Strategic approach to the development of animal identification and movement control (Traceability) systems. The linkage to veterinary surveillance and other agriculture and livestock databases

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Introduction

A system for identification, registration and movement control (I&R systems) is essential for adequate veterinary surveillance (animal health and consumer protection) and can support different agricultural databases (selection centres, milk recording, subsidy payments).

The advantages of an I&R system will be explained in this paper. It will be particularly focussed on bovine animals. The system can be similarly used for sheep, goats and pigs. The recommendations of the EU Commission regarding I&R systems have been considered.

The application of the system as introduced in this paper is not restricted to a certain infrastructure of a country. The implementation requires, besides a legal basis, a well defined strategy, thoughtful planning and co-operation of concerned bodies and participants.

For preplanning, planning, and implementation of the system assistance is usually needed. EU Member States have learned from each other and eastern European countries are in favour to use previous experience of EU Member States.

The system should ideally be run not just for its own sake (animal identification, registration and movement control). It should be a part or better it can be a core of an integrated system which can comprise veterinary surveillance, breeding and other data.

Access to the database can be granted via a password system so that each legal body or participant can use only the specific data for his purpose.

In the past the standards of I&R systems might have looked like the following:

- Nothing at all and/or.
- Different methods of identification of cattle used in the same country.
- The means of identification range from a paper based description of the animal, marking with colours, hot and cold brand marks, ear tags in various types of forms, electronic marks like subcutaneous chips or ruminal boluses and genetic fingerprints.
- Campaign based temporary identification and registration of animals.
- Animal identification works very basically to help to identify an animal if a certain event (vaccination, treatment, disease surveillance, artificial insemination, etc.) takes place.
- Different standards for registration of holdings and identification of animals (i.e. numbering system of ear tags).
- Registration only paper based (no computerised database) and client based (only for special holdings or breeding programmes).
- No records about events (birth, death, slaughter, movements) leading to databases which do not describe the real situation after a time period.
- No records about veterinary events.

I&R standards in the future should be built up in line with:

- Unified standards for holding registration.
- Unified and unique method - including numbering - of identification of animals.
- Registration of animals on a central database.
- Registration of births, movements, deaths and slaughters.
- Registration of veterinary events and other events.

The application of markers can be done by the farmer, or the field services (public and private veterinarians, technicians, breeding and selection centres, etc.).

Registration of animals and events can be done via a network or internet connection to the database (recommended for big holdings or slaughterhouses) or with help of a paper based notification card system and the field services. The most effective solution will depend upon the local technical infrastructure and the prevalence of computers. The database should register all bovine animals, births, slaughters, deaths and movements. The most work intensive part is to register movements between holdings.

Movement recording enables the competent authorities, in the case of disease outbreak, to trace forward and backwards animals movements and to quickly find the locations of suspected animals or contact holdings. This is indispensable for the surveillance of diseases and for planning the appropriate measures in case of disease outbreaks. Since registration of movements is work intensive the "holdings" should be defined carefully.

Pasture systems, or villages with common grazing land can be defined as special "linked" holdings in order to avoid unnecessary movement announcements.

The EU has developed a system of identification and registration of equines as well, which is based on the description of the exterior of the animals. Countries have implemented a system for identification, registration and movement control of animals considering:

- Improvement of animal health
- Improvement of Public health and
- Improvement of the statistics and the development of the livestock sector particularly with a view to subsidy payments

Key performance results of a system for identification, registration and movement control of bovine animals

Animal health

Recent disease outbreaks (BSE, FMD, ESP) have caused tremendous damage to certain national economies. The reason for this is not the disease outbreak itself so much as the inadequate instruments for controlling the disease outbreaks which has made diseases so unpredictable and the eradication processes very expensive.

Livestock trade facilitates the spread of diseases within a very short time period over big distances. A calf traded from a market or a collecting point will have the possibility to contact many other calves and the agent can spread to different herds and holdings. Contacts with up to 90 holdings resulting from one calf or pig traded are not uncommon.

Effective control of fast spreading diseases depends therefore not on drawing a restriction circle around the first holding identified with the disease (in reality it might not be the first holding which has the disease, just the first identified). Effective disease control depends on a fast identification of all holdings and regions that might be infected. The fast identification of contact holdings to the first identified with the disease is essential. The same applies for slow developing diseases like BSE.

A working I&R system with effective movement control could have lowered the damage during the 2001 FMD crisis in the United Kingdom drastically. The economic losses due to inadequate disease control can profoundly harm the economic viability of farming, connected industry branches, trade and the whole rural economy. Estimates suggest that the recent UK Foot and Mouth outbreak costs the economy approximately 5 billion pounds sterling.

Public health

Consumers are concerned about food safety. BSE, Dioxin and several drug scandals have shown that competent authorities do not have appropriate instruments to find and exclude the sources effectively. Consumers are concerned by insufficient information concerning the meat they buy. Public confidence in meat and meat products can be recovered if the production chain is transparent and open to regulatory measures if needed. International trade with meat and meat products follows this rules as well.

