dimensions, Girth circumference Individual Feed intake Real Time Ultrasound Muscle area, Subcutaneous fat, Marbling Carcase and Meat traits Grading, Dressing percentage, Tenderness, Retail meat yield
<b>Fibre Production</b> Sheep Goats	Fleece weight (8-12 months growth)	Fibre diameter Staple length Clean fleece weight (8-12 months growth)	Fibre diameter variation Percentage of fibres over/under desirable diameters

		Fibre strength Body weight Pleat score Kemp & undesirable fibres	Percentage of impurities Colour Percentage of modulated fibre
<b>Pig Meat Production</b>	Litter size Litter weight	Individual piglet weight at weaning Number of teats Sow weight	Individual piglet weight at birth Body measurements Real time ultrasound scanning Muscle depth, Marbling, Subcutaneous fat thickness Carcass & Meat properties Dressing percentage, Drip loss, Marbling, Muscle yield Stress susceptibility
<b>Poultry Meat Production</b>	Batch weight at slaughter, mortality, and feed consumption	Individual weight at slaughter Age at slaughter	Individual weight at hatch and at adult age Body conformation Individual feed consumption Carcass (eviscerated) weight Weight of breast and legs Walking ability (or other leg problems)
<b>Egg production</b>	Total egg mass, mortality and feed consumption	Number of eggs per hen Egg weight	Age at first egg Shell strength (breaking force weight or specific gravity) Shell colour Albumen and yolk weight Fertility and hatchability

Animal production (milk, meat, eggs, fibre) levels are an important component of overall animal value, although they are not necessarily the most important component in low to medium input production systems. The levels of milk production at various points during lactation and the duration of lactation are the main indicators of dairy production. Body size is the main indicator of meat production. Measures of body size may be taken at weaning and at marketing time. Body size (prior to maturity and linked to age) at weaning provides information on both the growth potential of the offspring and the mothering ability of the dam. Often, in low input smallholder production systems, there is a tendency to sell the largest animals and to keep smaller ones for replacement, leading to a negative selection on this trait.

Definition of quality traits must be made in relation to current and potential markets. Measuring quality traits is appropriate only if it leads to increased product prices or if the trait is an indicator of other important economic traits (e.g. lean animals usually have higher feed efficiency).

The occurrence of disease and the need for health care can have a significant impact upon animal productivity and profitability. It is therefore desirable to identify animals that require higher-than-normal levels of health care. This can be fairly easy to achieve in dairy production when animals are handled daily, but nearly impossible when the animals are not handled regularly (e.g. in the pasture).

Adaptation, while difficult to define, is a critical characteristic in many production systems. Adaptation is not a single trait; rather it involves different sets of characteristics in each production environment. Therefore, measurement of adaptation must first involve identification of the most important animal stressors, including diseases, climatic conditions, endo- and ecto-parasites, dietary deficiencies and seasonal feed and water shortages. The variation in reproduction and production parameters usually serve as indicators of adaptability and suitability to these conditions. Poorly adapted animals do not produce, reproduce or survive well.

In some countries it is important to measure suitability as draught animals, as well as manure production, especially pertinent in mixed crop-livestock production systems.

### ***Trait measurement and data collection***

This paragraph defines the data elements for each trait and the detailed procedures for the measurement of each data element. A data element for a trait refers to what must be measured and/or recorded for that trait. For example, if the desired trait is 'conception rate', data elements that must be recorded include:

- ID code of the female to be inseminated;
- date and time of insemination; and
- details of the sire whose semen is used, ideally including a record of the technician that carried out the insemination.

The procedure describes how each data element is to be recorded or measured. By way of example, Table 5 lists the key data elements and persons who could be entrusted to collect data for a PR system in the dairy sector, in addition to their umbrella organization. A similar exercise can be conducted for any other PR system.

**Table 5: Data sources and persons to collect data for PR systems: A dairy example**

	<b>Trait Group</b>	<b>Traits</b>	<b>Data elements</b>	<b>Who collect data</b>	
				<b>For Large herds owned by educated producers</b>	<b>For smallholders and large herds owned by less educated producers</b>
				<b>Service Providers</b>	<b>Data collector</b>
1	Fertility	<ul style="list-style-type: none"> <li>• Conception rates</li> <li>• No. of Inseminations per Conception</li> <li>• Service Period</li> <li>• Dry Period</li> <li>• Inter calving period</li> <li>• Ease of calving</li> </ul>	<ul style="list-style-type: none"> <li>• Date of inseminations</li> <li>• Date of calving</li> <li>• Calving ease</li> </ul>	Producers	<ul style="list-style-type: none"> <li>• Artificial insemination service providers</li> </ul> Artificial insemination technicians
2	Production	<ul style="list-style-type: none"> <li>• Lactation yields</li> </ul>	<ul style="list-style-type: none"> <li>• Test day yield</li> </ul>	Producers or Milk	<ul style="list-style-type: none"> <li>• Milk Recording</li> </ul> Milk Recorders

				Recorders of Milk Recording Organization/ Breeding Companies/ Breed Associations	Organizations or • Breeding Companies or • Breed Associations	
3	Quality	Milk Components	<ul style="list-style-type: none"> <li>• Fat percentage</li> <li>• Protein percentage</li> <li>• Lactose percentage</li> <li>• Somatic Cell Count</li> <li>• Milk Urea Nitrogen</li> </ul>	Producer and Milk Component Laboratory	Milk Component Laboratory	Milk Recorders and Milk Component Laboratory
4	Body Conformation	Body conformation traits	<ul style="list-style-type: none"> <li>• Measurement and scoring of all linear traits</li> </ul>	Breed Associations/ Breeding Companies	<ul style="list-style-type: none"> <li>• Breed Associations/ Breeding Companies</li> </ul>	Body Types
5	Health	Herd Health Traits	<ul style="list-style-type: none"> <li>• Udder health: <ul style="list-style-type: none"> <li>- Mastitis</li> </ul> </li> <li>• Reproductive disorders: <ul style="list-style-type: none"> <li>- Retained placenta</li> <li>- Metritis</li> <li>- Cystic ovary</li> </ul> </li> <li>• Digestive &amp; metabolic disorders <ul style="list-style-type: none"> <li>- Milk Fever</li> <li>- Ketosis</li> <li>- Digestive ruminal, abomasal and intestine disorders</li> </ul> </li> <li>• Leg and Feet disorders</li> <li>• Infectious and parasitic diseases</li> </ul>	Producer (in some cases) Government, Cooperatives or Private Veterinarians	<ul style="list-style-type: none"> <li>• Government, Cooperative or Herd Health Service Providers</li> <li>• Private Veterinarians</li> <li>• Disease Diagnostic Laboratories</li> </ul>	Veterinarians & other health workers

The International Committee for Animal Recording (ICAR) establishes rules, standards and guidelines for measurement of different traits in various species. The latest ICAR guidelines on recording practices, published in 2012, provides guidance on the measurement of various traits in different species. The guidelines can be used as a reference document for writing down detailed procedures for the measurement of data elements of each selected trait, tailored to the needs and existing constraints of developing countries.



Duplicating a PR system that has been developed for high input production systems may not be applicable for low to medium input production systems.

### ***Measurement tools***

The measurement tools used in PR systems vary widely in complexity and sophistication. Simple procedures and equipment are always preferable to complex procedures and equipment, provided they allow achievement of the goals of the PR activity. To allow the PR system to operate successfully, it is crucial that measurement tools are used in a consistent manner. A few examples are given below:

- **Dairy traits:**
  - Smallholders might own only a few animals and will hand-milk their animals in small vessels. Measurement of milk production will have to be performed volumetrically, possibly through appropriately calibrated jars (see Box 7) or digital weighing scales. Therefore milking parlours and milking machines might not be cost effective.
  - In countries with temperate climates it is common for milk samples to be collected from a very large number of farmers and for these to be analysed at a central milk component laboratory. Owing to the logistical issues involved, this process may not be feasible in some situations such as in tropical climates. In such a situation a dispersed milk component laboratory network, comprising of a few small milk component laboratories could be established at strategic locations within the area of operation.
- **Meat traits:**
  - For small ruminants, poultry and pigs, body weights can be obtained using mobile weight measuring sets (e.g. a tripod, spring balance or hanging canvas sling). However, it may not be practical to measure cattle with weighing machines (including mobile weighing machines) in well-dispersed smallholdings. Other indirect methods of estimating body weight, based on body measurements, should be considered. This may include simple linear and volumetric tools such as tapes for measuring animal size, with associated weight conversion tables.
  - Similarly, the use of ultrasound equipment for recording body characteristics in live animals may also not be feasible for logistical and economic reasons. Instead, simple indirect measures of body characteristics such as body scoring and palpation could be considered, provided that the technicians in charge of such tasks are well trained.
- **Reproduction traits:**
  - No tools are required to measure these types of traits. Records of dates, numbers of offspring, offspring survival, and indications of reproductive events are the most important information.
- **Disease traits:**
  - Simple enzyme-linked immunosorbent assay (ELISA)-based methods to assess antibody or hormone titres or any diagnostic procedures that involve only collection of blood or a tissue sample could be considered.
  - Scores or counts can be used to quantify resistance to ticks. Simple laboratory-sourced egg counts in faeces can quantify internal parasite loads.

### **Box 7: Standard operating procedures for milk recording in dairy cattle**

1. A specific person should be assigned the task of milk recording.
2. In the case of smallholders, a milk recorder may not be able to record more than five animals per day.
3. First records should be taken no earlier than five days and no later than 25 days after calving.
4. Milk recording for an animal should be done once a month, in the morning and the evening. If milk records are also taken in the afternoon, then three milk records should be taken. Milk recording should be carried out on a fixed date each month (plus or minus five days).
5. Milk recording should be carried out using a transparent calibrated plastic jar with a sensitivity of 100 cc or using an accurate, calibrated weighing machine.



**Calibrated Plastic Jug**

6. After milk recording, a milk sample should be taken for milk component analysis.
7. Each animal should be recorded both for milk volume and milk components on a monthly basis by milking the animal 11 consecutive times, or until the animal becomes dry.
8. When the animal becomes dry, the dry date should be recorded.
9. If an animal's milk yield drops by 50 percent of the previous recording, or if an animal is suffering from illness, the milk yield should not be recorded. In such cases the reason for the decreased yield should be recorded and the milk recording should be reattempted after a period of at least five days.
10. If an animal only gives milk once, then only that single event should be recorded and the other records should be left blank.
11. The milk recorder should record the details of the recorded yield in a milk recording card, to be given to the farmer.
12. Standard Lactation Yield of the milk recorded animal should be calculated using the Test Interval Method (A4) described at Section 2.1.5.1 of the International Agreement of Recording Practices published by ICAR.

Source: Dr. Kamlesh Trivedi

### ***Data processing***

Data errors may arise from misunderstanding of measurement and recording procedures, improper training of farmers and/or technicians, or recording errors. Data editing (to identify erroneous or fabricated data) and validation is therefore a crucial step of data processing. Data editing should be conducted as soon as possible after the data is recorded. This should

take place on the farm and in the data processing centre, and should include checks for reasonableness and consistency of data.

Data processing is necessary to assure the utility of the recorded data as a management and/or selection tool. Requirements for data processing can vary widely between PR schemes, depending upon the type of traits being measured and the objectives of the PR system. However, data processing should be no more complicated or time-consuming than is necessary. Depending upon the PR system, it can be performed locally by the farmer or field technician or centrally by a specialized team (as in the case of genetic improvement programmes). In all cases, data should be stored in a central database.

After adjustments have been made for differences in conditions (e.g. the age of the animal, age of the dam and sex adjustments for weaning weight in calves), the results derived from the recorded data enable comparisons to be made between animals or groups of animals.

To compare the genetic merit of animals, a methodology that describes the additive genetic differences between the animals in question is generally applied. Predictions are generally based on recorded differences between animals within groups that were subjected to similar treatment and environmental conditions (called contemporary groups), on the (additive) genetic relationships among all animals, and taking the genetic parameters (heritabilities, and genetic (co)variances of traits) into account. There is, however, a challenge in defining the contemporary groups in PR systems in the case of smallholder production systems.

Since smallholders that keep only one or two animals cannot have contemporaries within their herds, it is necessary to consider these animals in the context of a larger animal group. One way to solve this problem is to consider an entire village or a neighbourhood within a village as a herd or a contemporary group. It is observed that farmers within a village learn from each other and often follow common management practices. Genetic relationships could then be established between villages by producing progeny from as many sires as possible within a village and across many villages. This necessitates the development of appropriate procedures for estimating genetic merit under smallholder production situations.

### ***Reporting and use***

In order to encourage keepers to use the results of PR systems to inform their management decisions (e.g. selling animals, selecting replacements and organizing mating) results must be disseminated quickly, and in a form that meet their needs.

The information needs of a dairy farmer with a large herd may not be relevant to a farmer with only one or two animals since the latter knows each of their animals in detail. However, sending text messages as alerts to carry out certain activities for an individual animal, on the other hand, could be very relevant for smallholders. By way of example, such messages may include:

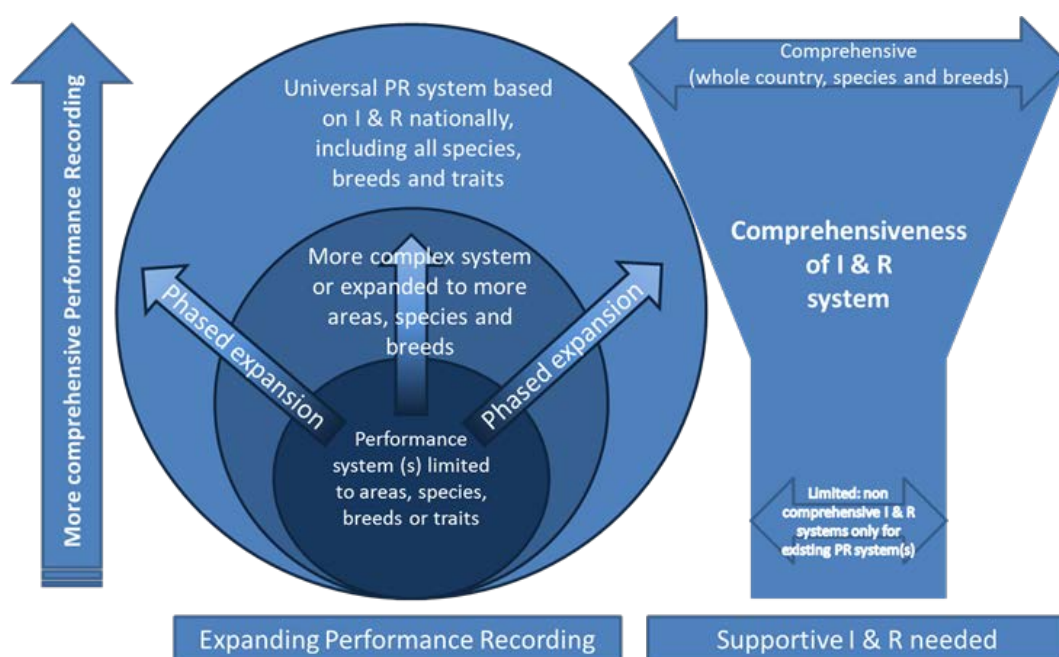
- likely to come in heat in one or two days;
- to be examined for pregnancy diagnosis;
- to be dried off;
- likely to calve in one week;
- lactation production abnormal;
- have subclinical mastitis;
- due for foot-and-mouth disease/haemorrhagic septicaemia/brucella vaccination; or

- due for de-worming.

Moreover, a performance report produced for an individual herd may be less valuable than a report produced for all producers within a village, providing comparative performance on certain economically important traits. Reports produced for farmers should be simple and action-oriented taking into account their level of education. Farmers often require guidance on how to interpret and apply the results.

## 5. *Considerations for the integration of PR systems*

In the absence of a comprehensive and integrated national animal recording system, a PR system might develop independently due to the interests of groups of keepers, breeders or regions. The challenge is to reconcile such independent PR systems with the overarching animal identification and recording system when implemented on a countrywide basis. Figure 16 illustrates the relationship between the expansion of a PR system (or systems) in a country and the animal identification and registration system.

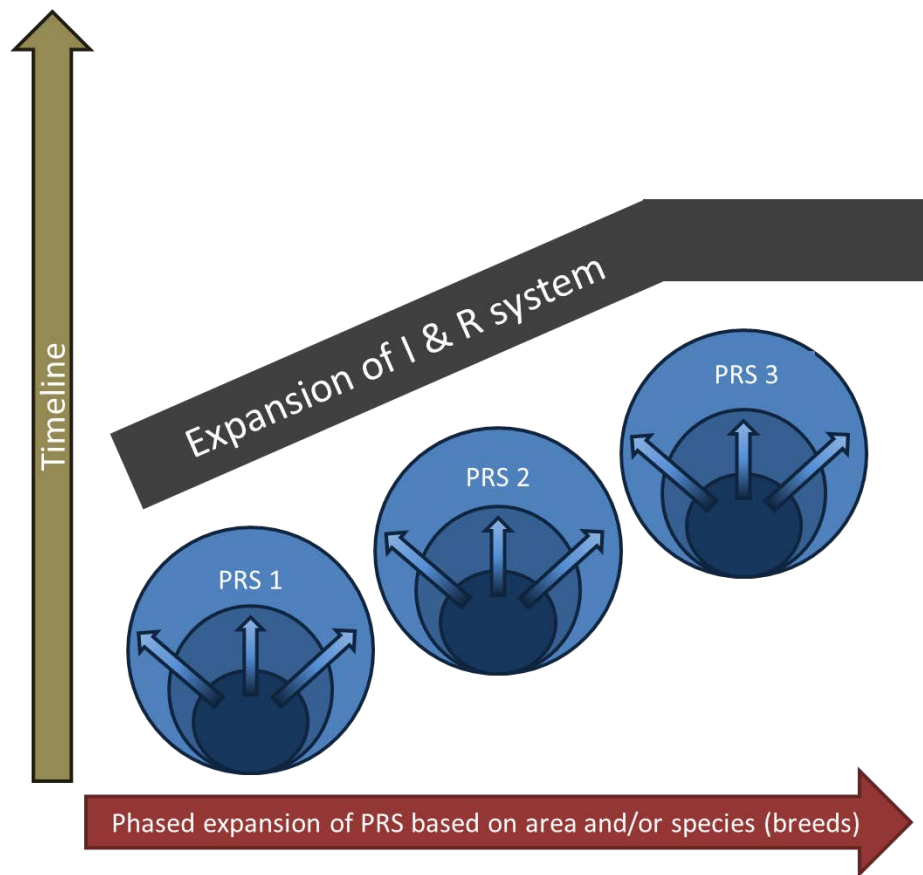


**Figure 16: Possibilities of a phased expansion in a PR system and the animal identification and registration needs**

As illustrated in Figure 16, the PR system 'generates' its own animal identification and registration to meet its own functional needs. Such an identification and registration system will, however, be limited to the animals recorded in the specific PR system. This may be limited to a species, a production system, a specific area (e.g. districts, provinces, states) or breed. In the event that such a specific PR system exists, other PR systems may emerge that operate for different breeds or species, a different area, or a different group of keepers.

The absence of a more comprehensive animal identification and registration system could lead to implementation problems as the absence of unique animal identification (as well as

owner, keeper and premises identification) can restrict the joint evaluation of animals recorded in different systems. Figure 17 illustrates the case where more PR systems exist and how it affects the need for a more comprehensive animal identification and registration system to cater for proper coexistence of the PR systems.



**Figure 17: Illustration of the existence of PR systems phased out over time and the need for a more comprehensive identification and registration system to serve them**

## **PART 3: PUTTING THE CONCEPT INTO PRACTICE**

# SECTION VII. Developing the strategic plan

## INTRODUCTION

Section II describes an integrated multipurpose animal recording system composed of four components; namely, animal identification and registration, animal traceability, animal health information and performance recording. Conceptual frameworks for these components are presented in Sections III, IV, V and VI, respectively. This section provides guidance on preparing a strategic plan for developing the integrated multipurpose animal recording system. Implementation of such a system is addressed in Section XI. The strategic plan is common to all animal recording system's components, and specificities are given as needed. The user may decide to incorporate all or some of these components. However, animal identification and registration is a central component, which provides data to all other components.

## OBJECTIVE

The objective of this section is to provide guidance on how to develop a strategic plan for establishing an integrated multipurpose animal recording system, taking into account the specifics of its components.

## TASKS AND ACTIONS FOR PREPARING THE STRATEGIC PLAN

In order to prepare the strategic plan to establish an integrated multipurpose animal recording system (simply called animal recording system), the following tasks need to be completed:

1. conduct a study to assess the current situation in the country;
2. identify the participating stakeholders and their needs; and
3. draft the strategic plan to establish an animal recording system.

## TASK 1: ASSESS THE CURRENT SITUATION

### *Action 1: Assess the production systems and the value chain*

The assessment of the production systems gives an indication on the feasibility of the animal recording system as a whole, or of its components individually. Collect the following information:

- the number of herds and animals by species and breed, their geographical distribution, and past and future trends, if possible;
- by species and area (e.g. region, agro-climatic zone) the profile of the keepers and production systems, expressed in terms of (i) literacy rates among keepers (ii) herd size (categorized as small, medium and large) and, if possible, (iii) level of input (categorized as low, medium and high);
- seasonality of births, grazing, slaughters, disease control measures. This information is useful for planning field activities, such as for determining the

best period for animal identification from the standpoint of animal health (e.g. to avoid infection after branding during the rainy season);

- age at slaughter and the number of times the animals change owner before being slaughtered, importance of home slaughtering and the age of animals at home slaughtering - in some dairy systems, calves are home slaughtered at an early age and might not be identified;
- practice of transhumance and other migrations, e.g. for social reasons;
- presence of private veterinarians or service providers, and their distribution; and
- accessibility of veterinarians and other health workers or technicians for keepers, and their capacity to carry out additional animal recording services. In some countries and in low input production zones, only government staff (e.g. livestock assistants, dip tank assistants or community animal health workers) are present and can perform animal identification and recording activities.

Likewise, for the assessment of the value chain, the following should be considered:

- livestock gross domestic product (GDP) as a proportion of overall agricultural GDP;
- food of animal origin as a proportion of the total food basket;
- percentage of pastoralists population in the country/territory;
- number, size and distribution of livestock markets, slaughterhouses, dairy plants, exhibition sites, and fairs;
- level of current exports and/or potential for export;
- level of current imports and potential for import substitution (for countries that import a large part of their food products);
- incidence of diseases and disease control measures likely to be improved by animal recording in general, and animal health information and traceability systems in particular;
- presence of (or potential for) zoning (disease-free, commercial zone) and compartmentalization; and
- existence of control systems, especially in countries where theft is a serious problem.

The above information demonstrates the various possible drivers for implementing an animal recording system in a country. When trade (domestic or international) is a major driver, one should also:

- review existing policies on promotion of export of animals and animal products;
- list the countries where major export of animals and their products occurs and their key import requirements;
- describe the existing guidelines on import of animals and their products; and
- state the key requirements for getting a health certificate for export and a licence for import of animals.

## ***Action 2: Assess animal recording activities***

In most countries there exists at least a basic animal identification and recording system; traditional branding and marks by scars are often used to identify owners. Individual animal



identification and recording systems may also exist, particularly in commercial dairy farms, government farms, feed lot operations and ranches. The temporary marking of animals when they are vaccinated is a common practice in many countries. Information on such prevalent practices must be collected during the assessment study.

Similarly, the assessment study should identify existing schemes and programmes in which animal recording plays an important role, including the following:

- disease control and eradication programmes, where animals are vaccinated;
- genetic improvement programmes, where pedigree and individual animal performance records are maintained;
- productivity enhancement schemes (e.g. artificial insemination schemes), where data are maintained for individual animals; and
- subsidy schemes, where livestock owners receive benefits based on the number of animals they own.

Additionally, insurance companies that insure animals and banks that extend loans for buying of animals likely have their own recording systems. It would therefore be important to collect information on the scale and area of their related operation.

In countries where an animal recording system exists, the assessment should gather all key information, including the benefits realized, lessons learned, legislation adopted, institutions involved, costs incurred, funding strategies adopted, identification devices used, numbering system followed, and information systems employed. Ideally, collection of this information should be supported by visits to areas in which these activities are ongoing. A complete review of such systems should include an audit of the:

- IT system architecture and operation;
- software implemented;
- animal recording database;
- data capturing and management processes;
- field operations and inspections, particularly in case of traceability and/or animal health information systems;
- organization of the responsible unit; and
- costs and sources of funding.

### ***Action 3: Assess the institutional and legal frameworks***

This includes the institutional environment in which the animal recording system will operate, as well as existing policies and legislation related to livestock in general and animal recording in particular. The strengths and weaknesses of the institutions that may participate in the implementation of animal recording should be assessed, including veterinary departments, livestock departments and extension service providing organizations (e.g. private veterinarians, farmers' associations, breeding organizations, performance recording organizations, meat boards, milk processors, and livestock markets). The roles, functioning and capacities (particularly the human resources) of such institutions should be analyzed.

One should also examine existing:

- livestock and food-related legislation; particularly any that may impact directly or indirectly upon animal identification, traceability and health;

- policies relating to livestock and livestock product subsidies, taxes, incentives, export promotion, import substitutions; and
- policies related to management of animal genetic resources in general, and of animal breeding in particular.

(See also task 3 of Section 10)

#### ***Action 4: Assess the infrastructure for information and communication***

Information and communication channels include telephone and fax, postal mail services, countrywide or region-wide services (e.g. the veterinary service), and internet. Existing channels should be identified and assessed in terms of their speed, reliability and costs. Mobile internet services (e.g. smartphones) are becoming more affordable and reliable.

Communication networks within the Ministry of Agriculture and its decentralized husbandry and veterinary services should also be assessed. It is worth noting, however, that in some countries the competent authority may be attached directly to the Prime Ministry. This is especially common in the case of food safety and related public health matters. A detailed description should be made providing information on the network's architecture, accessibility (e.g. the times within which the servers are turned on), maintenance and replacement policies, and any system backups and security policies. In addition, the assessment should describe the reporting procedures (if any) in place between potential partners and agencies that could support the implementation of the animal recording system.

Some regions may have a weak telecommunication infrastructure, which should be identified in the assessment. The assessment should describe the type of connectivity available, such as:

- full internet access (dial up) and general packet radio service (GPRS);
- poor internet access (dial up) and GPRS;
- no internet access (dial up), but GPRS; or
- no internet access (dial up) and no GPRS (or weak GPRS signal).

For each of these situations, a flexible approach could be developed. For example, data entry centres may be established at a regional level if data cannot be entered directly at source due to poor connectivity.

## **TASK 2: IDENTIFY THE STAKEHOLDERS, THEIR NEEDS AND ROLES**

The assessment study can also be used to identify the stakeholders that are willing to participate in the animal recording system. Their participation will become compulsory in the case of mandatory animal identification and registration, traceability and/or animal health information systems. The primary stakeholders in any animal recording system are the livestock owners or keepers, who are responsible for the identification and registration of their animals and the notification of events (e.g. birth, movement, disease occurrence). However, depending upon the objectives and the animal recording system's components, all or some of the following stakeholders may be included:

- livestock keepers or breeders and/or their associations;
- officers of animal health and production departments of the ministry of agriculture and/or livestock, and of their decentralized offices;

- field veterinarians, livestock extension staff, artificial insemination service providers, or authorized field agents;
- livestock market staff;
- hauliers/livestock traders;
- distributors and retailers;
- abattoir and processing plants staff; and
- disease, feed, milk, etc., testing laboratory staff.

After identifying the stakeholders that will implement or use the animal recording system, the next step is to identify their needs. These could include information and/or technical assistance. For example, large-herd owners/keepers may tag their animals themselves, but smallholders, keeping only a few animals, may request identification agents to do it. The needs should be assessed through structured personal interviews and/or during a consultation workshop, which will also be used to assess the level of commitment of the stakeholders for establishing an animal recording system in the country.

### **TASK 3: DRAFT THE STRATEGIC PLAN FOR ESTABLISHING THE ANIMAL RECORDING SYSTEM**

Based upon the information collected during the assessment study and the discussions with the relevant stakeholders, the next step is to draft the strategic plan.

#### ***Action 1: Define the objectives and scope of the animal recording system***

The objectives should state in clear terms what the animal recording system aims to achieve, who it intends to serve and what services it intends to offer. Ensure that these objectives are in line with the national livestock development objectives. It is necessary to discuss and agree upon these objectives with all relevant stakeholders in order to ensure their willingness to participate in the development of the animal recording system, and to contribute to its costs. A list of possible objectives for animal identification and registration, traceability, animal health information and performance recording systems are presented in Sections III, IV, V and VI respectively.

The scope of the animal recording system depends upon the desired outcomes and what is feasible taking account of the circumstances in question (e.g. costs, accessibility to services, and responsiveness of livestock keepers). The scope should be defined in terms of the species covered within a specific geographical area. Owing to constraints of time, available financial resources and manageability, often it will not be possible to implement a system that covers all species and geographical areas from the beginning. Consequently, implementation of the most critical systems should be prioritized, in terms of critical species and geographical areas. This may be expanded to cover other species and areas at a later stage. In order to further define the scope of the animal recording system's components, it may be useful to consider questions such as:

- Should the animal identification and registration system include all livestock species, or be restricted to a particular species?
- Is individual identification necessary, or can animals be identified by their herd or village?

- Are animals identified at birth or at a later age (e.g. when they leave the community or establishment of origin)?
- Does the traceability system cover the entire country, or is it restricted to particular geographical zones (e.g. a foot and mouth disease free zone, or a zone with commercial producers/slaughterhouses accredited to export products)?
- Who are the stakeholders that should be included (e.g. keepers associations, livestock markets, slaughter houses, product distributors and retail markets)
- What are the priority traits for performance recording?

Answering the above questions would help for example to define the breadth, depth and precision of an animal traceability animal recording system. ‘Breadth’ refers to the quantity of information that is maintained in the system for each animal. ‘Depth’ refers to how much of the production or supply chain is covered, e.g. whether this only applies from birth to death or whether it also includes meat traceability after slaughter. ‘Precision’ refers to the level of detail stored in the system, e.g. whether the system supports individual animal identification, or less precise group identification.

## ***Action 2: Decide on the type of animal recording system and define its elements***

Because of their specificities, the type of system to be introduced and its respective elements are described separately for each component of the animal recording system.

**Animal identification and registration.** There are two types of animal identification: individual and group identification. The decision concerning which one to use should be based upon the objectives and a cost-benefit analysis (see a simulation in Section IX). Once this decision has been made, it is necessary to decide upon the identification code and appropriate identification method using the recommendations provided in Section III of these guidelines.

Animal identification and registration refers not only to identification and registration of animals, but also to identification and registration of premises, and identification and registration of keepers and owners. These are key elements of any identification and registration system. A premises is a geographical location where animals are kept on a temporary or permanent basis. Premises, owners and keepers, and animals should have respective registers in the database. Taking account of Figures 4, 5 and 6 in Section III, it is necessary to define the specific data that these registers should contain.

**Animal traceability.** Animal traceability systems, addressed in detail in Section IV, Subsection 3 of these guidelines, may be categorized into three types depending upon: (i) the extent of the value chain covered; (ii) the type of the data management system (paper or computer based, or both); and (iii) the type of the identification system (animals may be identified and traced individually or in groups). A decision must be reached on the type of traceability system to be implemented, taking account the objectives and the scope defined above.

As explained in Section IV of these guidelines, an animal identification and registration system is a prerequisite of a functional animal traceability system; the latter cannot be

developed until the former is in place. Therefore, those elements that comprise the animal identification and registration system are an integral part of the animal traceability system. Other key elements of the animal traceability system include the recording of animal movement, the recording of sanitary information, and information reporting. It is necessary to decide on how to integrate these elements.

**Animal health information.** Section V describes four types of animal health information systems, which are: animal disease notification, animal health emergencies, animal disease surveillance and early warning, and risk assessment. These are not mutually exclusive, but a certain degree of overlap may be observed between them in practice. It is necessary to select the type of animal health information system based upon the objectives and the scope defined above.

The key elements of an animal health information system are defined in terms of data gathering, data storage and manipulation, data analysis, and reporting. Subsection 3, Paragraph 3 of Section V describes these elements in detail. It is important that these elements are adapted to suit the specific circumstances of the country in which they are being implemented.

**Animal performance recording.** Section VI defines four types of performance recording systems that address the objectives of establishing baseline animal performance levels, comparing specific production system alternatives, supporting individual animal management and enabling genetic improvement. The main features of these systems are summarized in Section VI (Table 3). These systems have a common goal: to promote understanding and control of the production process in order to increase production, to enhance efficiency and sustainability of resource use, and to identify opportunities to improve management. However, they differ with regard to the beneficiaries, and to the structural and organizational requirements. Taking account of the objectives and the scope defined above, a decision must be reached regarding the type of performance recording system to be implemented.

The key elements of a performance recording system are animal identification, performance measurement, data processing, and data reporting and use. A key aspect of performance measurement is the identification of the traits to be measured. Answering the following questions will help to decide on what to measure:

- What biological traits should be improved in order to move toward the set objective?
- Which of these can be measured directly on the farm, and which cannot?
- For those traits that cannot be measured directly, are there alternative traits that provide indirect information? If so, when can they be measured?
- On what basis are the relationships between the indicator traits and the traits of interest determined?
- What equipment, technical skills, infrastructure, etc. are required so to enable cost-effective recording of these traits?

Subsection 4, Paragraph 5 of Section VI describes in detail the elements of a performance recording system. As with animal traceability and animal health information, many of the data elements can be provided by the animal identification and registration system. These elements must be adapted to the unique circumstances of each country, and must be integrated accordingly.

### ***Action 3: Define the rules and procedures for animal recording***

Agreement must be reached between all stakeholders on the rules and procedures before entering the development and implementation phase. Each of the animal recording system's components is addressed separately below.

**Animal identification and registration.** Standard operating procedures should be developed for identifying and registering premises, keepers, owners and animals. These procedures should be based upon the conceptual framework described in Section III of these guidelines, while taking account what is feasible in the given situation. For example, it would be necessary for standard operating procedures to:

- provide a clear definition of a premises in a situation where animals are mixing together routinely;
- prescribe whether a single tag or two tags must be used for individual animal identification;
- define the procedure for retagging an animal when a tag falls;
- prescribe the numbering system to be followed; and
- specify the data that should be collected at the time of registering premises, owners, keepers and animals; and
- set out rules for data entry.

**Animal traceability.** In addition to the rules and procedures established for identification and registration, rules must also be established concerning animal movement. For example, it is necessary to specify those data that should be contained in the animal movement ID card when issued, and those data that must be recorded in the movement ID card following movement of the animal. These data are detailed in Section IV. The timescale within which every newborn animal should be issued with its animal movement ID card must be specified. Similarly, in the event of an animal being moved, the timescale within which a record must be made in the animal movement ID card should also be specified. The rules and procedures for issuing a new animal movement ID card and for returning the movement ID card to the designated authority on an animal's death or slaughter should be clearly specified.

**Animal health information system.** In addition to the rules and procedures established for identification and registration, it is necessary to set rules and procedures for disease data gathering, data storage and manipulation, and data analysis and reporting. Further guidance on these rules and procedures are provided in Section V of these guidelines. The first step is to identify and select the animal health events or priority diseases to be recorded, through open discussions and agreement with all relevant stakeholders. Data collection is usually performed through the use of specific reporting forms or templates. It is necessary to define the content of such forms and to decide upon the frequency of data collection.

Data can originate from different sources (e.g. veterinarians, technicians, keepers, and staff of slaughterhouses, abattoirs or laboratories), which renders designing of the data flow a critical step in the development of the animal health information system. This requires the specification of users' profiles with appropriate data security settings.

**Performance recording.** The rules and procedures for performance recording should be based upon the recommendations given in Section VI. In particular, the following should be specified:

- the data to be collected, its source, the frequency with which it must be collected, and the person(s) responsible for collecting them;
- the standard operating procedure (SOP) to be followed to measure each trait. For example, see Box 7 in Section VI for a SOP for milk recording in a smallholder situation; and
- the contents of information to be sent to each stakeholder. This should be made available in various formats that are tailored to the needs of each type of stakeholder, e.g. alert messages, operational reports, review reports, graphs, analytical reports, statistical summary reports, etc. It is also necessary to consider how this information will be transferred, e.g. paper, email, PDF files, HTML pages, smartphones/PDAs, mobiles, etc.

#### ***Action 4: Specify the IT system requirements***

Animal recording systems are reliant upon the availability of dedicated systems and technologies (hardware and software) for timely data collection, processing and reporting. Specify those that fit the type of system selected, its elements and its data requirements, taking into account the findings of the assessment study (in particular those related to internet and/or mobile phone coverage). Information technology experts should be involved in determining the specification for the tools and technologies required to meet the system requirements. This includes specifying:

- the devices to be used for data entry and validation - handheld devices/netbooks/laptops/desktops;
- the communication network(s) to be used - wired or wireless network;
- the institution hosting and managing the central database;
- the data exchange protocol to be followed among various databases;
- the software solution - whether a readymade software is to be procured or whether a new application is to be developed. The process of development and validation of the software are described in detail in Section VIII; and
- the backup of the software and central database. This can be done locally in a dedicated server, externally or online. For external backup, data security and data backup agreement need to be considered if a different institution or company becomes responsible. In the absence of automatic backup, data should be backed up manually regularly (e.g. once a week).

The inclusion of geographic information systems (GIS) and mapping applications in the animal recording system (in particular for animal traceability and disease surveillance) leads to additional challenges in relation to building a standardized repository for geographical data that is fully integrated with the rest of the data that is being collected and stored. Detailed standards and procedures must be specified in order to define in the best way possible the geo-locations of the premises (farms, slaughterhouses, markets, pastures, etc.). In addition, specific software applications and algorithm solutions must be considered for geographical data manipulation and analysis. Finally, appropriate technologies must be added for developing and managing geo-referred data and generating a variety of geo-outputs, such as interactive web maps. It should be ensured that the required specific expertise is available in the team that is tasked with developing such a system.



### ***Action 5: Define the legal, policy and institutional support required***

It should be determined whether the provisions that are contained in existing legislation would be adequate to ensure full compliance by keepers and other stakeholders with requirements for identification and registration of premises, keepers, owners and animals, and for notification of animals' events, movements and diseases. If not, a new legislation should be proposed. The status of the animal recording system should also be specified (mandatory or voluntary). Experiences from many countries have shown that a multi-purpose animal recording system cannot be effective unless its animal identification and registration component is made mandatory through appropriate legislation. The elements of such legislation are described in Section X.

It should be specified whether the provision of any existing government subsidy payment or free services to keepers will be conditional upon their compliance with meeting particular requirements concerning the animal recording system, or some of its components (e.g. animal identification and registration, animal traceability, or animal health information). If these do not exist, a proper incentive scheme could be proposed. Likewise, if any penalty is to be imposed for non-compliance, this should be stated clearly.

Development of an appropriate institutional set up to implement the animal recording system is the other key area that needs to be addressed in the legal framework. It would be necessary to identify the competent authority that will regulate/coordinate the animal recording activities and manage the central database. The latter can delegate all or part of the activities to an implementing institution (that could be a private company contracted by the competent authority). It is crucial that the line of command is clearly defined and remains under the competent authority, or at least under one Ministry. The roles and responsibilities of the competent authority and the implementing institution, if they are different, should be defined. For example, the implementing institution may be allocated responsibility for supplying equipment and materials, maintaining the database, training, and coordinating all other participating organizations. The involvement of local organizations (e.g. keepers' associations and cooperatives, or local offices of larger central institutions) will provide mechanisms for keepers input into the operation of the system through regular meetings, seminars, fairs, and other events. If many institutions are involved, the roles and responsibilities of each should be specified, and a governing and monitoring structure should be established (e.g. the establishment of a steering committee comprised of representatives from all stakeholder groups, to monitor the implementation). Likewise, an independent institutional arrangement may also be needed to put in place a quality assurance scheme.

### ***Action 6: Prepare a human resource requirement plan***

The human resource plan should first define the profiles needed for staff involved in:

- data collection, entry and validation;
- data analysis;
- information reporting and feedback to users;
- database maintenance; and
- IT development.

An implementation unit responsible for the operation and control of all aspects of the system must be defined (for further information see point 7.2 of Action 7 below). In order to estimate



the total human resources required (e.g. number of field workers, supervisors and data entry staff), the following parameters should be determined:

- number of premises that can be registered per day;
- number of animals that can be tagged and registered per day in the initial phase;
- number of new premises that can be registered per day;
- number of newly born animals that can be identified per day in the maintenance phase; and
- number of records (e.g. events to be notified) that can be entered per day.

Based on the above, the required technical, administrative and field staff should be identified, recruited and placed. A human resource development strategy, for building the capacity of personnel at all levels, should be established.

### ***Action 7: Prepare an implementation plan***

This action aims to develop a strategy for the field implementation of the animal recording system. A phased approach consisting a pilot phase and a rolling out phase is recommended. The pilot phase aims to test the system on a limited scale. The duration of this phase may vary between three to six months. During the rolling out phase, the entire country, or identified geographical area, is gradually covered. The duration of the rolling out phase would depend upon the size of the country or the geographical area. Whether it is in the pilot phase or in the rolling out phase, the implementation plan can be divided in three stages: preparation, execution and maintenance (see Section XI).

However, before developing the road map for this phased implementation, one should identify the pilot intervention area, establish the implementation unit and define the operational roles and responsibilities.

#### **7.1 Identify a pilot intervention region**

Testing all aspects of animal recording in a small pilot area before it is rolled out on a large scale would always be a prudent strategy. The choice of the pilot area depends upon the objectives and the animal recording system's components. In the case of animal traceability, this area could be around export abattoirs, a special commercial production zone, a disease free zone, etc. The selected area should have attributes that facilitate controls between the defined zone and the territory external to the zone. Natural boundaries, such as a river or a mountain, could be used when defining a zone; otherwise one may think about fencing the zone. In the case of performance recording, it will likely be necessary to start with a few influential and progressive keepers to maximize the likelihood of success. It is also advisable to select keepers that operate in the same geographical area, rather than from different villages. This will make the pilot easier to operate for logistical reasons and will also favour an environment of mutual support between the keepers.

All functionalities of the animal recording system should be tested during the pilot phase. For animal identification and registration, all animals of the same species (or all species that fall within the set objectives) in the pilot area should be included. If this approach is not used, it is likely that some keepers would not participate on the basis they do not fall within the scope

of the pilot intervention and that their animals need not to be identified. Accordingly, there must be legal authority demanding mandatory participation by all relevant keepers.

## **7.2 Establish an implementation unit**

A dedicated unit shall be established within the identified coordinating organization to take overall control of the implementation and management of the recording system. This unit shall combine several skills: management, logistics, training, help desk and IT. A set of job descriptions for key members of an animal identification and traceability system unit is presented in Box 8. These job descriptions can easily be adapted to fit that of implementation units for animal health information or performance recording systems. Members of the unit may have multiple responsibilities, but responsibilities should not be shared.

## **Box 8: Animal identification and traceability system unit - Job descriptions**

### **Head of AITS Unit**

The Head of the animal identification and traceability system unit reports to the Director of the competent authority, and he/she is responsible for organizing and coordinating the activities of the animal identification and traceability system unit, preparing medium term and annual work plans of the unit, and monitoring their realization. Their job specification may include:

#### *General obligations:*

- assigning the tasks, monitoring the activities and achieving the set goals;
- approving different manuals for stakeholders;
- monitoring the performance of employees of the animal identification and traceability system unit;
- keeping regular contacts with concerned departments (e.g. animal health unit of the veterinary department) and exchanging information and experiences;
- participating in the preparation and amendment of primary and secondary legislation and other related legal documents;
- reviewing international animal identification and traceability system-related legislation (e.g. of important meat importing countries, for suggesting possible changes in the national legislation);
- preparing budgets for the implementation of the animal identification and traceability system activities;
- coordinating activities relating to designing, testing, implementing and upgrading the animal identification and traceability system information system including specifying the requirements of the central database, other field related hardware and software application;
- coordinating interfacing and integrating the animal identification and traceability system database with other IT systems in the veterinary department and Ministry;
- communicating and promoting animal identification and traceability activities;
- approving all documents, reports and records dealing with the animal identification and traceability system.

#### *Specific obligations:*

##### **Continuous routine operations:**

- monitoring activities of field service providers and addressing the challenges faced;
- monitoring printing and issuing of movement ID cards and other documents produced centrally;
- managing first registration of new premises (establishments);
- training of field service providers and veterinary inspectors, or other inspectors in charge of checking the animal identification and traceability system.

##### **At fixed intervals (yearly):**

- generating statistics on animal identification and traceability activities (Annual report on identification, registration and traceability containing, inter alia, the number of establishments, animals, inspection controls and imposed measures and penalties);
- establishing risk criteria and carrying out risk analysis for inspection control;
- preparing annual plans for inspection of field service providers and keepers.

#### **Help desk operator**

- online and on-the-spot support to the system users (field service providers, veterinary inspectors and border inspection posts);
- analyzing the system functionality/effectiveness;
- preparing presentations to the stakeholders;
- organizing training courses and preparing operating manuals for end-users;

#### **Logistics operator**

- procuring hardware and software;
- coordinating and monitoring the ordering, contracting and delivering animal identification and traceability materials and equipment (farm registers, movement ID cards, ear tags, applicators, IT equipment), and managing the stock.

#### **AITS administrator**

- registering new establishments, confirming changes to establishment information;
- updating the central establishment register with newly established, ceased and changed ownership establishments;
- granting of privileges in the case of new private field service providers;
- organizing the maintenance of the hardware, software and electronic field devices (if any);
- proposing improvements;
- following up inspection control of field service providers and keepers;
- putting in place back-up procedures;
- generating reports.

#### **IT administrator**

- administrating the IT system;
- installing remote support software with the field service providers or other regional units;
- trouble shooting - hardware and software usage;
- granting system accounts, privileges;
- correcting errors encountered;
- setting up and changing the system parameters, whenever required;
- following up maintenance contracts with the software and hardware suppliers;
- coordinating testing activities.

### 7.3 Define operational roles and responsibilities

Operational roles and responsibilities for data and information transmission to and from the central database are summarized below for different actors:

1. **Keepers.** Report identified animals, movements and deaths, and request for material such as ear tags, cattle movement ID cards. Events can be notified by means of specific forms, oral communication or phone calls. Keepers may also conduct performance measurements and recording. If this is the case, it is important to ensure that they understand the objectives and the operational rules and procedures, that they have the requisite skills to accurately record data, and that they receive appropriate support in recording data and interpreting results.
2. **Livestock technicians /veterinarians.** Identify and register premises, owners/keepers and animals, measure animal performance, report ear tag change, movement, death, etc. to regional/district offices or directly to the central implementation unit (central database). Where there is a shortage of public livestock technicians/veterinarians, service providers can be contracted to conduct these tasks. Among these, one can list private veterinarians, breeders' associations, and farmers' cooperatives. Livestock technicians/veterinarians or service providers should preferably be physically located in close proximity to participating premises. This limits the costs of travel and allows a close working relationship to develop between the livestock technicians/veterinarians and the keepers.
3. **Regional/district offices.** These provide first level of support to livestock technicians, veterinarians or service providers. They enter slaughter data (if the abattoirs have no direct database access or do not generate electronic batch files to be sent to the central database), effectuate changes of premises, animal attributes and movements, request for printing of movement ID cards or other documents. Regional offices might exist in larger countries and in places where field service providers do not directly enter the data.
4. **Central implementation unit.** This unit is responsible for managing the system as a whole, including:
  - training keepers, technicians and professionals of participating organizations;
  - validating questionable premises;
  - distributing data collection forms, animal movement ID cards or any other official forms;
  - supervising the ordering of ear tags (or other identifiers);
  - supplying required equipment and materials to regional offices and field units;
  - checking invoices for services (if partially paid by the government); and
  - operating a help desk and providing the second level of support. See for example the job description presented in Box 8.
5. **Inspectors/auditors.** Prepare annual plans for the inspection of premises, animals, animal movement recording at all premises including farms, slaughter houses, etc. Inspectors/auditors will also, carry out inspections of randomly selected premises.
6. **Other institutions that participate in implementing the animal recording system.** These may include the following:
  - ear tag manufacturers, which provide ear tags for the system;
  - veterinary labs, which tests samples, the results of which can be directly transmitted to the central database;

- slaughterhouses, which provides notification of all animals that have been slaughtered;
- livestock markets, which provides notification of all animal movements;
- border inspection posts, which provide notification of all livestock imports and exports; and
- research institutes, which help to define performance measurements, analyze the data, interpret the results and use them for improvement of breeding or husbandry practices.