Subsidy payment surveillance system

Livestock development and subsidy payment will require accurate data about number of animals, holdings and owners. Preventing fraud in the subsidy payment scheme was a mayor stimulant for administrations and farmers to implement a streamline I&R system in the EU.

The I&R system will contribute to:

- *The disease surveillance and eradication programmes* - The system will assist with implementing surveillance strategies for *Office International des Epizooties* (OIE) List A and B category diseases and zoonoses important for human health.
- *The contingency planning and reaction to disease outbreaks* - In the event of an outbreak of an OIE List A disease the system will allow the Veterinary Services to identify infected animals, establish their immediate recent locations and movements and implement contingency plans based on this information.
- *Assisting Trade* – Standardised disease surveillance and contingency planning will lead to a improved disease situation within the country and consequent markets will open for agricultural and livestock products.
- *Livestock and Veterinary Sector Planning* -The system has the potential to be a valuable tool to assist with planning in the Livestock and Veterinary Sectors. Outsourcing of certain tasks within the system will support the Veterinary Sector to move towards privatisation.
- *Platform for Other Informatics Systems* - The scheme could provide the basis for other Ministry of Agriculture or Veterinary Services information systems such as Herd Health, Milk recording or breeding schemes.

The system itself

Figure 1 shows the data registered in the I&R database and the use of the data for different purposes.

The purposes of the database can be described as follows:

- to provide an up to date register of all holdings, herds, animals, owners and keepers;
- to provide records relating to all births, deaths, slaughters and movements;
- to provide records of all ear tags supplied to farmers;
- to provide records of the health status of individual animals, herds and holdings;
- to facilitate certification of animals for movements (in country trade and export);
- to track and trace movements of animals in case of disease outbreak;
- to provide the necessary data for meat labelling with regard to the animal and it's origin;
- to provide up to date common reference data (holdings, herds, individual animals) which can be supplied to a number of other databases, e.g. selection service;
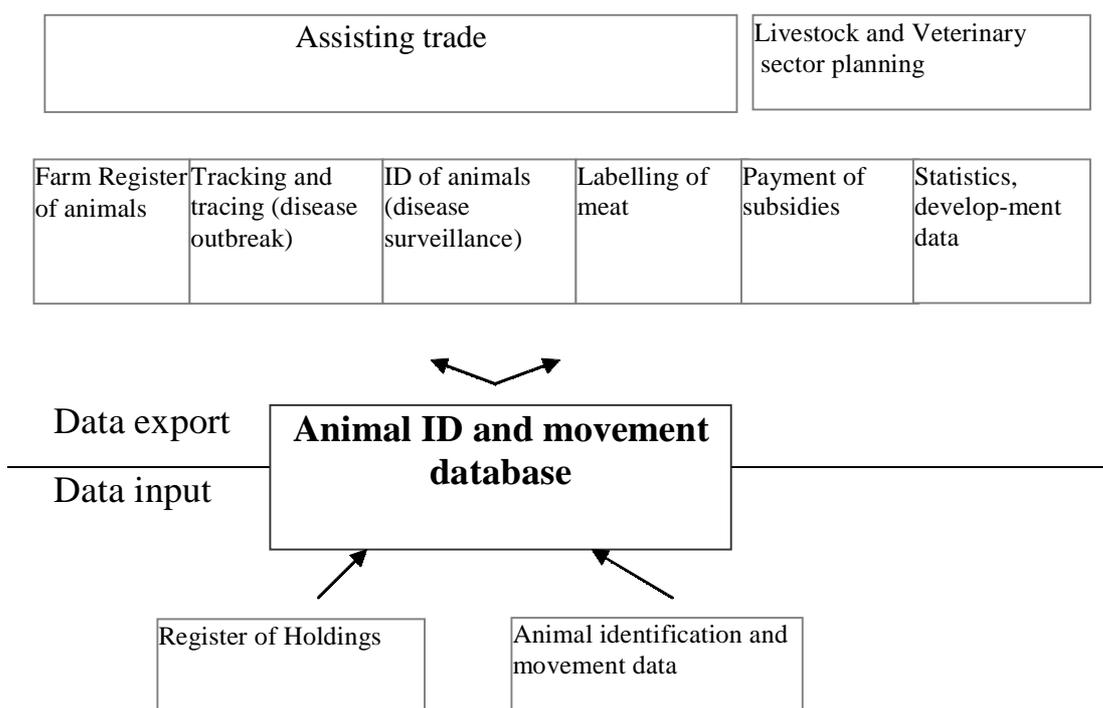
Assisting trade	Livestock and Veterinary sector planning

Farm Register of animals	Tracking and tracing (disease outbreak)	ID of animals (disease surveillance)	Labelling of meat	Payment of subsidies	Statistics, develop-ment data

Data export

Animal ID and movement database

Data input

Register of Holdings

Animal identification and movement data

Figure 1. Possible data export and benefits of the I&R system.