The list of roles and responsibilities should be adapted based on the objectives and/or components of the system, and the particular conditions of the country in question.

#### **7.4 Prepare a road map for phased implementation**

A roadmap for the implementation of a national animal recording system is presented in table 16 of Section 11. It comprises three phases: preparation, execution and maintenance.

#### ***Action 8: Develop a monitoring and evaluation mechanism***

A system should be developed that enables regular review of all activities. This should be supported by a mechanism to ensure its implementation. To facilitate strong compliance with an animal recording system, it would also be necessary to establish an independent quality control system.

The prevalent practices of animal recording should not only be checked on the farms, but also on other premises such as seasonal grazing areas and village pastures, traders' holdings, livestock markets, fairs, exhibition sites, slaughterhouses, etc.

#### ***Action 9: Prepare budget and secure funding***

A detailed budget (organized by activity and by year) should be prepared for the planned period. All assumptions made and the assumed unit cost parameters should be stated clearly. It would also be necessary to identify the sources of funds and the contribution to be made by different stakeholders. A detailed description of these aspects is presented in Section IX.

## **Section VIII. Designing and developing the IT system**

### **INTRODUCTION**

The previous section described a strategic plan for developing an integrated multipurpose animal recording system composed of four components, namely animal identification and registration, animal traceability, animal health information and performance recording. A key element of the strategic plan is the development of the information technology (IT) system that supports the activities of each component. This IT system enables users to capture and validate data, to process and store data, and to generate and transmit relevant information to the same or other users for decision-making and planning. It should mirror the reality accurately, and stick to the field activities and workflows. The IT system has two components: a software application and a hardware infrastructure. The nature and the scope of the IT system to be developed will vary depending upon the specific objectives of the animal recording system. Nonetheless, there are many commonalities in the workflows, rules and procedures (called in IT language business processes) followed and the technical design employed. This section describes these commonalities.

### **OBJECTIVE**

The main objective of this section is to provide guidance for procuring or developing a software application for an integrated multipurpose animal recording system and for setting up the necessary computer hardware. In particular, it aims to guide the user on how to:

- gather and express in a convenient way all relevant requirements concerning software and hardware;
- call for tender IT companies; and
- develop and test the software.

### **TASKS AND ACTIONS FOR DEVELOPING THE IT SYSTEM**

The standard process for the development of an IT system is briefly described in Box 9. This section focuses particularly on the first phase, the user requirement specifications (URS), since this impacts heavily upon the other phases and the success of the development process.

The following tasks need to be undertaken in order to prepare the URS and develop the IT system:

1. establish an IT project group responsible for the preparation of the URS;
2. organize preparatory field visits and interviews of key stakeholders;
3. define the objectives and scope of the IT system;
4. provide a general description of the required software;
5. describe in detail the functionalities of the software;
6. describe the technical requirements;
7. validate the URS and the mock-up;
8. call IT companies for tender; and

9. develop and test the animal recording IT system.

## **TASK 1: ESTABLISH AN IT PROJECT GROUP RESPONSIBLE FOR THE PREPARATION OF THE URS**

The IT part of the animal recording project constitutes a project in itself, for which a project leader must be appointed. This person (who is preferably not an IT person) is empowered to lead the IT project. A project group has to be established around the project leader to help him to write down, in a clear and consistent manner, all the functional and technical requirements. The project group should comprise:

- user representatives, who support the operational objectives (see below) and contribute their core business technical skills;
- management representatives, who support the strategic objectives (see below) and provide their organizational and managerial skills; and
- a facilitator; a consultant (or consultancy service provider) experienced in the development of this type of systems, recruited to help the group to prepare the URS.

Usually, after the URS phase, the project group becomes a project monitoring committee, and includes IT persons from the contracted IT company.

## **TASK 2: ORGANIZE PREPARATORY FIELD VISITS AND INTERVIEWS OF KEY STAKEHOLDERS**

The information needs of stakeholders in the areas of identification and registration, traceability, health and performance recording are described in the conceptual sections earlier in these guidelines (Sections III-VI respectively) and defined in Section VII. At this stage, the project group should gather detailed information on the functionalities required by the users of the IT system. In order to do this, they should visit and interview key stakeholders, and collect detailed information before they begin the preparation of URS document.

The persons to be interviewed are: livestock keepers and producers, directors or managers of concerned organizations, technicians, veterinarians, and service providers who undertake field work. It is necessary to interview each type of person who will directly use the IT system. Questions to consider during the interview include:

- What is the existing situation?
- What are the needs and requirements of the stakeholders for the proposed IT system?

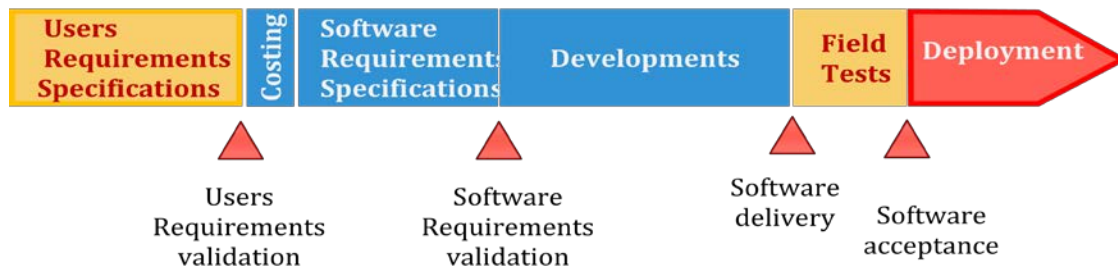
The first question refers to current activities and workflows of the different stakeholders, existing IT systems and infrastructures, existing paper forms, and existing human resources. This question is normally addressed during the preparation of the strategic plan (see Section VII, Task 1). If this has not already been done, collect all relevant information.

It is important to listen carefully to each stakeholder. If the stakeholders feel that their views are being taken into account and if they realize that the system will include functionalities that serve their needs, they are more likely to participate and to view the system favourably. On the contrary, if stakeholders feel that they are being coerced to adopt a rigid system, this may generate resistance. Furthermore, stakeholders usually wish to be in control of their own system and are unlikely to share governance. Nevertheless, IT systems offer different



### Box 9: Standard process for the creation of an IT system

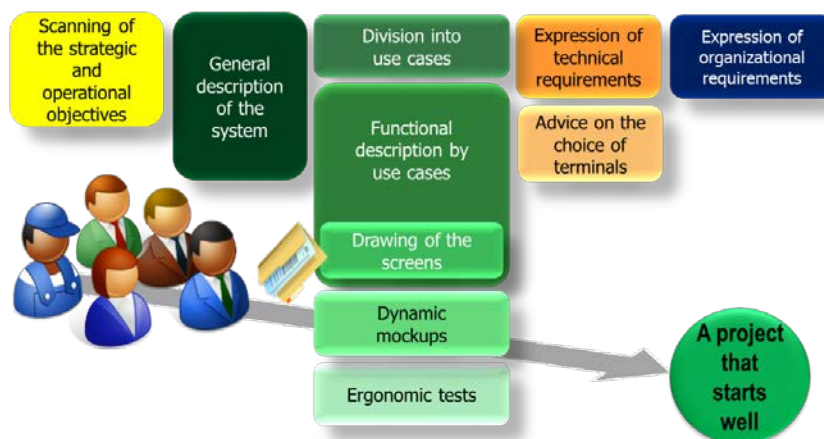
In order to implement an IT system to support an animal recording system, the project group should adopt the standard IT project methodology. This will help to establish a good partnership arrangement with the contracted IT company, and will prevent additional costs that might arise otherwise as a result of misunderstandings and delays. A simplified project timeline is presented in Figure below.



**Figure 16: Simplified project timeline for the creation of an IT system**

The timeline can be divided into four phases:

- 1. Users requirement specifications:** In the chart above, the first phase consists of detailing the stakeholders' needs in the user requirements specifications (URS) document. This phase can be divided into several steps (see Figure 17). The project group is responsible for completion of this phase.
- 2. Development:** The costing, software requirement specifications (SRS) drafting, and developments (including internal tests) are established by the contracted IT company. The developed software will be then set up on the platform implemented in the host data centre.
- 3. Tests:** The project group should conduct a test of the software using real data. Once testing is complete and the system is operating satisfactorily, a document called an acceptance form must be signed
- 4. Deployment:** Deployment should commence with a pilot phase before being rolled out across a larger scale.



**Figure. 17: Steps for developing the URS document**

possibilities to share data and services without the need for individual control to be relinquished.

Describe for each stakeholder the activities and workflows to be supported by the IT system. Focus on the functions required by each type of stakeholder in the field (identification technician, inseminator, performance recording technician, etc.). It is important to remember that a single function may be required by several types of actors. Examples of functions required by dairy producers are provided in Annex 1.

As these interviews proceed, the functional analysis becomes clearer and the different parts of the system gradually assemble.

### **TASK 3: DEFINE THE OBJECTIVES AND SCOPE OF THE IT SYSTEM**

Once the interviews have been conducted, and the required information has been collected, the project group can focus upon the production of the URS document. This document must be understandable by both stakeholders and the contracted IT company.

#### ***Action 1: Define the objectives***

The objectives of the IT system must serve those of the animal recording system, but they have to be IT specific. Their formulation must be precise since this will underpin the functional design, and will support the post-implementation assessment. The objectives are often formulated at two different levels:

- At strategic level. They express, precisely and concisely (in three or four clear sentences), the reasons for creating the IT system, and what is expected of it. For example, the system must enable the country to comply with EU regulations on meat exportation. This information must be specified in the URS document, which is the only technical document that will be provided to the IT company.
- At operational level. They serve the strategic objectives and describe in a systematic manner the operational services and outcomes of the IT system. A list of three to ten bullet points is usually appropriate. For example, these may be:
  - to provide technicians with a smartphone application that allows them to identify premises, keepers and animals;
  - to capture health and production events and to report these data to a central database; or
  - to provide stakeholders with an internet-based dashboard that provides them with identification, traceability, health and production data (according to their privileges).

The formulation of operational objectives is a useful exercise because it naturally drives the project group to describe the services and functionalities that the system will provide to the users. The strategic and operational objectives of the IT system may be different for each country. Table 6 identifies a number of objectives, to be adapted or completed based on the specific requirements of the country.

### ***Action 2: Define the scope of the IT System***

The scope is the list of functions and entities that the IT system will have to accommodate in order to achieve the defined objectives. As shown in the example below (see Table 7), it is not necessary at this stage to provide too much detail. Incorporating all these functions into the IT system from the beginning may not be feasible due to constraints of time and financial resources. Hence, it is necessary to establish priorities so that the functions that are most critical to the success of the animal recording system will be developed first. Those that are less critical can be added later. This means the IT system has to be modular.

## **TASK 4: PROVIDE A GENERAL DESCRIPTION OF THE REQUIRED SOFTWARE**

### ***Action 1: Identify the actors and define their responsibilities in the IT system***

Before designing the IT system, it is necessary to identify all users of each of the animal recording system's components (called here functional areas). For example, users of the IT system for performance recording in the dairy production sector may include;

- dairy farmers;
- service providers such as inseminators, technicians of milk recording services, technical advisers, etc.;
- geneticists implementing genetic evaluation programs;
- operators of milk component testing laboratories or feed testing laboratories;
- operators of dairy processing plants;
- private veterinary practitioners; and
- nutritionists.

Similarly, users of the IT system for health purposes may include:

- staff of organizations implementing disease eradication, vaccination and/or testing programmes;
- private veterinarians; and
- staff of abattoirs, disease diagnosis laboratories, provincial and state veterinary health departments.

**Table 6: Examples of objectives of the IT system, to be adopted and/or reformulated based on a country's circumstances**

	STRATEGIC OBJECTIVES	OPERATIONAL OBJECTIVES
<input type="checkbox"/>	Gather in an unique national database, under the control of _____, all information concerning premises, keepers, owners and animals, in order to provide a livestock data management system for public and private organizations involved in animal production and health.	<input type="checkbox"/> Create an integrated web portal, available online, for all relevant stakeholders according to their privileges, that offers a wide range of services concerning: <ul style="list-style-type: none"> <li>• animal identification, tag management;</li> <li>• traceability of movements, updated inventory;</li> <li>• health, diseases control, prophylactics;</li> <li>• milk and meat performance recording.</li> </ul>
<input type="checkbox"/>	Centralize all information concerning animal movement or transportation within the country, from birth to death, in order to trace any animal at any time, and to distribute incentives equitably. Provide an updated animal inventory of each premises to relevant stakeholders.	<input type="checkbox"/> Provide field technicians of public and private livestock organizations with a multi-device software (compliant with Android, Apple and Windows smartphones and/or tablets), for the following field activities: <ul style="list-style-type: none"> <li>• premises, keeper and owner registration;</li> <li>• animal tagging and registration;</li> <li>• recording of animal movement;</li> <li>• animal insemination and reproduction management;</li> <li>• performance recording.</li> </ul>
<input type="checkbox"/>	Provide an integrated set of relevant services and harmonized information on animals and production data to stakeholders (e.g. farmers, service providing organizations, farm consultants), according to their privileges, in order to support milk and meat production chains and food security in the country.	<input type="checkbox"/> Create a set of standard data web services (protocol SOAP or equivalent), thereby enabling authorized stakeholders to interact with the central system from their own IT systems (e.g. to declare newborn calves, or receive slaughter results of their animals automatically).
<input type="checkbox"/>	Create a unique national set of services and unified data for disease control. Make it available by web and mobile devices in order to achieve maximum participation of public and private health organizations, veterinarians and keepers.	<input type="checkbox"/> Create a decisional and statistical data warehouse, and produce automatically each month a set of reports and statistical newsletters for the information of relevant stakeholders, including updated data about cattle, sheep, milk production, exports, etc.
<input type="checkbox"/>	....	<input type="checkbox"/> ....

**Table 7: Example of scope of the IT system**

Functions to be adapted based on the objectives of the IT system and on the specific requirements of the country		Year 1	Year 2	Year 3	Year 4
Animal Identification & Registration	Registration of premises	x			
	Registration of owners	x			
	Registration of keepers	x			
	Registration of animals	x			
	Tag management	x			
	Recording of births and deaths.	x			
Animal movement	Registration of movement between premises	x			
Animal health	Management of health status for animal, herd, zones		x		
	Authorization of animal movement according to health status		x		
	Management of animal controls and analyses before movements for diseases eradication purposes		...		
	Registration and management of vaccination campaigns (e.g. FMD) and other preventive measures				
	Supporting animal health services				
	Disease diagnosis and testing services				
Animal breeding	Enabling performance recording				
	Supporting artificial insemination				
Farm management and Nutrition	Nutrition advice - ration balancing				
	Feed and fodder sample testing services				
	Proof of ownership – reduce cattle rustling				
Administration and livestock statistics					

The project group should elaborate this list at the person level rather than at the organization level, because:

- the software is to be used by individual persons, in their own specific tasks,
- some individuals belonging to different organizations may have common requirements (e.g. inseminators of different organizations will have to register inseminations).

Based on the information collected, the project group will have to develop a table of actors and related responsibilities (for example, see Table 8), where actions should strictly mirror the defined field tasks and workflows. In the software, the actors will become profiles, and the lines will become relevant screens and functionalities.

**Table 8: Example of table of actors and responsibilities**

Actors	Roles & Responsibilities in the target system
Tagging assistant	<ul style="list-style-type: none"> <li>Registers new animals and premises</li> <li>Updates paper lists of animals present in the premises</li> <li>Performs the same tasks with mobile application</li> </ul>
Data entry operator	<ul style="list-style-type: none"> <li>Captures the identification forms</li> <li>Prints premises inventories, ID cards and inspection sheets</li> <li>Sends documents to the relevant actors</li> <li>Handles minor entry errors and provides report</li> </ul>
Field inspector	<ul style="list-style-type: none"> <li>Captures ear tag acknowledgement and allocation to tagging assistants</li> <li>Reads the data entry and error reports</li> <li>Reads the person list, premises list and animal list of his region</li> <li>Reads the inspection sheet, and captures corrected data</li> <li>Does the same on the mobile application</li> </ul>
Veterinarian in charge of meat inspection	<ul style="list-style-type: none"> <li>Seizes the animal ID card and ear tags</li> <li>Captures animal ID of slaughtered animals</li> </ul>
Livestock market agent	<ul style="list-style-type: none"> <li>Captures movements of sold animals</li> </ul>
Laboratory analysis agent	<ul style="list-style-type: none"> <li>Capture individual analysis results (alternative of data flow)</li> </ul>
Central/state authority	<ul style="list-style-type: none"> <li>Reads the person list, premises list and animal list</li> <li>Captures ear tag orders to manufacturer</li> <li>Captures ear tag series acknowledgement</li> <li>Captures allocation or reallocation of ear tag</li> <li>Assigns the privileges to the actors</li> <li>Handles errors</li> <li>Reads management report</li> </ul>
Central technical unit	<ul style="list-style-type: none"> <li>Reads the person list, premises list and animal list</li> <li>Manage the quality of the system</li> <li>Reads management report</li> <li>Manage the Portal Content</li> </ul>
livestock organizations	<ul style="list-style-type: none"> <li>Obtain datasets in real time for their zone</li> <li>Read livestock reports</li> <li>Read selected management reports of their level</li> </ul>
guest user (without authentication)	<ul style="list-style-type: none"> <li>Reads public reports (maps and other information, without access to sensitive data)</li> <li>Captures the user's opinion</li> </ul>

### ***Action 2: Describe the regulatory requirements***

The URS should describe the legal requirements – both existing and necessary additional ones (see Section X on legal elements of the animal recording system). For example, the structure and the unicity of the premises/owner/keeper/animal identifiers must be respected in the software. If the law requires certain mandatory details attached to declared entities, the software will have to make these details mandatory too. A review of the country's existing legislation on veterinary health, public health, livestock breeding, data management and statistics, etc., has been addressed during the preparation of the strategic plan (see Section VII, Task 1).

### ***Action 3: Identify the data interfaces and data exchanges with other systems***

This part of the URS document addresses data flows between systems; it does not describe the screens made for data capturing. If other IT systems are likely to exchange data with the animal recording system, the project group should try to find the simplest way to effect this exchange. The data interfaces should be described in a table, as in the example presented in Table 9.

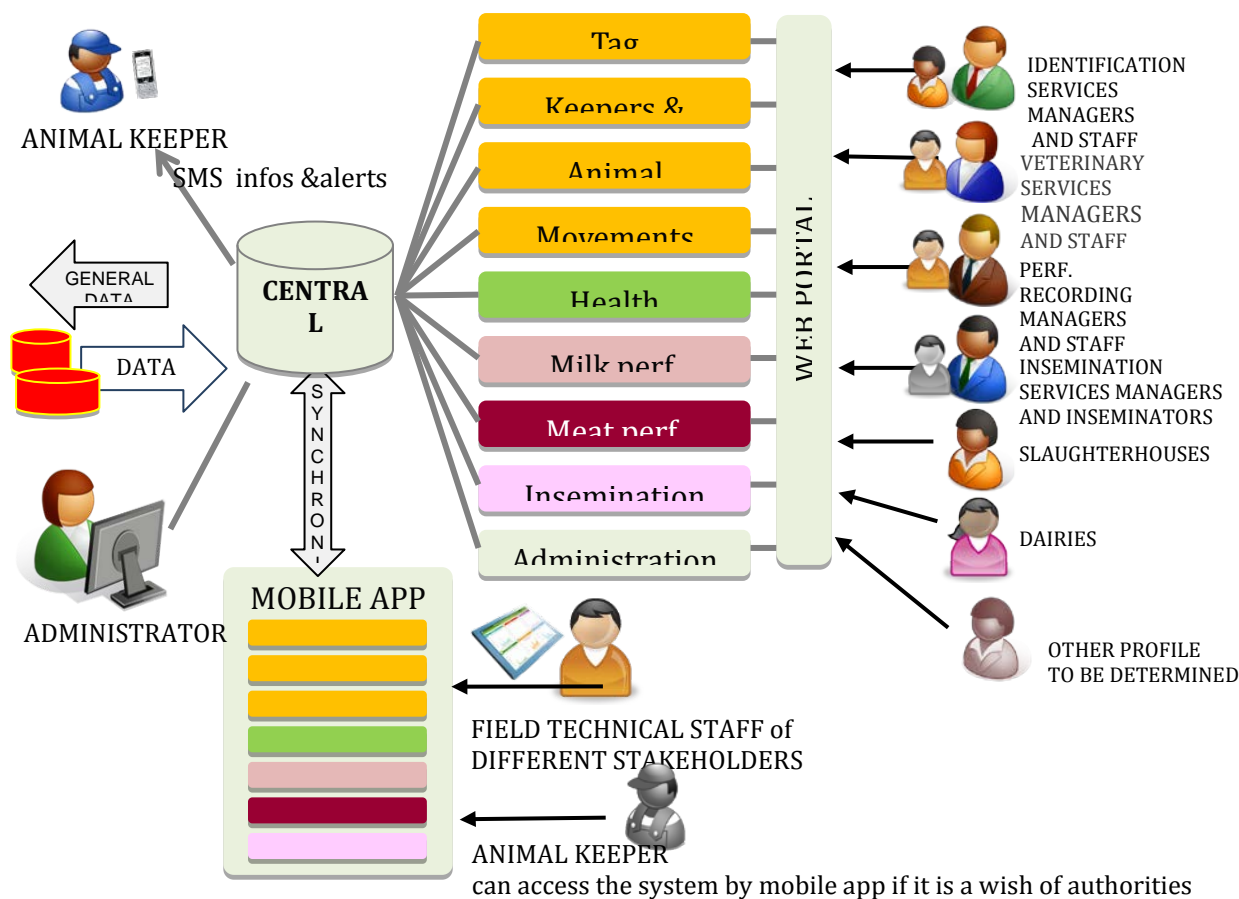
The project group should bear in mind that data interfaces are often costly in terms of development and maintenance, especially bidirectional exchanges. This is why, in countries where few livestock IT systems currently exist, it is strongly recommended to build a fully integrated system with a single database for all functional domains.

**Table 9: Example of data input and output interfaces table**

Orientation	Description	Mode	Frequency
Input →	From existing national laboratory IT system: input of blood analysis results in order to enable the display of blood analysis results in the health module of the animal recording system. The latter will ask for data in real time from the laboratory database, and display it directly in its own interface (e.g. SOAP web service)	Consultation by data web service	On demand
Input →	...		
← Output	The animal recording system will produce a standard file for any relevant stakeholder, with information on: <ul style="list-style-type: none"><li>• Premises</li><li>• Owners</li><li>• Keepers</li><li>• Animals</li></ul>	Standard File transfer (XML)	Daily
← Output	...		

### ***Action 4: Draw the functional chart of the IT system***

When the functional physiognomy of the IT system becomes clear, representation of this by the project group in the form of a visual chart, is a useful tool to make things easily understandable and clear to all stakeholders. Figure 18 gives an example of such a chart.



**Figure 18: Example of general function chart of the target system**

In Figure 18, databases are represented as cylinders and functionalities as rectangles. The persons (and possibly their main activities) are also represented, with simple arrows representing their web connections or access to an application. Double arrows represent synchronization between databases, or between a database and a mobile application, which comprises its own database.