- to provide data to subsidy payments schemes to assist with the prevention of fraud;
- to enable the farmer to keep his farm register on-line;
- to provide statistical information to Government Departments.

The I&R database can enrich and complete the functions of other databases as well. Veterinary data (tests, vaccinations, treatments, disease outbreaks, disease surveillance data, herd health status) must be linked to holdings and single animals. Therefore recording of veterinary events should be connected to the I&R database if the full benefits in surveillance and control are to be achieved. But other agricultural data systems like selection and breeding databases or milk recording databases can benefit from the I&R database as well. Figure 2 shows databases which can profit from a I&R system.

Figure 3 shows the data input and data export from an integrated I&R database with different modules.

The animal identification, registration and movement control system as recommended by the EU Commission consists basically of four elements:

Elements of the system

- The ear tags as markers (with each animal having a unique lifetime number).
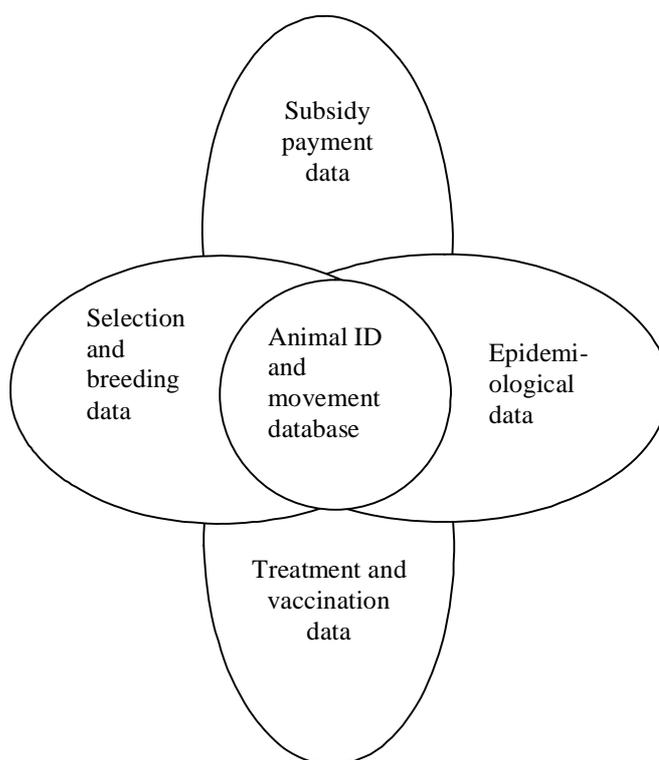- The database (for recording entities and events).

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Figure 2. Core of the integrated database system (animal ID and movement database and elements suitable for possible integration.

- The cattle passports (which are issued after marking and accompany animals lifelong).
- On farm register of animals.

The markers

The animals should be identified with simple means, which can be applied easily, which are cheap, which will stay permanently and which can be read without technical equipment.

Therefore ear tags as identification marks should be preferred to other animal identifiers (boluses, microchips). The advantages of ear tags are:

- Animals can be identified without sophisticated reading equipment.
- Ear tag identification is used at the routine work with the animals (vaccinations, tests, artificial insemination, treatments, milk recording).
- Ear tags can easy be applied and replaced.

The ear tags should comply with the following specifications:

1. They shall be of flexible plastic material.
2. They shall be tamper-proof and easy to read throughout the lifetime of the animal.
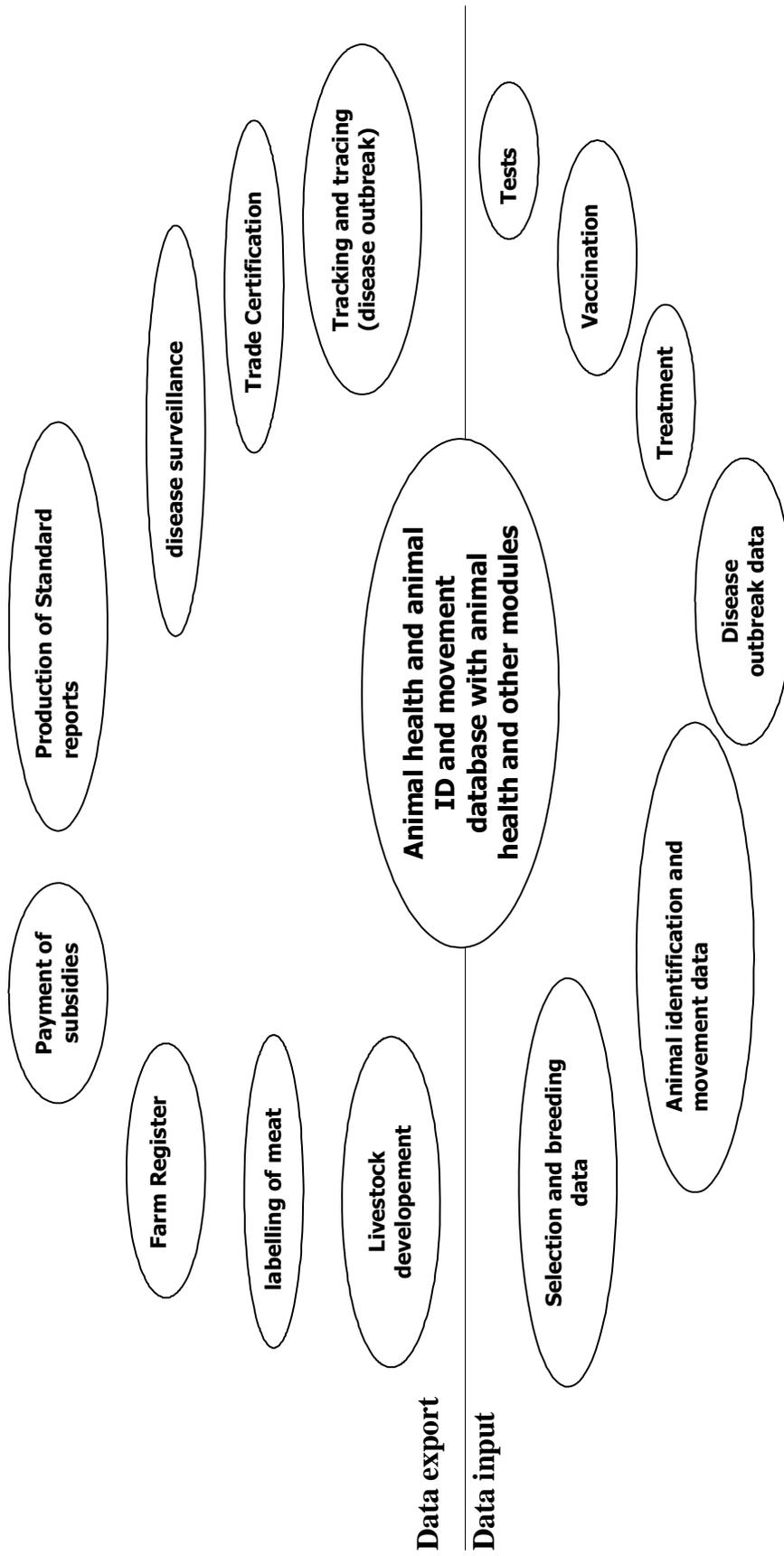3. They shall not be re-usable.

Figure 3. Integrated animal ID and movement database with different modules.

4. They shall be of a design which will remain attached to the animal without being harmful to it.

5. They shall carry only non-removable inscriptions.

Each animal should be ideally tagged with two ear tags with identical numbers. This is a safety measure in case one ear tag gets lost.

The database

Software recommendations

It is important that the national I&R database is compatible with related national databases and with similar systems in other countries; it must conform to certain standards. The EU has adopted software recommendations for animal identification, herd registration and movement control systems, with the future possibility to add animal health surveillance and public health monitoring capabilities. The recommendations specify that appropriate software should provide:

- A large centralised database, accessible on-line with a short response time (e.g. Oracle or equivalent).
- A fully relational database management system (dbms) providing multi-site, multi-user, possible internet access to all remote registered users across the territory, which can easily exchange data with other national databases, for example existing cattle production and milk recording databases.
- Records of species other than bovines (porcines, ovines, caprines) should be possible later on the same database to allow user friendly access for mixed herd operators;
- Individual registration of bovines.
- Future extension to recording of disease outbreaks, pharmacovigilance monitoring and recording of veterinary activities (tests, vaccinations, treatments) should be possible;
- A tool for identification of holdings and herds by map reference, preferably with gis capability.
- Full backward and forward tracing from any specific date of individual animals and herds, herd reconstitution on specified dates, including contact animals and related animals/herds.
- Automatic restriction on individual animals, herds, geographical areas and genealogical lines on animal health and veterinary public health grounds.
- The system to be adapted for multilingual use.

The database should store data on the following principle entities:

- Owners (unique identifier, address, contact details, etc).
- Keepers (unique identifier, address, contact details, etc).
- Holdings (unique identifier, address, contact details, map reference, etc).
- Herds (unique identifier, breed of animals, number of animals, health history, current health status, etc).
- Animals (breed, colour, purpose, etc)

The database should record data on the following events:

- Birth of an animal (date of birth, holding of birth, ear tag, breed, sex date of identification, identification of sire and dam, etc).
- Third country import.
- Direct import for slaughter (slaughter date + birth date, breed, sex, country of origin).
- Death/slaughter of an animal (date of death/slaughter, etc).
- Movement of animal (date of departure, date of arrival, holding of origin, holding of destination, identification of transport vehicle, etc).
  - Movement into the herd: holding of introduction, ear tag, date.
  - Movement from the herd/exports: holding of departure from the herd, ear tag, date, country of destination.
  - Fallen stock/home slaughtering: holding number, ear tag, date.
  - Collection by a rendering plant: ear tag, date of collection.
- Disappearance of an animal (date of disappearance, etc).
- Slaughtering:
  slaughterhouse, ear tag, date, slaughter number, slaughter weight or live weight, as appropriate, category.
- Disease Outbreaks (dates, animals affected, etc).
- Vaccinations (date of administration, type of vaccination, batch number, dosage, etc).
- Health and residue/Substance tests (date of administration, type of test, results, etc).
- Treatments (date of administration, type of treatment, dosage, etc); (recorded in integrated - I&R and veterinary - databases).