### ***Action 5: Establish the general table of functionalities***

This table is the key element of the URS document. It provides the functional structure of the IT system, and it will be used by the IT company to calculate the cost of the system, functionality by functionality. Each service (functionality) is described in one line, and the table often comprises of 70 to 150 lines. Each line provides the assumed number of screens that it will be necessary to develop to enable functionality, imports and exports, and printings. It shows the privileges for each user, and the mode(s) to be developed: on web screens and/or mobile application screens. An example of a table of functionalities is presented in Table 10.



**Table 10: Example of first lines of a table of functionalities** (adapted from Indian URS document, the letters in the actors columns mean their privileges, for example B for block, D for District, N for national K for keepers, etc.).

#	Module	Name of the service	Description of the functionalities	Screens	Imports/Exports	printings		Tagging	Data entry op.	Farmer	Service provider	Market agent	Vet/Meat inspect.	Field Inspector	SD/D/St	Central Authority	AITs Tech. Unit	Livestock Org	Guest User		Web screens	Mobile app
1	KEEPERS AND PREMISES	Capture of keepers & premises	This service allows the users to capture or update the data collected on the field about keepers and their premises. Two different screens are provided for premises and keepers. The forms contain the same data as the paper forms. The disposition of the screen must be compatible with the capturing from paper forms. The service is also available in the mobile app. A shortcut to the animal list is provided.	2				B	B		K				D	N	N				X	X
2		List of premises & Print	The list shows one line by premise, and in columns: Premise ID, First name of keeper, last name, Gender, phone, cooperative, hamlet, village name, village ID, block, district. Each line provides a link to its detail, to authorized actors allowing updating or deleting: shortcut to “Capture of keepers & premises” form.	1		1		B	B		K	D	D	D	D	N	N	Z			X	X
3		List of keepers in-charge	This list shows person in-charge of Premises Registration with their contact and other details. The page will have an option to print the list of person in-charge for premises registration.	1		1		B	B		K	D	D	D	D	N	N	Z			X	X
4		Premises Census progress	This service provides some synthesis indicators about progress of census in the geographical area of the user: number of registered keepers, premises, and % of villages covered in the area.. The user filters the area by state, district and/or sub-district, and obtains list of villages: number of keepers and premises by villages.	1										D	D	N	N				X	
5		Premise close down	Here the block authority can capture a date and reason of end of activity for a premises.	1					B					D	D	N	N				X	

### ***Action 6: Describe the usage conditions and ergonomic requirements***

This part of the URS focuses on the usability of the system. One should be careful about this aspect because software that is not user friendly is very difficult to deploy. If users do not like it, they will not use it. Several items are to be described carefully:

- Usage in mobile conditions.
  - Requirements regarding the screen size: the mobile application should adapt to screens from x to y inches: 4 to 5.5 for smartphones, 7 to 10 inches for tablets, 4 to 10 for both).
  - Size of the touchable elements (buttons, checkboxes): minimum 7x7 mm (real size for fingers), preferably 9x9 mm for frequently used elements.
  - Colours and contrasts: the contrast must be higher than five between text and background, if application is to be used outdoors in daylight conditions.<sup>42</sup>
- Performances. The project group should take into account the web speed available in the country (which is often slow). If necessary, they should take speed measurements and record these in the URS. In normal web speed conditions (e.g. one megabyte per second), the usual level of requirement for a professional web page is to appear in less than five seconds. This point should be raised in the URS in order to avoid misunderstanding with the IT company and to optimize the amount of data to be downloaded on each device. If possible, the project group should provide the specifications of the device that will be used, or select the appropriate model(s) with the IT company during the development phase.
- Efficiency of the services. The number of steps (of clicks) and the work sequence must be optimized to meet the field conditions: in daily used screens this point can become critical and may lead to non-acceptance of the software.
- Other ergonomic aspects. Describe the menu of the portal (and the mobile application if any), and the navigation in the system (especially transverse navigation), describe the required elements to guide the user (tooltips, icons, etc). Describe the possibilities to filter and order the lists, the pagination mode, the error messages, etc. The project group should request from the IT company, and should validate, a user interface guidelines document.
- Languages. If the software has to be multilingual, this has to be specified clearly in the URS, with details about the type of characters to be used (e.g. Latin, Cyrillic, Arabic). The IT company will propose an external file for texts and labels. Usually the translations are done by the project group.

### ***Action 7: Decide on whether to build a specific national software or buy an existing software***

The project group should choose between two IT solutions:

- buy an existing software, built by an IT company for several countries, parameterize it and/or adapt it to the country; or

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<sup>42</sup> See W3C Guidelines, available at: <http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505>

- recruit an IT company to develop an IT system specifically designed for the country.

Generally, the first option is less expensive than the second one. However, substantial modification/adaptation of an existing software package is generally very costly, and the final cost could be much higher than a custom designed solution. If the project group decides to buy an existing software, the general table of functionalities (see Table 9) must be established before comparing the offers. If the project group decides to develop a specific system, the project group will have to produce a detailed functional description of the software (see Task 5 below).

## **TASK 5: DESCRIBE IN DETAIL THE FUNCTIONALITIES OF THE SOFTWARE**

### ***Action 1: Follow a standard methodology to describe the modules and functionalities***

Traditionally, one functionality is one entry of the menu - for example “capture the premises data”. A comprehensive list of functionalities and an individual description of each is a fundamental requirement. The IT persons will need this description to design the data model, the business rules and the screens. If it is too long, it is possible to aggregate some functionalities within sub-modules. For example, the functionalities of administration of the database could be regrouped into a single description (administration of stakeholders, users, and services).

### BOX 10: Example of description of a functionality

The classical methodology to describe a functionality is the following:

1. **Purpose of the functionality.** The purpose of the functionality is to capture the premises data on a mobile application or on web screens from paper collected by the field technicians, and to display the list of premises.
2. **Steps of use, navigation.** When entering a new premises or updating information, the user will start from the premises list of the area, and will check if the premises already exists. If it exists, he can select it, display its detailed sheet and modify it. If it does not exist, he will create a new one; the software produces an automatic premises identifier and displays an empty sheet ready for data capture. The validation is authorized if the business rules described below are respected.

In the special case where the premises corresponds to an unique keeper who keeps only the premises' animals, the user can declare this unique link (in this case, the inventory of the premises and the keeper will be the same). When the premises is created, the user gets a shortcut to animal registration; he can declare the animals associated with the premises.

### 3. Main data displayed, main data captured

Name of the data	Premises sheet	List of premises	Controls, remarks
Form Number	M		Only if the capture is made from paper form (i.e. on classic web screen)
Date of census	M		If the capture is made directly by mobile, the date of census is the date of the day
Person in charge of paper capture	M		If the capture is made directly by mobile: the person in charge is the user (cannot be
State of the premises	M		Choice in drop list of reference
District of the	M		Choice in drop list of reference
Block of the	M		Choice in drop list of reference
Village Name	M		Choice in drop list of reference
Village ID of the			Deducted by the system
Latitude of the	O		Kilometric latitude coordinate in UTM
Longitude of the	O		Kilometric longitude coordinate in UTM
Organization name	O		Name of organization (moral person): choice in drop list of the organizations of the state
Organization ID			Internal ID generated by the system

Cooperative of the premises	O		Name of cooperative: choice in drop list of the cooperatives of the district
Provider service attachment	M		Each premises is attached to a service provider (private or not). This attachment defines the responsibility of the service provider or the local authority on the
Official ID of the premises			Provided by the system for every new premises – not captured separately
Name of the premises	M		If human ID has been captured this is displayed by the system. Otherwise free text
Phone #	O		Phone number (the system controls the format: number of digits, etc.)

• **Legend:**  Read only  Read-write : M: mandatory capture, O: optional, blank: cannot be captured

**4. Main business rules.**

- The premises is defined by an official identifier provided by the system, this is a location, within a village, if possible with GPS coordinates.
- At a given time, an animal always lives in a single premises, or it is dead.
- A premises can belong to a cooperative and/or an organization (moral persons).
- There is no direct relationship between keeper and premises; the link passes through each animal. This data architecture is made to take into account the commercial farms as well as collective premises, where animal belonging to, or managed by different keepers, live in the same places (sharing the same premises but not the same keeper).

**5. Screen simple mock-up, documents to print.** The screen mock up is to be made for important screens, because it makes easier the functional design for the group. Printings: it is useful to include in the URS the existing or mock-ups of needed documents.

## ***Action 2: Share the vision of the project in order to generate adhesion of the stakeholders***

The project group has a central role in engaging and involving stakeholders. They should share their vision of the project by;

- preparing a simple and visual description of the IT system, with charts and tables, for example using PowerPoint slideshow;
- creating a dynamic mock-up of the main screens of web portal and mobile application. This is not a technical prototype; the role of this mock-up is not to be reused in development phase;
- Sharing these support materials with the key stakeholders and collecting their views, before finalizing the URS document; and
- organizing users' interface testing with different types of end users. Even if incomplete, these ergonomic tests are based on the dynamic mock-ups and on typical simple operational scenarios (like declaring a new premises, a new

animal, etc.). This phase is quick and easy to organize, is very instructive and is useful to avoid possible serious design errors.

## **TASK 6: DESCRIBE THE TECHNICAL REQUIREMENTS**

Usually the technical design of the IT system is developed by the IT company to meet the functional requirements; this is why the URS document can describe only particular technical requirements. This part of the URS is therefore much shorter than the functional description.

### ***Introduction to the technical elements of the system***

The various elements of the IT system can be divided into two main subsets (see Figure 19):

- Central infrastructure to store data and provide web-based services; and
- Distributed infrastructure for capturing data and receiving information.

#### **Central infrastructure to store data and provide web-based services**

The main resources required include a database server to host data, a separate server to host web-based applications and synchronization services, and high speed internet access. The central infrastructure should also have well secured data backup and recovery services. Generating complex reports and graphs often consume a lot of resources. Therefore it would be advisable to have an additional data warehouse server, which stores data in specified formats to produce specific reports and graphs as required by the users, if defined in functional requirements.

#### **Distributed infrastructure for capturing data and receiving information**

The available technologies for capturing data at field level may be divided into the following three groups (See Figure 18):

- Collecting data on paper and entering data through connected desktops/laptops. The central server provides functionalities by web pages, allowing various stakeholders to capture or display information, usually through a web portal that grants personalized privileges and access to specified information;
- Entering data offline through smartphones or tablets in a local database and synchronizing the local database with the central server periodically; and
- Data exchange between the central server and other databases through XML files or web services for real time data exchange (simple object access protocol (SOAP) or other interoperable technology).

##### **a. Collecting data on paper and entering data through desktops/laptops and producing operating reports**

In this case, the field worker collects data on specified formats and dispatches them to a nearby workstation, where data entry operators enter data using a web-based application through desktops/laptops connected to the central server. This approach

not only duplicates the work of data entry, but also increases errors, adds to cost and causes delays. However, in many situations, this could be the first option. The web-based application provides various user interface (UI) forms to enter and to validate data. It could also produce operational reports on the desktops/laptops, which need to use appropriate web browsers (such as Internet Explorer, Firefox, and Chrome).

**b. Entering data offline through smartphones or tablets in a local database and synchronizing the local database with the central server periodically**

In this case, field workers are provided with smartphones or tablets. The smartphone is embedded with a custom designed client application, a local database and a synchronization middleware. The client application provides UI to enter and validate data and updates the local database. The synchronization middleware synchronizes the local database with the central database via wireless connectivity. The smartphone uses any of the available mobile operating system (OS) viz. Google's Android, Apple's iOS, Microsoft's Windows phone, etc. When smartphones are used, data entry occurs only once, errors are rectified right at the source and data updating occurs (locally) without any delay. The central database is updated when the device is synchronized; this synchronization can be automated. Unlike the workstation, here, data is entered by many field workers using smartphones that have been supplied to them. This means many smartphones will have to be supplied and maintained. In addition, each field worker will have to be given a user ID.

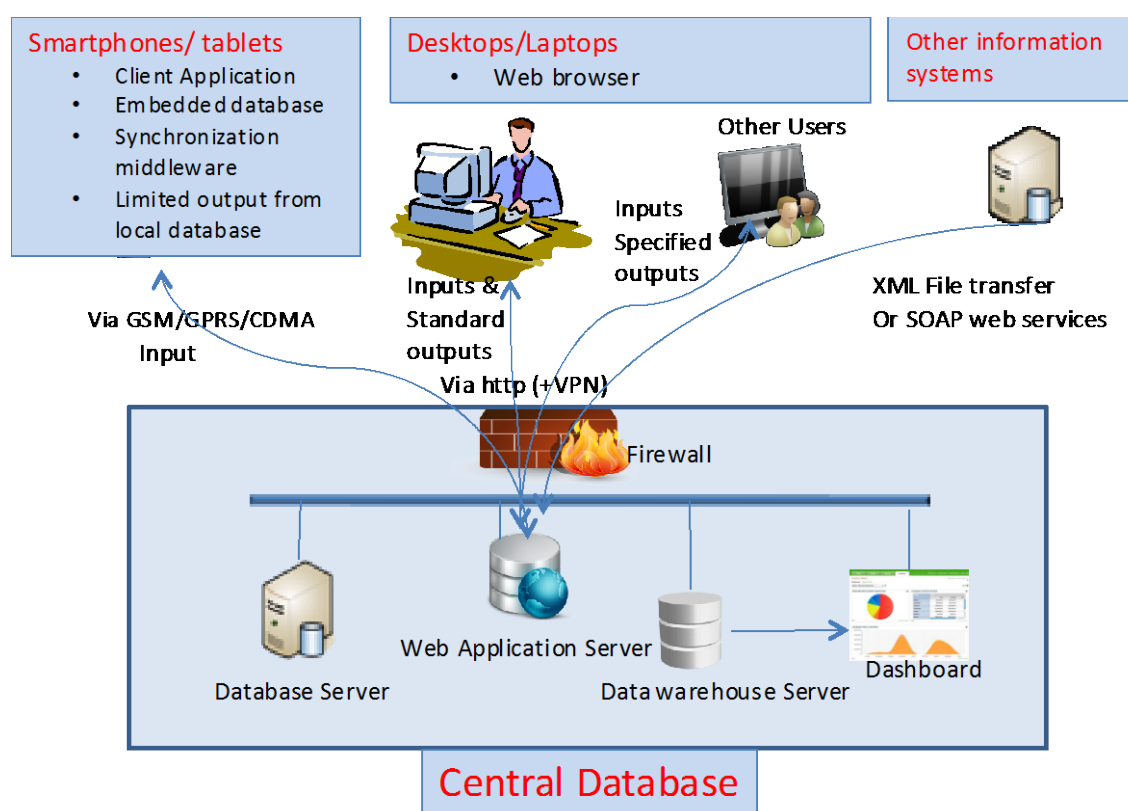
**Box 11: Example of NDDDB's Information Network for Animal Productivity and Health (INAPH)**

The National Dairy Development Board of India has developed an integrated IT System referred to as "Information Network for Animal Productivity and Health (INAPH). This information network is based on field force automation, using mobile technology (GSM or CDMA). The field force is provided with handheld devices (PDAs/Phones/Netbooks) to record activities in real time with proper validation, and to generate information for monitoring and control of their daily activities at the village level. It is a Windows mobile-based application developed using .net framework having SQL CE database along with mobile synchronization middleware. Field level workers synchronize their data with the INAPH central server at Anand in the state of Gujarat using GPRS/CDMA services. The Web-based version of the network is available on the desktops/laptops for entering data and for generating the required information. The desktop version is also developed using .net framework. A DBMS Microsoft SQL server is set up at Anand to host data. A separate web server is maintained to host all web-based applications. The Microsoft ASP .net framework is used in developing the applications. The system also has the facility to send SMS messages to farmers on their cell phones to alert them on what is due on animal(s) they have (for details on INAPH see <http://NDDDB.coop>).

Source: Dr. Kamesh Trivadi

**c. Data exchange between the central server and other databases through XML files or data web services (SOAP or equivalent)**

As discussed in Section II, and in Action 3 of Task 4 above, the development of a fully integrated system is a preferable option for countries where little has been done concerning animal recording. However, most countries already have several single- or multi-purpose IT systems with corresponding databases in place. In such cases, one can exchange data between the central server and these databases through XML files protocol or real time technologies like SOAP. Other option could be a file transfer. This option could be useful for an external organization that is not capable of implementing a web-based application. In this case, the participating organization enters its data in a specified file and transmits it electronically using internet broadband or virtual private network (VPN) to the central server. An application on the web-based server provides an FTP file service to transfer such data.



**Figure 19: Technical elements of the IT system**

***Action 1: Describe the technical requirements regarding the software***

The project group should write in the URS what is required in terms of:

- **Volume of data.** Provide information concerning the volume of the main entities to store in the database; give roughly estimated numbers of users, premises, keepers, animals, movements, events, documents, etc.



- **Security of access.** Indicate what type of security is required (cyphered password, renewing of passwords, etc.). Specify whether the login and password should be the same as in another system.
- **Functional logs.** The software should register functional logs at each step. It should be able to know who did what at each step (who captured the data, when, who modified it, who cancelled it, etc.). This is essential for effective supervision of the system, and to guarantee a reliable data quality. This is useful also in order to provide utilization statistics and billing files if necessary.
- **Display optimization** for a range of screen sizes and resolutions. Require an optimized presentation on the screens to be used:
  - For a mobile application it could be: four to six, or four to ten, or seven to ten inches, with resolution starting from 480 x 800 pixels, or 1024 x 600 pixels.
  - For a web portal it could be eleven to nineteen inches, resolution starting from 1024 x 600 pixels.
- **Compatibility of mobile application with operating systems (OS) referred.** Require full compatibility with Android, Windows 8 and Apple, or single compatibility with Android if it is preferred. Require sustainability - adapting changes of OS over times.
- **Compatibility of web services with main browsers** (Internet Explorer, Firefox and Chrome). Specify the versions and require sustained compatibility.
- **Requirements regarding development technologies and architectures.** If the system is to be maintained by a local company or organization, which uses one technology, the project group will demand that the IT company develop the new system with the same technology. For example, some organizations are only Microsoft, or only Java.

## ***Action 2: Describe the platform and hosting service requirements***

The IT system should be hosted in datacentre that guarantees supply of key elements, such as electrical supply, power generators, air conditioners, firewalls, backup systems, access to the internet, etc., as well as physical security, against fire, flood, intrusion. These requirements are necessary for systems requiring high availability and security.

The project group may decide to call a tender during the development phase to select a datacentre. If there is no compliant datacentre in the country, the system can be hosted abroad. The decision should, as far as possible, be based on technical and security aspects. For this tender, the project group should specify the level of service expected, including bandwidth requirement (see example in Table 11). Hosting the system by the IT company who developed the software, at least for the first few years, could be a good solution as it will facilitate better reactivity and troubleshooting.

**Table 11: Example of hosting services requirements**

Hours of operation of the system	7/7 24/24
Hours of supervision of the system	Monday to Friday 7:00 to 21:00
System availability percentage, monthly	99,98 percent
Response time of a page of 50 kilobytes (internal time)	2 seconds
Provided bandwidth	4 Megabytes per second
Maximum duration of service interruption during the hours of supervision	4 hours
Providing a pre-production platform	Identical platform
Providing a test and training platform	Yes

## **TASK 7: VALIDATE THE USER REQUIREMENT SPECIFICATIONS AND THE MOCK-UP**

The project group will require around six months to gather information and to write the URS. The validation of this document is a key step in the overall process. It should be undertaken in a formal manner, involving the key stakeholders and top management of the implementing institution. Usually, the mock-ups are validated at the same time. Once validated, the URS becomes the reference technical document for the call for tender.

## **TASK 8: CALL IT COMPANIES FOR TENDER**

This approach traditionally consists of providing the URS to IT companies according to the country's tender regulations and procedures. It is useful to provide standard costing grids to the candidates in order to obtain comparable solutions, and to understand the difference between the various solutions. The question of full ownership of the software should be mentioned in the tender documents, because some IT solutions could be delivered with a licence (in such cases ownership of the software is retained by the vendor in this case).

## **TASK 9: DEVELOP AND TEST THE ANIMAL RECORDING IT SYSTEM**

### **Organization**

As indicated in Task 1, the project group and the team leader of the IT company can form a monitoring committee, which will oversee the development of the software. Likewise, the project leader, the director of the implementing institution and the manager of the IT company can form a steering committee, which will take any important decisions about planning and budgeting during the implementation of the IT project.

## Development Phases

The software development process may follow the following sequential steps (see Box 9):

- a. Preparation of the software requirement specification document (SRS) by the IT company, which involves:
  - Specifying in technical terms all use cases, giving details of purpose, data elements, business rules, etc. This is a very critical phase of any software development process. The project group should carefully check that all their requirements have been well understood and ensure that nothing is left out.
  - Provide details on data model, business rules and technical architecture of the web and mobile software.

Depending upon the complexity involved, this phase may take three to six months.

- b. Careful validation of SRS by the project group, and acceptance of it.
- c. Provision of real datasets and scenarios for testing by the project group.
- d. Development of each functional module and internal testing by the IT company.
- e. Testing by the project group with different referred devices and computers and configurations (this activity could take three months).
- f. Any problems arising during such testing of the application are rectified by the IT company development team. The final version of the software is made available to the user after incorporating all changes.
- g. Final acceptance of the software. Depending upon the complexities involved, the entire process may take 24-30 months.

The IT company and the project group need to work together during the development of the software. The latter needs to provide continuous guidance and regular feedback to the former. It is recommended to follow an agile software development method, wherein the project group and the IT company development team work in collaborative way. In this approach, the development team works on each module, discusses the solution with the project group, adds modifications suggested by the latter, and both of them accept the solution. The IT company then proceeds to the second module and repeats the procedure. As the development team finishes working on one functional module, it makes it available to the project team for testing. Thus the process of development and testing progress in tandem.

## **Section IX. Evaluating investment decisions**

### **INTRODUCTION**

Developing a national animal recording system requires large investments not only to implement the system but also to maintain it. Therefore, governments should analyze the costs and benefits of such a system before embarking in such enterprise. The analysis should also consider the implications of not investing, such as the risk of being excluded from a market or the increased difficulties in exporting live animals and animal products.

In project formulation, one should identify the objectives and outcomes, define the strategy to achieve the formers and estimate the budget needed to implement the strategy. As resources are always limited, this is an iterative process until a compromise is reached. These guidelines have been prepared to support those undertaking this process. A strategic plan for developing an integrated multipurpose animal recording system and the information technology (IT) that supports the related activities were described in Section VII and VIII, respectively. This section provides guidance on how to perform a preliminary analysis of costs and benefits to support decision-making concerning the type of animal recording system to develop and the elements to include. Simulations and examples are presented to help the user in this exercise. The section also discusses options for making the system affordable and acceptable to all stakeholders. Particular attention is given to animal identification, registration and traceability systems, for which some data are available.

### **OBJECTIVE**

The main objective of the section is to provide the user with a clear breakdown of costs and benefits of an animal recording system, particularly animal identification, registration and traceability system, to facilitate their evaluation and to identify ways to make an equitable distribution of costs between the main beneficiaries.

### **TASKS AND ACTIONS FOR EVALUATING THE COSTS AND BENEFITS**

The literature on costs and benefits of animal recording systems for livestock is scarce. Although some structured approximations of cost are available (an example is given in Table 12), it is difficult to find references concerning the quantification of benefits. This is due partly to the fact that animal recording is merely a tool and not a purpose in itself. Therefore, any benefits are indirect; they derive from the outcomes of the purpose for which the tool is being used. Published financial analyses show variations depending on the objectives, species, regions, extent of coverage, size and type of the production system, and level of participation of the keepers, among other factors.

**Table 12: Cost structure of animal identification and traceability systems (based on data aggregated from several projects by Ferdinand Schmitt (2009))**

Description	Cost in US\$ per new born calf
Ear tags and forms	0.40 – 0.70
Central Unit, regional offices for data entry	0.50 – 0.70
Depreciation/maintenance of hard and software	0.30 – 0.50
Tagging and movement recording services including transportation fees	1.00 – 3.00
Control of animal identification and traceability	0.50 – 1.00
Total costs	2.70 – 5.90

The following tasks need to be undertaken in order to evaluate the costs and benefits of animal recording system:

1. identify and evaluate the costs;
2. identify and evaluate the benefits;
3. evaluate the cost-benefit relationship; and
4. define the requirements for sustainability.