Cattle passports (stating date of birth, place of origin, sex, breed, identification number, ID of mother and movement data) are issued after the calf has been marked. The issuing authority must also be defined. The passport accompanies the animal lifelong.

The cattle passports

Once the database is fully operational (all movement data are recorded) passports do not need to be issued anymore except for trade and export. The passport proves – beside a veterinary certificate - that the trade is legal.

An advantage of passports is that the ID and the movement of cattle can be followed up easy without access to a PC.

The on-farm register should assure that there is always a list available about the animals present at the holding stating where they came from (if not born at the holding) and to where animals have been shipped from the holding. The on-farm register of animals keeps the same information as the database. Therefore the on farm register can be created on line and downloaded. Authorised field services can manage the on farm register if required.

On-farm register of animals

Events

Birth

Movement

Death
s

Entities

Keeper   Vets

Owner   Eartag

Holdings   Animals

*Medical
events*

Tests

Diseases

Vaccinations

Treatment

DATABASE

Herd Health
Status

Trade Certification

Residue monitoring
Beef labelling

Consumer protection

Tracking & Tracing

Movement
History/Contacts

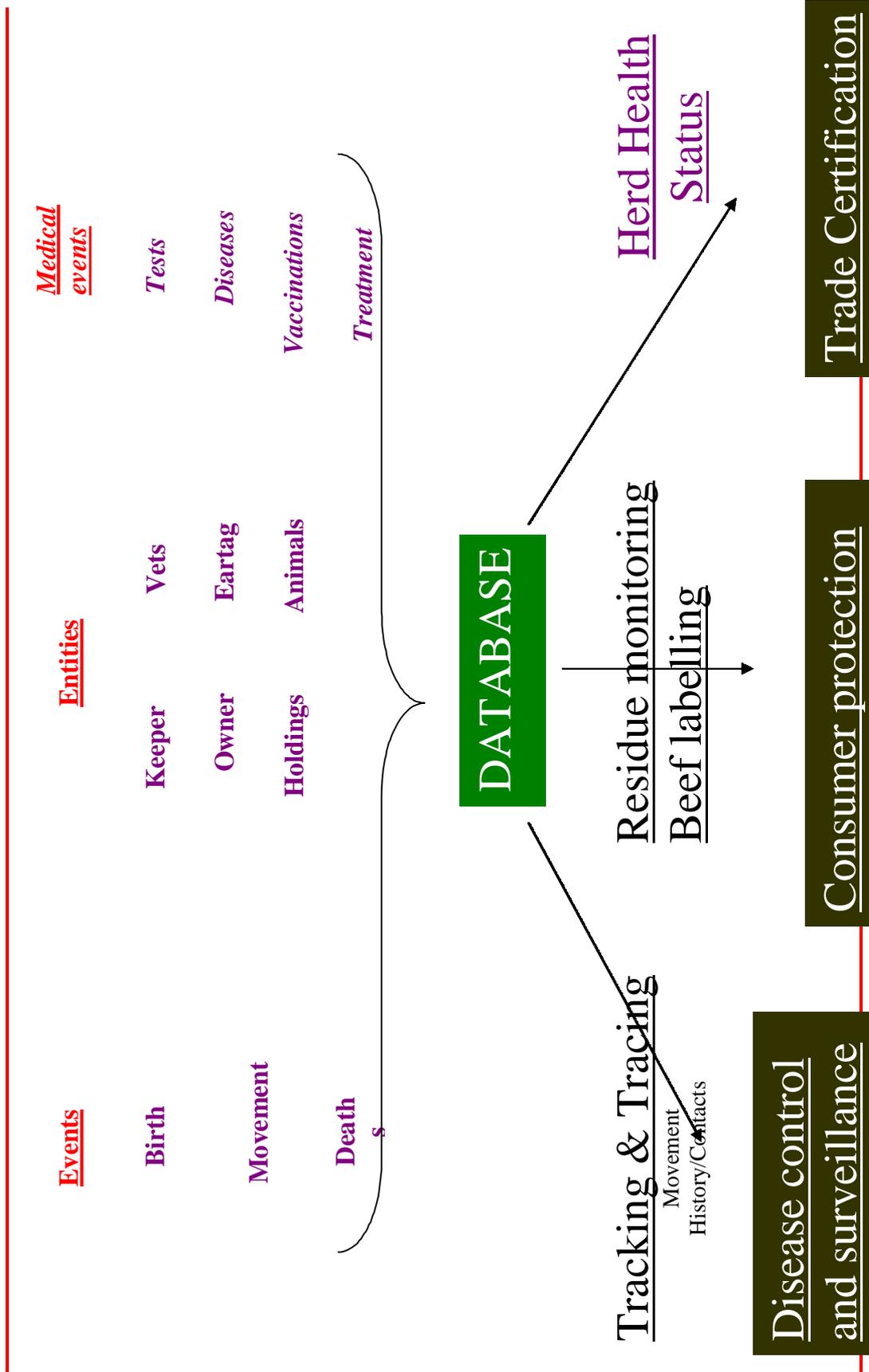Disease control
and surveillance

Figure 4. Events and entities to be recorded in the I&R database and key performance results.

Figure 4 shows the items to be recorded on the database and the purpose of the data. Medical events recorded in the database support the key performance results.

The system can be implemented if the **participants of the system** (farmers, traders, slaughterhouses, markets, etc) are aware and prepared to contribute to the system. Farmers and other holders of cattle (traders, slaughterhouses, markets, etc) must report events (birth, death, slaughter and movements) to the database. Data collection procedures are briefly described below.

Operating procedures must be defined and an organisation (administrative body or organisation assigned for this purpose) must be in charge, trained and able to collect and record the required data and to run and maintain the database.

Field services (data entry offices, operating agency, regional agencies) must be defined for ear tagging and notification, if this is not to be done by the farmer.

The responsible Authority must create and implement surveillance.

All those modalities depend on the local situation. Countries have to find a solution for operating the I&R system which is appropriate to the particular circumstances of farming, livestock services and the administrative set up.

The implementation of the system requires the following elements in place which have to be designed and enforced before the system can be run successfully:

- **A. Awareness among the stakeholders about benefits, costs and requirements**
  The system can only be implemented if the participants of the system (i.e. farmer, trader, slaughterhouses, markets,) are aware of the system and the problems and prepared to contribute to the system and to resolving the problems.

- **B. Operating procedures**
  Operating procedures must be defined and an organisation (administrative body or organisation assigned for this purpose, i.e. data entry offices) must be in charge, trained, able to collect and record the required data, to run and maintain the database. The procedures shall be defined in such a way that their practical handling and execution is possible.
  The following procedures shall be defined:
  - Ordering and distribution of ear tags (new and replacements).
  - The application of the ear tags: who is allowed to order ear tags and who is allowed to ear tag animals .
  - The notification and registration of births, slaughters, deaths and movements of animals by farmers, traders, markets, collecting centres and slaughterhouses (i.e. by notification cards, phone, internet; batch data via internet).

- Creation of manuals as instruction and information provided to involved parties
- Issuing of cattle passports
- The operation and servicing of the central database
- The surveillance and review of the system

- **C. Definition of duties of stakeholders and administration**
  Rights and duties of individuals (i.e. farmer, veterinarians, other persons) and/or services (i.e. head of villages) must be defined for ear tagging and notification;

- **D. Insurance of sustainability**
  The cost calculations shall include the costs for ear tags, ear tagging, notification (paper based, internet, etc) and data entry (recording of data), issuing of cattle passports and data administration; It shall be aspired to share the costs among the stakeholders.

Generally three ways of registration are possible. Notification cards, telephone and the Internet; Cards can be filled by the field service and forwarded to the organisation in charge of the data collection and registration. Different models are possible and in are use in different countries.

Collecting centres and slaughterhouses will usually send their announcements (animal arrived and dispatched, animal arrived and slaughtered) electronically as batch data or via the Internet.

The procedures should be preferably laid down in a manual. Information must be given to the involved parties within a specified time period.

Possible reporting channels

- Paper
  - Through pre-printed notification cards on birth, movement (into or out of the herd, fallen stock) and slaughterings
  - Directly to the data entry offices for processing
- Telephone with Interactive Voice Response (difficult).
  - Dialogue with central database via tone dialling and language menus.
- Online via Internet.
  - Dialogue programme with central database via WWW-Browser.
- Batch.
  - Mass transfer directly to CDB.

Preconditions for the implementation

In order for the system to be developed and implemented, certain essential elements must be in place:

Responsible authority

A competent authority must be defined, authorised and enabled to develop a strategy, a plan, implementation and surveillance of the system. Co-operation with concerned bodies must be ensured.

Legislation

Legislation must be drafted and passed to provide the legal obligation on the various parties to supply information and to participate;

IT Strategy

A strategy must be developed in order to find the appropriate structure of the database system and a basis of data exchange between different databases in order to use the resources most effectively and to achieve most cost-effective results.

Funds

Funds must be raised to pay for the system, e.g. purchase and maintenance of hardware and software, provision of ear tags, application of ear tags, announcement procedures, etc. It must be clear which part of the system will be financed by the Government and which part by the private sector. Funds must be found, not just to establish the system in the first place, but to pay for its continued operation;

Staff

The staff must be found to operate the system effectively and must be given sufficient training (some key staff should be exposed to the systems used by other countries). The types of staff likely to be involved with operating the system are veterinarians and computer specialists.