## **TASK 1: IDENTIFY AND EVALUATE THE COSTS**

### ***Action 1: Identify the elements of the costs of animal identification, registration and traceability systems***

For any project, initial investments or capital costs are needed to acquire certain assets that are used for a long period of time, and operating costs are incurred on a regular basis for implementing the project. Capital costs may include costs of building, equipment, IT and communication hardware, software, vehicles, etc. Operating costs are usually grouped into two categories:

- variable costs (or direct costs), which vary depending on the level of activity. In the case of animal identification, registration and traceability system, they may vary depending on the number of premises, owners, keepers, animals and animal movements recorded; and
- fixed costs (or indirect costs), which are recurring costs. They include staff costs (salary and compensations), administrative costs, hardware maintenance and software operating costs, training and awareness raising, etc.

All these cost items are summarized in Table 13 and briefly described thereafter.

**Table 13: Cost items for identification, registration and traceability**

<b>Capital Costs or Fixed Assets</b>
<ul style="list-style-type: none"> <li>• Reading equipment</li> <li>• IT and communication hardware</li> <li>• Software</li> <li>• Vehicles</li> </ul>
<b>Operating Costs</b>
<b>Variable costs</b>

Direct material costs
<ul style="list-style-type: none"> <li>• Identification devices and applicators</li> <li>• Printing material</li> </ul>
Direct labour costs:
<ul style="list-style-type: none"> <li>• Identification and registration of premises, keepers, owners and animals and recording of movements</li> </ul>
Other variable costs
<b>Fixed costs</b>
<ul style="list-style-type: none"> <li>• Staff costs</li> <li>• Central hardware and database management costs</li> <li>• Software operating costs</li> <li>• Administrative costs</li> <li>• Training and awareness campaign</li> <li>• Depreciation, and interest</li> </ul>

### Capital costs or fixed asset costs

- **Reading equipment.** Depending on the identification devices selected, radio frequency identification (RFID) or bar code readers may have to be purchased. The former are substantially more expensive than the latter. Depending upon the implementation plan that is adopted, the reading is done by keepers, service providers or livestock public services. This has direct implications on the number of readers to be purchased, and on who will cover their costs.
- **IT and communication hardware.** Items under this heading include: central servers, computers, printers, telecommunication hardware (i.e. routers, modems, etc.), projectors, global positioning systems (GPS), etc.
- **Software.** As the software that is developed or purchased will be used for a long period of time, all costs related to its development are usually considered as capital cost.
- **Vehicles and accessories.** This refers to vehicles and accessories that will be needed to perform the field work. Their quantity depends on the scope of the system, the size of the implementing organization and its coverage of the territory (its proximity to the keepers), and the geographic dispersion of the premises.

Some of the equipment listed above (computers, printers, readers, servers, modems, GPS, etc.) are required not only for the recruited staff but also by all those who will contribute to implementation of the system (e.g. producers' associations), or to those who will be involved in ensuring compliance with the system (e.g. police officers).

### Operating costs

#### *Variable costs*

- **Identification devices and applicators.** The selection of the identification device is an important decision because of the wide range of qualities and prices. This selection should take into account the objective of the identification, the species and the type of production system. The number of

identifiers needed depends on the scope (fraction or whole population), rules (e.g. simple or double tagging), and the environmental challenges that affect the rate of loss. Indeed, re-identifying animals bears a cost. This cost is lowest if the re-identification involves the use of a new ID code. If the rules impose re-identification using the same ID code, the cost would be much higher. One has to consider also the costs of applicators, documents, and shipment of identifiers. The cost of collection and destruction of the identifiers following the death or slaughter of animals, must also be considered. For example, if endorumenal boluses are used, slaughterhouses may need to adapt slaughter line equipment in order to retrieve the bolus and avoid damage to offal grinder machines. For public/state slaughterhouses this cost must be considered.

- **Printing material.** Whatever the system, there will be a requirement for a number of printed official documents that guarantee the transaction, the ownership and the identification of the animals. One has to add also the cost of shipment of such documents.
- **Direct labour cost.** This includes the cost of labour for identifying and registering premises, keepers, owners and animals and for reporting movements of animals. Depending upon the implementation plan adopted, the identification and registration. The collection of movements, and the transmission of data may be performed by the keeper, the service provider, or the field technicians. These variations affect the mode of payment of the service, which can be subsidized, fully charged by the service provider or fully covered by the government, respectively. Even if these activities are performed by public field technicians, the cost should be considered as direct labour cost, instead of classifying it as a fixed cost under staff costs, as it provides an idea of direct labour costs involved.

### *Fixed costs*

**Cost of staff.** The animal identification, registration and traceability system should have a functional organizational structure that consists of a permanent central unit to manage the system, and field technical staff to implement and/or monitor it. The recruitment, assignment and/or deployment of the necessary staff are key for establishing such a structure. The strategic plan should specify the job descriptions with lines of command, duration of contracts, financing and renewal plan. The staff structure may include the following profiles:

- **National programme coordinator or director.** The permanent technical unit would be managed by a national coordinator or director who could be a veterinarian or an animal production scientist. The unit would include system developers, help desk officers and administrative officers.
- **System developers.** Their role is to adapt, to maintain and to improve the system through the development of new functionalities.
- **Help desk officers.** They must be livestock technicians with a good knowledge of the rural environment (including the lexicon of rural producers), animal identification, registration and traceability systems and information technology. In addition, they must be personable and accessible to the public. In a well rolled out system, it would be possible to train employees to respond to requests through reference to and in accordance with a standard help desk manual.

- **Administrative officers.** According to the scope of the system and the implementation plan, it may be necessary to recruit administrative staff such as a secretary, an accountant, etc.
- **Field technicians.** Generally, each country is divided into veterinary administrative zones. If this is not the case, divide the country into farming regions according to livestock demographic population to ensure its full coverage with technical capacities. There must be at least one technician per region or zone.
- **Auditors or inspectors.** Their number must be sufficient to have at least one inspector covering about 50,000 animals.
- **Data entry officers.** These are responsible for data entry and error correction at the field and/or central level: their number depends on system design (digital documents, paper, etc.).

Estimation of the necessary human resources to manage the animal identification, registration and traceability system depends on a number of parameters such as the population size, number of premises/establishments, identification method, etc. An example is given in the simulation study presented in Annex II.

- **Central hardware and database management costs.** The related cost items may include: maintenance of central hardware and communication network, maintenance and further development of software, purchase of software licenses, and cost of communication and internet connectivity. When considering the cost of communication, it is necessary to distinguish between the infrastructure costs (e.g. optical fibre) and the communication costs (mainly wireless communication and internet connectivity). If the central hardware (and database) is owned by the implementing institution, it becomes a capital cost and its depreciation is included under fixed costs. If the central hardware is hosted outside the implementing institution then its cost should be included as annual fixed costs.
- **Administrative costs.** All office running costs including courier, telephone, power supply, network connectivity, etc., should be considered here. If any fire, theft insurance is taken for any assets, it should be considered as fixed administrative cost.
- **Training and awareness-raising costs.** The awareness raising plan should employ a communications strategy that uses all available information and communication modalities such as mobile phones, internet, press and radio and/or television programs, manuals, brochures, posters and videos. As for monitoring, evaluation and audit, the cost of awareness raising and training should be considered as being a primary running cost.
- **Depreciation and interest.** The capital costs are accounted as depreciation charges on the basis of original capital cost. If interest is to be paid on borrowed money used for asset creation that should be accounted as fixed cost.

Table 12 could be used for evaluating the various cost items in a given situation.



## ***Action 2: Identify the elements of the costs of other components of the animal recording system***

The existence of a well-functioning animal identification and registration system is a pre-requisite for the establishment of an integrated animal health information as well as performance recording systems, which require additional costs in terms of equipment (computers, data storing servers), software for data recording, retrieval, manipulation and representation (for example web-based bulletin, web-GIS sites, etc.), internet connectivity, and computerized procedures for data alignment, exchange and sharing. Training costs for personnel of all structures involved (veterinary offices, laboratories, slaughterhouses, etc.) must be considered. If specific software is to be developed for animal health information systems and/or for performance recording systems, then those costs should be considered as capital costs. One must note here that the above-mentioned costs are specific to animal recording and not to providing various services under animal health or performance recording.

When an integrated animal recording system is developed the major challenge is the elaboration of coherent data exchange procedures among the various databases included in the system. This implies significant additional IT work, the existence of adequate IT infrastructures and the availability of fast and secure internet connections. The impact of systems integration on the single components should not be underestimated. For example, the integration between laboratory information management systems and the animal identification and registration system implies changes in the internal laboratory procedures of samples recording and labelling with consequences on personnel allocation and skills needed. All these indirect impacts must be taken into account when the whole cost of establishing an integrated animal health information system and/or performance recording system has to be assessed.

## ***Action 3: Estimate the costs for various scenarios of animal identification, registration and traceability***

This action presents a simulation of three implementation scenarios and their resulting costs.

1. **Full traceability with electronic identification.** The first scenario consists of implementing an animal identification, registration and traceability system for a cattle population of 3,000,000 head. The implementation is gradual, where individual identification of all newborn calves in each year is performed before the age of six months, using a pair of identifiers (electronic and visual). The implementation is completed in five years, by which some 90 percent of the animals are expected to be individually identified.
2. **Full traceability with visual identification.** The second scenario is similar to the first, the primary change being the replacement of the visual and electronic identifiers by a pair of visual plastic ear tags (without bar codes).
3. **Group traceability.** Here the system is based exclusively on the identification of premises, keepers and owners as well as the control of movement of animals in a group. Hot branding is considered for identifying the animals. In contrast with the first two scenarios, group traceability is implemented at once.

The advantages and disadvantages of establishing an animal identification, registration and traceability system gradually (only newborn animals) or at once for the whole population are discussed in the Box 12.

**Box 12: Advantages and disadvantages of establishing an animal identification, registration and traceability system gradually (only newborn animals) or at once**

**Only new born animals yearly**

Advantage: the investments are spread over a certain number of years and human and financial resources to be mobilized can be less.

Disadvantage: the benefits of having in place an animal identification, registration and traceability system are quite limited (even null) for years before the completion of population identification and recording. For a certain number of years more than an unique identification system may be in place (new and old animals) with possible additional management costs related to that.

**Whole population at once**

Advantage: an unique animal identification, registration and traceability system is in place with organizational efficiencies. The benefits and the additional value of having such a system in place are immediately available.

Disadvantage: more resources mobilization needed.

Irrespective of the option selected, there is no difference in the IT system requirements (it should be designed and implemented, and ready to manage the full dataset). The choice should be made taking into account the availability of resources and the possibility to combine the identification and registration in-field activities with other pre-existing activities such as vaccination campaigns.

The main results of the simulation are given below. Detailed description of the parameters assumed and the resulting costs are given in Annex II.

The average cost per identified animal, or newborn calf, was US\$5.30 for the first scenario, US\$4.90 for the second scenario, and US\$2.90 for the third scenario (see Table 14). As there is no individual animal identification in the third scenario, the annual cost is normally expressed per bovine. However, to ensure adequate comparison with the other scenarios, the cost is also expressed per newborn calf.

**Table 14: Average cost per newborn calf registered under three scenarios**

Scenario	Total new born calves identified	Total cost for five years in US\$	Average cost per calf in US\$
Scenario 1	2,873,304	15,228,708	5.3
Scenario 2	2,873,304	14,244,593	4.9
Scenario 3	2,873,304	8,278,018	2.9

The variation in average costs among the three scenarios are due to:

- **Differences in the costs of the identification devices used.** The unit cost for a pair of visual and electronic tags assumed is US\$2, whereas that for a pair of

visual plastic ear tags (without bar codes) is US\$1. In case of group identification, the cost of hot branding is assumed to be US\$0.14 (for details on advantages and disadvantages of different identification devices, see Section III).

- **Difference in staff costs.** When using visual plastic ear tags, the reading and data processing work would require more work force (or man-days) compared to use of electronic tags. It is very difficult to estimate the increase in the workforce, but a rough estimation of 30 percent increase of staff cost was assumed. In the case of group traceability, due to increased fieldwork, a further increase of technical staff (data entry operators and field technicians) by about 30 percent compared to the scenario with visual identification system, was assumed. This is due to the fact that each group movement is accompanied with documentation, which must be collected and entered in the system for monitoring and traceability.
- **Difference in operating costs.** The cost of equipment and field data collection and transfer increases with visual ear tag identification, which increases the overall operating cost. Most of the cost reduction due to the use of the plastic tag is offset by the substantial increase of the operating costs. The costs of movements and ownership changes, which are proportional to the number of identified animals, are the most determinant components when calculating these operating costs. In case of group traceability, the need for field equipment (readers, internet, and other equipment) is considerably reduced. Likewise, the cost of movement control (habilitation/qualification, documentation and shipment) also goes down, reducing the overall operating costs.

#### ***Action 4: Explore options for reducing the costs***

As shown above, animal identification, registration and traceability systems are costly. Any action or measure that contributes to reducing its cost should be explored. Among others, one can:

- Train the livestock keepers to identify their animals, complete the registration forms and submit them to regional or central offices, rather than sending field technicians or service providers to carry out these activities. Organizing such training through keepers associations or cooperatives could be a solution to reduce costs.
- Pool equipment and services. Producers' groups and associations can have joint access to equipment, training and support.
- Establish agreements with public institutions that have national coverage such as the national mail services, for shipping materials (e.g. documents, identifiers, equipment).
- Use existing information and communication technologies and networks for online data entry: filling of documents, registration of animals, reporting of movements and updating data and correcting errors. Likewise, scaling up an existing system, such as animal performance recording, and further developing it into a national animal recording system or a component of it could also be explored.

- Adopt rules and procedures that reduce costs, when possible. For example, the use of the same numbering for animal re-identification requires a reprint of the lost ear tag, and hence is more expensive than re-identification with a new number. However, the consequences must be evaluated before deciding on which method to use. This raises the issue of the quality of the device, which greatly influences the rate of loss. It is recommended to use International Committee for Animal Recording (ICAR) approved devices. Another example relates to admission to slaughterhouses and abattoirs, where the high cost of using of static reading equipment will be offset by the gain in reading speed.
- Promote the development of regional systems that address the specific needs of each country. In areas, regions or groups of countries with similar conditions or common markets, a regional system would meet common objectives while reducing the development costs.

## **TASK 2: IDENTIFY AND EVALUATE THE BENEFITS**

### ***Action 1: Identify the benefits of the animal identification, registration and traceability systems***

Benefits can be classified into primary and secondary benefits. The primary benefits include better management and control of diseases, ensuring safe and quality food, etc. The secondary benefits may be classified according to four levels of action. These are: market access and trade, public and animal health risk management, farm and industry management, and governance. Potential benefits under each level are listed below. The list should be adapted and completed according to the country's particular situation.

#### **Market access and trade:**

- Maintain the access and eligibility of current exports of animals and animal products (e.g. fibre, hides, skins, meat, milk and dairy products) to major markets, which increasingly are becoming more demanding in terms of standards of animal health and animal products' safety. This does not necessarily imply an increase in the prices or in the sales, but rather a guarantee of continuity of existing business relationships.
- Open new markets and position the animals and animal products of the region/country in more demanding markets.
- Increase the competitiveness of the livestock sector and take advantage of regional and extra-regional markets for export of live animals for fattening, slaughtering and breeding.
- Strengthen the image of a country producing safe animal food and other products.

#### **Food safety:**

- Ensure better control of biological, chemical or physical incidents affecting the safety of food of animal origin.
- Increase the confidence and assurance of consumers by certifying the origin of animal products.

- Contribute to the identification of the causes of episodes of food contamination and reduce their probability of expansion.
- Make rapid response possible to consumer complaints or concerns.

#### **Animal health:**

- Increase the efficiency in managing outbreaks of endemic, exotic and emerging diseases.
- Improve the efficiency of health plans and programs; surveillance, vaccination programs, early response, notification systems, inspection, certification, zoning and compartmentalization.
- Improve the efficiency of veterinarian in-field activities. For example, the registration of ID codes of sampled animals in large sheep flocks may be performed in a few minutes if animals are electronically identified and they are moved through a passage equipped with a static ID reader.
- Ensure the sanitary status of animals, farms, areas or regions.

#### **Industry:**

- Improve the image and value of the brand.
- Help the management of purchase and supply of animals for slaughter or of their products such as milk.

#### **Farm:**

- Improve the management and competitiveness of the farm (breeding, animal husbandry indicators, feeding, etc.).
- Reduce the theft of livestock.

#### **Governance:**

- Continuously provide up-to-date statistical information on the dynamics and characteristics of the sector (census).
- Facilitate the elaboration of public policies to support the sector, and favour planning, monitoring and decision making.
- Contribute to the organization of the sector (control of premises, livestock (cattle) population, animal movement, animal transportation, etc.).
- Improve the control of livestock smuggling and theft.

In all cases one should ask if the benefits could be attributed directly to the animal identification, registration and traceability system.

The benefits can be quantified when treated individually (e.g. for a keeper to improve the productivity of his herd, for a breeder to produce genetically superior animals, for a group of producers to conquer a new market), but they become more difficult to quantify when treated collectively (e.g. better animal health status, reduction of stock theft). In the latter case, the quantification of the benefits would require the collection of detailed information and expertise to perform the analyses, which may not be possible or available. To overcome this problem, one may perform a qualitative evaluation of these benefits as in the example presented in Table 15.

**Table 15: Classification of benefits according to the magnitude of benefit on the actors (adapted from Hobbs et al. (2007))**

Immediate or potential benefit	Producer	System	Society
<b>Risks</b>			
Animal health management	+++^	+++^	+
Incentive for good practices	+++^	+++^	+
Reputation/credibility	+>+++^	+>+++^	-
Market	+++^	+++^	+
Food security/human health	-	-	+++
<b>Supply chain</b>			
Information on the quality	+++	+++	-
Better operability	++	++	-
Logistics and management of inventory	+	++	-
Coordination of supply	+	++	-
<b>Market improvement</b>			
Information of the individual carcass	+++	++	-
available animal information	+	++	-
Quality check	+^	++^	+
Real time results	+	++	-
Verification of ownership	++	+	-
Connectivity	+^	+^	-
Credibility	+^	++^	+
<b>Government</b>			
National system	+^	++^	+++
Security of maintaining the official system	+>+++	+>+++	-
Synergy in tasks collaboration	++	++	+

- insignificant    + small    ++ medium    +++ large    +>+++ with future possibilities. ^ Greater if there is an export market

### ***Action 2: Identify the benefits of other components of an animal recording system***

The establishment of an integrated animal health information system can increase the efficiency of veterinary activities, making available all identification and sanitary information to whom is needed (e.g. for animal sample registration in laboratories, for vaccination practices, for certificates issuing, etc.).

A performance recording system provides information to its users. The value of information therefore could be gauged on the basis of the benefits it provides to its users (see Table 2 in Section VI and Annex I). Producers make use of this information for day-to-day management of their animals based on action list received, design proper feeding strategies, take preventive healthcare measures, take culling decisions, prepare mating strategies all of which assist them to increase productivity of their animals and reduce costs of their farm operations and in turn increase profit. Service providers engage field technicians to provide services to producers. For supervising their operations they engage supervisors and managers.

A performance recording system provides information to field technicians, supervisors and managers. Field technicians receive online information about all their customers and performance of animals, which not only help them to provide better services to dairy producers, but also support them to expand their services. Supervisors and managers are able to know the performance of their field technicians and aid them design correct capacity building strategies. All these together help service providers to provide efficient services to dairy producers. Likewise, breeding companies get breeding values of their bulls, which help them decide right pricing strategies for their semen doses and optimize their profit.

An integrated performance recording system thus helps many stakeholders improving efficiency of their operations and enhancing their incomes. Overall improvement in the efficiency of operations and profit lead to expansion of the sector and creation of more employment opportunities for people.

### **TASK 3: EVALUATE THE COST-BENEFIT RELATIONSHIP**

Ideally the cost-benefit relationship is analyzed and evaluated in economic terms (e.g. profit or return on investment). However, as explained in Action 1 of Task 2, this may not be possible because of the difficulties to estimate the benefits quantitatively. Therefore, depending upon the level of action and on the objective, animal recording systems will need to be evaluated not only in terms of formal economic indicators, but also in terms of additional criteria that give consideration to the less tangible outputs such as its impact on public health and animal health. The weight given to these criteria will need to be discussed and agreed upon.

When evaluating the cost-benefit relationship, the following points need consideration:

- The higher the number of users of a system, the better the cost-benefit relationship. Multipurpose animal recording systems, which maximize the number of users are preferable.
- Complex systems using most advanced technology may not have a better cost-benefit relationship than simple systems using ‘old’ proven technology. The design of the system should then be driven by the objective and the needs rather than the technology.
- The evaluation of the cost-benefit relationship can help the negotiation with the different stakeholders on how to share the costs of the system; those who benefit most should logically contribute more.

## **TASK 4: DEFINE REQUIREMENTS FOR SUSTAINABILITY**

The sustainability of the system depends upon the fair distribution of its costs among all stakeholders. Develop different scenarios to reach a consensus on the best mechanism for public and private contributions that will offer financial sustainability for the system. Some suggestions for cost sharing between actors are presented below:

- Costs borne by the government:
  - System administration;
  - Organizational structure and staffing;
  - Official documentation;
  - Inspections and audits;
  - Software and database, and their hosting; and
  - Implementation campaign.
- Costs covered by the producers and other actors:
  - Identifiers;
  - Equipment;
  - Collection of movement data; and
  - Labour.
- Shared costs:
  - Customer attendance (in various official offices, producers associations, and other public and private institutions); and
  - Sending documents, ID devices, notifications, re-identifications.

The legislation should specify how animal recording costs shall be shared amongst the different stakeholders (between the government and the beneficiaries). Countries might resort to imposing user fees on the animal recording services.

The user should be aware that the sustainability is not merely dependent upon financial resources. It depends upon several other factors that are addressed elsewhere in these guidelines, such as:

- the development of specific legislation, which, amongst others, lays down its financing so that there are no charges that must be solved in the future (see Section X for more details);
- the development of a training plan to qualify the actors involved in the implementation of the system;
- the development of a multipurpose system;
- the use of an up-to-date platform, which ensures constant availability to the users and remains simple to use, does not add unnecessary complications.



## Section X. Developing the legal framework

### INTRODUCTION

A strong legal foundation is a prerequisite for an animal recording system. This section identifies the key considerations when formulating this legal framework, including an overview of broader legal areas that it may interact with, key policy issues that should be taken into account, and any mechanisms that may need to be established through legislation for this system to operate effectively. The supporting legal framework must be tailored to the country in question, taking account of numerous factors, including the legal traditions of the country, relevant national legislation already in existence, available capacity to implement and operate an animal recording system, and any practices that are already taking place on the ground.

### OBJECTIVE

The objective of this section is to provide the reader with an overview of the key steps and considerations that must be addressed in order to develop a legal framework for an animal recording system, and to highlight key policy and regulatory decisions to be made when implementing such a system.

### TASKS AND ACTIONS FOR DEVELOPING THE LEGAL FRAMEWORK

The following tasks need to be undertaken in order to develop the legal framework:

1. determine the purpose and scope of the animal recording system;
2. consider all relevant international frameworks;
3. identify all relevant areas of existing national regulatory frameworks;
4. determine an appropriate national legal framework for an animal recording system; and
5. develop suitable legislation.

### TASK 1: DETERMINE THE PURPOSE AND SCOPE OF THE ANIMAL RECORDING SYSTEM

#### *Action 1: Identify the desired purpose*

The potential uses and benefits of an animal recording system are numerous, and are discussed in detail in Section I and in the conceptual Sections III to IV of these guidelines. The various reasons for implementing an animal recording system, referred to here as ‘regulatory objectives’, may affect the form and content of the required legal framework. When developing animal recording legislation, the regulatory objectives of the system should be considered since this will determine the type of animal recording system that is implemented. This in turn affects the required scope and elements of the supporting legal framework.

Animal recording systems that seek to provide animal health information will usually require mandatory identification and registration of individual animals and associated holdings, which will be consistently monitored and enforced. This enables the implementation of control measures to prevent the spread of animal disease. To limit the initial impact upon livestock owners, it is strongly recommended that mandatory animal recording systems should be implemented gradually, starting with specific areas or species, or with a transitional period that is first voluntary and fostered by different means of governmental support, to become compulsory on a set date.

If the key regulatory objective of an animal recording legal framework is animal traceability, accurate identification and registration of animals will be crucial. Records of all movements and any inputs used should also be required. Ideally, such a system should also be supported by comprehensive monitoring, inspection and enforcement measures, which should be clearly set out in legislation.

Finally, an animal recording system implemented to facilitate performance recording will, through necessity, require individual animal identification. Due to the voluntary nature of performance recording systems, details specifying suitable methods for identification, performance recording and strategic breeding may be set out in voluntary guidelines or codes of best practice, instead of secondary legislation.

### ***Action 2: Identify the desired scope***

In addition to the key regulatory objectives, it is also necessary to consider the desired scope of the system, as this will serve as the basis for drafting the legislation at a later stage. Depending upon national requirements and priorities, the animal recording system may be applied to all species, or simply to those that pose a significant risk, to all production species or just to those production species that are most commonly traded internationally. Furthermore, a system may be applied nationwide, or it may simply be applied within a limited geographical area.

The desired scope will depend upon national circumstances and capacity, as well as the key regulatory objectives. If the primary interest is conservation of genetic diversity, or international trade, then the system may only need to be voluntary and/or extend to particular species, or breeds. A good regulatory framework should be consistent with national policy and, at the same time, enable future incorporation of new animal species, geographical areas or animal recording components (i.e. animal traceability, animal health information or performance recording) into the animal recording system.

## **TASK 2: CONSIDER ALL RELEVANT INTERNATIONAL FRAMEWORKS**

There are a number of international instruments and institutions that should be considered when developing a legal framework for a national animal recording system. This international framework plays a key role in harmonizing national systems, and in facilitating international trade.

## The World Trade Organization (WTO)

The Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), to which all WTO members are signatories, seeks to prevent the imposition of unjustified barriers to trade between member territories, specifically with regard to the application of food, animal and plant health protection measures to international trade in these commodities. The SPS Agreement allows importing countries to implement sanitary measures that are considered necessary to protect humans, plants, or animals from hazardous organisms that potentially are associated with imported commodities. However, these measures cannot be more stringent than is necessary to achieve the desired aim (i.e. protection of human and animal health), and they must be fully supported by a scientific risk assessment.<sup>43</sup>

It is therefore essential when implementing animal recording legislation to ensure that the system is no more stringent than is necessary according to WTO rules. One way to achieve this would be if the importing state were to apply international reference standards, such as the OIE Terrestrial Animal Health Code (subsequently referred to as ‘the Code’), which is described in Section I of these guidelines.<sup>44</sup> National animal recording systems formulated in accordance with the Code are presumed not to constitute unnecessary sanitary barriers to trade for the purposes of compliance with the SPS Agreement.<sup>45</sup> For this reason, it is strongly recommended that reference be made to the Code when formulating national animal recording legislation. The Code includes general principles and recommendations on the design and implementation of identification systems in order to achieve optimal animal traceability. Article 4.2.3, paragraph 6 of the Code sets out a number of recommendations on the legal framework for animal recording systems that contain an animal traceability component (see Box 13 below).

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<sup>43</sup> WTO Agreement on Sanitary and Phytosanitary Measures (SPS Agreement), Article 2.

<sup>44</sup> See <http://www.oie.int/about-us/our-missions/>

<sup>45</sup> OIE standards are specifically mentioned as international reference standards in the SPS Agreement. This is not the case for the TBT Agreement, which refers broadly to “relevant international standards”. However, the Appellate Body of the WTO in the “Sardines case” (Dispute DS231) recognized Codex standards to be “relevant international standard” under Article 2.4 of the TBT Agreement.

**Box 13: International OIE standards for the design and implementation of identification systems to achieve animal traceability**

**The OIE Terrestrial Code Chapter 4.2.3.** – Animal recording systems that seek to achieve animal traceability should address the following:

1. desired outcomes and scope;
2. obligations of the veterinary authority and other parties;
3. organizational arrangements, including the choice of technologies and methods used for the animal identification system and animal traceability;
4. management of animal movement;
5. confidentiality of data;
6. data access / accessibility;
7. checking, verification, inspection and penalties;
8. where relevant, funding mechanisms;
9. where relevant, arrangements to support a pilot project.

Source: OIE, Terrestrial Animal Health Code (21<sup>st</sup> Edition), Chapter 4.2

**Other international standards on animal identification and traceability**

In addition to codes and standards formulated by the OIE, there are a number of other standards that should be considered when formulating animal identification systems. ICAR standards are not recognized as reference standards for the purpose of the WTO SPS Agreement. Nonetheless, ICAR standards are widely applied by livestock keepers to foster the harmonization of animal recording systems worldwide, and therefore help to promote international trade in animals and animal products. Accordingly, it is recommended that reference be made to ICAR standards when developing national animal recording systems.

**TASK 3: IDENTIFY ALL RELEVANT AREAS OF EXISTING NATIONAL REGULATORY FRAMEWORKS**

Before implementing animal recording legislation it is necessary to conduct a thorough assessment of the existing legal system, including all relevant legislation, constitutional provisions and the general administrative and institutional structure of the country in question. Identifying all areas of overlap or conflict with existing legislation will facilitate an informed legislative drafting process. The draft animal recording legislation, or the existing regulatory frameworks, may then be amended or updated as necessary. The result of this exercise will be effective animal recording legislation that integrates smoothly with existing regulatory frameworks.

***Action 1: Conduct a legislative assessment and gap analysis***

A legislative assessment should be conducted to identify all existing legislation that may impact upon, or require revision for the implementation of an animal recording system (see Box 14). Once identified, a ‘gap analysis’ of existing legislation should be conducted to identify any gaps, shortcomings, or areas of duplication within the

existing system. Any duplication of provisions or duties risks causing confusion and increasing the administrative burden upon the relevant government bodies. At this stage, the OIE Code may be used as a checklist of key elements to assess the structural integrity of the national legal framework. It is also important to take into account any responsibilities assumed at an international or bilateral level, such as international trade agreements. Such restrictions may limit the options available to the national government when implementing new legislation. Analysis of the legal framework may also reveal an existing legal basis for the implementation of an animal recording system, for example within general animal health or disease legislation.

**Box 14: Key regulatory areas that may require consideration or amendment when implementing an animal identification and traceability system**

There are a number of key legislative areas that should be considered when implementing animal recording legislation, including:

- **Animal health and production legislation** – Regulatory areas to consider would include legislation governing animal health, animal welfare, disease eradication and drug administration programs, farm registration, transportation and housing of animals, and rules governing sustainable livestock production.
- **Transportation of livestock** – Existing legislation regulating the movement of livestock might be affected by and will be supported by the introduction of an animal recording system, which will likely impose more onerous recording requirements for all animal movements nationwide. This will also extend to legislation governing the import and export of animals and animal genetic material (semen and embryos).
- **Slaughterhouse and marketplace controls** – Legislation imposing controls upon slaughterhouses, marketplaces, and other livestock gathering points will interact closely with an animal recording system. Introduction of the latter will likely impose more stringent recordkeeping and reporting requirements upon operators of such livestock gathering points.
- **Sale and distribution of animal products** – The ability to trace animal products to their farm of origin is often a key requirement in the sale and distribution of animal products, especially in an international context. The introduction of an animal recording system will therefore impact greatly upon regulatory systems governing the sale and distribution of animal products.
- **Food safety and Consumer protection** – Food safety and consumer protection is a crucial area of food production, which frequently introduces systems to trace food products from the farm to fork. Accordingly, an animal recording system will play an integral role, and will need to work in close conjunction with any food safety legislation.
- **Biosafety** – A range of legislation addressing various biosecurity issues, including the prevention of invasive alien species, quarantine measures to prevent the spread of disease, and similar legislation will be aided by the introduction of an animal recording system.

### ***Action 2: Assess the practical application of existing legislation and collect information from different stakeholders***

It is strongly recommended that study be undertaken to assess, not only the contents of existing legal instruments, but also how they are applied in practice. If animal identification provisions already exist within the country but do not operate effectively, it is necessary to investigate the practical reasons for this. Unless this is done and the practical issues are addressed, it is possible that a new animal recording system will not operate any better in practice than an existing one.

Stakeholders, especially keepers and small holders, should be involved in all stages of the consultation and drafting process, starting from the earlier stages of the assessment. Gathering primary information from keepers on the practical impact of existing legislation will allow better understanding of existing shortcomings and regulatory needs. Stakeholders participation will help drafting legislation adapted to national circumstances and facilitate consensus building and, at a later stage, the implementation of the legislation.

### ***Action 3: Identify where legislative competence lies***

A key step before developing legislation is to understand where legislative or rule making competence lies within the country, as this will impact heavily upon the scope of any animal recording legislation. In some instances, the competence for legislating on animal production and animal health may lie exclusively with decentralized administrations.<sup>46</sup> In such instances, it may be appropriate to include traceability systems under the authority of the central government to legislate on global health protection and harmonization of trade standards. Harmonized legislation on such matters at a central level will help to ensure that identification and traceability systems are consistent nationwide, thus optimizing their effectiveness.

## **TASK 4: DETERMINE AN APPROPRIATE NATIONAL LEGAL FRAMEWORK FOR AN ANIMAL RECORDING SYSTEM**

### ***Action 1: Identify available capacity***

Before taking tangible steps to implement an animal recording system, there are a number of key policy issues that must be considered. It is necessary to consider whether the country has sufficient financial and administrative capacity to implement, to monitor, and to enforce a compulsory system, and whether animal keepers are likely to have adequate financial capability to comply. In certain circumstances, a voluntary system may prove more effective than a poorly monitored and enforced compulsory system. Additionally, the resources available to both the government and to keepers will help to determine the most suitable form of identification.

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<sup>46</sup> For example, in India the power to legislate on matters relating to agriculture lies exclusively with state legislatures (Constitution of India, Schedule 7, Article 246). For further information, see below.

## ***Action 2: Identify the appropriate legal structure***

Legislation is necessary to introduce compulsory animal recording requirements, but also to harmonize the use of voluntary animal recording systems. For example, legislation may serve to harmonize the animal identification methods, or movement tracking and recording methods used in an animal recording system containing an animal identification component and an animal traceability component, respectively. Any legislative drafting concerning animal recording systems should be compliant and compatible with the national legal framework, including constitutional provisions, legislation already in force as well as the policy objectives of such systems and the national capacities for implementation. Box 15 summarizes the key differences between primary and secondary legislation.

The form of legislation required to implement an effective animal recording system will vary according to the existing legal framework and legislative practices of the country in question, and whether its legal system is based upon common law, civil law, religious law, or another legal structure.

In some cases, the creation of new primary legislation may be the most suitable option, specifically if the law is aimed at modifying previous primary legislation, establishing new responsibilities for existing institutions or creating a new institution with a legal mandate, introducing taxes, infringements or sanctions, or any other matter which is necessary according to the rule of law in the national legal system. Secondary legislation can then be used to prescribe the specific methods of identification for specific species, and any technical details that may need to be amended or updated to take account of technical advancements as they occur.

### **Box 15: Key differences between primary and secondary legislation**

**Primary legislation** is passed by the legislative branch of government, which is commonly called the Parliament or the National Assembly.<sup>47</sup> It constitutes the highest legal authority, second only to a national Constitution.

**Secondary legislation** is passed by the executive branch of government, in accordance with powers granted by primary legislation. The scope of any secondary legislation may not exceed the limits set out in the corresponding primary legislation.

Secondary legislation is commonly used to expand upon general principles contained in primary legislation and to set out technical or detailed aspects of a legal framework, such as approved methods of animal identification. In most cases, secondary legislation is easier and quicker to amend than primary legislation, and is therefore a way of quickly introducing new standards or amendments to technical requirements.

Alternatively, animal recording may be afforded a legal basis in general animal health or broader veterinary legislation. The specific details of the system could then be implemented through secondary legislation. Regardless of which model is chosen, it is important that specific details (such as approved methods of identification used in

<sup>47</sup> In some countries, Constitutions allocate to the executive branch of the State the power to pass primary legislation in specified areas and under specified conditions.



the animal identification and registration component) are in a form that is easily amendable, thus allowing modifications to be made as technology advances. In practice, the most suitable form of legislation will depend upon the applicable national legal system, and the scope of any legislation already in existence.

**Box 16: Animal recording legislation and legislative traditions**

In Argentina, which uses a civil law system, regulations on animal recording are contained within primary legislation published by the '*Servicio Nacional de Sanidad y Calidad Agroalimentaria*' (SENASA).<sup>48</sup> Livestock identification and traceability in Spain, which also applies a civil law system, is implemented through a series of primary legislation (commonly in the form of Royal decrees) of the Ministry of Agriculture, Fisheries and Food (MAPA) and the Ministry of Health (MISACO).<sup>49</sup>

In the United Kingdom, identification and traceability systems are implemented through secondary legislation enacted under the authority of the Animal Health Act 1981.<sup>50</sup> Regulations concerning the identification and traceability of livestock within the European Union are commonly contained within EU Regulations, which have direct effect within all Member States.<sup>51</sup> However, legislation relating to the identification and traceability of swine and poultry is contained within EU Directives, which must be implemented within Member States before they have legal effect.<sup>52</sup>

Selection of the legal instrument will also be affected by a country's form of government. A centralized government is one where a national government may make decisions that provincial, state, or regional governments must adhere to. In contrast, a decentralized government has the power to make its own decisions within given areas of law as per the constitution of the country. Additional challenges may arise when implementing an animal recording system within a decentralized or federal government systems. In this context, issues to consider include the distribution of powers between federal and state or decentralized authorities. In such a government system, it is important to find a balance that allows the implementation of a harmonized animal recording system, while respecting the semi-autonomous nature of

<sup>48</sup> Livestock identification in Argentina is regulated on a species-specific basis. For example, the identification and registration of cattle is governed by Resolución No.103/2006 '*Créase el Sistema Nacional de Identificación de Ganado Bovino*'.

<sup>49</sup> The primary legislation regulating the Spanish livestock identification and traceability system (*Sistema de Trazabilidad Animal* (SITRAN)) includes: Real Decreto 1980/1998, of 18<sup>th</sup> September, which establishes a system for the identification and registration of sheep and goats, and; Real Decreto 479/2004, of 26<sup>th</sup> March, which establishes and regulates the National Livestock Holding Database (REGA).

<sup>50</sup> Specifically, the Cattle Identification Regulations 2007, the Sheep and Goats (Records, Identification and Movement) (England) Order 2009, and the Pigs (Records, Identification and Movement) Order 2011.

<sup>51</sup> For example, Regulation (EC) No.1760/2000 of the European Parliament and of the Council 'establishing a system for the identification and registration of bovine animals and regarding the labelling of beef products and repealing Council Regulation (EC) No.820/97'.

<sup>52</sup> Council Directive 2008/71/EC 'on the identification and registration of pigs', and Council Directive 2005/94/EC of 20 December 2005 'on Community measures for the control of avian influenza and repealing Directive 92/40/EEC'.



each administrative division. The distribution of powers concerning animal health control and animal production may impact significantly upon the design and implementation of an animal recording system; specifically whether legislative powers for matters relating to animal health and production lie with the central government, or decentralized authorities or state governments.

To achieve harmonization in cases where decentralized levels have authority to implement legislation, it is important that decentralized animal recording systems comply with certain minimum coordination standards set at a central level. Decentralized authorities may be closely involved in the formulation of such standards, thus encouraging and increasing their likelihood of compliance, and may retain the discretion to implement more stringent regulations than those enacted by central government.

#### **Box 17: Different options for animal recording legislation**

The most suitable structure will, in many cases, vary between countries. For example, in the USA, federal legislation creating an animal recording system has been implemented, which imposes mandatory identification and traceability requirements upon all animals moved interstate.<sup>53</sup> This federal system does not include within its scope any animals that are moved within the boundaries of a single state or tribe. Individual states and tribes remain free to regulate animal movements within their territory, and may choose to implement an animal recording system that is more stringent than that implemented at federal level. The competent authority that is responsible for implementation and management of animal recording at a federal level is the Animal Plant Health and Inspection Service (APHIS), which is part of the United States Department of Agriculture (USDA). To enable successful implementation of these systems within each administrative division (states and tribes), APHIS must work closely with state and tribal animal health authorities.

In India, animal husbandry and agriculture are state issues, as prescribed by the Constitution of India.<sup>54</sup> Accordingly, the control of central government over state implementation of regulations concerning livestock health or production is limited. The federal authority responsible for matters relating to livestock health, production, and wellbeing (including identification and recording) is the Department of Animal Husbandry, Dairying and Fisheries (DADF), which is a Department within the Ministry of Agriculture. The role of the federal government is to facilitate coordination and to provide advice and assistance (financial or otherwise) to state authorities on such matters. Most States have a department of Agriculture and Animal Husbandry that is responsible for matters pertaining to animal health and production.

Box 17 illustrates how powers and responsibilities for matters relating to livestock production and health, including animal recording systems, may be divided in practice. Regardless of which model a country chooses, a key consideration is that legislation should be of an appropriate form that is sufficiently flexible to enable its amendment to take account of technological advancements in the field of

<sup>53</sup> For further information, see: <http://www.aphis.usda.gov/traceability/>

<sup>54</sup> Constitution of India, Schedule 7.

identification and traceability methods. To achieve this, approved identification devices and associated technical requirements, such as the construction and composition of ear tags, may be set out in easily amendable schedules or annexes to the legislation.

## **TASK 5: DEVELOP SUITABLE LEGISLATION**

### ***Key elements of animal recording legislation***

Although the format and structure of legislation will vary widely depending upon national circumstances, the remainder of this section lists a number of key components that can often be found in animal recording legislation. This list is not intended to be prescriptive. It is intended to serve as a guide to support the formulation of national legislation, and it should be noted that the specific provisions of such legislation will vary widely according to national legislative practices, the desired objectives, and the type of legislation through which the animal recording system is established. Nonetheless, in order to achieve a harmonized, consistent national approach, it is crucial that the legislation is clear and unambiguous in how the system will operate and, as far as possible, it should identify the key actors and their specific roles.

#### **1. Objectives**

As discussed at the start of this section, the ‘regulatory objective’ of an animal recording system is the primary reason for which the system is established. Before implementing animal recording legislation, governments must identify the regulatory objectives that they seek to achieve.

The regulatory objectives of animal recording legislation should be clear, and it should be evident how these objectives will support wider national strategies and policies relating to, for example, human health or economic development. The objectives of an animal recording system may be stated expressly, as is the case with European Union (EU) legislation. In other legal systems, where the objective is not expressly stated, it may be implied by the title of the legislation, or by the subject matter that it addresses. However it is strongly recommended that this be expressly specified in the legislation unless this is contrary to national legislative practices.

#### **2. Scope**

The scope of legislation refers to the range of people, practices or activities to which it applies. When regulating animal recording systems, countries may want to identify where applicable: the geographical areas or administrative divisions within their territory that the law will apply to, the species that will be covered, and the operators that will be affected. This may vary widely in practice. For example, animal recording may only be required for the movement of a specific species of livestock that cross the borders between administrative divisions within a country.

It is therefore crucial that the scope of legislation, and any exemptions from the animal recording system, are explicitly stated in clear and precise language to avoid the risk of uncertainty. For example, exemptions may be applied to persons that keep

or produce animals only for personal consumption. If so, this should be expressly stated in the text of the legislation.

For practical purposes, and to minimize the initial impact upon producers, governments may wish to introduce an animal recording system gradually. This may be achieved in a number of ways, such as:

- Specifying that an animal recording system will only apply to animals born after a specific date;
- Providing that animal recording requirements will only apply to animals that are moved between farms or establishments;
- Specifying in the legislation timeframes for the implementation of the system's various components, including the premises registers and databases, and the coordination and distribution of tasks within the competent authority; or
- Implementing a voluntary animal recording system that will evolve into a mandatory system upon a clearly specified date, areas or conditions (e.g. legislation may provide that animal traceability is voluntary in general, but compulsory for breeding animals or for animals intended for export).

### **3. Definitions**

To ensure consistency and to avoid ambiguity, legislation must clearly define all key terms and phrases and be consistent in their usage. These include, but are not restricted to, the following: “*animal*”, “*identification device*”, “*holding*”, “*establishment*”, “*owner*”, “*keeper*”, “*traceability*”, and “*competent authority*”. While definitions are by no means universal and terms may be used differently between countries, general guidance can be found in the OIE Terrestrial Animal Health Code Glossary. Countries may also get inspiration from existing animal recording legislation from different countries and regions, with a special interest in target markets.

### **4. Institutional structure**

To set up a national animal recording system, the government would need to designate one or more entities as responsible for implementing, regulating and managing activities related to animal recording, including the coordination of potential entities involved in the system, both at the central and at the decentralized levels. When designing an institutional framework and appointing responsible national authorities, governments should consider (i) the main purpose of the system, and (ii) the administrative and constitutional division of powers within the country.

With regard to the main purpose of the system, animal recording systems that are focused upon health interests may need to take into consideration the roles and duties of all the institutions with a health-related mandate. These systems may (immediately or progressively) extend to all animals from the same species or to different species and would, therefore, require strong coordination amongst the regional or local authorities responsible for farm registration, markets, slaughterhouses and animal movement control. Animal recording systems that primarily aim to facilitate animal

traceability or performance recording will commonly involve government bodies responsible for animal husbandry and production.

With regard to the administrative and constitutional division of powers, the issue of decentralization, and the allocation of responsibilities for managing an animal recording system within a decentralized or federal state must be considered. In practice, the balance of powers between centralized and decentralized government bodies, or federal and state governments, will be determined on an *ad hoc* basis, and is addressed in greater detail earlier in this section.

In any case, animal recording legislation should identify the authority or authorities with a role in setting up and implementing the system, and should clearly designate their powers and duties and any coordination mechanisms that will be used to promote consistency of the system. The key authorities should include the following:

- **National Veterinary Service ('the competent authority').** As discussed above, the most suitable government body to manage an animal recording system may depend upon the regulatory objective of the system, and also upon the country's administrative structure.
- **Enforcement authorities.** In any legal framework that imposes duties or responsibilities, it is essential to ensure that these are adequately monitored and enforced. In the case of an animal recording system, these functions will often be performed by employees of the competent authority or outsourced to a third party under government supervision.
- **Livestock owners, keepers or responsible persons.** In many jurisdictions, legislation distinguishes between 'owners' and 'keepers' of livestock. 'Owner' refers to the legal owner of animals, while 'keeper' means any natural or legal person responsible for the daily management of livestock. While the apportionment of responsibilities and liability may vary between countries, it is important that at least one party is responsible for ensuring, where deemed necessary by law, identification and registration of animals, maintenance of registers, reporting this information and making it accessible for inspection by the authorities, and ensuring that animals are moved in accordance with official requirements, and with all required documentation.
- **Businesses that produce and procure identification tools.** Registration of these actors is recommended to promote harmonization, and quality assurance in the production of identification devices. As discussed in detail in Section III, consistency in the form of identification devices and the information that they provide is crucial to achieve nationwide harmonization, and identifiers must meet strict standards set out by the national competent authority.<sup>55</sup> To ensure that such standards are met, legislation can demand that businesses that produce and procure identification tools must be registered in a central database.

## 5. Allocation of responsibilities

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<sup>55</sup> For example, see European Union 'Commission Regulation (EC) No.911/2004 of 29<sup>th</sup> April 2004 implementing Regulation (EC) No.1760/2000 of the European Parliament and of the Council as regards eartags, passports and holding registers', Chapter 1.

As confirmed in the OIE Terrestrial Animal Health Code, legislation should clearly delineate the obligations placed upon each actor in order to establish a secure animal recording system that facilitates ‘farm to fork’ traceability and accurate disease tracking in the event of an outbreak.<sup>56</sup> Depending upon the form of legislation in place within a country, some actors, such as slaughterhouse operators, may be addressed under separate legislation, in which case the implementation of an animal recording system may require the amendment of such legislation.