Computer equipment

Computer equipment must be provided, i.e. hardware, software and communications equipment.

Holding register

There must be an up to date list of all existing holdings and locations where animals are kept, i.e. a farm register.

Unification of Marks

There must be a unified national system for identifying animals with each animal having a unique lifetime number. The design of the ear tags for cattle should ideally comply with EU standards;

Sustainability

Sustainability of the system must be ensured. It will predominantly depend on:

- costs of running the operating management structure for the database.
- costs of the field services.
- long term financing of ear tagging by farmers.
- acceptance of the system by farmers, slaughterhouses and the trade.
- future support of the system by Government funds.
- evolution of the system from expensive manual data collection to an on-line data delivery system (long term).

Phased implementation and costs

For better acceptance the system can be implemented in two phases.

Phase 1 (Tagging, birth announcement and recording, passport, slaughter announcement) without movement announcements to the database

The movement control in this phase shall be executed by the cattle passports which accompany the animals livelong and gradually by database supported movement evaluation, based on notification of movements to the database, well being aware that full movement track by notification of movements to the database will need to evolve. In this phase the full requested plausibility tests will not be possible, the most "a priori" plausibility tests can be conducted.

Phase 2 (as phase 1 including all movement announcements to database)

The successful implementation of phase 2 can be measured on the detection and correction of implausible data after carrying out all "a priory" and "a posteriori" plausibility tests.

The animal disease control and eradication measures need as minimum prerequisite the full implementation of phase 1. Storage of herd health, disease, treatment and other data may start whenever appropriate.

Costs

Costs of the system will vary from country to country depending on the infrastructure, number of animals, present administrative setup and development of the livestock sector. Anyway in the present paper it was tried to calculate costs with assumed figures. The calculations should show:

1. There are costs with cannot be avoided (sustainability in many countries end up in failure, because of the non realistic approach of thinking that there would be no costs)
2. The costs need to be calculated beforehand (before starting the system at all)
3. The costs need to be communicated and shared between the stakeholder to reach acceptance (cost benefit calculations will show that the benefits exceed the costs)

Roadmap for I&R implementation

Educational work and information provided in time to decision makers and to beneficiaries is vital in order to achieve broad acceptance and cooperation. The successful implementation of the system is very much depending on the information given to participants (farmers, veterinary and livestock services, meat industry) of the animal ID and movement system and to the public. The information will explain the benefits and necessity of the system for the Livestock Industry and trade development and also the responsibilities and duties of the participants.

The competent Authority must be identified and authorised to implement the system. It is recommended to break down I&R implementation in phases and to plan the phases thoroughly. Furthermore preplanning, planning and implementation would be facilitated with assistance of experienced experts.

The following tools will be essential for the successful implementation of the system: Flexible planning, Change management tools, phased results and awareness by information campaign and training

The project involves complex logistics. The timeframe for implementation must take into account that decisions and acceptance outside the control of the project planning can not be fully assumed. Therefore a flexible project plan separating establishment and testing of the system from the operation of the system should be established. The critical path of project planning should allow extend phases if required.

Flexible planning

The success of implementation of a system involving change management requires the use of Quality Management tools. The essential enablers are:

Change management tools

- A competent Leadership coalition.
- Team building and communication.
- A clear strategy and goals.
- Adequate resources.
- Project management techniques (design, plan, review control).

The importance of this approach should be recognised and built into the project design to ensure effective and coherent implementation of the activities.

Before the system becomes operational throughout a country different components need to be established and testing must take place. To ensure successful establishment of operational procedures the implementation should be split into two phases: one phase as system establishment, secondly system operation. The system operation will be tested at pilot level, reviewed and then rolled out through the entire country.