## **6. Methods of identification**

It is crucial that animal recording legislation clearly specifies the accepted methods for identification of animals, which are discussed in greater detail in Section III of these guidelines. Regardless of the method chosen, required specifications for identifiers and identification methods should be prescribed in detail in an appropriate legal instrument that permits appropriate flexibility to allow changes to be made as and when necessary. In many countries this requirement is stipulated in secondary legislation, which is generally easier to amend than primary legislation. However, in situations where an animal recording system is implemented to facilitate performance recording, these may instead be recorded in voluntary guidelines and codes of practice.

## **7. Record keeping, registration and databases**

The maintenance of appropriate registers and communication of relevant information is fundamental to the functioning of an animal recording system, and is addressed in detail in Section III of these guidelines. To support the recording and storage of such data, animal recording legislation should do the following:

- Clearly identify each register that must be created, including a list of all information that this should contain;
- Identify the person(s) responsible for maintenance of each of the registers, and clearly set out the scope and limits of their responsibilities;
- Prescribe record keeping requirements, including the minimum length of time for which records must be kept; and
- Where relevant, impose an obligation upon record keepers to share this information with relevant authorities upon request.

## **8. Management of animal movements and other events**

The necessary elements of an animal traceability system are set out in detail in Section IV. If the animal recording system is intended to enable animal traceability, then it is important that legislation clearly specifies the following details:

- The accepted procedure for the movement of animals;
- All information that must be submitted to the relevant authority when an animal is moved;
- Which persons are responsible for submitting the movement notification; and
- When the notification must be given in relation to the movement.

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<sup>56</sup> OIE, Terrestrial Animal Health Code (21<sup>st</sup> Edition, 2012), Article 4.2.3, paragraph 6.

### **Box 18: Traditional traceability models and nomadic pastoralism**

Pastoralism involves the frequent and often irregular movement of livestock to find fresh pastures, and is most commonly practiced in central Asia and Africa. This form of animal husbandry highlights the limitations of traditional traceability models, particularly with regard to the notification of animal movements. In such cases, legislation may instead require that livestock owners notify authorities of their intended route and the expected duration of their movement, prior to their departure.

It is also important to consider who should be made accountable for the identification of animals, and the notification of animal movements and other events. In some cases animal keepers may be difficult to contact. It may therefore be difficult to hold them accountable. In practice, it may instead be appropriate to apply joint liability to owners of establishments and to local authorities.

## **9. Monitoring and inspection**

To ensure the effectiveness of an animal recording system, governments should ensure that legislation contains adequate monitoring and inspection provisions. In the case of animal recording systems that are intended to provide animal health information and to promote food safety, implementing legislation should establish sufficiently strong monitoring requirements that comprise of both announced and unannounced inspections of establishments, to allow inspectors to determine whether appropriate records are being maintained, and whether all animals are being correctly identified and recorded.

To enable effective monitoring, legislation often affords inspectors a range of powers, such as the following:

- Enter and inspect facilities;
- Handle and mark animals;
- Require keepers to provide them with any appropriate records (either written or electronic);
- Make copies of any records; and
- Seize items that are considered necessary for investigation.

In practice, the exercise of these powers may impinge upon fundamental rights, such as the right to personal property. Consequently, it is important that inspectors are mandated to exercise these powers under primary legislation that clearly sets out the parameters of the inspectors' powers. In countries where these powers are already included in animal health primary legislation, they may not need to be repeated in animal recording legislation. The body responsible for carrying out monitoring and inspections may vary between countries. In federal states this may be performed by either federal or regional authorities. In practice, the exercise of such powers will

require the inspector to present appropriate documentation approved by the competent authority.<sup>57</sup>

## **10. Funding**

Governments may want to ensure that appropriate funding is provided for their animal recording system through legislation. The national government normally decides whether costs incurred in the operation of an animal recording system will be borne (wholly or partially) by the state, or whether costs will fall entirely upon keepers. If financial support mechanisms are provided (see for example the suggestion made in Section IX Task 4), it is important that they are outlined within the legislation.

## **11. Confidentiality of information**

The implementation and operation of an animal recording system will require the submission of potentially sensitive information, such as personal contact details, details of animals held at establishments, and animal movement records. As a result, there may be resistance to the creation of such a system. To minimize such resistance and to protect the interests of all parties involved, governments must ensure that their animal recording legislation contains provisions assuring the confidentiality of any sensitive information or a reference to the appropriate data protection legislation. Due to the nature of the information that will be provided in the operation of an animal recording system, data-protection provisions may need to be stricter than measures contained in any pre-existing data-protection legislation.

## **12. Enforcement**

To ensure the effectiveness of an animal recording system governments should ensure that legislation contains adequate enforcement procedures, and that inspectors have the necessary authority to effectively carry out enforcement. When developing an enforcement system, a number of steps should be taken.

**Identify all violations.** Firstly, it must be decided which acts or omissions will amount to a violation. All violations must be clearly identified in the legislation. It should cover violations that may be committed by the key actors that will be affected by an animal recording system, including producers and market place owners. Violations that potentially could be committed by persons acting on behalf of the competent authority should also be addressed. Possible violations include failure to identify and/or register an animal correctly, failure to submit notification of animal movements within prescribed time limits, and failure to register an establishment where animals are kept.

Having developed a list of violations, each must be categorized as administrative or criminal in nature.<sup>58</sup> In practice, this will depend upon the gravity and potential

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<sup>57</sup> A similar range of powers are possessed by inspectors in the UK, the exercise of which are conditional upon the presentation of appropriate documentation (The Cattle Identification Regulations 2007, Part 4).

<sup>58</sup> A criminal violation is an offence.

consequences of a specific violation. Making a violation an offence and imposing criminal sanctions may serve as the greatest deterrent. However, if the violation is administrative in nature, then power to declare an act or omission as a violation will normally lie with the appropriate body, and not with national judicial institutions. This may be easier, quicker and more cost-efficient from a practical perspective. Administrative violations will also require lower evidence standards and will therefore be easier and quicker to enforce. In contrast, higher evidence standards are required for offences and the imposition of criminal sanctions that may be harder to enforce.

**Identify appropriate penalties.** Once the nature of a violation has been determined, it is then necessary to determine appropriate penalties in terms of severity, which must be specified within legislation. This may include the issuance of a fine, the imposition of movement restrictions that prevent animals entering or exiting a particular establishment, or other measures intended to limit a producer's right to operate. Penalties must be sufficiently high to deter non-compliance, but must not be so harsh that they are disproportionate to the scale of the offence.

Over time, the deterrent effect of monetary penalties set out in the animal recording legislation may decrease due to inflation. A number of steps may be taken to address this issue:

- Include mechanisms to facilitate the update of such penalties.
- Implement new legal instruments as necessary, which provides that penalties contained in the animal recording legislation are to be multiplied by a certain number, to take into account inflation or other relevant factors.
- Do not specify the exact penalty within legislation, but provide a range within which the penalty for a specific offence may fall. This will allow the responsible authority to exercise their discretion, allowing adjustment to take account of the gravity of the offence, and other factors such as inflation.
- Innovative solutions may be used, such as linking the size of a penalty to a non-monetary indicator, such as an accurate cost-of-living index.

**Specify all relevant procedures.** Once the appropriate penalties for violations have been determined, legislation must clearly specify the procedures that apply in the event that a violation occurs. It is crucial that these procedures respect all basic legal rights afforded to individuals under international law, and under the national constitution particularly if the violation is considered a criminal offence. Legislation must respect the right of due process, and include a right to appeal any decision to a higher authority.



# **Section XI. Implementing the animal recording system**

## **INTRODUCTION**

Section II described an integrated multipurpose animal recording system composed of four components, namely animal identification and registration, animal traceability, animal health information and performance recording. A strategic plan for developing such a system was described in Section VII. This section provides guidelines for its implementation.

The type of activities needed for implementing the system will vary depending upon the objectives or the system's components, and the extent of these activities will vary depending upon the scope (e.g. species and geographical areas to be covered). However, the process to be followed to implement the animal recording system will be more or less the same. Table 16 presents this common process, which applies to both the pilot and roll out phases. This section details the activities listed in Table 16; in doing so, this section provides a synthesis of all previous sections.

## **OBJECTIVE**

The objective of this section is to provide guidance on how to implement the integrated multipurpose animal recording system, based on the established strategic plan.

## **TASKS AND ACTIONS FOR IMPLEMENTING THE ANIMAL RECORDING SYSTEM**

Before any animal recording system is deployed in a large area, it is always advisable to test all its functionalities in a pilot area. This will enable identification of and feedback on any problems experienced during the field implementation, improvement of the operational plan, and rectification of any potential errors found in the software. Both in the pilot region and during roll-out, the implementation activities can be categorized within three phases:

1. The preparatory phase;
2. The execution phase; and
3. The maintenance phase.

Once the system is in the maintenance phase, it is advisable to perform independent evaluations at regular intervals in order to ensure compliance with the standard operating procedures.

## ***I. THE PREPARATORY PHASE***

The tasks involved during the preparatory phase are to:

- set up the enabling environment;
- deploy the personnel and train them;
- prepare public awareness materials;
- field test the software application;
- procure relevant equipment and consumables; and
- prepare a budget and secure funding.

This phase may take at least one year to complete when the pilot project is initiated for the first time. With the experience gained in implementing the pilot project, the duration of the preparatory phase for the roll out of the system in other areas may be reduced significantly.

**Table 16: Process for implementing animal recording activities**

<b>Phase</b>	<b>Tasks and actions during pilot and roll out phases</b>
<b>I. Preparation</b>	<ol style="list-style-type: none"> <li><b>1. Set up the enabling environment</b> <ul style="list-style-type: none"> <li>• Establish the legal framework</li> <li>• Establish the institutional framework</li> <li>• Establish the IT infrastructure and develop the software application</li> </ul> </li> <li><b>2. Deploy personnel and train them</b></li> <li><b>3. Prepare public awareness material</b></li> <li><b>4. Field test the software application</b></li> <li><b>5. Procure relevant equipment and consumables</b></li> <li><b>6. Prepare the budget and secure the funding</b></li> </ol>
<b>II. Execution</b>	<ol style="list-style-type: none"> <li><b>7. Training of field staff</b></li> <li><b>8. Public awareness campaign</b></li> <li><b>9. Distribution of equipment and consumables</b></li> <li><b>10. Implement the animal identification and registration system</b> <ul style="list-style-type: none"> <li>• Premises Census: Identification and registration of premises, keepers and owners</li> <li>• First time tagging: Identification and registration of animals</li> </ul> </li> <li><b>11. Implement the animal traceability system</b> <ul style="list-style-type: none"> <li>• Record movements, deaths or slaughters</li> </ul> </li> <li><b>12. Implement the animal health information system</b> <ul style="list-style-type: none"> <li>• Record health events</li> </ul> </li> <li><b>13. Implement the animal performance recording system</b> <ul style="list-style-type: none"> <li>• Record performance recording events</li> </ul> </li> </ol>
<b>III. Maintenance</b>	<ol style="list-style-type: none"> <li><b>14. Animal recording, registration and traceability</b> <ul style="list-style-type: none"> <li>• Record new premises and change of keepers and owners of existing premises</li> <li>• Record new births</li> <li>• Continue to record movements, deaths or slaughters</li> </ul> </li> <li><b>15. Animal health and performance recording</b> <ul style="list-style-type: none"> <li>• Continue to record health events</li> <li>• Continue to record performance events</li> </ul> </li> <li><b>16. Monitoring and evaluation</b></li> </ol>

## **TASK 1: SET UP THE ENABLING ENVIRONMENT**

### ***Action 1: Establish the legal framework***

A legal base is fundamental for the implementation of the animal recording system. If no appropriate legislation is in place, then this should be developed and implemented. The process for the development of a suitable legislation and the required content of such legislation are addressed in detail in Section X of these guidelines. The time taken to pass legislation may vary from country to country, but may take at least one year. In countries with a federal governance structure, this can take longer yet. Legislation should be in force before implementing animal recording activities in the pilot region.

### ***Action 2: Establish the institutional framework***

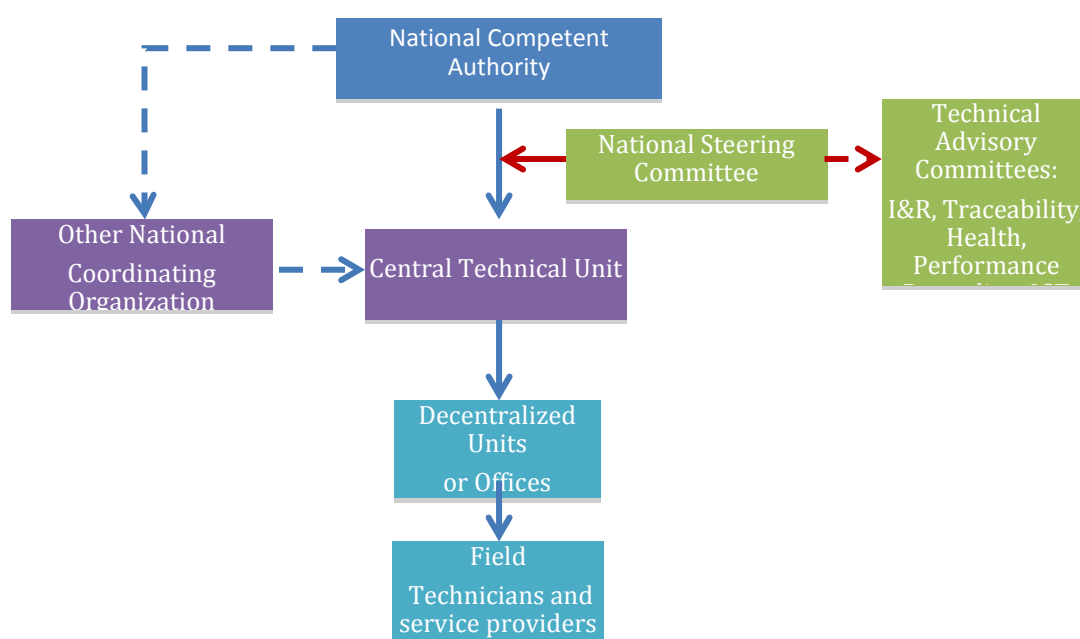
The government should first designate the competent authority as per the legislation, and establish a national steering committee representing the major stakeholders to oversee the implementation of the animal recording system. The steering committee may form any number of technical committees to advise on technical matters, depending upon the objectives and scope of the project. For example, it may form a technical advisory committee for each of the components of the animal recording system.

The competent authority either coordinates the implementation of the animal recording system and the set up of a dedicated central technical unit, or delegates this task to a coordinating institution. It is critical that the coordinating institution has the capability to maintain the required central servers and communication infrastructure, and to run the software application. For large countries, this scheme could be replicated at state or provincial level, if necessary.

The main responsibilities of the coordinating institution are to:

- issue detailed guidelines and prepare manuals for implementing the various components of the animal recording system for personnel at all levels;
- train the trainers of the decentralized offices and field staff; prepare material for awareness campaigns;
- field test the software application;
- migrate data from other databases;
- establish a help-desk for providing support to users nationwide;
- prepare the budget;
- procure all equipment and material such as ear tags, print products;
- carry out public awareness campaigns;
- coordinate field activities through regional and district level teams; etc.

In large countries, these responsibilities could be shared between the central (national) and local (state/provincial) coordinating institutions.



**Figure 20: Institutional structure for implementing an animal recording system**

### ***Action 3: Put in place the software platform and the IT infrastructure***

Before initiating animal identification and recording activities in any area, it is first necessary to implement a fully operational software application and the required infrastructure for the central database and communication network to link to the central database. These would have been developed and implemented on the basis of the guidelines presented in Section VIII; in particular those related to the purchasing and adaption of ready-made software or developing a tailored one, and to hosting the software application internally or externally. Other IT related activities that must be carried out include:

- preparation of operating manuals for implementing the software application;
- commencement of training for trainers of decentralized offices and service providers;
- establishment of a help-desk to support users to solve problems they face in using the software application;
- migration of data, if any, from other systems;
- establishment of a data exchange protocol using XML technology for regular data exchange with other organizations;
- create the required master files (the various standard files such as a list of organizations, a list of users within the organizations and their privileges, a list of registered owners, keepers, animals, list of bulls used, list of diseases, list of feed materials, etc. used for validation of data entered); and
- provision of support to participating organizations to purchase required equipment and to establish wired or wireless connectivity.

## **TASK 2: DEPLOY PERSONNEL AND TRAIN THEM**

The central technical unit should be manned by professionals who have first-hand experience in implementing various aspects of the animal recording system. If such personnel are not available locally, at least one or two key personnel could be recruited from outside the country for an initial period. The size of the central technical unit depends upon the objective and scope of the animal recording system (see the example presented in Annex II).

The coordinating institution must decide how to organize the field operations and who will perform the operations. Apart from its own staff, service providers could be outsourced to perform field operations. They could be authorized for a specific time period and for a specific service region.

## **TASK 3: PREPARE PUBLIC AWARENESS MATERIAL**

Before commencing any operation, it is important to launch an awareness campaign for keepers. The campaign should explain to keepers the animal recording system, its objectives and benefits and the related activities, and should urge them to participate for their own interests and the interests of the nation as a whole. During the preparatory phase, all campaign materials should be prepared, in the form of press releases, short movies, posters, leaflets, etc. A strategy should be developed to use a range of communication media (e.g. the press, TV, radio, displaying hoardings, keepers meetings, etc.).

## **TASK 4: FIELD TEST THE SOFTWARE APPLICATION**

Before field-testing the software application, all functionalities and use cases should be thoroughly checked, both by the developer and the coordinating institution. For example, it should be tested for all validation checks built into the system (e.g. a letter instead of a number, an illogical date or a first calving age less than 15 months, etc.). Appropriate warnings and error messages should be generated by the system to help the user (See Section VIII for more details).

The field-test will be performed in a small pocket (a few selected premises) to test the software in real conditions and with real data. During the field-testing of the software application, a sufficient amount of accurate test data must be entered to simulate the workflow of the whole system and to test all functions. A procedure must also be developed to record any errors found and to ensure that they are rectified. In particular, the following steps need to be incorporated:

- establishment of test cases for testing each function of the software;
- specification of a full test, where complete sets of follow-up actions are simulated;
- establishment of procedures for testing the hardware and software;
- nomination of testers from central and decentralized units, and other users' groups;
- familiarization of the testers with the software application;
- evaluation of test cases and modification of the application on the basis of test results.

There must be close collaboration between the technical staff of the coordinating institution and the software developers to ensure that the product finally meets the needs of the users.

## **TASK 5: PROCURE RELEVANT EQUIPMENT AND CONSUMABLES**

The main supplies needed for the implementation of the animal recording system are: ear tags (or other identification devices), applicators, readers, handheld devices/smart phones, laptops and desktops, printers, copiers, scanners, central servers, and stationery. Other support equipment such as vehicles may be required to cope with the additional work involved, or in case of newly established units. It is important to receive the required supplies in a timely manner. It is also important to follow standard procurement procedures to assure competition and best value for money.

Frequent problems and proposed solutions related to procurement are:

- **Inadequate budget allocation.** If possible, the prices should be checked before publishing the tender.
- **Inadequate time period to complete the tendering process.** It is important to plan sufficient time to pass through the whole procurement cycle and leave time if an unsuccessful tender has to be repeated (e.g. when the bids exceed the projected budget). Extended time may be required for approval of the tender dossier by the beneficiaries and possibly by donors (if any).
- **Additional time required to prepare technical specifications, as different interests are in play.** The technical specifications must be sufficiently detailed to avoid inadequate offers, but must not be so detailed as to restrict the number of bidders. This is especially important as in many cases the cheapest bid is chosen among those who fulfil the specifications. Technical specifications may also be used to pre-select suppliers.

The time required to prepare a tender, to invite bids, to evaluate them, to award a contract and finally to receive delivery may be three to six months in the case of ear tags, whereas it may extend to two years in the case of a software application (if this requires to be developed). Specialists should be present on the evaluation committee to assess the technical details, particularly for ear tags, computer hardware and software applications. Appropriate service and maintenance provisions must be established for software applications and hardware infrastructures. The process for informing local companies regarding applications to tender should be considered (e.g. for print-products). Local companies may require assistance in completing the necessary tendering documentation.

## **TASK 6: PREPARE BUDGET AND SECURE FUNDING**

Preparing a budget for the activities planned and ensuring a long term commitment of the government or donors to meet the cost of the animal recording system are essential for its successful implementation. A plan for assuring long term funding must be developed at the outset. This should include agreement between the central

and local governments concerning the sharing of costs. Sustainability of animal recording systems can only be ensured when the private sector shares, or takes over, responsibility for implementing such systems and meeting part of the cost of their implementation over a period of time.

## ***II. THE EXECUTION PHASE***

The activities to be executed at the field level will depend on which of the components of the animal recording system will be implemented (i.e. whether the system will facilitate only animal traceability, animal health information or performance recording, or any combination of these). Irrespective of which components are included, the following tasks need to be undertaken before implementing the field activities;

- train the identified field staff;
- launch a public awareness campaign; and
- procure and distribute the required equipment and consumables.

Once these have been completed, all or some of the following tasks need to be undertaken:

- implement the animal identification and registration field activities;
- implement the animal traceability field activities;
- implement the animal health field activities; and
- implement the performance recording field activities.

### **TASK 7: TRAINING OF FIELD STAFF**

The trained decentralized officers should in turn train the field technicians and/or service providers and keepers. The training programme should cover the following topics:

- **Keepers:**
  - Objectives and benefits of the animal recording system; and
  - How to record appropriate events.
- **Field technicians and/or field service providers:**
  - Identification and registration of premises, keepers, owners and animals;
  - Obtaining a movement ID card and recording movements;
  - Recording health events;
  - Recording performance events;
  - Data entry procedures; and
  - Software training.
- **District/regional centres:**
  - Data entry procedures; and
  - Software training.
- **Other stakeholders** (personnel of livestock markets, slaughterhouses, breeders' associations, breeding organizations, road police, etc.):
  - Data entry procedures; and
  - Software training.

Training support materials include PowerPoint presentations, leaflets, guidelines, standards and various official documents. The guidelines will assist, technically and operationally, the different actors in implementing the animal recording system. The standards may be encompassed in secondary legislation. Leaflets providing a brief overview of correct procedures, paper forms and identifiers are issued for keepers, livestock markets and police.

## **TASK 8: PUBLIC AWARENESS CAMPAIGN**

It is important to launch the awareness campaign immediately before the actual activities are initiated in the target area. Launching this activity too early would raise expectation at a time when the system is not yet operational, which may cause disappointment amongst stakeholders. On the other hand, launching this activity after the start of the field work will render stakeholders unprepared, who may consequently view the system as an intrusion into their affairs. The activities related to promotion and publicity may include:

- a press conference and press release;
- distribution of leaflets to keepers with animal recording extension messages;
- distribution of leaflets and posters to veterinary practitioners, extension offices, breeding organizations, breeders' associations, farmers' union, etc.;
- preparing promotional videos;
- preparing short commercials for national and regional radio and television;
- renting billboard in target regions/areas;
- organizing physical meetings with keepers, traders, market agents, and other relevant stakeholders.

Responsibility for managing the primary media campaign may be assigned to the coordinating institution, whereas responsibility for managing regional (e.g. village level) campaigns could be assigned to local offices or service providers.

## **TASK 9: DISTRIBUTION OF EQUIPMENT AND CONSUMABLES**

Before the actual field operations begin, the required equipment and consumables must reach the concerned persons. For example, all field assistants must receive the required quantity of identification devices, applicators, readers, official paper documents, handheld devices, and measuring tools. This must be monitored through the software application to ensure their proper use. Important official documents should be assigned serial numbers and their distribution monitored (e.g. movement ID cards).

## **TASK 10: IMPLEMENT ANIMAL IDENTIFICATION AND REGISTRATION**

Animal identification and registration should be undertaken in two steps:

1. initial identification and registration of premises, keepers and owners; and
2. first time identification and registration of individual animals.



### ***Action 1: Conduct the identification and registration of premises, keepers and owners***

The activities involved are as follows:

- Tagging assistants are supplied with pre-printed, uniquely numbered registration forms for premises, keepers and owners;
- Tagging assistants carry out interviews of keepers and owners and complete a premises registration form for each premises in his assigned area. Section III prescribes in detail the information to be collected for premises, owners and keepers;
- Tagging assistants either enter data directly into the central server through handheld devices/notebooks/laptops or send the completed forms to a nearby local office where data entry persons enter the data into the central database;
- Registration of transitional premises such as livestock markets, livestock fairs and slaughterhouses can be done by means of a file transfer, as their numbers and ownership details are known in advance.

In the case of large herds, it may be worthwhile to first carry out identification and registration of all premises along with their keepers and owners (preferably in combination with a mass vaccination programme) before undertaking individual animal identification and registration, and its linking to the premises. In the case of smallholders, the identification and registration of premises, keepers and owners can be undertaken along with that of individual animals, since the premises, keeper and owner of the animal may often be the same entity.

### ***Action 2: conduct the first time identification and registration of individual animals***

The activities involved are as follows:

- Tagging assistants are supplied with the required ear tags, applicators, readers, a list of local premises (e.g. within a specific village), animal registration forms and handheld devices/laptops/notebooks;
- Tagging assistants apply the ear tags, one on each ear, which display the same unique ID code;
- Tagging assistants complete an animal registration form for each animal and provide the keeper with a copy. Section III details the data to be collected for each animal;
- Tagging assistants either enter data directly into the central server through handheld devices/notebooks/laptops or send the completed forms to a nearby local office where data entry persons enter the data into the central database;

In the event that the tagging assistants encounter premises that are not yet registered, they must first register the premises, then tag each animal and complete an animal registration form.

Initial identification and registration of animals in one geographical area may be undertaken incrementally, or all at once (see Box 12 in Section IX for a comparison

between these two approaches). If possible, the latter approach is preferable as it facilitates rapid implementation of the animal identification component and easy identification of new arrivals (whether they are newborn animals or whether they have been moved from another area). This can be undertaken in conjunction with a mass vaccination programme. During visits, vaccinators can identify and register unidentified animals in addition to newborn animals. Identification and registration can also be performed under a genetic improvement programme, where all animals within a given area are included in the programme.

## **TASK 11: IMPLEMENT ANIMAL TRACEABILITY**

The registration of animal movements forms the basic requirement of animal traceability. When an animal enters or leaves a premises, these events constitute a movement. The activities involved in recording movements include the following (see Section IV for more details):

- Keepers are issued with an individual movement ID card for each animal, either upon their request, or upon provision from service providers. The minimum information that must be contained in an individual movement ID card includes the animal ID, the colour(s), the sex, the year of birth (and exact date if known), the premise ID of birth. Depending upon the objective, additional information may be added, including the sire ID, the dam ID, the health status and vaccination history, and any treatments.
- When an animal is moved from a premises, the movement details are recorded in the movement ID card. The minimum information that is recorded at the time of movement includes the original premise ID and the date of departure, the new premises ID and the date of arrival, the type of movement, and the vehicle ID (optional).
- It is necessary to specify the duration within which newborn animals must be issued with a movement ID card (e.g. within one month of birth) and the duration within which every movement is to be recorded in the movement ID card (e.g. within three days of the movement). Animals should be accompanied by their movement ID card during any movements throughout the course of their life.
- The ID card should be returned to the designated authority on the animal's death or slaughter.
- In case of animal import, a record of the animal identification from the exporting country should be kept and linked with the animal identification assigned by the importing country. Similarly, in the case of animal export, a record of the animal identification from the exporting country should be provided to the veterinary authority in the importing country.

Movement reporting will increase if controls and incentives are implemented. Incentives should only benefit herds that are in compliance with animal traceability requirements. Controls should be undertaken at a number of stages: during transportation (by road police), in livestock markets and in slaughterhouses. Only animals which are in compliance should pass and be accepted. The controls should not only include the official livestock markets and slaughterhouses but also unofficial ones, as failing to include the latter will present a risk to the whole traceability system (see Section IV for more discussion).

## **TASK 12: IMPLEMENT ANIMAL HEALTH INFORMATION RECORDING**

Veterinarians performing on-farm activities, such as vaccination or sampling, must be equipped with paper forms or electronic devices (smartphones, tablets, etc.) for the registration of all pertinent information regarding their activities (e.g. date of intervention, control program of concern, type of vaccine used or type of samples taken, tests requested to the laboratory, etc.) and the identification codes of animals. Regardless of the method used in the farm (i.e. paper or electronic device), all these data must be inserted into the animal health information system. As a general rule, whenever possible the data produced during veterinary activities should be entered into the system by the same person that performed the activity, as early as possible. This reduces the risk of errors being made due to misinterpretation, which is significantly greater if the information is entered at a later date.

In the case of a paper-based registration, when the national animal identification database is in place, it is advisable to use forms that are pre-filled with farm and animals identification data. When samples must be taken for laboratories, the field operators should be equipped with labels that are pre-printed with the animal identification codes, to be used for identification of samples. The pre-filled forms and labels will often include barcodes to facilitate the data registration at the laboratory, therefore avoiding typing errors.

When smartphones, laptops or tablets are used directly in the farm, it is possible to also use small portable printers for the production of labels. In addition, when the animals are electronically identified, transponder readers are connected with laptops or tablets to automatically register the codes of animals subjected to control activities.

A particular aspect of field activities within the framework of an animal health information system is represented by the registration of information, in the event of suspected or confirmed disease outbreaks. The use of smartphones or tablets on the farm will allow authorities to be notified of any issues quickly, and veterinary authorities to be provided with the required information in a timely manner.

Laboratory information management system must be strictly integrated with the rest of the animal health information system. Laboratory results are recorded into the laboratory information management system following specific procedures and using a standard nomenclature for samples and a description of tests. This nomenclature must be compatible with that used in the animal health information system. Laboratories must be equipped with computers, servers for data storage and internet connections.

## **TASK 13: IMPLEMENT PERFORMANCE RECORDING**

Service providers, through their field technicians, provide different services to keepers and collect specified data for the identified events. For example, artificial insemination technicians collect data on artificial insemination, pregnancy diagnosis and calving. They may also register newborn calves and record its parentage.

Similarly, milk recorders collect monthly yield data and have samples analyzed at milk component laboratories, etc. The specific activities involved are as follows:

- Service providers arrange to supply the required equipment and consumables (e.g. ear tags, applicators, readers, handheld devices, laptops, flow meters, measuring jars, measuring tapes, weighing tools, etc.), to their field technicians.
- Field technicians provide services and collect data in a specified format.
- Field technicians either enter data directly into the central database through handheld devices/notebooks/laptops or send the completed forms to a nearby local office where data entry persons enter the data into the central database.
- Field technicians provide feedback to keepers and support them in planning and decision making.
- Service providers monitor all field operations, organize review meetings with field technicians, supervisors and managers, and take corrective action to improve overall efficiency of services they provide to keepers.

### ***III. THE MAINTENANCE PHASE***

The maintenance phase is a continuing phase, during which the activities initiated are carried forward with increased vigour and efficiency.

#### **TASK 14: CONDUCT ANIMAL RECORDING, REGISTRATION AND TRACEABILITY**

In case of large herds, the continuing identification and registration of newborn animals and recording of movements (including transfer of ownership and death) can be performed by the keepers themselves. In the case of smallholders, these tasks can be performed by service providers when they carry out periodical premises inventories (e.g. every six months). If such regular premises inventories are performed by official veterinary staff, they can be performed in conjunction with disease vaccinations that are repeated at six-month intervals. In order to carry out periodic premises inventory, tagging assistants or field technicians must:

- be provided with prepopulated premises inventory forms for both the relevant area (e.g. village) and premises. These forms must display the premises ID and data for all live animals;
- identify and register all new born animals, and record animal movements;
- in case of lost or illegible ear tags, re-tag the animal and record data concerning the old and the new tags; and
- record data in the central server through handheld devices/notebook/laptops or send the completed forms to a nearby local office where data entry persons enter the data into the central database.

If field technicians regularly visit keepers to provide other services (e.g. artificial insemination or milk recording services), such visits may also be used to undertake animal identification and registration. For such keepers, a premises inventory may be taken annually. Keepers of large herds may report the above-mentioned activities

themselves via the internet or other means, as and when they happen. They may also provide their farm inventory data on an annual basis.

Operators of transitional premises such as livestock markets, fairs and slaughter houses must maintain and update the list of animals that enter and exit their premises on a daily basis. They can either record these movements directly in the central database via internet, or by submitting appropriate paper forms to a local veterinary office, where the data entry staff enter the data to the central database.

## **TASK 15: CONDUCT ANIMAL HEALTH AND PERFORMANCE RECORDING**

The activities pertaining to health recording and performance recording to be carried out during the maintenance phase will be the same as those carried out during the execution phase. In addition to the activities mentioned in Tasks 12 and 13, the following specific activities may also need to be performed during the maintenance phase to improve overall efficiency of the animal recording system:

1. improve the performance of hardware, communication channels and software application, and reduce response time;
2. incorporate changes to meet the new requirements of all stakeholders including keepers;
3. document benefits of the animal recording system and publicize the success stories;
4. organize workshops to exchange experiences;
5. encourage formation of farmers' organizations to take over animal recording activities;
6. work towards making the animal recording system sustainable by ensuring fair sharing of costs by the beneficiaries, including keepers, service providers, and governments. (for further details see Section IX); and
7. organize a strategic review of the animal recording system every five years through an independent external agency to review progress, identify facilitating factors and constraints, document benefits, identify opportunities, improve existing SOPs, etc.

## **TASK 16: IMPLEMENT A MONITORING AND EVALUATION MECHANISM**

A monitoring mechanism should be developed to ensure compliance with the standard operating procedures laid down for implementing the animal recording system. For example, the mechanism should check that all newborn animals are identified and registered, that all deaths and movements are reported, that no animals are kept or moved without an official identification number, and that all new premises are identified and registered. The distribution of identification devices must also be monitored until their final use, in order to avoid misuse and to reduce the inventory of unused identification devices. Appropriate routine supervisory systems should be built in to check for false recording of data under animal identification and registration, traceability, health or performance recording systems. Review meetings

should also highlight the problems faced and take appropriate corrective action where required.

To ensure compliance with animal recording requirements, it is also necessary to implement an independent quality control system. Once a year, spot checks should be undertaken by an independent team on randomly selected locations (e.g. villages) and keepers to check for compliance with animal identification and registration, traceability, health or performance recording requirements. For example, in the case of animal identification, registration and traceability, inspectors should visit randomly selected farms to check whether premises, owners, keepers and animals are being correctly identified and registered, and whether births and movements (including deaths) are being correctly recorded. The inspectors must also visit selected livestock markets, livestock shows and slaughterhouses to check for compliance concerning reporting of animal movements. In case of performance recording, the inspectors can randomly select villages and keepers and check compliance on measurement of different traits. For example, for milk traits, extra testing shall follow the day after regular testing and shall include milk yield as well as milk components. If the difference between regular and extra testing exceeds a specified critical percentage, the relevant farm should be subjected to further control. Repeated testing shall comprise a specified percentage of all participating farms each year. The observations of the independent inspectors should be recorded in the system, which may be used at a later date for a risk analysis.

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# Annex I: Information needs of stakeholders of dairy sector in low-medium external input production systems in developing countries

## i) Dairy Producers:

- Pedigree details of their animals;
- List of animals that are: due for insemination, pregnancy diagnosis, drying off, calving, inseminated more than three times, having sub-clinical mastitis or other health problems, etc.;
- Lactation performance of their animals with respect to milk yield, fat percentage, protein percentage, lactose percentage, etc.;
- Reproductive performance of their animals in terms of number of services per conception, calving ease, service period, dry period, inter calving period, etc.;
- Body conformation scores of their animals;
- Performance of animals compared to average performance of animals in the area (village, district, state, etc.);
- Quantity of different feeds, feed supplements, forages to be mixed to feed to their animals;
- Due date for vaccinations against specific diseases;
- Due date for de-worming.

## (ii) Organizations providing artificial insemination (AI) services

Artificial insemination service providing organizations engage AI technicians to provide AI services to farmers' animals, supervisors to manage field operations, and managers to provide overall policy guidelines and support. The information needs of AI technicians, supervisors, managers are briefly described below:

**AI Technicians** may like to have herd- and village-level information on: animals to be examined for pregnancy; animals to be dried off; animals whose calving details are to be recorded; animals which may be served; animals inseminated more than three times; average fertility parameters, etc.

**Supervisors** may like to have, on a monthly basis, information at a village- and AI technician-level: number of AIs done; number of pregnancy diagnosis carried out; number of calving recorded; semen doses used; average fertility parameters.

**Managers**, in addition to the information required by supervisors, may require the same information for each supervisor and for the whole organization.

## (iii) Breeding Organisations



Breeding organizations put their bulls under a test programme and may like to obtain estimates of breeding values of their bulls on key parameters such as lactation yield, fat percentage, fat yield, protein percentage, protein yield, lactose, somatic cell count, fertility, fitness, type characteristics, etc.

**(iv) Milk Component Laboratories**

They may need:

- season/month wise and breed wise variation in fat percentage, protein percentage, lactose percentage and somatic cell count;
- herd/village-level average of milk components – fat percentage, protein percentage, lactose percentage, somatic cell count (SCC), milk urea nitrogen (MUN); and
- Relationship between milk components and milk yields.

**(v) Breed Associations:**

They may require information on body conformation scores:

- list of heifers to be classified and which have been classified;
- conformation scores herd/village-level as well as bull wise; and
- relationship between type score, longevity and performance parameters.

**(vii) Feed and Fodder testing laboratories**

They may need:

- proximate analysis of feed and fodder resources in different areas.
- information on metabolic disorder (e.g. milk fever, acidosis, bloat).

**(viii) Animal Health Authorities and disease testing laboratories**

They may need information on:

- incidences of various diseases in the area;
- geographical distribution of diseases;
- effect of various management practices on health of animals;
- evaluation of efficacy of therapeutic and prophylactic procedures;
- data on disease testing and diseases outbreaks;
- economic losses due to various diseases; and
- use of antibiotics.

**(x) Private veterinarians**

Apart from the information needs listed above for animal health authorities, they may like to have past records of animals being treated by them on production, reproduction and health on individual animal and herd/village basis.

**(xi) Milk Processors**

They may like to have information in their area of operation on: geographical and trend analysis of dairy farms, animal numbers, productivity and production, and milk components, incidence and geographical distribution of diseases.

**(xii) Policy makers**

Policy makers may look for summarized information on the performance of dairy production sector as a whole. They would be interested to look at trends and major changes happening in the sector. They would also be interested in knowing the performance of different organizations as well as information to assess where additional investment would be necessary.

## ANNEX II: Estimation of the costs for various scenarios of animal identification, registration and traceability

This annex presents a simulation of three implementation scenarios and their resulting costs.

### 1. Full traceability with electronic identification

The first scenario consists of implementing an animal identification, registration and traceability system for a cattle population of 3,000,000 head. The implementation is gradual, where individual identification of all newborn calves in each year is performed before the age of six months, using a pair of identifiers (electronic + visual). The implementation is completed in five years.

For calculating the cost of movement and change of ownership of animals, it is assumed:

- First year – movement of 30 percent of animals born this year;
- Second year – movement of 30 percent of animals born in the first year and 30 percent of animals born this year;
- Third year – movement of 40 percent of animals born in the first year, 30 percent of animals born in the second year and 30 percent of animals born this year;
- Fourth year – movement to slaughter of 100 percent of animals born in the first year, 40 percent of animals born the second year, 30 percent of animals born in the third year, and 30 percent of animals born this year.

Implementation is carried out by a public institution, in coordination with other actors. Movement data are collected by a service provider. Table 17 below summarizes the simulation parameters. These parameters are inspired by the Uruguayan system.

**Table 17: Simulation parameters**

Demographic parameters	
Population size	3.000.000 (with annual growth of three percent)
Number of target regions or areas	8
Fraction of cows	41 percent
Rate of annual calving	0.44
Identification devices	
Type of device	Visual and Electronic (RFID)
Applicators	Variable amount
Equipment for field public officers	

Readers of RFID devices	65
Bar code readers (in case of plastic tags)	100
GPS	35
Maintenance of the equipment	Variable amount
Vehicles	9
Motorcycles	20
Fuel	Variable amount
Maintenance and Spares, including tires	Variable amount
Annual tuition and insurance	Cost of patent and vehicle insurance
Computers	50
Laser printers	25
Servers, licenses and warehouse services	2 Servers and variable amount for licenses and warehouse services
Equipment for other actors	
Computers	50
Laser printers	50
Readers	60
Modems	Annual servicing
Staff	
National coordinator	1
IT specialist (deputy coordinator)	1
System developers/analysts	4
Help desk officers	4
Administrative officers	2
Field technicians	8 (1 Technician per region)
Auditors (inspectors)	1 supervisor and 60 auditors
Data entry officers	20
Operations	
Central office	
Internet connectivity	30 mobile modems
Communication mobile network	Average cost of communication
Collection of movement data	Cost of the service provider (US\$1/animal)
Stationery and forms	Variable amount
Support materials	Variable amount
Projectors	8
Furniture	Variable quantity
Archive	Variable amount
Consumables	Variable amount
Field mission allowances	Average value for daily allowance
Training and awareness raising	

Promotion in radio and TV media	Variable amount
Promotion in printed media	Variable amount
Training	Variable amount
Study tours	Variable amount
Miscellaneous	One to two percent

The results of the simulation are presented in Table 18 below. As per the scenario described above, only newborn animals in a given year are identified. The cost of identification devices is then a direct function of the number of calves that are born (which is a function of the annual calving rate and the percentage of available cows). The unit cost for a pair of visual and electronic tags used is two US\$. By year five, it is estimated that over 90 percent of the cattle population is individually identified. For the remaining unidentified cattle, one can either organize a specific identification campaign or wait for their gradual decline.

The cost of vehicles and other equipment is high in the initial phase and decreases later on to become stable (corresponding mainly to the costs for fuel and for maintenance and renewal). For the sake of simplicity, no discount factor (or depreciation rate) of the equipment was applied. A similar trend can be observed for training and awareness raising. The staff cost is stable. The slight increase is due to applied annual three percent salary increase. The operating costs are proportional to animal movements, which in turn, are proportional to the number of identified animals. The unit cost for collecting movement data used was one US\$ per animal movement.

The cost per identified animal, or newborn calf, varies around five US\$. As the implementation proceeds, the costs increase due to a higher reading cost. By having more animals identified, there will be more movements and therefore higher costs of reading the electronic devices. If the animal is likely to be read and recorded in the central database less than three times in its entire life time, and machine reading is not envisaged in routine farm management operations (milking, growth rate monitoring, animal disease testing, livestock market operations), it may not be cost effective to opt for electronic identification.

**Table 18: Summary of costs (in US\$) of implementing a traceability system with electronic identifiers**

Costs Components	Year 1	Year 2	Year 3	Year 4	Year 5
Identification devices	1,082,400	1,114,872	1,148,318	1,182,768	1,218,251
Equipment for public officers	670,700	214,450	214,450	214,450	214,450
Equipment for other actors	129,800	12,000	12,000	12,000	12,000
Staff	322,400	332,072	342,034	352,295	362,864
Operating costs	520,260	671,691	887,559	1,445,437	1,478,852
Training and awareness raising	190,000	190,000	60,000	60,000	60,000

Miscellaneous	200,000	100,000	100,000	100,000	100,000
Total cost	<b>3,115,560</b>	<b>2,635,085</b>	<b>2,764,361</b>	<b>3,366,950</b>	<b>3,446,417</b>
Annual cost per new born calf	<b>5.8</b>	<b>4.7</b>	<b>4.8</b>	<b>5.7</b>	<b>5.7</b>

Note: The unit costs used in these simulations are taken from the analysis of the Uruguayan system, on the basis of newborns, done by Gabriel Osorio in 2013.

## 2. Full traceability with visual identification

The second scenario is similar to the previous one, the unique change being replacement of the visual and electronic identifiers by a pair of visual plastic ear tags (without bar codes), the cost of which were fixed at half the price, one US\$.

When using visual plastic ear tags, the reading and data processing work would require more workforce (or man-days). It is very difficult to estimate the increase in the workforce, but a rough estimation of 30 percent increase of staff cost was assumed. Consequently, the number of field technicians rises to 10, of data entry staff to 26, etc. It was also assumed that the cost of equipment increases by the same percentage, as well as the cost of field data collection and transfer by the service provider, which rises from 1 to 1.30 US\$ per animal.

The costs are estimated assuming the movement and change of ownership of animals as described in scenario 1. The resulting annual cost per newborn calf is only slightly lower than in the previous case. Most of the cost reduction due to the use of the plastic tag is offset by the substantial increase of the operating costs. The costs of movements and ownership changes, are the most determinant components when calculating these operating costs.

**Table 19: Summary of costs of implementing a traceability system with plastic ear tags**

Investment Concept	Year 1	Year 2	Year 3	Year 4	Year 5
Identification devices	541,200	557,436	574,159	591,384	609,125
Equipment for officers	782,370	269,220	269,220	269,220	269,220
Equipment for other actors	77,600	12,000	12,000	12,000	12,000
Staff	361,400	372,242	383,409	394,912	406,759
Operating costs	670,328	843,088	1,137,366	1,862,608	1,906,048
Training and awareness raising	190,000	190,000	60,000	60,000	60,000
Miscellaneous	200,000	100,000	100,000	100,000	100,000
Total cost	2,889,948	2,402,944	2,650,945	3,394,712	3,371,893
Annual cost per new born calf	<b>5.3</b>	<b>4.3</b>	<b>4.6</b>	<b>5.7</b>	<b>5.5</b>

### 3. Group traceability

This system is based exclusively on the identification of premises, keepers and owners, as well as the control of group movement. Hot branding could be recommended here for identifying the animals, and its costs is assumed to be US\$0.14. To ensure maximum operating efficiency for such a system, the following cost variations were considered:

- Increase of technical staff (data entry operators and field technicians) by about 30 percent compared to the scenario with visual an identification system, due to increased fieldwork. This is due to the fact that each group movement is accompanied with documentation, which must be collected and entered in the system for monitoring and traceability.
- Doubling of operating costs and of support equipment and other inputs, due to the increased work arising from the collection of group data (entry of forms, movement control, auditing premises, livestock inventories, etc.).
- Similarly, increase of hardware by 30 percent, while the necessary field equipment is reduced (no need for readers, internet, and other equipment). The cost of movement control (habilitation/qualification, documentation and shipment) is estimated at US\$0.5 per animal.

The results of this scenario are presented in Table 20 below. As there is no individual animal identification, the annual cost is normally expressed per bovine. However, to ensure adequate comparison with the previous scenarios, the annual cost is also expressed per newborn calf. As expected, group identification and traceability is much less costly than full traceability. It could be recommended for countries with limited resources or marginal livestock sectors, to evolve in the future into a full traceability system with individual animal identification, when necessary taking account of the market or health conditions.

**Table 20: Summary of costs of implementing a group traceability system**

<b>Investment Concept</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
Identification devices	75,768	78,041	80,382	82,794	85,278
Equipment for Officers	752,320	269,220	269,220	269,220	269,220
Equipment for other actors	79,800	12,000	12,000	12,000	12,000
Staff	421,200	433,836	446,851	440,686	453,906
Operating costs	558,360	522,845	524,004	525,197	526,427
Training and awareness raising	190,000	190,000	60,000	60,000	60,000
Miscellaneous	200,000	100,000	100,000	100,000	100,000
<b>Total cost</b>	<b>2,277,448</b>	<b>1,605,942</b>	<b>1,492,457</b>	<b>1,489,897</b>	<b>1,506,830</b>
<b>Annual cost per bovine</b>	<b>0.8</b>	<b>0.5</b>	<b>0.5</b>	<b>0.5</b>	<b>0.4</b>
<b>Annual cost per new born calf</b>	<b>4.2</b>	<b>2.9</b>	<b>2.6</b>	<b>2.5</b>	<b>2.5</b>