Phased results

Figure 5 shows the phases to be accomplished for achieving a full operational I&R database. Within the phases a short outline of the activities in each phase is given.
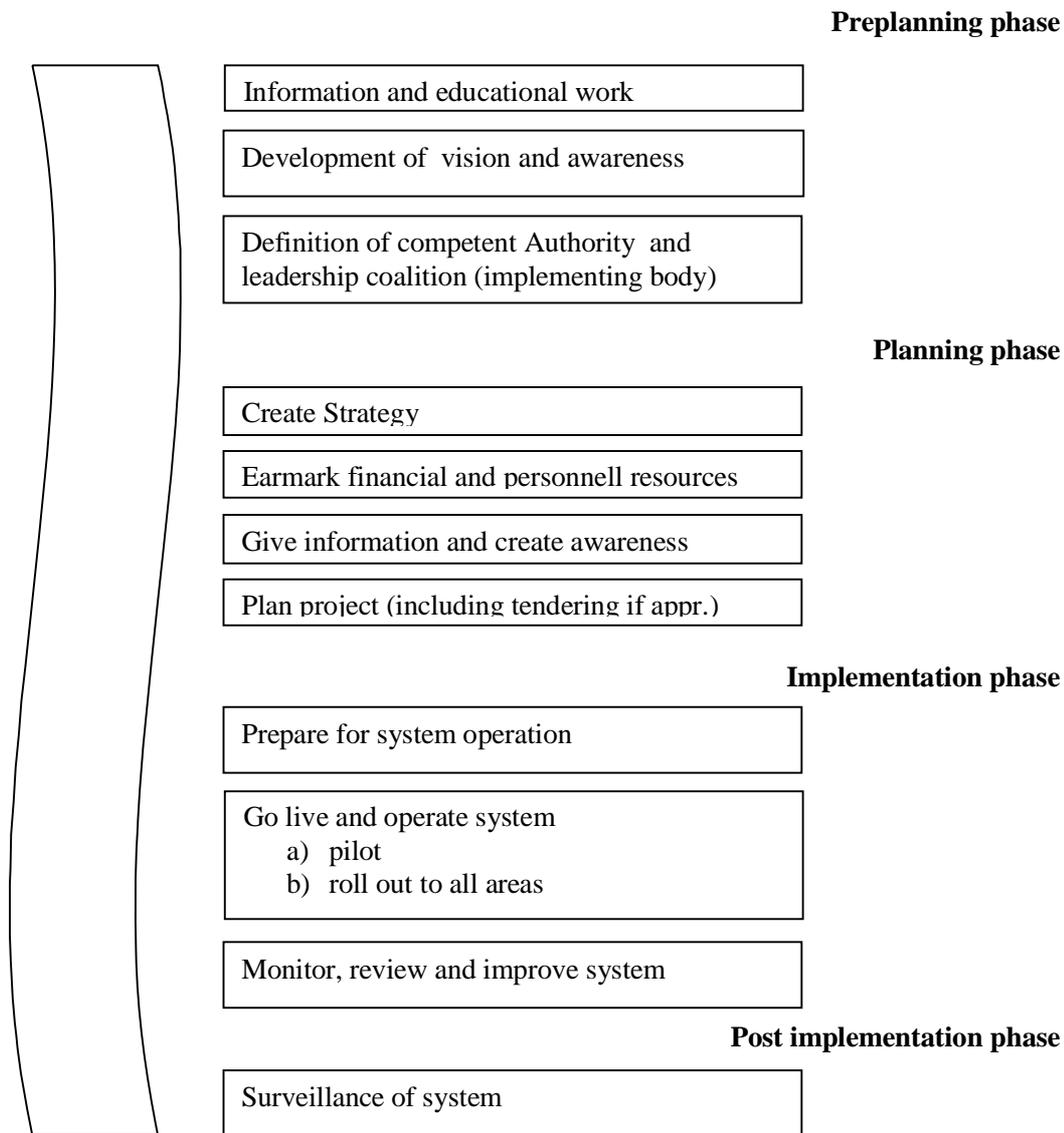
Preplanning phase

Information and educational work

Development of vision and awareness

Definition of competent Authority and
leadership coalition (implementing body)

Planning phase

Create Strategy

Earmark financial and personnell resources

Give information and create awareness

Plan project (including tendering if appr.)

Implementation phase

Prepare for system operation

Go live and operate system
   a) pilot
   b) roll out to all areas

Monitor, review and improve system

Post implementation phase

Surveillance of system

Figure 5. Phases with an outline of activities in each phase.

The system must be accepted by the participants. Benefits and the necessity of this system for farmers and the livestock industry must be made transparent from the outset. Furthermore farmer and other keepers of cattle must be informed about their obligations for a successful and sustainable animal ID and movement system. Staff must be well trained in order to run the system effectively and to avoid misunderstanding.

Awareness by information campaign and training

The tagging of animals even a big number is not difficult. Mostly it is accomplished as a one time effort, and it works. Difficult is to connect all the different elements of the system, to make it useful and to guarantee long lasting achievements and results. A one time tagging campaign may result in a straw fire with out long lasting benefits. Mayor problems for sustainability are very often:

1. Insufficient information campaigns before any action start. Stakeholders are not aware of their benefits and their duties in the system. This results in less motivation to continue.
2. Procedures are not clear defined and/or unrealistic. Implementing staff is overworked and can not cope with the demands of keeping upright to run the system (ear tagging, notification, supervision).
3. The costs of the system are unrealistic defined and continuation fails, because of lack of long term funding. Sharing of the costs between the stakeholders (farmer, meat industry, trade, consumer [state]) is not given or not accepted.

What can go wrong

Frequent observations in new installed identification and registration system:

This is a shortened version of the Base Paper: Strategic Approach for the Development of Animal Identification and Movement Control (Traceability) systems. The Linkage to Veterinary surveillance and other Agriculture and Livestock databases, *prepared by Dr. Bambauer for the FAO Animal Production and Health Service and including example costs and further details of control of notifications and data quality. Full copies of the paper can be obtained from FAO, Rome.*